ECOLOGY AND NATURAL HISTORY OF THE MASARID WASPS OF THE WORLD WITH AN ASSESSMENT OF THEIR ROLE AS POLLINATORS IN SOUTHERN AFRICA (HYMENOPTERA: VESPOIDEA: MASARIDAE)

THESIS
Submitted in fulfilment of the
requirements for the Degree of
DOCTOR OF PHILOSOPHY
of Rhodes University

by

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Volume 1: Sections 1 - 3

December 1992

Preface and acknowledgements

The present work was born from an ongoing wide ranging study of the ethology of aculeate Hymenoptera in the semi-arid areas of southern Africa initiated jointly in 1972 and conducted synergistically by Dr Fred Gess and the present author with enthusiastic field assistance from their sons David, Harold and Robert, particularly with the collection of insect specimens (see Appendix 1) and the search for nests. Twenty seven papers (excluding popular articles, conference abstracts and the systematic papers of F.W.Gess) have resulted. They include ethological studies of species of Pompilidae, Eumenidae, Masaridae, Ampulicidae, Sphecidae, Larridae, Crabronidae, Nyssonidae, Philanthidae, community studies and landuse impact assessment. Nest investigations and insect/flower relationships have been the present author's particular province. Those papers on which the present work is based are listed in the references. A considerable amount of as yet unpublished work has been added.

The author wishes to acknowledge with grateful thanks:

Those who gave access to their land or the land under their care;

All those who assisted with identifications, in particular Dr Fred Gess of the Albany Museum (the majority of the insects), Professor P.D.Theron of Potchefstroom University (mites), Mrs Jo Beyers of the Stellenbosch Herbarium (some plants, especially the _Wahlenbergia_ and _Microcodon_ species), Mrs Sue Dean of the Karoo Biome Research Station (some plants), Mrs Estelle Brink of the Botanical Research Institute at the Albany Museum (some plants) and Mr Jan Vlok of Saasveld Forestry Centre (_Aspalathus spinescens_ Thunberg);

Dr Fred Gess for translating passages from German;

Those who gave assistance with the production of some of the illustrations - Mr Robin Cross of the Electron Microscopy Unit, Rhodes University for taking the scanning electron micrographs; Dr Fred Gess, Mr David Gess and Mr Harold Gess for taking the photographs reproduced as Figures 29 e and f and 40 a; 54 a; and 29 a and c and 35 a respectively; and Mr Alan Weaving for assistance with taking the photographs reproduced as Figures 44 c, d and f and 47 b and with producing colour negatives from colour slides;

Professor Randall Hepburn, of Rhodes University and Dr Fred Gess for reading and commenting on earlier versions of the manuscript;

Mr Brian Wilmot, Director of the Albany Museum for permission to spend time on the present thesis whilst in the employ of the Albany Museum.

Abstract

The worldwide knowledge of the ecology and natural history of the masarid wasps, those wasps which bee-like provision their nest cells with pollen and nectar, is synthesized and discussed putting into context the investigations concerning nesting and flower visiting by southern African masarids conducted by the present author.

Masarids are found mostly to favour warm to hot areas with relatively low rainfall and open scrubby vegetation. At the generic level the masarids of the Nearctic, Neotropical and Australian regions are distinct from each other and from those of the Palaearctic and Afrotropical regions combined. No species are shared between regions. Southern Africa is apparently the area of greatest species diversity. In this region, at least, there is a high incidence of narrow endemism.

Masarids are associated with a relatively small range of plant families. Where sufficient records are available distinct major preferences are shown between zoogeographical regions. Relatedness of plant preferences between zoogeographical regions is apparent when relatedness of plant taxa is considered. Within a region there is marked overlap in masarid generic preferences for flower families. At the specific level there is marked oligolecty and narrow polylecty.

The majority of nesting studies indicate that nest construction, egg laying and provisioning are performed by a single female per nest, however, nest sharing has been alledged for two species. No parasitic masarids have been recorded. Egg laying precedes provisioning. Mass provisioning is the rule. According to species, nests are sited in the ground, in non-friable soil or friable soil, in earthen vertical banks, on stones or on plants. Seven nest types are defined. Three bonding agents, water, nectar and self-generated silk are used.

Masarids are evaluated as potential pollinators of their forage plants in southern Africa. The "masarid pollination syndrome", though less broad is shown to fall within that designated melittophily. The case studies considered make it clear that, whereas the masarids visiting some flower groups are members of a guild of potential pollinators, the masarids visiting others are probably their most important pollinators.

Increasing land utilization is shown to threaten the existence of narrowly endmic masarid species.

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1 Introduction

The present work reviews, synthesizes and discusses the knowledge of the ecology and natural history of the masarid wasps, those wasps which bee-like provision their nest-cells with pollen and nectar. Having established which are the favoured plant families visited by the masarid wasps, it examines the role of these wasps in southern Africa as potential pollinators of their forage plants. There follows a brief consideration of the trends in landuse in the semi-arid areas of southern Africa and how these are likely to affect masarid biodiversity.

The only previous attempt to review and discuss the knowledge of the natural history of the masarids as a group was that of Richards (1962: 28-34) at a time when there were few and mostly fragmentary accounts of nesting and flower visiting. Contributions by Gess and Gess (1980, 1986, 1988a, 1988b, 1989, 1990 and 1992) on Ceramius, Jugurtia, Masarina, Celonites and Quartinia in southern Africa, Houston (1984 and 1986) and Naumann and Cardale (1987) on Paragia in Australia, and Richards (1963b) and Torchio (1970) on Pseudomasaris in North America form the bulk of the present review, synthesis and discussion. The only previous attempt to assess a masarid as a potential pollinator was that of Torchio (1974) in his study of Penstemon (Scrophulariaceae) and Pseudomasaris vespoides. The present assessment involves four plant families and 92 species of masarids.

The taxonomic history of the taxon here treated as a family, the Masaridae, in the superfamily Vespoidea stems from the description of a family Masarides by Latreille (1802). Latreille's family derived its name from the genus Masaris Fabricius, 1793. The first masarid to be described was, however, not a species of Masaris but of Celonites, C. abbreviatus, originally named as a species of Vespa by Villers in 1789.

In the interval since 1802 the taxon has been variously delimited and ranked but has always been grouped with the "vespids" and "eumenids" (Latreille, 1825;

Shuckard, 1837; Spinola, 1851; Bequaert, 1918 and 1929; Bradley, 1922; Richards, 1962; Giordani Soika, 1974; and Carpenter, 1982, 1987, 1988, 1991 and in prep.). The first standard classification of the Vespoidea is that of Bradley (1922) modified by Bequaert (1928) (Table 1). This was followed by that of Richards (1962) (Table 1) which was based on the examination of a wide range of species and that of Carpenter (1982) (Table 1) based on a cladistic analysis in which he investigated the monophyly and interrelationships of all the suprageneric taxa.

Richards' superfamily Vespoidea is constituted of three families: Masaridae, Eumenidae and Vespidae. His family Masaridae is constituted of three subfamilies: Euparagiinae, Gayellinae and Masarinae. He based his discussion of the phylogeny of the Vespoidea on characters which he considered to be most characteristic of the group and least often seen in any other group. He considered that the vespoids are derived from the same stock as that which gave rise to the Scolioidea of which he considered the Tiphiidae to be the least specialized modern representative. He thus considered that any character which is characteristically vespoid and is not found in the scolioids is the sign of a group which has proceeded some way on the vespoid path.

He stated that acroglossal buttons (the sclerotized pads at the tips of the glossa and paraglossae) are known only in the vespoids but are absent in the more primitive masarids and he therefore believed that they must have been separately evolved or reacquired in the higher masarids.

He considered that short, non-crossing mandibles are primitive and that long mandibles have developed separately in the Eumeninae, Gayellinae and Ceramius and probably in Raphiglossoides.

Like Bequaert (1929) he believed the emargination of the eyes to be an ancestral character since it is also found in some scolioids. Its loss in many Masarinae he considered to be secondary.

He considered the presence of three submarginal cells in the fore wings to be primitive and that the majority of the Masaridae are specialized in the loss of one cell. The long median cell ($M + Cu_1$) he considered to be a vespoid specialization and the short median cell of many masarids probably to be the primitive condition. The folding of the wings is a specialization which has not occurred in the majority of masarids and he therefore believed that in those genera in which it occurs (Celonites and Quartinia) it must have been acquired by convergence.

Table 1. Three classifications of the Vespoidea.

Bradley (1922) and Bequaert (1928)	Richards (1962)	Carpenter (1982)
VESPIDAE	VESPOIDEA	VESPIDAE
	Masaridae	
Euparagiinae	Euparagiinae	Euparagiinae
		Masarinae
Gayellinae	Gayellinae	Gayellini
Masaridinae	Masarinae	Masarini
Paragiini	Paragiini (includes Masaridini in part)	
Masaridini	Masarini (includes Masaridini in part)	
	Eumenidae	Eumeninae
Raphiglossinae	Raphiglossinae	
Zethinae	Discoeliinae	
Eumeninae	Eumeninae	
	Vespidae	
Stenogastrinae	Stenogastrinae	Stenogastrinae
Vespinae	Vespinae	Vespinae
	Polistinae	Polistinae
Epiponinae	Polybini	
Polistinae	Polistini	
Ropalidiinae	Ropalidiini	

He noted the basal ring on the mid femur to be a primitive vespoid character which has been lost in all the masarids except Euparagia.

The fusion of the tergite and sternite of the first gastral segment he considered to be a highly characteristic vespoid feature but noted that it seems not to have been evolved at the time that the masarids diverged and is not seen in any scolioids except in a few wingless females.

The retraction of the posterior gastral segments within the second he noted as peculiar in the vespoids but absent in the Masaridae except for the Gayellinae in which he considered that it was acquired independently from the Eumenidae.

The fusion of the male abdominal sternites 8 and 9, noted by Snodgrass (1941) as characteristic of vespoids, Richards noted is not fully developed in masarids and more of the 8th sternite is exposed than usual.

Finally he noted that spine-like parameres are highly characteristic of the vespoids but have been lost in most Masaridae, being, however, retained in the Gayellinae and in a modified form in his Paragiini and in the Euparagiinae.

Richards summarized his speculations on the phylogeny of the Masaridae diagramatically (Fig. 1). They were considered by him to be an ancient group which has suffered much extinction. He considered that the most primitive (i.e. the form that most resembles a likely universal ancestor) living masarid is Euparagia, the only one still being predatory, all others provisioning with pollen and nectar. He considered the Gayellinae to be in some ways (mandibles, clypeus, wing-venation, gaster especially of Paramasaris, male genitalia) more eumenid-like than any other masarid but doubted that this is due to direct relationship. He considered Ceramiopsis to be the nearest thing to a connecting-link between the Paragia-group and the Ceramius-group and that Trimeria is in several respects a link between his Paragiini and his Masarini.

Carpenter (1982) states that it is apparent that Richards in his discussion of the phylogeny of the Vespoidea did not distinguish between ancestral and derived states in many of his critical characters, that is, that his phylogeny is based upon unanalysed similarity. He therefore, like Charnley (1973), Spradbery (1975) and van der Vecht (1977) questioned whether or not Richards' classification is a natural one. In the course of his study Carpenter examined the external morphology of 136 genera and 506 species of Vespoidea, representing all the recognized suprageneric taxa, and 21 genera and 45 species of Scoliidae, representing the two subfamilies

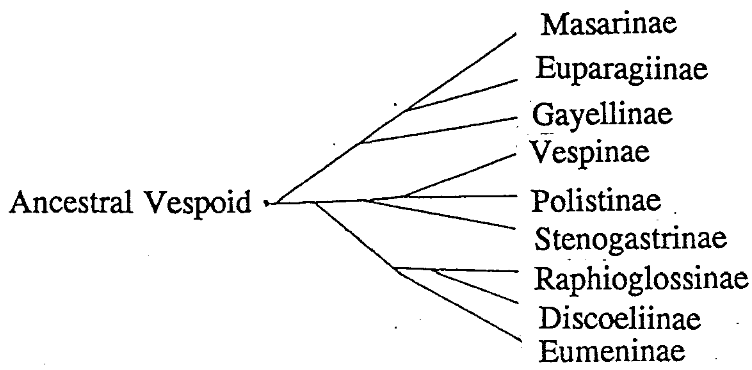


Fig. 1. Phylogeny of the subfamilies of the Vespoidea (sensu Richards) from Richards (1962).

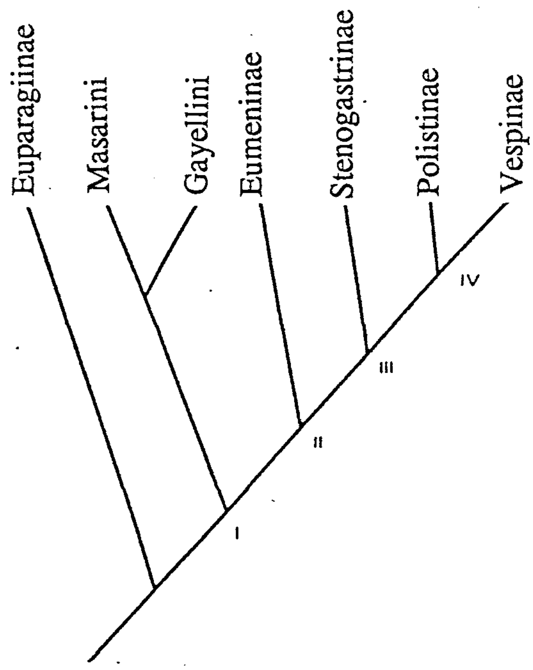


Fig. 2. Cladogram of the subfamilies and tribes of the Vespidae (sensu Carpenter) from Carpenter (1982). Roman numerals refer to components listed in the Carpenter's section on ground-plan character states.

and three tribes. He included examples of Scoliidae as the suggested closest relative of the Vespidae following Richards (1962) and Brothers (1975). Characters of the larvae, internal morphology and behaviour were extracted from the literature. The behavioural characters for Masaridae available to him were very limited, the work of Gess and Gess (1980, 1986, 1988a, 1988b, 1989 and 1992), Houston (1984 and 1986), and Naumann and Cardale (1987) having either not been noted or not yet published. Analysis of the data followed the principles of phylogenetic reasoning elaborated by Hennig (1966). The subfamilies and tribes were surveyed for unique features (autapomorphies) to establish their monophyly; these groups were linked by shared features (treated as synapomorphies at this level of analysis) and the most parsimonious cladogram constructed, that is one which minimized convergences. Polarities for the characters were then assigned, based upon comparison with states found in the sister-group of the Vespoidea, the Scoliidae, as well as in other Aculeata. The construction of the most parsimonious cladogram was then repeated, with uninformative characters identified and eliminated. These characters subsequently had their polarity reassigned based upon their position in the cladogram, in such a way as to minimize homoplasy. The results were checked by computer analyses using Wagner and character compatability methods. The result of this thorough investigation is presented in Fig. 2.

Carpenter found the outstanding autapomorphies of his Vespidae (Richards' Vespoidea) to be the elongate discal cell (at least the equal of the submedian cell), spined parameres and oviposition into an empty cell. The sister-group relationship between Euparagia and the rest of his Vespidae was established especially by the forewing with cu-a straight and the hindwing with the anal lobe reduced in all vespids aside from Euparagia. Presence of acroglossal buttons also supports this relationship, but these were considered to be secondarily lost in the stenogastrines. Carpenter's Masarini and Gayellini were grouped on the basis of hypostomal apodemes (elongate projections into the oral fossa below the level of the hypostoma and set off from it by a furrow) (lost in some Masarini), loss of the mesoscutal lamella (a raised carina opposite the tegula and produced from the posterolateral corner of the mesoscutum), loss of the midfemural basal ring, and mellifery. Both these groups show independent development of several of the characters that link component II. The hypothesis of a sister-group relationship between them was considered by Carpenter to best describe the distribution of characters.

Based on his analysis Carpenter proposed the classification presented in Table 1. Thus in his classification he recognized a single family Vespidae with six subfamilies: Euparagiinae, Masarinae, Eumeninae, Stenogastrinae, Polistinae and

Vespinae. He thus disassociated the Euparagiinae, which provision their nest cells with beetle larvae, from Richards' Gayellinae and Masarinae, which provision with pollen and nectar. At the same time he associated more closely the Gayellinae (sensu Giordani Soika, 1974) and the Masarinae (sensu Richards, 1962) by placing them together as tribes (Gayellini and Masarini) in his subfamily Masarinae. This proposal was followed by Gess (S.K., 1992) who dealt solely with masarid wasps. In the present work, in which comparable ranking of taxa for all aculeate Hymenoptera is required, the classification adopted follows Krombein et al. (1979) (Table 2), however, the classification within the Vespoidea follows that of Carpenter apart from the fact that it requires the subfamily groups to be considered as families. Carpenter himself stated that "the subfamily groups could of course be considered to be families, in as much as rank is arbitary, but this would involve the creation of two new families, one for Euparagia and one for the Stenogastrinae".

Carpenter and Rasnitsyn (1990) added a seventh, though extinct, subfamily to Carpenter's Vespidae. This subfamily the Priorvespinae is placed by them as a sister group of all other Vespidae (sensu Carpenter 1982) based on a cladistic analysis using the informative data for vespid families and tribes coded from Carpenter (1982) and Hennig86 (Farris, 1988). The result of this analysis is presented in Fig. 3. The Euparagiinae are seen as a sister group to the ancestor of all the other extant vespids. Carpenter's Masarinae are seen to be on a line diverging from that giving rise to his Eumeninae, Stenogastrinae, Polistinae and Vespinae. Thus the line giving rise to the pollen and nectar provisioning masarines in the Vespidae (or Vespoidea) is seen by Carpenter and Rasnitzyn to have been a relatively early divergence in the history of the otherwise predatory Vespidae (or Vespoidea) just as the pollen and nectar provisioning Apidae are seen by Michener (1974) and Brothers (1975) to have been a relatively early divergence in the history of the otherwise predatory Sphecoidea. It should be noted that whereas the most highly eusocial sphecoids, the honeybees, head the line of pollen and nectar provisioners in the Sphecoidea, the pollen and nectar provisioning line, that of the Masaridae, in the Vespoidea has not lead to sociality, the vespoid wasps commonly known as the Social Wasps heading the main vespoid line.

Within the Masarinae, the larger of the subfamilies of the Masaridae (present sense), are recognized two tribes the Paragiini and the Masarini, however, the delimitation of these subgroups has been disputed. Richards (1962) considered the Paragiini to be constituted of two subgroups, one including Paragia Shuckard, Metaparagia Meade-Waldo, Rolandia Richards and Riekia Richards and the other including Ceramiopsis Zavattari and Ceramius Latreille. Carpenter (1982) concluded that Richards' Paragiini is paraphyletic, and hence did not recognize

Table 2. Classification of the aculeate wasps and the bees referred to in the present work (following Krombein et al., 1979 with the classification of the Vespoidea as given Table 3).

Superfamily	Family
Bethyloidea	Chrysididae
Scolioidea	Tiphiidae
	Mutillidae
	Scoliidae
	Sapygidae
Vespoidea	Masaridae
	Euparagiidae
	Eumenidae
	Vespidae
	Polistidae
	Stenogastidae
Pompiloidea	Pompilidae
Sphecoidea	Ampulicidae
	Sphecidae
	Pemphredonidae
	Larridae
	Crabronidae
	Nyssonidae
	Philanthidae
Apoidea	Colletidae
	Andrenidae
	Halictidae
	Melittidae
	Fideliidae
	Megachilidae
	Anthophoridae
	Apidae

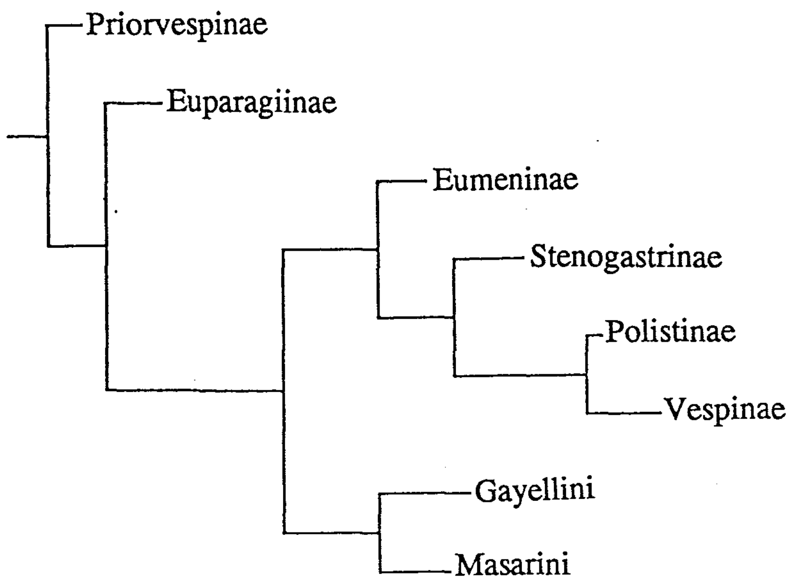


Fig. 3. Cladogram of the subfamilies of the family Vespidae (sensu Carpenter and Rasnitzen) and tribes of the subfamily Masarinae (sensu Carpenter and Raznitzen) from Carpenter and Rasnitzen (1990).

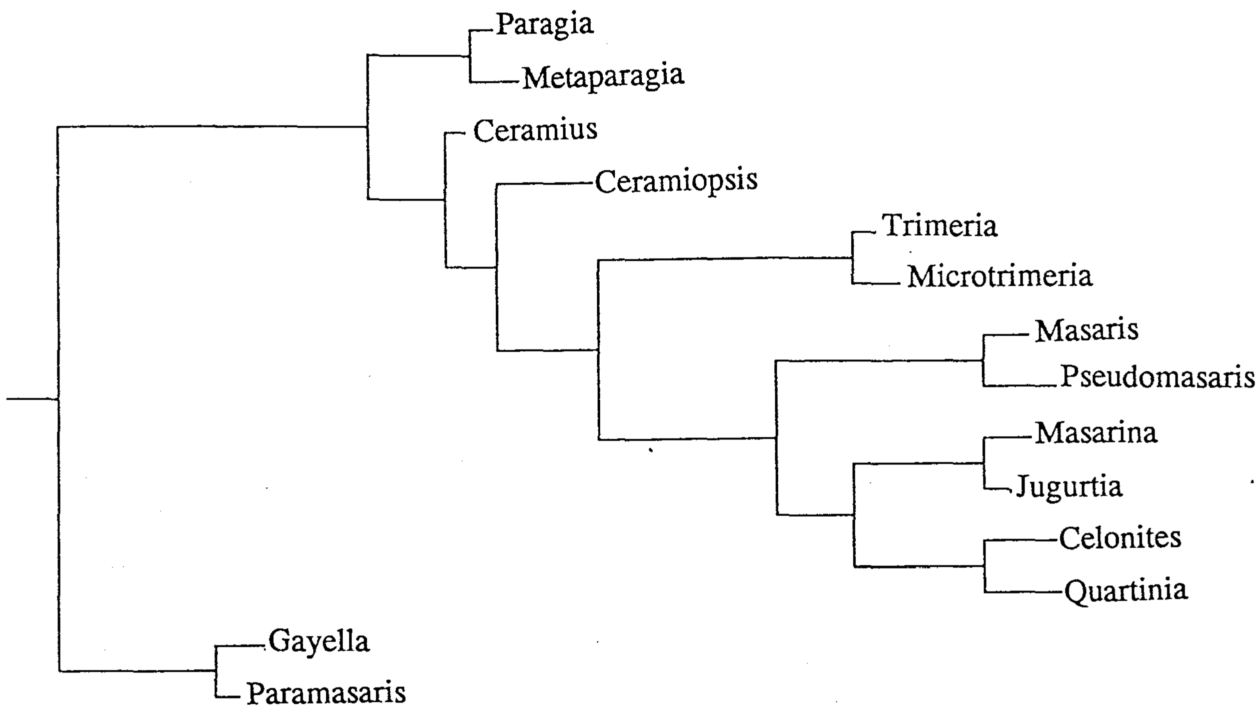


Fig. 4. Suggested cladogram of the genera of the subfamily Masarinae (sensu Carpenter) from Carpenter (pers. comm.).

Richards' grouping. Carpenter (in prep.a), however, has demonstrated by means of a cladistic analysis of the first of Richards' subgroups within the Paragiini (i.e. Australian masarids) that it comprises a monophyletic group, the sister group of Richards' second subgroup of the Paragiini together with Richards' Masarini. Carpenter's findings are reflected in the classification followed here (Table 3). By means of a further cladistic analysis Carpenter (in prep.b) has analysed relatedness of genera within the Masaridae as a whole and he (pers.comm.) has proposed a cladogram (Fig. 4) resulting from this analysis.

Seven of the nineteen genera recognized by Richards (1962) and a genus newly erected by Snelling (1986) are listed by van der Vecht and Carpenter (1990) as junior synonyms:

Paragayella Giordani Soika, 1974 as a junior subjective synonym of Paramasaris Cameron, 1901.

Riekia Richards, 1962, Rolandia Richards, 1962 and Ammoparagia Snelling, 1986 as junior subjective synonyms of Metaparagia Meade-Waldo, 1911.

Microtrimeria Bequaert, 1928 as a junior subjective synonym of Trimeria Saussure, 1854.

Masarina Richards, 1962 as a junior subjective synonym of Jugurtia Saussure, 1854.

Quartiniella Schulthess, 1929 and Quartinioides Richards, 1962 as junior subjective synonyms of Quartinia Ed. André, 1884.

Only the synonymies of Quartinioides and Quartiniella with Quartinia and of Reikia, Rolandia and Ammoparagia with Metaparagia are reflected in Carpenter's cladogram (Fig. 4).

As the rationale for the synonymies has not been published, all the genera are retained in the presently used classification (Table 3) and the species list (Appendix 4).

In the present study there has been a departure from the use, as in previous publications of Gess and Gess, of old plant family names, such as Compositae, Umbelliferae and Labiatae, and the adoption of the presently preferred names following Cronquist (1988). The previously used names are given in parentheses to

Table 3. Classification of the Masaridae as drawn up for use in the present work.

Family	Sub-family	Tribe	Genus
Masaridae	Gayellinae		Gayella Spinola
			Paragayella Giordani Soika
			Paramasaris Cameron
	Masarinae	Paragiini	Paragia Shuckard
			Metaparagia Meade-Waldo
			Riekia Richards
			Rolandia Richards
			Ammoparagia Snelling
		Masarini	Ceramius Latreille
			Ceramiopsis Zavattari
			Trimeria Saussure
			Microtrimeria Bequaert
			Masaris Fabricius
			Pseudomasaris Ashmead
			Jugurtia Saussure
			Masarina Richards
			Celonites Latreille
			Quartinia Ed. Andre
			Quartinioides Richards
			Quartiniella Schulthess

avoid confusion. The family Aizoaceae has been variously delimited. In the present account the assessment of Bittrich and Hartmann (1988) is followed. Following Hartmann (1991) the collective term Mesembryanthema is used for all Aizoaceae which have petaloid staminodes, in fact for those plants commonly termed "mesems".

SECTION 1:

Ecology and natural history of the masarids of the world

2 Biogeography

Masarids have been stated to be gondwanan in origin (Carpenter, 1988). An account of the historical biogeography of the group, based on cladistic analysis, is being prepared by Carpenter. The account of the biogeography of the Masaridae presented here, which is largely based on Gess (S.K., 1992), is confined to present distributions.

World distribution, diversity and areas of endemism

Certain generalizations can be made if one considers the world distribution of the Masaridae, as deduced from published records (Blüthgen, 1961a and b; Fischer, 1964; Fritz, 1968; Gess, 1965, 1968 and 1973, 1989 and 1992; Gess, and Gess, 1980, 1986, 1988a, 1988b, 1989, 1990 and 1992; Giordani Soika, 1974; Gusenleitner, 1966 and 1973; Houston, 1984 and 1986; Naumann and Cardale, 1987; Neff and Simpson, 1985; Panfilov, 1961 and 1968; Parker, 1967; Perez, 1989; Richards, 1962, 1963a, 1963b, 1964. 1966, 1968, 1969, 1982 and 1985; Rossi, 1790; Snelling, 1986; Wharton, 1980; Willink, 1963; Willink and Ajmat de Toledo, 1979; and Zucchi et al., 1976) (Fig. 5). Masarids have not been found to occur further north than 50°N or further south than 50°S. Within these limits they have, furthermore, not been recorded from eastern North America or from eastern and southern Asia. Records are concentrated in Mediterranean and temperate to hot semi-arid to arid areas outside the tropics as delimited by di Castri et al. (1981), Evanari et al. (1985 and 1986) and West (1983) (Fig. 6). Concerning these areas Schmida (1985) has stated that they exhibit a north-to-south (or south-to-north as in Argentina (Mares et al., 1985)) or west-to-east macrogradient in which the winter rains diminish and the summer rains increase. Between such areas there is a broad similarity in the vegetation types which replace each other along the macrogradient from Mediterranean climates to extreme deserts - from a dense maquis on the

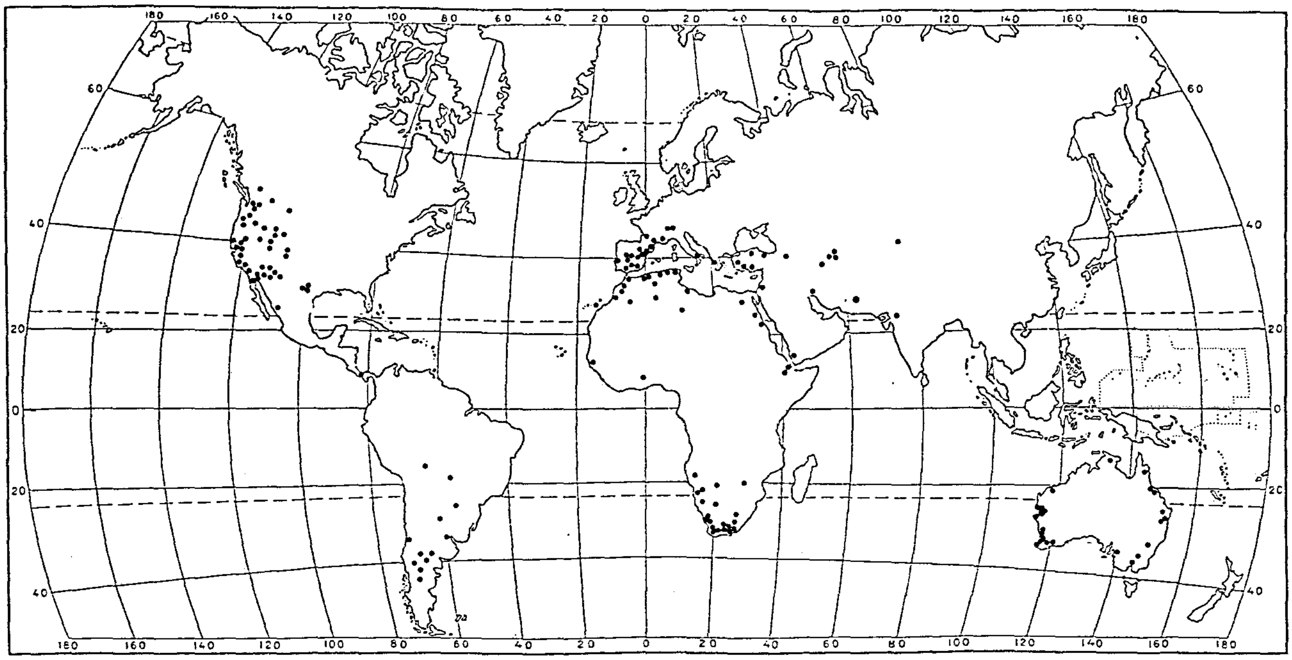


Fig. 5. The world distribution of the Masarinae based on published records.

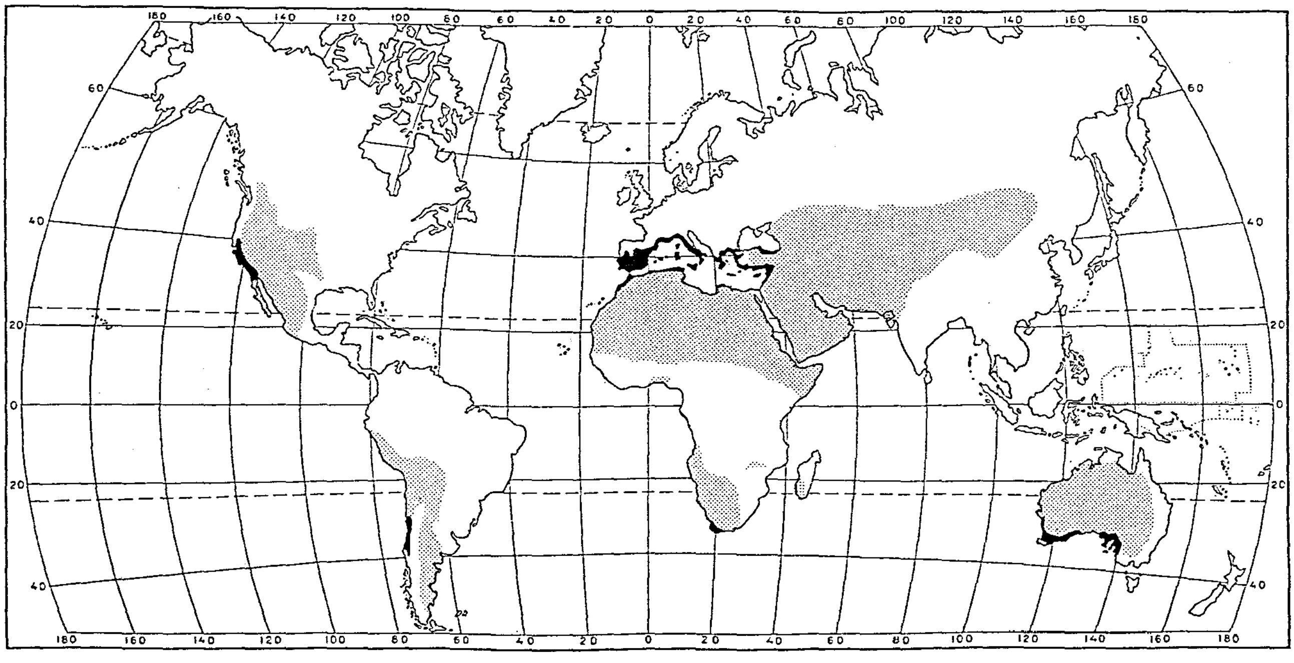


Fig. 6. The distributions of the Mediterranean (black) and the temperate to hot, semi-arid to arid areas of the world (grey) as defined in Evanari, Noy-Meir and Goodall (1985), West (1983) and di Castri, Goodall and Specht (1981).

mesic side of the gradient the vegetation becomes progressively more open, low and sparse. The level of shared plant families is high but that of shared genera is low.

The representation in zoogeographical regions of the taxa is presented in Table 4. The subfamily Gayellinae is restricted to the Neotropical Region whereas the subfamily Masarinae is more widespread, being represented in the Nearctic, Neotropical, Palaearctic, Afrotropical and Australian regions. Within the Masarinae the tribe Paragiini is endemic to the Australian Region. The tribe Masarini on the other hand is absent from the Australian Region but is represented in the Palaearctic, Afrotropical, Neotropical and Nearctic regions. At the generic level the Masarini of the Nearctic and Neotropical regions are distinct from each other, and from those of the Palaearctic and Afrotropical regions combined. Four genera are common to the Palaearctic Region and to southern Africa within the Afrotropical Region, however, there are no shared species. A fifth genus is endemic to the Palaearctic and three further genera are endemic to southern Africa within the Afrotropical Region.

One species Quartinia indica has been recorded from the Oriental Region. This record is for Deesa (22°04′ N, 36°23′ E), India. As at least 50 species of Quartinia (sensu stricto) have been recognized from the Palaearctic and Afrotropical regions and as Deesa is close to the accepted boundary between the Palaearctic and the Oriental regions masarids cannot really be considered to have an Oriental distribution. This is in keeping with the statement in Roubik (1989) that the bee species of the northern and xeric areas of India are Palaearctic rather than Oriental species. It is also supported by a consideration of the phytogeography of the area, the proportion of Indo-Malayan flora : Perso-Arabian flora being 1:7 (Gupta, 1986).

Distribution, areas of diversity and degree of endemism of in southern Africa

The distribution of masarids in southern Africa plotted as number of species per degree square is shown in Fig. 7. If this distribution is compared with that of the Fynbos, the Succulent Karoo and Nama Karoo biomes of Rutherford and Westfall (1986) (Fig. 8), the Mediterranean and semi-arid areas, it is clear that the masarids of southern Africa are largely confined to these biomes. Furthermore the nodes of greatest diversity are located in the western and southern Karoo and in the southwest at the interface between the Karoo and the Fynbos.

Table 4. Representation in zoogeographical regions of the taxa of Masaridae.

Zoogeographical Region	Subfamily	Tribe	Genus
Nearctic	Gayellinae		none
	Masarinae	Paragiini	none
		Masarini	Pseudomasaris Ashmead
Neotropical	Gayellinae		Gayella Spinola Paramasaris Cameron
	Masarinae	Paragiini	none
		Masarini	Ceramiopsis Zavattari Trimeria Saussure Microtrimeria Bequaert
Palaearctic	Gayellinae		none
	Masarinae	Paragiini	none
		Masarini	Ceramius Latreille Masaris Fabricius Jugurtia Saussure Celonites Latreille Quartinia Ed. Andre
Afrotropical	Gayellinae		none
	Masarinae	Paragiini	none
		Masarini	Ceramius Latreille Jugurtia Saussure Masarina Richards Celonites Latreille Quartinia Ed. Andre Quartinioides Richards Quartiniella Schulthess
Australian	Gayellinae		none
	Masarinae	Paragiini	Paragia Shuckard Metaparagia Meade-Waldo Riekia Richards Rolandia Richards Ammoparagia Snelling
		Masarini	none

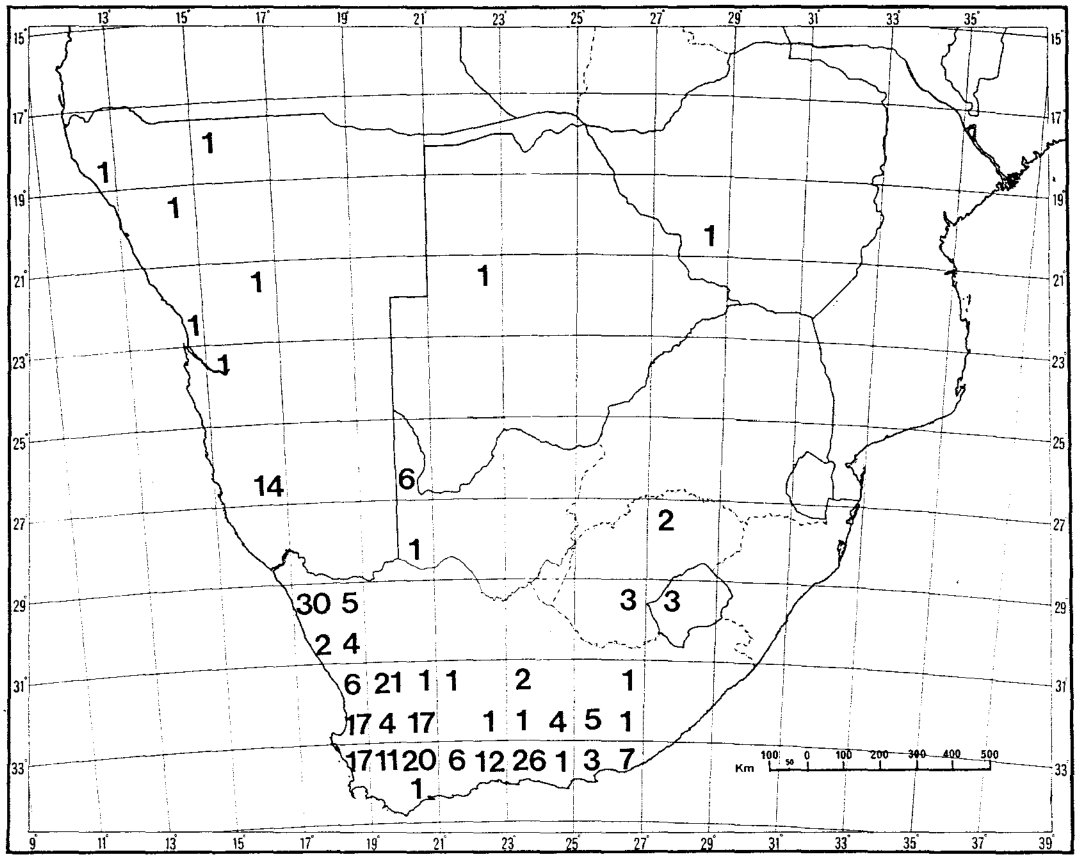


Fig. 7. The distribution of Masarinae in southern Africa plotted as number of species per degree square.

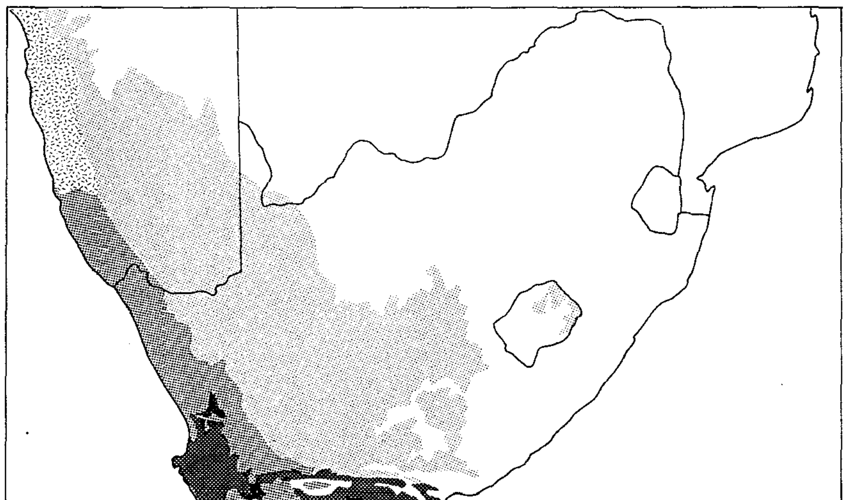


Fig. 8. The distributions of the Fynbos (dark grey), the Succulent Karoo (medium grey), the Nama Karoo (light grey) and the Desert (speckled) biomes after Rutherford and Westfall (1986).

The Fynbos Biome encompasses a broad category of evergreen sclerophyllous heathlands and shrublands in which fine-leaved low shrubs and rush-like plants (Restionaceae) predominate (Hilton-Taylor and le Roux, 1989). It includes five of Acocks' (1953 and 1975) Veld Types. An acceptable definition for and classification of fynbos is still, however, a matter of debate and relevant phytosociological studies have been and are being pursued (Cowling, 1992). The number of masarid species apparently associated with the Fynbos is somewhat skewed. The degree square 33,23 with a count of 26 species would, from a comparison with Fig. 8, appear to be in an area of fynbos. Although fynbos vegetation does indeed occur on the high lying ground that of the low lying ground is karroid with a strong succulent element and it is with this vegetation that the 26 masarid species are associated. Similarly in the extreme west there is in Fig. 8 an over simplification. Degree square 32,18, with a count of 17 masarid species, appears to be in an area of fynbos whereas it is in fact a mosaic of fynbos and karroid scrub. In this instance the 17 masarid species are associated with vegetation made up of dry fynbos species with an admixture of succulent karoo species.

The Succulent Karoo and the Nama Karoo collectively known as the Karoo can be divided into three climatic regions characterized by (i) predominantly winter rainfall; (ii) predominantly spring and autumn rainfall; and (iii) predominantly late summer rainfall. Plant growth and flowering, and insect activity are seasonal and linked to the rainfall pattern. The mean annual rainfall varies from less than 100 mm to 500 mm but is rarely more than 250 mm. Cyclical droughts are a feature of the spring and autumn, and the summer rainfall areas resulting in rainfall decreasing over six to ten year periods and increasing over alternating six to ten year periods; the length of the periods varying spacially and temporally (Novellie, 1988). There are large temperature fluctuations, both daily and seasonal.

The western Karoo lying in the winter rainfall region is characterized by a noticeable succulent element and is consequently known as the Succulent Karoo. It is constituted of seven of Acocks' Veld Types. The central and eastern Karoo, lying in the late summer rainfall region and having a markedly lower succulent element, are together known as the Nama Karoo. This is constituted of 21 of Acocks' Veld Types. The southern and southeastern Karoo and the Little Karoo lying in the spring and autumn rainfall region show a progressive decrease in the succulent element from west to east. The vegetation of the Karoo as a whole is characterized by dwarf open shrubland dominated by Asteraceae and Aizoaceae.

The vegetation of the Succulent Karoo (Hilton-Taylor and le Roux, 1989) is low to dwarf (usually one metre tall), open to sparse (15 to 50% canopy cover) succulent shrubland. This shrubland is dominated by stem and leaf succulents (particularly of the families Aizoaceae, Crassulaceae, Asclepiadaceae, and Euphorbiaceae), fine-leaved evergreen shrubs and some obligatory deciduous shrubs. Grasses are infrequent and mainly annuals. The mass flowering displays of annuals (mainly Asteraceae) and geophytes (Liliaceae sensu lato and Iridaceae) in spring, particularly in disturbed areas, are characteristic. Low trees are common on rocky outcrops and along river courses. The high succulent species diversity is unparalleled elsewhere in the world. This together with the geophytic and annual taxa, makes the Succulent Karoo a unique biome of international importance.

The vegetation of the Nama Karoo (Hilton-Taylor and le Roux, 1989) is low to dwarf, open to sparse (see previous definitions), grassy shrubland. The shrubland is dominated by facultatively deciduous shrubs, some leaf succulents and perennial grasses. Grasses become more dominant from west to east. Scattered trees grow on rocky outcrops, low hills and along river courses. The Nama Karoo does not appear to have a species-rich or unique flora. Many of the plant species are shared with the Savannah, Grassland, Succulent Karoo and Fynbos biomes.

Ceramius, Jugurtia, Celonites and the Quartinia group show distributions (Figs 9 a-d) similar to that of the Masaridae as a whole. The distribution of Masarina appears to be somewhat more limited, being apparently confined to the Fynbos and Succulent Karoo (Fig. 9 e).

In southern Africa Ceramius is the only genus for which the taxonomy and behaviour are sufficiently well known that a more detailed consideration of species distributions is warranted. The genus Ceramius has been divided on morphological characters into eight species groups (Richards, 1962 amended by Gess and Gess, 1986, 1988b and 1990) (Table 5). These groupings are supported by nest structure and forage plant associations (Gess and Gess, 1986, 1988b, 1990 and unpublished fieldnotes).

With the exception of groups 1 and 7 which are endemic to the Palaearctic all of these species groups are endemic to southern Africa.

Groups 5 and 8, all species of which forage on Mesembryanthema (Aizoaceae), are distributed throughout the greater part of the distribution range of the Masarinae as a whole (Figs 15 and 17).

Group 4 has a surprisingly disjunct distribution, C.beyeri which forages on Mesembryanthema having a relatively wide southern distribution (Fig. 14 a) and

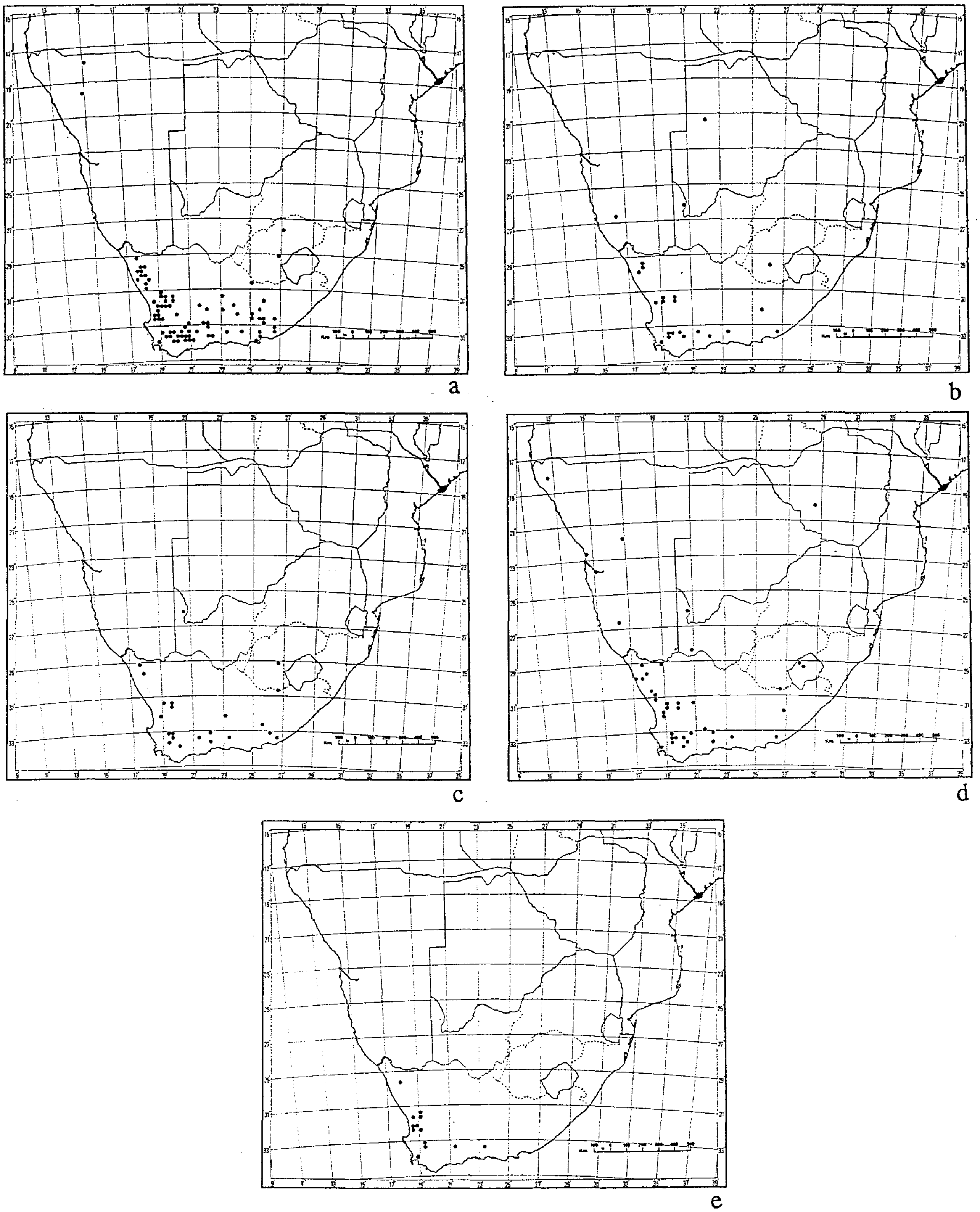
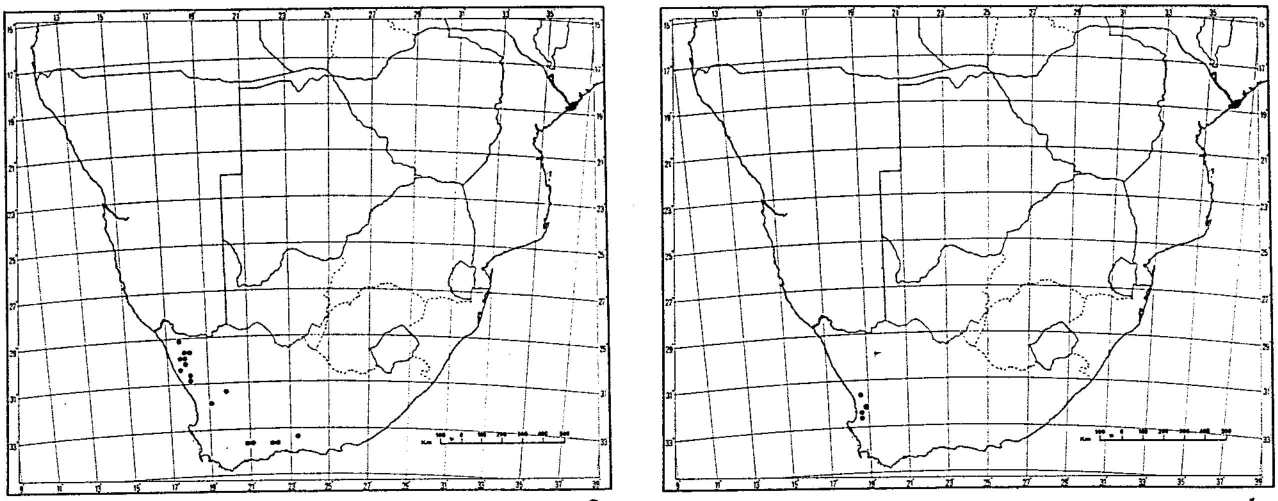


Fig. 9 a-e. The distributions of the southern African masarine genera: (a) Ceramius; (b) Jugurtia; (c) Celonites; (d) the Quartinia group (Quartinia, Quartinioides and Quartiniella); (e) Masarina.

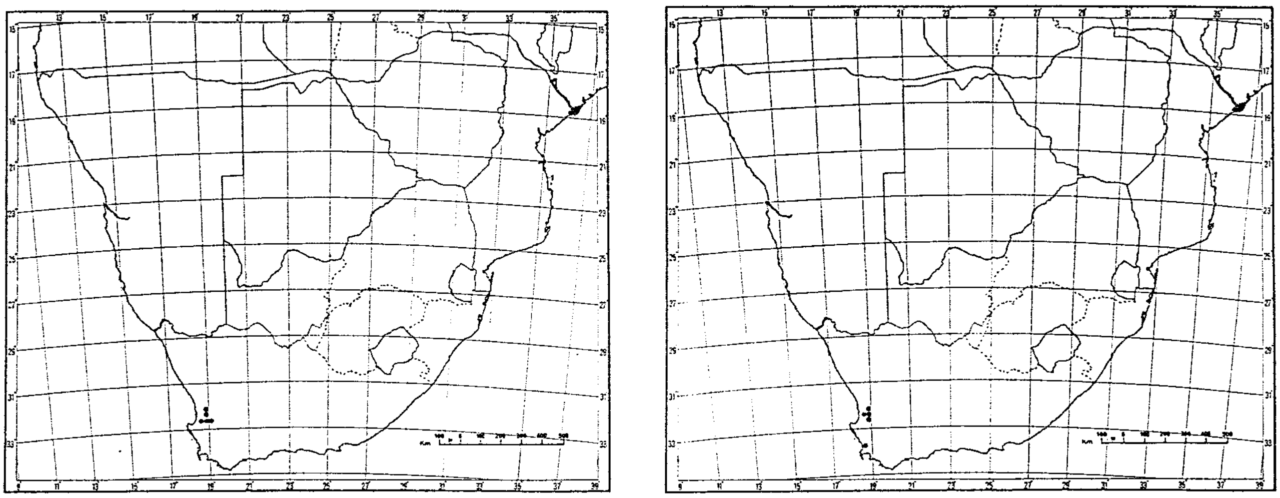
Table 5. Species groups of Ceramius (Richards, 1962 amended by Gess and Gess, 1986, 1988 and 1990).

species group	Ceramius species included in group
Group 1	fonscolombei Latreille, caucasicus Ed. Andre, bureschi Atanassov.
Group 2 A	cerceriformis Saussure, peringueyi Brauns.
Group 2 B	clypeatus Richards, richardsi Gess.
Group uncertain	micheneri Gess.
Group 3	nigripennis Saussure, toriger Schulthess, braunsi Turner, jacoti Richards.
Group 4	beyeri Brauns and probably damarinus Turner.
Group 5	lichtensteinii (Klug).
Group 6	caffer Saussure, metanotalis Richards, rex Saussure.
Group 7	hispanicus Mercet, moroccanus (G. Soika), spiricornis Saussure, beaumonti (G. Soika), lusitanicus Klug, tuberculifer Saussure, bischoffi Richards.
Group 8	bicolor (Thunberg), linearis Klug, capicola Brauns, socius Turner.



a b

Fig. 10 a and b. The distributions of the species of Ceramius Group 2A: (a) Ceramius cerceriformis; (b) Ceramius peringueyi. (both species forage on Mesembryanthema (Aizoaceae)).



a b

Fig. 11 a and b. The distributions of the species of Ceramius Group 2B: (a) Ceramius clypeatus (forages on Aspalathus spp. (Papilionaceae)); (b) Ceramius richardsi (forages on a "legume" (Papilionaceae)).

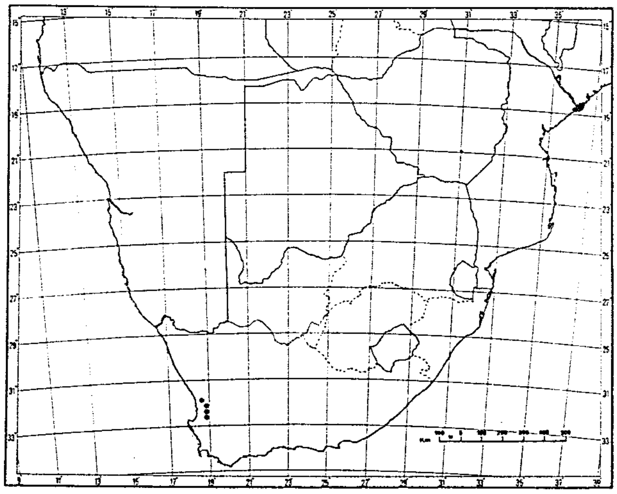


Fig. 12. The distribution of Ceramius micheneri (Group uncertain, morphologically closest to Group 2B) (forages on Aspalathus spp. (Papilionaceae)).

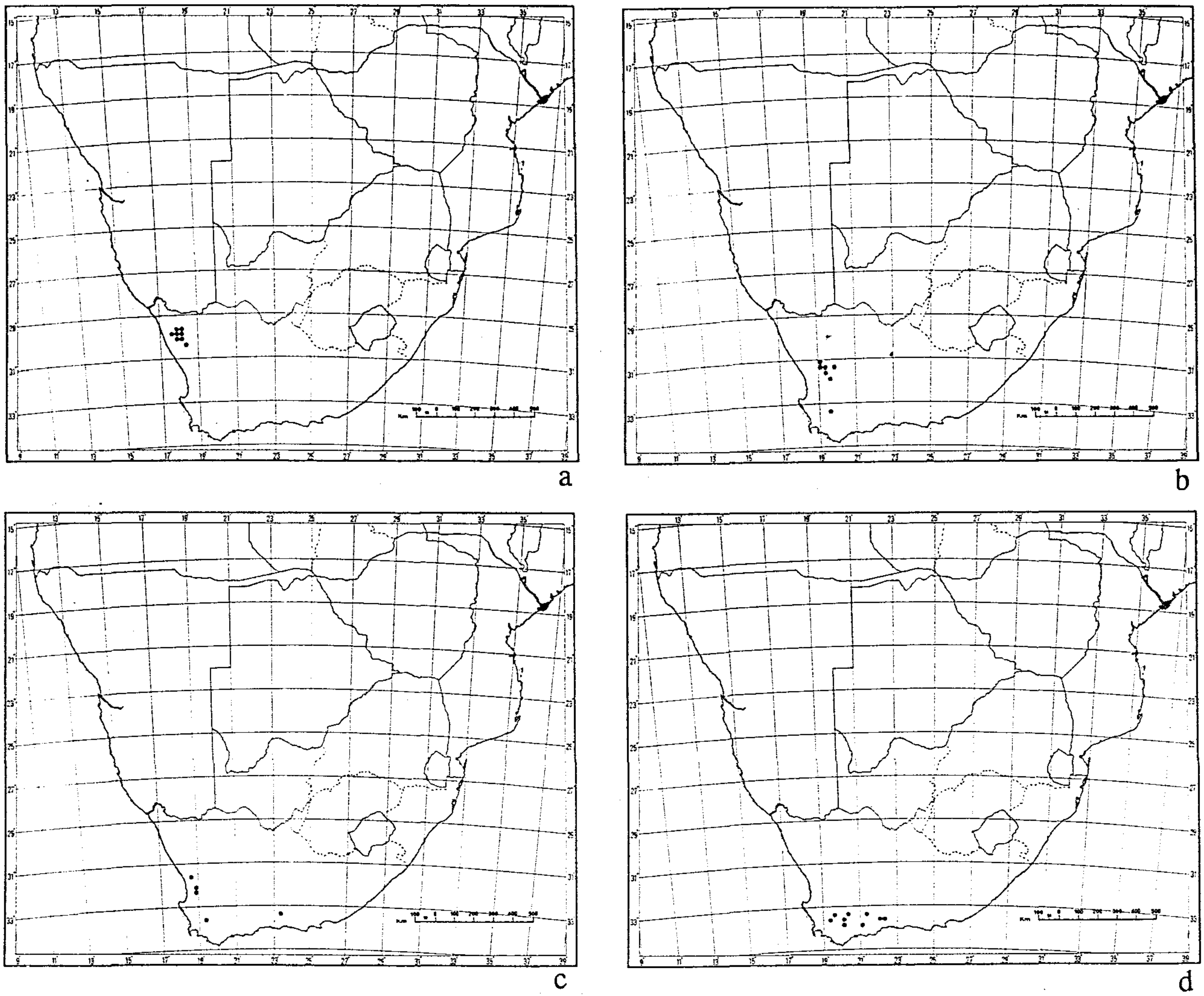


Fig. 13 a-d. The distributions of the species of Ceramius Group 3: (a) Ceramius nigripennis; (b) Ceramius toriger; (c) Ceramius braunsi; (d) Ceramius jacoti. (all four species forage on Asteraceae).

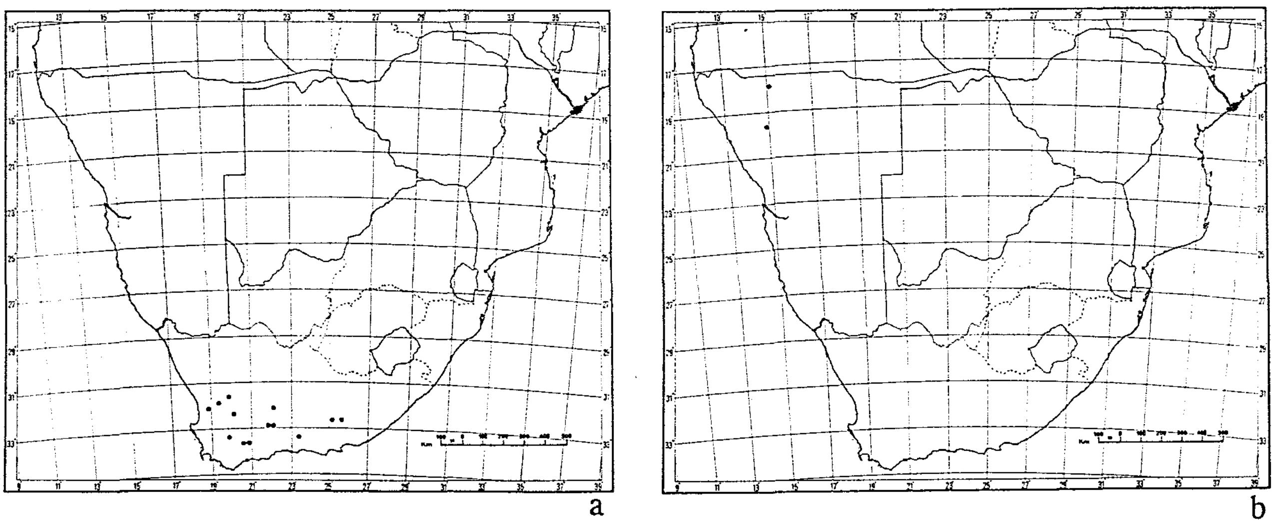


Fig. 14 a and b. The distributions of the species of Ceramius Group 4: (a) Ceramius beyeri (forages on Mesembryanthema (Aizoaceae)); (b) Ceramius damarinus (forage plant unknown).

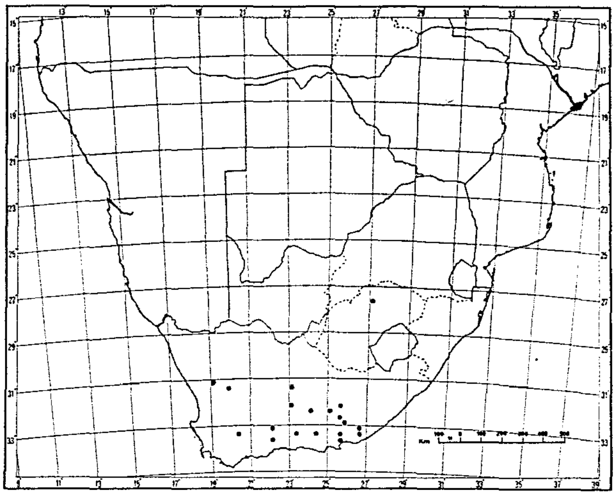


Fig. 15. The distribution of the single species of Ceramius Group 5: Ceramius lichtensteinii (forages on Mesembryanthema (Aizoaceae)).

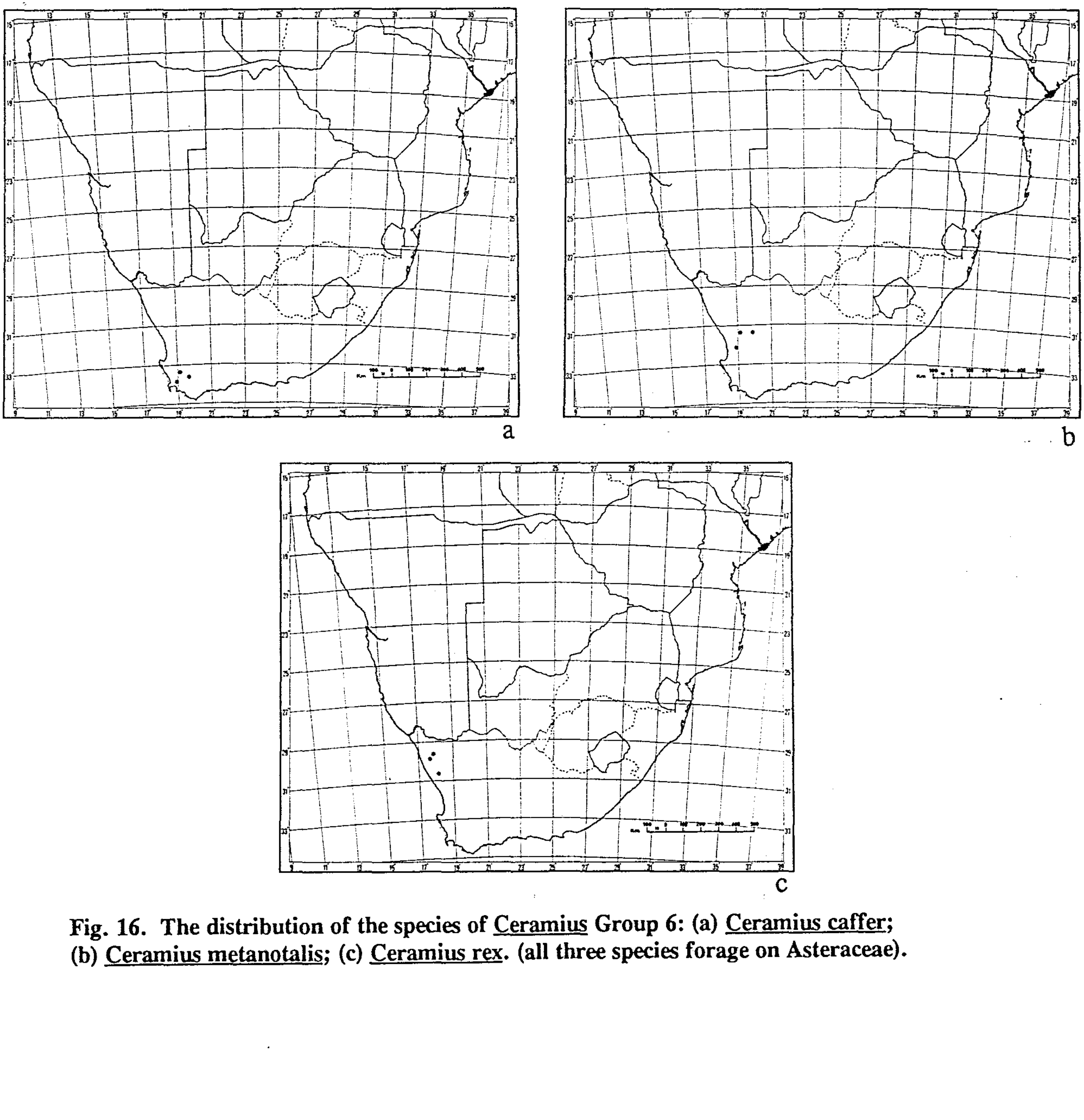
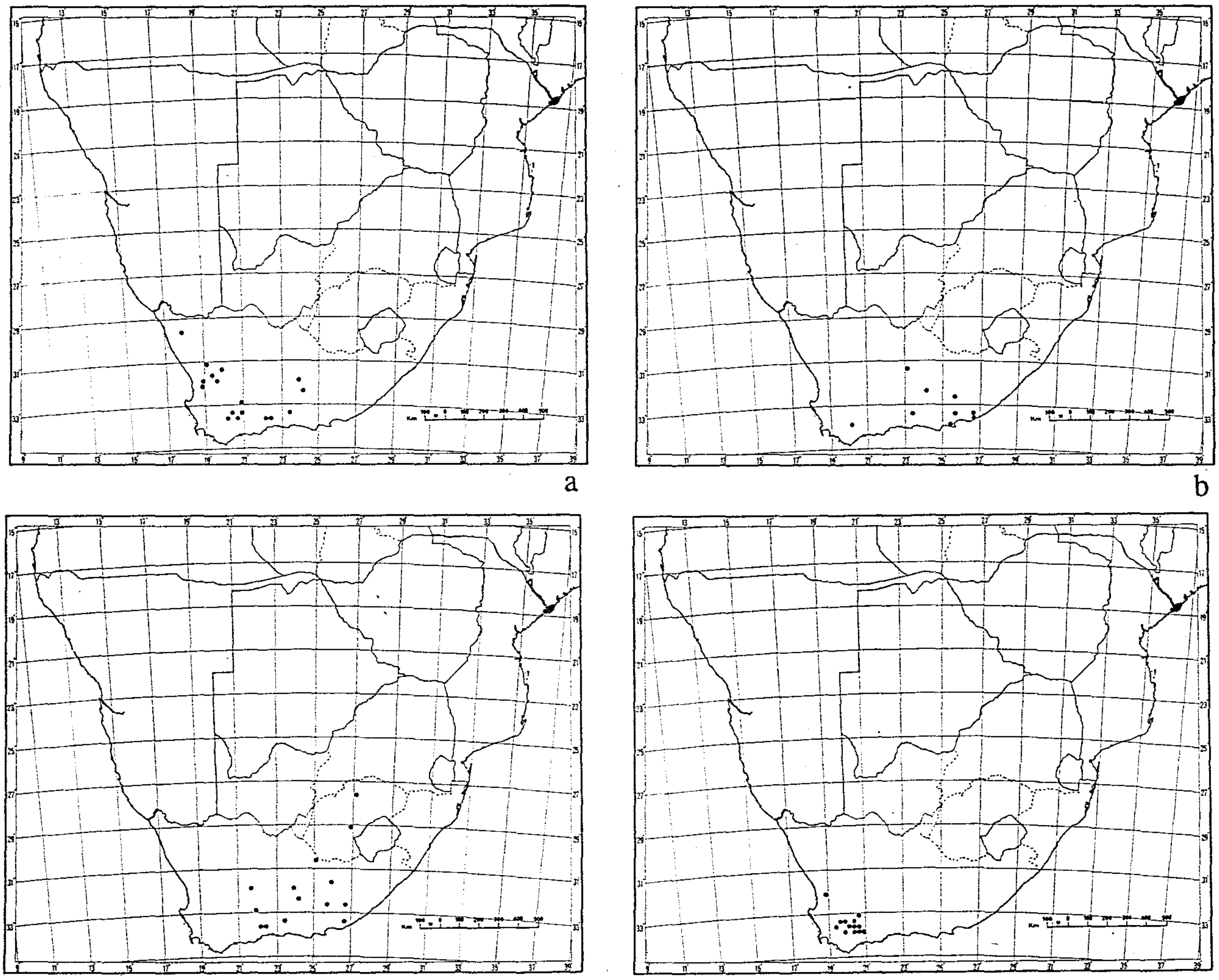


Fig. 16. The distribution of the species of Ceramius Group 6: (a) Ceramius caffer; (b) Ceramius metanotalis; (c) Ceramius rex. (all three species forage on Asteraceae).



a b c d

Fig. 17 a-d. The distributions of the species of Ceramius Group 8: (a) Ceramius bicolor; (b) Ceramius linearis; (c) Ceramius capicola; (d) Ceramius socius. (all four species forage on Mesembryanthema (Aizoaceae)).

C. damarinus for which forage plants have not been recorded being restricted to northern Namibia (Fig. 14 b).

Group 2A, both species of which forage on Mesembryanthema, has a western and southern distribution (Fig. 8), C. cerceriformis being found throughout the group's distribution range (Fig. 10 a) and C. peringueyi seeming to be the most restricted of the species foraging on Mesembryanthema having been recorded solely from southern Namaqualand (Fig. 10 b).

Groups 3 and 6, all species of which forage on Asteraceae, are relatively limited in distribution (Figs 13 and 16), Group 3 being restricted to the western and southwestern Cape and Group 6 to the extreme western Cape. The individual species in Group 3 show very little overlap in their distributions. Those of Group 6 are completely discrete and very restricted, that of C. caffer being to the south of the Olifants River Mountains, that of C. metanotalis to the north of these mountains but to the south of Namaqualand and that of C. rex being in the area of Namaqualand termed Klipkoppe.

The two species of Group 2B, C. richardsi and C. clypeatus, and C. micheneri forage on Papilionaceae. C. clypeatus and C. micheneri seem to be restricted to Aspalathus and to a small area in and adjacent to the southern Olifants River Valley to the north of the Olifants River Mountains (Fig. 11 a and 12). C. richardsi has been recorded not only from the southern Olifants River Valley but also from south of the Olifants River Mountains (Fig. 11 b).

From this survey of the distributions of the Ceramius species it can be concluded that although all the species of southern African Ceramius are relatively narrowly endemic, most of the species associated with the Mesembryanthema group of the Aizoaceae are more widely distributed than those species associated with Asteraceae and Papilionaceae. Furthermore amongst the latter species there are species which can be considered to be extremely narrowly endemic.

Distribution of the Masaridae compared with that of the bees and of non-masarid aculeate wasps

As masarid wasps and bees, provisioning with pollen and nectar, fill the same general behavioural niche a comparison of their distributions is of particular interest.

It is of note that although bees are well represented in the tropics they are most abundant and diverse in certain warm temperate, xeric regions of the world (Michener, 1979). Furthermore it is of note that bees are especially abundant and diverse in the Mediterranean Basin, the Californian Region and the contiguous xeric areas but that other warm temperate xeric areas, like central Chile or the western part of southern Africa, have less rich faunas (Michener, 1979). It is perhaps of significance that from a consideration of known species it would appear (even taking into account possible differences in collecting intensity between areas) that masarid wasps are by contrast most diverse in southern Africa. From this region c 155 species, all endemic, have been recorded as compared with c 90 species from the Mediterranean Basin and associated xeric areas, c 31 species from Australia (Naumann, 1991), c 16 species from South America and c 14 species from North America.

At the family level, some bee families have a wider distribution than the Masaridae and others have very much more limited distributions. Of note are two families, the Colletidae which has an entirely Austral distribution with the greatest species diversity in Australia and the Fideliidae which is limited to parts of southern Africa and Chile (Michener, 1979).

Of marked contrast to the distribution of the masarids is that of the social vespoid families, the paper wasps. Of these all but one genus, Vespula, have species with all or part of their distributions in the tropics (Evans and Eberhard, 1970). Other than a few of the nearly 800 Polistes species none occurs north of latitude 30^{o} N (Wenzel, 1990).

In southern Africa whereas the species diversity of the Masaridae is greatest in the semi-arid areas of the south west, the species diversity of the Vespidae is greatest in the sub-tropical areas of the north east. The only three genera of social paper-nest wasps represented are Belanogaster, Polistes and Ropalidia. They appear to be species rich in more tropical parts and in southern Africa display a north east to south west gradient of decreasing species numbers.

From available museum records it appears that whereas all three genera are represented (albeit in reduced species numbers) in the eastern Cape, the central Karoo (Colesberg) and westwards along the Orange River (Upington, Kakamas and Augrabies), and that Polistes and Ropalidia, at least, extend westwards through the southern Karoo (Willowmore, Oudtshoorn, Prince Albert, Ladismith and Karoo Poort east of Ceres) and Polistes, at least, along the south coastal regions as far as the Cape Peninsula and the Olifants River Valley (P. marginalis), the vespids are absent from Namaqualand west of the Bokkeveld Escarpment. The contention that vespids are absent from Namaqualand is further supported by the absence of vespids from the flower visiting lists of Struck (1990). A single Belanogaster species collected at Vioolsdrif during the present study is believed to be associated with the Orange River Valley and is not counted as being of Namaqualand.

Whereas the family Masaridae has a principally southwestern distribution and the family Vespidae has a principally eastern distribution, the other vespoid family present in southern Africa, the Eumenidae, is well represented throughout the region. Indeed the Eumenidae as a family worldwide is widespread and cosmopolitan.

Doubt has been cast by Wenzel (1990) on theories concerning the origins of the Vespidae and Polistidae in Southeast Asia (van der Vecht, 1957, 1967 and Richards, 1978) and that concerning the radiation of the tropical taxa from a common gondwanan ancestor after South America and Africa separated (Carpenter, 1982). This results from his acceptance of the description by Brown (1941) of a fossil from Cretaceous deposits in Utah, USA as that of a paper wasp nest, an assignation which was disputed by Bequaert and Carpenter (1941). It is of interest in this regard to note that the most primitive extant vespoids, the Euparagiidae (Carpenter, 1982) are unique to southwestern North America.

When considering the distribution of masarid genera it is immediately apparent that there are no genera common to all the zoogeographical regions such as are Eumenes (sensu van der Vecht and Carpenter, 1990) (Eumenidae), Polistes (Polistidae), Isodontia (Sphecidae), Cerceris (Philanthidae) and Bembix (Nyssonidae), to name a few. Indeed there are no genera shared by more than two zoogeographical regions. It is notable that those genera, Ceramius, Jugurtia, Celonites and Quartinia, which are shared are all Afrotropical/Palaearctic genera. The remaining genera are endemic to single zoogeographical regions. Of these Masarina, at least, can be considered to be narrowly endemic. There appear to be no endemic island faunas or odd and highly disjunct distributions such as are found amongst, for example, the Chrysididae (Kimsey and Bohart, 1990).

As the Afrotropical and Palaearctic regions do share species such as Prionyx kirbii (Vander Linden) (Sphecidae) and Philanthus triangulum (Fabricius) (Philanthidae) it is of note that no species of masarids are shared between these regions.

To conclude, whereas the adoption of provisioning with pollen and nectar by the sphecoids lead to a group, the bees, which has a worldwide distribution including a broad range of biomes the adoption of provisioning with pollen and nectar by the vespoids lead to a group, the masarids which though present in five zoogeographical regions is within those regions markedly restricted to a narrow range of biomes.

Within the Vespoidea four types of distribution can be recognized: widespread worldwide - Eumenidae; worldwide with the highest representation in the tropics - the three social vespoid families as a group; widely distributed but with the highest representation outside the tropics almost entirely in semi-arid and Mediterranean areas - Masaridae; and endemic to a single zoogeographical region - Euparagiidae.

3 Flower associations

Comparison between flower visiting by masarid wasps, non-masarid wasps and bees

Most aculeate wasps and bees as adults, both male and female, visit flowers to obtain nectar for their own nourishment. In addition adult female masarid wasps and the majority of adult female bees visit flowers to collect pollen and nectar for provisioning their young. Certain masarid wasps and bees collect nectar for use in nest construction and a small minority of bees collect oils.

Nectar and/or pollen seeking visitors are categorized as follows:

a. males obtaining nectar for their own nourishment - masarid wasps, non-masarid wasps and bees.
b. females obtaining nectar for their own nourishment - masarid wasps, non-masarid wasps and bees.
c. females collecting nectar for provisioning their young - masarid wasps, and non-parasitic bees.
d. females collecting nectar for use in nest construction - some masarid wasps and some bees.
e. females collecting pollen for provisioning their young - masarid wasps and non-parasitic bees.

It has been erroneously stated that among the Aculeata only the bees have elongated probocises (Kevan and Baker, 1983). It is true that short tongues are characteristic of the majority of wasps, however, most masarids have long tongues (Table 6 and Fig. 18), some considerably longer than the wasp's length from the frons to the tip of the abdomen. Consequently masarids, like long tongued bees,

Table 6. Body length, tongue length, and the ratio of tongue length to body length for some southern African masarids.

Genus	Species	sex	N	average body length mm	average tongue length mm	average tongue length / average body length
Ceramius	bicolor	F	4	10,83	2,96	0,27
		M	2	10,50	2,92	0,28
	braunsi	F	10	17,28	4,70	0,27
	caffer	F	1	17,00	5,41	0,32
	capicola	F	8	10,90	2,54	0,19
	cerceriformis	F	4	17,33	4,08	0,24
		M	6	17,06	4,46	0,26
	clypeatus	F	10	15,43	2,98	0,19
		M	10	15,48	3,18	0,21
	lichtensteinii	F	6	17,78	5,56	0,31
		M	4	17,83	5,54	0,31
	metanotalis	F	4	19,34	6,23	0,32
		M	2	19,83	5,75	0,29
	micheneri	F	3	13,61	2,75	0,20
		M	2	12,50	2,38	0,19
	nigripennis	F	6	14,86	4,08	0,27
		M	7	15,17	4,57	0,30
	rex	F	1	20,86	5,83	0,28
	richardsi	F	1	14,33	2,92	0,20
	socius	F	9	14,30	4,22	0,30
		M	7	13,74	4,02	0,29
	toriger	F	9	15,33	5,56	0,36
		M	2	15,33	5,21	0,34
Jugurtia	braunsi	F	8	9,92	3,69	0,37
	braunsiella	F	3	11,17	4,11	0,37
	confusa	M	4	10,08	4,23	0,42
Masarina	familiaris	F	8	10,09	3,54	0,35
		M	5	8,80	3,28	0,37
	mixta	F	10	8,85	3,71	0,42
		M	8	7,45	2,92	0,39
Celonites	bergenwahliae	F	3	7,56	4,28	0,57
		M	7	6,56	3,35	0,51
	capensis	F	7	8,89	5,71	0,64
		M	2	8,75	5,04	0,58
	clypeatus	F	10	8,80	5,68	0,66
		M	2	7,63	4,96	0,65
	latitarsis	F	3	8,33	4,33	0,52
		M	2	6,91	3,42	0,51
	peliostomi	F	20	6,76	4,73	0,70
		M	4	7,08	4,17	0,59
	wahlenbergiae	F	6	7,47	4,29	0,57
		M	6	6,88	3,40	0,49
Quartinia	parcepunctata	F	1	5,53	2,25	0,42
Quartinioides	laeta	F	3	3,69	4,88	1,32
	sp. F	F	2	3,94	5,40	1,32

Measurements taken from pinned dried specimens with tongues extended (vouchers in Albany Museum collection).

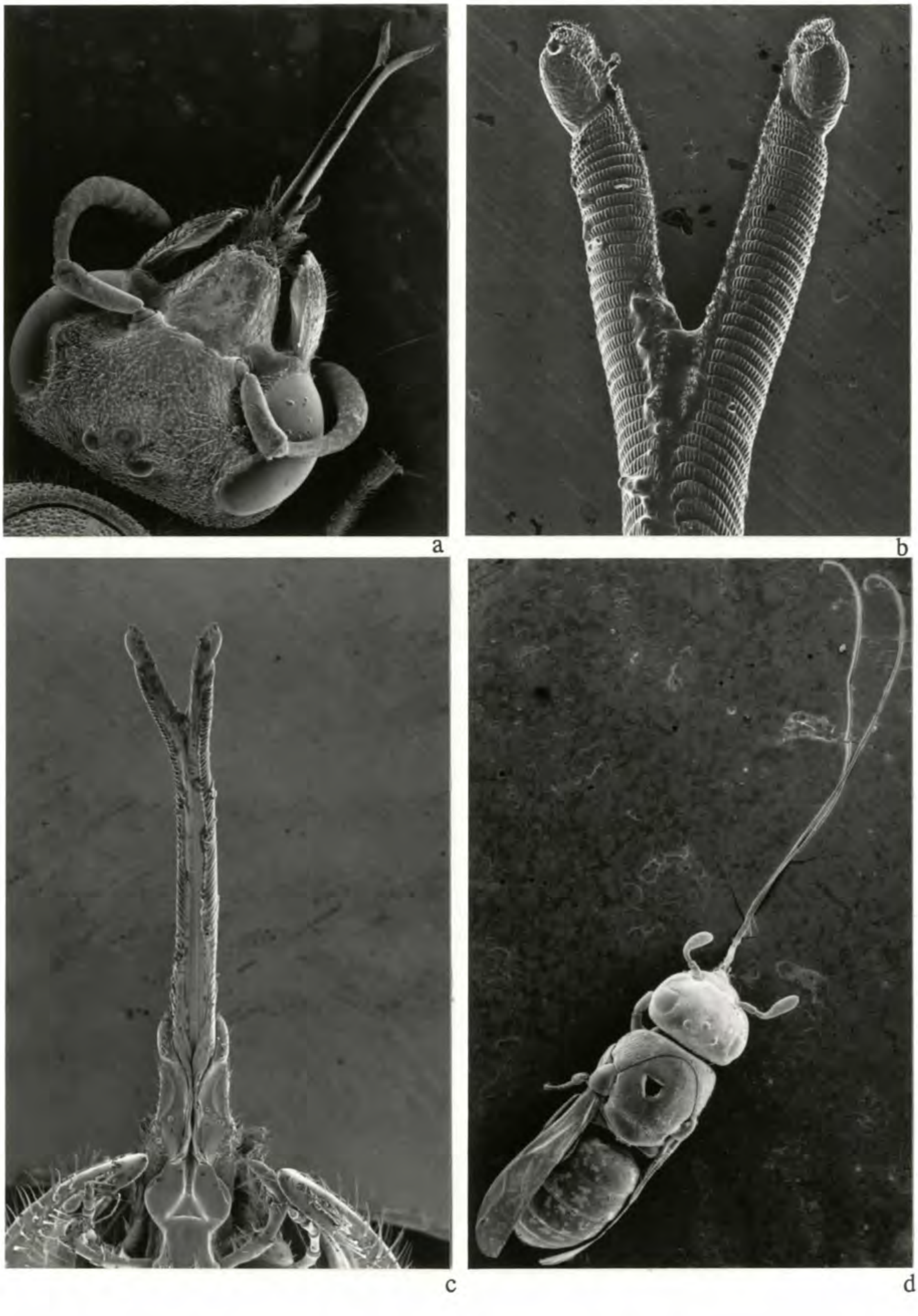


Fig. 18 a-d. (a - c) Ceramius clypeatus, an example of a relatively short tongued masarid wasp: a. dorsal view of head with tongue extended (x 14); (b) dorsal view of tongue tip showing overlapping "scales" and acroglossal buttons (x 100); (c) ventral view of tongue (x 30); (d) Quartinioides laeta, an example of a relatively long tongued masarid wasp, dorsal view with tongue extended (x14).

have the potential to obtain nectar from a wider range of flower forms than do short tongued wasps and short tongued bees which most are obliged to visit flowers in which the nectar is readily accessible.

Taking the semi-arid areas of southern Africa as a study area an attempt was made to compare the diversity of flower families visited by masarids, non-masarid wasps and bees and the closeness of association with forage plant families by these groups. All the sampling areas are within the distribution range of masarids. The locations of the eight principal sampling areas are shown in Fig. 19. The general features of the sampling sites are shown in Figs 20 and 21.

All plants in flower at the sampling sites during the sampling periods were examined for flower visitors. Those which were receiving regular visits from wasps and/or bees were sampled over periods throughout the day. In effect the wasps and bees present in an area were all being offered the choice of visiting all those plants which were in flower. Each site sampled therefore represented a "choice chamber" in which all the aculeate wasps, in all cases including masarid wasps, and the bees were offered the same choice of plants in flower.

These records form the bulk (7 179, i.e. 92%) of Appendix 1. The remaining records (8%) are from label data on specimens in the Albany Museum collection (collectors of these specimens were C.F.Jacot Guillarmod, J.G.H.Londt, E.McC.Callan, M.Struck, T.F.Houston and A.J.S.Weaving) and the South African Museum collection (collectors C.D.Michener and V.B.Whitehead) and from publications of O.W.Richards and R.E.Turner. In the counts for comparative analysis between all taxa the records of Struck, Houston, Michener, Whitehead, Richards and Turner have been excluded as these are for masarids only. This has reduced the number of included species of masarids by 10 and therefore percentages of masarid species associated with flower families listed in Table 7 - differ from those given in the discussion of masarid distribution in relation to masarid forage plant associations.

Flowers of 35 families of flowering plants were sampled for visits by solitary aculeate wasps and solitary bees. Of these flower families 14 were visited by masarid wasps, 29 by non-masarid solitary aculeate wasps, and 30 by solitary bees.

Some measure of the percentage diversity of choice at the specific level, D, was obtained using the formula D = a-b/b x 100 where a = the sum of the number of species recorded visiting each of the flower families and b = the number of species of flower visitors. Clearly if each species visited only one family of plants D

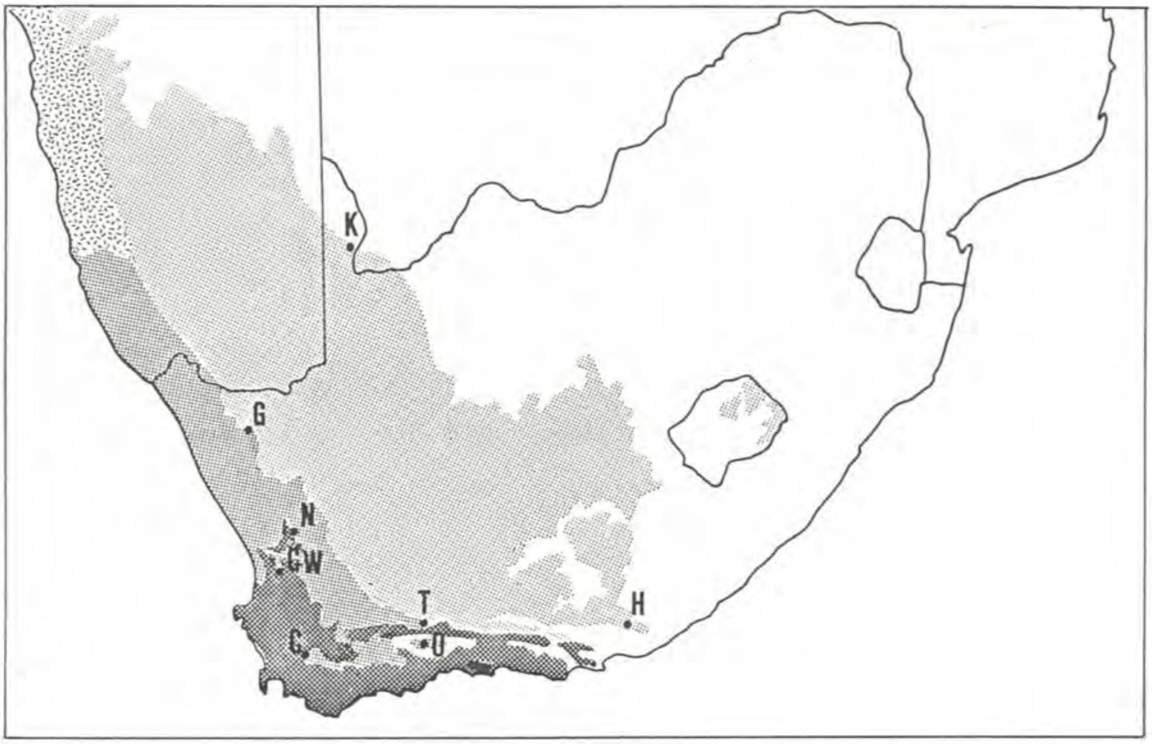


Fig. 19. Map of southern Africa showing the major sampling areas.

K = Lower reaches of the Nossob River Valley, Kalahari Gemsbok National Park;
G = Goegab Nature Reserve;
N = Nieuwoudtville;
CW = Clanwilliam;
C = Ceres;
T = Tierberg;
O = Onverwacht;
H = Hilton.

Fig. 20 a - d. (a) Lower reaches of the Nossob River Valley, Kalahari Gemsbok National Park, an area at the interface between the Karoo and Savannah Biomes; (b) Goegab Nature Reserve, Springbok, Namaqualand, in an area of Namaqualand Broken Veld (Acocks' Veld Type 33); (c) Skuinshoogte Pass, 15 km north of Nieuwoudtville, in an area of Western Mountain Karoo (Acocks' Veld Type 28); (d) Caleta Cove, Clanwilliam, in an area of Karroid Broken Veld (Acocks' Veld Type 26).

Fig 21 a - f. (a) Klein Alexandershoek, west of Clanwilliam in an area of Macchia (Fynbos) (Acocks' Veld Type 69); (b) Tierberg, Prince Albert, in an area of False Karroid Broken Veld (Acocks' Veld Type 26) in the southern Great Karoo; (c) Onverwacht, Oudtshoorn, in an area of False Karroid Broken Veld (Acocks' Veld Type 26) in the Little Karoo; (d) Hilton, Grahamstown district, in an area of False Karroid Broken Veld (Acocks Veld Type 26) in the southeastern Nama Karoo.

A masarid wasp, Ceramius lichtensteinii (Klug), (x 3,6).

Table 7. Numbers and percentages of species of aculeate wasps and bees recorded visiting flowers of the listed plant families.

Hymenopteran taxon	Bethyloidea		Scolioidea		Vespoidea Eumenidae		Vespoidea Masaridae		Pompiloidea		Sphecoidea		Apoidea		
number of species	32		45		55		86		49		112		228		
	no. of spp.	%	no. of spp.	%	no. of spp.	%	no. of spp.	%	no. of spp.	%	no. of spp.	%	no. of spp.	%	
Plant family															Total no. of spp.
Aizoaceae	3	9,4	4	8,9	8	14,5	36	41,9	3	6,1	15	13,4	40	17,5	109
Portulacaceae	-	-	-	-	3	5,5	-	-	-	-	-	-	-	-	3
Plumbaginaceae	-	-	-	-	-	-	3	3,5	-	-	3	2,7	2	0,9	8
Elatinaceae	1	3,1	1	2,2	-	-	-	-	2	4,1	1	0,9	2	0,9	7
Tiliaceae	-	-	-	-	-	-	-	-	1	2,0	-	-	7	3,1	8
Sterculiaceae	-	-	-	-	-	-	-	-	-	-	-	-	6	2,6	6
Malvaceae	-	-	-	-	-	-	-	-	-	-	1	0,9	-	-	1
Capparaceae	-	-	-	-	-	-	-	-	-	-	-	-	3	1,3	3
Ebenaceae	1	3,1	3	6,7	1	1,8	-	-	2	4,1	5	4,5	4	1,8	16
Crassulaceae	-	-	-	-	-	-	1	1,1	-	-	-	-	5	2,2	6
Rosaceae	-	-	-	-	-	-	-	-	-	-	-	-	4	1,8	4
Mimosaceae	5	15,6	19	42,2	27	49,1	1	1,1	16	32,7	40	35,7	28	12,3	136
Caesalpinaceae	-	-	-	-	-	-	-	-	-	-	-	-	1+	0,4	1
Papilionaceae	1	3,1	3	6,7	9	16,4	7	8,1	8	16,3	13	11,6	57	25,0	98
Proteaceae	-	-	6	13,3	-	-	-	-	2	4,1	6	5,4	8	3,5	22
Celastraceae	-	-	7	15,6	5	9,1	-	-	9	18,4	19	17,0	7	3,1	47
Salvadoraceae	-	-	-	-	1	1,8	-	-	-	-	-	-	-	-	1
Euphorbiaceae	-	-	-	-	-	-	-	-	1	2,0	1	0,9	-	-	2
Rhamnaceae	-	-	-	-	14	25,5	-	-	7	14,3	12	10,7	1	0,4	34
Polygalaceae	-	-	-	-	-	-	-	-	-	-	-	-	6	2,6	6
Anacardiaceae	-	-	-	-	1	1,8	-	-	-	-	-	-	-	-	1
Zygophyllaceae	-	-	1	2,2	-	-	-	-	-	-	4	3,6	8	3,5	13
Geraniaceae	-	-	1	2,2	5	9,1	3	3,5	-	-	-	-	4	1,8	13
Apiaceae	12	37,5	19	42,2	15	27,3	-	-	33	67,3	57	50,9	18	7,9	154
Asclepiadaceae	-	-	8	17,8	4	7,3	-	-	7	14,3	14	12,5	25	11,0	58
Solanaceae	-	-	-	-	3	5,5	-	-	-	-	3	2,7	8	3,5	14
Boraginaceae	-	-	3	6,7	1	1,8	1	1,1	-	-	5	4,5	17	7,5	27
Lamiaceae	-	-	-	-	-	-	-	-	-	-	-	-	30	13,2	30
Scrophulariaceae	-	-	1	2,2	-	-	12	14,0	1	2,0	7	6,3	6	2,6	27
Selaginaceae	-	-	5	11,1	2	3,6	-	-	2	4,1	10	8,9	4	1,8	23
Acanthaceae	-	-	-	-	6	10,9	1	1,1	-	-	2	1,8	23	10,1	32
Campanulaceae	-	-	1	2,2	1	1,8	17	19,8	-	-	5	4,5	20	8,8	44
Asteraceae	18	56,3	13	28,9	13	23,6	40	46,5	7	14,3	37	33,0	94	41,2	222
Liliaceae	-	-	4	8,9	-	-	1	1,1	5	10,2	1	0,9	3	1,3	14
Iridaceae	-	-	1	2,2	-	-	-	-	-	-	-	-	5	2,2	6
TOTAL	41		100		119		123		106		261		446		

Underlining draws attention to the six plant families attracting the highest number of aculeate wasp and bees species.

would equal 0. The values for D obtained by applying this formula to the counts recorded in Table 7 were: 43,0% for masarid wasps, 114,0% for non-masarid wasps, 95,6% for solitary bees. These percentages indicate a markedly narrower diversity of flower choice at the specific level by masarid wasps overall than by solitary non-masarid wasps and by solitary bees.

Marked variations in diversity of flower visiting between families of bees are apparent. Percentage diversity of choice was calculated for the individual bee families excluding Andrenidae and Fideliidae for which flower visiting records for only 4 species each were obtained (Table 8). The percentages obtained were: 38,1% for Colletidae, 121,2% for Halictidae, 44,4% for Melittidae, 73,6% for Megachilidae and 150,8% for Anthophoridae. This indicates a similar percentage diversity of choice for masarid wasps, Colletidae and Melittidae and a greater diversity of choice for Halictidae, Megachilidae and Anthophoridae.

It should be noted that the paucity of records for Fideliidae results from their flight period beginning relatively earlier in the spring than that of the masarids and being almost over when that of the masarids is beginning. Records of Whitehead (1984) indicate a low percentage diversity of choice, a strong tendency to oligolecty having been noted.

When the numbers and diversity of species visiting flowers of the 35 plant families were tabulated (Table 7) it became immediately apparent that seven families, Aizoaceae, Mimosaceae, Papilionaceae, Celastraceae, Apiaceae, Asclepiadaceae and Asteraceae, were visited by a large number and wide range of species of wasps and bees. Social wasps and honeybees were not included in the table for analysis. Social wasps were, however, represented in samples from Mimosaceae, Papilionaceae, Celastraceae, Apiaceae, Asclepiadaceae and Asteraceae and honeybees in samples from Aizoaceae, Papilionaceae, Apiaceae and Asteraceae.

Some measure of the percentage preference, P, was obtained using the formula $P = c/d \times 100$ where c = the number of species of a taxon recorded as visiting the flowers of a plant family and d = the total number of species of that taxon for which flower visiting records are listed. The results are presented as bar graphs (Fig. 22). It can readily be seen that masarid wasps were strikingly absent from assemblages of visitors to the flowers of Mimosaceae, Celastraceae, Apiaceae and Asclepiadaceae, yielding percentage preferences of 0-1,1% whereas non-masarid solitary wasps, excluding the Bethyloidea, yielded percentage preferences ranging from 7,3-63,7% and solitary bees 3,1-12,3%. By contrast masarid wasps as a group yielded percentage preferences of 42,2% for Aizoaceae, 44,4% for

Table 8. Numbers and percentages of species of bees, by family, recorded visiting flowers of the listed plant families.

bee family	Colletidae		Andrenidae	Halictidae		Melittidae	Fideliidae	Megachilidae		Anthophoridae	
no. of spp.	21		4	33		9	4	91		67	
	no. of spp.	%	no. of spp.	no. of spp.	%	no. of spp.	no. of spp.	no. of spp.	%	no. of spp.	%
plant family											
Aizoaceae	5	23,8	2	8	24,2	2	-	9	9,9	14	20,9
Portulacaceae	-	-	-	-	-	-	-	-	-	-	-
Plumbaginaceae	-	-	-	1	3,0	-	-	-	-	1	1,5
Elatinaceae	-	-	-	-	-	-	-	2	2,2	-	-
Tiliaceae	-	-	-	-	-	-	-	2	2,2	5	7,5
Sterculiaceae	-	-	-	-	-	-	-	6	6,6	-	-
Malvaceae	-	-	-	-	-	-	-	-	-	-	-
Capparaceae	-	-	-	-	-	-	-	-	-	3	4,5
Ebenaceae	1	4,8	-	1	3,0	-	-	-	-	2	3,0
Crassulaceae	-	-	-	1	3,0	-	-	2	2,2	2	3,0
Rosaceae	1	4,8	-	2	6,1	-	1	-	-	1	1,5
Mimosaceae	-	-	-	5	15,2	-	-	12	13,2	11	16,4
Caesalpinaceae	-	-	-	-	-	-	-	-	-	1	1,5
Papilionaceae	1	4,8	-	4	12,1	2	-	33	36,3	17	25,4
Proteaceae	3	14,3	-	1	3,0	1	-	-	-	3	4,5
Salvadoraceae	-	-	-	-	-	-	-	-	-	-	-
Celastraceae	1	4,8	-	5	15,2	-	-	-	-	1	1,5
Euphorbiaceae	-	-	-	-	-	-	-	-	-	-	-
Rhamnaceae	-	-	-	1	3,0	-	-	-	-	-	-
Anacardiaceae	-	-	-	-	-	-	-	-	-	-	-
Polygalaceae	-	-	-	-	-	-	-	6	6,6	-	-
Zygophyllaceae	1	4,8	1	-	-	-	-	3	3,3	3	4,5
Geraniaceae	-	-	-	-	-	-	-	2	2,2	2	3,0
Apiaceae	2	9,5	-	7	21,2	-	-	3	3,3	6	9,0
Asclepiadaceae	1	4,8	-	3	9,1	-	-	15	16,5	6	9,0
Solanaceae	-	-	-	2	6,1	-	-	-	-	6	9,0
Boraginaceae	-	-	-	-	-	-	-	3	3,3	14	20,9
Lamiaceae	-	-	-	1	3,0	-	-	12	13,2	17	25,4
Scrophulariaceae	-	-	1	3	9,1	-	-	1	1,1	1	1,5
Selaginaceae	-	-	-	2	6,1	-	-	1	1,1	1	1,5
Acanthaceae	-	-	-	-	-	-	1	10	11,0	12	17,9
Campanulaceae	1	4,8	-	5	15,2	5	-	2	2,2	7	10,4
Asteraceae	11	52,4	-	18	54,5	1	2	34	37,4	30	44,8
Liliaceae	1	4,8	-	1	3,0	-	-	-	-	1	1,5
Iridaceae	-	-	-	2	6,1	2	-	-	-	1	1,5
TOTAL	29		4	73		13	4	158		168	

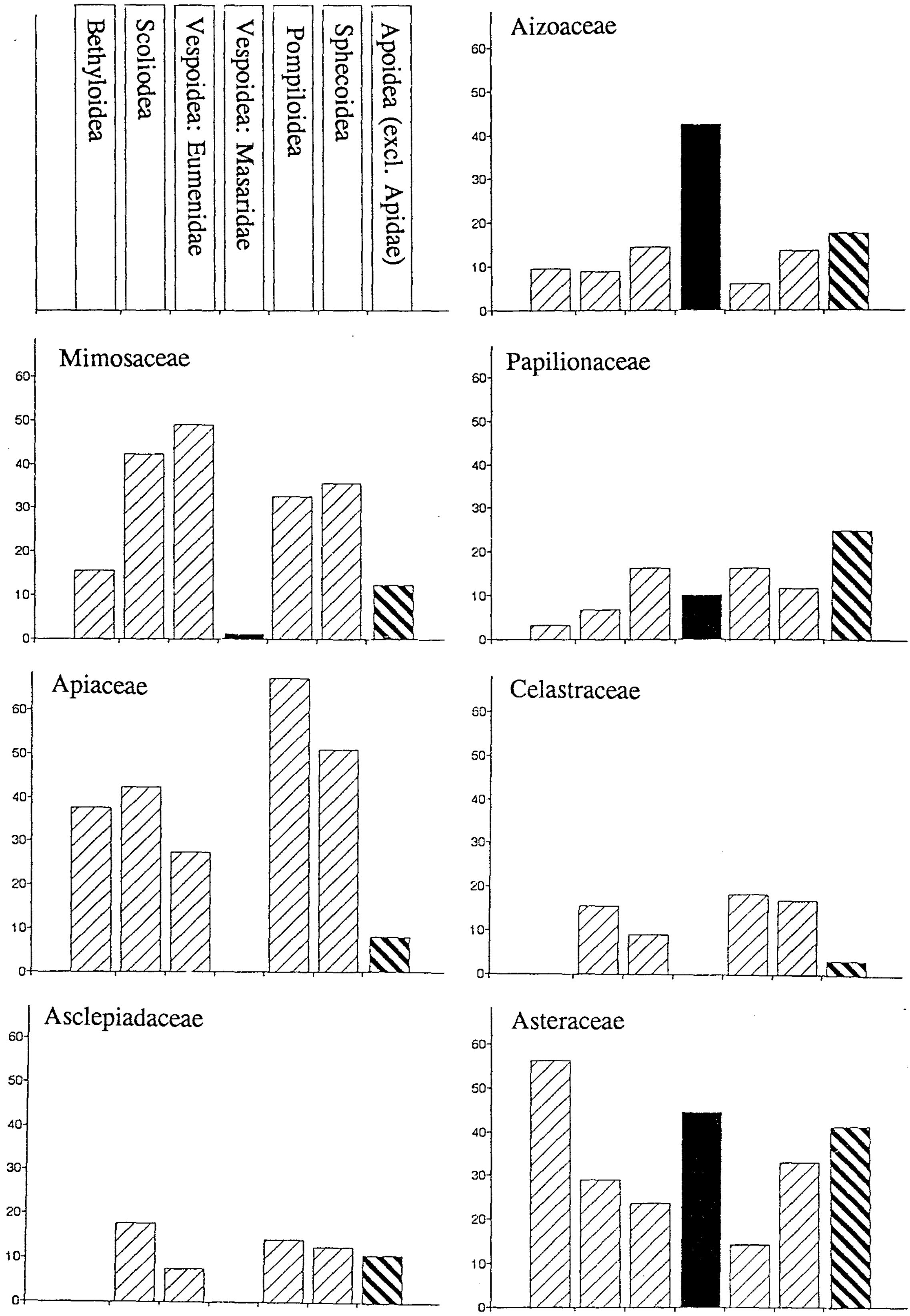


Fig. 22. Bar Graphs showing percentage preferences of non-masarid wasps, masarid wasps and bees for flowers of the seven plant families recorded as attracting the highest number of aculeate wasp and bee species (data from Table 7). Light cross hatching - non-masarid wasps; black - masarid wasps; heavy cross hatching - bees excluding honeybees.

Asteraceae and 10% for Papilionaceae compared with 6,1-14,5%; 14,3-33%; and 6,7-16,3% respectively for non-masarid wasps and 17,5%, 41,2% and 25% respectively for bees.

Though not high, the percentage preferences shown for Scrophulariaceae and Campanulaceae by masarid wasps, 13,3% and 18,9% respectively, are notably higher than those shown by non-masarid wasps, 0-6,2%, and solitary bees, 0-8,8%. Neither social wasps nor honeybees were recorded from Scrophulariaceae and only honeybees from Campanulaceae.

In strong contrast to the flower families which attract a wide range of visitors is the family Lamiaceae from which only solitary bees and honeybees were recorded, and Polygalaceae from which only solitary bees were recorded. It is surprising that Lamiaceae did not receive even casual visits from masarids as in Europe there is a strong association between Celonites abbreviatus and Lamiaceae (Schremmer, 1959).

Review of world masarid/flower associations

Available flower visiting records for the masarids of the world have been assembled and are presented in tabular form in Appendix 1: 259-280 (southern Afrotropical) and Appendix 2 (Nearctic, Neotropical, Palaearctic and Australian).

Gayellinae

Flower visiting records for the Gayellinae (Appendix 2) are scant and too fragmentary for possible associations to be identified. Gayella eumenoides has been recorded from Quillaja saponica (Rosaceae), Schinus dependens (Anacardiaceae) and Baccharis sp. (Asteraceae), Gayella araucana from Homalocarpus dichotomus (Apiaceae) and Gayella reedi from Adesmia melanthes (Papilionaceae).

Masarinae: Paragiini

Flower visiting records for the Australian group Paragiini are available for eight species of Paragia Shuckard, one species of Ammoparagia Snelling, three species of Riekia Richards and two species of Rolandia Richards (Appendix 2), that is for 14 of the 31 described species. Of these 14 species 50% have been recorded from the flowers of Myrtaceae and 47% from the flowers of Goodeniaceae suggesting a strong association with these plants. This suggestion is further strengthened by the fact that the pollen from the provision from nests of two species of Paragia, P.tricolor and P. decipiens, was found to be myrtaceous pollen. A further species of Paragia, P. vespiformis, though recorded from the flowers of Myrtaceae, and therefore included in the 50%, was, however, found to have provisioned solely with Acacia (Mimosaceae) pollen. This seems to be an unusual preference as there are no other records of masarids provisioning with Mimosaceae. The only other record of a masarid visiting flowers of Mimosaceae, though insects from these flowers have been well collected, is of unusual casual visiting by a male Jugurtia confusa (in the Afrotropical Region), a species which regularly provisions solely with the pollen of Aizoaceae.

The preference shown by Australian masarids for Myrtaceae is shared with the Australian bees which show an overwhelming oligolectic preference for Myrtaceae (Michener, 1965).

Two species of Paragia have been recorded from Proteaceae, apparently as casual visitors. These appear to be the only records of visits by masarids to Proteaceae apart from a record by Hattingh and Giliomee (1989) of a "masarid" from flowers of Leucadendron in the Afrotropical Region. The present author has been unable to establish the identity of the wasp as the specimen concerned no longer exists (Hattingh, pers. comm., letter 27.ii.1990).

One female of Paragia oligomera has been recorded from the flowers of Reglia ciliata (Bromeliaceae). No other flower visiting records are available for this wasp and there appear to be no other records of any masarids visiting Bromeliaceae and so it is not possible at present to evaluate this record.

All the above records are for Western Australia or New South Wales making the record from the Northern Territory of four female and three male Rolandia borreriae from the flowers of Borreria exserta (Rubiaceae) of particular interest. The size of the sample and the lack of other flower visiting records for this species does suggest a possible association with Rubiaceae, a family of plants for which there appear to be no other records of masarid visits. It should be noted, however, that the Rubiales are closely related to the Asterales (Cronquist, 1988), an order of plants strongly favoured by a high percentage of the southern African masarids.

Masarinae: Masarini

Ceramius Latreille

The available flower visiting records for Palaearctic Ceramius species (Ceramius groups 1 and 7) (Appendix 2) are few and casual and do not indicate any preferences. On the other hand flower visiting records are available for 18 of the 19 described southern Afrotropical Ceramius species (groups 2-6 and 8) (Appendix 1). Of these 18 species, 50% have been recorded from the flowers of Asteraceae, 44% from the flowers of Aizoaceae, and 22% from the flowers of Papilionaceae. That the percentages for flower families visited is in excess of 100% is explained by records of occasional visits by some species to plants of families other than those preferred. Such visits appear to be for nectar only. For example females of Ceramius braunsi, a species showing a clear preference for Asteraceae, have been collected exceptionally from flowers of Aspalathus spinescens (Papilionaceae). However, pollen from the crop of such a female was examined and found to be entirely derived from flowers of Asteraceae.

Other plants recorded as being occasionally visited by Ceramius species in southern Africa are Wahlenbergia (Campanulaceae) by Ceramius socius and Blepharis (Acanthaceae) by Ceramius lichtensteinii. Visits to Wahlenbergia flowers are not unusual for some other masarid genera, being the known preferred flowers of some southern African species of Celonites and Quartinia and a species of Masarina, and being occasionally visited by Jugurtia. Flowers of Acanthaceae are not otherwise visited by masarids though flowers of the closely related family Scrophulariaceae are the preferred flowers of some species of southern African Celonites and Quartinioides and of the North American genus Pseudomasaris.

Pollen from provision obtained from 14 Ceramius species was for each species derived from a single plant family which indicates that the genus Ceramius is markedly oligolectic and makes it possible to recognize clear associations (Table 9).

A high percentage of species associated with Asteraceae and Aizoaceae is shared with southern African Jugurtia and the Quartinia, Quartinioides and Quartiniella complex.

Table 9. Ceramius species/forage plant associations.

Species Group	Species	forage plant taxon
Group 2A		
	cerceriformis	Aizoaceae : Mesembryanthema
	peringueyi	Aizoaceae : Mesembryanthema (foraging records only)
Group 2B		
	clypeatus	Papilionaceae : Aspalathus
Group uncertain		
	micheneri	Papilionaceae : Aspalathus
Group 3		
	nigripennis	Asteraceae
	jacoti	Asteraceae
	braunsi	Asteraceae
	toriger	Asteraceae
Group 4		
	beyeri	Aizoaceae : Mesembryanthema (foraging records only)
Group 5		
	lichtensteinii	Aizoaceae : Mesembryanthema
Group 6		
	rex	Asteraceae
	metanotalis	Asteraceae
	caffer	Asteraceae (foraging record only)
Group 8		
	capicola	Aizoaceae : Mesembryanthema
	linearis	Aizoaceae : Mesembryanthema
	bicolor	Aizoaceae : Mesembryanthema
	socius	Aizoaceae : Mesembryanthema

Ceramiopsis Zavattari

There appear to be no flower visiting records for the Neotropical genus Ceramiopsis.

Trimeria Saussure

Available flower visiting records for the Neotropical genus Trimeria (Appendix 2) are few both in number of species, four, and in instances. Associations with Portulacaceae, Verbenaceae and Boraginaceae are, however, indicated. Visits to Malvaceae and Asteraceae though recorded are too few for evaluation. Portulacaceae though not otherwise recorded as a family visited by masarids is, interestingly, closely related to Aizoaceae, a family so much favoured by masarids in southern Africa. Verbenaceae and Boraginaceae are closely related families and though Verbenaceae is not otherwise known as a family visited by masarids. Boraginaceae appears to be favoured by Celonites and possibly Masaris vespiformis in the Palaearctic. A single visit by a male Celonites capensis to Boraginaceae has been recorded from southern Africa.

Microtrimeria Bequaert

There appear to be no flower visiting records for the Neotropical genus Microtrimeria.

Masaris Fabricius

Flower visiting records for the Palaearctic genus Masaris are scant (Appendix 2). A possible association between Masaris vespiformis and Echium (Boraginaceae) is indicated by its having been collected on flowers of these plants in both Algeria and Egypt. There is, however, a record of it from Lamiaceae in Israel. The record of Masaris carli from Tamarix (Tamaricaceae) in Kazakhstan is of interest, if taken together with the record of casual visiting of Tamarix by Pseudomasaris edwardsii in North America.

Pseudomasaris Ashmead

Flower visiting records are available for 13 of c 15 described species of the Nearctic genus Pseudomasaris (Appendix 2). Of these 92% have been recorded from flowers of Hydrophyllaceae of the genera Phacelia and Eriodyction and 31% have been recorded from flowers of Scrophulariaceae, in particular of the genus

Penstemon. That the sum of the percentages for flower families visited, given above, is in excess of 100% is explained by records of visits by some species to both families. Fifteen other flower families are listed as being visited, however, sizes of samples and observations of those (Richards, 1963b and Torchio, 1970 and 1974) who have made studies of Pseudomasaris flower visiting and nesting behaviour indicate that visits to these families are casual in nature. This supports Cooper's (1952) conclusion that Pseudomasaris species are in the main oligolectic, favouring principally Phacelia or Penstemon. Tepedino (1979), basing his argument on field observations of his own, questioned Cooper's assertion with regard to P. vespiformis and expressed the opinion that Cooper had acted arbitarily in discarding the records of Clements and Long (1923) and Hicks (1927). However, he does not comment on Torchio's (1974) study of the pollination of Penstemon by this wasp.

Jugurtia Saussure

Flower visting records are available for seven southern African species and three Palaearctic species of Jugurtia (Appendices 1 and 2). Six of the seven southern African species and one Palaearctic species have been recorded from flowers of Asteraceae and two southern African species have been recorded from Aizoaceae. For one of the latter species, J. confusa, provision was obtained. The pollen from this provision was found to be derived solely from flowers of Aizoaceae suggesting that J. confusa at least is oligolectic. The other species, J. braunsi, has been recorded in addition from Asteraceae and Campanulaceae (Wahlenbergia pilosa). Regrettably its provision is not known. Records for the Palaearctic species are scant precluding evaluation. The records of visits to Apiaceae are remarkable as wasps and bees visiting Apiaceae in southern Africa have been well collected and there have been no records of visits by masarids.

Masarina Richards

Flower visiting records are available for all the known species of the southern Afrotopical genus Masarina (Appendix 1). Four of the five species have been recorded from Papilionaceae (Fabaceae). For the fifth, only one record is known, that of a female from Hermannia disermifolia of the family Sterculiaceae (Malvales). This appears to be the only record of a masarid visiting flowers of this family. There are, however, records of casual visiting of flowers of Malvaceae (Malvales) by Jugurtia in Algeria, Trimeria in South America and Pseudomasaris in North America. Of those species visiting Papilionaceae Masarina familiaris and Masarina hyalinipennis can be said to be closely associated with Papilionaceae of the Cape Group of the Crotalarieae having been collected repeatedly from widely separated sites from flowers of this group but from no other. Furthermore pollen examined from provision of M. familiaris was also all from this group. Masarina mixta on the other hand has been recorded many times from Wahlenbergia (Campanulaceae) whereas only one female has been collected from Papilionaceae and one other has been collected from Asteraceae. These appear to be casual visits and it therefore seems probable that it, like some of the southern Afrotropical Celonites species, is associated almost entirely with Wahlenbergia.

Celonites Latreille

Flower visiting records are available for 10 species from the southern Afrotropical Region (Appendix 1) and nine species from the Palaearctic Region (Appendix 2). Of the Afrotropical species, six species have been recorded from flowers of Scrophulariaceae, four species from flowers of Campanulaceae and one species from flowers of the closely related family Lobeliaceae, five species from flowers of Asteraceae, and three species from flowers of Aizoaceae.

Of the six species recorded from Scrophulariaceae, three species have been collected abundantly from widely separated localities solely from Aptosimum and Peliostomum indicating a close association between these wasps and these plant genera, a preference shared with some species of Quartinioides. The remaining three species recorded from Scrophulariaceae were collected on Polycarena to which they seem to be casual visitors. Three of the species visiting Campanulaceae are closely associated with Wahlenbergia species although two, at least, are not restricted to them. The fourth appears to be a casual visitor. The species visiting Lobeliaceae has only been collected from Lobelia linearis but records are too few for an evaluation of the closeness of the association to be made. Of the species visiting Asteraceae only one, possibly two, species have a close association with these plants and the remainder are casual visitors.

Eight of the nine Palaearctic species have been collected from Boraginaceae, a family known to be visited only casually by one species of southern Afrotropical Celonites. Though the collecting records are few the number of species involved does suggest a possible association, a preference indicated for some species of Trimeria. Two species have been collected from Lamiaceae and Schremmer (1959) suggests a close association by Celonites abbreviatus with this family. This is of particular interest as in the southern Afrotropical Region no masarids have been found to be associated with this family even as casual visitors. However, in the Palaearctic Ceramius and Masaris, and in the Nearctic Pseudomasaris have been recorded as casual visitors.

Quartinia Ed. André, Quartinioides Richards and Quartiniella Schulthess group

Flower visiting records are available for 17 species of Quartinia, 37 species of Quartinioides, and one species of Quartiniella in the southern Afrotropical Region (Appendix 1) and for seven species of Quartinia in the Palaearctic Region (Appendix 2).

As these genera are very closely related (Carpenter, in prep.) they will be treated as a group. Of the 55 southern Afrotropical species 55% have been recorded from Aizoaceae, 33% from Asteraceae, 16% from Campanulaceae, and 11% from Scrophulariaceae. In addition Wharton (1980) recorded an undescribed species of Quartinioides foraging abundantly on Zygophyllum simplex (Zygophyllaceae).

Exceptional is the record of a good sample of Quartinoides antigone from Aloe striata (Liliaceae). The only other record of a masarid visiting Liliaceae, indeed any "monocot", is a casual visit by a species of Pseudomasaris to Yucca.

Records for most species are insufficient to indicate how many species can be expected to be associated with a single family of plants. Certainly provision from Quartinia vagepunctata was all derived from flowers of Asteraceae, the single recorded visits to Aizoaceae and Papilionaceae seemingly representing casual visiting.

Of the Palaearctic species the six species from North Africa are all recorded from Asteraceae and the remaining species from Samarkand and Tadzhikistan (as Tadjkistan in Richards, 1962) from Chenopodiaceae, a family closely related to Aizoaceae.

Discussion of masarid forage plant associations in relation to masarid distributions

It is clear from the foregoing review of masarid/flower associations that, where satisfactory foraging and provisioning records are available for masarid wasps, oligolecty (collection of pollen from flowers of plants of a single family or even genus) and narrow polylecty (collection of pollen from plants of a limited range of families) are the rule. Broad polylecty (collection of pollen from a wide range of families) are the rule. Broad polylecty (collection of pollen from a wide range of families) in masarids seems to be the exception. That some of the flowers favoured by masarids are themselves generalists, for example Asteraceae, and others specialists, for example Scrophulariaceae, is not surprising when one realizes that the evolutionary factors favouring specialist or generalist pollinators are not necessarily the same as those favouring specialist or generalist flowers (Cruden, 1972 and Heinrich, 1979 as cited in Kevan and Baker, 1983 ; and Proctor, 1978). Indeed Moldenke (1979) observed that a one-to-one bee/plant relationship is rarely observed in nature. Rather there is a tremendous overlap in the forage plant preferences of specialist bees.

The high incidence of oligolecty in masarids is in accord with the statement of Michener (1979) with regard to bees - that oligolecty is highest in the arid, warm temperate areas where climatic conditions lead to simultaneous flowering of many kinds of plants. Indeed Emlen (1973 as cited in Kevan and Baker, 1983) concluded that, if resources are predictable and their density or quality is high, specialization is favoured.

Moldenke (1979) in a study of ecosystem organization in the semi-arid areas of Chile and California found that the majority of bee species are specialist feeders upon a particular genus, family or similar limited array of closely related plant taxa. In addition, he pointed out that along the Pacific Coast and in the Sonoran Desert of the United States, there are nearly 2 000 species of bees, of which nearly 60 percent or 1 200 species are specialized feeders. However, that of these 1 200 specialists at least 950 frequent taxa of only about 45 plant genera. This is of interest when one considers the small range of plant groups visited by the oligolectic masarids in any one zoogeographical region (Table 10).

Major marked foraging preferences are shown by the Australian masarid wasps for Myrtaceae (Myrtales) and Goodeniaceae (Campanulales), by the Nearctic genus Pseudomasaris for Scrophulariaceae (Scrophulariales) and Hydrophyllaceae (Solanales) and by the Afrotropical masarids (based on data for 92 species representing all seven genera) for Aizoaceae (Caryophyllales) (predominantly Mesembryanthema) (45%), Asteraceae (=Compositae) (Asterales) (41%), Campanulaceae (Campanulales) (18%), Scrophulariaceae (13%) and Papilionaceae (=Fabaceae) (Fabales) (7%). Data available for the Neotropical and Palaearctic species are inadequate for definite associations to be recognized, however, associations are indicated for one species of Trimeria with Verbenaceae (Lamiales) in the Neotropical Region, and for Quartinia species with Asteraceae in the Palaearctic Region.

Table 10. Major plant preferences of masarines with possible preferences suggested by number or nature of records given in [ ].

Masarid taxon	Region	no of spp. with data	Plant taxon
Paragiini Paragia + Metaparagia + Riekia + Rolandia + Ammoparagia			
	Australian	14	Myrtaceae (Myrtales) 50%; Goodeniaceae (Campanulales) 47%; Mimosaceae (Fabales); [Rubiaceae (Rubiales); Bromeliaceae (Bromeliales)].
Masarini Ceramius			
	S Afrotropical	18	Asteraceae (Asterales) 50%; Aizoaceae (Caryophyllales) 44%; Papilionaceae (Fabales) 22%.
	Palaearctic	2	[Resedaceae (Capparales); Plumbaginaceae (Plumbaginales)].
Ceramiopsis			
	Neotropical		unknown
Trimeria			
	Neotropical	4	Verbenaceae (Lamiales); [Boraginaceae (Lamiales); Portulacaceae (Caryophyllales)].
Microtrimeria			
	Neotropical		unknown
Masaris			
	Palaearctic	2	[Boraginaceae (Lamiales); Lamiaceae (Lamiales); Tamaricaceae (Violales)].
Pseudomasaris			
	Nearctic	13	Hydrophyllaceae (Solanales) 92%; Scrophulariaceae (Scrophulariales) 31%; [Boraginaceae (Lamiales); Ranunculaceae (Ranunculales); Asteraceae (Asterales)].

continued on next page

Table 10. continued

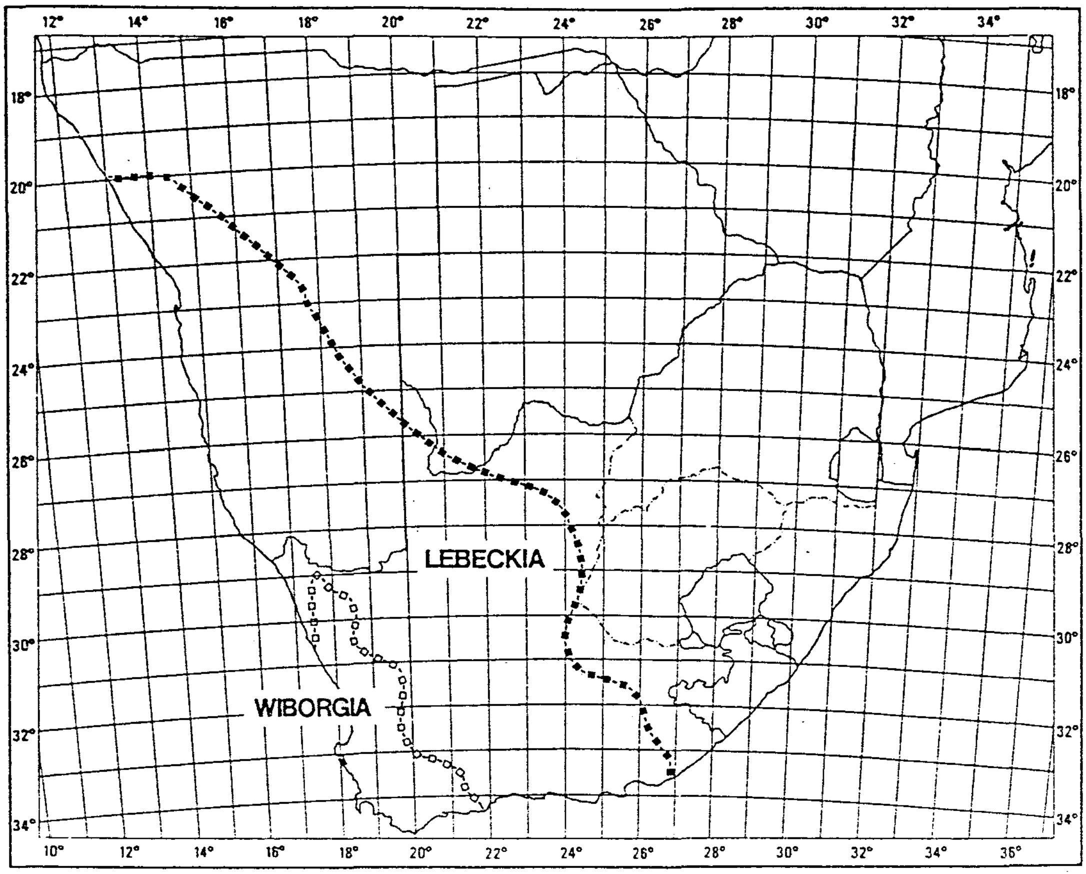
Masarid taxon	Region	no of spp. with data	Plant taxon
Jugurtia			
	S Afrotropical	7	Asteraceae (Asterales); Aizoaceae (Caryophyllales); [Campanulaceae (Campanulales)].
	Palaearctic	3	[Asteraceae (Asterales); Apiaceae (Apiales)].
Masarina			
	S Afrotropical	5	Papilionaceae (Fabales); [Sterculiaceae (Malvales)].
Celonites			
	S Afrotropical	10	Asteraceae (Asterales); Aizoaceae (Caryophyllales); Scrophulariaceae (Scrophulariales); Campanulaceae (Campanulales); Lobeliaceae (Campanulales); [Geraniaceae (Geraniales)].
	Palaearctic	9	Lamiaceae (Lamiales); [Boraginaceae (Lamiales)].
Quartinia + Quartinioides + Quartiniella			
	S Afrotropical	55	Aizoaceae (Caryophyllales) 55%; Asteraceae (Asterales) 33%; Campanulaceae (Campanulales) 16%; Scrophulariaceae (Scrophulariales) 11 %; [Liliaceae (Liliales); Zygophyllaceae (Sapindales)].
Quartinia	Palaearctic	7	[Asteraceae (Asterales) 6 spp.; Chenopodiaceae (Caryophyllales) 1 sp].

The Myrtaceae (Myrtales), although relatively widespread, show marked species diversity in Australia. The association of some Australian masarids with this family stands out as distinct. If one considers that the Myrtales are members of the subclass Rosidae, a connection can be found with known masarid associations with Fabales also of the subclass Rosidae: with Mimosaceae by a single species in Australia, with Papilionaceae by 7% of southern African species and casually by a Palaearctic species and a Nearctic species.

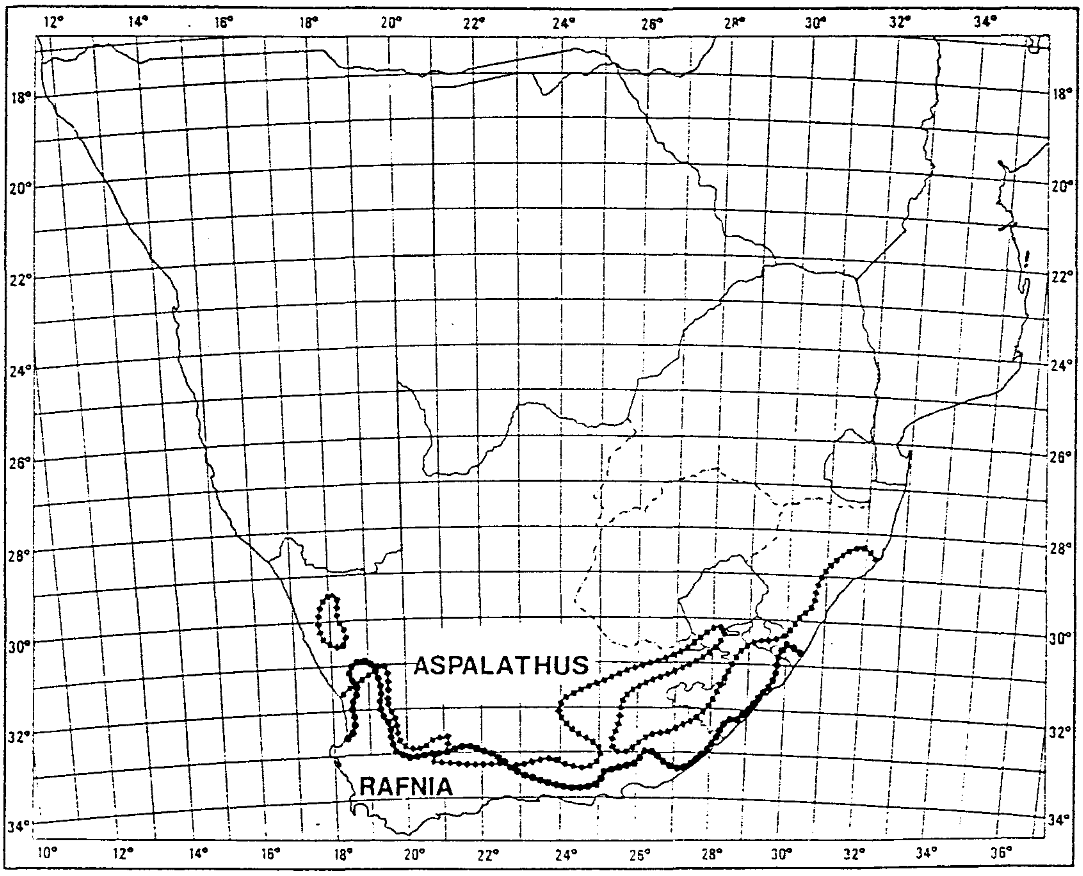
The three southern African species of Ceramius associated with the genus Aspalathus (Papilionaceae) are strikingly restricted in their distributions. The species of Aspalathus with which they are associated are all species with restricted distributions although somewhat less so than their masarid visitors. Masarina familiaris and Masarina hyalinipennis, associated with Aspalathus, Lebeckia and Wiborgia are less restricted having both been recorded from Namaqualand and the Olifants River Valley and M. familiaris in addition eastwards to Willowmore in the southern Karoo. They have therefore together been recorded from about half the range of the genus Aspalathus which extends eastwards beyond the semi-arid areas into Natal, the southwestern third of the range of the genus Lebeckia and most of that of Wiborgia (van Wyk, 1991) (Fig. 23).

The marked preference for Asteraceae (Asterales) by many Afrotropical species can be linked to the apparent preference by some species of masarids for this family in the Palaearctic Region. It seems surprising, however, that it is only within the Afrotropical and Palaearctic regions that the family Asteraceae has been exploited by masarids. This family is widespread and there was a rapid production of many genera and species in response to the expansion of semi-arid and sub-humid habitats (Raven and Axelrod, 1974). There is therefore a rich diversity of "composites" within the distribution ranges of the masarids worldwide.

It is noteworthy that the Asterales are relatively closely allied to the Campanulales in the subclass Asteridae (Cronquist, 1988). A significant number of Australian masarids are associated with Goodeniaceae and Afrotropical masarids with Campanulaceae, both families of the Campanulales. The Goodeniaceae show their greatest species diversity in Australia, especially in the southwest (Cronquist, 1988). The family Campanulaceae is relatively widespread, however, the genus Wahlenbergia, with which at least 18 species of southern African masarids are associated, is in the main African (Thulin, 1975). Of the 200 species nearly 150 species occur in southern Africa, the greatest concentration of species being in the southwest. It is notable that in this region deep-flowered Wahlenbergia species are almost invariably attended by masarids.



a



b

Fig. 23 a and b. Approximate geographical distribution of the genera of the Cape Group of the Crotalarieae from van Wyk (1991): (a) Lebeckia and Wiborgia and (b) Rafnia and Aspalathus.

Also included in the Asteridae and of importance to the masarids are the Scrophulariales, the Solanales and the Lamiales. The Nearctic masarids fall into two groups, one markedly associated with Scrophulariaceae (Scrophulariales) and the other with Hydrophyllaceae (Solanales). Also markedly associated with Scrophulariaceae are 13% of the Afrotropical masarid species. One casual collecting record for a masarid on Scrophulariaceae in the Palaearctic Region has been noted. Masarids have been collected from all three families of the Lamiales: Lamiaceae (=Labiatae) in the Nearctic and the Palaearctic regions ; Boraginaceae in the Nearctic, Neotropical, Palaearctic and Afrotropical regions; and most notably Verbenaceae in the Neotropical Region.

In western North America the species of Pseudomasaris fall into two groups, one associated with Penstemon (Scrophulariaceae) and the other with Phacelia (Hydrophyllaceae). Penstemon and Phacelia are principally North American genera with the greatest concentration of species in the west (Willis, 1966).

In southern Africa three species of Celonites are associated with Aptosimum and Peliostomum (both Scrophulariaceae). Aptosimum and Peliostomum are African genera, the majority of species being southern African and being concentrated mostly in the western dry regions (Dyer, 1975). Two, at least, of the species of Celonites associated with these plants are widely distributed throughout their range.

The high percentage of Afrotropical species associated with Aizoaceae cannot be matched in any other region. Several Palaearctic species have, however, been collected from the flowers of Chenopodiaceae and one Neotropical species has been collected from Portulacaceae, both, like the Aizoaceae, families of the Caryophyllales.

Of note is the striking similarity between the overall distribution and the areas of diversity richness of the Afrotropical masarids (Fig. 7) and the Mesembryanthema (Fig. 24) (from Hartmann, 1991), particularly the correspondence of nodes of species richness designated by Hartmann as Gariep centre, Vanrhynsdorp centre and Little Karoo centre, and of areas of relatively high diversity of southern Namibia and the southwestern Cape. There is similarly a correspondingly low diversity in the Great Karoo with limited areas of higher diversity near Bloemfontein and Maseru.

In conclusion, taking masarids as a group, a relatively narrow range of plant taxa is favoured. Taking major plant preferences by zoogeographical region marked distinctions are apparent. Relatedness of plant preferences between zoogeographical

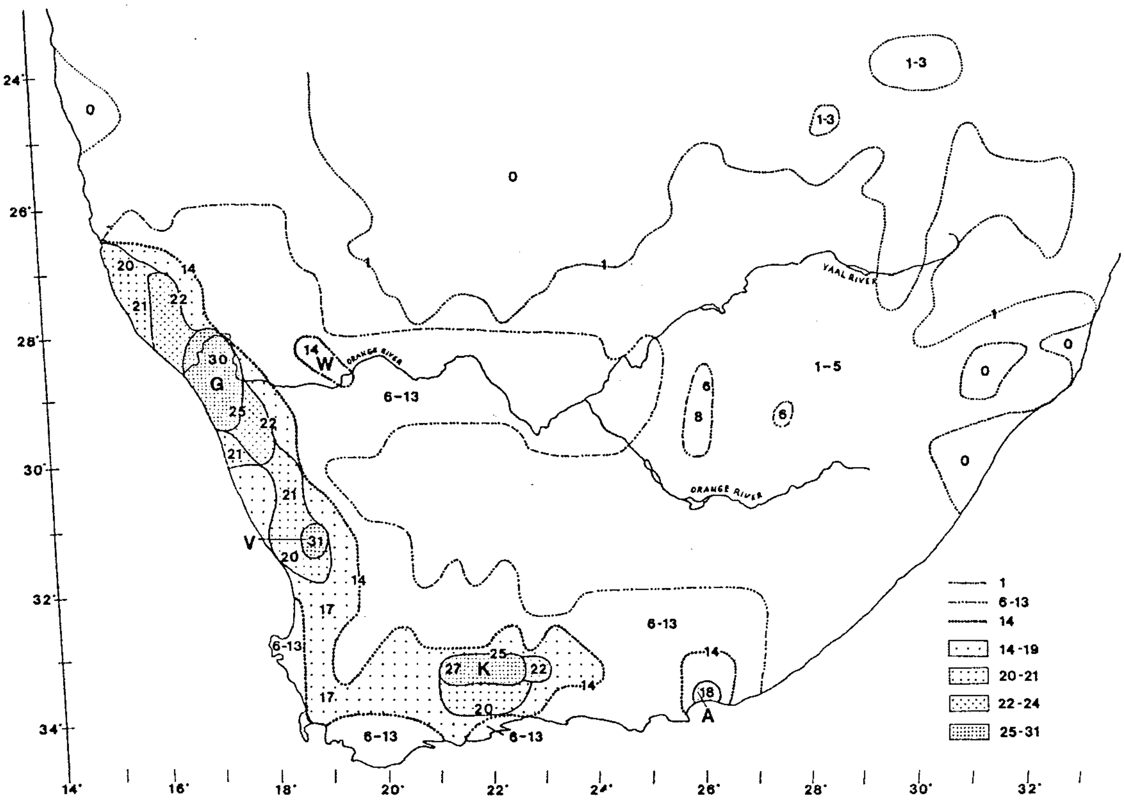


Fig. 24. The distribution and frequency of the 116 recognized genera of Mesembryanthema from Hartmann (1991). A - Albany centre; G - Gariep centre; K - Little Karoo centre; V - Vanrhynsdorp centre; W - Pofadder centre.

regions becomes more apparent when relatedness of the plant taxa is considered. Furthermore there are marked correlations between areas of species richness of masarids and of their forage plants. The oligolectic species though dependent on the presence of their forage plants are, in some instances at least, more narrowly endemic than their forage plants. This corroborates Michener's (1979) observation that plants commonly range more widely than their oligolectic visitors.

4 Life history

Life cycle

Masarid wasps exhibit the usual holometabolous development of egg-larva-pupa-adult. The egg, larval and pupal stages are passed enclosed within a cell with earthen walls, which either terminates a shaft in a multicellular nest excavated in the ground or in vertical earthen banks or is constructed aerially on stones or plant stems or in a pre-existing cavity with water, nectar or self-generated silk being the bonding agents (Chapter 5).

No masarids have been found to be nest parasites. The unusual form of the abdomen which gives Celonites the ability to roll itself in the manner of the Chrysididae led to an assumption that it would be found to be a nest parasite of other Hymenoptera in chrysidid manner. Rossi (1790, cited in Blüthgen, 1961) placed Celonites abbreviatus (Villers) (as Chrysis dubia Rossi) in the Chrysididae. The same species was believed by Saussure (1854) (cited in Blüthgen, 1961) to be parasitic. In 1869, however, Lichtenstein recorded that Celonites abbreviatus constructs its own cells. Despite this Friese (1926, as cited in Blüthgen, 1961) held the opinion that the morphology and rolling behaviour indicated a parasitic way of life like that of the chrysidids. No evidence has been found to support this opinion. On the other hand, nest construction has been recorded for seven, possibly eight, species of Celonites.

The formation of nesting aggregations is usual for ground nesting species. It could result from the congregation of unrelated nesting individuals or from a tendency for individuals to nest in close proximity to their natal nests. The latter, at least, is indicated - reused multicellular nests with multiple emergences occupied by a single female having been found associated with new nests in most species of Ceramius and one species of Masarina (Gess and Gess, 1986, 1988a, 1988b and 1990).

The majority of nesting studies indicate that nest construction, egg laying and provisioning are performed by a single female per nest, however, nest sharing has been alleged by Zucchi et al. (1976) for Trimeria howardi and by Brauns (1910) for Ceramius lichtensteinii. Nest sharing by C. lichtensteinii is certainly not habitual having been found not to occur in the population of this species studied by Gess and Gess (1980). As nests are reused it is conceivable, however, that with a break down in territorial aggression nest sharing could occur. Some flexiblity in the behaviour of this species has been noted by these authors - mud-pellets discarded during nest excavation were dropped outside the limits of the nesting aggregation at one locality whereas at other localities they were dropped amongst the nests.

Masarid eggs can be seen to be relatively large for wasps' eggs but relatively small compared with bees' eggs, if the ratio of egg length to female length is compared (1:5,4; 1:3,3; and 1:1,5 respectively for a random sample of non-masarid wasps, masarids and bees).

Masarids oviposit into an empty cell before provisioning takes place as do all the other vespoids and some of the nyssonines. They therefore differ from the majority of aculeate wasps and the majority of bees which oviposit onto the provision in a partially or fully provisioned cell. In common with the majority of aculeate wasps and bees a single egg is laid in each cell. It is positioned at the blind end of the cell either lying free as in the ground nesting Paragia, Ceramius and Jugurtia or glued to the wall at the blind end in Masarina familiaris nesting in vertical banks and in the aerial nesting Gayella and Pseudomasaris.

According to Ferton (1901) the egg of Ceramius tuberculifer is deposited only provisionally at the bottom of the cell and after the cell has been provisioned with a firm pollen loaf of characteristic retort shape (Ferton, 1901: Plate 1, Fig. 10) the mother moves the egg onto the neck of the "retort". In this position the little larva is alleged to begin feeding. Much has been made of Ferton's assertions by Malyshev (1968) who in his chapter on the genesis of bees, has based his "Secondary Bee Phase of Vespoid Type" upon them. Ferton's assertions concerning the transfer of the egg by the female wasp cannot be accepted. In the large number of Ceramius cells examined by the present author the egg was left where it was first deposited and the larva upon hatching found its own way onto the nearby pollen loaf. There is no reason to suppose C. tuberculifer to be different in this respect. Moreover, it is difficult to visualize how it would be physically possible for the female wasp to reposition her egg onto the pollen loaf as the latter would be situated between her and the egg. It is therefore believed that Ferton drew incorrect conclusions and that Malyshev's hypothesis is therefore based on false premises.

Cell provisioning follows egg laying. The provision unlike that of all non-masarid wasps but like that of most bees is constituted of pollen and nectar. Masarids transport the provision internally in the crop like the colletid bees of the subfamilies Euryglossinae and Hylaeinae but unlike the majority of bees which carry pollen loads for provisioning externally. Mass provisioning is the general rule (Chapter 5) although progressive provisioning has been alleged by Zucchi et al. (1976) for Trimeria howardi and by Brauns (1910) for Ceramius lichtensteinii. Brauns' contention was mentioned by Richards (1962) who did not comment other than to state that this was not recorded for the European species studied. Torchio (1970), presumably on the strength of Brauns' assertion, listed the genus Ceramius as practising progressive provisioning in contrast to the genera Gayella, Paragia, Pseudomasaris and Celonites which he listed as not provisioning progressively. Malyshev (1968) not only accepted Brauns' statement but elaborated upon it, writing that "This method of progressive feeding of the larvae on honey (sic!), provided when it is needed and only given directly into the larva's mouth, is bound to reflect the moment ... when the instincts of the wasp were transformed into those of the bee". Gess and Gess (1980), however, established that C. lichtensteinii practises mass provisioning, and, under optimal conditions of favourable weather and an abundance of forage flowers, provisioning and sealing of the cell is completed by the female before the egg hatches. Under less favourable conditions the rate of provisioning is slowed down leading to the finding of unsealed cells containing larvae and varying amounts of provision and under really unfavourable conditions the situation as reported by Brauns results.

The egg phase in common with all but the social wasps lasts only a few days. Shortly before hatching the segmentation of the larva is visible through the pellicle.

The number of larval instars has not been recorded, however, five is the norm for aculeate wasps and bees. The only masarid larval descriptions are for the diapausing final instar larvae of Pseudomasaris edwardsii (Torchio, 1970) and Trimeria howardi (Zucchi et al., 1976). Feeding is completed during the final larval stage when the provision has all been consumed. The larva then commences spinning a cocoon closely attached to the walls of the cell so that it is inseparable from it except, in some at least such as Ceramius, at the truncate outer end. Characteristically of wasps, defecation occurs only once during larval development, that is following cocoon spinning. The larva then becomes semi-flaccid and markedly curved and enters a resting prepupal phase.

As in most solitary wasps and bees it is the prepupa which overwinters. The prepupa enters a state of dormancy, that is diapause. Pupation and emergence as an adult may take place in the following spring or summer, however, it is possible for diapause to last for some years.

As a general rule at temperate latitudes masarids appear to be univoltine, however, it is suggested by Zucchi et al. (1976) that Trimeria howardi in subtropical South America may be bivoltine.

The flight periods for masarids, in the semi-arid areas of southern Africa at least, are variable according to the climatic conditions prevailing in a particular year. Certain generalizations may, however, be made. In the winter rainfall area in the west emergence is earlier than in the east where the wettest seasons are spring and autumn. Thus emergences in the west start in August and peak activity can be expected in September/October. Thereafter as the dry summer season advances and forage plant flowering is over and temporary pools of water dry up there is a rapid fall off in activity. By December activity is over except in the vicinity of permanent water where forage plant flowering periods are somewhat extended. In the east earliest emergences are in late September and greatest activity can be expected from early November to mid-December depending on timing of rain. When rain has been late there has been a shift to December-January or January-February. Late summer or early autumn rain has even resulted in a second but insignifiant flush of nesting by Jugurtia confusa from February to early April (Gess and Gess, 1980). In the north, in the southern Kalahari, where localized thunderstorms can be expected in late summer co-incident localized emergences of Celonites and Quartinioides and flowering of their forage plants are experienced (Gess and Gess, 1991).

A similar activity pattern appears to prevail in Australia, judging from the available records for Paragia (C.) vespiformis and Paragia (P.) decipiens. The former flies in the southwest from July until October (Houston, 1986) whereas in the southeast the latter has been noted to be most abundant in December (Naumann and Cardale, 1987). The activity pattern of P. (P.) tricolor, however, is at variance. Collecting dates (Houston, 1984) suggest that the period of activity to the north and east is as could be predicted December/January, however, in the southwest its activity period is from February to April.

The few published collecting dates for Trimeria from South America are for the period November to May.

In the northern hemisphere collecting dates for the Mediterranean (Richards, 1962) suggest that, in this winter rainfall region, activity is in spring and early summer.

Collecting dates (Richards, 1963b) for the North American masarid genus Pseudomasaris indicate a period of activity from March-April to July-August depending on species with the peak of activity being in April/May, June, or June/July, depending on species. Differences between climatic regions are not taken into account and are difficult to establish from the available data, however, the overall picture is therefore emergence in early spring and peak activity in spring, early or mid-summer according to species.

Mate location

The evolution of insect mating systems has been explored in depth by Thornhill and Alcock (1983). They found that mate location behaviour appears to be evolutionarily labile, sensitive to and shaped by ecological pressures peculiar to a species. They stated that as a rule searching males tend to gather in that part of the environment where receptive females are concentrated but that males of species of which the females are scarce or widely scattered may employ the alternate strategy of waiting for females on landmarks.

Male masarids searching for females where they are concentrated can be predicted in all species to favour forage plant patches. For those species which use water in nest excavation and construction water is an equally probable search location as too are nesting areas for species which nest in aggregations.

Quartinia and Quartinioides males rest on the ground in the vicinity of forage plants and rise up in response to the arrival of females which they then mount and copulate with on the flowers (Gess and Gess, 1992 and unpublished fieldnotes). Celonites males are similarly commonly present, apparently waiting, in the vicinity of forage plants (Gess and Gess, 1992). Ceramius cerceriformis males have been observed perched on vegetation above the forage plant but no interactions with females were observed (Gess, fieldnotes). Actual mounting of females by males on flowers by Ceramius species has been observed for Ceramius clypeatus (Fig. 25) and Ceramius lichtensteinii (Gess and Gess, 1990 and unpublished fieldnotes).

Longair (1987) made observations on mating behaviour at floral resources by two species of Pseudomasaris, P. vespoides and P. zonalis. These wasps patrolled patches of flowers where females obtained pollen and nectar for provisioning nests.

Fig. 25. Pairing by Ceramius clypeatus on a forage plant, Aspalathus spinescens, Clanwilliam Dam. Actual length of female c 18 mm.

Fig. 26. Pairing by Ceramius socius at a watering point on wet sand, Kransvlei, Clanwilliam district. Actual length of females c 13,5 mm.

Males patrolled several patches, but frequently remained within one patch for extended periods, perching and investigating insects which entered the patch. Absolute numbers of males were low, and while interactions between males were thus rare, they were sometimes intense. No size differences could be distinguished between males that copulated and males not observed to copulate.

Paragia, Ceramius, Jugurtia and Masarina all use water in nest construction and males would therefore be able to contact females at water sources. Males of Paragia (P.) decipiens alight on water surfaces to drink in company with females. One record is given of a male attempting to mate with a female on the ground near water (Naumann and Cardale, 1987). Males of 11 Ceramius species, C. micheneri, C. toriger, C. braunsi, C. nigripennis, C. rex, C. metanotalis, C. lichtensteinii, C. bicolor, C. capicola, C. linearis, and C. socius have been observed at water (Gess and Gess, 1980. 1986, 1988b, 1990 and unpublished fieldnotes).

Shortly after they emerge from their nests in the morning, female ground nesting C. socius aggregate at a selected watering point. (A hundred or more individuals have been observed to congregate in this manner.) The males join them and at this "swarming" point coupling takes place (Fig. 26). A male having gained a firm hold on a female the pair flies off together (Gess and Gess, 1988b). On a fine day "swarming" continues until late afternoon. No couplings were observed either on flowers or in the nesting area although males were present abundantly with females in these locations.

Both sexes of C. lichtensteinii, C. capicola and C. linearis have frequently been observed to fly up and down the length of a puddle together. The females alight on the water surface, legs widespread. Whilst a female is thus resting on the water surface and gently drifting a male alights on top of her and both fly off together, the male grasping the female (Gess and Gess, 1980). As noted above C. lichtensteinii also couple on forage flowers. For this species, at least, coupling can take place in more than one location.

Males of C. toriger and C. clypeatus have been observed to "wait" in large numbers on raised ground at a short distance from and overlooking water being visited by females, however, no instances of pairing were observed (Gess and Gess, 1990 and D.W.Gess, unpublished fieldnotes).

Although large numbers of females of Jugurtia confusa, Jugurtia braunsi and Jugurtia braunsiella have been observed collecting water from saturated soil at the water's edge no males have been observed in attendance (Gess and Gess, unpublished fieldnotes).

Males of Jugurtia confusa, a ground nesting species, appear in numbers shortly before the females and are present for most of the flight period, becoming scarce as the season advances. They were observed to fly low, 5-8 cm above the ground, particularly skirting bushes at the periphery of the nesting area and also alighting on the ground within the nesting area where they sun themselves and rise up to chase females and each other. They are seen to descend rapidly upon the females and although mating was not observed it seems likely that it takes place within the vicinity of the nesting area (Gess and Gess, 1980).

Males of Paragia (P.) tricolor and Paragia (P.) decipiens, both ground nesting species, are present in the nesting area. Those of P. (P.) tricolor patrol the margins of the nesting area and a male has been observed pouncing on and grappling with a female (Houston, 1984). Those of P. (P.) decipiens have been seen to watch open nest entrances but it was not noted whether they were waiting for females or guarding the nests (Naumann and Cardale, 1987).

The male strategy of waiting for females on landmarks has been suggested for Pseudomasaris maculifrons (Alcock, 1985). Males of this wasp perch on rocks in open areas on peaktops and ridges in central Arizona. The same areas are occupied from February to May in different years by different generations of males. Individuals regularly return to the same small perching location on a peaktop over an interval of as long as 29 days. As is the case with other "hilltopping" species, nesting and foraging females appear to be scarce and widely scattered.

Nest guarding

Males of six species of Ceramius, C. micheneri, C. toriger, C. lichtensteinii, C. capicola, C. socius and C.bicolor, have been observed in association with nests (Gess and Gess, 1980, 1986, 1988b and 1990).

C. socius males are present in the nesting areas before the females emerge from their nests in the morning. After pairing with the females at their watering point they do not, however, seem to return to the nesting area and no males were found sheltering in nests (Gess and Gess, 1988b). On the other hand male C. bicolor guard the nests whilst the females are away from them (Gess and Gess, 1986). Each nest seems to be attended by a male. The male guard drives off other males or any other insects which come too near the nest. On a cloudy day, when four nests were investigated, two contained a male each. These two nests each contained an unsealed but provisioned cell. Males of C. lichtensteinii and C. capicola similarly are present in the nesting area whilst nesting activities are in progress (Gess and Gess, 1980). One instance of a male C. micheneri and two of a male C. toriger together with a female in her nest have been noted (Gess and Gess, 1990).

Sleeping and sheltering

When nests are being worked upon sleeping or sheltering in the nest by females at night or in inclement weather seems to be common amongst the masarids, having been recorded for Ceramius capicola, C. socius, C. lichtensteinii, C. toriger, C. nigripennis, C. micheneri, Jugurtia confusa, Celonites latitarsis (Gess and Gess, 1980, 1986, 1988b and 1992) and Pseudomasaris edwardsii (Torchio, 1970).

As aerial nesters do not have burrows the nest is only available for sheltering when there is an open cell. When there is no open cell an alternative sleeping place must be found. Celonites abbreviatus has been observed sleeping rolled around a grass culm, with the antennae folded downwards, the retracted legs pressed into their resting position on the thorax and the folded wings clamped in the gap between the thorax and the abdomen (Bischoff, 1927, cited in Blüthgen, 1961a). There is a single record of a female Celonites andrei sleeping on a dry stem on to which it was holding with its mandibles (Brauns, 1905). Females of Pseudomasaris edwardsii have been recorded sleeping within the corolla tube of the forage plant flower, Phacelia sp., and exposed clinging to green seed pods of mustard, Brassica sp. (Torchio, 1970).

As already indicated in the section on male behaviour the males of some species of Ceramius are known to shelter and sleep in nests with or without females. Male Masarina mixta commonly sleep in the flowers of Wahlenbergia to which they and the females come to forage (Gess and Gess, unpublished fieldnotes). No females have been found sleeping in the flowers and it seems most likely that they sleep in their nests which are most probably burrows.

There are no records of sleeping aggregations.

Discussion of evolutionary considerations

That masarid wasps are, as far as is known, essentially solitary wasps is perhaps not surprising when it is considered that they are principally wasps of semi-arid areas outside the tropics (Chapter 2). The development of sociality and a tendency to sociality amongst wasps, as with insects in general (Wilson, 1979) and with bees in particular (Roubik, 1989), is principally associated with humid subtropical to tropical areas. Little is known of nesting by those few masarids which do occur in the tropics. If development towards sociality does occur in the masarids it is most probable that it is amongst these that it will be found.

Some of the behavioural characters considered to be prerequisites for the evolution of eusociality are present. Oviposition into an empty cell has been thought to be important in permitting the evolution of the extended brood care characteristic of social wasps (Evans, 1957). The possibility of nest sharing, the basis of West-Eberhard's model for the evolution of sociality (1978) is suggested. Carpenter (1991) considers cell reuse to be an important character. This is most certainly not uncommon in the masarids. Progressive provisioning and brood care, though shown to have been mistakenly attributed to Ceramius lichtensteinii by Maleshev could be evolved from delayed provisioning. The short adult phase and long prepupal phase characteristic of the species living in semi-arid areas with seasonal rain, however, preclude a continuous chain of interaction between adults of different generations required for eusociality. It is conceivable that some masarids in the tropics might be living under conditions conducive to a proportional change.

Evans and Eberhard (1970) gave a brief summary of what they understood to be the evolution of the nesting behaviour of solitary wasps. They presented this summary as "The social ladder", a ladder with ten steps. The simplest step in the extant Vespoidea - Nest-egg-(prey)^n-[cell closed & new cell prepared-egg-(prey)^n]^n - ranked "step 7b" is shared by the Euparagiidae and Eumenidae. If "provision load" is substituted for "prey" then the Masaridae also share this step. If one considers the position of the bees on this ladder, again substituting "provision load" for "prey" then the lowest step represented is "step 5c", Nest-(prey)^n-egg-closure. Following Evans and Eberhard the masarids must be considered to be at a higher step on the evolutionary ladder towards sociality than the vast majority of solitary bees.

Malyshev (1968) in his consideration of the "genesis of the bees" sought to find amongst the masarids, whose evolution he saw as parallel to that of the bees, a clue to the possible way in which the change took place from provisioning with arthropods to provisioning with pollen and nectar. He thus saw the change as being loss of provision with prey and instead direct feeding of the larva with "honey food" which being "juicy" could not be prepared in large amounts in the cells. He considered that later "when appropriate adaptations had taken place in the mother wasp and, in particular, in her mouthparts, directed towards collecting flower pollen, she began to feed her larvae on a thicker and more concentrated food, containing an abundance of protein-rich pollen." This he saw as leading to the abandonment of progressive provisioning in favour of mass provisioning with a pollen loaf. This theory breaks down at the outset as his first phase was based on his mistaken belief that Ceramius lichtensteinii larvae are fed directly with "honey". It does not seem that the masarids will provide the answer to how the change could have taken place from provisioning with arthropods to provisioning with pollen and nectar.

5 Nesting

The available species nesting accounts for the masarids of the world have been assembled and synthesized to give generic accounts. These accounts are presented in a consistent form under the headings: description of the nesting areas and nest situation; provision; water collection; description of the nests; method of construction of the nest and reuse of nests. The taxa are ordered as in Table 2. There follows a discussion of nesting under the headings: basic nest types, bonding agent, method of excavation, evolutionary sequence, and oviposition and provisioning.

Nesting accounts

Gayellinae

Gayella Spinola

There appears to be only one published record of the nesting of the Neotropical genus Gayella, that for G. eumenoides (Claude-Joseph, 1930 as reported in Richards, 1962) which constructs aerial nests.

Description of nest situation

The nests are attached to rocks.

Provision

The pollen and nectar provision must be very moist as it was suggested by Claude-Joseph that nectar alone is stored.

Description of the nest

The nest consists of constructed mud-cells attached in groups to rocks. The cells are shortly ovoid and arranged side by side in a line. Sometimes up to three such rows of cells may be parallel to and touching one another. The groups of cells are normally partly obscured by a layer of mud.

Reuse of nests

Old cells may be cleaned out and used again.

Masarinae: Paragiini

Paragia Shuckard

Nesting has been recorded for four species of the Australian genus Paragia: three species of Paragia (Paragia), P. (P.) smithii (Wilson, 1869 - observations only of females coming and going from turreted burrows), P. (P.) tricolor (Houston, 1984), P. (P.) decipiens (Naumann and Cardale, 1987); and one species of Paragia (Cygnea), P. (C.) vespiformis (Houston, 1986). All excavate a vertical to sub-vertical burrow in the ground. No nests of Paragia (Paragiella) have been recorded.

Description of nesting areas and nest situation

From a comparison between vegetation maps for Australia (Groves, 1981) and the distribution map of masarids (Fig. 5) it would appear that paragiines are most commonly associated with somewhat open Eucalyptus woodland or shrubland, vegetation generally higher than that of most of the semi-arid areas of the world, although equally sparse.

P. (P.) tricolor and P. (P.) decipiens were recorded as nesting in clayey soil in close proximity to water and Eucalyptus (Myrtaceae) woodland (Fig. 27 a), E. calophylla and E. camaldulensis respectively. No description of the nesting area of P. (P.) smithii was given.

P. (C.) vespiformis was recorded as nesting in sandy soil between dunes in Acacia (Mimosaceae) and Grevillea (Proteaceae) scrub.

a

b

Fig. 27 a and b. **Paragia tricolor: (a) Nesting area, nest site arrowed; (b) female emerging from entrance turret carrying soil pellet in mandibles. From Houston (1984).**

Provision

The provision, a pollen and nectar mixture, is in the form of a loaf having folds and annulations and increasing in diameter towards the open end of the cell. That of P. (C.) vespiformis rests on papillae.

The pollen loaves of P. (P.) tricolor and P. (P.) decipiens were each constituted of a single pollen type matching pollen of Eucalyptus calophylla and Eucalyptus camaldulensis respectively. Those of P. (C.) vespiformis were constituted of Acacia pollen.

Water collection

Water collection by the three species of Paragia (Paragia) and P. (C.) vespiformis was recorded. Furthermore it was noted that P. (P.) decipiens, P. (P.) smithii and P. (Paragiella) odyneroides and P. (C.) vespiformis alight on the water surface.

Description of the nests

In all instances the burrow is sub-vertical. That of P. (P.) smithii and P. (P.) tricolor is surmounted with a vertical or curved to horizontally opening mud turret (Fig. 27 b). That of P. (P.) decipiens allegedly lacks a turret, however, it is stated that where entrances were concealed beneath leaves or rocks, the shaft was extended above ground level as an incomplete thin-walled tube. The burrow of P. (C.) vespiformis lacks a turret.

The subterranean nest structure of P. (P.) smithii was not recorded. The nests of P. (P.) tricolor (Figs 28 a and b) and P. (P.) vespiformis (Figs 28 d and e) are multicellular, nests with up to 14 cells and 4 cells respectively having been recorded. Only one nest of P. (P.) decipiens had a cell, however, it is likely that the nest of this species is also multicellular.

The cells consist of an excavated cell within which is a constructed mud-cell. The inner surface of the cell of P. (P.) tricolor is polished and waterproofed.

Method of construction of the nest

The turret of P. (P.) tricolor is constructed in the initial stages of burrow excavation. It is smoothed on the inner surface. Pellets not used in turret construction are carried away from the nest and discarded. The main shaft is

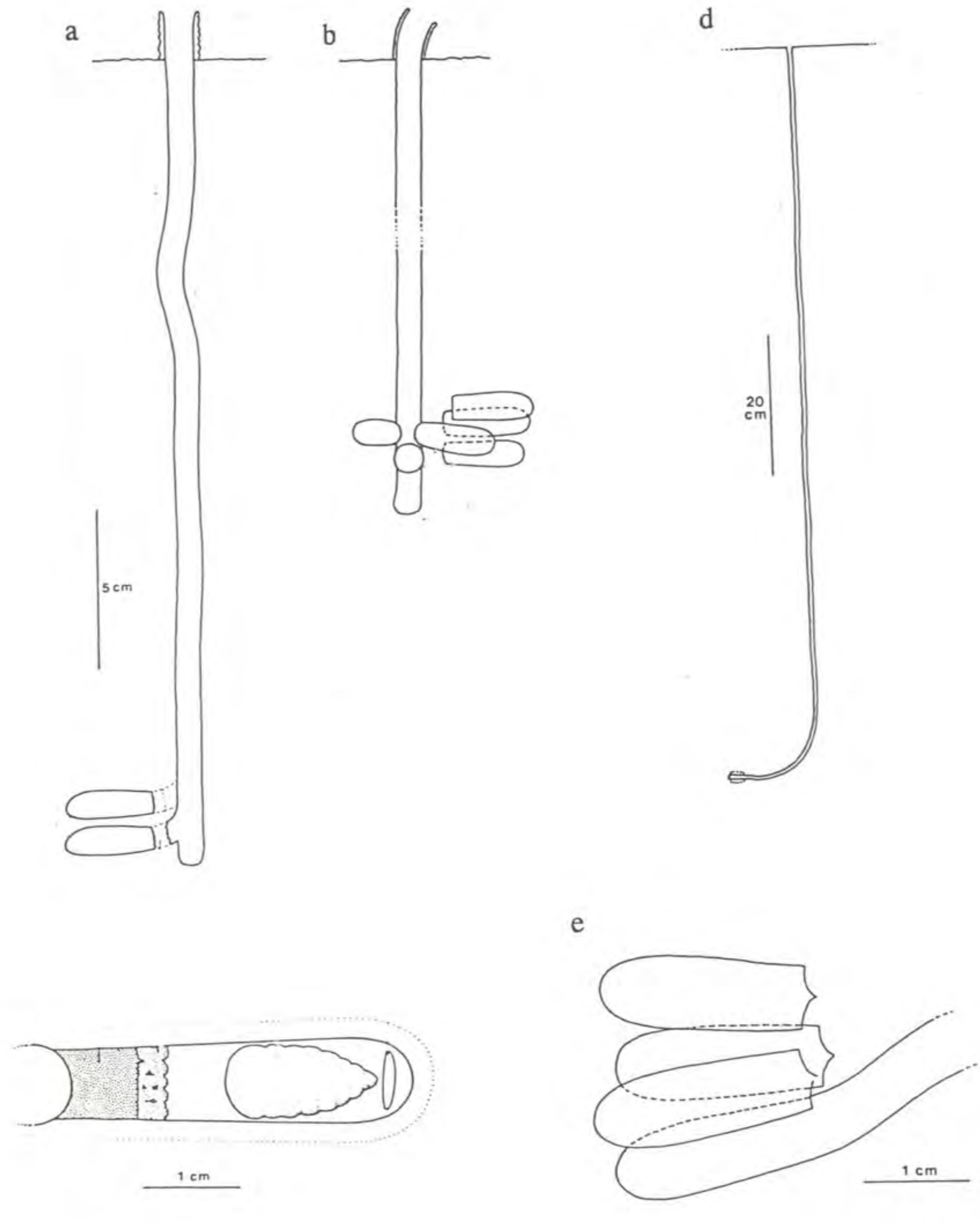


Fig. 28 a - e. Vertical plans of turrets and underground workings of nests of Paragia species: (a - c) P. (P.) tricolor from Houston (1984), no cell terminating main shaft; (d and e) P. (C.) vespiformis from Houston (1986), cell terminating main shaft.

excavated in such a way that its diameter equals the inner diameter of the turret and this diameter is maintained constant throughout its length. Whilst excavating the shaft the wasp always reverses out of the burrow indicating that it cannot turn within the shaft as do species of Ceramius which construct a turning "bulb". The diameter of the main shaft of the nests of P. (P.) decipiens and P. (C.) vespiformis is similarly constant throughout.

No cell terminates the main shafts of the two Paragia (Paragia) species. Short horizontal lateral shafts each terminating in a cell are excavated, usually all to one side of the shaft. In the nest of the Paragia (Cygnea) species, P. (C.) vespiformis, the main shaft curves at its lower end to terminate in a horizontal cell. Further cells terminate secondary shafts all of which are excavated to one side of the main shaft.

The cells attained their maximum diameters near their rounded ends. Recorded wall thicknesses are about 2 mm (tricolor), 1-2 mm (decipiens) and 0,5 mm (vespiformis). It was not established whether the constructed mud-cells were built in or formed by impregnation of the walls of the excavated cavities nor what the nature of the substance was which was used for polishing and waterproofing them.

Following oviposition and provisioning, each cell is closed with a plug of cemented earth, followed by compacted soil filling the access burrow which is then sealed off flush with the main shaft.

Metaparagia Meade-Waldo, Ammoparagia Snelling, Rolandia Richards and Riekia Richards

There appear to be no records of nesting by Metaparagia and Ammoparagia and only scant observations concerning the nesting of Rolandia and Riekia. Rolandia maculata and an undescribed species of Riekia were observed entering burrows in sandy ground (Houston, 1984). The burrows were simple, oblique and ended blindly without any cells and neither had an entrance turret.

Masarinae: Masarini

Ceramius Latreille

Nesting has been recorded for three Palaearctic species of Ceramius, groups 1 and 7 - Group 1, C. fonscolombei (incomplete nest, Fonscolombe, 1835) and Group 7, C. tuberculifer (Giraud, 1871 and Ferton, 1901) and C. bischoffi (incomplete nest, Richards, 1963a) and for fifteen Afrotropical species of Ceramius, groups 2 a and b, 3, 4, 5, 6 and 8 - Group 2a, C. cerceriformis (Gess and Gess, 1988b); Group 2b, C. clypeatus (Gess and Gess, 1990); Group uncertain, probably 2b, C. micheneri (Gess and Gess, 1990); Group 3, C. nigripennis (Gess and Gess, 1986), C. jacoti (Gess and Gess, 1988b), C. braunsi and C. toriger (Gess and Gess, 1990); Group 4, C. beyeri (incomplete nest, Brauns, 1910 and incomplete nest, Gess and Gess, 1988b); Group 5, C. lichtensteinii (Brauns, 1910 and Gess and Gess, 1980); Group 6, C. rex (Gess and Gess, 1988b) and C. metanotalis (Gess and Gess, unpublished fieldnotes); and Group 8, all four species, C. capicola and C. linearis (Gess and Gess, 1980), C. bicolor (Gess and Gess, 1986) and C. socius (Gess and Gess, 1988b).

All excavate a vertical to sub-vertical burrow in the ground.

Description of nesting areas and nest situation

In southern Africa Ceramius species nest in areas of dry fynbos or karroid scrub (Figs 20 and 21) in relatively close proximity to their forage plants and a water source. Ceramius appears to show a preference for horizontally presented soil though some species, C. lichtensteinii, C. jacoti, C. braunsi and C. socius at least, will nest in sloping ground. Ceramius species have never been found nesting in vertically presented soil.

The soil particle size varies from relatively coarse to very fine. In all instances the clay factor is sufficient that the soil is malleable when mixed with water. Nests are aggregated in bare areas. Nest aggregation siting varies from apparently random within a bare area to a definite positioning. Several different nesting sites need to be visited before a definite positioning can be assumed. The nests of C. nigripennis always seem to be in close proximity to the base of a bush whereas those of C. socius may be fully exposed and massed in the centre of a large bare area or scattered in bare areas between the spreading branches of its forage plant.

Provision

The provision, a pollen and nectar mixture, is in the form of a firm pollen loaf (Figs 38 d and e) positioned at the blind end of the cell, free from the cell walls and filling the cell to about two thirds of its length. The pollen from the provision of all species investigated by Gess and Gess was examined microscopically and compared with the pollen of flowers found in the vicinity of the nesting area. For each species the provision was found to be derived from flowers of a single family or genus and furthermore to be constant within a species group. This is supported where foraging records only were obtained. Furthermore foraging records indicate that nectar is almost always derived from the same flowers as is pollen. Ceramius species/forage plant associations are given in Table 9.

Water collection

The nearness of nesting sites to a water source is either stated or implied by all authors and all the species are recorded as visiting water. Gess and Gess have shown that all species studied fill the crop with water which, when regurgitated upon the clayey nesting substrate, makes the latter more easily worked and thus makes nest construction possible. Similarly, Ferton (1901) with respect to the pool-visiting of C. tuberculifer made it abundantly clear that what the wasp collects is water, not mud.

Other authors, however, have claimed that some species, at least, collect not water but mud. Fonscolombe (1835) stated that C. fonscolombei went to ponds to collect sodden earth ("terre délayée") but later in his account appears to have been uncertain for he stated that the turret was constructed of pellets derived from the excavation of the nest (which would indicate the collection of water, not mud) or of pellets carried to the nest from without (which would support his earlier contention).

Similarly, Brauns (1910) stated that whereas C. beyeri, C. lichtensteinii and C. linearis settle on the water surface at the middle of the pool to collect water, C. cerceriformis, C. bicolor and C. capicola alight at the edge of the pool and collect mud in little pellets which he maintained are used by them for the construction of their cells and turrets. The Gesses have shown Brauns to have been mistaken. Those species which alight at the edge of the pool do not collect mud but like those which alight on the water surface collect water.

It seems that water collecting behaviour is most usually constant for species and species groups.

All four species of Group 3, C. nigripennis, C. jacoti, C. braunsi and C. toriger, the single species of Group 5, C. lichtensteinii, and two species of Group 6, C. rex and C. metanotalis (water collection has not been observed for the third species C. caffer) alight on the water surface to collect water (Fig. 29).

Three species of Group 2, C. cerceriformis, C. clypeatus and C. richardsi (water

Fig. 29. Female Ceramius nigripennis filling her crop with water whilst standing on the water surface. Actual length of female 15 mm.

Fig. 30. Aggregation of Ceramius socius on wet sand near water's edge, females collecting water. Actual length of females 13,5 mm.

collection has not been observed for the fourth species C. peringueyi) and C. micheneri (group uncertain) alight at the edge of the water.

Group 8 seems to be exceptional in showing intra- and inter-specific variation in water collecting behaviour. C. linearis alights on the water surface, C. bicolor and C. socius collect water from the damp soil at the water's edge (Fig. 30) and C. capicola seems to collect water either on the water surface or at the water's edge.

Description of the nests

All the known nests of Ceramius species consist of a multicellular subterranean burrow surmounted by a sub-vertical or curved tubular mud turret (Fig. 31) of the same diameter as the burrow opening. Each successive cell terminates a secondary shaft. The section of the secondary shaft between the cell and the main shaft is filled with soil and is sealed off from the main shaft with a thin mud-plate. Within each excavated cell of all but Group 8 is a constructed mud-cell sealed with a mud plug (Fig. 35). The diameter of the cells is greatest towards the rounded end. The structure of the subterranean burrow differs between species groups but is constant within a group.

For Group 1 nesting has been recorded for only one of the three species. No details of the subterranean burrow are given.

In the nests of Group 2 A and B (Figs 32 a and c) the relatively long slender main shaft descends sub-vertically and for the greater part of its length is of the same diameter as the burrow entrance. Near the lower end of the shaft there is a short wider section forming a "bulb" below which the shaft continues with a diameter equalling that of the upper section of the shaft. The main shaft at its base turns outwards to form a short lateral shaft terminating in a cell which lies sub-horizontally. Successive cells terminate secondary lateral shafts and all lie to one side of the shaft in a group. The nests of Ceramius micheneri (Fig. 32 b) investigated were all at the first cell stage and at that stage they resemble those of Group 2.

In the nests of Group 3 (Fig. 33) the burrow consists of a short shaft, having the upper part of the same diameter as the entrance and the lower part of a diameter up to three times as great depending upon the number of cells present. From the basal "bulb" extend very short sub-vertical secondary shafts each terminating in a cell.

The nature of the nests of Group 4 is incompletely known, burrows of C. beyeri

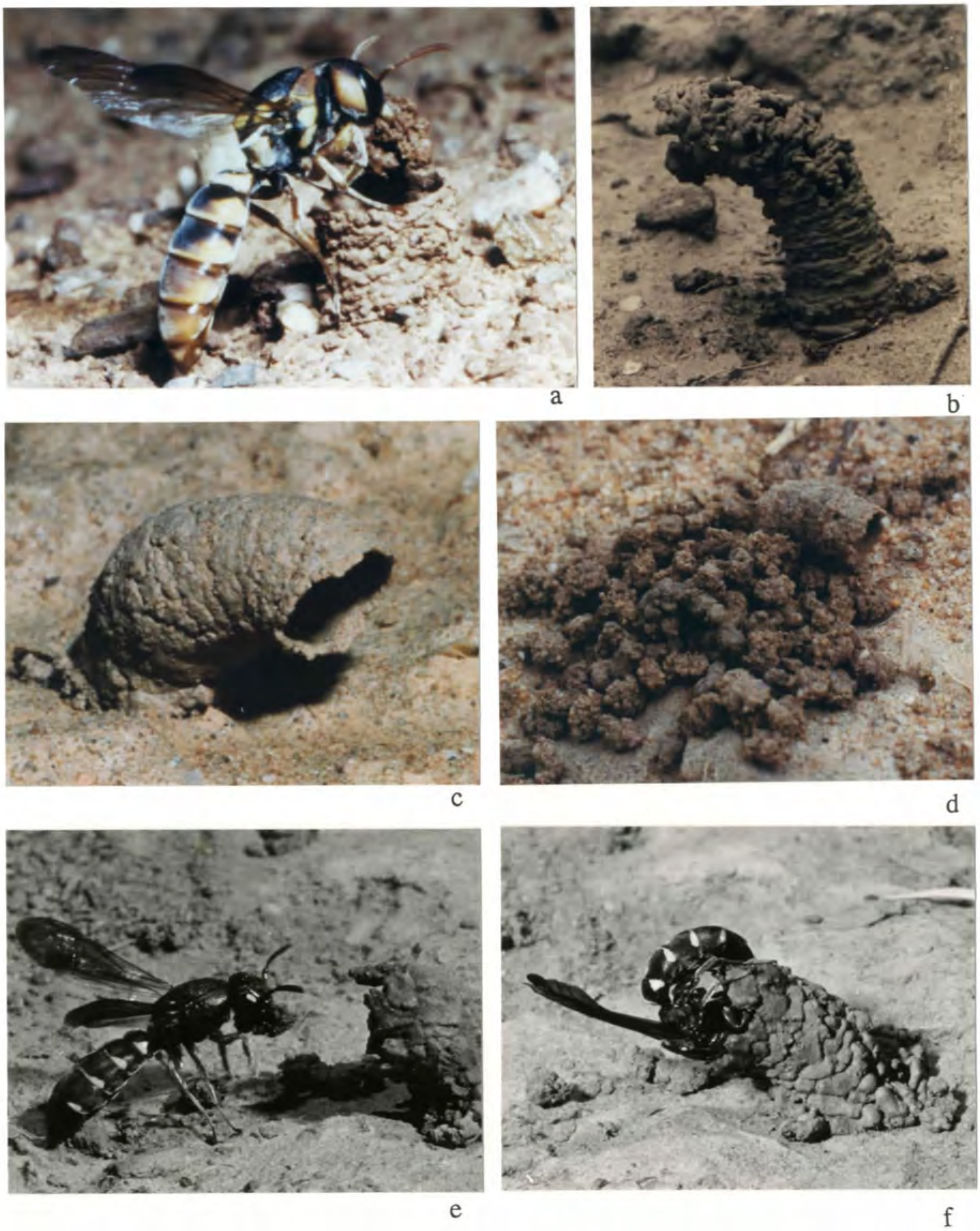


Fig. 31 a - f. Nest entrance turrets of <u>Ceramius</u> species: (a and b) <u>C. lichtensteinii</u>, a. wasp with mud-pellet held between mandibles, typical erect turret, b. unusually long curved turret; (c) <u>C. jacoti</u>; (d) <u>C. metanotalis</u>, note discarded mud-pellets; (e and f) <u>C. capicola</u>, e. wasp holding mud-pellet, f. wasp building turret.

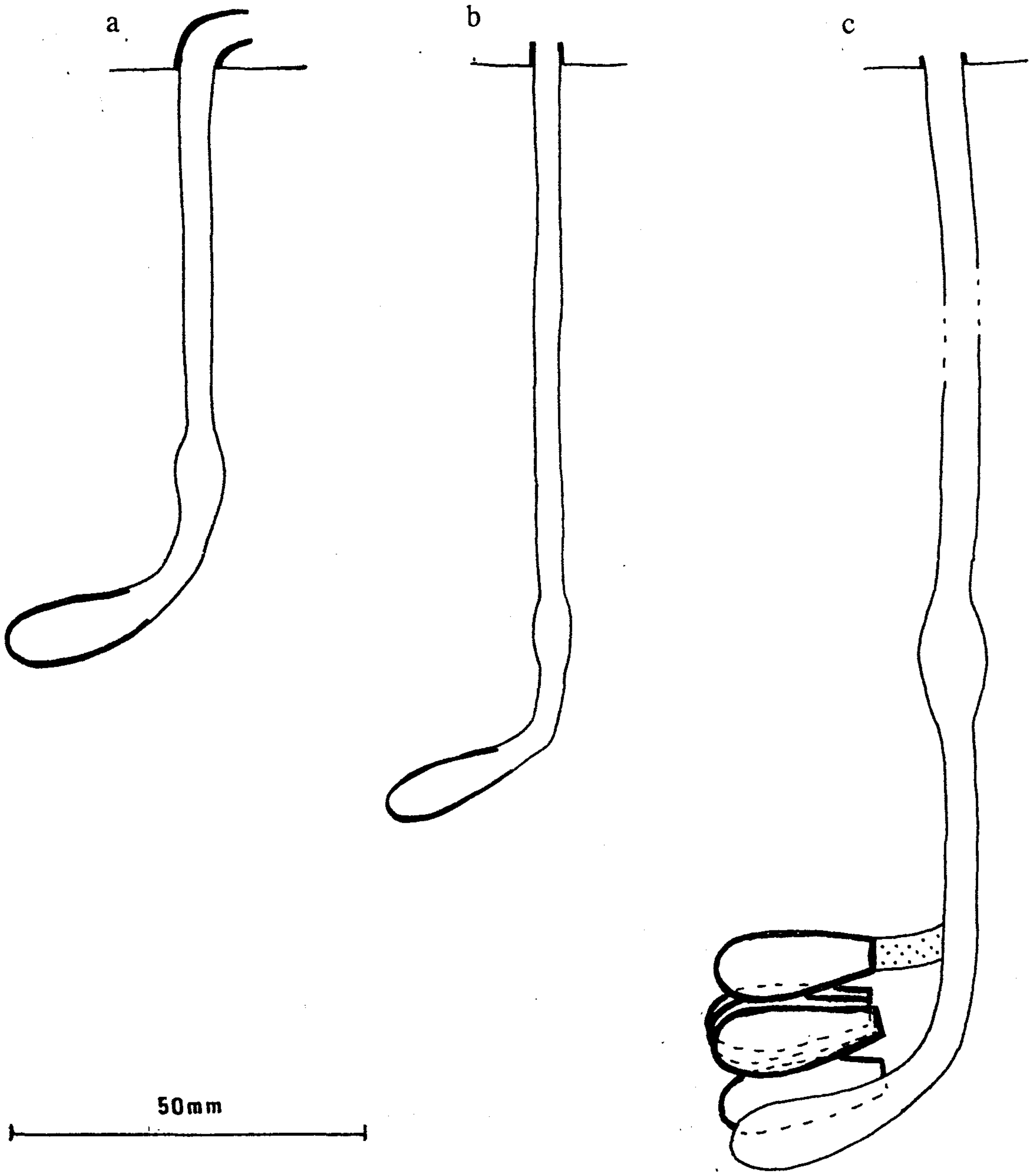


Fig. 32 a - c. Vertical plans of nests of Ceramius Group 2 and of the closely allied Ceramius micheneri: (a) C. cerceriformis; (b) C. micheneri; (c) C. clypeatus. Cell terminating main shaft, cells subhorizontal and grouped to one side of main shaft, constructed cell within excavated cell.

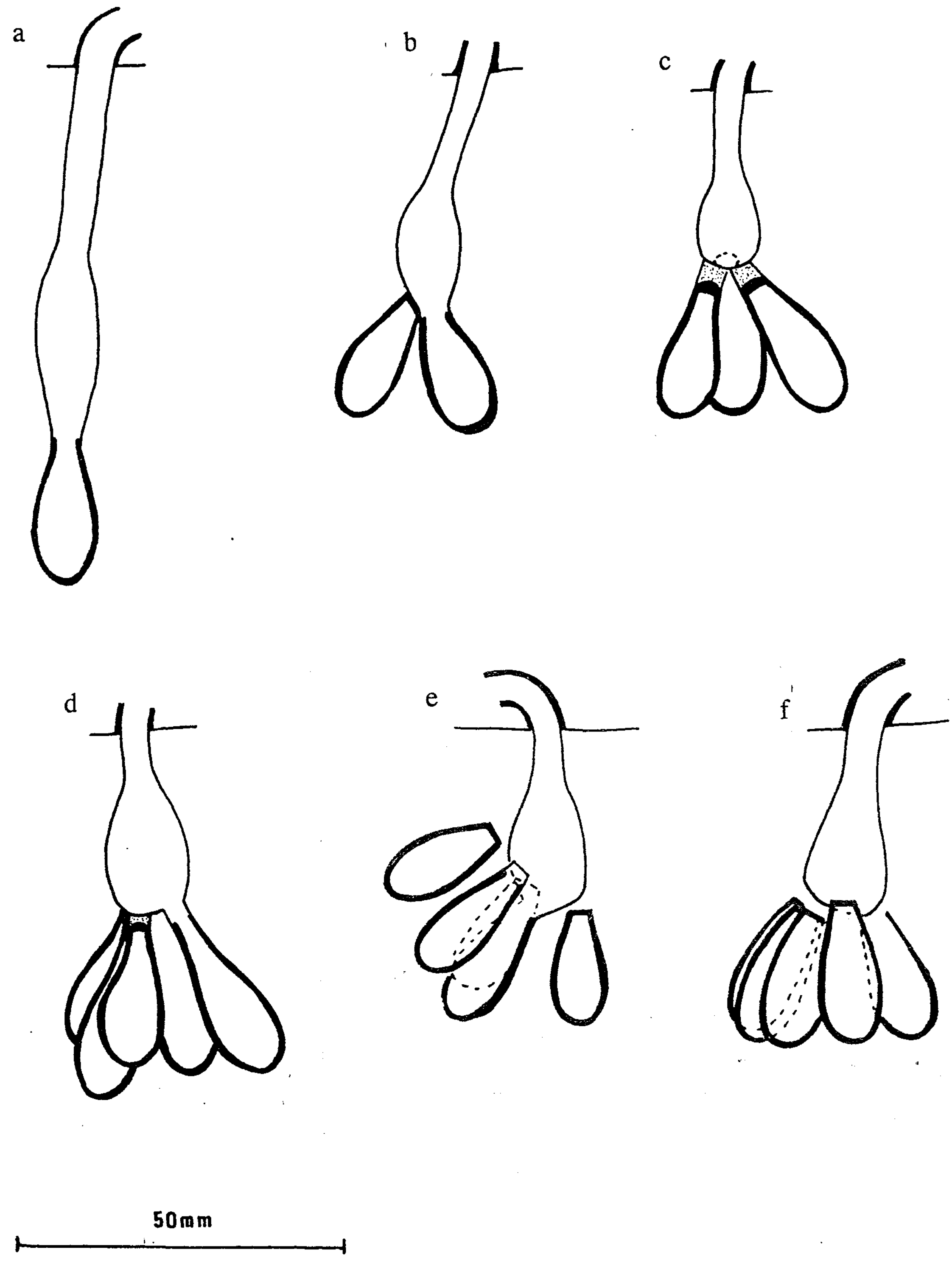


Fig. 33 a - f. Vertical plans of nests of <u>Ceramius</u> Group 3: (a) <u>C. jacoti</u>; (b - d) <u>C. nigripennis</u>; (e) <u>C. toriger</u>; (f) <u>C. braunsi</u>. Cell terminating main shaft, cells subvertical and grouped to one side of main shaft, constructed cell within excavated cell.

investigated by both Brauns and Gess and Gess were incomplete and those of C. damarinus are unknown.

In the nest of the monospecific Group 5 (Fig. 34) the relatively long main shaft descends sub-vertically. For the first third of its length it is of the same diameter as the burrow entrance. There follows a short wider section forming a "bulb" below which the shaft continues with a diameter equalling that of the upper section of the shaft. No cell terminates the main shaft. Extremely short, horizontal, lateral, secondary shafts roughly grouped in whorls radiate out from the main shaft at depths from shortly below the "bulb" to a short distance above the base of main shaft.

In the nests of Group 6 (Fig. 35), based on the nesting of two of the three species, the main shaft is of moderate length, descends sub-vertically and is initially of the same diameter as the entrance but widens after some distance. The wider section of the main shaft varies in length from nest to nest. In some new nests with only one cell the wide section is no more than a "bulb" below which the shaft continues with a diameter equalling that of the upper section of the shaft. In nests at a more advanced stage, that is with several cells, the entire lower section of the sub-vertical shaft is wide. In some nests the diameter of this lower wide section of the shaft fluctuates so that its sides are very uneven. At the base of the sub-vertical section the shaft curves outwards to terminate in a cell which lies sub-horizontally. Sub-horizontal secondary shafts each terminating in a cell fan out from the main shaft but never form a complete whorl so that the cells lie together in a group. In some instances the cells are at different depths but always forming a group.

For Group 7 nesting has been recorded for only one of the six species. No details are given of the general nest plan, however, it is recorded that a mud-cell is constructed within an excavated cell.

In the nests of Group 8 (Fig. 36), based on all four species, the relatively long main shaft descends sub-vertically and is of the same diameter as the entrance with, usually, at approximately half its depth a short "bulb". Towards its lower end the main shaft curves to one side and terminates in a sloping cell. Relatively long secondary shafts diverge from the main shaft at the level at which it departs from the sub-vertical. Each secondary shaft ends in a cell. An excavated cell is smoothed on the inside. Mud-cells are not constructed. A completed cell is sealed with a mud-plate.

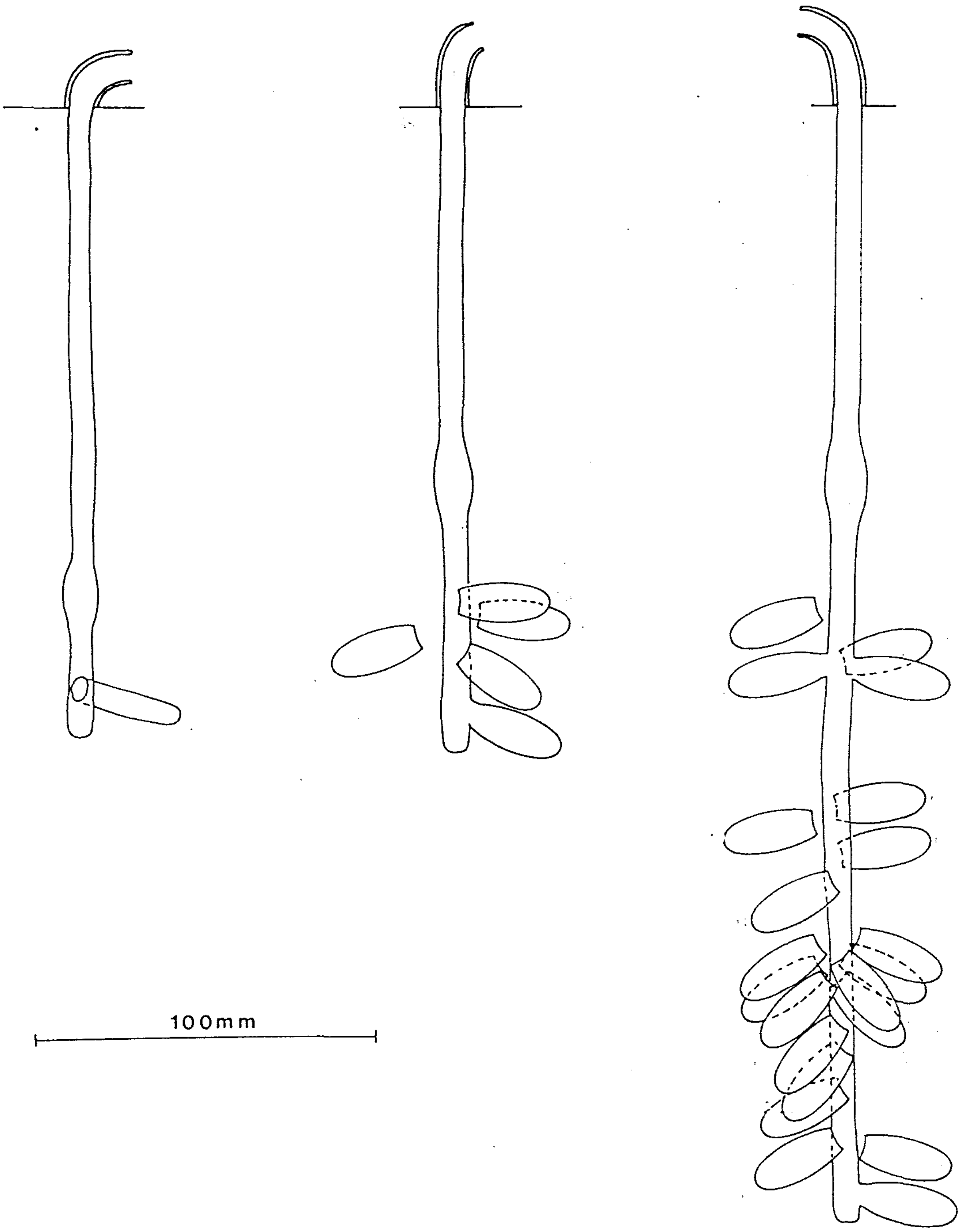


Fig. 34. Vertical plans of nests of <u>Ceramius</u> Group 5: <u>C. lichtensteinii</u>. No cell terminating main shaft, cells horizontal, not grouped to one side of shaft, constructed cell within excavated cell.

Fig. 35. Vertical plans of nests of Ceramius Group 6: C. rex. Cell terminating main shaft, cells subhorizontal and grouped to one side of main shaft, constructed cell within excavated cell.

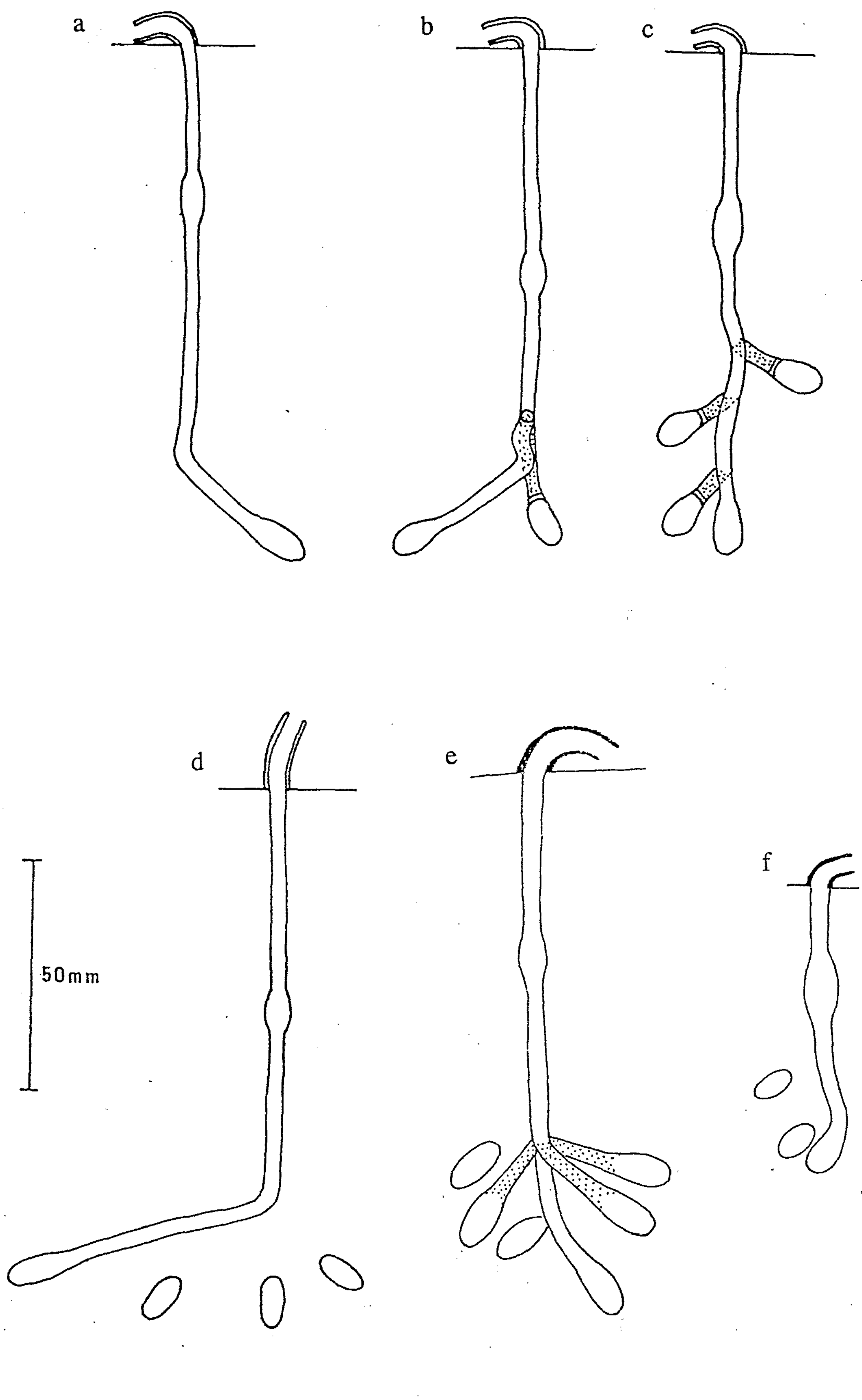


Fig. 36 a - f. Vertical plans of nests of Ceramius Group 8: (a - c) C. capicola; (d) C. linearis; (e) C. socius; (f) C. bicolor. Cell terminating main shaft, cells sloping, not grouped to one side of main shaft, no constructed cell within excavated cell.

Method of construction of the nest

Nest excavation is initiated by the female's regurgitating water from her crop onto the ground. Using her mandibles she works this water into the earth to form mud from which she forms a pellet. A number of pellets are formed in this way from a crop-full of water. The first pellets excavated from the shaft-initial may be discarded. The shaft-initial is circular in cross section due to the female's rotating evenly and always completing a circle. At the commencement of turret construction, the pellets, instead of being discarded, are laid down in a circle around the shaft-initial in such a way that the inner diameter of the turret will be the same as that of the shaft.

Shaft diameter is in almost direct proportion to head width. Thus head width (measured across the eyes) ranges from 2,5-2,8 mm (bicolor) to 4,6-5,3 mm (rex) and shaft diameters range from 3,5-4,0 mm (bicolor) to 5,5-7,0 mm (rex). The variation in shaft diameter within a species is similarly explained by the variation in head width in individuals. This is nicely illustrated by the fact that, for C. lichtensteinii nesting at Hilton, average head width (measured across the eyes) for females is 5,03 mm (n = 30, range 5,0-5,5 mm) and average shaft diameter is 6,2 mm (n = 19) whereas at Tierberg where average head width for females is 6,35 mm (n = 30, range 6,0-7,0 mm) shaft diameter is 8,0 mm (n = 22). In other words the head width of the Tierberg population is 26 per cent greater than that of the Hilton population and shaft diameter is 29 per cent greater.

The method of placement of pellets by C. capicola was observed most clearly. The wasp backs up the shaft with a pellet between her mandibles and reaching the turret opening holds the sides of the turret with her legs whilst placing the pellet in position and smoothing it on the inner surface with her mouthparts and supporting it on the outer surface with the tip of the ventral surface of her abdomen which is curved around for this purpose (Fig. 31 f). As many as twelve pellets may be added to the turret per water load. If the turret is destroyed by rain or mechanical means, the wasp will build a new one of similar design and dimensions as the original one.

In the construction of a vertical cylindrical turret pellets are added regularly whereas in a sloping or curved turret more pellets are added to that part of the turret wall which will be uppermost than to that which will be lowermost.

The turret having been completed, the wasp continues to excavate the shaft but the

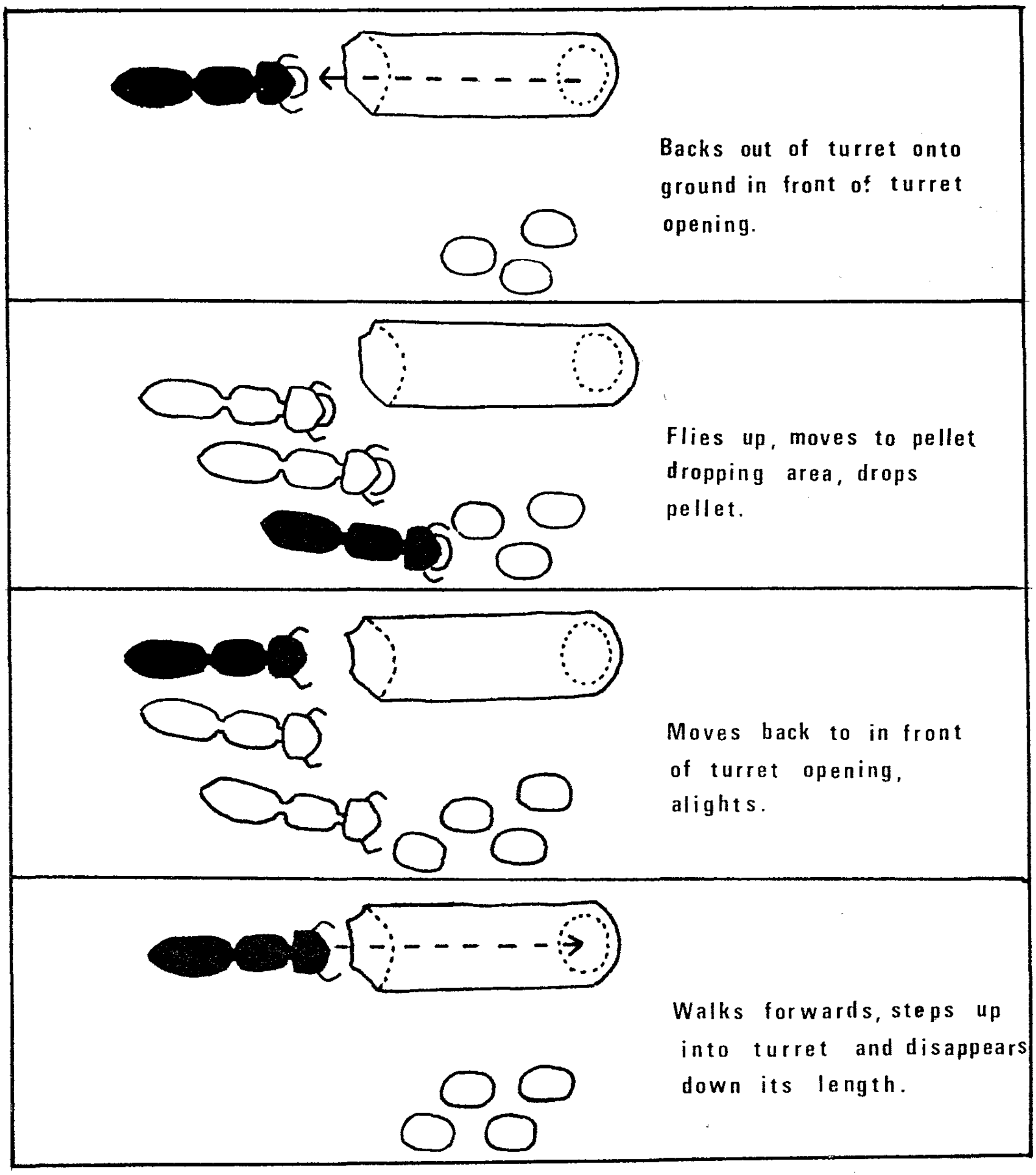


Fig. 37. Sequence showing, in diagrammatic form, the method of pellet deposition after turret construction by Ceramius capicola.

pellets then extracted are discarded either in a definite pellet-dropping area in close proximity to the nest or at some distance. C. capicola is an example of a species which has a clearly defined pellet-dropping area (Fig. 37). When discarding a pellet, a female of this species backs out from her nest until her head is free from her turret, then flies sideways and slightly forwards just above the surface of the ground to the pellet-dropping area a few centimetres from and to one side of the turret. She drops the pellet and still orientated parallel to her turret flies in reverse motion back to the nest entrance, which she is then facing, and enters. In this way the pellet-dropping operation takes up the minimum of time and exertion, differing from that of most mud-excavating wasps including some species of Ceramius which fly up in a wide circle when dropping pellets. In some species whether or not pellets are dropped in close proximity to nests or at some distance varies between populations, both behaviour patterns having been observed for C. lichtensteinii but in different localities. The nesting aggregations of one population were littered with discarded pellets whereas that of another was completely free from scattered pellets and the females were observed to fly to the edge of the clearing in which they were nesting and there to drop discarded pellets into the bushes.

After the "bulb" has been excavated the wasp is able to turn around in the nest and may emerge from the nest head first. Cycles of water carriage and pellet extraction are performed rapidly and without interruption during active nest excavation.

Cell excavation having been completed, the cells of the Group 8 species are ready for oviposition whereas in the other groups a mud-cell is first constructed within each excavated-cell. Mud for the construction of these cells must be quarried within the nest as these wasps do not fetch mud from elsewhere. It is thought probable that mud used by C. lichtensteinii is obtained by deepening the lower end of the main shaft. In the nests of species of groups 3 and 6 the diameter of the "bulb" is greater the larger the number of cells suggesting that mud for cell construction is probably quarried from the walls of the "bulb". The mud-cells are constructed in such a way that the outer surface is rough and separate applications of mud are discernable whereas the inner surface is carefully smoothed (Fig. 38 a).

Each cell is sealed with mud after the completion of oviposition and provisioning. The seals of constructed mud-cells are positioned just within the mouth of the cell. The outer surface of the mud-plug is generally rough and convex (Fig. 38 b). Those of C. cerceriformis (Group 2A) and C. clypeatus (Group 2B) are markedly concave.

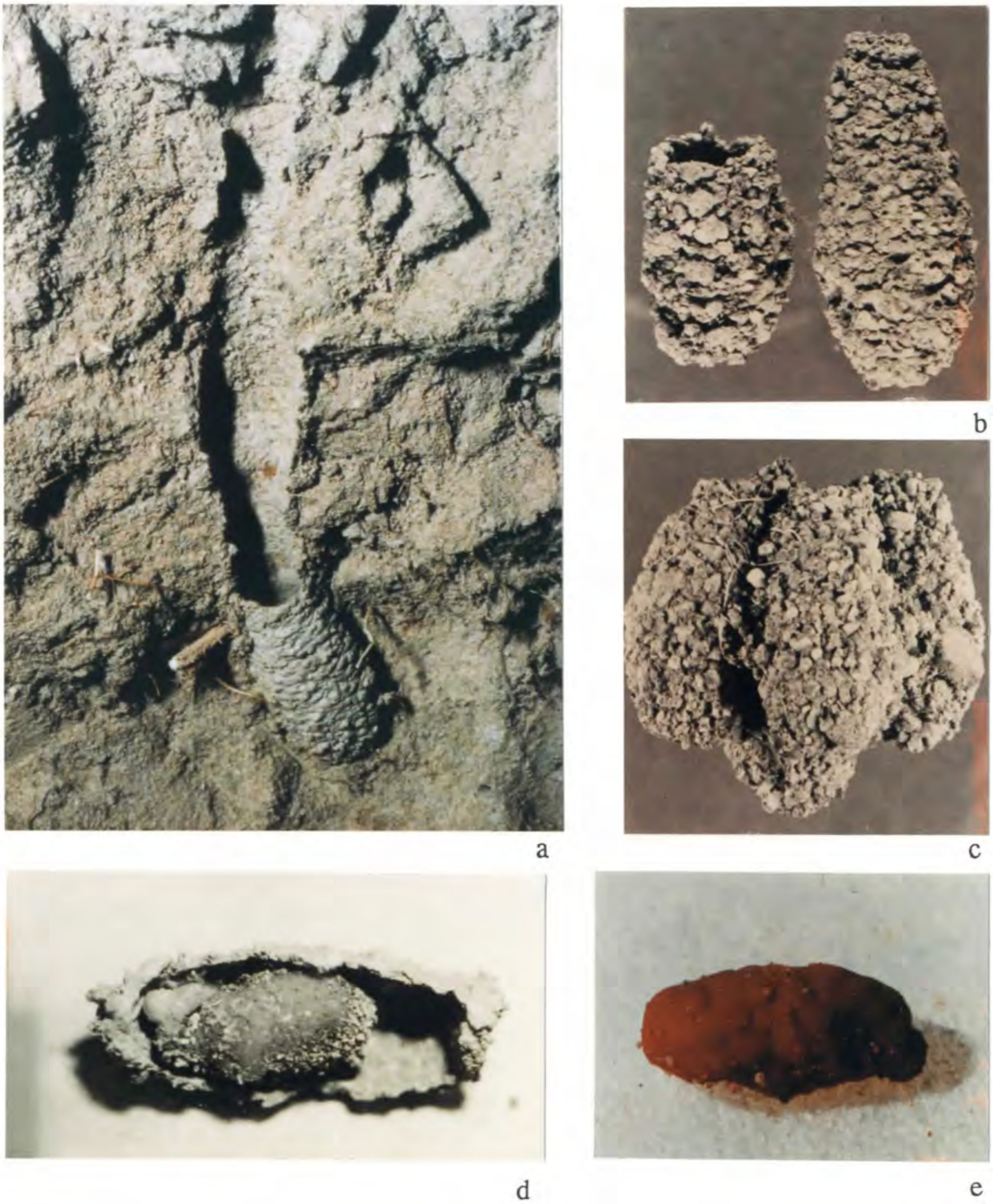


Fig. 38 a - c. **Cell and provision of Ceramius species: (a) vertical cut away of newly constructed one-celled nest of C. jacoti showing bulb and constructed earthen cell; (b and c) constructed earthen cells of C. nigripennis, b. left - half constructed and right - completed and sealed; (c) group of four; (d) constructed earthen cell of C. cerceriformis cut longitudinally to show provision and position of young feeding larva; (e) pollen and nectar loaf of C. clypeatus.**

After a cell has been sealed the shaft above the cell is filled with earth until the vertical section of the shaft is reached. As no earth is carried into the nest earth for filling must be obtained within the nest. After filling is completed a mud seal is constructed. This seal is smoothed so perfectly that it is not visible on the surface of the main shaft.

Further cells terminate secondary shafts and are prepared in a similar fashion to the first. The number of cells prepared is probably dependent in part on the availability of water for nest construction and pollen and nectar for cell provisioning, suitability of weather and the constraints imposed by the nest architecture. Clearly the Group 5 nest plan allows for a greater number of cells to be excavated than does the Group 3 plan.

Ceramius lichtensteinii differs from the other species for which nest construction is known in that it continuously deepens the main shaft. This is possible because in its nests, unlike those of other species, the main shaft does not terminate in a cell.

Reuse of nests

No evidence has been found of reuse of nests by wasps of groups 2 and 8, however, reuse of nests seems to be the rule for wasps of groups 3, 5 and 6. Insufficient information is available for comment to be made for groups 1, 4 and 7.

On emergence wasps of groups 3, 5 and 6 either initiate a new nest or enlarge the maternal nest. When several females emerge in a season, only one remains in the nest. All the others leave to initiate new nests. A reused nest is surmounted by a newly constructed turret. A new cell is constructed or a vacated cell is cleaned out and reused. In the case of a cell being reused the old cocoon is left in position. It seems that only the cell from which the possessor of the nest emerged is reused, all other cells and secondary shafts leading to them are freshly excavated.

It has been established that a nest may be reused over a period of several years.

Ceramiopsis Zavattari

There appears to be only one published record of the nesting of the Neotropical genus Ceramiopsis, that of C. paraguayensis (almost certainly a synonym of C. gestroi (Richards, 1962)) entering a burrow in the ground, surmounted by a turret (Bertoni, 1921 as reported in Richards, 1962).

Trimeria Saussure

Nesting has been recorded for two species of the Neotropical genus Trimeria, T. howardi (Zucchi et al., 1976) and T. buyssoni (Neff and Simpson, 1985). Both excavate burrows in the ground.

Description of nesting areas and nest situation

T. buyssoni was recorded as nesting in deep, hard open soil on an incline. No information was given concerning the nesting area of T. howardi.

Provision

The provision of T. howardi was described as a food mass made from pollen and nectar, and relatively solid with an irregular annulation which probably corresponds to successive foraging trips.

The nature of the provision has not been established, however, Neff and Simpson (1985) describe pollen collection from flowers of species of Verbenaceae and Boraginaceae.

Water collection

Water collection is not recorded, however, water is most probably used in excavation to soften the "hard" soil.

Description of the nest

The nest of T. howardi is a nearly vertical burrow excavated in soil and surmounted by a vertical turret. A variable number of lateral shafts are excavated. Each terminates in at least one cell. It is claimed that some laterals are terminated by two or even three cells. The cells are horizontal, elongate oval with the inner walls smooth and polished. It is noted that cells are not constructed within excavated cells.

Reuse of nests

Reuse of nests is recorded.

Microtrimeria Bequaert

There appear to be no records of nesting by the Neotropical genus Microtrimeria.

Masaris Fabricius

The only recorded observations of nesting by the Palaearctic genus Masaris seem to be two conflicting accounts for M. vespiformis. Morice (1900) recorded having seen a female entering a simple burrow in flat sand. Doubt has been expressed by Richards (1962) as to the accuracy of Morice's observation. He is more inclined to support the allegation by Ferton (1920) that certain mud cells attached to rocks were those of this wasp. Ferton, however, though his allegation was supported by circumstantial evidence, neither saw a wasp entering the cells nor reared wasps from the cells.

Pseudomasaris Ashmead

Nesting has been recorded for eight species of the Nearctic genus Pseudomasaris, P. coquilletti (Richards, 1963b), P. edwardsii (Torchio, 1970), P. maculifrons (Parker, 1967), P. occidentalis (Hungerford, 1937 as reported in Torchio, 1970), P. phaceliae (Parker, 1967 and Torchio, 1970), P. texanus (Bequaert, 1940 as reported in Torchio, 1970), P. vespoides (Torchio, 1970), and P. zonalis (Parker, 1967). All construct aerial earthen-cells.

Dorr and Neff (1982) described a nest in a beetle boring. The nest consisted of a linear series of four unlined cells separated by mud partitions. This they alleged to have been a nest of Pseudomasaris marginalis, however, they did not confirm the identity of the builder.

Description of nesting areas and nest situation

Little information has been given on the nesting areas of Pseudomasaris. The fullest description is that given for P. maculifrons and P. phaceliae. These species were found nesting along the banks of a river between the levee and the river bed. The soil was sandy and water-worn stones were common on the surface. There were patches of flowering Phacelia congesta (Hydrophyllaceae). P. zonalis was similarly found nesting near a stream but P. coquilletti was nesting on a rocky knoll and P. vespoides in an orchard. All but P. vespoides, which had constructed a nest on a twig, were nesting on stones. Where given, the position of the nests on the stones varied, those of P. maculifrons and of P. zonalis having been on the underside and those of P. phaceliae on the sides.

Some P. edwardsii were taken by Torchio from a grassy hillside on which Phacelia leucophylla was in flower and were kept in confinement in a greenhouse where they nested. The natural nesting situation was not recorded. In the greenhouse nest sites were always in open but concealed niches.

Provision

The provision of P. maculifrons and P. phaceliae was described as composed of pollen and nectar pellets tightly packed and that of P. edwardsii as a tacky, homogeneous mass of Phacelia pollen bound with Phacelia nectar and shaped into a solid cylinder (Fig. 39 d). Papilla-like projections were moulded by P. edwardsii during the deposition of each load of pollen and nectar.

Flower associations (Chapter 3) indicate that the pollen and nectar of most species is either derived from Penstemon (Scrophulariaceae) or Phacelia and Eriodyction (both Hydrophyllaceae) but that that of some species may be of mixed provenance.

Description of the nest

The nests of the Pseudomasaris species studied are composed of one or more elongate, parallel-sided earthen-cells joined longitudinally to the substrate and to each other (Fig. 39 a). After cells are constructed additional soil is often placed over them as a complete covering (Fig. 39 c).

The cell of P. edwardsii has been described in the greatest detail. It is a parallel-sided structure 14-21 mm in length and 5-6 mm in width. The walls vary in thickness from 0.25 mm to 1,0 mm, however, wall thickness in any particular cell is constant. The inner surface is smooth, unlined and nonreflective. The cell cap is a plug of soil with a flat, unlined inner surface, usually of two concentric rings. Its outer surface is normally flat, smooth and flush with the anterior margin of the cell. The thickness of the cell cap varies between 0,75 mm and 1,80 mm.

The cells attached to the substrate are incomplete and asymmetrical in cross section because the area of attachment is not coated with soil.

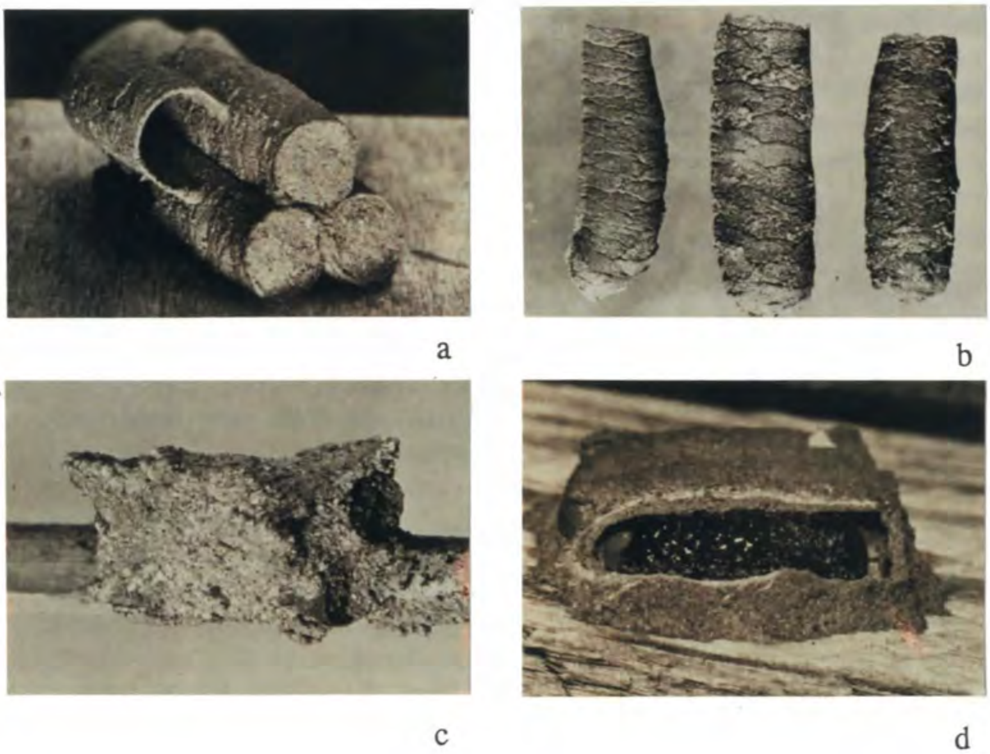


Fig. 39 a - d. Pseudomasaris edwardsii: (a) cluster of cells; (b) outer surface of cells showing "fish-scale pattern"; (c) completed nest with soil covering; (d) position of egg and provision in cell. All from Torchio (1970).

Method of construction of the nest

The only account of cell construction, oviposition and provisioning is that of Torchio for P. edwardsii.

Cell construction was initiated after the wasp had selected nest and soil collection sites.

At the soil collection site soil was scraped up with the mandibles and collected together beneath the head. Nectar exuded through the folded mouthparts was rapidly absorbed into the soil until it was moist and adhered to the postgenal surfaces of the head. After the wasp had gathered a load of soil she flew back to the nest site.

During cell construction, the returning wasp landed on the brim of the cell and curved her body until the posterior two or three abdominal sterna touched the outer surface of the brim. At the same time she thrust her head into the cell cavity until her mandibles, which appressed against the inner surface of the cell, were opposite the posterior abdominal sterna. As soil was deposited she moved her mandibles to shape the deposit whilst she simultaneously tamped the outer surface of the fresh deposit with her posterior abdominal sterna.

Each deposit added to the cell during construction left an outline scar which roughened the inner and outer surfaces of the cell wall. As construction neared completion, the wasp deposited the last few loads of soil within the cell and used them to smooth the inner surface.

After the completion of the cell oviposition followed by provisioning takes place and the cell is then sealed.

Nest covering is very variable in extent.

Jugurtia Saussure

Nesting has been recorded for two southern African species of the Afrotropical and Palaearctic genus Jugurtia, J. confusa (Gess and Gess, 1980) and J. braunsi (Gess and Gess, unpublished field notes). Both excavate a vertical burrow in the ground.

Description of nesting areas and nest situation

J. confusa and J. braunsi nest in horizontal to sloping ground in areas of karroid scrub in relatively close proximity to their forage plants and a water source. One nest of J. confusa has been recorded as excavated in a pocket of soil on a ledge of a raised bank. This apparently unusual situation, however, falls within the category of horizontally presented soil.

The soil contains a sufficient clay factor that it is malleable when mixed with water. J. confusa nests are aggregated in bare areas. Those of J. braunsi, so far recorded, occurred singly in bare areas, however, it is probable that nesting was not in full swing and that this species will also be found to nest in aggregations.

Provision

The provision of J. confusa, the only species of Jugurtia for which provision has been obtained, is a moist sticky loaf composed of pollen and nectar. Pollen from the provision was examined microscopically and compared with pollen from flowers found in the vicinity of the nesting area. It was found to be all of one type and matched that of Drosanthemum floribundum (Aizocaeae: Mesembryanthema). Available flower visiting records indicate that the provision of J. braunsiella, J. polita and J. turneri is most probably derived from flowers of Asteraceae. That of J. braunsi is of uncertain provenance but most probably mixed as this wasp has been found visiting flowers of Aizoaceae (Mesembryanthema), Asteraceae and Campanulaceae.

Water collection

Water for nest excavation is collected by J. braunsi, J. braunsiella, J. confusa and J. polita females from saturated soil near the edge of a water source. Brauns (1905) observed J. saussurei similarly engaged.

Description of the nest

The nests of J. confusa and J. braunsi consist of a subterranean burrow surmounted by a short cylindrical mud-turret (Fig. 40). The subterranean burrow consists of a vertical shaft of constant diameter for its entire length and from which at its lower end there branches a short sub-horizontal shaft terminating in an excavated cell within which is a constructed mud-cell (Fig. 41 a).

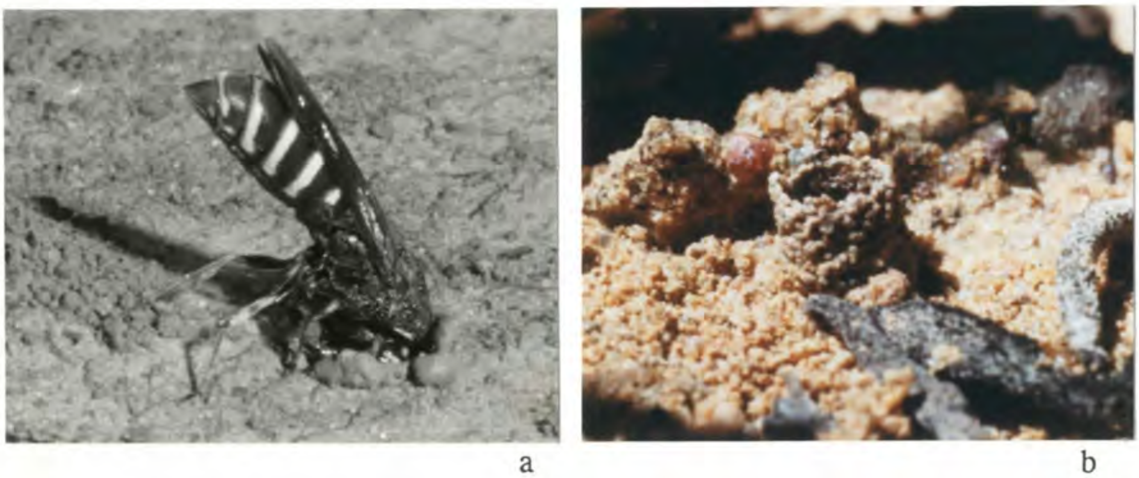


Fig. 40 a and b. Turrets of Jugurtia species: (a) Jugurtia confusa extracting mud from shaft initial, turret in early stage of construction ; (b) turret of J. braunsi.

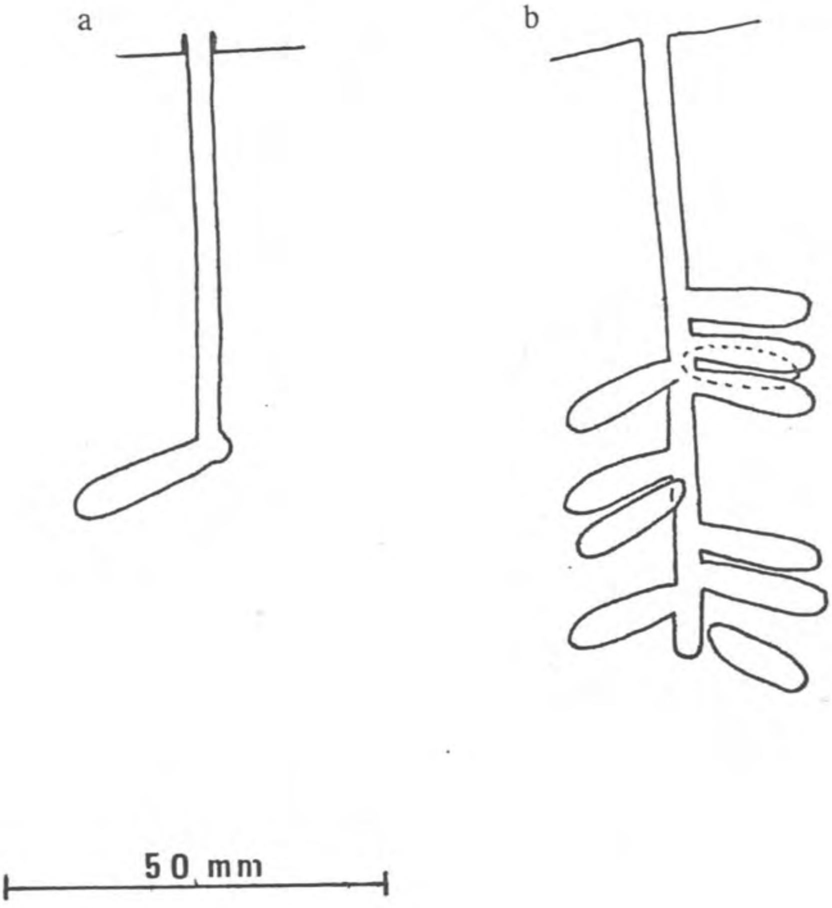


Fig. 41 a and b. Vertical plans of turrets and underground workings of nests of Jugurtia confusa, Hilton, Grahamstown: (a) newly constructed nest; (b) reused nest, no cell terminating the main shaft.

A nest at a more advanced stage of construction has been obtained only for J. confusa. In this nest further sub-horizontal secondary shafts each terminating in a cell were present (Fig. 41 b). Each secondary shaft including a cell was barely longer than the cell itself. All completed cells were sealed with a mud-plug constructed within the neck of the cell like a cork in a bottle.

Method of construction of the nest

Nest excavation is initiated by the female's regurgitating water from her crop onto the ground. Using her mandibles she works this water into the earth to form mud from which she forms a pellet. A number of pellets is formed in this way from each crop-full of water. The first pellets excavated from the shaft-initial may be discarded. The shaft-initial is circular in cross section due to the female's rotating evenly, not altering the direction of rotation without first completing a circle. At the commencement of turret construction, the pellets, instead of being discarded are laid down in a circle around the shaft-initial in such a way that the inner diameter of the turret will be the same as that of the shaft. Additional pellets are added regularly so that the resultant turret is a vertical cylinder.

After completion of the turret the wasp continues to excavate the shaft but the pellets then extracted are discarded. J. confusa has no clearly defined pellet-dropping area, however, the wasp does confine her arrivals at and departures from the nest to a set quarter segment.

Cycles of water carriage and pellet extraction are performed rapidly and without interruption during active nest excavation.

Shaft diameter is maintained constant so that there is no "turning bulb" such as is formed by Ceramius. In consequence the wasp continues to emerge backwards throughout shaft excavation.

From the bottom of the main shaft a secondary shaft is excavated in a sub-horizontal plane in such a way that the distal end lies deeper than the bottom of the main shaft and is enlarged to form a cell. A mud-cell is constructed within the excavated-cell. Mud for the construction of such a cell must be quarried within the nest as mud is not brought into the nest. In nests of J. confusa in which a mud-cell has been constructed there is an enlarged "heel" at the bottom of the shaft. It is thought probable that at least part of the soil used in constructing the mud-cell is excavated from this source. The mud-cells are constructed in such a way that the outer surface is rough and separate applications of mud are discernable whereas the inner surface is carefully smoothed. The average thickness of the walls is 0,7 mm.

After oviposition and provisioning the cell is sealed with mud, the remaining section of the secondary shaft is filled with earth and sealed off from the main shaft with mud which is smoothed so that the entrance to the secondary shaft is no longer visible.

Succeeding cells are constructed in the same manner, the number probably being dependent on the availability of water for nest construction and pollen and nectar for cell provisioning.

Reuse of nests

Evidence was obtained for reuse of nests by J. confusa. A nest marked at the end of one summer season was seen at the start of the following season to be being worked upon by a freshly emerged female which had furnished it with a new turret. Sunning himself in the vicinity of the nest was a freshly emerged male. On excavation it was found that eight of the eleven cells were open, empty and parchment lined. They were therefore clearly cells from a previous year's nesting season.

Masarina Richards

Nesting has been recorded for one species of the Afrotropical genus Masarina, Masarina familiaris (Gess and Gess, 1988a). This wasp excavates a multicellular sub-horizontal burrow in vertical earth banks.

Description of nesting areas and nest situation

Masarina familiaris has been recorded nesting at three sites to the west of the Olifants River Valley, all in dry fynbos and in an area of mixed dry fynbos and karroid scrub and in relatively close proximity to a water source. It has been recorded nesting in banks (Fig. 42) varying in height from 15-100 cm at heights of a few centimetres to half a metre. The soil of the nesting sites varied from a sand coloured clay-sand mixture with a relatively low proportion of clay to a hard non-friable red clay-sand mixture with a relatively high proportion of clay. In all cases

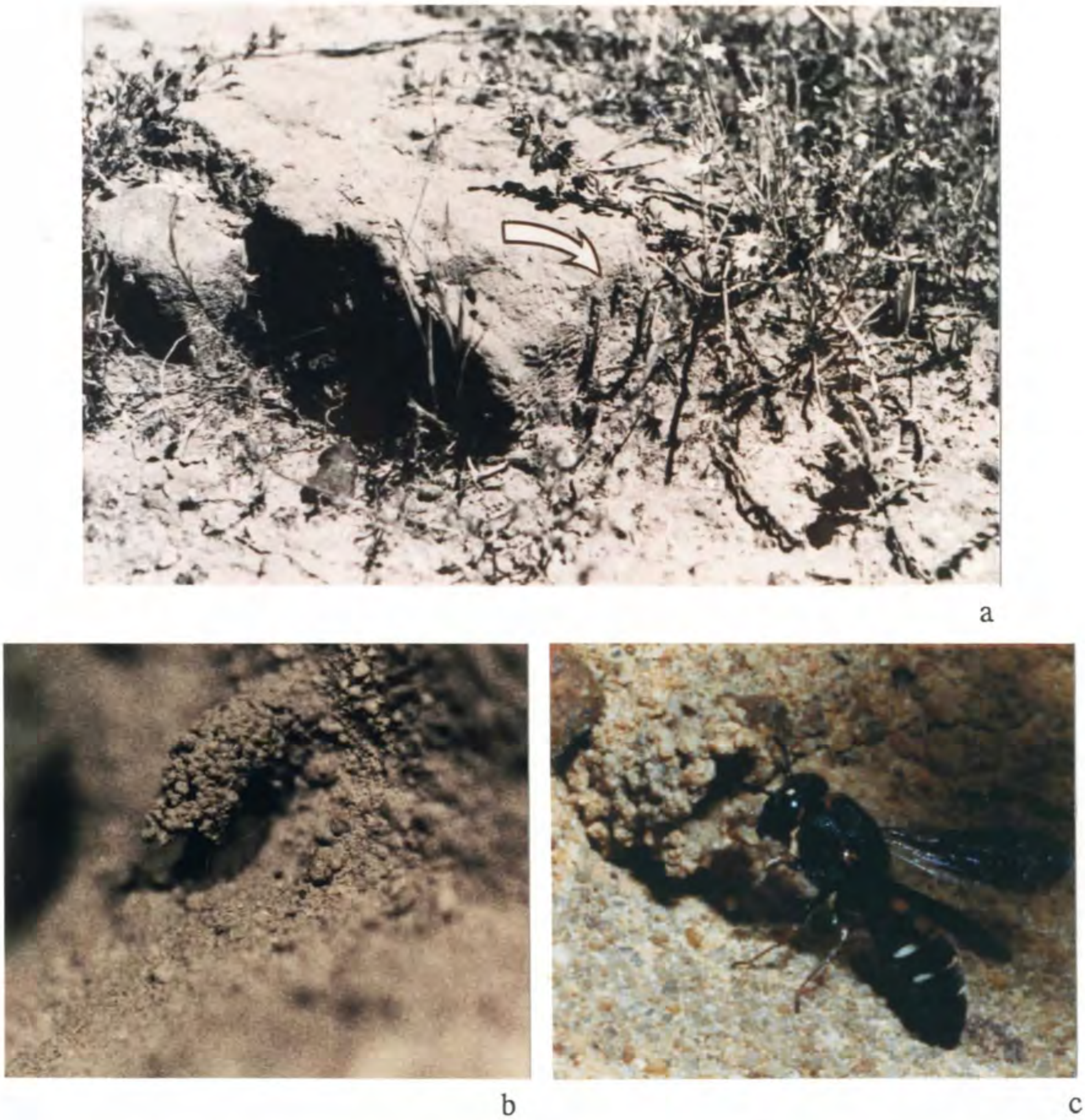


Fig. 42 a and c. Masarina familiaris: (a) nest site on vertical bank; (b) turret (x 2); (c) turret and builder (x 4).

the soil was malleable when mixed with water.

The nests occurred singly and also grouped in the vicinity of an old nest, suggesting that there is a tendency for a newly emerged female to initiate a nest in close proximity to the nest from which she herself emerged.

Provision

The provision which is a mixture of pollen and nectar is very wet and sticky. Being wet it has no discrete shape of its own. It occupies about two thirds of the cell.

In the Clanwilliam district pollen for provisioning was derived solely from flowers of one or more Aspalathus species (Papilionaceae), the only flowers on which it has been observed foraging in that district. It is possible, however, that in other areas pollen from Lebeckia and Wiborgia (both also Papilionaceae) may be used as Masarina familiaris has been recorded foraging on these plants in the Springbok area.

Foraging records indicate that it is probable that the provision of M. mixta is derived from Wahlenbergia (Campanulaceae).

Water collection

Water for nest construction is collected by females from saturated soil at the edge of a water source.

Description of the nest

The nest of M. familiaris consists of a multicellular burrow with at its entrance a downwardly curved tubular mud-turret (Fig. 43). The turret (Fig. 42) is constructed of mud pellets smoothed on the inside but left rough on the outside. A large number of interstices are left open so that the turret has a somewhat lacy appearance. The turret and shaft entrance are of the same diameter. There are one or more sub-horizontal to upwardly or downwardly sloping shafts each ending in a cell. All shafts leading to sealed cells are filled with earth and sealed with a mud-plate a short distance inside the burrow entrance. A cell is, over most of its length, of the same diameter as the shaft. There is a distinct neck of smaller diameter than that of the cell and shaft. Distally the cell walls slope inwards abruptly to a truncate end wall.

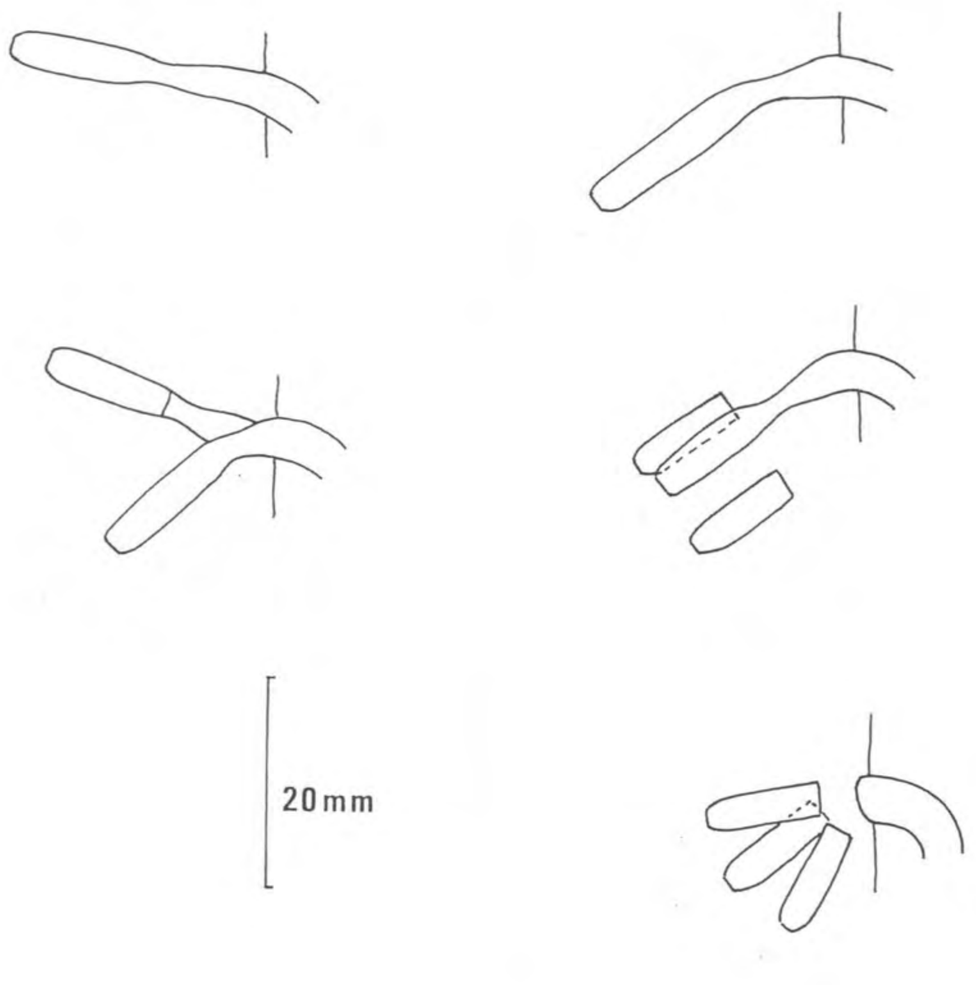


Fig. 43. Vertical plans of turrets and underground workings of Masarina familiaris.

Method of construction of the nest

Water is required for nest construction. At an early stage in burrow excavation turret construction is initiated using pellets extracted from the excavation. At the commencement of turret construction pellets are laid down around the shaft opening in such a way that the turret will have the same diameter as the shaft. Almost from the start additional pellets are added in such a way that the turret curves over and downwards. After turret construction has been completed further pellets extracted from the excavation are dropped so that they accumulate in a pile at the base of the bank beneath the nest.

The shafts are short and generally slope downwards although they may less commonly slope upwards. The average angle of slope for the sample was 26^{o}. A shaft is extended without change of angle to end in a cell. Cell excavation is preceded by a reduction of 1 mm in the diameter of the shaft over a short distance to form a neck. After the neck has been created the diameter returns to that of the shaft until the inner end of the cell is approached so that the cell walls are parallel over most of the length of the cell. Shortly before the end of the cell is reached there is a rapid reduction in diameter so that the sides slope inwards to the end of the cell which is truncate, not curved.

The excavated cell is very carefully smoothed and shaped so that, although a mud cell is not constructed within it, the walls of the cell are stabilized to such a degree that in nests constructed in relatively friable soils parts at least of the cell walls can be separated from the surrounding soil.

After oviposition and provisioning the cell is sealed with a thin mud plate and the shaft is filled with earth. Several secondary shafts each terminating in a cell may be similarly excavated and completed.

Reuse of nests

No indication has been found of reuse of nests.

Celonites Latreille

Nest construction has been recorded for seven, possibly eight, species of Celonites.

Aerial earthen-cells on stones or plant stems are constructed by five of these: three Palaearctic species, C. abbreviatus (Lichtenstein, 1869 (as C. apiformis Fabricius);

Ferton, 1901 and 1910; Fahringer, 1922 as reported in Richards, 1962; and Bellmann, 1984), C. fischeri (Bingham, 1898 as reported in Richards, 1962), and C. mayeti (Lichtenstein, 1875 and Ed. André, 1884 as reported in Richards, 1962); a Palaearctic/northern Afrotropical species, C. jousseaumei (Richards, 1962); and an Afrotropical species, C. andrei (Brauns, 1913). In addition mention is made in Gess and Gess (1989) of an aerial nest, a putative nest of C. promontorii.

Earthen-cells are constructed in a pre-existing burrow by one species, C. wahlenbergiae (Gess and Gess, 1992), and a burrow, in which is constructed an earthen-cell, is excavated by another, C. latitarsis (Gess and Gess, 1992).

Description of nesting areas and nest situation

Little information seems to be available concerning the nesting areas of the aerial nesting Celonites species. Bellmann (1984) noted that C. abbreviatus was nesting in rocky or stony dry meadows. C. andrei and C. promontorii are wasps of karroid scrub. Nesting situation may be variable, nests of C. abbreviatus being situated under and on the sides of stones and on rocks at heights of 1-2 m (Bellmann, 1984), on dry plant stems (Lichtenstein, 1869) and under bark (Fahringer, 1922 in Richards, 1962).

The areas in which the two ground nesting species were investigated is open dry fynbos. The soil is sandy, relatively coarse and loose on the surface but finer and more compact beneath. The finer sand is brought to the surface by the Cape Dune Molerat, Bathyergus suillus (Schreber) (Bathyergidae). The molehills stabilize forming "hillocks" of compacted sand in which the wasps nest.

Provision

The provision of C. abbreviatus examined by Bellmann (1984) was orange and of a honey-like ("honigartiger") consistency. This "honey" was only in contact with the cell walls at isolated points and its surface was divided by furrows into portions representing provision loads which would indicate that it was of a firm consistency. The pollen was not identified, however, Bellmann stated that Teucrium montanum (Lamiaceae) was favoured for the collection of pollen and nectar in the area where nesting was studied. Schremmer (1959) observed the collection of pollen and nectar from Salvia officinalis (also Lamiaceae) in Istria, Jugoslavia.

The provision of C. wahlenbergiae examined was olive green, very moist and yet did not adhere to nor wet the cell walls. The pollen, examined microscopically, was found to be of two types, both apparently smooth walled. On comparison with pollen from plants growing in the vicinity of the nest one of the pollens was found to match only that from Wahlenbergia paniculata (Campanulaceae) and the other only that from a Coelanthus (Aizoaceae) species which was growing mixed with the Wahlenbergia. Although Crassula dichotoma (Crassulaceae) was known to be visited by the nester no pollen from this plant was found in the sample of provision examined. It is possible that it was being visited for nectar only.

As provision has only been obtained from the Clanwilliam Dam site no comment can be made on whether any of the other plants visited by the wasp in other areas was being made use of for obtaining pollen and/or nectar for provision.

Pollen from the provision of C. latitarsis was all of one type. On comparison with pollen from plants growing in the vicinity of the nest it was found to match only that of Wahlenbergia psammophila (Campanulaceae).

Description of nest

The aerial nests consist of a group of earthen-cells in close proximity to each other. The arrangement of the cells is variable even within species, the cells of C. abbreviatus described by Bellmann (1984) being abutted lengthwise and those described by Lichtenstein (1869) end to end, sometimes with another row parallel to the first. Completed groups of cells are either left uncovered (Richards, 1962 based on the accounts available to him) or are covered with a common layer of earth (Figs 44 a and b) about as thick as the cell walls, the spaces between the cells being left as cavities (Bellmann, 1984). The cells seem to be most commonly orientated vertically, opening downwards and less commonly inclined to horizontal.

Of the ground nesters, the nest of C. wahlenbergiae consisted of three linearly arranged earthen-cells attached to the wall of an apparently pre-existing burrow excavated in sandy soil (Fig. 45). The three cells, two completed and sealed and the third in an early stage of construction (Figs 44 c and d), were of a diameter appreciably less than that of the burrow. The nest of C. latitarsis consisted of an arched entrance (Fig. 44 e) leading to a short sloping burrow terminating in a horizontal excavated cell (Fig. 46). Within the excavated-cell and of the same diameter was a constructed earthen-cell (Fig. 44 f).

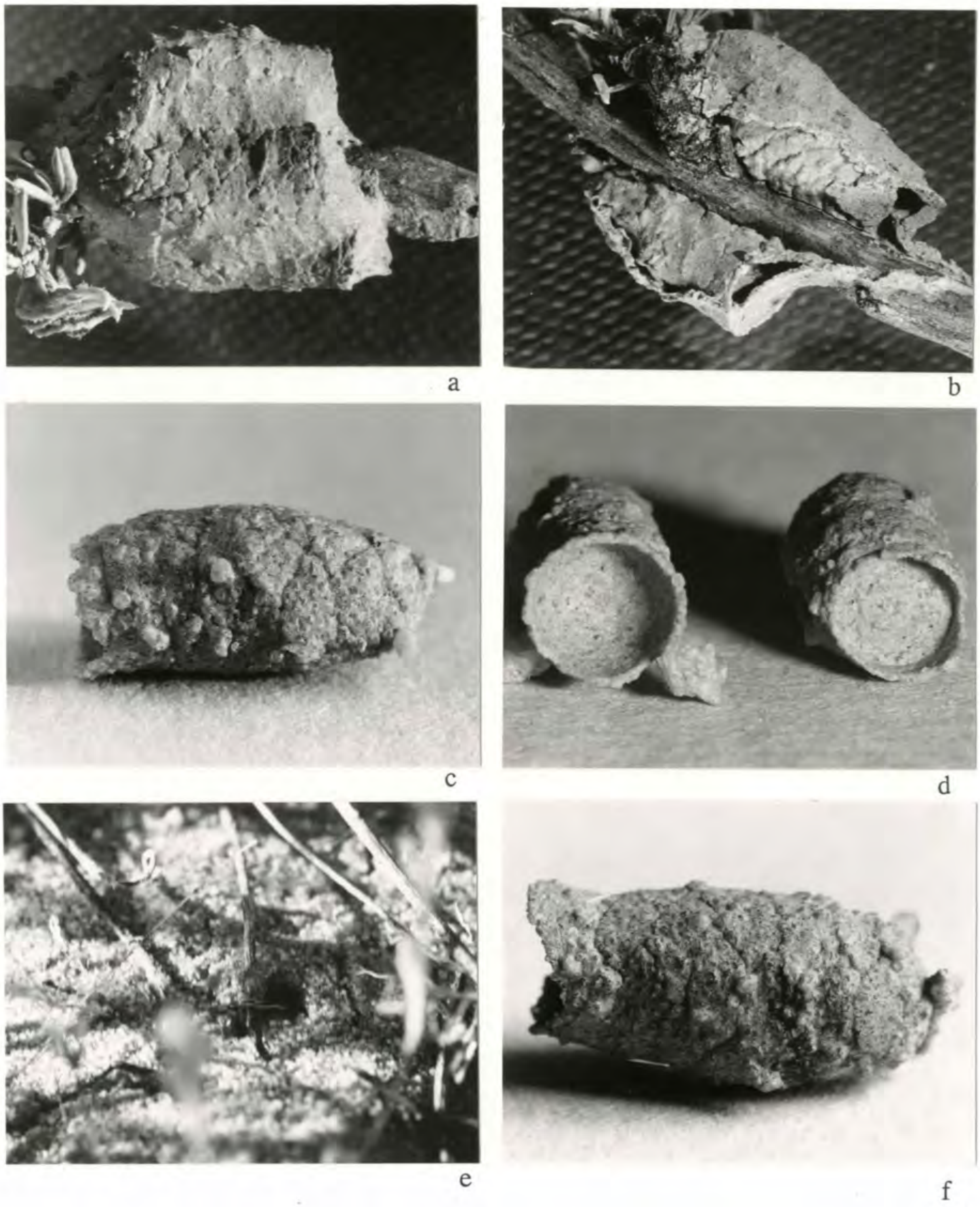


Fig. 44 a - f. Celonites species: (a and b) Celonites promontorii, putative nest (x 4); (c and d) Celonites wahlenbergiae, c. cell, d. left - incomplete cell showing rounded blind end and right - sealed completed cell, (x 6); (e and f) Celonites latitarsis, e. nest entrance and f. cell (x 6).

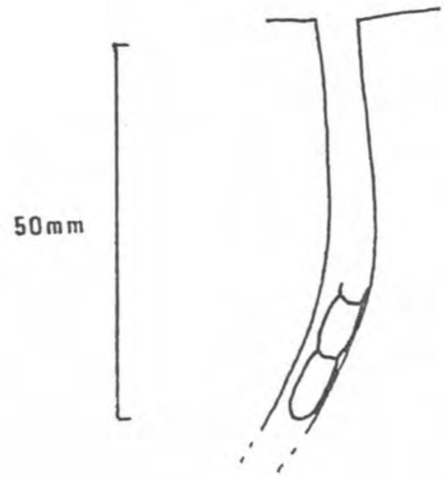


Fig. 45. Vertical plan of nest of Celonites wahlenbergiae.

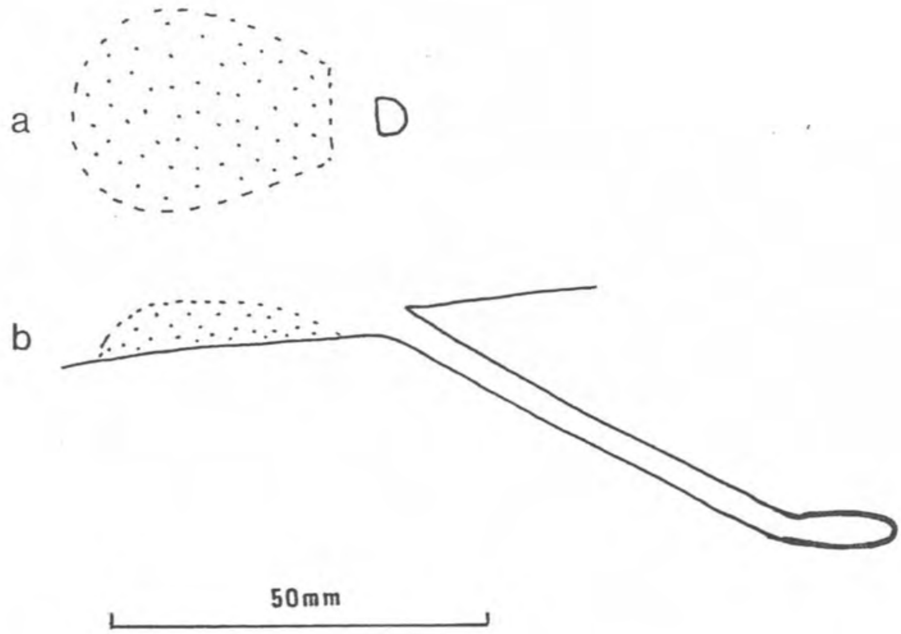


Fig. 46 a and b. Diagrams of nest of Celonites latitarsis: (a) nest entrance and tumulus from above; (b) vertical plan.

Apparently characteristic of all species is the distinct "fish scale" pattern on the outer surface of the constructed earthen-cell. All cells are rounded at the closed end and somewhat truncate at the open end. A seal is positioned just inside the cell opening. The cells from the nests of C. wahlenbergiae, C. latitarsis and the putative nest of C. promontorii are ovoid whereas those of C. abbreviatus figured by Bellmann are almost parallel-sided. The constructed walls of most of the cells investigated by Bellmann were incomplete, the substrate forming part of the cell wall.

Method of construction of the nest

From a consideration of the observations of Bellmann (1984) and Gess and Gess (1992) it seems likely that the method of cell construction is similar in all species. Whilst building a cell a wasp makes regular visits to a quarry site. The quarry sites of the two ground nesting species observed were on stabilized mole-rat hillocks, 2,5 m (latitarsis) and 3 m (wahlenbergiae) from the nests. At the quarry site the wasp vibrates up and down vigorously whilst scraping up a load of sand which is held by the mouthparts. The visits to the quarry alternate regularly with periods in/at the nest during which building material is added to the cell. Alternating with a cycle of visits to the quarry and the nest (five to seven observed for latitarsis) are periods away to collect liquid to mix with the dry sand to make it malleable for cell construction. As the cell walls are harder and more durable than they would be had water been used and as Celonites has never been observed at water it seems probable that nectar is used. Certainly between bouts of quarrying and cell construction C. latitarsis regularly visited a succession of Wahlenbergia psammophila flowers.

Each load of earth is added to the cell in the form of a semi-circular plate. Bellmann observed that when a C. abbreviatus female is building she positions herself with her head inside the cell and her abdomen curved around on the outside. Cell construction by C. latitarsis was monitored from start to finish. It took approximately two hours during which time 36 additions to the cell were made. Each visit to the quarry took 29 seconds (n = 36) and each period in the nest during which cell construction proceeded took 48 seconds (n = 37). Absences for liquid collection took 10-20 minutes.

After oviposition and provisioning have been completed the cell is sealed with a plate constructed just inside the lip of the cell from moistened earth laid down in concentric rings.

Further cells may then be constructed. After the completion of the construction of a group of aerial cells the builder may bring further "mortar" for the construction of a covering.

In nest construction by C. latitarsis cell construction is preceded by burrow excavation. Sand excavated from the burrow is drawn out by the wasp as she reverses out of the burrow. Excavated sand accumulates as a tumulus approximately 20 mm down slope from the burrow entrance. From time to time a certain amount of raking of the "path" between the burrow and the tumulus takes place. The burrow entrance is left open while the wasp is away from the nest.

Quartinia Ed. André

Previous to the account of the nesting of Q. vagepunctata (Gess and Gess, 1992) the only record of nesting by Quartinia was the observation of Jacot Guillarmod (pers. comm.) that he had seen the burrows of a Quartinia species in garden soil. The presence or absence of turrets was not mentioned. There appear to be no records of nesting by the Palaearctic species of Quartinia.

Description of nesting area and nest situation

The nesting site of Q. vagepunctata was a bare patch, approximately 1 metre square, of somewhat uneven level ground between shrubs in an area of karroid scrub (Fig. 20 c). The soil was sandy and friable. Each nest had its entrance to one side of an earth clod or stone (Fig. 47 a).

Provision

The provision from each of four nests of Quartinia vagepunctata was in the form of a relatively moist bright yellow nectar and pollen mass almost entirely filling the cell, adhering to the cell walls and therefore not forming a discrete pollen loaf. The pollen from one of the nests was found to be all of one kind and to match that of Cotula cf. leptalea (Asteraceae). That from the other three nests matched that of Relhania and Cotula (both Asteraceae).

Description of the nest

The nest consists of a subterranean silk-lined burrow surmounted by a horizontal turret constructed from silk and sand (Fig. 47), the inner surface being of silk and the outer surface of sand (grain size: 0.16 mm - 1,2 mm) held together by the silk.

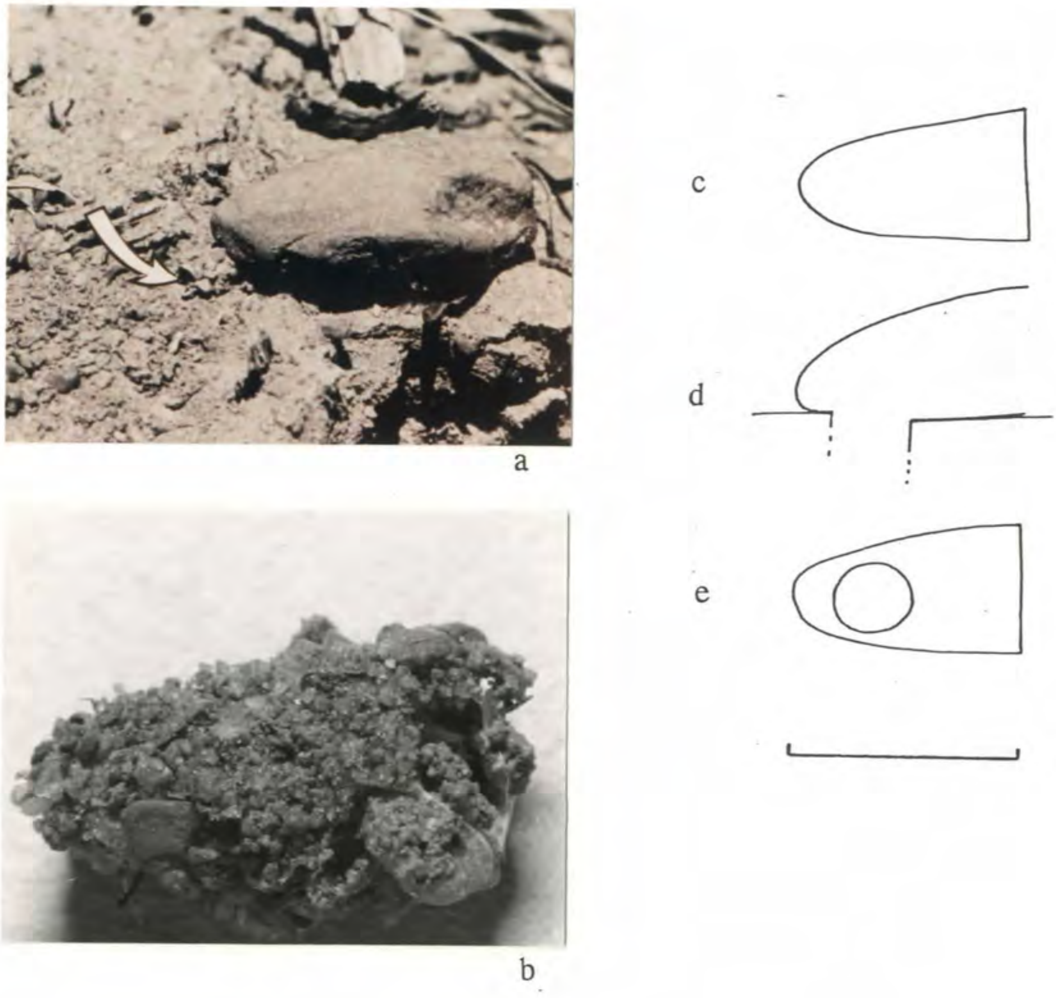


Fig. 47 a - e. Quartinia vagepunctata: (a) nesting site, arrow indicating sand and silk nest entrance turret (x c 1,3); (b) dorsal view of nest entrance turret (x c 14); (c - e) plans of turret, c. from above, d. vertical section, e. from below, (scale bar = 5 mm).

The turret is bag-like, approximately circular in cross-section with its diameter greatest at its outer open end and smallest at its closed inner end. The opening to the burrow entrance is at some little distance from the closed inner end of the bag (Fig. 47 e).

The burrow consists of a subvertical shaft which terminates in a sealed roughly ovoid cell. The cell walls are constructed of sand bonded together with silk and well cemented with a substance somewhat resinous in appearance. In one of the nests the female was found sheltering in a lateral shaft which would suggest that more than one cell per nest is probably constructed.

Method of construction of the nest

The soil in which the nest is excavated is friable. Water is not required for nest excavation and is not used as a bonding agent. It is therefore not surprising that Q. vagepunctata though collected commonly at flowers has never been collected at water.

The silk used in nest construction is spun by the nest- builder. One individual was observed whilst it was joining together sand grains with silk. It was rotating its head and the silk was apparently issuing from its mouth suggesting that the silk may well be produced by mandibular glands.

The nature of and provenance of the substance used in conjunction with silk in the bonding of the cell walls has not been determined.

Quartinioides Richards

The only observation concerning the nesting of the Afrotropical genus Quartinioides seems to be that of Gess and Gess (1988a and 1989) of vertical burrows in friable beach sand. The burrows were not surmounted by turrets.

Quartiniella Schulthess

There appear to be no records of nesting by this Afrotropical genus.

A discussive overview of nesting by the masarids as a family

Nest situation and basic nest type

Gess (1981) in considering the structuring of aculeate wasp and bee communities devised a classification for aculeate wasps and bees based on ethological characters. In this classification four basic nesting situations were recognized, the ground, vertical banks, stones and plants. Nesters in soils were divided into two main types, nesters in friable soil and nesters in non-friable soil, and nesters associated with vertical banks and plants were divided into those nesting in or on the substrate. All four basic nesting situations and both the basic soil types have been exploited by masarid wasps.

The basic form of self-excavated nest prepared by aculeate wasps is a single celled burrow dug in friable soil. This basic nest type, typical of some sphecids and pompilids has not been recorded for any masarids. Derived from this nest type are multicellular nests of varied architecture dug in friable soil. From this nest type is derived nest excavation in non-friable soil with the adoption of the use of water for softening the soil and usually with the use of some of the spoils of excavation for the construction of a turret surmounting the burrow entrance. The prevalence of nesting in non-friable soil by masarids is only matched by the Eumenidae although it is not uncommon amongst the bees. In the Sphecoidea and Pompiloidea, although ground nesting is common, indeed the greatest number of ground nesting species is to be found amongst the sphecoids, only one genus each is known to have species nesting in non-friable soil, Bembecinus (Nyssonidae) (Gess and Gess, 1975), and Dichragenia (Pompilidae) (Gess and Gess, 1974 and 1976). Even in the large genus Bembecinus, nesting in non-friable soil is the exception having been recorded for only two species. Clearly the habit of nesting in non-friable soil and using water in excavation must have evolved independently in the Apoidea, Sphecoidea and Pompiloidea, however, it seems probable that it is ancestral for both the Eumenidae and the Masaridae in the Vespoidea. Certainly nesting in friable soil by Pterocheilus (Eumenidae) and Celonites latitarsis (Masaridae) is derived.

In all groups, nesting in vertical banks, which is seen as derived from nesting in horizontal ground, is less common than nesting in the ground. It, however, seems to be exceptionally uncommon in the Masaridae, being known only for Masarina.

Both excavating burrows in living tissue, as exemplified by Dasyproctus species (Crabronidae) and excavation of burrows in dead plant tissue as exemplified by the Xylocopinae (Anthophoridae) are unknown in the Masaridae (Gess, 1981).

Nesters on plants together with nesters on stones are associated with the substrate merely as a suitable support for the nest, the nesting materials not being derived from the substrate but brought to it. As noted such nesters have arisen several times amongst the higher masarids. They are also to be found amongst the eumenids and the social wasps in the Vespoidea, the Pompiloidea and the Sphecoidea.

In Gess' classification nesters in all situations are divided into three categories based on the degree of participation in the construction of the nest: nest constructed entirely by the nester; pre-existing cavity modified by the nester; and pre-existing cavity not modified by the nester.

The masarids for which nesting is known almost all fall into the category "nest constructed entirely by the nester". The only masarid known to fit into the nesting category "pre-existing cavity modified by the nester" is Celonites wahlenbergiae, nesting as it does in a pre-existing cavity in the ground (Gess and Gess, 1992). Nesting in a pre-existing cavity in logs by Pseudomasaris marginalis has been claimed by Dorr and Neff (1982) but unfortunately the identity of the nester was not confirmed. Richards (1962) when discussing the Quartinia group stated that he would "not be surprised if they nested in hollow stems", however, as yet no evidence of nesting in such situations has been found, the only three species for which nesting situation is known being ground nesters (Gess and Gess, 1992). Nesting in pre-existing cavities modified by the nester is not uncommon in the vespoid family the Eumenidae and, furthermore, occurs in the pompiloids and is common amongst the sphecoids and the bees.

Nesters in "pre-existing cavities not modified by the nester" include those species which provision a cavity without preparing the cavity in any way, principally Scoliidae and Tiphiidae, and those species which are labour parasites ovipositing into a nest provisioned by an individual of another species. The latter category of nesting is typical of the Chrysididae and is found amongst the sphecoids and the bees. The unusual form of the abdomen which gives Celonites the ability to roll itself in the manner of the Chrysididae led to the assumption that it would be found to be a nest parasite of other Hymenoptera in the chrysidid manner (Saussure, 1854 cited in Blüthgen, 1961). However, this was, as has been shown (Chapter 4), an erroneous assumption.

Classification of masarid nest types

From an analysis of the nesting accounts it is possible to recognize seven basic nest types and to allocate forty species to these nest types as listed below.

Nest Type 1 - a multicellular sub-vertical burrow in horizontal to sub-horizontal ground excavated by the nester, with an entrance turret constructed from earth extracted from within the burrow but with the excavated cells not containing constructed cells:

four species of Ceramius: all species of Group 8 - C. capicola, C. linearis, C. bicolor and C. socius; and

one species of Trimeria: T. howardi.

Nest Type 2 - a multicellular sub-horizontal burrow in vertical to sub-vertical ground excavated by the nester, with an entrance turret constructed from earth extracted from within the burrow, and with the walls of each excavated cell lined with cemented earth excavated within the burrow:

one species of Masarina: M. familiaris.

Nest Type 3 - a multicellular sub-vertical burrow in horizontal to sub-horizontal ground excavated by the nester, with or without an entrance turret constructed from earth extracted from within the burrow, and with each excavated cell containing a constructed cell formed from earth excavated within the burrow:

three species of Paragia: P. (Paragia) tricolor, P. (Paragia) decipiens and P. (Cygnea) vespiformis;

eleven species of Ceramius: Group 2a - C. cerceriformis; Group 2b - C. clypeatus; Group uncertain, probably 2b - C. micheneri; all species of Group 3 - C. nigripennis, C. jacoti, C. braunsi and C. toriger; the single species of Group 5 - C. lichtensteinii; Group 6 - C. rex and C. metanotalis; Group 7 C. tuberculifer; and

two species of Jugurtia: J. confusa and J. braunsi.

Nest Type 4 - a group of constructed cells attached to plant stems or stones:

six species of Celonites: C. abbreviatus, C. fischeri, C. mayeti, C. jousseaumei, C. andrei and probably C. promontorii;

eight species of Pseudomasaris: P. coquilletti, P. edwardsii, P. maculifrons, P. occidentalis, P. phaceliae, P. texanus, P. vespoides and P. zonalis; and

one species of Gayella: G. eumenoides.

Nest Type 5 - constructed cells located in a pre-existing cavity; soil for cell construction is collected from a quarry site at some distance from the nest:

one species of Celonites: C. wahlenbergiae.

Nest Type 6 - a self-excavated sloping burrow in friable soil with an excavated cell in which is an earthen cell constructed from soil collected from a quarry site at some distance from the nest:

one species of Celonites: C. latitarsis.

Nest Type 7 - a sub-vertical silk-lined burrow in friable soil, surmounted by a silk and sand turret and having an excavated cell in which is a constructed sand and silk cell:

one species of Quartinia: Q. vagepunctata.

Ground nesting has been recorded for an additional ten species: Paragia (Paragia) smithii; Rolandia maculata; Riekia sp.; Ceramiopsis paraguayensis; three species of Ceramius, Group 1 - C. fonscolombei and C. bischoffi, and Group 4 - C. beyeri; one species of Trimeria, T. buyssoni; Quartinia sp. and Quartinioides, however the observations are too incomplete for determination of nest type.

Nest characters can be used to test groupings based on morphological characters. For example, they can be applied to test the validity of the species groups within the genus Ceramius:

1 Excavated cells not containing constructed cells .... Group 8
- Excavated cells containing constructed cells 2

2 No cell terminating main shaft .... Group 5
- Cell terminating main shaft 3

3 Cells sub-vertical.. Group 3
- Cells sub-horizontal... 4

4 "Bulb" short, bottom end well above level of cells .... Group 2
- "Bulb" long, bottom end level with cells .... Group 6

Groups 1, 4 and 7 have been omitted as to date insufficient data have been recorded.

An interesting nest character is cell shape. The blind ends of the cells of Masarina familiaris are markedly truncate whereas the blind ends of the cells of the Paragia, Ceramius, Pseudomasaris, Jugurtia and Celonites species for which they are known are rounded. This together with the situation of the nests in vertical banks and the attachment of the egg sets the nests of Masarina apart from those of Jugurtia. Van der Vecht and Carpenter (1990) list, without giving reasons, Masarina as a junior synonym of Jugurtia. The ethological differences, particularly in cell shape and in attachment or not of egg, cast doubt on the validity of this synonymy.

Bonding agent

Three bonding agents, water, nectar, and silk, are known to be used by masarids in nest construction.

Use of water in excavation and as the bonding agent is either stated or implied in all nesting accounts of nest types 1, 2 and 3. In addition the inner surfaces of the cells of Trimeria howardi are polished (Zucchi et al.) and those of Paragia (P.) tricolor are polished and waterproofed (Houston, 1974) with unidentified substances.

Nectar is the proven bonding agent employed by Pseudomasaris edwardsii of Nest Type 4 (Torchio 1970). Circumstantial evidence furthermore suggests that nectar is used by Celonites of Nest Types 4, 5 and 6 (Gess and Gess, 1992).

The use of self-generated silk sets Nest Type 7, as exemplified by Quartinia vagepunctata, apart from all the others (Gess and Gess, 1992). The use of silk in nest building by wasps seems to be altogether uncommon. It has been noted for two eumenids, one ground nesting (Gess and Gess, unpublished fieldnotes) and one nesting in pre-existing cavities (Weaving, pers. comm.), and has been recorded for two social pemphredonids, one constructing aerial nests, Microstigmus comes Krombein (Myers, 1934, Matthews and Starr, 1984) and one nesting in pre-existing cavities, Arpactophilus mimi Naumann (Matthews and Naumann, 1988). The adult pemphredonids secrete the silk from glands near the tip of the metasoma. Adult Q. vagepunctata observed appeared to produce silk from their mouths and it is suggested therefore that silk is most probably produced by the mandibular glands.

Using nectar or silk as a bonding agent frees the user from dependence on water, an often ephemeral resource in arid areas. The use of silk furthermore makes it possible for the users to construct nests in and with friable soil which otherwise becomes readily unstable under dry conditions.

Method of excavation

In the first three nest types water is carried from a water source in the crop. On arrival at the nest it is regurgitated and worked into the soil with the mandibles to form mud. The spoils of excavation are removed with the mandibles in the form of mud pellets which are either discarded, used for the construction of a turret or for the construction of cells.

In Nest Type 6, as exemplified by Celonites latitarsis, the burrow is excavated in friable soil. Water is not used and the spoils of excavation are raked out and accumulate to form a tumulus. This is of particular note when the structure of the fore tarsi of C. latitarsis is compared with that of ten other Afrotropical species of Celonites (Gess, 1992). Of those species compared, only C. latitarsis has widely expanded tarsomeres suitable for raking soil, which suggests that its nest type may be unusual for Celonites.

Sand raking seems to be unusual not only for masarids but for Vespoidea as a whole. Furthermore it seems that nesting in friable soil in the Vespoidea is probably derived rather than primitive as it is in the Sphecoidea and Pompilidae. Apart from C. latitarsis none of those species known to excavate nests in friable soil has fore tarsal sand rakes as possessed by many ground nesting Sphecoidea and Pompilidae. Soil removal is effected by the mandibles as in those species excavating in non-friable soil. For example Pseudepipona herrichii (Saussure), a eumenid nesting in a vertical burrow in friable ground, removes sand particles with the mandibles one at a time (Spooner, 1934 as in Spradbery, 1973). The only recorded morphological modification for sand removal is that of the mouthparts of Pterocheilus (Bohart, 1940) for which nesting in vertical burrows in friable soil by two species has been recorded (Isely, 1914; Evans, 1956). Amongst the masarids turretless inclined burrows excavated in sandy ground have been recorded for an undescribed species of Riekia and for Rolandia maculata (Houston, 1984) and for Masaris vespiformis (Morice, 1900). Unfortunately the method of excavation was not noted and the nests were incomplete.

Not only is the substrate and the method of excavation of the burrows of Nest Type 6 very different in nature from that of Nest Type 3 but, as importantly, so is the nature of and method of construction of the cells. Whereas the earthen cells of Nest Type 3 are constructed from soil quarried within the burrow and bonded with water those of Nest Type 6 are constructed from soil quarried at some distance from the burrow and bonded not with water but most probably with nectar. The method of construction and nature of the earthen cells of Nest Type 6 as exemplified by C. latitarsis in no way differs from that of Nest Type 5 as exemplified by C. wahlenbergiae nesting in pre-existing burrows and that of Nest Type 4 as exemplified by the aerial nesting Celonites species.

Evolutionary sequence

A possible evolutionay sequence is discernable within the Masaridae from excavated burrows with excavated cells only (Nest Type 1) through excavated burrows with constructed earthen cells within excavated cells with earth for construction being derived from within the burrow (Nest Type 3) to the presumably more advanced construction of aerial earthen cells (Nest Type 4) (discussed in Gess and Gess, 1980).

A further possible sequence, within the genus Celonites, has been suggested (Gess and Gess, 1992); that is, a return to the ground from aerial constructed cells (Nest Type 4) through constructed cells in pre-existing cavities in the ground (Nest Type 5) to self excavated burrows with constructed cells within excavated cells with earth for construction being mined outside the burrow (Nest Type 6). This second sequence is based on the method of construction of Nest Type 6: notably the sand raking behaviour with the consequent possession of sand-rakes as yet not recorded for any other masarids; soil for cell construction being obtained from a site at some distance from the nest not from within the nest; and the bonding agent being nectar as used in Nest Type 4 and 5 not water as is used in Nest Type 2.

Nest Type 7, in which self generated silk is used for bonding, is distinct and is possibly derived from a vertical burrow excavated in stable friable soil without the use of a bonding agent.

When the proposed phylogeny of the Masaridae (Carpenter, pers. comm., introduction) together with the present knowledge of nesting are considered it is immediately apparent that construction of aerial earthen cells, Nest Type 4, has evolved independently at least three times, once in the the Gayellinae and twice in the Masarinae, in the Pseudomasaris and Celonites lines.

6 Associates

The associates of masarids considered are those arachnids and insects which are ectoparasites, endoparasites, "parasites" in nests, scavengers in cells, nest usurpers, and predators.

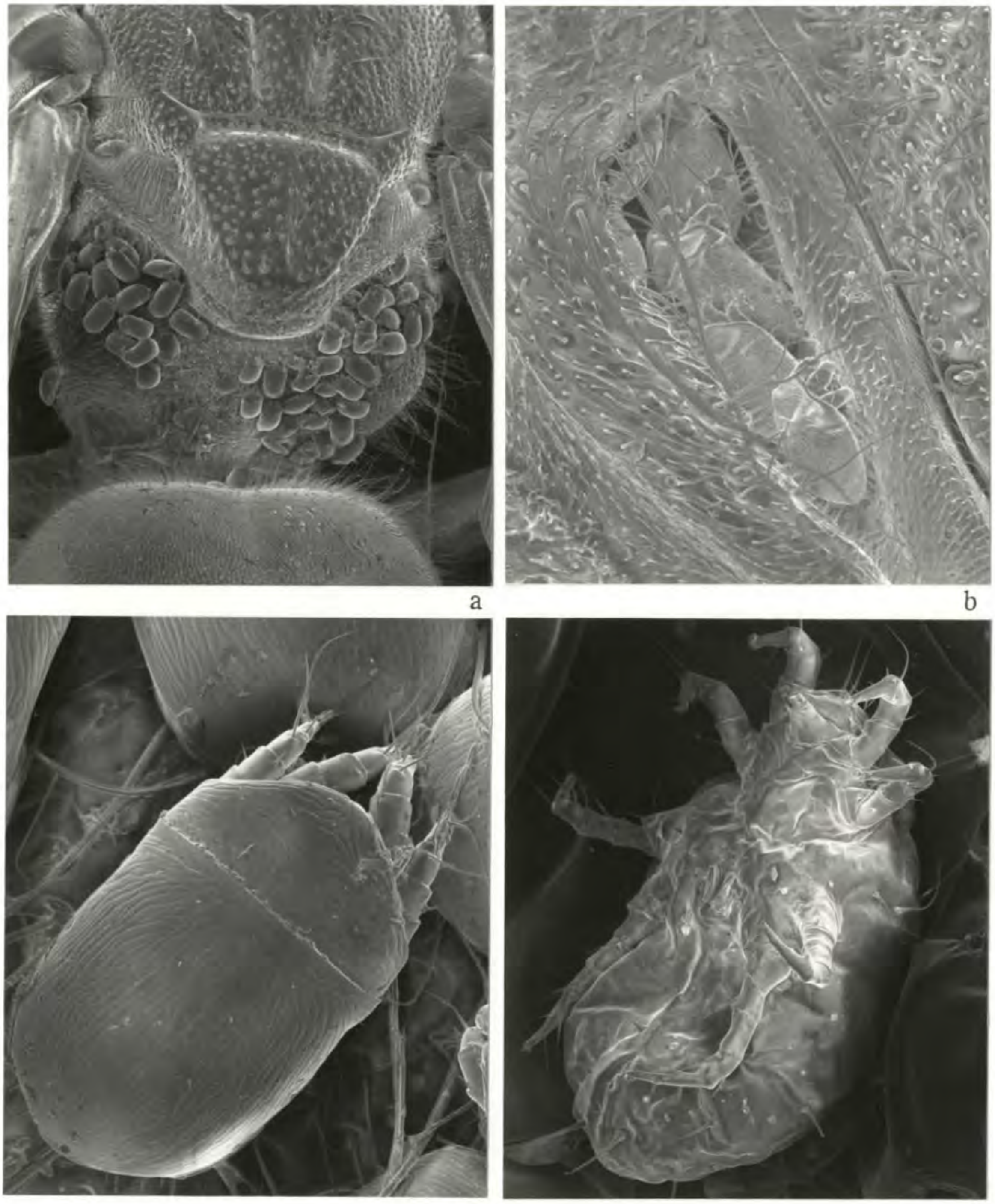
Masarid nests, when unattended, are open to intruders for, unlike many sphecoid wasps, masarids do not close their nests when leaving them. Females and those males which practise nest guarding do, when present in or near their nests, attempt to drive off intruders. They are, however, ill equipped for defensive action and are ineffectual against a persistent intruder.

The construction of a curved entrance turret, as practised by many ground nesting species, may offer some sort of protection. Certainly it effectively conceals the nest from some intruders, such as some bombyliid flies which are known to seek host nests in flight and to oviposit into a dark hole (Evans and Eberhard, 1970 and Linsley et al., 1980).

Ectoparasites

Acarina

Mites (Acarina) associated with adult masarids have been recorded only for Ceramius species (Richards, 1962 and Gess 1965 and 1968). In the present study an examination of all the southern African genera of masarids revealed an association of mites with Ceramius alone. The presence of a pair of acarinaria positioned laterally on the metanotum of C. caffer and C. metanotalis was noted by Richards (1962) and of C. rex by Gess (1965) (Fig. 48 b). In the specimens examined by Richards only the acarinaria of C. caffer contained mites, however, Gess (1965) observed mites in the acarinaria of all three species. In addition Gess noted that a female of C. richardsi, though like the rest of the Ceramius species it does not have acarinaria, carried mites on the axillae and in the lateral depressions



a b c d

Fig. 48 a - d. Mites associated with Ceramius species: (a) hypopi on an adult female C. nigripennis, a species which does not have acarinaria (x 20); (b) hypopi in one of the pair of acarinaria of an adult female C. rex (100); (c) hypopus on an adult female C. nigripennis (x 250); (d) hypopus on a prepupa of C. rex (x 100).

of the metanotum. Gess (1968) noted, in addition, mites similarly located on C. cerceriformis and C. nigripennis (Fig. 48 a). In the present study 1 983 individuals, representing 18 of the 19 species of southern African Ceramius were examined for mites (Table 11). It was established that all species of groups 3 and 6 (all of which provision with composite pollen) carry mites and that all species of groups 5 and 8, and C. beyeri, the only species of Group 4 available, (all of which provision with mesem pollen) lack mites. Group 2 with the closely allied C. micheneri is less clear cut. C. cerceriformis (which provisions with mesem pollen), C. clypeatus and C. richardsi (which provision with papilionate pollen) carry mites but C. peringueyi (which forages on mesems) and C. micheneri (which provisions with papilionate pollen) do not.

Cocoons containing fully grown larvae of C. nigripennis of Group 3 and C. rex of Group 6 were opened and examined for the presence of mites. They were found to contain mites identical with those carried by the adults (Fig. 48 d).

Mites from the adult Ceramius and from last instar resting larvae (prepupae) were all hypopi (= heteromorphic deutonymphs) and apparently all of the same species (P.D.Theron, pers. comm.). They were identified as Acaroidea probably of the family Saproglyphidae (P.D.Theron, pers. comm.).

Saproglyphid mites are cosmopolitan and are richly represented in temperate or tropical zones of both hemispheres (Mostafa, 1970). Some are free living on dead, decaying organic material, however, the majority are insect associates living in the galleries of bark beetles and in the nests of solitary bees and wasps (Mostafa, 1970). The association with bees and wasps may be parasitic or symbiotic, the mites either sucking blood from but not harming the wasp prepupae and pupae or feeding on organic debris in the cells (Krombein, 1967). The developmental stages of these mites consist of the egg, larval, nymphal and adult stages ordinarily found in other mite groups. The larva, protonymph, tritonymph and adult have functional mouthparts but the hypopus (deutonymph) is a resting stage which lacks mouthparts and has a suctorial plate ventrally on the opisthosoma (Mostafa, 1970). Hypopi of many saproglyphids are phoretic on insects (Krantz, 1978) to which they attach themselves with their suctorial plates.

Many saproglyphid mites are related in their mode of living to the insects with which they are associated (Woolley, 1989). Some have developed a very complex symbiotic relationship with solitary vespoids (Krombein, 1961). Krombein's account of the life history of saproglyphids associated with vespoids is based on studies of the mites Vespacarus and Monobiacarus. The rythmic pulsation of the

Table 11. Incidence of adult carriage of mites by southern African Ceramius species.

Ceramius spp.	present study: no. examined		present study: no. with mites		Gess 1965 + 1968: no. examined		Gess 1965 + 1968: no. with mites	
	F	M	F	M	F	M	F	M
GROUP 2A								
cerceriformis	70	20	37	2	30	9	19	1
peringueyi	14		0					
GROUP 2B								
clypeatus	109	30	24	1				
richardsi	2		2		6	2	4	0
GROUP UNCERTAIN								
micheneri	16	28	0	0				
GROUP 3								
nigripennis	128	36	107	2	64		21	
toriger	48	23	42	0				
braunsi	120	10	23	0				
jacoti	28	6	1	3				
GROUP 4								
beyeri	17	1	0	0				
damarinus								
GROUP 5								
lichtensteinii	199	61	0	0				
GROUP 6								
caffer	1		0		28	3	28	3
metanotalis	18	6	18	3	27	3	6	0
rex	34	13	34	7	1		1	
GROUP 8								
bicolor	79	57	0	0				
linearis	149	215	0	0				
capicola	209	154	0	0				
socius	54	28	0	0				

Richards 1962 for Ceramius caffer		no. examined	no. with mites
	F	8	3
	M	8	2

wasp's abdomen during movement of the egg from the oviduct prior to oviposition may be the signal for as many as 20 hypopi to leave the wasp's body and drop off in the cell. The transformation of the mites to the tritonymphal and adult stages takes place in the interval of a few days between oviposition by the wasp and completion of feeding by the wasp larvae. The adults are on the wasp larva as it begins to spin, and they are enclosed in the finished cocoon. They begin to feed on the wasp larva as soon as it has voided the meconium and has assumed the quiescent form. In heavy infestations by saproglyphid mites the resting wasp larva is literally peppered with tiny black feeding punctures. However, Krombein never observed that this feeding was injurious to the wasp.

The engorged adult female mite ceases feeding and begins to lay eggs as soon as the wasp transforms to the pupal stage. The mites' larval and protonymphal stages are passed on the pupa over which they wander more or less freely. Most of the mites are in the protonymphal stage when the adult wasp is ready to shed the pupal exuviae. As eclosion draws near, the mites cluster on the venter of the wasp around the mouthparts and legs. They are shed along with the pupal exuviae and in a brief time transform to the deutonymphal state (hypopus). Those of Vespacarus leave the pupal exuviae and clamber onto the tip of the wasp's abdomen and crawl forward until they reach the apical margin of the depressed acarinarium. They then turn around and back into the acarinarium.

It seems likely that the saproglyphid mites associated with Ceramius species will be found to have a similar life-cycle. However, the hypopal stage appears to be reached earlier in the life-cycle of these wasps, hypopi having been found on last instar resting larvae (prepupae).

Endoparasties

Strepsiptera

The order Strepsiptera comprises a small number of very anomalous insects, the larvae of which are endoparasitic. They are sometimes classified as Coleoptera (Crowson, 1981). The majority of females remain all their lives in a puparium which protrudes slightly from the body of the host. The adults are termed "stylops" and an insect bearing these parasites is said to be "stylopized". They have been recorded from Thysanura, Blattodea, Mantodea, Orthoptera, Hemiptera, Diptera and aculeate Hymenoptera (Kathirithamby, 1991).

Gess (F.W., pers. comm.) in examining in excess of 4 500 Afrotropical masarids found none which had been stylopized. The Australian Paragia (P.) decipiens is in fact the only masarid which has been recorded as being stylopized. Records were given by Richards (1962) and by Naumann and Cardale (1987) and in addition specimens of P. decipiens in the South African Museum were noted by Gess (F.W., pers. comm.) to be stylopized. In their sample of Paragia (P.) decipiens Naumann and Cardale found that 25 percent (n = 24) of adult females and 13 percent (n = 54) of adult males were stylopized. Riek (1970) gave the identity of the strepsipteran associated with P. decipiens as a species of Paragioxenos of the family Stylopidae.

Richards (1962) observed that, of the 13 male and 6 female parasites he recorded, the males were beneath tergite 3 and the females beneath tergite 4 and that a parasitized female Paragia acquires male characters. A male is less altered but the tubercle of sternite 2 is reduced.

"Parasites" in nests

"Parasites" recorded from masarid nests are species of Chrysididae, Mutillidae, Gasteruptiidae, ?Chalcididae, Meloidae and Bombyliidae.

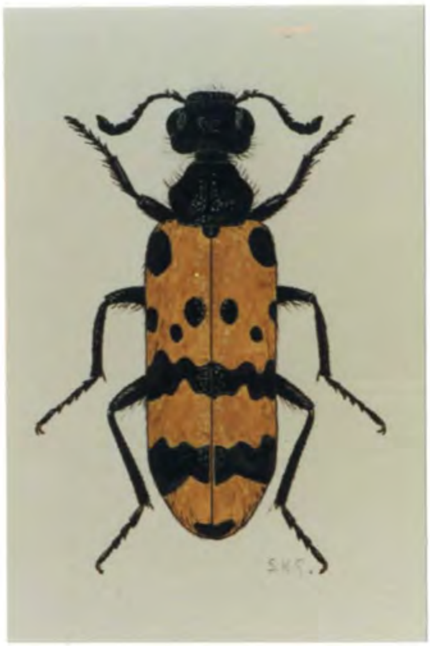
Mutillidae

Mutillids, commonly called Velvet Ants, are larval ectoparasitoids of terrestrial immatures of other insects -fully fed larvae or pupae of a wide variety of bees and wasps within cells and/or cocoons; the puparia of some flies; the pupae of some moths; the pupae of some beetles; and the oothecae of cockroaches having been recorded (Brothers, 1989). Typically the female mutillid penetrates the cocoon or puparium with its ovipositor and deposits an egg or eggs either on the host or the inner wall of the cocoon (Mickel, 1928). Up to four individuals are known to develop on a single host (Brothers, 1984). Any one species of mutillid is not necessarily limited to a single species or genus of host. Rather, they appear to be associated with a particular ecological niche and to attack suitable host species found within that niche. For example Dasylabroides caffer (Kohl) (Figs 49 a and b) has been reared from cocoons of a masarid wasp Ceramius lichtensteinii (Gess and Gess, 1980) and also from cocoons of two sphecid wasps, Ammophila ferrugineipes Lepeletier and Ammophila insignis Smith (Weaving, pers. comm.). Additional records of mutillid/masarid associations are Stenomutilla argentata (Vill.) as a probable "parasite" of Masaris vespiformis (Ferton, 1920) and

a

b

c



d

Fig. 49 a-d. Nest "parasites": (a and b) Dasylabroides caffra (Mutillidae), a. female and b. male; (c) Allocoelia capensis (Chrysididae: Allocoeliini); (d) Ceroctis groendali (Meloidae). (all x c 5).

Photopsis sp. as a parasite of Pseudomasaris edwardsii (Hicks, 1929 as in Richards, 1962).

Chrysididae

All species of chrysidids, commonly called cuckoo-wasps, are "parasitic". The nature of the host is practically a subfamilial character in Chrysididae. Thus, Amiseginae and Loboscelidiinae attack stick insect eggs, Cleptinae sawfly pupae, and Chrysidinae (except Praestochrysis) aculeate wasp and bee larvae (Kimsey and Bohart, 1990). Some of the Chrysidinae monitor the nests of their hosts and at the stage when a cell has received an egg and provision enter and oviposit and others break into closed cells or dig through closed entrances in order to oviposit (Evans and Eberhard, 1970). In the former the egg hatches before or after that of the host and having found the egg or small larva of the host the chrysidine destroys it and consumes the provision (Krombein, 1967 and Evans and Eberhard, 1970). In the latter there is reason to believe that it may be the fully grown larva and not the provision which is consumed (Evans and Eberhard, 1970).

Kimsey and Bohart (1990) record the chrysidine genera Allocoelia (Allocoeliini), Chrysis (Chrysidini), Chrysurissa (Chrysidini) and Spintharina (Chrysidini) to be associated with masarids.

Allocoelia of the monogeneric tribe Allocoeliini occurs in southern Africa, specifically in Namibia, Zimbabwe, and South Africa. Suggestive evidence for an association between Allocoelia and masarids is the fact that of the nine Allocoelia species seven have been found in association with masarid nests (Table 12) (Gess, 1973; Gess and Gess, 1980 and unpublished field notes) and have been seen to monitor nests which are being worked upon. Definite evidence is that one of these, A. capensis (F. Smith) (Fig. 49 c), has been reared from cells of Ceramius lichtensteinii (Brauns, 1910). The remaining two species occur within the distribution range of the masarids in the southwestern Cape and it seems probable that they will also be found to be associated with these wasps.

Two genera of Chrysidini, Chrysurissa and Spintharina like Allocoelia seem to be closely associated with the Masaridae. Chrysurissa densa (Cresson), the only described species of Chrysurissa, occurs in western North America. It has been reared only from the nests of Pseudomasaris species, specifically P. vespoides and P. edwardsii (as Chryis densa, Hicks, 1927 and 1929 respectively, cited in Richards, 1962), P. zonalis (as Chrysura densa, Parker, 1967) and P. occidentalis (as Chrysis densa, Hungerford, 1937, cited in Richards, 1962).

Table 12. Allocoelia species associated with masarid nests (Gess and Gess records except where otherwise indicated).

Allocoelia species	masarid species	locality
bidens Edney	Jugurtia confusa	Hilton, Grahamstown
capensis (F. Smith)	Ceramius lichtensteinii	Clifton, Grahamstown ? Willowmore (Brauns, 1910)
	Ceramius cerceriformis (as C. schulthessi)	? Willowmore (Brauns, 1913)
glabra Edney	Masarina familiaris	11 km W Clanwilliam
latinota Edney	Ceramius capicola	Strowan, Grahamstown
	Ceramius lichtensteinii	Tierberg, Prince Albert
minor Mocsary	Ceramius capicola	Strowan, Grahamstown
	Ceramius clypeatus	Clanwilliam Dam
mocsaryi (Brauns)	Quartinia vagepunctata	15 km N Nieuwoudtville
quinquidens Edney	Masarina familiaris	11 km W Clanwilliam

Kimsey and Bohart (1990) list 26 species of Spintharina, 14 Palaearctic and 12 Afrotropical, and note that most inhabit arid zones. In the Palaearctic Region S. versicolor (Spinola) is known as a parasite of Celonites sp. (Linsenmaier, 1959, as in Kimsey and Bohart, 1990). In the Afrotropical Region S. arnoldi (Brauns) has been reared from a putative nest of Celonites promontorii (Gess and Gess, unpublished fieldnotes) and S. bispinosa Mocsary (as Sintharis [sic] bispinosa) has been reared from cells of Celonites andrei (Brauns, 1913) and recorded as present in a nesting aggregation of Jugurtia confusa (Gess and Gess, unpublished fieldnotes).

Three species of Chrysis have been recorded as parasites of masarids: C. tingitana Bischoff of an unidentified masarid (Linsenmaier, 1959 as in Kimsey and Bohart, 1990); C. emarginatula Spinola of Ceramius lusitanicus (Ferton, 1901); and C. splendidula Rossi (as C. versicolor Spinola) of Celonites abbreviatus (as C. apiformis) (Berland and Bernard, 1938 as in Richards, 1962). Species of the large and widely distributed genus Chrysis of about 1000 species have otherwise been recorded as "parasites" of a wide range of wasps and bees of the families Sphecidae, Larridae, Philanthidae, Eumenidae, Megachilidae, and Anthophoridae (Kimsey and Bohart, 1990).

?Chalcididae

An unidentified chalcid has been recorded from the nest of Pseudomasaris edwardsii (Hicks, 1929, as in Richards, 1962).

Gasteruptiidae

Gasteruptiids oviposit into the nests of sphecoids, vespoids and bees where the larva feeds on the egg or larva and provision of the host (Gauld and Bolton, 1988).

Carinafoenus sp. has been recorded from the nesting area of Paragia (P.) tricolor and gasteruptiid larvae were found in three cells of this wasp (Houston, 1984). Houston concluded that the gasteruptiid, Carinafoenus sp. evidently develops on the provision of Paragia, probably after the destruction of its eggs. Several observations have been made of another gasteruptiid, Hyptiogaster sp., entering nests of Paragia (P.) decipiens (Naumann and Cardale, 1987).

Meloidae

As far as is known, all meloids show hypermetamorphosis, with an egg, a very active first instar larva (triungulin), three fleshy grublike feeding stages (caraboid and two scarabaeoid), two non-feeding stages (coarctate (pseudo-pupal) and scolytoid) and a pupa (Clausen, 1940). The triungulins are broadly divisible into two types, non-phoretic and phoretic (Crowson, 1981 and MacSwain, 1956). A non-phoretic triungulin has "running" legs and finds its own way to its host's nest or egg-burrow whereas a phoretic triungulin has "clamp-like" legs with which to attach itself to its host, which then carries it to its nest. The adults are flower feeders and the larvae of in excess of 76 species feed on acridid eggs (Greathead, 1963) and in excess of 34 species on the provision laid in by bees, Megachilidae, Andrenidae and Anthophoridae (Xylocopinae) (Krombein et al., 1979; Watmough, 1974; and Gess, 1981). The larvae of a few species are known to feed on the larval provision and larvae of aculeate wasps, one larrid (Fabre, 1943), two eumenids (Gess and Gess, 1976 and 1991) and one masarid, Ceramius lichtensteinii (Brauns, 1910 and Gess and Gess, 1980). Brauns found the coarctate larvae or pupae ("Puppen") of a meloid in the masarid wasp's cells but was unable to identify them as he was unable to rear them through to the adult stage. Gess and Gess found two adult specimens of Ceroctis groendali (Billberg) (Lyttinae: Mylabrini) (Fig. 49 d) and six meloid larvae in various stages of development in cells of C. lichtensteinii (Table 13). Though rearing these larvae was attempted none came through to the adult stage which would have proved their identity. It is, nevertheless, believed that they were conspecific with the adults.

The triungulin larvae from cells of C. lichtensteinii have "running" legs. Their association with their masarid host is consequently not brought about by chance collection of phoretic triungulins which wait in flowers for visiting bees.

The fourth instar larva of some species is known to migrate and to prepare a pupal cell apart from the host's nest-cell or egg-burrow (MacSwain, 1956), however, the complete development of the beetle after the larva has reached a cell of its masarid host takes place within that cell. Migration is probably precluded by the non-friable nature of the cell wall and of the soil in which the masarid nests are constructed.

It was established that the meloid larvae feed upon both the provision and the larva of the masarid.

Bombyliidae

The majority of bombyliids are in the larval stage "parasitic" on the eggs, larvae or pupae of other insects Bowden (1980) and are well known from the nests of wasps (Evans and Eberhard, 1970) and bees (Linsley et al., 1980). It is therefore

Table 13. Contents of cells of Ceramius lichtensteinii in which four meloid larvae were found.

meloid larval stage	masarid egg or larval stage	state of masarid pollen loaf
triungulin - moulted and died	egg near hatching	being fed upon
probably first scarabaeoid - fed and moulted three times to coarctate resting stage	large pre-spinning larva killed and eaten	finished
second scarabaeoid - died	none	being fed upon
second scarabaeoid - died	small, dead	being fed upon

surprising that no bombyliids have been reared from the nests of masarids, however, several observations have been made of Anthrax sp. entering nests of Paragia (P.) decipiens (Naumann and Cardale, 1987).

Scavengers in cells

Acarina

Eggs, nymphs and adults of a mite, Tyrolichus casei Oudemans (Acaridae), a pest of stored products, were found in a cell of Paragia (P.) tricolor (Houston, 1984). No host immature was present.

Nest usurpers

Megachilidae

In southern Africa ground nesting masarids are subject to usurpation of nests by megachilid bees. Megachile aliceae Cockerell has been recorded from nests of Ceramius nigripennis in the Springbok district, Namaqualand (Gess and Gess, 1986) and of Ceramius braunsi in the Clanwilliam district, Olifants River Valley (Gess and Gess, 1990), an undetermined megachilid from nests of Ceramius jacoti in the Oudtshoorn district, Little Karoo (Gess and Gess, 1988b), and a species of Hoplitis from nests of Masarina familiaris in the Clanwilliam district (Gess and Gess, 1988a). M. aliceae is not restricted to usurping the nests of masarids having been recorded usurping nests of Parachilus insignis (Saussure) (Eumenidae) in the Grahamstown district, eastern Cape (Gess and Gess, 1976) and of Paravespa mima Giordani Soika (Eumenidae) in the Prince Albert district, southern Great Karoo (Gess and Gess, 1988c).

It was the activity of the bee, M. aliceae, which originally drew attention to the presence of a C. nigripennis nesting aggregation. Several of these bees were harassing the wasps which had clearly just started nesting as all were constructing turrets. Three days later 15 turreted nests were investigated and of these three contained M. aliceae cells. In two of these nests the bee had made use of the cell from which the wasp had emerged. In both instances it was clear that the wasp had been evicted as the bee had sealed the main shaft a short way below ground level. The third nest was newly excavated and contained a single newly constructed mud-cell in which the bee had constructed her own cell. The bee had not yet sealed her cell and was found in the nest. In addition two nests from which no wasp had yet emerged in the present season were investigated. Both contained M. aliceae cells. Three of eight nests of C. braunsi investigated contained a petal-cell. All of the nests were new and one-celled. Two were closed with a final bee seal but in each of the other two, in which the petal-cells were still being constructed, a female M. aliceae was found in the nest.

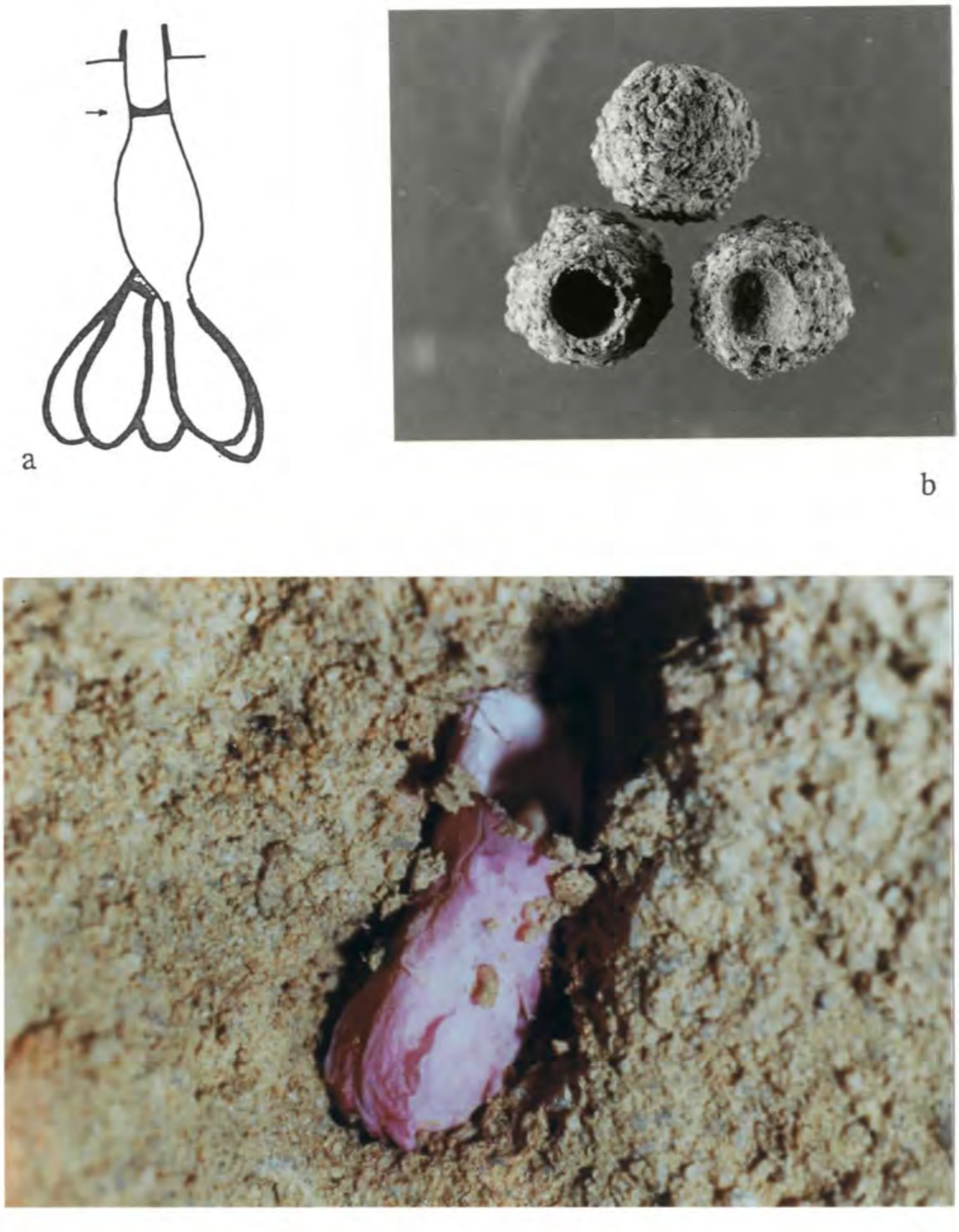
The bee constructs its flask-shaped petal-cells within the masarid's cells in such a way that it entirely fills the latter. The petal-cells from C. nigripennis nests were all constructed from lengths cut from the orange "petals" of the Namaqualand Daisy, Dimorphotheca sinuata (Asteraceae) and three of those from C. braunsi nests from the pink petals of a species of Pelargonium (Geraniaceae) (Fig. 50 c). The "petal" pieces are carried to the nest cut-end first. They are arranged in such a way that a round bottomed "flask" is constructed with the "petals" running vertically and tucked under at the bottom.

The provision is syrupy. The pollen from provision, a mixture of pollen and nectar, from both sites was examined and found to be a mixture derived from two or more plant species. It was compared with pollen from plants flowering in the vicinity of the nests. One of the pollens was found to be from a yellow flowered species of Homeria (Iridaceae), another was of the spiny composite type and three others were probably from "mesems". Pollen from D. sinuata and the Pelargonium species were examined but did not match any of the pollen derived from the bee's cells. Pollen for provision was therefore collected from different plants from those from which nesting materials were taken.

A cell, after provisioning and oviposition have taken place, is sealed using shorter pieces of "petal" laid cross-wise across the mouth of the petal-cell with the ends curved upwards into the mouth of the wasp's mud-cell which is then sealed with a mud-plug, concave above and with a smooth surface. Sealed mud-cells containing bee-cells are readily distinguishable from sealed cells of C. nigripennis, the mud-plugs of which are convex above and with the surface left rough (Fig. 50 b).

The bee constructs a final closure in the main shaft about 5 mm below the ground surface (Fig. 50 a). This closure consists of a short length of "petal" laid across the shaft followed by a layer of mud, concave above with the surface smoothed.

The megachilid which had invaded a C. jacoti nest had constructed a leaf cell within the nest.



a b c

Fig. 50 a - c. (a) vertical plan of nest of Ceramius nigripennis usurped by Megachile aliceae showing position of final bee seal; (b) three earthen cells of Ceramius nigripennis, above - convex seal of C. nigripennis, below left - open cell, below right - concave seal of Megachile aliceae; (c) cell of Megachile aliceae constructed from petal pieces, cut from flowers of Pelargonium sp. (Geraniaceae), in earthen cell of Ceramius braunsi.

A species of Hoplitis was seen in attendance at two nests of M. familiaris. One nest was an old two-celled nest which lacked a turret but the other was a newly constructed four-celled nest which was being attended by its wasp builder in addition to the bee usurper.

The wasp cells utilized by the bee had been widened by the latter prior to the construction of its petal-cells. The petals utilized were those of a purple flowered species of Cyanella hyacinthoides (Amaryllidaceae) which was growing in the vicinity. After a petal-cell had been sealed with pieces of petal the excavated cell had been sealed with compacted soil.

Pollen from the provision, a mixture of pollen and nectar, was examined and found to be a mixture derived from three or more plant species. Pollen from C. hyacynthoides was examined but did not match any of the pollen derived from the bee's cells. Pollen for provision was therefore collected from different plants from that from which nesting materials were taken.

Predators of adult masarids

There are no records of predators which prey specifically on masarids. Masarids, however, have been listed as prey of two sphecoids which provision with mixed hymenopteran prey. Ceramius capicola has been recorded as prey of Palarus latifrons Kohl (Larridae) in southern Africa (Brauns, 1911) and two Pseudomasaris species, P. edwardsii and P. zonalis, have been recorded as prey of Philanthus zebratus (Cresson) (Philanthidae) in Wyoming, U.S.A. (Evans, 1970 and Evans and O,Neill, 1988).

Although not recorded, it is highly likely that birds, robber flies (Asilidae), assasin bugs (Reduviidae), mantids (Mantodea) and crab spiders (Thomisidae) which prey upon flower visiting insects include masarids in their captures.

It seems likely that the fully grown larvae and the stored pollen and nectar provision are a food resource for some small mammals. Certainly empty broken earthen-cells of Ceramius species have been found scattered on the ground in nest aggregation sites which showed signs of the diggings of some small animal (Gess and Gess, unpublished fieldnotes).

SECTION 2:

Masarids as potential pollinators, and masarids and landuse in southern Africa

7 Masarids as potential pollinators

Studies of aculeate Hymenoptera as pollinators have been concerned in the main with bees. General works on pollination such as Percival (1969), Proctor and Yeo (1973), Richards (A.J., 1978), Faegri and van der Pijl (1979), Jones and Little (1983), Real (1983), and Barth (1985) have few references to flower visiting by any aculeate wasps. Masarids are mentioned only in Proctor and Yeo (pages 367-368), Jones and Little (in Chapter 6 by Simpson and Neff, page 148) and Barth (pages 33 and 61). Vogel (1954) in his study of the pollinators of the southern African flora surprisingly makes no mention of masarids, however, Whitehead et al. in Rebelo's (1987) preliminary synthesis of pollination biology in the Cape flora state that masarids "are probably important floral visitors in southern Africa" but give no indication of masarid/flower associations although flower visiting records were available to them in Gess (1968 and 1973) and Gess and Gess (1980 and 1986).

Richards (O.W., 1962, pages 32-34) in his world revision of the Masaridae reviewed the literature on flower visiting by these wasps and concluded that "higher masarids are so closely attached to particular kinds of flowers that the subject cannot be omitted from any serious study of the group though our knowledge is still very incomplete and inaccurate. It may well be possible in the future to relate the structure of some of the genera to that of the flowers they visit and to the methods they use in exploiting them." This conclusion is not directly supported by Richards but appears to be based on Cooper's (1952) contention that most Pseudomasaris species for which flower associations were known were essentially oligolectic and on his own statement based on the scant records available to him that in the Quartinia group nearly all species favour Asteraceae (as Compositae).

Torchio (1974) investigated the potential of Pseudomasaris vespoides as a pollinator of Penstemon (Scrophulariaceae) showing that wasp/flower fit and wasp behaviour do support such a potential relationship with some violet flowered Penstemon species. Blue flowered species he considered to be bee pollinated and red flowered species to be bird pollinated.

Gess and Gess (1989) presented a preliminary investigation of flower visiting by masarids in southern Africa. They demonstrated high percentage associations of masarids with Asteraceae and Aizoaceae and in addition marked but lower percentage associations with Papilionaceae, Campanulaceae and Scrophulariaceae, and a high incidence of oligolecty. The high incidence of oligolecty is a measure of the importance of the plants to the masarids. It is not, however, necessarily a measure of the importance of the masarids as pollinators of the flowers which they visit. This chapter attempts to evaluate the potential of masarids as pollinators and their possible importance as such to the plants with which they are associated.

For a flower to be pollinated by a visitor that visitor must receive pollen from a flower in such a position that when it enters a conspecific flower with a receptive stigma some of that pollen is transferred to the stigma. For this to be successfully achieved the visitor must in all but "mess" pollinated flowers follow a regular pattern of behaviour and "fit" the flower. Gess and Gess gave examples of masarids which do fulfil these requirements.

The present chapter explores in greater depth the flowers visited by masarids and attempts to evaluate comparatively their insect visitors as potential pollinators. The flowers will be considered in the context of the groups to which they belong, however, it is necessary to preface these accounts with a consideration of some of the requirements of pollinators.

Clearly the assumption of Whitehead et al. (1987) that "The nine families of bees occurring in southern Africa are all **important pollinators** of the local flora, **since they require pollen** as a protein source for their progeny" is illogical (highlighting in bold that of present author). It is essential that a pollinator should transport pollen, however, the potential of an insect as a pollinator cannot be judged by its pollen requirements. The pollen which is deliberately collected by masarids and bees and stowed away for transport by ingestion into the crop (masarids and some colletids) or packed into external pollen carrying structures (most bees) is not available for pollination. The pollen which brings about pollination is free pollen which adheres, usually accidentally, to the carrier not pollen collected for provisioning. Pollen which is free for pollination is just as likely to be collected and transferred by an insect collecting nectar as by an insect collecting pollen.

Indeed this transfer is most frequently performed by insects seeking nectar rather than pollen (Kevan and Baker, 1983). In order to achieve cross pollination there must be movement between flowers. This is achieved if the nectar produced is enough to attract but not enough to satisfy (Kevan and Baker, 1983).

If the insect positions itself randomly the chance of pollen being successfully transferred will also be random and the chances of its pollinating the flower will be random. If, however, the insect positions itself regularly and this positioning is such that successful pollen transfer is brought about then the chance of its pollinating the flower will be high.

Insect size in relation to flower size is of variable importance. As with regularity of behaviour good insect/flower fit generally increases in importance with an increase in flower complexity. Gullet flowers and campanulate flowers, for example, require a snug insect/flower fit. A relatively small insect is able to enter and leave these flowers successfully obtaining nectar and pollen for its own use without necessarily receiving a pollen load or coming into contact with the stigma. A relatively over large insect on the other hand is not able to enter these flowers, however, if it has a long enough proboscis, it may be able to rob a flower of nectar without receiving a pollen load or coming into contact with the stigma. For successful pollination of papilionate flowers the size restraint is clearly not one of insect/flower fit in the sense of fitting snugly into the flower but of being of the correct size and weight to trip the mechanism which permits the release of the essential parts from the keel in which they are enclosed. A flower visitor which specializes in flowers of a particular taxon may due to size differences between flowers of different species, even of the same genus, successfully pollinate some and yet fail to pollinate others. Such species therefore have a mutualistic relationship with some of the flowers which they visit and yet their visits to other flowers are only of benefit to themselves.

Pollinators show varying degrees of dependability and insect pollinated flowers show varying degrees of specialization with respect to "acceptability" of insect visitors. One species of insect visiting only one species of flower (monolecty), the ultimate in dependability, is the exception. Oligolectic flower visitors are clearly more dependable than polylectic species as the probability of their choosing a particular species of flower is greater. Where only one of their preferred flower species occurs in an area where other plants not favoured are in flower they will clearly be expected and dependable visitors to that species. Such a plant may depend solely on the services of such an insect for pollination or may be serviced by a guild of oligolectic species which are themselves either related or not related.

They may even in addition be randomly serviced by polylectic species. Indeed generalist flowers which are pollinated randomly by a wide range of insects or at least a wide range of wasp and bee species may be amongst those plants favoured by oligolectic species. The evolutionary factors favouring specialist or generalist pollinators are not necessarily the same as those favouring specialist or generalist flowers (Kevan and Baker, 1983).

Care must be taken not to confuse monolecty and temporary fidelity. Some insect visitors having found a plant species in flower which proves to be a good resource show temporary fidelity to flowers of that species. When the rewards diminish such a visitor may transfer to flowers of an unrelated species to which it then shows temporary fidelity. Whilst working flowers of a particular species it may be servicing them more efficiently than a more dependable visitor. It may or may not be reliable on a year to year basis, however, and is even less likely to be reliable on a locality to locality basis.

There follows an evaluation of masarids as potential pollinators of the plants of the families Aizoaceae (just Mesembryanthema), Asteraceae, Papilionaceae (just Crotalarieae of the Cape Group), Campanulaceae and Scrophulariaceae most favoured by them in southern Africa. The evaluations take into account the biology of the flowers and compare the masarids and the other members of the flower visiting guilds, taking into account pollen carriage, pattern of and regularity of behaviour in/on flowers, flower fit, and dependability. The presentations for the Aizoaceae and Asteraceae are generalized. Those for the Crotalarieae are by flower genus demonstrating that a characteristic guild structure can be recognized at that level. Those for Campanulaceae and Scrophulariaceae are for flower genus and species as there are marked differences in guild structure at the generic and specific levels.

Aizoaceae

The family Aizoaceae has been variously delimited. In the present account the assessment of Bittrich and Hartmann (1988) is followed. The family is seen to consist of five subfamilies arranged in two groups: Aizooideae, Sesuvioideae, and Tetragonioideae forming one group without a formal taxonomic rank and name; Rushioideae and Mesembryanthemoideae forming the second group, named Mesembryanthema.

The non-Mesembryanthema are cosmopolitan in distribution. The distribution of Mesembryanthema is centred in southwestern Africa (Hartmann, 1991). As already noted (Chapter 3) there is a striking similarity between the overall distribution and areas of diversity richness of the Afrotropical masarids (Fig. 7) and Mesembryanthema (Fig. 24).

In the western Cape, particularly north of the Olifants River Mountains, with a high species diversity of both Mesembryanthema and masarids, the peak of the flowering period for some species of Mesembryanthema is from late September to late October. This coincides with the peak of the flight period for masarids as a group. The peak flowering time of other species falls either earlier or later. Many of those species of Mesembryanthema flowering earlier have their peak flowering times coincident with the peak of the flight period of Fidelia (Fideliidae). Whitehead (1984) recorded three species which are restricted to Mesembryanthema for obtaining both pollen and nectar. The lists of insects collected on early flowering Mesembryanthema in the Goegab Nature Reserve by Struck (1990) indicate that these species are in addition to fideliids patronized by a wide range of other bees, almost all polylectic species.

The Mesembryanthema are most strikingly separated from the other subfamilies by the possession of brightly coloured petaloid staminodes. Hartmann (1991) reviews the knowledge of their reproductive biology. She states that: "Most flowers are protandrous and open repeatedly by basal growth of the androecial elements. At the same time, the stigmata elongate, and later they spread. As a consequence, most flowers have a distinctive early male and later female phase. One of the most common patterns of development is that the stigmata (styles are very rare in Mesembryanthema) are at first shorter than the stamens. When the stamens wither, they collapse, and the elongating stigmas take a prominant place in the centre of the flower. At the same time the stigmas spread widely and present a conspicuously papillate surface which is also more intensively coloured than in the unripe green state."

Hartmann further states that "only a few data on the pollination of Mesembryanthema are available" and cites Vogel (1954), Gess and Gess (1989) and Liede (1990a and b). To this should be added the preliminary comments and list of insect visitors to selected species in the Goegab Nature Reserve given by Struck (1990).

Vogel (1954) recognized clear divisions of form, including six forms suited to Hymenoptera and others to Lepidoptera. His divisions are re-presented and amended by Hartmann (1991). The forms suited to Hymenoptera, that is the melittophilous forms, are characterized by an open presentation of large quantities of pollen in conjunction with hidden nectaries, diurnal opening of the flowers and bright shiny petaloid staminodes. These forms can be summarized as follows:

1. Stamen carpet flowers (Fig. 51)

The open flower is rather flat and almost saucer-shaped, the petaloid staminodes are much longer than the stamens. In the male phase the centre is completely filled by numerous stamens and an insect walking on a flower receives a coating of pollen ventrally. In the female phase the centre of the flower is occupied by the spreading stigmas. As pollen is no longer available it may well be that nectar production becomes important in this phase. It is assumed that pollen is transferred onto the stigmas from insects in search of nectar.

Stamen carpet flowers are widespread in the Mesembryanthema.

Genera included in the flower visiting catalogues (Appendices 1 and 3) are: Aridaria subg. Aridaria, Delosperma p.p., Drosanthemum (Fig. 51 b), Malephora, Leipoldtia, Mesembryanthemum and Carpobrotus.

2. Central cone flowers (Fig. 52)

In these flowers there are two kinds of staminodes. The larger outer ones are petaloid and open out horizontally and the inner ones surround the stamens in the form of a central cone. Differences in size determine the processes of pollen transfer.

2a. Small central cone flowers

These are small flowers (up to 20 mm in diameter) with low central cones of stamens which, according to Vogel (1954) and Hartmann (1991), only permit a visiting insect to insert its proboscis into the cone. They state that in the male phase the head of the insect makes contact with the pollen. To deliver the pollen in the female phase, the receptive parts of the stigmas must be placed in an equivalent position. This implies that the central cone is kept in its shape almost unaltered during the entire anthesis, the tips of the withering androecial elements curl up while the tips of the stigmas spread over them.

Genera included in the flower visiting catalogues (Appendices 1 and 3) are: Ruschia, Stoeberia (Fig. 52 b), Mestoklema, Polymita, Psilocaulon, Delosperma p.p., Prenia and Sphalmanthus.

2a. Large central cone flowers

These are large flowers (over 20 mm in diameter) which, according to Vogel (1954) and Hartmann (1991), have rather high central cones which the insects have to enter in order to reach the nectar.

Not represented in the catalogue.

3. Recess flowers

A recess or hidden cavity is developed in the centre of these flowers into which the visiting insects have to crawl in order to reach pollen or nectar. The insect when entering receives a coating of pollen all over. Delivery of pollen to the stigmas is left to chance, the probability of success being high.

Morphologically, the recess is formed by a more or less well developed hypanthium at the upper rim of which the nectary is placed. The petaloid staminodes spread out horizontally. The stigmas are reduced and are sometimes connate forming a cushion.

Not represented in the catalogue.

4. Cup flowers (Fig. 53) (This type has been added as it does not seem to be covered by the types described by Vogel, 1954 and Hartmann, 1991.)

In these flowers the receptacle is unusually wide. The petaloid staminodes are very numerous, in several series spreading in different planes. The stamens are at first inflexed and reach the stigmas, then erect and finally spreading, not forming a "carpet" but rather a loose "cup".

One genus is included in the flower visiting catalogue (Appendices 1 and 3): Herrea (Fig. 53 b).

a

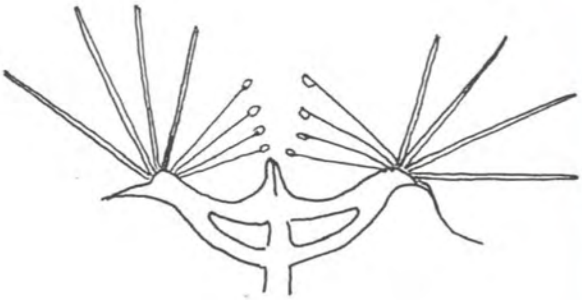
b

Fig. 51 a and b. Stamen carpet flower: (a) diagrammatic representation of longitudinal section; (b) <u>Drosanthemum</u> sp. being visited by <u>Quartinioides</u> sp. I (x c 2,7) .

a

b

Fig. 52 a and b. Central cone flower: (a) diagrammatic representation of longitudinal section; (b) <u>Stoeberia</u> sp. being visited by <u>Quartinioides laeta</u> (x c 3,8).



a

b

Fig. 53 a and b. Cup flower: (a) diagrammatic representation of longitudinal section; (b) <u>Herrea</u> sp. (x c 1).

When envisaging the behaviour of visitors to their flower types Vogel (1954) and Hartmann (1991) seem to have had in mind a "standard model" bee.

In the present study it has been established that in southern Africa 45% of masarids for which flower visiting records are available visit the flowers of Aizoaceae, principally of the group Mesembryanthema to which the majority is probably restricted. Clearly the oligolectic species, at least, are dependent upon Mesembryanthema. Masarids are expected and dependable visitors in the areas where and at the times when they are nesting. At some such sites and times they are furthermore the most abundant visitors to the stamen carpet and central cone flowers except for the dark centred deep purplish pink and the crimson flowered species. Deep purplish pink and crimson "mesem" flowers are most notably visited by monkey beetles (Scarabaeidae: Hopliini), Peritrichia species of the ursus group (referred to in Gess and Gess (1989) as species of Anisonyx, a closely related genus). The cup shaped flowers of Herrea species, which open in the afternoon, although visited by masarids, are more abundantly visited by colletid and halictid bees.

The manner in which the masarids behave on the "mesem" flowers is largely dependent both on the flower type and on the size of the flower in relation to the size of the wasp. Some examples will serve to clarify this point. Although large Ceramius species perch on the edge of small cone flowers and insert only the front of the head into the centre of the cone, very small masarids such as Quartinioides species enter the small cone flowers in the manner suggested by Vogel and Hartmann for large cone flowers. Furthermore although masarids which are small in relation to the size of stamen carpet flowers walk around over the anthers and become coated with pollen on the underside large species of Ceramius visiting these flowers "perch" on the side of the flower and only their heads are coated with pollen. Both are equally efficient potential pollinators as their behaviour is constant.

Asteraceae

The Asteraceae is a very large cosmopolitan family containing about one-tenth of the total number of flowering plants (Rendle, 1963). The following general account of inflorescence structure and flower structure and behaviour is unless otherwise credited derived from Rendle (1963).

The flowers of the Asteraceae, generally referred to as florets, are characteristically grouped in heads referred to as capitula. The capitulum is surrounded by few to many involucral bracts. In some species groups of heads are secondarily aggregated into cymose secondary heads (Fig. 55). The florets are generally sessile on a common receptacle. All or most of the florets of a head are bisexual or unisexual with the corolla regular, bilabiate or ligulate. The "daisy" head combines a majority of fertile regular flowers, the disc florets, and an outer "ring" of asexual ligulate florets giving the capitulum as a whole a flower-like appearance (Fig. 54). In some species, groups of capitula are secondarily aggregated into compound cymose heads.

The stamens are generally inserted on the corolla tube. The filaments are generally free and the anthers are united laterally to form a tube and are inwardly dehiscent. The ovary is inferior and the style slender divided at the top into two stigmatic lobes bearing hairs on the outer surfaces or at the tip. The style is generally surrounded at its base by a ring-like or shortly tubular nectary. As in the Campanulaceae the stigmatic lobes are at first closely applied face to face and are surrounded by the anthers. After anthesis the style elongates and the stigmatic head, which is hairy on its outer surface, carries the pollen aloft. Later the stigmatic lobes open exposing their receptive surfaces. In some species in the absence of insect-visitors self-pollination is achieved by the stigmatic lobes curving backwards till the receptive surfaces come into contact with the pollen. To a great extent the power of self-pollination has been lost.

Response to tactile stimulation by the anther-tube is common. In response the anthers contract and squeeze some pollen out at the upper end. Small (1915) recorded such sensitivity to touch in 253 of 360 species and varieties examined, amongst which were represented all the tribes and the majority of the subtribes. In the majority there was in addition to the presentation of pollen a lateral movement of the pollen tube towards the touch. Irritability of the style has been recorded for three genera of the tribe Arctotidae of southern Africa (Small, 1915). Recovery is rapid and irritability is regained in less than half a minute.

Rendle (1963) gives a good introduction to the biology of the composite capitulum. Marked protandry of the florets, associated with centripetal development in each head, favours crossing between separate inflorescences. In cases where the development of the bisexual florets proceeds slowly from the margin inwards, an insect alighting on the head at the margin will, in the early stages of the head, visit pollen-bearing florets only, and in later stages of the head will visit florets in the second or female stage before it reaches those in the male stage. Florets, however, open in such quick succession that the head is for a time purely male and for some time purely female. In the comparatively few cases where the florets are unisexual,

Fig. 54 a - d. Asteraceae with capitula presented singly: (a) Arctotis laevis (Arctoteae) being visited by Ceramius braunsi (x c 1,8); (b) blue rayed Felicia sp. (Astereae) and Cotula sp. (Anthemideae) (x c 1); (c) Relhania pumila (Inuleae) being visited by Quartinia vagepunctata (x c 3,8); (d) Berkheya fruticosa (Arctoteae) (x c 1).

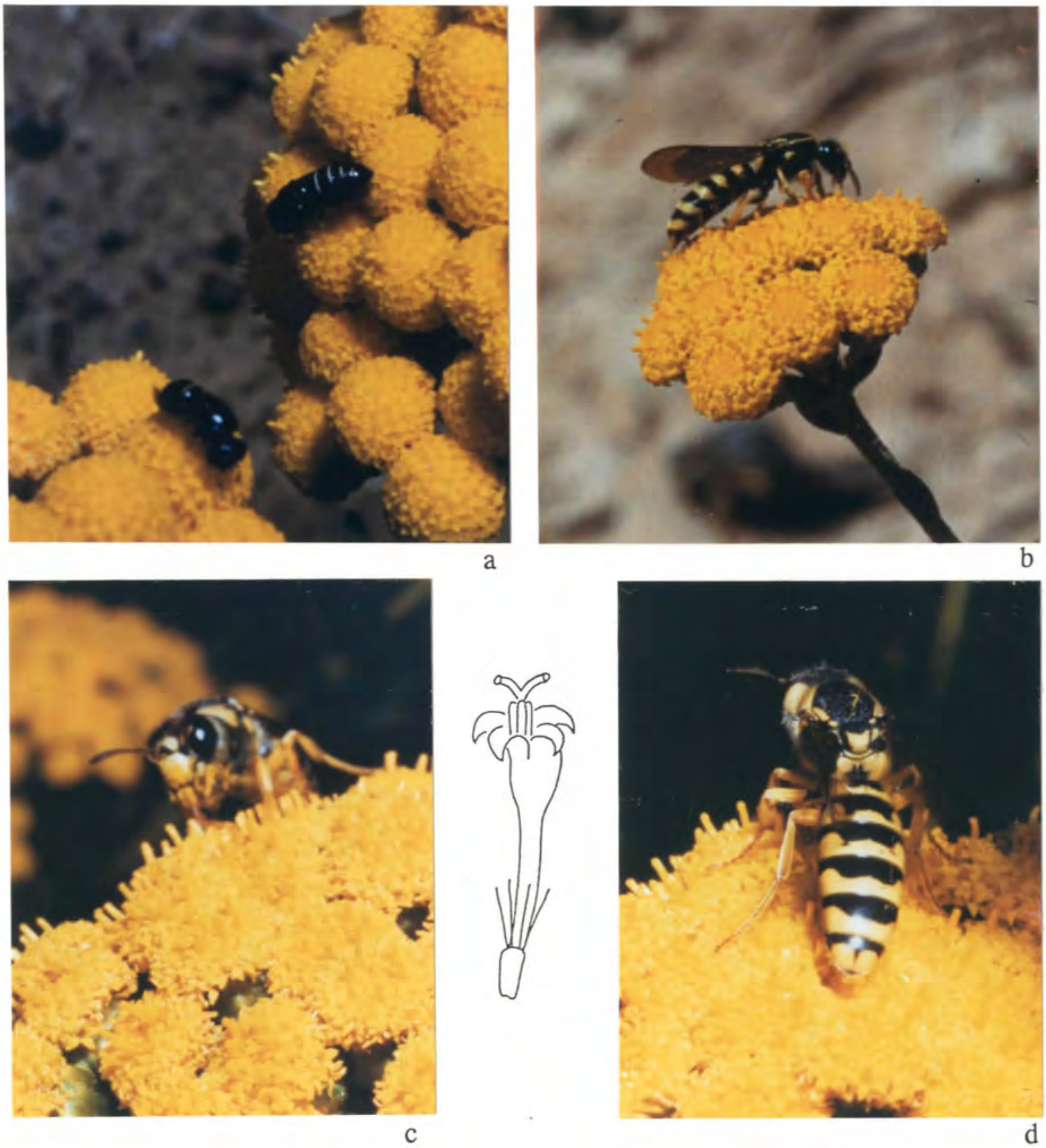


Fig. 55 a - d. Asteraceae with capitula presented in clusters: (a) Pentzia suffruticosa (Anthemideae) being visited by Quartinia vagepunctata (x c 4) ; (b - d) Athanasia trifurcata (Anthemideae), b. being visited by Ceramius braunsi (x c 1,7) , c. and d. being visited by Ceramius metanotalis (x c 2,6) - c. wasp's tongue inserted into a floret and d. dorsal view of wasp, head raised withdrawing tongue.

the outer and first visited are female and the inner functionally male, or the two kinds occur in separate heads.

Vogel (1954) considers that South African composites are generally Hymenoptera-flowers though flies and certain beetles may also play a large part in pollination. Features which he puts forward to support his Hymenoptera-flower hypothesis are: the presence of nectar which is concealed at a depth of some millimetres only; blue and yellow colours; honey guides in the form of contrasting colour between disc and ray florets or contrasting markings at the base of the ligulae; variously produced shine or lustre; the possession of honey scent; and the exhibition of sleeping movements. He further considers that pollination usually results on the brush-principle, from insects crawling around on the capitulum or sucking from the disc florets taking up pollen on their ventral surfaces. He furthermore notes that small capitula borne singly on long flexible stalks are by preference visited by small bees, bombyliids and syrphids. He considers that elongation of the flower tube up to 20 mm and the appearance of scarlet flower colour in some Senecioneae and Mutiseae indicate a tendency to psychophily (butterfly pollination).

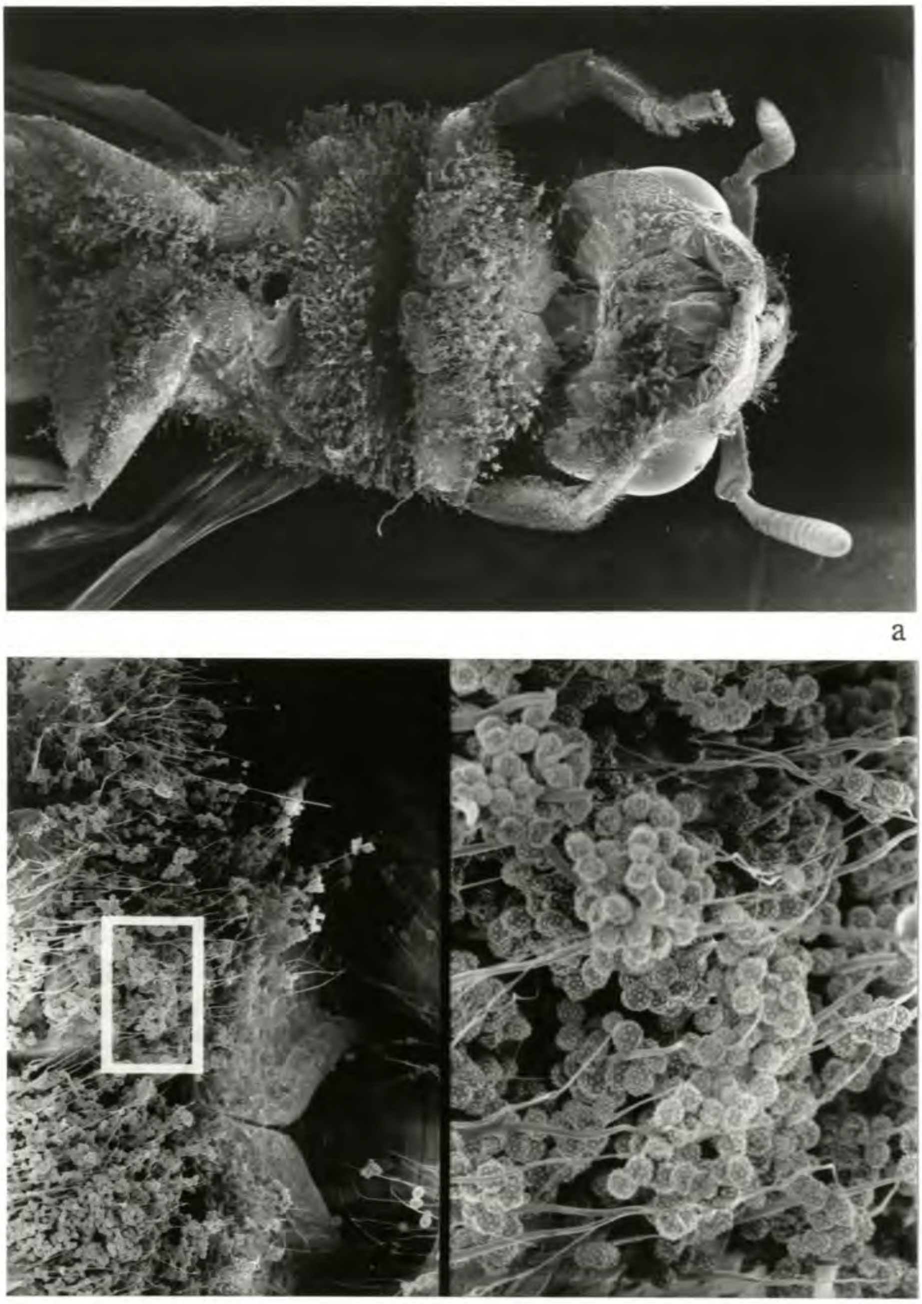
All six tribes of Asteraceae characteristic of the semi-arid areas of southern Africa are represented in Appendices 1 and 3. The other seven tribes are sub-tropical, mostly New World or mostly northern hemisphere in distribution. Generally the flowers are visited by a wide range of insect orders, notably Hymenoptera, Diptera, Lepidoptera and Coleoptera. The species listed are those, the flowers of which were found to be visited by Hymenoptera. Amongst the wasps and bees a wide range of families is represented, most notably Braconidae, Chrysididae, Scoliidae, Tiphiidae, Pompilidae, Masaridae, Eumenidae, Vespidae, most families of Sphecoidea, Colletidae, Megachilidae, Halictidae, Fideliidae, Anthophoridae and Apidae.

Only amongst the masarids and the bees will hymenopterans dependent upon Asteraceae be found. Most of the bee visitors appear to be polylectic. A notable exception is the fideliid Fidelia braunsiana Friese which is restricted to the genus Berkheya (Arctoteae) (Whitehead, 1984). Amongst the masarids, 41% of which have been recorded visiting Asteraceae, seven species of Ceramius, some species of Jugurtia, Quartinia, Quartinioides and Quartiniella are restricted to or show a marked preference for flowers of Asteraceae. Clearly these species are dependent upon the presence of Asteraceae. To what degree their visits are of importance to the flowers that they visit is not clear. Certainly where they occur they are the most dependable visitors and as such can also be depended upon to make successive visits to composite flowers. It has been noted that where a species of masarid is present in large numbers and is actively foraging on a composite that composite receives few other visitors although the same species at another site where the masarids are absent may be visited by a wide range of polylectic visitors.

Particularly stiking in this regard is Athanasia trifurcata (Anthemideae) (Figs 55 b and d) which grows abundantly in the Clanwilliam district. In the vicinity of nesting areas of Ceramius braunsi along the Olifants River to the south of Clanwilliam it was, in several successive years, almost exclusively visited by this wasp. Similarly, at the same times, in the vicinity of the nesting areas of Ceramius metanotalis along the Olifants River to the north of Clanwilliam it was almost exclusively visited by that wasp. At sites along the Olifants River between the nesting areas of these wasps Athanasia trifurcata was abundantly visited by polylectic hymenopterans. It would seem therefore that where they occur in abundance the two Ceramius species are important visitors to the flowers of Athanasia trifurcata and are undoubtedly efficient pollinators, however, that where they do not occur these flowers are undoubtedly efficiently serviced by polylectic visitors.

There is no indication that any species of masarids are restricted to a particular genus or species of composite. For example at some sites in the Clanwilliam district where Athanasia trifurcata (Anthemideae) is abundant near the nesting areas of Ceramius braunsi this wasp forages solely on that plant. At other sites where Arctotis laevis (Arctoteae) (Fig. 54 a) is also in full flower it is equally abundantly visited by Ceramius braunsi. Preferences are, however, shown. Pentzia (Anthemideae) species flowering abundantly in nesting areas are rarely visited. At sites in the Nieuwoudtville district where nesting Ceramius toriger and nesting Quartinia vagepunctata are abundant Pteronia divaricata (Astereae), Pentzia suffruticosa and Cotula leptalea (both Anthemideae), Berkheya fruticosa (Arctoteae), Osteospermum oppositifolia (Calenduleae), Senecio prob. nivea (Senecioneae), and Relhania pumila and Leysera gnaphalodes (both Inuleae) flower simultaneously. Ceramius toriger forages on the deeper more robust capitula of the Pteronia and Berkheya species whereas Quartinia vagepunctata forages on the smaller shallower capitula of the Relhania, Leysera, Senecio, Cotula and Pentzia species.

The behaviour of a masarid on a capitulum is governed by the size of the masarid and the diameter of the capitulum. As a general rule the larger masarids (notably Ceramius species) forage by preference on composites with relatively wide deep capitula and the smaller masarids (most notably species of the Quartinia group)



a

b c

Fig. 56 a - c. Ceramius braunsi: (a) ventral view of anterior half of wasp showing pollen of Arctotis laevis (Asteraceae: Arctoteae) on hairy underside (x 11); (b) part of prosternum and base of front legs (x 30); (c) boxed area x 150.

forage on composites with relatively smaller shallower capitula. As a general rule the diameter of the capitulum therefore allows the wasp to alight on the upper side of the capitulum and stand on all six legs (Fig. 54 a). Whilst taking nectar (Figs 55 c and d) it inserts its tongue into one floret after another, the insertion and removal resulting in a bobbing motion. When ingesting pollen it rotates its short curved front legs in such a way that pollen is brushed towards the mouth. When engaged in both these operations the wasp is liberally coated with pollen on its undersurface (Fig. 56) and will, when it visits another capitulum, transfer pollen to stigmas presenting their receptive surfaces. The activities of the wasp will furthermore be a sufficient stimulus to trigger the "irritable" behaviour of arctotid flowers. When the length of the masarid is considerably in excess of the diameter of the capitulum the wasp "perches" on its rim. In such instances, for example when Ceramius species visit Pteronia, only the head, the prosternum and the bases of the front legs will receive a coating of pollen. Due, however, to the regular behaviour of the wasps this would be sufficient for transfer of pollen from one capitulum to another. Masarids are thus potentially efficient pollinators. As a general rule the composites have a wider distribution than their masarid visitors, however, they are visited by more than one species of masarid and are visited by different masarids in different areas throughout their range. For example Athanasia trifurcata is visited by Ceramius braunsi to the south of Clanwilliam, Ceramius metanotalis to the north of Clanwilliam and by Ceramius toriger in the southern Tankwa Karoo to the south of Sutherland. Certainly in areas where masarids specializing in Asteraceae are common they are probably important potential pollinators of the plants which they visit, indeed in some areas probably the most important potential pollinators.

Papilionaceae

The family Papilionaceae is a very large cosmopolitan assemblage of herbs, shrubs and trees, most diverse in the warm temperate regions of the northern and southern hemispheres. It is the youngest of the three families of the Fabales (Cronquist, 1981).

The flowers are characteristically "pea flowers", having one free posterior petal which is the standard or vexillum, two lateral petals which form the wings or alae and an anterior pair of petals which are closely adpressed, often more or less coherent, and which form the keel or carina in which the stamens and the single carpel are enclosed (Cronquist, 1981).

The Papilionaceae have been sampled for self-incompatability showing an overall high frequency of self-incompatability in woody groups in both the temperate and tropical regions (Arroyo, 1981). In the truly zygomorphic, bilateral papilionoid flower both pollen and nectar are concealed and become available only after tripping (Arroyo, 1981). The tripping requirement has not only led to pollen and nectar economy, but has also precipitated the development of relationships with increasingly specialised pollinators capable of working the successively more complex mechanisms (Arroyo, 1981).

It is generally considered that the Papilionaceae are bee-pollinated and that they have been associated with bees throughout their evolutionary history. Arroyo (1981) considers that melittophilous legumes as a whole may be classed as "generalist", in that a wide range of bees is used and dependence on a limited number of bees is uncommon. She states further that within the broad category of generalist, relationships between bees and legumes are diverse and complex, and the legume family cuts across the entire spectrum of bees. Of particular interest is her statement that comparative data for the South African and Australian regions are few but that nevertheless Scott-Elliot's (1890-1891) notes for Madagascar and South Africa rarely mention more than 2-3 species of bees on papilionoid legumes. This is clearly at variance with the present findings (Appendix 3), most notably those for Aspalathus spinescens, since visits by up to 16 species of bees have been recorded.

Crotalarieae: Cape Group

The Crotalarieae are essentially African although a few genera extend to the Mediterranean Region, India, Australia and South America. The greatest generic diversity is centred in southern Africa. Thirteen of the 15 genera are represented in this region (van Wyk, 1991). Four genera, Aspalathus, Lebeckia, Wiborgia and Rafnia, constitute the Cape Group of Polhill (1981). This grouping, based on morphological characters, is upheld by the cladistic analysis, using both morphological and chemical characters, of van Wyk and Verdoorn (van Wyk, 1991). The analysis further indicates a close subgrouping of Aspalathus, Lebeckia and Wiborgia separately from Rafnia.

Van Wyk (1991) states that for the Crotalarieae, despite on-going taxonomic research, virtually no biological information has been added to the literature.

In the present study six species of Aspalathus, two species of Wiborgia, two species of Lebeckia, and one species of Rafnia were sampled for flower visitors

(Appendices 1 and 3). All are shrubs with relatively small yellow "pea flowers". In some species of Aspalathus, notably Aspalathus spinescens, and in Lebeckia sericea the petals change to a reddish hue as the flowers age (Fig. 60 b). This colour change apparently follows pollination and increases pollination efficiency by discouraging non-productive visits (Vogel, 1954 and Arroyo, 1981).

Aspalathus

The genus Aspalathus is mostly restricted to the Cape fynbos, however, a few outliers extend to the Transkei and Natal (van Wyk, 1991) (Fig. 23 b). Of the species investigated in the present study five, A. divaricata, A. linearis, A. pulicifolia, A. spinescens, and A. vulnerans, are endemic to the southwestern Cape (Dahlgren, 1988). A. subtingens ranges from Laingsburg in the west to the Albany and Somerset East divisions in the East (Dahlgren, 1988). Preliminary observations on the relationship between masarids and Aspalathus in the Clanwilliam district have been published (Gess and Gess, 1989).

Observations of flower visitors were made at the height of the flowering season of the Aspalathus species, early summer (the last week of September to the second week of October) in the western Cape and late summer in the eastern Cape (February to March). In addition visitors to the flowers of A. spinescens were sampled in the Clanwilliam district at the start of the flowering season, mid-September. All five western Cape species were visited by masarid wasps and megachilid and/or anthophorid bees with the exception of A. vulnerans for which observations were probably too limited, only Masarina familiaris having been recorded from this species. Additional visitors recorded were eumenids, sphecoids, tiphiids, chrysidids, scoliids and honeybees. A. subtingens was observed only at the eastern extension of its range, in the Grahamstown district, where it was visited by megachilid and anthophorid bees. Additional visitors recorded were eumenids, halictids and honeybees.

The masarid wasps involved in late September and October in the Clanwilliam district were Ceramius clypeatus, Ceramius micheneri, Ceramius braunsi, Masarina familiaris and Masarina mixta. Of these C. clypeatus and C. micheneri seem to be restricted to foraging on Aspalathus species as they have not been found visiting flowers of any other plants although plants of the other families favoured by masarids were flowering abundantly in association with Aspalathus. Furthermore, samples of cell provision were found to contain pollen solely matching that of Aspalathus species. Masarina familiaris is less restricted, having been found in other areas visiting the flowers of Lebeckia and Wiborgia in addition. It has not, however, been found visiting any flowers other than those of the Cape Group of the Crotalarieae and samples of cell provision from sites in the Clanwilliam district contained solely pollen matching that of Aspalathus. Ceramius braunsi and Masarina mixta are casual visitors to Aspalathus, the usual forage plants of C.braunsi being composites and those of M. mixta being Wahlenbergia species.

At the start of the flowering season of A. spinescens a similar guild of visitors, masarids, megachilids, anthophorids, eumenids and honeybees, is present. The identity of the masarids, however, differs. The only species represented is Masarina hyalinipennis, an early flying species, whose flight period is over by the height of the flowering season.

Two behaviour patterns are exhibited by masarids when visiting the flowers of Aspalathus species, one pattern being consistantly followed by the Ceramius species and the other by the Masarina species.

A Ceramius, when alighting on the flower, grasps the alae with the second and third pairs of legs and curves the abdomen down beneath the flower aiding its balance (Figs 57 b and c). Perched in this way it inserts its tongue at the base of the standard to reach the nectary. In so doing it trips the flower. The carina opens and the essential parts curve upwards to make contact with the bases of the front legs, which are held folded beneath the wasp, and with the prosternum. A considerable amount of pollen is deposited on these hairy surfaces (Fig. 58) and as the wasp consistantly positions itself in the same manner it is ideally suited to transfer pollen from the anthers of one flower to the stigma of another. When collecting pollen for provision it grasps the alae with its second and third pairs of legs and balances itself in much the same manner as it does when alighting on the flower preparatory to imbibing nectar. It ingests the pollen directly from the anthers. A firm footing on the small curved alae is aided by the sculpturing of the petal surface, a common feature in Papilionaceae (Stirton, 1981).

A Masarina, a much smaller visitor than the Ceramius species, adopts a completely different stance on the flowers. Instead of alighting on the alae it alights on the standard in such a way that it faces downwards towards the centre of the flower (Figs 57 d and e). When imbibing nectar it inserts its tongue into the flower at the base of the standard to reach the nectary causing the carina to open and the essential parts to curve upwards to come firmly into contact with the frons of the wasp so that it receives a considerable load of pollen (Fig. 59). As the wasp always positions itself in the same manner it is ideally suited to transfer pollen from the

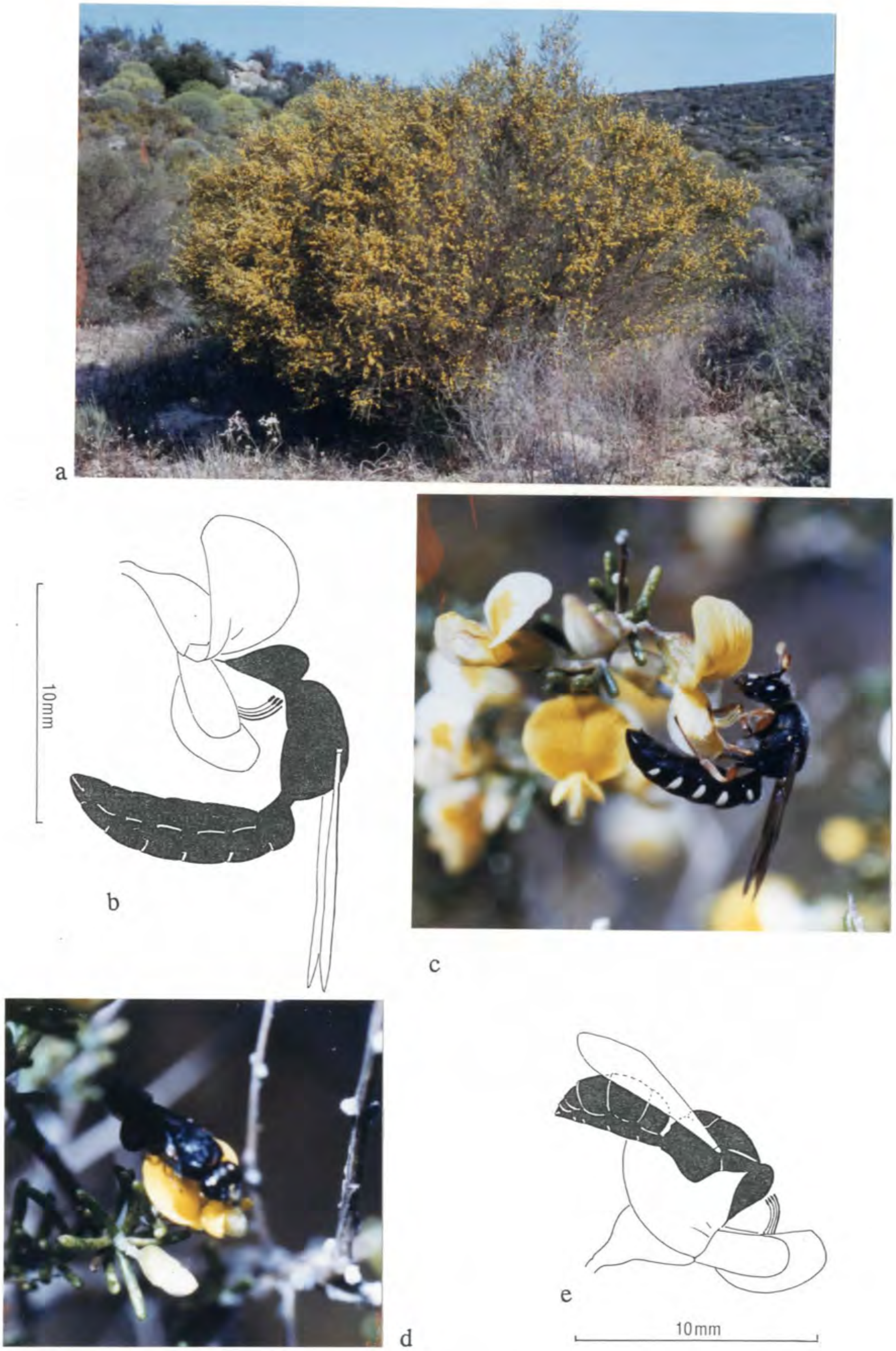


Fig. 57 a - e. Aspalathus spinescens **(Papilionaceae: Crotalarieae): (b) simplified diagrammatic representation of** Ceramius clypeatus **(legs omitted) in nectar drinking position on flower; (c)** C. clypeatus **withdrawing from a flower; (d)** Masarina familiaris **on flower; (e) simplified diagrammatic representation of** M. familiaris **(legs omitted) in nectar drinking position on flower.**

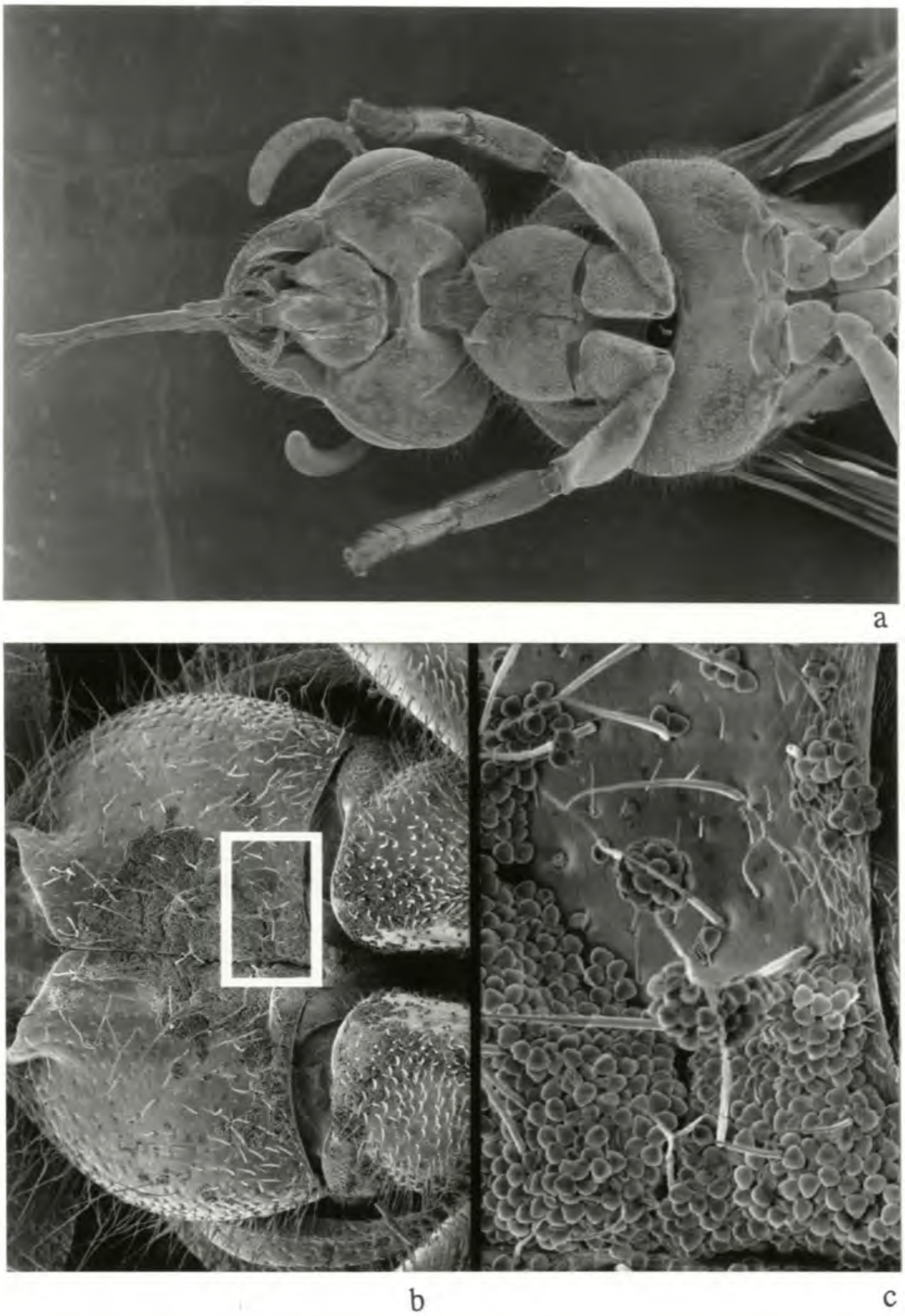
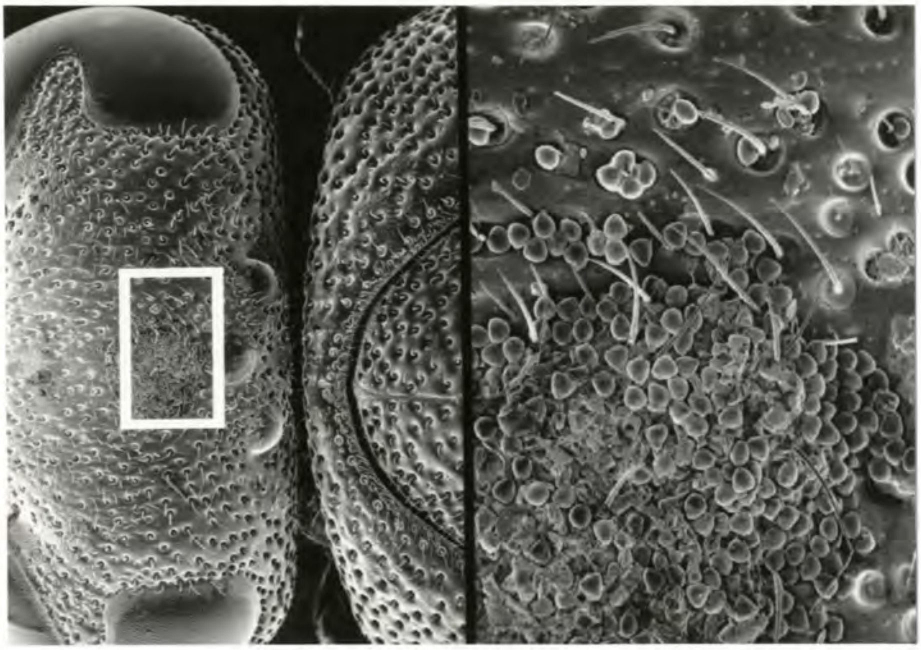


Fig. 58 a - c. Ceramius clypeatus: (a) ventral view of anterior half of wasp showing area of impact with anthers of Aspalathus spinescens (Papilionaceae: Crotalarieae) (x12); (b) prosternum and base of front legs (x 30); (c) boxed area x 150.

a



b c

Fig. 59 a - c. Masarina familiaris: (a) dorsal view of head showing area of impact with anthers of Aspalathus spinescens (Papilionaceae) (x 20); (b) area of impact x30; (c) boxed area x 150.

anthers of one flower to the stigma of another. When collecting pollen the wasp alights on the standard in the same manner and from this position ingests pollen directly from the anthers.

The combination of two methods of triggering the flowers is akin to that recorded by Stirton (1977) for Canavalia virosa (Papilionaceae) which is pollinated by two size categories of bees which like the Ceramius species and the Masarina species have different strategies for operating the flowers.

Where Ceramius clypeatus, Ceramius micheneri and Masarina familiaris occur they can be very numerous and the most abundant visitors to Aspalathus. This was most certainly the case when observations of visitors to Aspalathus spinescens growing on a slope above the Clanwilliam Dam were made during the second week of October 1987 and the first week of October 1988. At those times C. clypeatus and M. familiaris were the commonest visitors to the flowers of these plants. Furthermore their daily period of foraging activity was remarkably long, being from 9h30 to 17h30. C. clypeatus and C. micheneri have very limited distributions (Figs 11 and 12) within the distribution of Aspalathus as a genus (Fig. 31). M. familiaris occurs throughout a greater part of the range of Aspalathus. Certainly the presence of Aspalathus is probably essential for the successful nesting of C. clypeatus and C. micheneri and where these two wasps occur it is likely that they play an important part in the pollination of Aspalathus. M. familiaris and M. hyalinipennis are less dependent on Aspalathus as they will also forage on other papilionates, having been recorded in Namaqualand from Lebeckia and Wiborgia. However, when foraging on a particular species they are constant visitors there being little overlap in the areas of occurrence of their various forage plants. In the case of Aspalathus, at least, this is explained by the marked individual preferences of Aspalathus species for specific soil types (Dahlgren, 1988).

The recorded megachilid visitors - Branthidium braunsi; Carinanthidium cariniventre; six Chalicodoma species, C. aridissima, C. fulva, C. karooensis, C. murina, C. schultessi and C. sinuata; Immanthidium junodi; two Megachile species, M. sp. B and M. sp. C; Oranthidium sp. nov.; Serapista rufipes; and three Spinanthidium species, S. neli, S. trachusiforme and S. volkmanni in the western Cape and Coelioxys penetratrix, and three Megachile species, M. gratiosa, M. semiflava and M. spinarum, in the eastern Cape - and the recorded anthophorid visitors - Allodape friesei; three Ceratina species, C. sp. H, C. sp. F and C. sp. J; and four Xylocopa species, X. caffra, X. capitata, X. lugubris and X. rufitarsis in the western Cape and Allodape rufogastra/exoloma; Allodapula variegata; and Halterapis nigrinervis in the eastern Cape - are polylectic flower visitors

(Appendix 1) which, however, though not dependable visitors are none-the-less expected visitors to papilionate flowers. When visiting Aspalathus flowers they alight in a similar manner to the Ceramius species and like them trigger the opening of the carina and receive a pollen load on the ventral surface, the positioning of the pollen being dependent on the size of the visitor. If making successive visits, they would successfully transfer pollen from the anthers of one flower to the stigma of another. Many of these bees are more widely distributed than the masarid visitors and it seems likely that together with the masarids they constitute a guild of potential pollinators of Aspalathus.

Honeybees are often prominent amongst the visitors to Aspalathus. Unlike the masarids and the megachilid and anthophorid bees, they do not, however, have a set way of entering the flowers. They rarely trigger the opening of the carina and certainly, if they were to receive a pollen load, would be unlikely to transfer pollen from one flower to the stigma of another. They are therefore nectar thieves.

The remaining wasp visitors are casual and as such are unlikely, except by chance, to effect pollination.

Lebeckia

The genus Lebeckia is restricted to Namibia, Botswana and the Cape Province (van Wyk, 1991) (Fig. 23 a). This genus is considered by Polhill (1976) to be the least specialised in the Crotalarieae.

Brauns (1926) stated that Lebeckia nourishes a great number of bees, the majority of which are of western Cape origin. He further stated that Chalicodoma murina and Chalicodoma karooensis appear to be bound to Lebeckia pungens at Willowmore.

Two species of Lebeckia were observed for flower visitors, Lebeckia sericea (Figs 60 a and b) in the Springbok District during the first two weeks of September 1992 at the height of its flowering season and the second week of October 1989 towards the end of its flowering season, and in the Kamieskroon district during the second and third weeks of September 1992, and Lebeckia spinescens in the Springbok district during the second week of September 1992.

During both September and October there was an overall similarity in the guild of flower visitors to Lebeckia sericea, a single species of Masarina, several species of megachilids, honeybees, occasional anthophorids and small eumenids. There was,

a

b

c

d

Fig. 60 a - d. (a and b) Lebeckia sericea (Papilionaceae: Crotalarieae), b. inflorescence showing untripped flowers with closed carina, tripped flowers with essential parts exposed, and pollinated flowers of a reddish colour (x c 1); (c and d) Wiborgia monoptera (Papilionaceae: Crotalarieae), d. (x c 1).

however, species replacement. The Masarina in the September samples was, as in the samples from Aspalathus to the south, M. hyalinipennis, and that in the October samples was M. familiaris. The megachilids in the September samples were: Carinanthidium cariniventre, Chalicodoma karooensis , Chalicodoma murina, Spinanthidium bruneipes, Spinanthidium trachusiforme and Spinanthidium volkmanni whereas those in the October samples were: Chalicodoma bullata, Chalicodoma fulva, Chalicodoma murina, Serapista rufipes and Spinanthidium volkmanni.

The flowers are much larger than those of the Aspalathus species visited. Of particular note is that the carina is much longer. The Masarina species alight on the flower in the same manner as they do on Aspalathus flowers, however, when they insert the tongue at the base of the standard to obtain nectar they do not trigger the opening of the carina. Even if the carina were to open, due to the relative sizes of wasp and flower, the wasp would not receive a load of pollen. Clearly, whereas in their nectar collecting visits to Aspalathus the Masarina species are potential pollinators, in their visits to Lebeckia sericea they are thieves. It is, however, of note, that when collecting pollen, the Masarina species walk outwards along the keel and in so doing trip the flower.

The megachilids, as when visiting Aspalathus, alight on the alae and insert their tongues at the base of the standard when collecting nectar. In so doing they cause the carina to open and they receive a load of pollen on the ventral surface. As they always alight in the same way they have the potential to pollinate the flowers by transferring pollen from one flower to the stigma of another. As already noted they are polylectic and therefore not necessarily dependable visitors although they are clearly expected visitors.

Honeybees visiting Lebeckia sericea seem to be less able than they are on Aspalathus flowers to obtain nectar without positioning themselves in such a manner that they trip the flowers. They should therefore be considered to be amongst the potential pollinators, particularly where there are large patches of L. sericea reducing the likelyhood of lack of constancy.

The eumenids though a regular constituent of the guild of visitors are too small to trigger the flowers.

The flowers of Lebeckia spinescens are of comparable size to those of the Aspalathus species. They, too, were being visited in the main by Masarina hyalinipennis and megachilid bees, Chalicodoma karooensis, Spinanthidium volkmanni, Spinanthidium trachusiforme and Spinanthidium neli having been represented in the samples. Due to the small size of the flowers they are tripped by M. hyalinipennis which therefore should, with the megachilid bees, be considered to be a potential pollinator. L. sericea and L. spinescens are unlikely to compete for visitors as the former grows on stoney slopes and the latter in level sandy situations.

Wiborgia

The genus Wiborgia is restricted to the western and southwestern Cape Province (van Wyk, 1991) (Fig. 23 a). It is almost indistinguishable from some of the woody species of Lebeckia except for the winged, samara-like fruit (van Wyk, 1991).

Flower visitors were recorded from Wiborgia monoptera in Namaqualand, in the Kamieskroon district in mid-September 1992 and the Springbok district during the second week of October 1989, and from an unidentified Wiborgia species at the southern end of the Tankwa Karoo, 43 km ENE of Ceres during the first week of December 1989. The flower visiting guilds were similarly constituted to those visiting Aspalathus and Lebeckia. They included most notably a masarid, megachilids and eumenids from W. monoptera and megachilids, anthophorids, a colletid and eumenids from W. sp. (Appendix 3).

In September the masarid was again Masarina hyalinipennis and the megachilids were Chalicodoma karooensis, Chalicodoma murina, and in October the masarid was again Masarina familiaris and the megachilids were Chalicodoma fulva, Spinanthidium trachusiforme and Spinanthidium volkmanni.

The flowers are small (Figs 60 c and d), of comparable size with those of Aspalathus and Lebeckia spinescens and therefore the two masarids can similarly be included with the megachilids as potential pollinators.

Rafnia

The genus Rafnia is found from the southwestern Cape through to Natal (van Wyk, 1991) (Fig. 23 b).

Rafnia amplexicaulus is a frequent constituent of dry fynbos in the Clanwilliam district. It was observed for flower visitors in two areas in this district during the last week of September 1985, the first week of October 1990 and the second week of October 1987. A very limited range of insects was recorded: no masarids, two large anthophorids, Xylocopa capitata and Xylocopa caffra, one large megachilid Chalicodoma cincta and a eumenid Synagris maxillosa bequaerti. All were regular visitors and the bees were most certainly potential pollinators.

Evaluation

From a consideration of the guilds of visitors to the flowers of the four genera of the Cape Group of the Crotalarieae certain similarities are immediately apparent. All are visited by megachilids, principally species of Chalicodoma and Spinanthidium which for all genera are expected visitors and potential pollinators. Anthophorids are less common visitors except to Rafnia ampexicaulis to which two large carpenter bees, Xylocopa capitata and Xylocopa caffra, are expected visitors and potential pollinators.

Masarina familiaris and Masarina hyalinipennis within their distribution ranges are dependable visitors to Aspalathus, Lebeckia and Wiborgia and are potential pollinators of the smaller flowered species. Ceramius clypeatus and Ceramius micheneri within their limited distribution ranges are dependable potential pollinators of flowers of Aspalathus, at least of A. spinescens and A. pulicifolia.

Honeybees and eumenids are expected visitors but are probably of little importance as pollinators.

Campanulaceae

The family Campanulaceae is mainly temperate and subtropical in distribution. There are two well marked subfamilies, the Campanuloideae and the Lobelioideae, connected by a small group of transitional genera that are sometimes treated as a third subfamily Cyphioideae (Cronquist, 1988). The flowers of the Campanuloideae are regular and the anthers are generally free. The Lobelioideae are the more advanced group, marked by their highly irregular, resupinate flowers and connate anthers (Cronquist, 1988). Of the southern African masarids 18% have been recorded as visitors to flowers of Campanulaceae of the subfamilies Campanuloideae and Lobelioideae. All but one, a species of Celonites, which seems to be associated with Lobelia arenaria (Lobelioideae), are associated with the genera Wahlenbergia and Microcodon (Campanuloideae).

Wahlenbergia with which at least 16 species of southern African masarids are associated, is in the main African. About 200 species are known and of these nearly 150 occur in southern Africa, the greatest concentration of species being in the southwest. Microcodon, a genus closely related to and easily confused with Wahlenbergia, is known from four species, all endemic to the southwestern Cape. The following general account of Wahlenbergia flower structure and "behaviour" is derived from Thulin (1975) except where otherwise credited.

Wahlenbergia plants are mostly annual or perennial herbs, the majority of which are erect though some are straggling. Some have woody bases. The number of calyx-lobes, corolla-lobes and stamens is almost invariably five. The corolla is in many species campanulate with a distinct corolla tube and more or less broad lobes. From this probably generally primitive state there is a tendency towards a shortening of the tube to an almost choripetalous state and the narrowing of the lobes to give the corolla a stellate appearance. The stamens alternate with the petals. In some species filament bases are expanded. The anthers are either free or attached to the corolla. The position of the ovary varies from inferior to subsuperior. Thulin notes considerable intraspecific variation. The lower part of the style is glabrous or hairy with normal hairs and the upper part is variously clad with pollen supporting hairs as in other members of the family.

Protandry is a pervading characteristic of Wahlenbergia as well as of other members of the Campanulaceae. In the bud the ripe anthers form a tube through which the style grows pushing the stiff pollen-collecting hairs through the thecae and clearing them of the pollen which adheres to the style in the open flower. Nectar is produced on the top of the ovary.

The mechanism of pollen presentation strongly favours cross-pollination and allogamy. According to Thulin, self-incompatibility was proved in progeny of W. androsacea (which he considers probably to be conspecific with W. annularis) from Namaqualand and Namibia. In these plants seed-setting occurred only after artificial cross-pollination. In other taxa tested, namely W. abyssinica (tropical Africa southward to Natal), W. hirsuta (tropical Africa, India and Nepal, W. krebsii subsp. arguta (west Africa), W. lobelioides subsp. lobelioides (Madeira, Canary Islands, Cape Verde Islands), W. pusilla (higher mountains of Ethiopia, Kenya and Tanzania) and W. silenoides (uplands of tropical Africa), all outside the area presently under consideration, self-pollination and subsequent autogamy generally occurred by the recurving of the style-lobes which enabled the stigmatic surface to come into contact with the pollen of the same flower.

Little has previously been noted concerning flower visits to Wahlenbergia. Michener (1965) recorded colletid and halictid bees visiting Wahlenbergia in Australia. The bees' association with the flowers was apparently oligolectic. Unfortunately the species of Wahlenbergia was not recorded, however, only two species of Wahlenbergia are known from Australia, one of these, at least, is shallowly campanulate (Harris, 1948). Thulin (1975) stated that no information about insects visiting flowers of Wahlenbergia in Africa seemed to exist except for a note, "worked by bees for nectar", on the collection of Friend 361 of W. napiformis (a species with a short tube and broadly expanded filament bases).

Vogel (1954) noted that he often observed Hymenoptera the size of honeybees engaged in the pollination of Wahlenbergia species in the Cape. He also stated that it is possible that fly-loving (myiophilous) forms occur amongst them.

Struck (1990) listed insect visitors to two species of Wahlenbergia but recorded no observations concerning the comparative structure of the flowers or the behaviour of the insects at the flowers. He did, however, indicate whether one or more individuals was involved and in some instances gave the results of his examination of the pollen carried by the insects. This latter was recorded as percentage of Wahlenbergia pollen and number of types of pollen which gives one some indication of the constancy of visiting. From a consideration of his tables it is apparent that all species of Hymenoptera examined other than the honeybees and his Capicola sp. 4 (Melittidae) had clearly been visiting a mixture of plants. Honeybees are of course known to be polylectic but to show constancy of visiting, if a good resource is located. Capicola sp. 4 showed constancy but the sample was too small for any inferences to be made.

In the present study flower visitors to eight species of Wahlenbergia and one species of Microcodon in the southwestern Cape and one species of Wahlenbergia in the eastern Cape were observed and voucher specimens were collected (Appendices 1 and 3).

Two basic flower types were represented, deeply campanulate (Figs 61 a - d and 62) (W. psammophila, W. ecklonii, W. cf. constricta, W. paniculata, W. pilosa, W. prostrata, W. sp. N and M. sparsiflorum), and shallowly campanulate (Fig. 61 e) (W. annularis). In all species in the bud and the newly opened flower the receptive surfaces of the stigmatic lobes are closely adpressed. The upper part of the style and the outer surface of the closed stigmatic lobes bear variously arranged

Fig. 61 a - f. Wahlenbergia (Campanulaceae): (a and b) W. psammophila (x 3,8); (c) W. prostrata being visited by Quartinioides sp. M, dorsal surface towards centre of flower, (x c 3); (d) W. ecklonii (x c 7); (e) W. annularis being visited by Capicola sp. C, ventral surface towards centre of flower, (x 3); (f) W. annularis showing stigmatic lobes adpressed and pollen clad (x 3,8). (Reproduction of the colours has not been accurate, for guidance see text).

a

b

c

Fig. 62 a - c. (a) Wahlenbergia paniculata (x c 3); (b) Wahlenbergia pilosa (x c 1,5); (c) Microcodon sparsiflorum (x c 1,5). (Reproduction of the colours has not been accurate, for guidance see text).

pollen supporting hairs. The anthers closely surround the style. They dehisce introrsely before the bud opens. In a newly opened flower the pollen coats the upper part of the style and the outer surfaces of the closed stigmatic lobes giving the whole a club-like appearance. After the flower has been open some little while the hairs supporting the pollen disappear (apparently by invagination (Cronquist, 1981) and the pollen falls, being retained within the corolla in the deep flowered species but falling free in W. annularis. The style lobes then separate presenting their receptive surfaces.

The nectar secreting tissue on the upper surface of the ovary of all the species with deeply campanulate flowers is uncovered. That of the shallowly campanulate W. annularis is covered by the bases of the filaments which are expanded and closely adpressed to it.

The free lobes of the corolla of the open flowers of all species exhibit "sleeping" movements. The flowers open in mid-morning, close in middle to late afternoon and re-open towards mid-morning. Wasps and bees making use of this phenomenon for night sheltering were noted.

The importance of the flowers to the masarids and the relative potential of the masarids and the other insect visitors as pollinators of the flowers is considered. To be a potential pollinator an insect must, when visiting a newly opened flower, brush against the pollen clad style collecting a coating of pollen and then, when coming from such a flower to one in which the stigmatic lobes have spread out, it must transfer pollen to the stigma.

Wahlenbergia paniculata

Wahlenbergia paniculata is a much branched low growing upright slender annual. At Clanwilliam it grows in extensive patches, being the dominant plant cover in dry Fynbos on slopes above the dam in early summer. During the period of investigation, the first to the third weeks of October, it was in full flower together with Aspalathus spinescens (Papilionaceae), Arctotis laevis (Asteraceae), Athanasia trifurcata (Asteraceae), Pentzia sp. (Asteraceae), Coelanthum sp. (Aizoaceae), Psilocaulon acutisepalum (Aizoaceae) and Crassula dichotoma (Crassulaceae).

The flowers of W. paniculata are erect. The corolla, which is violet in colour, is deeply campanulate (Fig. 62 a). In the bud and the newly opened flower the receptive surfaces of the closely adpressed stigmatic lobes form a knob-like tip to the style. The upper two fifths of the style are hairy particularly at the lower end where the hairs are short and robust and form a distinct collar (Fig. 63 a).

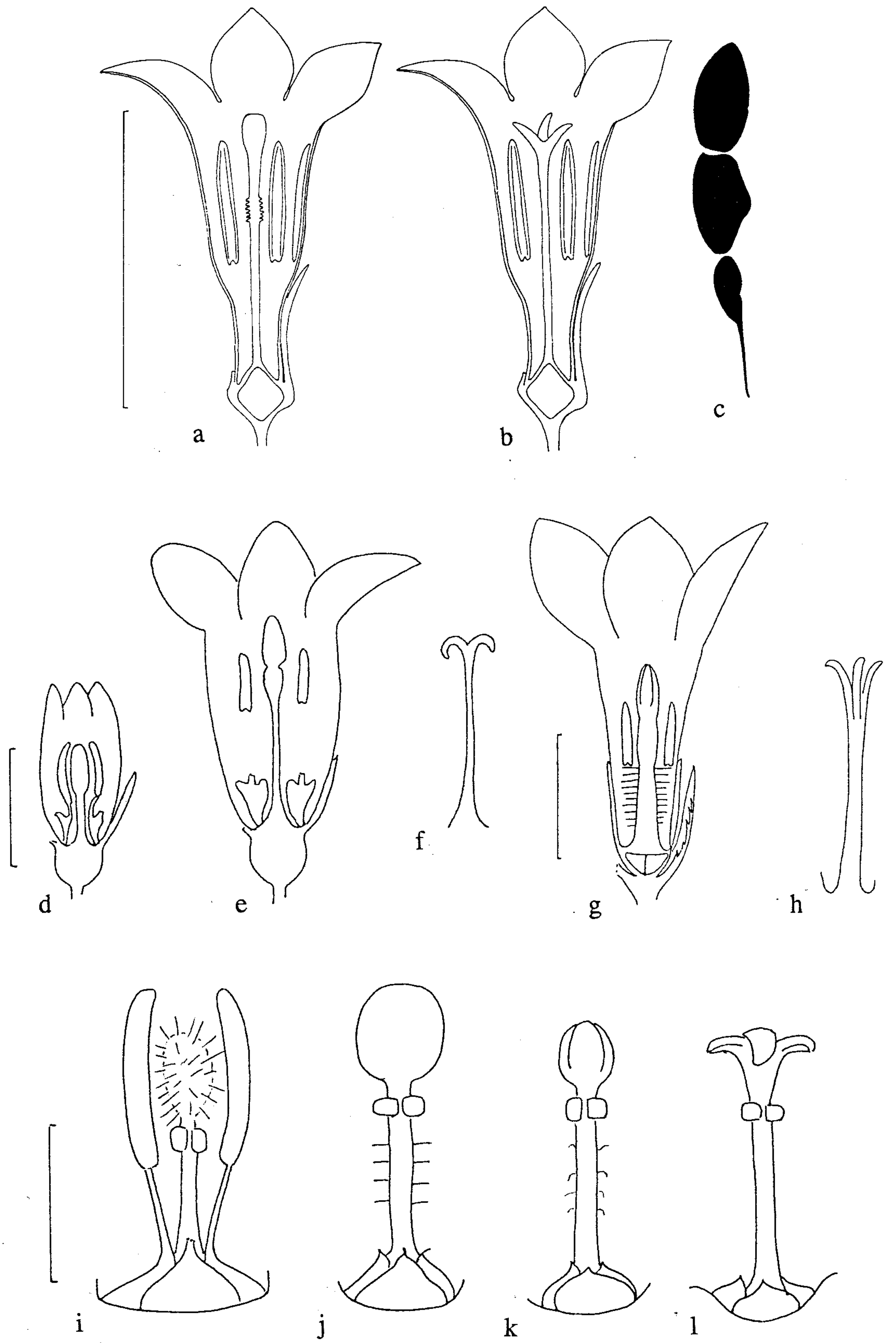


Fig. 63 a - l. (a and b and d - l) Simplified diagrammatic representations of longitudinal sections of flowers of Wahlenbergia species - (a and b) W. paniculata; (d - f) W. psammophila; (g and h) W. pilosa; (i - l) W. annularis - (c) Quartinia parcepunctata. (scale bar = 5 mm)

Seven species of masarid wasps, Ceramius socius, Masarina mixta, Celonites wahlenbergiae, Quartinia parcepunctata, Quartinia persephone, Quartinioides sp. N and Quartinioides sp. S, one species of megachilid bee, Hoplitis sp. C, and five species of bombyliid flies were recorded visiting the flowers (Appendix 3).

Celonites wahlenbergiae seems to be closely associated with Wahlenbergia having only been found at sites where Wahlenbergia was in flower and to be most notably visiting these flowers. At the Clanwilliam site it was, however, also visiting Coelanthum sp. and Crassula dichotoma and in addition has been recorded from Herrea sp., Polycarena sp. and Pelargonium to the west of Clanwilliam. Pollen from the provision from the nest of this wasp investigated at the Clanwilliam site was principally derived from the flowers of Wahlenbergia paniculata.

Masarina mixta has been recorded principally from Wahlenbergia, there being otherwise only a single record from Aspalathus spinescens and a single record from Athanasia trifurcata. It therefore seems to have a close association with Wahlenbergia.

Quartinia parcepunctata was an abundant visitor to W. paniculata and was not recorded from any of the other flowers. The only other flower visiting records for this species are from Wahlenbergia on the Theronsberg Pass, Ceres and from Microcodon to the east of Clanwilliam. It therefore seems likely that it has a close association with Wahlenbergia and Microcodon.

Quartinia persephone though recorded not only from W. paniculata at the Clanwilliam Dam but also from M. sparsiflorum was a less frequent visitor and was in addition, albeit in smaller numbers, recorded from Psilocaulon acutisepalum and Athanasia trifurcata, and, in the Nieuwoudtville district, from Senecio. It would therefore appear to be an expected visitor but not a dependable visitor to Wahlenbergia.

Quartinioides sp. N though an infrequent visitor to W. paniculata during the sampling period was an abundant visitor to W. sp. in the Nieuwoudtville district and has not been recorded from any other flowers.

The record of Quartinioides sp. S is for a single male and as there are no other flower visiting records for this species no comment can be made.

Ceramius socius was represented solely by a single male. It has otherwise been recorded abundantly from Mesembryanthema from which it has been shown to obtain its provision. It is clearly a casual visitor.

Few flower visiting records are available for Hoplitis sp. C. It was an infrequent visitor to W. paniculata and there are only single records of visits to W. annularis and Aspalathus spinescens in the Clanwilliam district and to W. pilosa in the Springbok district.

Masarids when visiting the flowers alight on the outwardly curved corolla lobes before entering so that when they enter a newly opened flower their dorsal surfaces brush against the pollen-clad style collecting a coating of pollen. When a masarid comes from such a newly opened flower and then enters a flower in which the stigmatic lobes have spread out pollen will be transferred from it to the stigma making it a potential pollinator.

The masarids collectively seem to represent the most dependable potential pollinators of W. paniculata. All would, furthermore, due to the manner of and constancy of their behaviour when visiting the flowers, be capable of pollinating them. Due to the manner of pollen presentation the most efficient pollinators will be the species with the best flower fit. That is those which are of a size small enough to enter the corolla tube but large enough that in doing so they cannot pass the pollen column without pressing against it. The species with the best flower fit will vary with variations in flower size which in turn varies with availability of water. At Clanwilliam Dam at the time of the study Quartinia parcepunctata had the best flower fit.

The bombyliids hovered above the flowers imbibing nectar from them through their long proboscises. As they did not enter the flowers it is unlikely that they received a pollen load and they are therefore not considered here as potential pollinators.

Wahlenbergia psammophila

Wahlenbergia psammophila is a relatively sparsely branched upright annual which, as its name indicates, grows in sandy soil. It was observed for insect visitors 11 km to the west of Clanwilliam on the road to Graafwater in an area of dry fynbos with a sandveld element. At this site it was the dominant Wahlenbergia species of relatively undisturbed ground. Less common was W. paniculata, the dominant species at the Clanwilliam Dam. Where the ground had been disturbed by cultivation these two species had been replaced by Wahlenbergia annularis. During the periods of the investigation during the first two weeks of October all three

Wahlenbergia species were in full flower together with Aspalathus spinescens (Papilionaceae), Coelanthum grandiflorum (Aizoaceae), Leucodendron sp. (Proteaceae), Herrea sp. (Aizoaceae), Helichrysum sp. (Asteraceae), Senecio sp. (Asteraceae), Polycarena sp. (Scrophulariaceae), Pelargonium sp. (Geraniaceae) and Monopsis debilis (Campanulaceae).

The flowers of W. psammophila are larger than those of W. paniculata from which they are also immediately distinct being purplish violet rather than bluish violet (Figs 61 a and b). The style bears a marked collar of pollen supporting hairs and the bases of the filaments, which are free from the corolla, are expanded and hairy. As the flower elongates the anthers which remain attached to the corolla tear free from the filaments (Fig. 63 e). The filament bases persist and the nectar is cupped within them.

During the periods of observation the flowers of W. psammophila were visited almost solely by masarid wasps. The only other visitor was a single male Capicola sp. C (Melittidae) which was observed examining a flower. This bee, being short tongued and too large to enter the corolla tube, would in any case not be able to reach the nectar and the record was therefore of a "non-visit".

Three Celonites species, C. latitarsis, C. wahlenbergiae and C.bergenwahliae, were regular visitors from the opening of the flowers in mid-morning to their closing in mid- to late-afternoon. Male Masarina mixta entered the flowers in late afternoon to sleep and were enclosed within them when they closed for the night.

Although C. wahlenbergiae and C. bergenwahliae were constantly in attendance at W. psammophila flowers throughout the day they were particularly busy in these flowers in the morning. When afternoon came they also visited, however, far less frequently, flowers of Pelargonium sp., Helichrysum sp. (only C. wahlenbergiae), Senecio sp. (only C. bergenwahliae), Polycarena sp., Coelanthum grandiflorum and Herrea sp. It should be noted that the flowers of the two species of Aizoaceae only open when the afternoon is well advanced. It is likely that the Wahlenbergia flowers have been adequately serviced by the time that these wasps become less constant in their visits and that the change in behaviour coincides with a fall off in available rewards of pollen and nectar.

Celonites latitarsis showed greater flower constancy having apart from one visit to C. grandiflorum by a male, not been recorded visiting any flowers other than those of W. psammophila. A nest of this wasp was investigated at this site and the pollen was found to be all of one type and to match that of W. psammophila.

The behaviour of the Celonites species, when visiting the flowers, is the same as that described for masarids visiting the flowers of W. paniculata. The Celonites are furthermore particularly well suited to effect pollination as they are small enough to enter the flowers but large enough to fit snugly.

Wahlenbergia pilosa

Wahlenbergia pilosa is a much branched low-growing annual. Investigation of flower visitors was undertaken at two sites in the Springbok district, one in the Goegab Nature Reserve to the northeast of Springbok and the other at Klipfontein to the southwest in areas of Namaqualand Broken Veld. At these sites W. pilosa forms dense patches in clearings between bushes and in two successive years it was in full flower during the second week of October. Also in flower at both sites was W. annularis and various "mesems" (Aizoaceae) and "composites" (Asteraceae), and in the Goegab Nature Reserve Peliostomum virgatum, Aptosimum spinescens, Aptosimum lineare (all three Scrophulariaceae), Hermannia spp. (Sterculiaceae), Lebeckia sericea (Papilionaceae) and Monopsis debilis (Campanulaceae).

The flowers of W. pilosa are erect. Their size seems to be dependent on the availablity of water when the plants are growing. The corolla which is deeply campanulate is "two tone" bluish violet (Fig. 62 b). The style bears no distinct collar of hairs, however, the upper part of the style and the non-receptive outer surfaces of the closed stigmatic lobes in the bud and newly opened flower are densely and uniformly covered with stiff pollen supporting hairs. Thus a relatively long pollen column is presented. The lower part of the style is clothed in persistent long soft hairs which extend almost to the corolla and through which a nectar gatherer must reach (Fig. 63 g).

The flowers were visited abundantly by masarids, Quartinia sp. E and to a lesser extent Quartinia sp. G, Jugurtia braunsi and Quartinioides sp. M in the Goegab Nature Reserve and Quartinioides sp.M and to a lesser extent Jugurtia braunsi at Klipfontein. In addition to the masarid visits, casual visits by butterflies, a sphecid wasp Ammophila punctaticeps, and a megachilid bee Hoplitis sp. C were recorded.

The Quartinia species and Quartinioides sp. M were recorded from Wahlenbergia species only. The Quartinia species are known only from the Springbok district whereas Quartinioides sp. M was also recorded as an abundant visitor to W. prostrata at Anenous.

Jugurtia braunsi appears to be narrowly polylectic having also been recorded from

Aizoaceae and Asteraceae at both sites in the Springbok district and at sites in the Nieuwoudtville district.

The behaviour of the masarids when visiting the flowers is the same as that described for masarids visiting the flowers of W. paniculata. The species with the best flower fit varies with variations in flower size resulting from variations in availability of water during the growing period.

Wahlenbergia prostrata

Wahlenbergia prostrata is a low growing annual herb. At Anenous it grows in patches in clearings between bushes. During the periods of investigation during the second week in October in two successive years it was in full flower growing together with Zygophyllum sp. (Zygophyllaceae), Peliostomum virgatum (Scrophulariaceae), Drosanthemum sp. (Aizoaceae), Galenia sp. (Aizoaceae) and Leysera gnaphalodes (Asteraceae).

The flowers of W. prostrata are erect. The corolla, which is pale violet in colour, is deeply campanulate (Fig. 61 c). The nectary is not covered but must be reached by the visitor's pushing its way between upwardly directed stiff hairs.

A masarid, Quartinioides sp. M, a melittid bee Capicola sp. E and a crabronid Belomicroides sp., were recorded visiting the flowers. All three insects are similarly sized and all gave a good flower "fit". One visit by an allodapine bee was recorded, however, this bee is too large to enter the flowers.

Quartinioides sp. M was the most common visitor. It has also been recorded visiting W. pilosa at two sites in the Springbok district. Its behaviour, when visiting the flowers, is the same as that described for masarids visiting flowers of W. paniculata.

Wahlenbergia cf. constricta

Wahlenbergia cf. constricta is an upright sparsely branched perennial. It was investigated for flower visitors during the first week of October at Klein Alexandershoek near Clanwilliam. At this site it was in full flower growing in clearings in dry mountain fynbos. Also in full flower was Aspalathus spinescens (Papilionaceae).

The flowers of W. cf. constricta are held erect. The corolla, which is bluish violet in colour, is deeply campanulate. The nectary is not covered.

The flowers were being regularly visited by Celonites bergenwahliae and to a lesser extent by Quartinia parcepunctata, the most abundant visitor to W. paniculata at the Clanwilliam Dam. Neither of these masarids was visting A. spinescens although the flowers of this plant were being visited by Ceramius clypeatus and Masarina familiaris.

The behaviour of the masarids, when visiting the flowers, is the same as that described for masarids visting the flowers of W. paniculata.

Wahlenbergia ecklonii

Wahlenbergia ecklonii is an erect or staggling perennial herb. Flowers of this plant were observed for insect visitors during the last week of November at two localities in the Ceres district, the Theronsberg Pass and the Gydo Pass. At both sites it was in full flower as too were Athanasia trifurcata and Berkheya carlinifolia (both Asteraceae). On the Gydo Pass it was growing amongst Aspalathus divaricata (Papilionaceae) which was also in full flower.

The flowers of W. ecklonii are erect. The corolla is deeply campanulate and bluish violet (Fig. 61 d). There is no distinct collar of pollen supporting hairs. Instead the whole of the upper half of the style and the outer non-receptive surfaces of the closed stigmatic lobes are covered with stiff pollen supporting hairs. Thus a relatively long pollen column is presented. The nectar secreting tissue is not covered. Nectar is produced extremely abundantly and at the height of production more than half fills the corolla tube so that it is visible as a shining surface from above.

During the periods of observation the flowers of W. ecklonii were being visited regularly and most abundantly by masarids, Celonites capensis on the Gydo Pass and Quartinia parcepunctata, Quartinia sp. H, and Quartinioides sp. U on the Theronsberg Pass. Also visiting the flowers on the Theronsberg Pass but in smaller numbers were two halictids, Lasioglossum sp. H and Nomioides ?maculiventris, an ant, Camponotus sp., a syrphid fly, a small ?lygaeid bug, and three small beetles including a chrysomelid and a malachid.

Celonites capensis and Nomioides ?maculiventris are known to visit, in addition, flowers of families other than Campanulaceae. C. capensis has been collected from flowers of Phyllopodium cuneifolium (Scrophulariaceae), Ehretia rigida

(Boraginaceae) and Berkheya (Asteraceae) in the Grahamstown district and of Pelargonium myrrhifolium (Geraniaceae) and Berkheya (Asteraceae) in the Oudtshoorn district. N. ?maculiventris has been collected from the flowers of Athanasia (Asteraceae) and Euclea (Ebenaceae) 43 km ENE of Ceres. Quartinia parcepunctata on the other hand has only otherwise been recorded from the flowers of Campanuloideae: W. paniculata, W. cf. constricta and M. sparsiflorum.

When the flowers are well charged with nectar, the visitors cannot enter but alight on the lip of the corolla and from this position imbibe nectar. The masarids were noted also to be collecting pollen while standing thus. Such an over abundant nectar production seems to be disadvantageous to a plant attracting insects for the purpose of pollen transfer.

Wahlenbergia annularis

Wahlenbergia annularis is an annual herb. It has a basal rosette of leaves and tall upright sparsely branched infloresence stems. In the Springbok, Clanwilliam and Citrusdal districts it grows sparsely in undisturbed areas but abundantly in disturbed ground where it is often the dominant pioneer plant.

The flowers are held upright and singly. The corolla, which is shallow and widely campanulate, is pale violet generally with a pronounced darker violet streak on the lower half of each of the corolla lobes (Fig. 61 f). In the bud and the newly opened flower the closed stigmatic lobes, which are markedly hairy on their outer non-receptive surfaces, form a knob-like tip to the style. Below the knob the style is encircled by three "cushions" (glands according to Thulin, 1975). Beneath the ring of glands the style is slender and clad in short sparse hairs. In the bud the anthers which are free from the corolla are held upright and closely surround the style (Fig. 63 i). The bases of the filaments are broadly expanded and adpressed to the upper nectar producing surface of the ovary, which they completely cover. The anthers dehisce within the bud. The pollen coats the upper portion of the style giving it a club-like appearance. After the flower has been open some while the hairs supporting the pollen disappear and the pollen falls away. The anthers shrivel and fall away leaving, however, the expanded filament bases covering the nectar. Still later the stigmatic lobes open and curve back exposing their receptive surfaces.

The flowers were most frequently visited by two large melittid bees, Capicola sp. A and Capicola sp. C, which enter the flowers directly, orientated such that the ventral surface is towards the style. They are thus able to penetrate under the filament bases covering the nectary and are also suitably positioned for collecting pollen. They are ideally suited to pollinating the flowers. When collecting nectar from a freshly opened flower such a bee receives a pollen coating on the ventral surface of the thorax. When it later enters a flower in which the stigmatic lobes have opened pollen will be transferred from the bee to the receptive surfaces.

Masarids were noticeably absent apart from a single instance of a visit by Masarina mixta. It seems probable that the nectar and pollen of these flowers, unlike those of the deeply campanulate flowers, is not available to masarids. As they alight on a corolla lobe and then enter with the dorsal surface towards the style, the nectar would be almost entirely closed to them. Furthermore the pollen before it falls would be beyond reach and after fall would be unavailable as it falls free.

Wahlenbergia sp. N

Wahlenbergia sp. N could not be identified to species by Jo Beyers who, however, noted on the determination label that "ovary 5 locular, opposite the calyx lobe therefore Wahlenbergia. (looks very much like Microcodon glomeratum !)". It is a low growing, much branched perennial herb. It was investigated for flower visitors during the last week of September in an area of fynbos at a site between Nieuwoudtville and the escarpment to the west. At the time of sampling the plants were flowering abundantly in clearings between bushes together with Homeria sp. and Wachendorfia sp. (both Iridaceae) and an occasional plant of Lobelia linearis (Campanulaceae). The notable flowering shrubs at the site were Paranomus bracteolaris (Proteaceae) and Aspalathus linearis (Papilionaceae).

The flowers of Wahlenbergia sp. N are smaller than those of the other species and are presented in clusters. The corolla, which is deeply campanulate, is pale violet. The style bears no distinct collar of pollen supporting hairs. Nectar is very abundantly produced and the nectar secreting tissue is not covered.

On the 29.ix.1990 Quartinioides sp. N, which was also recorded visiting Wahlenbergia in the Clanwilliam district, appeared to be the sole visitor to the flowers and was visiting them and solely them in large numbers. On the next day Podalonia canescens (Sphecidae), a broadly polylectic flower visitor and nectar feeder, was present in large numbers visiting the Wahlenbergia flowers in company with Ceratina sp. H (Anthophoridae) which was in addition visiting Lobelia linearis. Ceratina sp. H. was recorded in the Clanwilliam and Citrusdal districts visiting the flowers of Aspalathus spinescens (Papilionaceae) and the shallowly campanulate flowers of Wahlenbergia annularis. Additional visitors, present in smaller numbers, were Masarina mixta, Ceratina sp. J, Ceratina sp. K, and Capicola sp. C which primarily visits W. annularis. Also represented in the complex of visitors was the honeybee Apis mellifera which was otherwise commonly visiting Paranomus bracteolaris, Homeria sp. and Wachendorfia sp..

Of all these visitors the only one which was able to insert itself into the flowers was the Quartinioides sp. N. As this insect in addition is a dependable visitor, as it appears to visit only Wahlenbergia species, it seems likely that it should be considered to be the most important potential pollinator.

Microcodon sparsiflorum

Microcodon sparsiflorum is a low growing annual herb, much branched from the base. It was investigated for flower visitors during the first week of October at a site 5 km to the west of Clanwilliam in an area of fynbos where it was in full flower in clearings between bushes. Also in flower at this site were Aspalathus spinescens (Papilionaceae) and various species of Asteraceae.

The flowers of M. sparsiflorum are presented in clusters (Fig. 62 c). The corolla, which is deeply campanulate, is "two tone" bluish violet. There is no distinct collar of pollen supporting hairs. Instead the whole of the upper half of the style and the non-receptive outer surfaces of the stigmatic lobes are densely and uniformly covered with stiff pollen supporting hairs. Thus a relatively long pollen column is presented.

Microcodon sparsiflorum was being visited solely by masarids. Those captured entering flowers were Quartinia parcepunctata and Quartinia persephone. Celonites were in addition observed entering flowers. Celonites bergenwahliae was captured on the ground amongst the M. sparsiflorum plants and it is therefore highly probable that it was this species of Celonites that was seen to be visiting the flowers. Q. parcepunctata was considered to be the most important potential pollinator of W. paniculata. Quartinia species, however, seem to be rather small to be the pollinators of the larger flowered M. sparsiflorum and it seems likely that Celonites which have a better flower "fit" are the more important potential pollinators. It is probable, however, that Quartinia species are important pollinators when the flowers are small as a result of there having been insufficient water when the plants were growing.

Evaluation

In the southwestern Cape it was found that the deep campanulate Wahlenbergia species are predictably visited by one or more species of masarid but that the shallowly campanulate Wahlenbergia annularis is rarely visited by masarids. Conversely the shallow-flowered species is predictably visited by large melittid bees, Capicola spp., which very rarely visit the deep flowered species and then only casually. The melittid bee Haplomelitta ogilviei, only males of which have been recorded from W. annularis, is considered to be a casual visitor to Wahlenbergia. This is reinforced by the observations concerning it as a dependable visitor to Monopsis debilis growing in close proximity to Wahlenbergia. M. debilis (as M. simplex) has furthermore been recorded as the source of provision of H. ogilviei by Rozen (1974) who investigated nests of this melittid at Veldrif to the southwest of Citrusdal. A small melittid bee, Capicola sp. E has been collected from the deep flowered Wahlenbergia prostrata and it seems that it is most probably an expected visitor to this species at least. Other recorded insect visitors to Wahlenbergia, anthophorids, bombyliids, sphecoids, eumenids and lepidopterans, are opportunists.

Very few records of insect visitors to Wahlenbergia in the eastern Cape have been assembled. As yet no masarids or melittids have been recorded. All visitors have been opportunists, the most common being Ceratina species.

It is suggested that the deeply campanulate Wahlenbergia and Microcodon flowers are primarily masarid flowers and the shallowly campanulate Wahlenbergia flowers are primarily melittid flowers. This partitioning seems to be governed by the behaviour of the insects in relation to the structure of the flowers. In the deep flowered species the nectaries are not covered and the nectar is thus readily accessible to masarids which alight on an outwardly curved corolla lobe and enter with the dorsal surface towards the centre of the flower. In the shallowly campanulate flowers the nectaries are protected by the expanded bases of the filaments. A masarid alighting on an outwardly curved corolla lobe and entering with its dorsal surface towards the centre of the flower would have difficulty in obtaining access to the nectar. The melittid bees enter the flowers with their ventral surfaces towards the centre of the flower and close to the style so that they are positioned in such a way that they can readily obtain nectar from beneath the expanded filament bases.

It is concluded on the basis of behaviour in the flowers, flower fit and dependability that, in the western Cape, masarids are the most important potential pollinators of deep flowered Wahlenbergia species and melittids of the genus Capicola are the most important potential pollinators of the shallowly campanulate Wahlenbergia annularis.

Scrophulariaceae

The family Scrophulariaceae consists of about 190 genera and 4 000 species. It is cosmopolitan but is most diverse in temperate regions and on tropical mountains (Cronquist, 1981). Over 2 000 species are found in Africa. The flowers are bisexual and range from sub-actinomorphic to markedly zygomorphic. Various accounts have been given of pollination syndromes within the Scrophulariaceae (Faegri and van der Pijl, 1979), the most often associated with Scrophularicaeae being that of the melittophilous gullet flowers. In North America studies made of the pollination of Penstemon species are of particular relevance to the present discussion as there is a close association between some violet flowered species of this genus and masarids of the genus Pseudomasaris (Torchio, 1974). Little has been recorded concerning insect visitors to the flowers of Scrophulariaceae in southern Africa. The notable exception is the work on the oil-producing, spurred flowers of Diascia species with which are associated bees of the genus Rediviva (Melittidae) (Vogel, 1954; Vogel and Michener, 1985; Whitehead et al, 1984; Whitehead and Steiner, 1985; Steiner and Whitehead, 1988; and Manning and Brothers, 1986).

Three genera, Aptosimum, Peliostomum and Polycarena sensu lato, have been recorded as being visited by masarids (Appendices 1 and 3). Whereas the associations between masarids and Polycarena sensu lato are casual those with Aptosimum and Peliostomum are close.

Aptosimum and Peliostomum are endemic to Africa. They are mainly southern African and, though widespread in this region, are concentrated in the western dry regions (Dyer, 1975). There are about 20 known species of Aptosimum and about seven known species of Peliostomum. They are prostrate or densely tufted, wiry herbs or undershrubs, usually with a deep tap root. The flowers, which are gullet flowers, are bluish violet or purplish violet.

Vogel (1975) based solely on corolla structure, gullet, and the colour, violet, hypothesized that Aptosimum and Peliostomum are melittophilous. In the present study four species of Aptosimum and two species of Peliostomum were observed for flower visitors. Preliminary observations on the relationship between masarids and Aptosimum and Peliostomum have been published (Gess and Gess, 1989).

The flowers (Figs 65 a and 67 a and d) are presented with the long axis sub-horizontal. The corolla is very narrow in the basal region protecting the nectaries from all but long-tongued or minute visitors. The greater part of the corolla tube is wider but the lower surface is inwardly saccate requiring all but the smallest visitors to push their way into the flower. There are four stamens in two pairs, a pair with relatively long filaments and a pair with relatively short filaments. The shorter pair of stamens is sterile in some species of Aptosimum. The anthers are adpressed in pairs and positioned dorsally in the flower. The style is positioned in a dorsal groove. In a freshly opened flower the stigma barely projects at the mouth of the corolla but with time the style elongates and curves downwards.

In order to be an effective pollinator of these flowers an insect visitor must be able to enter the flower but be large enough to receive a pollen load. Such an insect requires to have a "tongue" of sufficient length to reach the nectar at the base of the narrow inner portion of the corolla tube. It is likely that such a visitor is required to trigger the dehiscence of the anthers. An insect filling these requirements would when coming from a flower from which it had received a dorsal coating of pollen (Figs 65 c and d) and entering a flower with a downwardly presented stigma transfer pollen to it.

Aptosimum procumbens

Aptosimum procumbens, a prostrate much branched woody perennial, forms mats (Fig. 64 a) of 300 mm or over during periods of years with good rains but dies back in drought years. The corolla is bluish purple with a white throat and with each of the free lobes marked with darker violet at its base (Fig. 64 b). Flowering time is synchronized with rain and may be at its height in early or late summer.

A. procumbens was observed for flower visitors from October to December and in March at several sites in a karroid area to the north west of Grahamstown. The most abundant and regular visitor was a masarid Celonites clypeatus which was furthermore found to be carrying pure A. procumbens pollen in its crop. Less abundant were another masarid, Quartinioides tarsata, and an anthophorid, Ceratina sp. F. Uncommon and apparently casual visitors were a halictid Pachynomia glabiventris and a tiphiid.

Celonites clypeatus appears to be oligolectic, having otherwise been collected from flowers only of Aptosimum and Peliostomum species, at Twee Rivieren in the

Fig. 64. a - d. Aptosimum (Scrophulariaceae): (a and b) A. procumbens (b - x c 2); (c) A. spinescens (x c 2); (d) A. sp. K (x c 3).

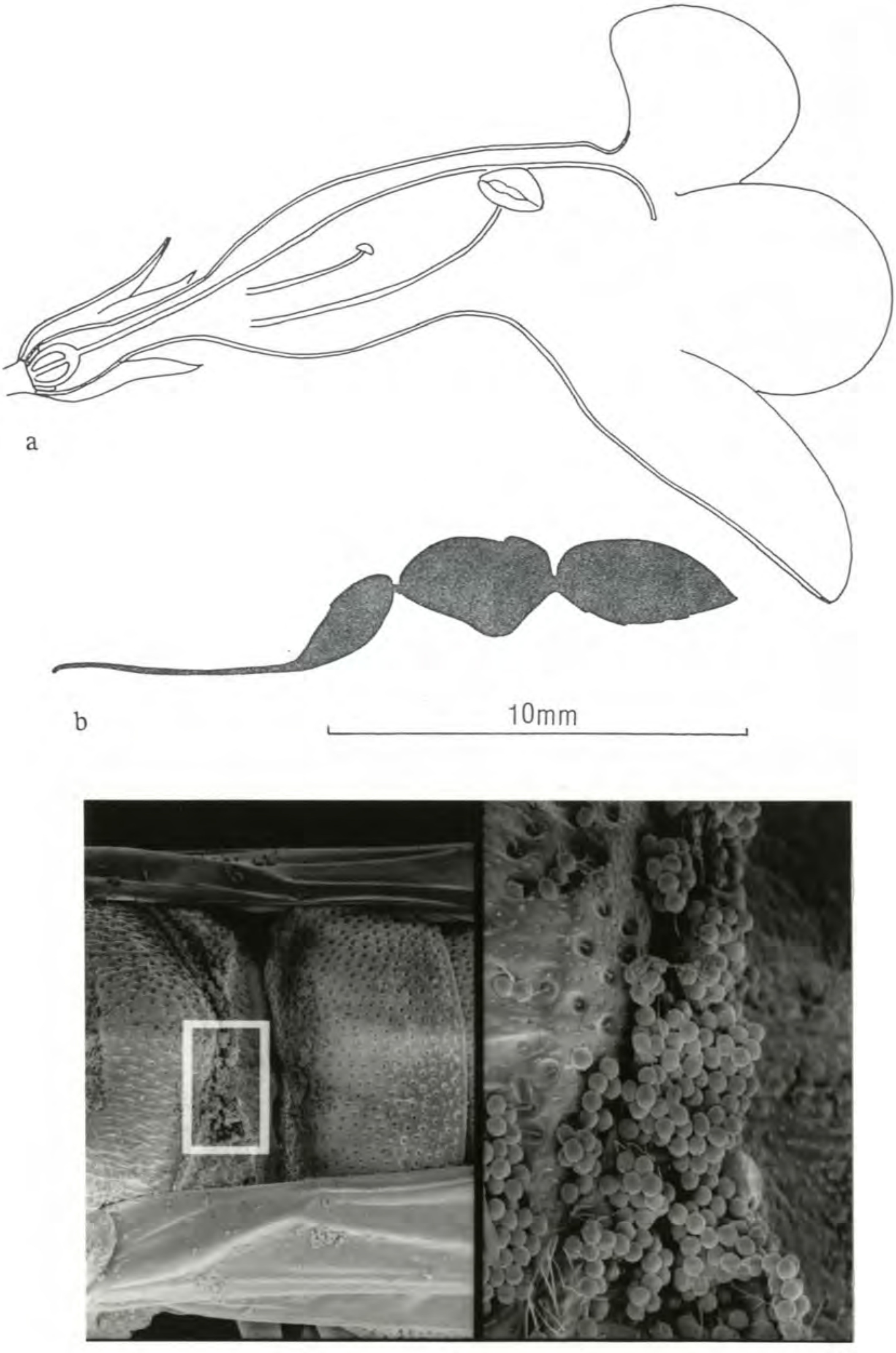


Fig. 65 a and d. (a) Aptosimum procumbens (Scrophulariaceae), simplified diagrammatic representation of longitudinal section of flower and (b) profile of Celonites clypeatus (legs and wings omitted) to demonstrate wasp/flower fit; (c and d) Celonites peliostomi, c. dorsal view of posterior end of thorax and anterior end of abdomen showing deposition of pollen (x 30), d. boxed area x 150.

southern Kalahari and near Springbok in Namaqualand. It is therefore a predictable visitor to Aptosimum and Peliostomum within its distribution range. In body size it fits the corolla snugly and its tongue, 5,8 mm long, is ideally suited to reaching nectar at the base of the narrow portion of the corolla, 5 mm long. C. clypeatus is clearly an ideal potential pollinator of A. procumbens.

Quartinioides tarsata is narrowly polylectic, having been collected not only from the flowers of Aptosimum and Peliostomum but also from flowers of Aizoaceae and Asteraceae. Furthermore its small size makes it possible for it to come and go from the flowers without receiving a pollen load or brushing against the stigma. It is thus an expected visitor but is not likely to be an effective potential pollinator.

Ceratina species F is similar in body size to Celonites clypeatus and is furthermore long-tongued. It is, however, polylectic, visiting in the Grahamstown district flowers of Asteraceae, Aizoaceae, Selaginaceae and Campanulaceae. It has also been recorded from Papilionaceae in the Clanwilliam district. Ceratina sp. F is thus an unreliable visitor to A. procumbens and although it would be possible for it to pollinate the flowers it is too unpredictable to be considered as an important potential pollinator.

Aptosimum spinescens

Aptosimum spinescens is a much branched spiny shrublet. The flowers are purplish violet with a dark purple marking centrally on each corolla lobe at the mouth of the corolla tube. Leading into and down the corolla tube from these purple markings are purple stripes on white (Fig. 64 c). Flowering time is synchronized with rain and may be at its height in early or late summer.

The flowers of A. spinescens were observed for flower visitors in the Goegab Nature Reserve, Springbok in Namaqualand during the second and third weeks of October and at Twee Rivieren in the southern Kalahari during the second week of March.

In the Goegab Nature Reserve the flowers were being visited solely by two Celonites species, C. peliostomi and C. andrei. During an uninterrupted period of observation from 10.30-11.30 am on 20.x.87, 12 instances of Celonites entering the flowers were recorded. The only other insect which approached the flowers was an anthophorid, Anthophora sp., which was too large to enter but momentarily hovered at the mouth of a flower. Of the voucher specimens taken randomly eight were of C. peliostomi and only one was of C. andrei. Pollen from the crop of a female C. peliostomi was examined and was found to be solely of pollen matching that of A. spinescens.

At Twee Rivieren the flowers were being visited most regularly and abundantly by the same two species of Celonites, C. peliostomi and C. andrei. One visit by a halictid, Nomioides sp. A was recorded. This bee was otherwise commonly visiting Deverra aphylla (Apiaceae).

Celonites peliostomi appears to be oligolectic, having otherwise been collected only from flowers of Aptosimum lineare and Peliostomum virgatum in the Goegab Nature Reserve, and from P. virgatum at Anenous and in the Nieuwoudtville district. It is therefore an expected and dependable visitor to Aptosimum and Peliostomum within its distribution range. In the Goegab Nature Reserve, where A. spinescens, A. lineare and P. virgatum were all flowering at the same time, mixed visits did not appear to be being made as the three flower species grow in different situations. In body size C. peliostomi fits the corolla of A. spinescens snugly and its tongue, 4,8-5,0 mm long, is ideally suited to reaching nectar at the base of the narrow portion of the corolla, 4,5 mm long. C. peliostomi is clearly an ideal potential pollinator of A. spinescens.

Aptosimum lineare

Aptosimum lineare is a densely tufted, long-leaved species with bluish violet flowers. It was observed for flower visitors in the Goegab Nature Reserve during the same periods that observations were made on A. spinescens and P. virgatum. Unlike these two species it received extremely few visits. Significantly, however, these were from Celonites. Only one specimen was taken. This was a male Celonites peliostomi, the same species as was the most common visitor to A. spinescens and P. virgatum.

Aptosimum sp. K

Aptosimum sp. K is a non-spiny shrublet. On opening the corolla is bluish violet with a white throat and very little, if any, sign of darker "honey guides" on the free lobes. As the day advances marked "honey guides" develop (Fig. 64 d) and later still they become obscured by the darkening of the throat. Each flower lasts only one day.

The flowers were observed for insect visitors at Twee Rivieren and at Kakamas during the second week of March. Insect visitation started only after the appearance of the "honey guides" but was at no time abundant. At Twee Rivieren two hymenopterans were recorded, a masarid, Celonites clypeatus, and an andrenid, Meliturgula sp. B. At Kakamas the observations were made only in the morning before the "honey guides" had developed and in the afternoon after the flowers had darkened and were beginning to fall. No insects were visiting in the morning and in the afternoon Meliturgula sp. B and monkey beetles were entering the flowers.

Celonites clypeatus in body size and tongue length is well suited to be a potential pollinator. The nature of the visits by Meliturgula are unclear. Of note is that these are short-tongued bees.

Peliostomum virgatum

Peliostomum virgatum is a sticky pubescent stringy herb bearing flowers abundantly on upright stems (Figs 66 a and b). The corolla is purplish violet and sticky. The free lobes are, at their bases, marked laterally with white and centrally with purple.

The flowers were observed for flower visitors at several sites in the Nieuwoudtville district during the first week of October, at Anenous during the second week of October, and at several sites in the Springbok district, in particular the Goegab Nature Reserve, during the second and the third weeks of October. They were being visited very abundantly and regularly at all the sites by Celonites peliostomi and in addition occasionally by C. andrei and C. clypeatus in the Goegab Nature Reserve and by Quartinioides tarsata at Anenous. The pollen contents of the crop of a female C. peliostomi foraging on P. virgatum was examined and found to be all of one type matching that of P. virgatum. As already stated, although C. peliostomi at the Goegab Reserve also visits A. spinescens and A. lineare, mixed visits did not appear to be being made as the three flower species grow in different situations.

All three species of Celonites have a good flower fit with respect to body size and tongue length and all are expected visitors. All are therefore potential pollinators of P. virgatum. C. peliostomi, however, seems to be the most commonly associated species.

Quartinioides tarsata is narrowly polylectic, having been collected not only from the flowers of Aptosimum and Peliostomum but also from flowers of Aizoaceae and Asteraceae. Furthermore its small size makes it possible for it to come and go

Fig. 66. a - d. Peliostomum (Scrophulariaceae): (a and b) P. virgatum (b - x c 3); (c and d) P. leucorrhizum (d - x c 3,5).

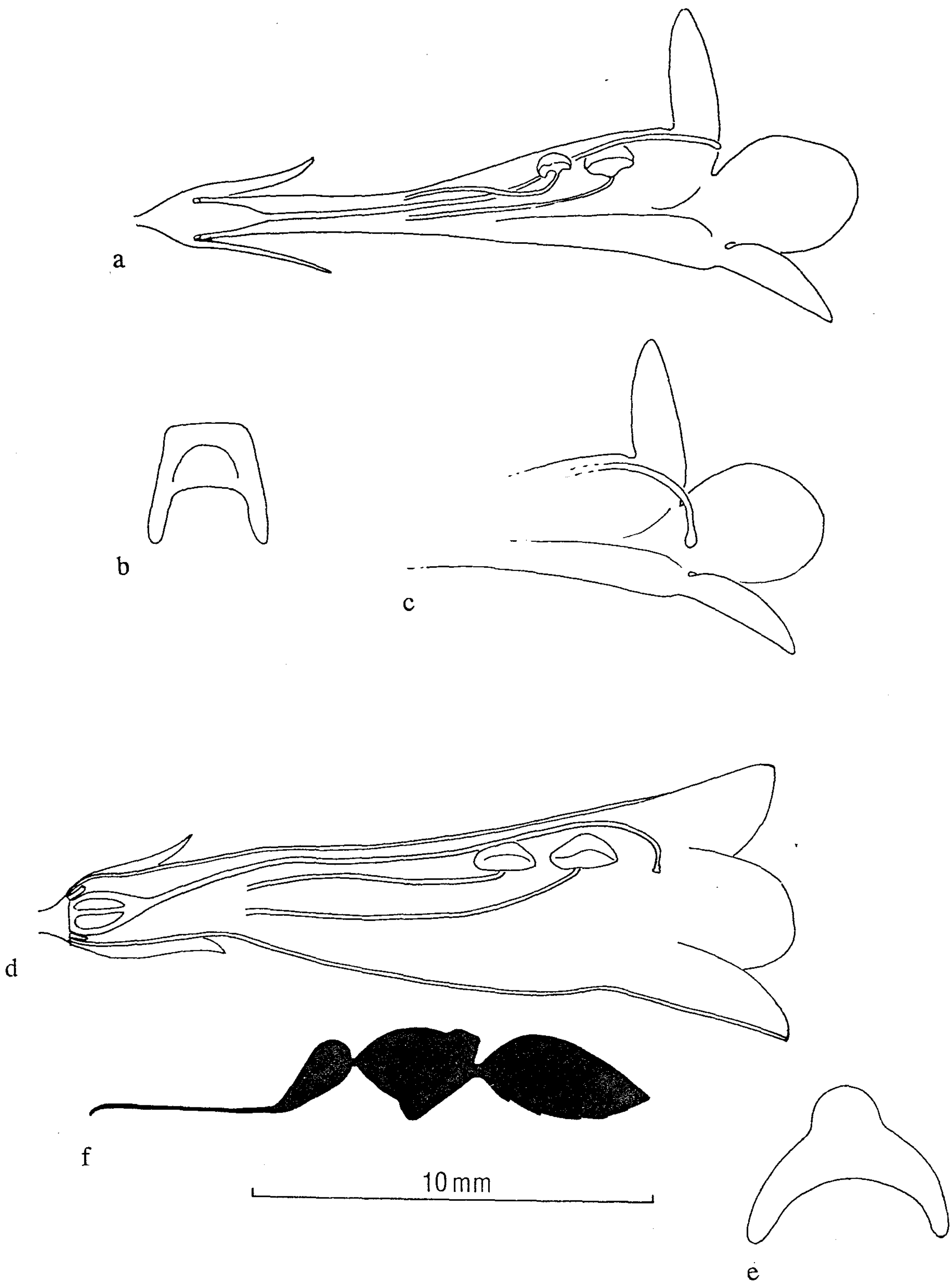


Fig. 67 a - f. (a - c) Peliostomum leucorrhizum (Scrophulariaceae), simplified diagrammatic representations of flower, a. longitudinal section before style elongation, b. cross section to show ventral invagination, c. partial longitudinal section after style elongation; (d and e) Peliostomum virgatum (Scrophulariaceae), simplified diagrammatic representations of flower, d. longitudinal section, e. cross section to show ventral invagination; (f) profile of Celonites peliostomi (legs and wings omitted) to demonstrate wasp/flower fit.

from the flowers neither receiving a pollen load nor brushing against the stigma. It is thus an expected visitor but is not likely to be an effective potential pollinator.

Struck (1990) also recorded visitors to P. virgatum. In addition to visits from Celonites peliostomi he recorded visits by two anthophorids, Anthophora diversipes and Amegilla niveata, and a visit by a megachilid, Megachile frontalis. The bodies of these bees are too large for them to be inserted into the corolla and although they have long tongues these are not nearly long enough for them to be able to reach the nectar source.

Peliostomum leucorrhizum

Peliostomum leucorrhizum is a much branched shrublet with strikingly pale grey to whitish stems (Figs 66 c and d). The flowers are bluish violet and markedly smaller than those of P. virgatum and the Aptosimum species considered here.

Flower visitors to P. leucorrhizum were observed at Williston in late September, and Kakamas and Twee Rivieren in early March. The most abundant and regular visitor at all three sites was Quartinioides tarsata. Three further species of Quartinioides were visiting in company with Q. tarsata at Twee Rivieren. They were, however, far less abundant.

Despite the fact that Quartinioides tarsata is narrowly polylectic, having been collected not only from the flowers of Aptosimum and Peliostomum but also from flowers of Aizoaceae and Asteraceae, it appears to be the most likely potential pollinator of P. leucorrhizum. The flowers of P. leucorrhizum are not visited by Celonites species which, due to their size, would not be able to gain entry. Q. tarsata gives a very good fit. When in position in the flower to take nectar the length of the tongue equals that of the narrow inner portion of the corolla tube, 5,8 mm and the waist between the thorax and the abdomen comes beneath the anthers.

Evaluation

Masarids were the principal visitors to the Aptosimum and Peliostomum species investigated. It is concluded that on the basis of behaviour in the flower, flower fit and dependability the masarids of the genus Celonites are the most important potential pollinators of A. procumbens, A. spinescens and P. virgatum and are probable potential pollinators of A. lineare and A. sp. K.

Furthermore on the basis of flower fit Quatrinioides tarsata appears to be the most important potential pollinator of P. leucorrhizum, the flowers of which are too small to admit the Celonites species. Q. tarsata is not, however, as dependable as the oligolectic Celonites species associated with Aptosimum and Peliostomum as it appears to be narrowly polylectic.

Discussion

Insect "pollination syndromes" have been defined (for example: Baker and Hurd, 1968; Faegri and van der Pijl, 1979; Whitehead, Giliomee and Rebelo, 1987; and Vogel, 1954). Accepted categories are: melittophily (bee and bee fly pollination, to which should be added some tabanids); myrmecophily (ant pollination); vespidophily (wasp pollination); myiophily (fly pollination); cantharophily (beetle pollination); psychophily (butterfly pollination); phalaenophily (settling moth pollination); rhinomyiophily (long-proboscid fly pollination); sphingophily (hovering moth pollination); sapromyiophily (carrion flower pollination). Such syndromes have been formulated by considering the characteristics of the flowers of the whole complex of flowers visited by the categories of insects giving their names to the syndromes. Characters usually listed relate to: time of anthesis; predominant colours; presence or absence of odour; nature of odour; flower shape; flower depth; presence or absence of nectar guides; presence or absence of nectaries; position of nectaries; and nature of nectar. Due, presumably, to the sparsity of information on flowers visited by masarids, these wasps have not been mentioned in discussions of pollination syndromes.

The "masarid pollination syndrome" based on the present knowledge of southern African masarids as flower visitors is characterized as follows:

> anthesis - masarids are all day-flying and consequently the flowers which they visit are open in the daytime, some are diurnal (closing at night);
>
> predominant colours - as a general rule masarids favour "light" coloured flowers - white, yellow, shades of pink (rarely puce and not red), violet (not purple and rarely blue);
>
> odour - lightly to heavily sweetly scented flowers are favoured. No

masarids have been recorded visiting flowers with fruity, aminoid or putrid scents;

flower form - both actinomorphic and zygomorphic flowers are included; shallow open flowers are almost entirely excluded; a colourful corolla is present in all but the Mesembryanthema in which it is absent but in which petaloid staminodes serve the same function; where present the corolla parts are fused forming a tube for the greater part of their length (Asteraceae, Campanulaceae and Scrophulariaceae) or are highly differentiated (Papilionaceae); flowers with tubular corollas are principally small, crowded into heads (Asteraceae), small to medium, of moderate length, presented singly or clustered and erect (Campanulaceae) or are horizontally presented gullet flowers (Scrophulariaceae);

nectar - nectaries or nectar producing tissue are present, more or less concealed, with the nectar protected from evaporation, covered by the stamens (Mesembryanthema), within the corolla tube (Asteraceae, Campanulaceae and Scrophulariaceae) or enclosed within the petals (Papilionaceae); the nectar being protected from evaporation is relatively non-viscose and can therefore be readily imbibed through the proboscis by "sucking" unlike exposed nectar which becomes viscose and must be "licked" (Kevan and Baker, 1983);

nectar guides - marked nectar guides are present in the gullet flowers.

From a consideration of the published definitions of the various insect pollination syndromes it is clear that the "masarid pollination syndrome" is not distinct but, though less broad, falls within the syndrome designated melittophily. Certainly the flowers recorded here as associated with masarids were all flowers assumed by Vogel (1954) to be melittophilous. This does not, however, mean that the flowers which masarids visit are necessarily equally efficiently serviced by bees and/or bee flies. Indeed the case studies considered in this chapter make it clear that, whereas the masarids visiting some flowers are members of a guild of flower visitors all of which are important potential pollinators, the masarids visiting others, most notably deep flowered Wahlenbergia species, Peliostomum and Aptosimum, are probably their most important potential pollinators. It is of particular note that these flowers are all violet in colour, the colour which in western North America is associated with Pseudomasaris pollinated Penstemon. Red Penstemon are pollinated by birds and blue Penstemon by bees (Torchio, 1974).

When considering the relative importance of masarids as members of a guild of pollinators it seems relevant to ask whether the masarids are always present in company with the other members of the guild or whether there are perhaps times or places when masarids are the sole or most abundant visitors. The studies considered in this chapter have shown that indeed at certain times and places masarids are the sole visitors or the most abundant visitors to many mesems of the carpet and cone flower types, to certain composites and to certain members of the Cape Group of the Crotalariae. This would indicate that there are conditions which favour masarids over the other members of the guilds. In some instances, at least, this may relate to the nature of the nesting requirements. It is also related to the degree of oligolecty shown by different members of a guild. Where flowers other than those investigated are in flower the less narrowly oligolectic and the polylectic members of the guild may select one of these other flowers. The narrowly oligolectic members of the guild, such as the masarids are under such conditions the most dependable visitors.

As noted in the introduction to this chapter, Richards (1962), when commenting on flower visiting by masarids, stated that "It may well be possible in the future to relate the structure of some of the genera to that of the flowers they visit and to the methods they use in exploiting them". The most notable structural modification of masarids for exploiting flowers is the development of long "tongues". The present study has demonstrated that tongue length and body size can be related to the structure of the flowers visited. This is most striking when the Celonites species associated with Peliostomum and Aptosimum are considered. Masarids are otherwise generally little modified for the exploitation of the flowers which they visit. Most of the southern African masarids have short curved legs used in pollen collection, most notably by visitors to composite capitula and mesems of the carpet flower types. Modification of the foretarsi of Trimeria buysoni for pollen collection from narrow tubular flowers of Verbenaceae has been recorded by Neff and Simpson (1985). Schremmer (1959) described button ended pollen collecting hairs on the frons of Celonites abbreviatus but examination of a specimen of this wasp (Gess and Gess, 1989) revealed that the frons is hairy but that the hairs taper towards their tips which are curved. It is clear from the case studies presented above that apart from tongue length and overall body size it is principally in behaviour that masarids "fit" the flowers which they visit.

In economic terms masarids may not be considered to be important pollinators in that they do not, like some of the indigenous megachilids, anthophorids and honeybees, play a role in pollinating plants of economic importance other than rooibos tea, Aspalathus linearis. Their role in the pollination of indigenous plants should not, however, be overlooked by those interested in the conservation of plant diversity.

8 Masarids and landuse

Considering that most species in the world are insects, it is remarkable that in the recent symposium Biotic Diversity in Southern Africa (Huntley, 1989) insects are barely mentioned and that the chapter "Conservation status of the fynbos and karoo biomes" (Hilton-Taylor and Roux, 1989) mentions only three insects, all pest species: the karoo caterpillar Loxostege frustalis, the brown locust Locustana pardalina and the harvester termite Hodotermes mossambicus. Is this perhaps a reflection of a prevalent apathy towards insects and a consequent lack of awareness of their presence unless they are responsible for large scale destruction? That there is the dawning of a general realisation that most species in the world are insects is suggested by Collins (1991) who states that:

> "In the past five years or so the biodiversity penny has dropped, and it is not just entomologists who now know that insects rule the world, even politicians appreciate the importance of insect diversity and ecology. They are asking what can be done to maintain global biodiversity? How can it be measured? What are the threats? Where should action be taken?"

In order to attempt to address such questions an intimate knowledge of the structuring of ecological systems is required. The present study makes it possible, at least for southern Africa, to indicate some of the effects of landuse on masarid diversity.

Masarids are particularly sensitive to habitat changes.

All masarids require the presence of their forage plants. As all are oligolectic or narrowly polylectic a very limited range of plants is acceptable. None is able to forage on the flowers of exotic crop plants.

Nesting success of nesters on plant stems, some Celonites species at least, may be adversely affected by unnaturally heavy browsing.

Ground nesters, Ceramius, Jugurtia, some Celonites species and some, if not all, of the species of the Quartinia species group cannot nest in soil which is subject to trampling.

Those using water for nest construction, Ceramius, Jugurtia and Masarina, require to nest within an energetically reasonable flying distance of the water source. The water must be clean and those species which collect water at the water's edge or from damp soil near the water's edge require there to be an undisturbed shallowly sloping "shore".

If one considers that in addition to a sensitivity to habitat change masarids mostly have very limited distribution ranges it is obvious that masarids are very vulnerable to extinction.

Land use in the context of this chapter is restricted in the main to agriculture, that is stock farming and the cultivation of crops, and does not therefore include mining, transport or habitation.

Historical landuse

Man as a migratory hunter gatherer in the Karoo is considered to have lived in natural balance with his environment. Although he had settlements which resulted in localized changes in the vegetation which persisted over at least 700 years (Sampson, 1986) he did not restrain the indigenous mammals nor introduce exotic species, nor did he cultivate crop plants. No domestication or herding of indigenous mammals occurred.

Herders of exotic species, sheep, goats and cattle entered the Karoo area from the north. The prehistory of Stone Age herders in the Cape Province is reviewed by Klein (1986). It is believed that domestic stock were introduced to the western and southern Cape at or shortly after 2 000 BP. The best documented stock in the western and southern Cape are sheep. Cattle occur much less often and may have been introduced somewhat later than sheep (?1 600-1 500 BP). Goats may have been relatively abundant in the northwestern Cape, at least after 800 BP. At Bethelsklip in the Succulent Karoo they have been identified from between about 800 BP and 360 BP (Webley, pers. comm.). Webley (1986) postulated that the Namaquas aggregated in large groups around permanent waterholes in the dry summer months and split into minimal herding units during the wet winter months. The missionary Shaw (1841) reported that the Namaquas who resided in the area of the Leliefontein mission station moved seasonally between the Kamiesberg (in the Succulent Karoo) in the summer and the coastal Sandveld in the winter.

These early herders do not seem to have penetrated into the Nama Karoo to any appreciable distance to the south of the Orange River or to the north of the southern Cape. Furthermore there does not seem to have been penetration of the area by the Iron Age agropasturalists coming down the east coast from the north. It would therefore appear that this area had not been subject to grazing by exotic domestic stock before these were introduced into the area by European pasturalists in the early Eighteenth Century.

By the end of Nineteenth Century the vast herds of naturally occurring grazing and browsing mammals had been shot out to give way to large scale stock farming. With the introduction of bore holes and windmill pumps it became possible to graze stock throughout the region on a year-round basis. This was followed by the fencing of farms in the early Twentieth Century.

The reduction in the numbers of indigenous large mammalian herbivores, their altered patterns of dispersion, and their replacement with domestic stock resulted in substantially altered intensities and patterns of defoliation which must have resulted in turn in large-scale changes in the vegetation. Unfortunately these changes are inadequately documented.

Present landuse

The Great Karoo

The Great Karoo, here taken in its widest sense to include all the karroid areas inland of the western and southern escarpments, now supports a profitable small stock industry which is in the main based on natural pastures.

The impact of small stock farming on the environment is variable. Variations in rainfall and vegetation dictate different choices of breed of goats or sheep and the number of head which can be supported. Furthermore which animals are run has a profound effect upon which plants are fed upon. Whether or not rotation is practised and what pattern of rotation is followed further affects the vegetation. For example in the Nama Karoo long term experimental grazing treatments have shown that on plots grazed in the summer only there is a marked increase in the dwarf shrub and decrease in the grass element whereas on plots grazed in the winter there is a marked decrease in the dwarf shrub element and increase in the grass element (Fig. 68 a) (Roux and Theron, 1987). Furthermore drought may cause high mortality of some species which, in the absence of continuous grazing, would re-establish after good rains. However, under current grazing practices, local extinction of species after drought is not uncommon, resulting in possibly irreversible changes in vegetation structure and composition (Roux and Theron, 1987). Many studies have aimed at assessing grazing capacities, especially since the launching of the National Grazing Strategy in 1985. Nearly all studies reflect excessive stocking rates, which together with injudicious veld management, is the cause of widespread degradation. It has been estimated that as much as 60% of the veld is currently in a poor condition (Scotney, 1988). The number, nature of and distribution of watering points is also variable and brings about different patterns of soil trampling. Clearly such variations in farming practice have a profound effect on the resources available to masarids and the other aculeate wasps and bees of the communities of which they are a part.

To a limited but ever increasing extent natural pastures are supplemented by the cultivation of lucerne pastures and lucerne hay. Lucerne production is restricted almost entirely to the generally very limited irrigable areas along water courses which are the favoured nesting areas of Ceramius and Jugurtia species and the only areas in which sizeable nesting aggregations of some thousands of nests develop. Plowing such land clearly has a devastating effect on populations of these masarids. Smaller aggregations do build up in association with farm dams and irrigation furrows, however, these are vulnerable to trampling. Furthermore, the water is liable to pollution by stock making it unacceptable to masarids which require clean water.

The Little Karoo

The Little Karoo, lying between the southern coastal mountains and the southern escarpment, an area of relatively high masarid species diversity (Fig. 7) is largely farmed for deciduous fruit with the Oudtshoorn area being the centre of ostrich farming. The ostriches, in the main, are pastured on lucerne lands in the irrigable river valleys resulting in the nesting areas of Ceramius, Jugurtia and, in this area, Masarina being reduced almost entirely to isolated patches often subject to trampling. Again water is liable to pollution making it unacceptable to masarids.

Namaqualand and the Olifants River Valley

The karroid areas to the west of the western escarpment can be divided into two regions, Namaqualand to the north of and including the Vanrhynsdorp district, and the Olifants River Valley to the south, both areas of relatively high masarid species diversity (Fig. 7) and endemism. Namaqualand is principally given over to small stock farming with, to the south of Springbok, opportunistic small scale grain production relying on winter rain. The greater area of the Olifants River Valley lies in karroid vegetation, however, the river rises in fynbos to the south in the Citrusdal district and passes through a mosaic of karroid scrub and dry fynbos in the Clanwilliam district (Moll et al., 1984). The river is strong flowing and perennial making the area ideally suited to irrigation farming. By 1732 European farmers were well established along the Olifants River as far north as its confluence with the Doorn River. With the construction of the Bulshoek Dam in 1922, the Clanwilliam Dam in the 1930s and a system of canals the valley has been intensively developed for the large scale production of citrus fruit, deciduous fruit, vegetables and vines. In the Vredendal district alone there are today more than 800 active land owners involved in the State's irrigation scheme and the largest co-operative wine cellar in the southern hemisphere.

It is notable that the area around Garies in Namaqualand previously known as a good collecting area for ground nesting species has in recent years been singularly unproductive. The ground has been severely damaged as a result of trampling by small stock making nesting by ground nesters impossible. Furthermore the species composition of the vegetation has been seriously affected, there having been a marked reduction in species diversity, the dominant plant now being Galenia africana (Aizoaceae) (Fig. 68 b). Owing to the fact that small stock do not utilize it, this plant, which is a pioneer, has increased and is now dominant in much of Namaqualand and the other semi-arid winter rainfall areas (le Roux and Schelpe, 1988).

Field experience has repeatedly demonstrated that Galenia africana is a plant that is unproductive of both phytophagous insects and flower visiting insects. It would appear to be as unattractive to insects as it is to small stock. In areas where it has become a dominant plant there will consequently have been a reduction in population sizes of and almost certainly a reduction in species diversity of masarids, indeed of insects overall. It is possible that the dramatic reduction in the populations of potentially important flower pollinating species, such as masarid wasps and solitary bees, may result in a reduction in seed set by their forage plants resulting in further loss of plant species diversity and consequently of insect diversity.

As water is required for nesting by excavators in non-friable soil it is relevant to consider available water sources in stock farming areas. Naturally occurring water sources are springs, rivers, temporary pans and temporary rain water puddles. These are supplemented by man-made earthen dams, contour furrows and water troughs fed from boreholes. In all instances water becomes unavailable if it is heavily polluted by drinking stock. Only species which alight on the water's surface are able to make use of water sources with steep sides. The impact of stock farming with respect to water on masarids is variable. Some practices have a negative effect and some a positive effect. Man's actions can cause marked temporary increases or decreases in population size. For example the construction of a small earthen dam in the Clanwilliam district resulted in the growth over a number of years of a large aggregation of thousands of nesting Ceramius socius whereas the subsequent destruction of this dam resulted in a dramatic reduction in the size of this localized population.

Crop production results in a complete change in the available resources. The soil structure and the plant cover of cultivated land are clearly different from those of uncultivated land. Where crops are farmed under irrigation, water sources are modified by changing water flow of rivers and by damming and furrow construction. The impact that cultivation will have on total species diversity clearly depends upon how extensive the cultivation is and how widespread the affected species are.

In those areas where patchy dry land cultivation is practised there is a mosaic of natural communities, cultivated areas in which the vegetation has been replaced by exotics and in which the insects have been in the main excluded by the destruction of their habitats, and fallow land with a small number of pioneer plants and the insects associated with them (Figs 68 b, d and e, and 69 a and b).

Dry land cropping is mainly practised in the winter rainfall areas, in particular south of Springbok in Namaqualand and to the west of the Olifants River Valley. Extensive areas have been ploughed for the opportunistic production of wheat (Figs 68 b, c and f). Replacement of the species rich vegetation with a single graminaceous species results locally in almost total insect species loss. When such lands are left fallow or abandoned, pioneer plants come in. Initially a limited range of annuals predominate, often forming almost pure stands. These annuals are species which are present but uncommon in the species diverse communities of the surrounding undisturbed areas. An increase in population size of the insect species associated with these plants and a decrease in species diversity as compared with that of the surrounding areas results. This effect is strikingly demonstrated by the

Fig. 68 a - f. (a) Grootfontein, eastern Nama Karoo, showing two plots one grazed in winter only and the other in summer only; (b) Killian's Pass, Namaqualand, Galenia africana an indicator of overgrazing in the foreground, a fallow field colonized by "daisies" in the middle distance, wheat lands beyond; (c and d) Kamieskroon district, Namaqualand, c. dry land wheat, d. fallow field colonized by daisies; (e) Clanwilliam district, to the west of the Olifants River Valley, strip cultivation of wheat in the middle distance, fallow land colonized by Herrea sp. (Aizoaceae) in the foreground; (f) Graafwater district, Sandveld, strip cultivation of dry land wheat.

Fig. 69 a - f. **(a and b) between Clanwilliam and Graafwater, fallow field, note dominance of <u>Wahlenbergia annularis</u>; (c and d) Olifants River Valley, c. extensive irrigation farming, d. strip plowing of <u>Ceramius metanotalis</u> nesting area; (e and f) south of the Olifants River Mountains, e. extensive land cultivation, f. water course invaded by exotic <u>Acacia</u> spp. and pine plantations on mountain slopes.**

wasp and bee species associated with a complex of sympatrically occurring Wahlenbergia species. A number of species with deep flowers are principally visited by several species of Masaridae whereas a shallow flowered species W. annularis is principally visited by two species of Melittidae. Areas in which the deep flowered Wahlenbergia species were formerly abundant and W. annularis was uncommon have been cultivated and then allowed to go fallow. In these areas W. annularis is now the dominant plant (Figs 69 a and b) which has resulted in the masarids being displaced and the melittids having become unnaturally abundant. As on overgrazed land in this area, the first perennial colonizer is Galenia africana and this rapidly becomes the dominant species resulting in a further change in insect representation.

In the Olifants River Valley where crops are farmed under irrigation, cultivated land is concentrated on the old flood plains and immediately adjacent areas. As water is available throughout the year planting time, growing period and success of fertilizer application are not limited by timing and amount of rain. This results in an intensive and continuous use of land for crop production. The use of ever larger multi-span self-propelled overhead sprinklers has resulted in ever larger lands and a consequent continuing loss of unploughed land (Fig. 69 c).

The areas most suited for large scale cultivation are the same areas which are, due to the availability of water, particularly suited for intensive nesting by masarids, indeed by a wide range of aculeate wasps and bees. Ploughing, vegetation clearing and replacement with a limited range of crop plants, most of which are exotics, and application of "artificial out of season rain" results in localized extermination of entire communities. The extent of the cultivated areas and of the distribution ranges of the aculeate wasps and bees will govern the overall extent of this loss. Where there is rapid expansion of land under cultivation and where there is a high incidence of endemism, as with the masarids, multiple species loss is anticipated. Five species of Ceramius with limited distributions centred on this area immediately come to mind. One of these five species is C. metanotalis which, though it forages on a relatively widespread plant, Athanasia trifurcata, is only known to nest in a limited area on the slopes above the Olifants River between Clanwilliam and Klawer. The area has been ploughed in strips (Fig. 69 d). The forage plants remain on the unploughed strips. The wasps nest on the access road and forage along the strips. Elsewhere along the river, fields are ploughed without strips. Should there be a change to such a ploughing pattern Ceramius metanotalis would be endangered.

Masarid wasps forage beyond the limits of their nesting sites. It is therefore possible to have a situation where, in an intensively cultivated area, suitable nesting sites for some species may remain on the fringes of these areas but that the forage plants are no longer available. Unlike some megachilid and anthophorid bees which are able to forage on exotic leguminous crops no masarid wasps transfer to crop plants.

Localized large scale flooding of land resulting from the damming of rivers clearly results in localized extirpation of whole communities of bees and aculeate wasps as a result of total habitat destruction. The availability of water for nesters on the fringes of large water bodies is dependant on the nature of the terrain, inlets with gently sloping shores and still water being more suited to aculeate wasps and bees which collect water or mud than are shores subject to wavelet action. Steep sided water bodies are unavailable to the majority of species. Furthermore the water in irrigation canals with steep concreted sides and rapidly flowing water is not available to aculeate wasps and bees and therefore such canals do not represent additional water sources.

The southwestern Cape

To the south of the Olifants River Mountains only small pockets of indigenous vegetation remain, almost all the land between the mountains which can be plowed having been given over to agriculture (Fig. 69 e), in the main to the production of wheat, grapes for wine, and deciduous fruit. Only small isolated pockets of unploughed land remain as refuges. River valleys are to a large degree infested with exotic weed species, most notably Australian Acacia species and Sesbania. Mountain slopes in some areas have been planted with pines (Fig. 69 f) and are generally increasingly subject to invasion by exotic weed species. Clearly in the area from the Olifants River Mountains to the Cape Peninsula the future for masarids is bleak. Two examples serve to illustrate this. Ceramius caffer which is endemic to this area and was previously recorded from the Stellenbosch and Tulbagh areas is now known, despite extensive search, only from Ceres and Bot River at the eastern fringe of its distribution. Similarly Ceramius richardsi is only known from two widely separated localities one in the Citrusdal district in the southern Olifants River Valley and the other in the extreme southwestern Cape at Philadelphia. Though other refuges for these two species surely exist they are undoubtedly small in area and widely separated making these two species highly vulnerable to extinction.

Conservation status

Hilton-Taylor and le Roux (1989) reviewed the conservation status of the Fynbos and the Karoo, the main areas of distribution of the masarids. They established that of the five Acocks' Veld Types included by them in the Fynbos less than 1% to 26% is conserved and that of all the Acock's Veld Types of the Karoo Biome, 21 occurring in the Nama Karoo and seven in the Succulent Karoo, excepting three, less than 1% is conserved. Six Veld Types have no portions conserved in state, semi-state or private conservation areas. The siting of many reserves has generally been purely opportunistic or arbitary, that is without regard to the distribution of plant endemics and threatened taxa. Furthermore most of the areas when declared were already degraded.

Whether or not these conservation areas include masarids is purely a matter of chance.

Reduction in population size or loss of masarids will inevitably result in reduction in population size or loss of dependent associates, most notably their chrysidid parasites. It should also be born in mind that the effects of landuse which result in the decline of masarids will inevitably and simultaneously be resulting in the decline of the whole communities of aculeate wasps and bees of which they are a part, the number of species which are able to continue to make a living in man-made habitats being but a fraction of those of natural habitats.

SECTION 3:

Summary of sections 1 and 2, and references

9 Summary of sections 1 and 2

Biogeography

Masarid wasps mostly favour warm to hot areas with relatively low rainfall and open scrubby vegetation. Records are concentrated in Mediterranean and temperate to hot semi-arid areas outside the tropics, none are further north than 50°N or further south than 50°S and none are from eastern North America or eastern and southern Asia.

The subfamily Gayellinae is restricted to the Neotropical Region whereas the subfamily Masarinae is more widespread, being represented in the Nearctic, Neotropical, Palaearctic, Afrotropical and Australian regions. Within the Masarinae the tribe Paragiini is endemic to the Australian Region. The tribe Masarini on the other hand is absent from the Australian Region but is represented in the Palaearctic, Afrotropical, Neotropical and Nearctic regions. At the generic level the Masarini of the Nearctic and Neotropical regions are distinct from each other, and from those of the Palaearctic and Afrotropical regions combined. Four genera are common to the Palaearctic Region and to southern Africa within the Afrotropical Region, however, there are no shared species. A fifth genus is endemic to the Palaearctic and three further genera are endemic to southern Africa within the Afrotropical Region.

It would appear that southern Africa is the area of greatest species diversity and that in this region, at least, there is a high incidence of narrow endemism.

Whereas the adoption of provisioning with pollen and nectar by the sphecoids lead to a group, the bees, which has a worldwide distribution including a broad range of biomes, the adoption of provisioning with pollen and nectar by the vespoids lead to a group, the masarids, which though present in five zoogeographical regions is within those regions markedly restricted to a narrow range of biomes.

Flower associations

Female masarids like all non-parasitic bees visit flowers to collect pollen and nectar for provisioning their nests and like most non-masarid aculeate wasps and bees both male and female collect nectar for their own nourishment.

Pollen for provisioning is ingested and carried in the crop. Generally the pollen is drawn towards the mouth by the short curved front legs or is taken by mouth directly from the anthers.

Masarids differ from the majority of wasps in that most have long tongues, some considerably longer than the length of the wasp from the frons to the tip of the abdomen. The masarids, like the long-tongued bees, therefore have the potential to obtain nectar from a wider range of flower forms than do short-tongued wasps and bees.

Masarids are associated with a relatively small range of the flower families visited by aculeate Hymenoptera.

Where sufficient records are available distinct major preferences are shown between zoogeographical regions: Nearctic - Hydrophylaceae (92%) and Scrophulariaceae (31%); Afrotropical Region - Aizoaceae (45%), Asteraceae (41%), Campanulaceae (18%), Scrophulariaceae (13%) and Papilionaceae (7%); Australian Region - Myrtaceae (50%) and Goodeniaceae (47%). Relatedness of plant preferences between zoogeographical regions is more apparent when relatedness of plant taxa is considered. Within a region there is marked overlap in masarid generic preferences for flower families. At the specific level there is marked oligolecty and narrow polylecty.

Distribution of areas of species richness of masarids and Mesembryanthema (Aizoaceae) in southern Africa coincide strikingly. Oligolectic species in some instances at least, are more narrowly endemic than their forage plants.

Life history

Masarids in general appear to be univoltine. The flight period in winter rainfall areas is spring to early summer and in spring and autumn or summer rainfall areas is early summer to late summer.

There is specific variation in mate location strategies. Any one species may practise one or more strategies. Males search for females in the vicinity of nests, at water sources or forage plants or practise "hilltopping".

The majority of nesting studies indicate that nest construction, egg laying and provisioning are performed by a single female per nest, however, nest sharing has been alleged for two species.

No parasitic masarids have been recorded.

Egg laying precedes provisioning. A single egg is laid per cell, either free or glued to the cell wall.

The provision is composed of pollen and nectar and is either wet and sticky with no definite form or is a firm "loaf". Mass provisioning appears to be the general rule.

The overwintering stage is the last instar larva which after it has finished feeding spins a cocoon, and then enters a resting prepupal phase.

Nest guarding behaviour by males is practised by some species but not by others.

There are no records of sleeping aggregations. Sleeping and sheltering in the nest is commonly practised by females but seems to be rare amongst males. Sleeping and sheltering in flowers or on plant stems has been recorded for both females and males of several species.

Nesting

According to species, nests are sited in the ground, in non-friable soil or friable soil, in earthen vertical banks, on stones or on plants.

The masarids for which nesting is known almost all construct their nests in their entirety. Only one masarid is known to nest in a pre-existing cavity in which it constructs cells.

No temporary nest closures are constructed.

Seven nest types can be defined:

Nest Type 1 - a multicellular sub-vertical burrow in horizontal to sub-horizontal ground excavated by the nester, with an entrance turret constructed from earth extracted from within the burrow but with the excavated cells not containing constructed cells.

Nest Type 2 - a multicellular sub-horizontal burrow in vertical to sub-vertical ground excavated by the nester, with an entrance turret constructed from earth extracted from within the burrow, and with the walls of each excavated cell lined with cemented earth excavated within the burrow.

Nest Type 3 - a multicellular sub-vertical burrow in horizontal to sub-horizontal ground excavated by the nester, with or without an entrance turret constructed from earth extracted from within the burrow, and with each cell containing a constructed cell formed from earth excavated within the burrow.

a. the main shaft terminating in a cell.

b. the main shaft not terminating in a cell.

Nest Type 4 - a group of constructed cells attached to plant stems or stones.

Nest Type 5 - constructed cells located in a pre-existing cavity; with soil for cell construction collected from a quarry site at some distance from the nest.

Nest Type 6 - a self-excavated sloping burrow in friable soil with an excavated cell in which is an earthen cell constructed from soil collected from a quarry site at some distance from the nest.

Nest Type 7 - a sub-vertical silk-lined burrow in friable soil, surmounted by a silk and sand turret and having an excavated cell in which is a constructed sand and silk cell.

Three bonding agents, water (nest types 1, 2, and 3), nectar (Nest Type 4 and almost certainly 5 and 6), and silk (Nest Type 7) are known to be used by masarids in nest construction.

Nesters in non-friable soil using water extract the soil solely by using the mandibles. The excavator in friable soil rakes out the soil with the aid of foretarsal rakes.

A possible evolutionary sequence is discernable from from ground nesting to aerial nesting - Nest Type 1 -> Nest Type 3 -> Nest Type 4 - with a return to the ground - Nest Type 4 -> Nest Type 5 -> Nest Type 6.

Associates

Ectoparasites

Mites, probably of the family Saproglyphidae, are only known to be associated with the genus Ceramius in which they are restricted to species of groups 2, 3 and 6. They are apparently present throughout the life cycle of the wasps with which their own life cycle is synchronized.

Endoparasites

Strepsiterans have been recorded as parasites of the genus Paragia but of no other masarids.

"Parasites" in nests - Mutillids have been reared from the cocoons of some masarid wasps. These are not, however, specifically parasites of their hosts, but rather appear to be associated with a particular ecological niche and to attack suitable host species found within that niche.

Four genera of chrysidids have been found associated with masarid nests. Allocoelia of the monogeneric tribe Allocoeliini is restricted to the Afrotropical Region. Evidence suggests that it is solely associated with masarids. Two genera of Chrysidini - a western North American genus, Chrysurissa, and a Palaearctic and Afrotropical genus, Spintharina - seem to be closely associated with masarids. Of the large and widely distributed genus Chrysis, otherwise recorded from a wide range of hosts, three species have been recorded from masarids.

There is a single record of an apparent association between a chalcid and Pseudomasaris and of several records of apparent associations between gasteruptiids and paragiines.

The larvae of a meloid Ceroctis groendali (Lyttinae: Mylabrini) feed on the provision and larvae of Ceramius lichtensteinii.

Nest usurpers - In southern Africa ground nesting masarids are subject to usurpation of nests by megachilid bees. These bees are not, however, restricted to masarid nests.

Predators of adult masarids - There are no records of predators which prey specifically on masarids. They have, however, been listed as prey of sphecoids which provision with mixed hymenopteran prey. It is highly likely that they also fall prey to birds, robber flies (Asilidae), assasin bugs (Reduviidae), mantids (Mantodea) and crab spiders (Thomisidae).

Masarids as potential pollinators

An evaluation of masarids as potential pollinators of their forage plants in southern Africa has shown that:

> The behaviour of masarid wasps on flowers of melittophilous Aizoaceae makes them efficient potential pollinators of these flowers.
>
> The flowers of Asteraceae are serviced by guilds of potential pollinators. Where they are abundant masarid wasps associated with Asteraceae are important members of these guilds.
>
> The Cape Group of the Crotalarieae is serviced by guilds of potential pollinators. Where they are abundant masarids associated with these plants, in particular with Aspalathus are probably important members of these guilds.
>
> There is a strong mutualistic association between deeply campanulate Wahlenbergia and Microcodon (both Campanulaceae) flowers and certain masarid wasps but not with shallowly campanulate Wahlenbergia flowers which are associated with certain melittid bees.
>
> There is a strong mutualistic and possibly exclusive association between certain masarid wasps and Aptosimum and Peliostomum (Scrophulariaceae).

The "masarid pollination syndrome", though less broad falls within that designated melittophily (the bee and bee-fly pollination syndrome). This does not, however, mean that the flowers which masarids visit are necessarily equally efficiently serviced by bees and/or bee-flies.Indeed the case studies considered make it clear that whereas the masarids visiting some flower groups are members of a guild of flower visitors all of which are potential pollinators the masarids visiting others are probably their most important pollinators.

Masarids and landuse

Masarids must be subject to population reduction and ultimately species loss in areas of intensive stockfarming and land cultivation resulting from:

> loss of forage plants due to overgrazing, seasonal grazing patterns which bring about changes in plant communities, and land clearing;
>
> destruction of ground nesting sites by excessive trampling, tilling of the land or flooding and of plant nesting sites by heavy browsing;
>
> unavailability of water as a result of damming, canalizing, pollution and trampling of the "shore".

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ECOLOGY AND NATURAL HISTORY OF THE MASARID WASPS OF THE WORLD WITH AN ASSESSMENT OF THEIR ROLE AS POLLINATORS IN SOUTHERN AFRICA (HYMENOPTERA: VESPOIDEA: MASARIDAE)

THESIS

Submitted in fulfilment of the requirements for the Degree of DOCTOR OF PHILOSOPHY of Rhodes University

by

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Volume 2: Section 4: Appendices

December 1992

SECTION 4:

Appendices

APPENDIX 1

Catalogue of flower visiting records for solitary aculeate Hymenoptera within the distribution range of the Masaridae in southern Africa

Introductory notes

The classification and order of presentation of groups - superfamilies, families, subfamilies and tribes (the latter two taxa being given for Apoidea only) - of aculeates follows Krombein et al (1979). The genera and species of aculeates are arranged alphabetically.

The families represented in the catalogue are listed below with the numbers of species represented in parenthesis and the starting page numbers ending the relevant lines.

(Total number of species - 616+)

The family names of the forage plants follow Cronquist (1987 as given in Jones and Luchsinger, 1987). Alternative names are given in parenthesis, where they are considered to be helpful. The generic and specific names follow those given in the list of species of southern African plants produced by the Botanical Research Institute (Gibbs Russel et al, 1987). For each hymenopteran species listed the the relevant plant families, genera and species are arranged alphabetically.

The bulk (7 179, i.e. 92 %) of the collecting records (7 780 excluding the "m" records) are those of D.W.Gess, F.W.Gess, H.W.Gess, R.W.Gess and S.K.Gess who have together purposefully collected in the semi-arid areas of southern Africa. The specimens derived from this survey are lodged in the collection of the Albany Museum. To these have been added other relevant records from label data on specimens in the Albany Museum collection (collectors of these specimens are C.F.Jacot Guillarmod, J.G.H.Londt, E.McC.Callan, M.Struck, T.F.Houston and A.J.S.Weaving). Additional records for masarines have been added from label data from the South African Museum collection (collectors C.D.Michener and V.B.Whitehead) and from published records (those from O.W.Richards and R.E.Turner).

Although full locality details are recorded on most of the specimen labels the localities are given in the catalogue by district, mostly expressed as the name of the nearest town, as it is more informative for the present purpose to group the localities.

The tabular form of the catalogue necessitates the use of abbreviations. These are:

Colours:	B - blue; C - crimson; O - orange; Pi - pink; Pu - purple; PuPi - purplish pink; V - violet; W - white; Y - yellow; WY - cream.
Sex:	F - female; M - male.
Numbers:	digits - numbers of specimens captured; m - many observations of visits to flowers; p - pollen from provision representing an unknown number of visits to flowers.
Collectors:	AJSW - A.J.S.Weaving; CDM - C.D.Michener; CFJG - C.F.Jacot Guillarmod; DWG - D.W.Gess; EMcCC - E.McC.Callan; FWG - F.W.Gess; HWG - H.W.Gess; JGHL - J.G.H.Londt; MS - M.Struck; OWR - O.W.Richards; RET - R.E.Turner; RWG - R.W.Gess; SKG - S.K.Gess; TFH - T.F.Houston; WHRG - W.H.R.Gess.

BETHYLOIDEA
CHRYSIDIDAE

Allocoelia Mocsáry						
Allocoelia bidens Edney						
Asteraceae (Compositae)						
Senecio L.						
S. rosmarinifolius L.f.	Y	-	1	Oudtshoorn	FWG	7-8.xii.86
Allocoelia capensis (Smith)						
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	-	5	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Senecio L.						
S. rosmarinifolius L.f.	Y	F	5	Oudtshoorn	FWG,HWG&RWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	9	Oudtshoorn	FWG,HWG&RWG	7-8.xii.86
Allocoelia glabra Edney						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	-	1	Nieuwoudtville	FWG	3-8.x.89
Asteraceae (Compositae)						
Cotula L.						
C. sp.	Y	-	1	Nieuwoudtville	FWG&SKG	27.ix.90
Allocoelia minor Mocsáry						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	F	2	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata L. (L.)	Y	F	1	Clanwilliam/ Klawer	FWG&SKG	9-10.x.90
Allocoelia mocsaryi (Brauns)						
Aizoaceae: Mesembryanthema						
Stoeberia Dinter & Schwant.						
S. sp.	Pi	-	3	Aggenys	DWG	14.x.88
Brugmoia Radoszkowski						
Brugmoia binodata (Edney)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Brugmoia torrida (Mocsáry)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	17-25.i.70
Chrysis Linnaeus						
Chrysis cf. alecto Edney						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	3	Twee Rivieren	FWG&SKG	8-11.iii.90

Chrysis alternans Dahlbom						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	-	9	Grahamstown	FWG,DWG&RWG	28.xii.86-3.i.87
Chrysis aurifascia Brullé						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Chrysis catagrapha Buysson						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	-	3	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	-	6	Clanwilliam	FWG&SKG	9.x.90
Senecio L.						
S. sp.	Y	-	6	Grahamstown	FWG,DWG&RWG	31.xii.86
Chrysis lincea Fabricius						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	23.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	-	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	-	1	Colesberg	DWG	17.i.85
Chrysis malachitica Dahlbom						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Chrysis meadewaldoi Mocsáry						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	-	26	Twee Rivieren	FWG&SKG	8-11.iii.90
Chrysis mionii Guérin-Méneville						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	-	7	Grahamstown	FWG,SKG&DWG	28.xii.86-31.xii.86
Chrysis nasuta Mocsáry						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	3	Twee Rivieren	FWG&SKG	8-11.iii.90
Chrysis oxygona Mocsáry						
Asteraceae (Compositae)						
Senecio L.						
S. rosmarinifolius L.*f.*	Y	-	3	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.*f.*	Y	-	4	Oudtshoorn	HWG	7-8.xii.86
S. rosmarinifolius L.*f.*	Y	-	1	Oudtshoorn	RWG	7-8.xii.86
Chrysis porphyrophana Mocsáry						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	2	43km ENE Ceres	RWG	2-3.xii.89

Chrysis splendens Dahlbom						
Asteraceae (Compositae)						
Senecio L.						
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Chrysis stilboides Spinola						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	24.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	-	4	Colesberg	DWG	17.i.85
Chrysis wahlbergi Dahlbom						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	1	Grahamstown	DWG	28.xii.86
Chrysis sp. Kalahari D.						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	-	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Elampus Spinola						
Elampus guillarmodi Kimsey						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	3-7.x.88

Hedychridium Abeille						
Hedychridium latifrons Edney						
Elatinaceae						
Bergia L.						
B. glomerata L. f.	WY	F	7	Grahamstown	FWG&SKG	20.xi.90
B. glomerata L. f.	WY	M	4	Grahamstown	FWG&SKG	20.xi.90

Hedychrum Latreille						
Hedychrum coelestinum Spinola						
Asteraceae (Compositae)						
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Senecio L.						
S. sp.	Y	F	1	Grahamstown	RWG	31.xii.86
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85
Hedychrum exspectatum Edney						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	-	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87

Parnopes Latreille						
Parnopes fischeri Spinola						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. &	Y	F	4	Twee Rivieren	FWG&SKG	8-11.iii.90
Schlechtd.) DC.	Y	M	8	Twee Rivieren	FWG&SKG	8-11.iii.90
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	3	Prince Albert	FWG,SKG&RWG	26.xi- 5.xii.86
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	M	12	Twee Rivieren	FWG&SKG	8-11.iii.90
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	1	60 km ENE Ceres	RWG	3.xii.89
Senecio L.						
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	RWG	7-8.xii.86
S. sp.	Y	F	2	Prince Albert	FWG,SKG&RWG	26.xi-
S. sp.	Y	M	2			5.xii.87
Pseudospinolia Linsenmaier						
Pseudospinolia ardoris Kimsey						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata L. (L.)	Y	F	1	Clanwilliam/Klawer	FWG&SKG	9-10.x.90
Spintharina Semenov						
Spintharina sp. nr bispinosa (Mocsáry)						
Asteraceae (Compositae)						
Senecio L.						
S. rosmarinifolius L. f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
Spintharosoma Zimmermann						
Spintharosoma chrysonota (Dahlbom)						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	2	43km ENE Ceres	RWG&HWG	2-3.xii.89
A. sp.	Y	M	1	43km ENE Ceres	RWG&HWG	2-3.xii.89
Senecio L.						
S. rosmarinifolius L. f.	Y	F	1	Oudtshoorn	FWG	7-8.xii.86
Spintharosoma destituta (Dahlbom)						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	3	43km ENE Ceres	FWG,SKG,HWG	2-3.xii.89
A. sp.	Y	M	1		&RWG	
Stilbum Spinola						
Stilbum cyanurum (Förster)						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Matroosberg Station	HWG	4.xii.86
"mesem"	W	F	1	Matroosberg Station	RWG	4.xii.86

Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	25.x.87
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	4	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	3	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	F	1	Grahamstown	DWG	4.i.78

SCOLIOIDEA
TIPHIIDAE

Anthobosca Guérin-Méneville						
Anthobosca erythrosoma (Cameron)						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Montagu/ Matroosberg	FWG	4.xii.86
"mesem"	W	M	1	Montagu/ Matroosberg	FWG	4.xii.86
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	5	Prince Albert	FWG,SKG&RWG	26.xi-
A. buchenaviana Schinz	WY	M	1			5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L. f.	Y	F	1	Grahamstown	FWG&SKG	2.xii.79
A. filiformis L. f.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	DWG	20.xii.77
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	DWG	2.xii.77
S. sp.	W	M	1	Grahamstown	DWG	2.xii.77
S. sp.	W	M	1	Grahamstown	FWG	20.xii.77
Anthobosca sp. Kalahari						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Meria Illiger						
Meria cf. basutorum (Turner)						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	15.xi.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	5.xii.80
Meria cf. braunsi (Turner)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A. W. Hill	Y	M	1	Grahamstown	FWG	5.ii.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	5	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Meria cf. limata (Smith)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	36	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L. f.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	4	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	2	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Celastraceae						
Maytenus Molina						
M. linearis L. f. Marais	WY	M	2	Grahamstown	FWG	16.xi.77
M. linearis L. f. Marais	WY	M	1	Grahamstown	FWG	22.xi.77
M. linearis L. f. Marais	WY	M	1	Grahamstown	FWG	6.xii.77
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
E. crispa (Thunb.) Guerke	WY	M	1	43 km ENE Ceres	HWG	2-3.xii.89
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	WY	M	1	Grahamstown	HWG	14.xii.82
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
Selaginaceae						
Selago L.						
S. sp.	W	M	5	Grahamstown	FWG	18.xii.75
S. sp.	W	M	1	Grahamstown	DWG	2.xii.77
S. sp.	W	M	4	Grahamstown	FWG	20.xii.77
Meria cf. perornata (Turner)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	3.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	11.i.77
A. karroo Hayne	Y	M	2	Grahamstown	DWG	21.xii.77

Meria rufinodis (Turner)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	12	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.i.77
Zygophyllaceae						
Sisyndite E. Mey.						
S. spartea E. Mey.	Y	M	1	Vioolsdrif	FWG&SKG	3.x.85
Meria rufifrons (Fabricius)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A. W. Hill	Y	F	2	Grahamstown	CFJG	24.i.70
F. vulgare A. W. Hill	Y	F	2	Grahamstown	JGHL	17-25.i.70
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	1	Grahamstown	FWG	5.xii.80
Selaginaceae						
Selago L.						
S. sp.	W	M	1	Grahamstown	DWG	2.xi.77
Meria sp. A						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	9	Grahamstown	FWG	10-15.xi.77
Celastraceae						
Maytenus Molina						
M. linearis (L.*f.*) Marais	WY	M	1	Grahamstown	DWG	6.xii.77
Meria sp. B						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	4	Grahamstown	FWG	3-10.xi.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	SKG	3.iii.78
Meria sp. F						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	49	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. sp.		M	2	43 km ENE Ceres	RWG	2-3.xii.89
Meria sp. G						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A. W. Hill	Y	M	10	Alexandria/Salem	FWG,HWG&RWG	16.i.84
Meria sp. H						
Aizoaceae: Mesembryanthema						
"mesem"	W	M	12	Montagu/Matroosberg	FWG,SKG,HWG&RWG	4.xii.86
"mesem"	W	M	16	Matroosberg	FWG,SKG,HWG&RWG	4.xii.86

"mesem"	W	M	2	Touws River/ Verkeerdevlei	FWG	4.xii.86
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	5	Prince Albert	FWG,SKG&RWG	26.xi.- 5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L. f.	Y	F	2	Grahamstown	FWG&SKG	2.xii.79
A. filiformis L. f.	Y	M	11	Grahamstown	FWG&SKG	2.xii.79
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam/Klawer	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	11.x.90
A. sp.	Y	F	4	43 km ENE Ceres	FWG,SKG,HWG &RWG	2-3.xii.89
A. sp.	Y	M	10	43 km ENE Ceres	FWG,SKG,HWG &RWG	2-3.xii.89
Helichrysum Mill.						
H. sp.	Y	F	2	Clanwilliam	FWG&SKG	9.x.90
Senecio L.						
S. pterophorus DC.	Y	M	1	Grahamstown	FWG	21.xi.79
S. rosmarinifolius L. f.	Y	F	1	Oudtshoorn	FWG&RWG	7-8.xii.86
S. rosmarinifolius L. f.	Y	M	6	Oudtshoorn	FWG&RWG	7-8.xii.86
S. sp.	Y	M	2	Grahamstown	FWG	28.xii.86
S. sp.	Y	M	1	Grahamstown	DWG	31.xii.86
S. sp.	Y	M	2	Grahamstown	SKG	31.xii.86
S. sp.	Y	M	2	Grahamstown	SKG	3.i.87
S. sp.	Y	M	1	Grahamstown	FWG	5.xii.80
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43 km ENE Ceres	HWG	2-3.xii.89
Elatinaceae						
Bergia L.						
B. glomerata L. f.	W	F	1	Grahamstown	FWG&SKG	20.xi.90
B. glomerata L. f.	W	M	2	Grahamstown	FWG&SKG	20.xi.90
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	W	F	1	Grahamstown	HWG	14.xii.82
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne.	Y	F	1	Grahamstown	RWG	2.i.78
A. karroo Hayne.	Y	M	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne.	Y	M	1	Prince Albert	FWG,SKG&RWG	26.xi.- 5.xii.87
A. karroo Hayne.	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	V	F	1	Grahamstown	SKG	27.xi.81

Mesa Saussure Mesa capensis (Lepeletier)						
Proteaceae						
Paranomus Salisb.						
P. bracheolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Mesa spoliata (Turner)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A. W. Hill	Y	F	1	Grahamstown	CFJG	24.i.90
F. vulgare A. W. Hill	Y	F	1	Grahamstown	FWG	26.i.90
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	6.xii.77
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG&SKG	16.xii.82
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	WY	F	2	Grahamstown	HWG	14.xii.82
Mesa sp. A (near spoliata (Turner))						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb) A.DC.	V	F	1	Clanwilliam	FWG&SKG	16-20.x.89
Euphorbiaceae						
Euphorbia L.						
E. sp.	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm.f.)Dahlgren	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	16-20.x.89
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
L. sp.	Y	M	2	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
L. sp.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	3	Nieuwoudtville	FWG&SKG	29-30.ix.90
P. bracteolaris Salisb. ex Knight	Pi	M	3	Nieuwoudtville	FWG&SKG	29-30.ix.90
Mesa sp. B (near spoliata (Turner))						
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	2	Nieuwoudtville	FWG&SKG	29-30.ix.90
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	7	Nieuwoudtville	FWG&SKG	29-30.ix.90

Mesa xanthocera (Gerstaecker)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	23.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	25.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	5.xii.80
Mesa sp. C						
Asteraceae (Compositae)						
Osteospermum L.						
O. cf. oppositifolia (Ait.) T. Norl.	Y	F	1	Nieuwoudtville	FWG&SKG	3-8.x.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Pteronia L.						
P. cf. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	DWG	3-7.x.88
Mesa sp. D						
Proteaceae						
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90

Tiphia Fabricius						
Tiphia sp. B						
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	DWG	6.xii.77
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	FWG	2.xii.77
Tiphia sp. C						
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	DWG	2.xii.77
Tiphia sp. D						
Proteaceae						
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90

MUTILLIDAE

Apterogyna Latreille						
Apterogyna globularia (Fabricius)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	28.iv.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	22.ii.83
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	11.xii.69
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	6.xii.72
Apterogyna karroa Péringuey						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	4	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Dasylabroides Ed. André						
Dasylabroides phylira (Péringuey)						
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	11.xii.69
Psammotherma Berthold						
Psammotherma flabellata (Fabricius)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	3	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	M	3	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	3	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	3	Grahamstown	FWG	11.xii.69

SCOLIIDAE

Campsomeriella Betrem						
Campsomeriella (Campsomeriella) caelebs (Sichel)						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85

Campsoscolia Betrem

Campsoscolia sp.

Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90

Cathimeris Betrem

Cathimeris (Cathimeris) capensis (Saussure)

Aizoaceae: Mesembryanthema						
Carpobrotus N.E.Br.						
C. sp.	Y	F	12	Paleisheuwel	FWG&SKG	26.ix.85
Drosanthemum Schwant.						
D. sp.	PuPi	F	1	Grahamstown	FWG&SKG	18.x.77
Herrea Schwant.						
H. sp. B	WY	F	3	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
"mesem"	W	F	1	Montagu/Matroosberg	FWG	4.xii.86
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	CFJG	24-26.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	RWG	16.i.84
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	2	Clanwilliam/Klawer	FWG&SKG	9-10.x.90
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	4	Grahamstown	FWG	20.x.77
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	3	Grahamstown	FWG	18.xi.77
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43 Km ENE Ceres	HWG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	3	Oudtshoorn	RWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	14.x.87
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	16-20.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
?	-	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
?	-	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90

Micromeriella Betrem

Micromeriella aureola godofredi (Sichel)

Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	M	3	Grahamstown	FWG	18.xi.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.i.77
A. karroo Hayne	Y	M	2	Grahamstown	FWG	20.xii.77

Scolia Fabricius

Scolia chrysotricha Burmeister

Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Montagu/Matroosberg	FWG	4.xii.86
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	8	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	F	6	Grahamstown	CFJG	24.i-15.ii.70
F. vulgare A.W.Hill	Y	M	4	Grahamstown	CFJG	24.i-15.ii.70
F. vulgare A.W.Hill	Y	F	3	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	JGHL	17-25.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	2	Prince Albert	RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	3	Grahamstown	FWG	3-10.xi.77
Senecio L.						
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	HWG	7-8.xii.86
Liliaceae						
Asparagus L.						
A. sp.	WY	F	2	Grahamstown	HWG	14.xi.82
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	5	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	3	Grahamstown	DWG	6-13.i.77
A. karroo Hayne	Y	F	2	Grahamstown	DWG	17.ii.83
A. karroo Hayne	Y	F	1	Grahamstown	DWG	5.xii.80
A. karroo Hayne	Y	F	1	Grahamstown	FWG	7.xii.73
A. karroo Hayne	Y	F	4	Oudtshoorn	FWG	9-12.xii.86

Scolia fulvofimbriata fulvofimbriata Burmeister

Asteraceae (Compositae)						
Senecio L.						
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	17.ii.83
A. karroo Hayne	Y	M	3	Grahamstown	DWG	17.ii.83
Sapotaceae						
Mimusops L.						
M. caffra E. Mey ex A.DC.	WY	F	1	Port Alfred	EMcCC	22.iv.79

Scolia terminalis Saussure						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20-24.i.70
F. vulgare A.W.Hill	Y	M	4	Grahamstown	FWG	20-24.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	CFJG	23-24.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	5	Grahamstown	JGHL	17-25.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
Scolia sp. A						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Oudtshoorn	RWG	9-12.xii.86
Scolia sp. B						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
Scolia sp. C						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	3	Oudtshoorn	RWG	9-12.xii.86
Scolia sp. D						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	6	Oudtshoorn	RWG	9-12.vii.86
Scolia sp. E						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9.12.xii.86
Scotia sp. C (CFJG)						
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	M	1	Grahamstown	FWG	10.xi.77
Scolia (*Scolia*) sp. A (Kalahari)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F M	2 1	Twee Rivieren	FWG&SKG	8-11.iii.90
Scolia (*Scolia*) sp. B (Kalahari)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F M	1 1	Twee Rivieren	FWG&SKG	8-11.iii.90
Scolia (*Scolia*) sp. C (Kalahari)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90

Trielis Saussure						
Trielis (Heterelis) braunsi (Turner)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Trielis (Heterelis) stigma (Saussure)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	17	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	11			
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-
A. buchenaviana Schinz	WY	M	1			5.xii.87
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	F	6	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	12	Colesberg	DWG	17.i.85

VESPOIDEA
EUMENIDAE

Alastor Lepeletier						
Alastor sp. 1						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Grahamstown	SKG	3.xii.81
Alastor sp. 2						
Geraniaceae						
Pelargonium L' Herit						
P. myrrhifolium Ait.	-	F	1	Oudtshoorn	CFJG	10.x.72
Alastor sp. 3						
Geraniaceae						
Pelargonium L' Herit						
P. myrrhifolium Ait.	-	M	5	Oudtshoorn	CFJG	10.x.72
Alastor sp. 4						
Aizoaceae: Mesembryanthema						
Ruschia Schwant.						
R. sp.	Pu	F	2	Grahamstown	FWG	8.xi.73
Alastor sp. 6						
Mimosaceae						
Acacia Mill.						
A.karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Alastor sp. 8						
Geraniaceae						
Pelargonium L' Herit						
P. myrrhifolium Ait.	-	F	1	Oudtshoorn	CFJG	10.x.72

Allepipona Giordani Soika						
Allepipona erythrospila (Cameron)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG	12.x.80
Ursinia Gaertn.						
U. anethoides (DC.) N.E. Br.	-	F	1	Lesotho	CFJG	29.xi.52

Antepipona Saussure						
Antepipona scutellaris Giordani Soika						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	4	Grahamstown	FWG	3-15.xi.77
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	3-15.xi.77
Senecio L.						
S. sp.	Y	M	1	Grahamstown	FWG	28.xii.86
S. sp.	Y	M	2	Grahamstown	FWG&DWG	31.xii.86
Selaginaceae						
Selago L.						
S. corymbosa L.	W	F	1	Grahamstown	RWG	2.xii.77
Antepipona sesquicincta (Saussure)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	2	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	23.i.70

Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xi.77
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	DWG	6.xii.77
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	DWG	9.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	F	1	Grahamstown	FWG	7.xii.73
A. karroo Hayne	Y	M	1	Grahamstown	FWG	10.ii.77
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.70
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
A. karroo Hayne	Y	M	3	Grahamstown	DWG	.xii.80
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zyh.	Y	F	1	Grahamstown	FWG&SKG	25.iii.92
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	2	Adelaide	CFJG	20-22.xii.72
Salvadoraceae						
Azima Lam.						
A. tetracantha Lam.	-	F	1	Kommadagga	FWG&SKG	23.x.85
A. tetracantha Lam.	-	M	7	Kommadagga	FWG&SKG	23.x.85
Antepipona silaos (Saussure)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
Antepipona tropicalis (Saussure)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	26.i.70
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Antepipona spp. indet.						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	25.x.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	5.xii.80
A. karroo Hayne	Y	F	1	Colesberg	DWG	12.i.85
A. karroo Hayne	Y	M	1	Colesberg	DWG	12.i.85
A. karroo Hayne	Y	F	1	Grahamstown	DWG	3.i.77
Portulacaceae						
Portulacaria Jacq.						
P. afra Jacq.	Pi	M	1	Grahamstown	DWG	8.ii.81
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72

Anterhynchium Saussure						
Anterhynchium sp.						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Anterhynchium sp.						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	DWG	16.i.84

Antodynerus Saussure						
Antodynerus incognitus (Giordani Soika)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Antodynerus radialis oogaster (Gribodo)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	23.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	10.ii.77
A. karroo Hayne	Y	F	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	F	1	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	3	Grahamstown	DWG	17.ii.83
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	2	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Antodynerus spoliatus (Cameron)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	FWG	5.i.79
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	DWG	7.i.79
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	DWG	3.ii.81
Asteraceae (Compositae)						
Lasiospermum Lag.						
L.bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L.bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	20.x.77
L.bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	3.xi.77
Antodynerus sp.						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	DWG	7.i.79
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	HWG	8.ii.81
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	FWG	10.ii.86
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	AJSW	6.ii.86
Solanaceae						
Lycium L.						
L. sp.	V	F	1	Grahamstown	FWG	8.ii.81
Antodynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85

Antodynerus sp.						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	12	Prince Albert	FWG,SKG&RWG	26.xi-
A. buchenaviana Schinz	WY	M	6			5.xii.87
Antodynerus sp.						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	5	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	5.ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Antodynerus sp.						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	2	Adelaide	CFJG	20-22.xii.72
Antodynerus sp.						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20.22.xii.72
Antodynerus sp.						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.70
Antodynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	10.ii.77

Delta Saussure						
Delta caffer (L.)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers. Juss.	W	F	2	Grahamstown	DWG	8.ii.81
Peristrophe Nees						
P. sp.	V	M	1	Grahamstown	SKG	10.ii.86
Aizoaceae: Mesembryanthema						
Ruschia Schwant.						
R. sp.	W	M	2	Grahamstown	FWG	22.xii.69
Sphalmanthus N.E.Br.						
S. sp.	Pi	M	1	Clanwilliam/Klawer	FWG&SKG	17.x.89
"mesem"	Pi	M	1	Grahamstown	SKG	22.xi.81
"mesem"	Pi	M	1	Grahamstown	DWG	22.xi.81
"mesem"	Pi	M	1	Grahamstown	RWG	27.xi.81
"mesem"	PuPi	F	1	Grahamstown	DWG	6.i.81
"mesem"	Pi	F	1	Grahamstown	FWG	30.xi.81
"mesem"	Pi	F	1	Grahamstown	RWG	30.xi.81
"mesem"	W	M	6	Matroosberg	HWG	4.xii.86
"mesem"	W	M	3	Matroosberg	FWG	4.xii.86
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham.&Schlechtd.) DC.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90

Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG,SKG&RWG	26.xi-
A. buchenaviana Schinz	WY	M	1			5.xii.87
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	M	4	Grahamstown	FWG&SKG	2.xii.79
Ebenaceae						
Diospyros L.						
D. sp.	YW	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Euclea Murray						
E. crispa (Thunb.) Guerke	YW	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	6	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Grahamstown	DWG&FWG	21.xii.76
A. karroo Hayne	Y	F	2	Grahamstown	DWG&FWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG&FWG	6.i.77
A. karroo Hayne	Y	F	2	Grahamstown	DWG&FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG&FWG	20.xii.77
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm.f) Dahlgren	Y	M	1	Clanwilliam/ Graafwater	SKG	19.x.89
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	17.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Citrusdal	FWG&SKG	19.x.89
A. spinescens Thunb.	Y	M	3	Clanwilliam/ Citrusdal	FWG&SKG	19.x.89
A. spinescens Thunb.	Y	M	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	3	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	1	Citrusdal/ Paleisheuwel	FWG&SKG	6.x.90
A. spinescens Thunb.	Y	M	2	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
A. spinescens Thunb.	Y	F	1	Nieuwoudt Pass	FWG&SKG	19.x.89
Wiborgia Thunb.						
W. sp.	Y	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Solanaceae						
Lycium L.						
L. sp.	V	M	1	Grahamstown	DWG	8.ii.81
Delta emarginatum (L.)						
Acanthaceae						
"acanth"	PiV	F	1	Nossob	FWG&SKG	8.iii.90
Aizoaceae: Mesembryanthema						
"mesem"	W	M	1	Touws River	FWG	4.xii.86

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.1.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	23.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	24.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	24.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	26.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	YW	M	1	Prince Albert	FWG,SKG &RWG	12-16.i.87
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	2	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	5	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	2	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	2	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Oudtshoorn	RWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	3-7.x.89
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG	3-7.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	16-20.x.89
Wiborgia Thunb.						
W. sp.	Y	F	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Delta hottentottum concinnum (Saussure)						
Anacardiaceae						
Rhus L.						
R. sp.	-	M	1	Riebeek East	RWG	1.i.86
Apiaceae						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	15.ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	24.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	FWG	16.i.84
Boraginaceae						
Anchusa L.						
A. sp.	B	F	1	Colesberg	FWG&SKG	28-30.xi.88
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Oudtshoorn	SKG	9-12.xii.86
A. karroo Hayne	Y	F	1	Grahamstown	FWG	9.i.74
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	24.iii.92
Wiborgia Thunb.						
W. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89

Delta hottentottum hottentottum (Saussure)						
Apiaceae						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	5	Grahamstown	FWG	20.i-5.ii.70
Delta lepeleterii (Saussure)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham.&Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	5	Colesberg	DWG	17.i.85
Eumenidiopsis Giordani Soika						
Eumenidiopsis bacilliformis (Giordani Soika)						
Geraniaceae						
Pelargonium L' Herit						
P. myrrhifolium Ait.	-	F	2	Oudtshoorn	CFJG	10.x.72
Eumenes Latreille						
Eumenes acuminatus Saussure						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L.bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	18.x.77
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	2	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	3	Grahamstown	CFJG	20-24.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	20-24.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Celastraceae						
Maytenus linearis (L.f) Marais	YW	M	1	Grahamstown	FWG&SKG	16.xii.82
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Psoralia L.						
P. pinnata L.	B	M	3	Grahamstown	CFJG	2-9.ii.75
Eumenes lucasius Saussure						
Celastraceae						
Maytenus linearis (L.f.) Marais	YW	M	1	Grahamstown	DWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Eumenes sp. A						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85

Euodynerus Dalle Torre						
Euodynerus euryspilus (Cameron)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	1	Colesberg	DWG	16.i.85
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
Euodynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	16.i.85
A. karroo Hayne	Y	F	2	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85
Euodynerus sp.						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Grahamstown	DWG	22.xi.81
"mesem"	Pi	M	1	Grahamstown	DWG	22.xi.81
"mesem"		F	2	Grahamstown	FWG	3.xii.81
"mesem"	Pi	F	1	Grahamstown	HWG	3.xii.81
"mesem"	Pi	F	1	Grahamstown	SKG	3.xii.81
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	1	Grahamstown	FWG&SKG	1.xii.79
Euodynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Euodynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	17.ii.83
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	3	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	2	Adelaide	CFJG	20-22.xii.72

Katamenes Meade-Waldo						
Katamenes macrocephalus (Saussure)						
Acanthaceae						
Peristrophe Nees						
P. sp.	V	M	1	Grahamstown	FWG	3.xii.81
P. sp.	V	F	1	Grahamstown	SKG	10.ii.86
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Grahamstown	FWG	27.xi.81
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	27.xi.73
Solanaceae						
Lycium L.						
L. sp.	V	M	1	Grahamstown	FWG	8.ii.81
L. sp.	V	M	3	Grahamstown	DWG	8.ii.81

Odynerus Latreille						
Odynerus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85

Parachilus Soika						
Parachilus capensis (Saussure)						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	2	Grahamstown	FWG	3.xii.81
"mesem"	Pi	M	2	Grahamstown	FWG	27.ix.81
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. macra Schltr. & V. Brehm.	V	F	1	Grahamstown	FWG	2.i.74
Parachilus insignis (Saussure)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	21.xii.76
Parachilus sp.						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72

Pseudonortonia Giordani Soika						
Pseudonortonia sp. 1						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	4	Adelaide	CFJG	20-22.xii.72

Raphiglossa Saunders						
Raphiglossa flavo-ornata Cameron						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	M	1	Nababeep	FWG&SKG	12-13.x.89
Leysera L.						
L. gnaphalodes (L.) L.	Y	M	1	Narap, Springbok	FWG&SKG	14.x.89
L. gnaphalodes (L.) L.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Senecio L.						
S. sp.	Y	F	1	Grahamstown	DWG	28.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	8-13.x.87
Raphiglossa natalensis Smith						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Matroosberg	RWG	4.xii.86

Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG&SKG	15.xi.77
B. sp.	Y	F	5	Riebeek East	DWG&RWG	1.i.86
B. sp.	Y	M	2	Riebeek East	DWG&RWG	1.i.86
B. sp.	Y	F	2	Riebeek East	FWG&SKG	1.i.86
B. sp.	-	F	1	O.F.S.	CFJG	1.xii.52
Cirsium Mill. emend. Scop.						
C. vulgare (Savi.) Ten.	Pu	F	1	Grahamstown	SKG	9.iii.78
Senecio L.						
S. sp.	Y	M	1	Grahamstown	FWG	28.xii.86
S. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
"daisy bush"	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Selaginaceae						
Selago L.						
S. sp.	W	M	2	Grahamstown	CFJG	16.xii.69

Rhynchium Spinola

Rhynchium marginellum sabulosum (Saussure)

Asclepiadaceae						
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	M	1	Kommadagga	RWG	14.i.86

Synagris Latreille

Synagris abyssinica Guérin-Méneville

Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	FWG	5.i.79
B. capensis (L. f.) Pers. Juss.	W	F	3	Grahamstown	FWG	7.i.79
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	DWG	7.i.79
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	FWG	3.ii.81
B. capensis (L. f.) Pers. Juss.	W	F	4	Grahamstown	DWG	3.ii.81
B. capensis (L. f.) Pers. Juss.	W	F	2	Grahamstown	RWG	8.ii.81
B. capensis (L. f.) Pers. Juss.	W	M	1	Grahamstown	HWG	8.ii.81
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	HWG	15.i.81
B. capensis (L. f.) Pers. Juss.	W	F	1	Grahamstown	DWG	15.i.81
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	4	Oudtshoorn	RWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummit	Y	M	-	Mamathes	CFJG	10.i.52
Medicago Tourn. ex L.						
M. sativa L.	V	F	2	Grahamstown	FWG	5.ii.70
Solanacaeae						
Lycium L.						
L. sp.	V	M	1	Grahamstown	HWG	8.ii.81
L. sp.	V	F	1	Grahamstown	HWG	13.iv.78

<u>Synagris maxillosa bequaerti</u> H. Brauns						
Papilionaceae (Fabaceae)						
<u>Rafnia</u> Thunb.						
<u>R. amplexicaulus</u> Thunb.	Y	M	2	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	28.ix.85
<u>Stroudia</u> Gribodo						
<u>Stroudia</u> sp.						
Geraniaceae						
<u>Pelargonium</u> L' Herit						
<u>P. myrrhifolium</u> Ait.	-	F	1	Oudtshoorn	CFJG	10.x.72
<u>Tricarinodynerus</u> Giordani Soika						
<u>Tricarinodynerus guerinii</u> (Saussure)						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
Celastraceae						
<u>Maytenus</u> Molina						
<u>M. linearis</u> (L. <u>f</u>.) Marais	YW	F	1	Grahamstown	FWG	9.xii.69
<u>M. linearis</u> (L. <u>f</u>.) Marais	YW	M	1	Grahamstown	FWG	11.xii.69
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. caffra</u> (Thunb.) Willd.	YW	M	2	Oudtshoorn	FWG	9-12.xii.86
<u>A. caffra</u> (Thunb.) Willd.	YW	M	1	Oudtshoorn	RWG	9-12.xii.86
<u>A. karroo</u> Hayne	Y	M	1	Colesberg	DWG	17.i.85
<u>A. karroo</u> Hayne	Y	M	1	Grahamstown	FWG	15.ii.74
<u>Calpurnia</u> E. Mey.						
<u>C. glabrata</u> Brummitt	Y	M	1	Mamathes	CFJG	2.xi.52
Rhamnaceae						
<u>Ziziphus</u> Mill.						
<u>Z. mucronata</u> Willd.		F	2	Adelaide	CFJG	20-22.xii.72
<u>Z. mucronata</u> Willd.		M	4	Adelaide	CFJG	20-22.xii.72
<u>Zetheumenidion</u> Bequaert						
<u>Zetheumenidion femoratus</u> (Schulthess)						
Asteraceae (Compositae)						
<u>Senecio</u> L.						
<u>S</u>. sp.	Y	F	1	Grahamstown	FWG&SKG	29.xi.79
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. caffra</u> (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
<u>A. karroo</u> Hayne	Y	M	1	Colesberg	DWG	17.i.85
Rhamnaceae						
<u>Ziziphus</u> Mill.						
<u>Z. mucronata</u> Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
<u>Zethus</u> Fabricius						
<u>Zethus bilaminatus</u> Giordani Soika						
Celastraceae						
<u>Maytenus</u> Molina						
<u>M. linearis</u> L.<u>f</u>. Marais	YW	M	1	Grahamstown	FWG&SKG	22.xi.77
<u>Zethus yarrowi</u> Giordani Soika						
Papilionaceae (Fabaceae)						
<u>Wiborgia</u> Thunb.						
<u>W. monoptera</u> E. Mey	Y	F	1	Springbok	FWG&SKG	14.x.89

Zethus sp.						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	1	Grahamstown	FWG&SKG	1.xii.79
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	11.i.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	6.i.77
Portulacaceae						
Portulacaria Jacq.						
P. afra Jacq.	Pi	F	1	Riebeek East	FWG	9.xii.80

MASARIDAE

Celonites Latreille						
Celonites andrei Brauns						
Scrophulariaceae						
Aptosimum Burch.						
A. spinescens (Thunb.) Weber	BV	F	1	Springbok	SKG	15-21.x.87
A. spinescens (Thunb.) Weber	PuV	F	3	Twee Rivieren	FWG&SKG	8-11.iii.90
Peliostomum Benth.						
P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	FWG&SKG	15-21.x.87
Celonites bergenwahliae Gess						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	2	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Aizoaceae : non-Mesembryanthema						
Coelanthum E. Mey. ex Fenzl						
C. grandiflorum E. Mey. ex Fenzl	W	M	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Asteraceae (Compositae)						
Senecio L.						
S. cf. arenarius Thunb.	Pi	F	2	Clanwilliam/	FWG&SKG	4.x.90
S. cf. arenarius Thunb.	Pi	M	2	Graafwater		
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. cf. constricta v. Brehmer	BV	F	2	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	6.x.88
W. cf. constricta v. Brehmer	BV	M	7	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	6.x.88
W. psammophila Schltr.	PuV	F	5	Clanwilliam/	FWG&SKG	4.x.90
W. psammophila Schltr.	PuV	M	1	Graafwater		
W. psammophila Schltr.	PuV	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Geraniaceae						
Pelargonium L'Herit						
P. sp.	Pi	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90

Scrophulariaceae						
Polycarena Benth.						
P. sp.	V	F	3	Clanwilliam/	FWG&SKG	4.x.90
P. sp.	V	M	1	Graafwater		
Celonites capensis Brauns						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	4	Riebeek East	FWG	22.xi.82
B. sp.	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Boraginaceae						
Ehretia P.Br.						
E. rigida (Thunb.) Druce	BV	M	1	Grahamstown	FWG&SKG	26.x.77
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. ecklonii Buek	V	M	1	Gydo Pass, Ceres	FWG	30.xi.89
W. ecklonii Buek	V	M	1	Gydo Pass, Ceres	SKG	30.xi.89
Geraniaceae						
Pelargonium L'Herit.						
P. myrrhifolium (L.) L'Herit.	WR	F	11	Oudtshoorn	CFJG	10.x.72
P. myrrhifolium (L.) L'Herit.	WR	M	1	Oudtshoorn	CFJG	10.x.72
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	3	Grahamstown	DWG	9-14.xii.82
Celonites clypeatus Brauns						
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	BV	F	24+	Grahamstown	FWG,SKG DWG&RWG	13.x-3.xii.81
A. procumbens (Lehm.) Steud.	BV	M	4	Grahamstown	FWG&SKG	22-30.x.81
A. procumbens (Lehm.) Steud.	BV	F	p	Grahamstown	FWG&SKG	30.x.81
A. spinescens (Thunb.) Weber	PuV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
A. spinescens (Thunb.) Weber	PuV	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
A. sp.	BV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Peliostomum Benth.						
P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	FWG&SKG	15-21.x.87
P. virgatum E.Mey ex Benth.	PV	M	2	Springbok	SKG	15-21.x.87
Celonites latitarsis Gess						
Aizoaceae: non-Mesembryanthema						
Coelanthum E. Mey.						
C. grandiflorum E. Mey. ex Fenzl	W	M	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. psammophila Schltr.	PuV	F	m	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
W. psammophila Schltr.	PuV	F	1	Clanwilliam/	FWG&SKG	4.x.90
W. psammophila Schltr.	PuV	M	1	Graafwater		
Celonites peliostomi Gess						
Scrophulariaceae						
Aptosimum Burch.						
A. lineare Marloth & Engl.	BV	M	1	Springbok	SKG	15-21.x.87
A. spinescens (Thunb.) Weber	PV	F	5	Springbok	FWG&SKG	15-21.x.87
A. spinescens (Thunb.) Weber	PV	F	p	Springbok	FWG&SKG	15-21.x.87
A. spinescens (Thunb.) Weber	PV	F	3	Springbok	SKG	10-11.x.89

Peliostomum Benth.						
P. virgatum E.Mey ex Benth.	PV	F	38	Springbok	FWG&SKG	15-21.x.87
P. virgatum E.Mey ex Benth.	PV	M	3	Springbok	FWG&SKG	15-21.x.87
P. virgatum E.Mey ex Benth.	PV	F	p	Springbok	FWG&SKG	15-21.x.87
P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	MS	-.x.89
P. virgatum E.Mey ex Benth.	PV	F	2	Nieuwoudtville	FWG	3-8.x.89
P. virgatum E.Mey ex Benth.	PV	M	1	Nieuwoudtville	FWG	3-8.x.89
P. virgatum E.Mey ex Benth.	PV	F	3	Nieuwoudtville	SKG	3-8.x.89
P. virgatum E.Mey ex Benth.	PV	M	4	Nieuwoudtville	SKG	3-8.x.89
P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	SKG	10-11.x.89
P. virgatum E.Mey ex Benth.	PV	F	1	Anenous	FWG&SKG	12.x.89
P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	FWG&SKG	14.x.89
P. virgatum E.Mey ex Benth.	PV	M	2	Springbok	FWG&SKG	14.x.89
Celonites promontorii Brauns						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89
B. fruticosa (L.) Ehrh.	Y	M	1	Nieuwoudtville	SKG	3-8.x.89
B. fruticosa (L.) Ehrh.	Y	F	2	Nieuwoudtville	FWG&SKG	30.ix.90
B. cf. spinosa (L.f.) Druce	Y	F	6	Prince Albert	SKG	26.xi.-5.xii.87
B. sp.	-	F	4	Thaba Nchu	CFJG	1.xi.52 (Richards, 1962)
Pteronia L.						
P. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	SKG	3-8.x.89
P. divaricata (Berg.) Less.	Y	M	1	Nieuwoudtville	SKG	3-8.x.89
P. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Senecio L.						
S. rosmarinifolius L.f.	Y	F	2	Oudtshoorn	FWG	7-8.xii.86
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	F	2	43 km ENE Ceres	SKG	2-3.xii.89
Celonites wahlenbergiae Gess						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	WY	F	2	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Aizoaceae: non-Mesembryanthema						
Coelanthum E. Mey. ex Fenzl						
C. grandiflorum E. Mey. ex Fenzl	W	F	1	Clanwilliam/ Graafwater	DWG	17.x.89
C. grandiflorum E. Mey. ex Fenzl	W	F	2	Clanwilliam/ Graafwater	FWG&SKG	17.x.89
C. grandiflorum E. Mey. ex Fenzl	W	M	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Asteraceae (Compositae)						
Helichrysum Mill.						
H. sp.	Y	F	3	Clanwilliam/	FWG&SKG	7.x.90
H. sp.	Y	M	3	Graafwater		

Campanulaceae						
Microcodon A. DC.						
M. sparsiflorum A. DC.	V	F	4	Clanwilliam/	SKG	17.x.89
M. sparsiflorum A. DC.	V	M	3	Graafwater		
M. sparsiflorum A. DC.	V	F	4	Clanwilliam/	FWG	17.x.89
M. sparsiflorum A. DC.	V	M	1	Graafwater		
M. sparsiflorum A. DC.	V	F	1	Clanwilliam/ Graafwater	DWG	17.x.89
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb.) A.DC.	BV	M	2	Clanwilliam	SKG	14.x.87
W. paniculata (Thunb.) A.DC.	BV	F	4	Clanwilliam	FWG&SKG	3-7.x.88
W. paniculata (Thunb.) A.DC.	BV	M	3	Clanwilliam	DWG	3-7.x.88
W. psammophila Schltr.	PuV	F	2	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
W. psammophila Schltr.	PuV		m	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
W. psammophila Schltr.	PuV	F	14	Clanwilliam/	FWG&SKG	4.x.90
W. psammophila Schltr.	PuV	M	4	Graafwater		
W. psammophila Schltr.	PuV	F	10	Clanwilliam/	FWG&SKG	8.x.90
W. psammophila Schltr.	PuV	M	4	Graafwater		
Crassulaceae						
Crassula L.						
C. dichotoma L.	Y&O	F	1	Clanwilliam	FWG	16-20.x.89
C. dichotoma L.	Y&O	F	1	Clanwilliam	SKG	16-20.x.89
Geraniaceae						
Pelargonium L'Herit						
P. sp.	Pi	F	3	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Scrophulariaceae						
Polycarena Benth.						
P. sp.		M	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Celonites wheeleri Brauns						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. cf. spinosa (L.f.) Druce	Y	F	2	Prince Albert	FWG&SKG	26.xi-5.xii.87
Celonites sp. nov. E						
Lobeliaceae						
Lobelia L.						
L. linearis Thunb.	Pu	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
L. linearis Thunb.	Pu	M	1	Nieuwoudtville	FWG&SKG	30.ix.90

Ceramius Latreille						
Ceramius Group 2a						
Ceramius cerceriformis Saussure						
Aizoaceae: Mesembryanthema						
Aridaria N.E.Br.						
A. sp.	W	M	1	Clanwilliam/Klawer	DWG	5.x.91
Mesembryanthemum sensu lato	Pu	F	1	Garies	FWG&WHRG	7/8.x.85
Mesembryanthemum L.						
M. crystallinum L.	W	-	-	Willowmore	CFJG	31.x.67

Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br. WPi		F	1	Springbok	FWG&SKG	1.x.85
P. acutisepalum (Berger) N.E.Br. WPi		F M	5 3	Clanwilliam/Klawer	DWG	5.x.91
P. acutisepalum (Berger) N.E.Br. WPi			m	Clanwilliam/Klawer	DWG	5.x.91
Ceramius peringueyi Brauns						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br. WPi		F	14	Vredendal	FWG&SKG	30.ix.85
Ceramius Group 2b						
Ceramius clypeatus Richards						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm.f.) Dahlgren	Y	F	5	Clanwilliam	FWG&SKG	16.x.89
A. linearis (Burm.f.) Dahlgren	Y		m	Clanwilliam	FWG,SKG &DWG	16.x.89
A. pulicifolia Dahlgren	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	M	2	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	F	1	Clanwilliam	DWG	19-20.x.89
A. pulicifolia Dahlgren	Y	F	2	Clanwilliam	FWG&SKG	11.x.90
A. pulicifolia Dahlgren	Y	F	1	Clanwilliam	FWG&SKG	13.x.90
A. pulicifolia Dahlgren	Y	F	1	Clanwilliam	DWG	6.x.91
A. spinescens Thunb.	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	26.ix.85
A. spinescens Thunb.	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	28.ix.85
A. spinescens Thunb.	Y	F	14	Clanwilliam	FWG&SKG	7-14.x.87
A. spinescens Thunb.	Y	F	p	Clanwilliam	FWG&SKG	7-14.x.87
A. spinescens Thunb.	Y	F	31	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	F	2	Clanwilliam	DWG	3-7.x.88
A. spinescens Thunb.	Y	F&M	m	Clanwilliam	FWG,SKG &DWG	3-7.x.88
A. spinescens Thunb.	Y	F	6	Clanwilliam	FWG&SKG	16-20.x.89
A. spinescens Thunb.	Y	F	1	Algeria	FWG&SKG	19.x.89
A. spinescens Thunb.	Y	F	2	Algeria	DWG	19.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	5.x.90
A. spinescens Thunb.	Y	F	3	Citrusdal/ Paleisheuwel	FWG&SKG	6.x.90
A. spinescens Thunb.	Y	M	2	Clanwilliam	DWG	2.x.91
A. spinescens Thunb.	Y	F&M	m	Clanwilliam	DWG	2.x.91
A. spinescens Thunb.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	DWG	4.x.91
A. spinescens Thunb.	Y	M	1	Klein Alexanders-hoek, Clanwilliam	DWG	4.x.91
Ceramius richardsi Gess						
Papilionaceae (Fabaceae)						
"legume"		F	1	Philadelphia	VBW	9.xi.83

Ceramius Group ?2b						
Ceramius micheneri Gess						
Papilionaceae (Fabaceae)						
A. pulicifolia Dahlgren	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	M	4	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	F	2	Clanwilliam	DWG	19-20.x.89
A. spinescens Thunb.	Y	M	1	Clanwilliam	FWG&SKG	8.x.90
Ceramius Group 3						
Ceramius nigripennis Saussure						
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	M	1	Springbok	DWG	
Berkheya Ehrh.						
B. sp.	Y	M	1	Springbok	FWG&SKG	15-21.x.87
B. fruticosa (L.) Ehrh.	Y	F	3	Springbok	MS	14-15.x.87
B. fruticosa (L.) Ehrh.	Y	F	3	Nababeep	FWG&SKG	12-13.x.89
		M	1			
B. fruticosa (L.) Ehrh.	Y	M	1	Nababeep	DWG	
Dimorphotheca Vaill. ex. Moench.						
D. sinuata DC.	O	F	2p	Springbok	SKG	9.x.85
Hirpicium Cass.						
H. alienatus (Thunb.) Druce	Y	F	1	Springbok	MS	30.x.87
H. sp.	Y	F	2	Springbok	FWG&SKG	10-11.x.89
H. sp.	Y	M	2	Springbok	DWG	10-11.x.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex. Merxm.	Y	F	1	Springbok	FWG&SKG	15-21.x.87
P. suffruticosa (L.) Hutch. ex. Merxm.	Y	F	1	Springbok	FWG&SKG	10-11.x.89
P. suffruticosa (L.) Hutch. ex. Merxm.	Y	F	1	Springbok	DWG	10-11.x.89
Ceramius jacoti Richards						
Asteraceae (Compositae)						
Pteronia L.						
P. incana (Burm.) DC.	Y	M	3	Barrydale	CFJG	1.x.67
Senecio L.						
S. rosmarinifolius L.f.	Y	F	23	Oudtshoorn	FWG,SKG HWG&RWG	7-12.xii.85
S. rosmarinifolius L.f.	Y	F	p	Oudtshoorn	SKG	7-12.xii.87
Ceramius toriger Schulthess						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	43 km ENE Ceres	SKG	2-3.xii.89
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	FWG&SKG	3-8.x.89
B. fruticosa (L.) Ehrh.	Y	M	2	Nieuwoudtville	FWG&SKG	3-8.x.89
B. fruticosa (L.) Ehrh.	Y	F	2	Nieuwoudtville	DWG	3-8.x.89
B. fruticosa (L.) Ehrh.	Y	F	5	Nieuwoudtville	FWG&SKG	30.ix.90
B. fruticosa (L.) Ehrh.	Y	M	2	Nieuwoudtville	FWG&SKG	30.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
P. divaricata (Berg.) Less.	Y	F	2	Nieuwoudtville	DWG	3-8.x.89
P. divaricata (Berg.) Less.	Y	M	5	Nieuwoudtville	DWG	3-8.x.89
"blue rayed"	B	M	3	Die Bos	CDM	19.ix.66

Ceramius braunsi Turner						
Asteraceae (Compositae)						
Arctotheca Wendl						
A. calendula (L.) Levyns	Y	F	2	Clanwilliam	DWG	2.x.91
A. calendula (L.) Levyns	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Arctotis L.						
A. laevis Thunb.	Y	F	2	Clanwilliam	FWG&SKG	3-7.x.88
A. laevis Thunb.	Y	F	6	Clanwilliam	DWG	3-7.x.88
A. laevis Thunb.	Y	F	2	Clanwilliam	DWG	16-20.x.89
A. laevis Thunb.	Y	F	2	Clanwilliam	FWG&SKG	16-20.x.89
A. laevis Thunb.	Y	F	m	Clanwilliam	FWG&SKG	16-20.x.89
A. laevis Thunb.	Y	F	2	Clanwilliam	FWG&SKG	11.x.90
Athanasia L.						
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	7-13.x.87
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	3-7.x.88
A. trifurcata (L.) L.	Y	M	4	Clanwilliam	FWG&SKG	3-7.x.88
A. trifurcata (L.) L.	Y	F	26	Clanwilliam	FWG&SKG	19-20.x.89
A. trifurcata (L.) L.	Y	F	4	Clanwilliam	DWG	19-20.x.89
A. trifurcata (L.) L.	Y	F	m	Clanwilliam	FWG,SKG&DWG	19-20.x.89
A. trifurcata (L.) L.	Y	F	15	Clanwilliam	FWG&SKG	11.x.90
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	13.x.90
A. trifurcata (L.) L.	Y	F	m	Clanwilliam	FWG&SKG	11.x.90
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	DWG	2.x.91
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	DWG	2.x.91
A. trifurcata (L.) L.	Y	F	m	Clanwilliam	DWG	2.x.91
Pentzia Thunb.						
P. sp.	Y	-	1	Clanwilliam	DWG	3-7.x.88
"composite"	Y	M	1	Clanwilliam	DWG	17.x.89
"composite"	-	F	p	Clanwilliam	SKG	3-7.x.88
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	F	2	Clanwilliam	DWG	3-7.x.88
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG	3-7.x.88
Ceramius Group 4						
Ceramius beyeri Brauns						
Aizoaceae: Mesembryanthema						
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	1	Prince Albert	FWG,SKG &RWG	26.xi.87-5.xii.87
"mesem"	W	F	1	Grahamstown	FWG	16.i.69
Ceramius Group 5						
Ceramius lichtensteinii (Klug)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	FWG&DWG	15.i.81
B. capensis (L.f.) Pers.	W	F	2	Grahamstown	FWG&DWG	3.ii.81
B. capensis (L.f.) Pers.	W	F	4	Waterford	FWG&RWG	25.xi.87
B. capensis (L.f.) Pers.	W	M	1	Waterford	FWG&RWG	25.xi.87
Aizoaceae: Mesembryanthema						
Aridaria N.E.Br.						
A. sp.	WY	-	-	Grahamstown	FWG&SKG	7.xi.72
Mesembryanthemum L.						
M. aitonis Jacq.	W	-	-	Grahamstown	FWG	16.i.69

Ruschia Schwant.						
R. sp.	W	-	-	Grahamstown	FWG	11.xii.68
R. sp.	W	-	-	Grahamstown	FWG	8.i.69
R. sp.	W	M	1	Grahamstown	FWG	30.xi.70
R. sp.	PuPi	-	-	Alicedale	FWG	2.xii.70
R. sp.	PuPi	-	-	Alicedale	JGHL	2.xii.70
R. sp.	-	F	p	Grahamstown	SKG	
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	m	Prince Albert	FWG,SKG	26.xi.87-
S. cf. bijliae (N.E.Br.) L.Bol.	WPi	M	m	Prince Albert	&RWG	5.xii.87
"mesem"	PuPi	M	1	Grahamstown		29.xi.79
"mesem"	PuPi	M	1	Grahamstown		26.x.77
"mesem"	Pi	F	2	Grahamstown	DWG	6.i.81
"mesem"	W	F	1	Grahamstown	FWG	1.i.81
"mesem"	W	M	1	Grahamstown	FWG	30.xi.81
"mesem"	WY	F&M	m	Kommadagga	FWG&SKG	1.xii.85
"mesem"	W	F&M	m	Kommadagga	FWG&SKG	1.xii.85
"mesem"	Pi	F&M	m	Kommadagga	FWG&SKG	1.xii.85
"mesem"	WPi	F&M	m	Grahamstown	FWG&SKG	xii.85-i.86
Asteraceae (Compositae)						
Senecio L.						
S. pterophorus DC.	Y	F	2	Grahamstown	FWG&SKG	29.xi-2.xii.79
		M	4			
(it was noted at the time that there were no mesems in flower)						
Ceramius Group 6						
Ceramius caffer Saussure						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. carlinifolia (DC.) Roessler	Y	F	1	Ceres	FWG&SKG	29.xi.89
B. sp.	Y	F	1	Bot River Estuary	VBW	28.x.82
B. sp.	Y	M	1	Bot River Estuary	VBW	28.x.82
Ceramius metanotalis Richards						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Clanwilliam/Klawer	FWG	17.x.89
A. trifurcata (L.) L.	Y	F	1	Clanwilliam/Klawer	SKG	17.x.89
A. trifurcata (L.) L.	Y	M	2	Clanwilliam/Klawer	DWG	17.x.89
A. trifurcata (L.) L.	Y	F	12	Clanwilliam/Klawer	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	2	Clanwilliam/Klawer	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam/Klawer	FWG&SKG	9.x.90
Ceramius rex Saussure						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. canescens DC.	Y	F	1	Springbok	FWG	15-21.x.87
B. canescens DC.	Y	F	3p	Springbok	SKG	15-21.x.87
Pteronia L.						
P. sp.	Y	M	1	Nababeep	DWG	12-13.x.89
"composite"		F	p	Springbok	SKG	15-21.x.87
Ceramius Group 8						
Ceramius bicolor (Thunberg)						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	M	1	Nieuwoudtville	FWG&SKG	3-8.x.89

Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br.	WPi	F&M	m	Klawer	FWG&WHRG	14/15.x.65
P. acutisepalum (Berger) N.E.Br.	WPi	F&M	m	Klawer	FWG&SKG	27.ix.85
P. acutisepalum (Berger) N.E.Br.	WPi	F	4	Klawer	FWG&SKG	9.x.85
P. acutisepalum (Berger) N.E.Br.	WPi	M	2	Klawer	FWG&SKG	9.x.85
P. acutisepalum (Berger) N.E.Br.	WPi	F	p	Klawer	SKG	29.ix.85
P. acutisepalum (Berger) N.E.Br.	WPi	F	p	Springbok	SKG	4.x.85
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L. Bol.	Pi	F	1	43 km ENE Ceres	SKG	2-3.xii.89
S. sp.	Pi	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
S. sp.	Pi	M	1	Nieuwoudtville	FWG&SKG	27.ix.90
"mesem"	PiVW	F	2	43 km ENE Ceres	RWG	2-3.xii.89
"mesem"		F	p	Springbok	SKG	4.x.85
"mesems"	W	-	-	Clanwilliam	CDM	19.ix.66
Ceramius socius Turner						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br.	WPi	F&M	m	Clanwillam	FWG&SKG	28.ix.85
P. acutisepalum (Berger) N.E.Br.	WPi	F&M	m	Clanwilliam	FWG&SKG	7-14.x.87
P. acutisepalum (Berger) N.E.Br.		F	p	Clanwilliam	SKG	7-14.x.87
P. acutisepalum (Berger) N.E.Br.	WPi	F	2	Clanwilliam	DWG	6.x.91
"mesem"	W	F	4	Montagu	FWG	3.xii.86
"mesem"	W	F	2	Montagu	RWG	3.xii.86
"mesem"	W	F	1	Montagu	SKG	3.xii.86
"mesem"	W	F	2	Touws River	FWG	4.xii.86
"mesem"	W	F	5	Montagu	FWG&SKG	4.xii.86
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb.) A.DC.	V	M	1	Clanwilliam	FWG	19-20.x.89
Ceramius linearis Klug						
Aizoaceae: Mesembryanthema						
Aridaria N.E.Br.						
A. dyeri L.Bol.	YW	F	3	Alicedale	FWG	2.xii.70
A. dyeri L.Bol.	YW	M	5	Alicedale	FWG	2.xii.70
A. plenifolia (N.E.Br.) Stearn	YW	F	4	Alicedale	JGHL	2.xii.70
A. plenifolia (N.E.Br.) Stearn	YW	M	4	Alicedale	JGHL	2.xii.70
A. plenifolia (N.E.Br.) Stearn	YW	F	1	Alicedale	FWG	16.xii.71
A. plenifolia (N.E.Br.) Stearn	YW	M	1	Alicedale	FWG	16.xii.71
A. sp.	YW	F	11	Grahamstown	FWG&SKG	17.x.72
A. sp.	YW	M	10	Grahamstown	FWG&SKG	17.x.72
Drosanthemum Schwant.						
D. floribundum (Hw.) Schwant.	Pi	M	1	Grahamstown		29.xi.76
D. floribundum (Hw.) Schwant.			p	Grahamstown	SKG	10.xii.74
Malephora N.E.Br.						
M. sp.	YW	F	22	Grahamstown	FWG&SKG	26.x.72
M. sp.	YW	M	44	Grahamstown	FWG&SKG	26.x.72
Mesembryanthemum L.						
M. aitonis Jacq.	W	F	4	Grahamstown	FWG	30.xii.71
M. aitonis Jacq.	W	M	3	Grahamstown	FWG	30.xii.71
M. aitonis Jacq.	W	F	1	Grahamstown	FWG	28.xi.82
Ruschia Schwant.						
R. sp.	PuPi	-	-	Alicedale	JGHL	2.xii.70
R. sp.	W	-	-	Grahamstown	JGHL	5.xii.69
"mesem"	W	F	1	Grahamstown	FWG	13.i.81
"mesem"	W	M	2	Grahamstown	FWG	30.xi.81
"mesem"	Y	F	2	Grahamstown	FWG&SKG	22.x.81

"mesem"	Y	M	1	Grahamstown	FWG&SKG	22.x.81
"mesem"	YW	F&M	-	Kommadagga	FWG&SKG	1.xii.85
"mesem"	W	-	-	Kommadagga	FWG&SKG	1.xii.85
"mesem"	Pi	-	-	Kommadagga	FWG&SKG	1.xii.85
"mesems"		F&M	m	Grahamstown	FWG&SKG	
Ceramius capicola Brauns						
Aizoaceae: Mesembryanthema						
Aridaria N.E.Br.						
A. plenifolia (N.E.Br.) Stearn	YW	-	-	Alicedale	FWG&JGHL	2.xii.70
Drosanthemum Schwant.						
D. floribundum (Haw.) Schwant.	Pi	F	p	Grahamstown	SKG	
Mesembryanthemum L.						
M. aitonis Jacq.	W	F	-	Grahamstown	FWG	6.ii.69
Mestoklema N.E.Br.						
M. tuberosum (L.) N.E.Br.	PuPi	F	-	Grahamstown	FWG	6.ii.69
M. tuberosum (L.) N.E.Br.	PuPi	F	-	Grahamstown	FWG	18.ii.69
Platythyra N.E.Br.						
P. haeckeliana (Berger) N.E.Br.	Y	F	1	Colchester, Port Elizabeth	SKG	16.xi.90
Ruschia Schwant.						
R. sp.	W	M	35	Grahamstown	FWG	27.xi.-11.xii.68
R. sp.	W	F	17	Grahamstown	FWG	8-16.i.69
R. sp.	W	F	4	Grahamstown	FWG	12.xi.-
R. sp.	W	M	15	Grahamstown	FWG	22.xii.69
R. sp.	W	M	1	Grahamstown	FWG	30.xi.70
R. sp.	W	F	8	Grahamstown	FWG	19.xii.71
R. sp.	W	-	-	Grahamstown	JGHL	4.xii.69
R. sp.	PuPi	-	-	Alicedale	JGHL	2.xii.70
"mesems"	WY	-	-	Kommadagga	FWG&SKG	1.xii.85
"mesems"	W	-	-	Kommadagga	FWG&SKG	1.xii.85
"mesems"	Pi	-	-	Kommadagga	FWG&SKG	1.xii.85
"mesems"	W	F	4	Hofmeyr	DWG	17.xi.87
"mesems"	W	M	5	Hofmeyr	DWG	17.xi.87
"mesems"			m	Grahamstown	FWG&SKG	
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	1	Thaba Nchu	CFJG	1.xii.52

Jugurtia Saussure						
Jugurtia confusa Richards						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. parvifolium (Haw.) Schwant.	Pi	F	p	Grahamstown	SKG	8.xii.76
D. parvifolium (Haw.) Schwant.	Pi	M	1	Grahamstown		
Mimosaceae						
Acacia Mill.						
A. karroo Hayne.	Y	M	1	Grahamstown		10.ii.77
Jugurtia braunsi (Schulthess)						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	1	Springbok	SKG	15-21.x.87
D. sp.	Pi	F	3	Nieuwoudtville	SKG	3-8.x.89
D. sp.	Pi	F	2	Nieuwoudtville	FWG	3-8.x.89
D. sp.	Pi	F	2	SW Springbok	SKG	14.x.89

Herrea Schwant.						
H. sp. A	Y	F	1	Nieuwoudtville	FWG&SKG	26-30.ix.90
Leipoldtia L. Bol.						
L. sp.	Pi	F	7	Springbok	SKG	10-11.x.89
"mesem"	Pi	F	1	Springbok	FWG&SKG	1.x.85
"mesem"	Pi	F	13	Nieuwoudtville	FWG&SKG	28.ix.90
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	F	1	Springbok	DWG	10-11.x.89
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	1	SW Springbok	SKG	14.x.89
Pentzia Thunb.						
P. suffruticosa (L.)Hutch. ex Merxm.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	F	3	Nieuwoudtville	DWG	3-8.x.89
P. divaricata (Berg.) Less.	Y	F	1	Clanwilliam	DWG	6.x.91
Senecio L.						
S. sp.	Y	F	4	Springbok	FWG&SKG	10-12.x.88
S. sp.		F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. pilosa Buek	V	F	4	Springbok	SKG	10-11.x.89
W. pilosa Buek	V	F	3	Springbok	FWG	10-11.x.89
W. pilosa Buek	V	F	3	SW Springbok	SKG	14.x.89
W. pilosa Buek	V	F	2	SW Springbok	FWG	14.x.89
Jugurtia braunsiella (Schulthess)						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	3	Clanwilliam/Klawer	FWG&SKG	9.x.90
Felicia Cass.						
F. sp.	B	F	1	Springbok	SKG	15-21.ix.87
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG&SKG	12.x.77
Pteronia L.						
P. cf. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89
P. cf. divaricata (Berg.) Less.	Y	F	7	Nieuwoudtville	FWG&SKG	28.ix.90
P. cf. divaricata (Berg.) Less.	Y	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
P. paniculata Thunb.	Y	F	1	Grahamstown	FWG&SKG	27.x.72
P. sp. A	Y	F	1	Nababeep	SKG	12-13.x.89
Senecio L.						
S. burchellii DC.	Y	F	1	43 km ENE Ceres	SKG	2-3.xii.89
S. rosmarinifolius L.*f.*	Y	F	5	Oudtshoorn	FWG&RWG	7-12.xii.86
S. rosmarinifolius L.*f.*	Y	F	p	Oudtshoorn	SKG	
S. rosmarinifolius L.*f.*	Y	F	1	43 km ENE Ceres	FWG	2-3.xii.89
Jugurtia polita Richards						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	M	5	Nieuwoudtville	FWG&SKG	27.ix.90
L. gnaphaloides (L.) L.	Y	M	1	Nieuwoudtville	FWG&SKG	29.ix.90
Osteospermum L.						
O. oppositifolia (Ait.) T.Norl.	Y	F	1	Nieuwoudtville	FWG	3-8.x.89
O. oppositifolia (Ait.) T.Norl.	Y	F	2	Nieuwoudtville	SKG	3-8.x.89

Senecio L.						
S. prob. nivea Less		M	1	Nieuwoudtville	FWG	3-8.x.89
S. sp.		M	1	Cradock	OWR	25.ix.52
					(Richards, 1962)	
Jugurtia turneri (Schulthess)						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	3	43 km ENE Ceres	SKG	2-3.xii.89
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	SKG	2-3.xii.89
A. trifurcata (L.) L.	Y	F	1	43 km ENE Ceres	RWG	2-3.xii.89
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	RWG	2-3.xii.89
A. sp. mixed						
A. sp.	Y	F	3	43 km ENE Ceres	FWG	2-3.xii.89
A. sp.	Y	M	1	43 km ENE Ceres	FWG	2-3.xii.89
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	1	43 km ENE Ceres	HWG	2-3.xii.89
Senecio L.						
S. rosmarinifolia L.f.	Y	F	1	43 km ENE Ceres	FWG	2-3.xii.89
S. rosmarinifolia L.f.	Y	M	1	43 km ENE Ceres	FWG	2-3.xii.89
Jugurtia sp. A.						
Asteraceae (Compositae)						
Pteronia L.						
P. cf. divaricata (Berg.) Less.	Y	F	2	Nieuwoudtville	DWG	3-8.x.89
Jugurtia sp. C.						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
"composite"	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90

Masarina Richards						
Masarina familiaris Richards						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	M	1	Gydo Pass, Ceres	SKG	30.xi.89
A. linearis (Burm.f.) Dahlgren	Y	F	3	Clanwilliam	FWG&SKG	16.x.89
A. linearis (Burm.f.) Dahlgren	Y		m	Clanwilliam	FWG,SKG &DWG	16.x.89
A. linearis (Burm.f.) Dahlgren	Y	M	1	Clanwilliam/Graafwater	DWG	17.x.89
A. linearis (Burm.f.) Dahlgren	Y	F	4	Nieuwoudtville	FWG&SKG	30.ix.90
A. linearis (Burm.f.) Dahlgren	Y	M	2	Nieuwoudtville	FWG&SKG	30.ix.90
A. pulicifolia Dahlgren	Y	F	6	Clanwilliam	FWG&SKG	8-13.x.87
A. pulicifolia Dahlgren	Y	M	4	Clanwilliam	FWG&SKG	8-13.x.87
A. pulicifolia Dahlgren	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	M	2	Clanwilliam	FWG&SKG	19-20.x.89
A. pulicifolia Dahlgren	Y	M	3	Clanwilliam	DWG	19-20.x.89
A. pulicifolia Dahlgren	Y	F	3	Clanwilliam	FWG&SKG	9.x.90
A. pulicifolia Dahlgren	Y	M	3	Clanwilliam	FWG&SKG	9.x.90
A. pulicifolia Dahlgren	Y	F	4	Clanwilliam	FWG&SKG	11.x.90
A. pulicifolia Dahlgren	Y	M	1	Clanwilliam	DWG	3.x.91
A. spinescens Thunb.	Y	F	10	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	8-13.x.87
A. spinescens Thunb.	Y	M	5	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	8-13.x.87
A. spinescens Thunb.	Y	F	10	Clanwilliam	FWG&SKG	14.x.87
A. spinescens Thunb.	Y	M	1	Clanwilliam	FWG&SKG	14.x.87
A. spinescens Thunb.	Y	F	3	Clanwilliam	FWG&SKG	12.x.87

A. spinescens Thunb.	Y	F	3	Paleisheuwel	FWG&SKG	13.x.87
A. spinescens Thunb.	Y	F	43	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	F	6	Clanwilliam	DWG	3-7.x.88
A. spinescens Thunb.	Y	M	4	Clanwilliam	DWG	3-7.x.88
A. spinescens Thunb.	Y	F	8	Clanwilliam	FWG&SKG	16-20.x.89
A. spinescens Thunb.	Y	M	1	Clanwilliam	FWG&SKG	16-20.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam	DWG	16-20.x.89
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG	16-20.x.89
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	19.x.89
A. spinescens Thunb.	Y	F	m	Clanwilliam	FWG,SKG	16-20.x.89
A. spinescens Thunb.	Y	M	m		&DWG	
A. spinescens Thunb.	Y	F	5	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	M	3	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	5.x.90
A. spinescens Thunb.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	12.x.90
A. spinescens Thunb.	Y	M	1	Citrusdal/ Paleisheuwel	FWG&SKG	6.x.90
A. spinescens Thunb.	Y	F	2	Citrusdal	FWG&SKG	16.x.90
A. spinescens Thunb.	Y	M	1	Citrusdal	FWG&SKG	16.x.90
A. spinescens Thunb.	Y	F	1	35 km E Clanwilliam	DWG	3.x.91
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG	4.x.91
A. vulnerans Thunb.	Y	F	1	Paleisheuwel	FWG&SKG	8-13.x.87
A. sp./spp.	Y	F	p	Clanwilliam	SKG	8-13.x.87
?	Y	F	1	Clanwilliam	SKG	16-20.x.89
Lebeckia Thunberg						
L. sericea Thunb.	Y	F	6	Nababeep	FWG&SKG	12-13.x.89
L. sericea Thunb.	Y	M	3	Nababeep	FWG&SKG	12-13.x.89
L. sericea Thunb.	Y	F	4	Nababeep	DWG	12-13.x.89
"pea flower"	Y	M	1	Clanwilliam	FWG&SKG	1.x.90
"pea flower"	Y	F	1	Clanwilliam	FWG&SKG	8.x.90
"pea flower"	Y	M	1	Clanwilliam	FWG&SKG	8.x.90
Masarina hyalinipennis Richards						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Graafwater	FWG&SKG	22.ix.92
Lebeckia Thunberg						
L. sericea Thunb.	Y	F	2	Springbok	MS	20-28.viii.85
L. sericea Thunb.	Y	F	1	Springbok	MS	25.ix.86
L. sericea Thunb.	Y	F	8	Springbok	FWG&SKG	9-10.ix.92
L. sericea Thunb.	Y	M	1	Springbok	FWG&SKG	9-10.ix.92
L. sericea Thunb.	Y	F	7	Kamieskroon	FWG&SKG	12-17.ix.92
L. spinescens Harv.	Y	F	1	Springbok	FWG&SKG	9.ix.92
L. spinescens Harv.	Y	M	3	Springbok	FWG&SKG	9.ix.92
Wiborgia Thunberg						
W. monoptera E. Mey.	YW	F	3	Kamieskroon	FWG&SKG	17.ix.92
"papilionate"	YW	F	2	Kamieskroon	TFH	21.viii.91

Masarina mixta Richards						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	F	1	Clanwilliam	FWG&SKG	9.x.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A. DC.	V	F	1	Clanwilliam	FWG&SKG	7.x.90
W. paniculata (Thunb.) A.DC.	V	F	19	Clanwilliam	DWG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	M	4	Clanwilliam	DWG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	M	1	Clanwilliam	FWG&SKG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	F	8	Clanwilliam	SKG	16-20.x.89
W. paniculata (Thunb.) A.DC.	V	M	2	Clanwilliam	SKG	16-20.x.89
W. paniculata (Thunb.) A.DC.	V	F	1	Clanwilliam	DWG	16-20.x.89
W. paniculata (Thunb.) A.DC.	V	M	2	Clanwilliam	DWG	16-20.x.89
W. psammophila Schltr.	PuV	M	1	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
W. psammophila Schltr.	PuV	M	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. psammophila Schltr.	PuV	M	1	Clanwilliam/ Graafwater	FWG	17.x.89
W. psammophila Schltr.	PuV	M	1	Clanwilliam/ Graafwater	FWG	17.x.89
W. sp.	W	F	1	Clanwilliam	SKG	16-20.x.89
W. sp.	V	F	4	Nieuwoudtville	FWG&SKG	30.ix.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	8-13.x.87
Masarina strucki Gess						
Sterculiaceae						
Hermannia L.						
H. disermifolia Jacq.	Y	F	1	Springbok	MS	20.viii.85
Masarina sp.nov.						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	M	1	Gydo Pass, Ceres	SKG	30.xi.89
A. divaricata Thunb. flying over	Y	M	5	Gydo Pass, Ceres	SKG	30.xi.89
Quartinia Ed. André						
Quartinia artemis Richards						
Asteraceae (Compositae)						
Leysera L.						
L. tenella DC.	Y	F	1	Nieuwoutdville	FWG	3-8.x.89
Quartinia atra Schulthess						
Aizoaceae: Mesembryanthema						
Mesembryanthemum	-	-	-		RET (Turner, 1939)	
Quartinia jocasta Richards						
Aizoaceae: non-Mesembryanthema						
Galenia L.						
G. filiformis (Thunb.) N.E.Br.	-	F	2	Springbok	MS	3.xi.87
Asteraceae (Compositae)						
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	1	Springbok	FWG	10-11.x.89
Quartinia media Schulthess						
Aizoaceae: Mesembryanthema						
Mesembryanthemum	C	-	-	Worcester	RET (Turner, 1939)	

Quartinia ochraceopicta Schulthess						
Aizoaceae: Mesembryanthema						
"mesem"	W	-	-	Aus (Namibia)	RET (Turner, 1939)	
Quartinia parcepunctata Richards						
Campanulaceae						
Microcodon A. DC.						
M. sparsiflorum A.DC.	V	F	4	Clanwilliam	FWG&SKG	5-6.x.88
Wahlenbergia Schrad. ex Roth						
W. cf. constricta V. Brehmer	V	F	4	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1-2.x.90
W. ecklonii Buek	V	F	5	Theronsberg Pass, Ceres	SKG	29.xi.89
W. ecklonii Buek	V	F	3	Theronsberg Pass, Ceres	FWG	29.xi.89
W. ecklonii Buek	V	F	1	Theronsberg Pass, Ceres	HWG	29.xi.89
W. paniculata (Thunb.) A.DC.	V	F	13	Clanwilliam	DWG	3-7.x.89
W. paniculata (Thunb.) A.DC.	V	M	1	Clanwilliam	DWG	3-7.x.89
W. paniculata (Thunb.) A.DC.	V	F	5	Clanwilliam	FWG&SKG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	M	1	Clanwilliam	FWG&SKG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	F	3	Clanwilliam	SKG	16-20.x.89
Quartinia persephone Richards						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br.	WPi	F	1	Clanwilliam/Klawer	FWG&SKG	27.ix.65
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1-2.x.90
Senecio L.						
S. sp.	Y	F	1	Nieuwoudtville	FWG	16-20.x.89
Campanulaceae						
Microcodon A. DC.						
M. sparsiflorum A.DC.	V	F	1	Clanwilliam	DWG	5-6.x.88
M. sparsiflorum A.DC.	V	M	2	Clanwilliam	DWG	5-6.x.88
M. sparsiflorum A.DC.	V	M	1	Clanwilliam	FWG&SKG	5-6.x.88
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb.) A.DC.	V	F	1	Clanwilliam	DWG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	F	2	Clanwilliam	SKG	16-20.x.89
Quartinia punctulatum Schulthess						
Aizoaceae: Mesembryanthema						
Mesembryanthemum L.						
M. crystallinum L.	YW	-	-	Aus (Namibia)	RET (Turner, 1939)	
M. crystallinum L.	YW	-	-	Matjesfontein	RET (Turner, 1939)	
M. crystallinum L.	YW	-	-	Pr. Albert Road	RET (Turner, 1939)	
Quartinia vagepunctata Schulthess						
Aizoaceae: Mesembryanthema						
	-	-	-		RET (Turner, 1939)	
Aizoaceae: non-Mesembryanthema						
Galenia L.						
G. sp.	Pi	F	1	Anenous	SKG	12.x.89

Asteraceae (Compositae)						
Cotula L.						
C. leptalea DC.	Y	F	1	Nieuwoudtville	FWG&SKG	3-8.x.89
C. leptalea DC.	Y	M	6	Nieuwoudtville	FWG&SKG	3-8.x.89
C. sp.	Y	F	2	Anenous	FWG	12.x.89
C. sp.	Y	F	7	Nieuwoudtville	FWG&SKG	27.ix.90
C. sp.	Y	M	1	Nieuwoudtville	FWG&SKG	27.ix.90
cf. Helichrysum						
cf.H. sp.	Y	F	3	Anenous	SKG	12.x.89
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	27	Anenous	FWG	12.x.89
L. gnaphalodes (L.) L.	Y	M	2	Anenous	FWG	12.x.89
L. gnaphalodes (L.) L.	Y	F	2	Anenous	SKG	12.x.89
L. gnaphalodes (L.) L.	Y	F	1	Springbok	FWG	10-11.x.89
L. gnaphalodes (L.) L.	Y	M	3	Springbok	FWG	10-11.x.89
L. gnaphalodes (L.) L.	Y	M	1	Springbok	SKG	10-11.x.89
L. gnaphalodes (L.) L.	Y	F	5	Narap, Springbok	FWG&SKG	14.x.89
L. gnaphalodes (L.) L.	Y	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
L. tenella DC.	Y	F	48	Nieuwoudtville	FWG	3-8.x.89
L. tenella DC.	Y	M	29	Nieuwoudtville	FWG	3-8.x.89
L. tenella DC.	Y	F	10	Nieuwoudtville	SKG	3-8.x.89
L. tenella DC.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89
L. tenella DC.	Y	F	m	Nieuwoudtville	FWG,SKG &DWG	3-8.x.89
L. tenella DC.	Y	F	p	Nieuwoudtville	SKG	3-8.x.89
Osteospermum L.						
O. cf. oppositifolia (Ait.)T.Norl.	Y	M	1	Nieuwoudtville	DWG	3-8.x.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	2	W end Wildeperdehoek Pass	SKG	14.x.89
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F M	39 3	Nieuwoudtville	FWG&SKG	27.ix.90
Relhania L'Herit. emend. Bremer						
R. sp.	Y	F	19	Nieuwoudtville	FWG&SKG	27.ix.90
R. sp.	Y	M	5	Nieuwoudtville	FWG&SKG	27.ix.90
Senecio L.						
S. sp. prob. nivea Less.	W	F	5	Nieuwoudtville	FWG	3-8.x.89
S. sp. prob. nivea Less.	W	M	5	Nieuwoudtville	FWG	3-8.x.89
Papilionaceae (Fabaceae)						
Lebeckia Thunb.						
L. sericea Thunb.	Y	M	1	Klipfontein	FWG	14.x.89
Quartinia sp. A						
Aizoaceae: Mesembryanthema						
Leipoldtia L. Bol.						
L. sp.	Pi	F	1	Springbok	SKG	10-11.x.89
Polymita N.E.Br.						
P. albiflora (L.Bol.) L.Bol.	-	F	1	Springbok	MS	6.x.87
"mesem"	Pi	F	1	Nieuwoudtville	SKG&FWG	28.ix.90
Quartinia sp. B						
Aizoaceae: Mesembryanthema						
Prenia N.E.Br.						
P. sladeniana (L.Bol.) L.Bol.	-	F	1	Springbok	MS	17.x.87

Quartinia sp. D						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	3	Springbok	FWG	10-11.x.89
L. gnaphalodes (L.) L.	Y	F	5	Narap, Springbok	FWG&SKG	14.x.89
L. gnaphalodes (L.) L.	Y	F	20	Nieuwoudtville	FWG&SKG	28.ix.90
L. gnaphalodes (L.) L.	Y	M	5	Nieuwoudtville	FWG&SKG	28.ix.90
L. tenella DC.	Y	F	4	Nieuwoudtville	SKG	3-8.x.89
Relhania L'Herit. emend. Bremer						
R. sp.	Y	F	2	Nieuwoudtville	FWG&SKG	27.ix.90
Senecio L.						
S. prob. nivea Less.	-	F	1	Nieuwoudtville	FWG	3-8.x.89
Quartinia sp. E						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. pilosa Buek	V	F	5	Springbok	SKG	10-11.x.89
W. pilosa Buek	V	M	2	Springbok	SKG	10-11.x.89
Quartinia sp. F						
Asteraceae (Compositae)						
cf. Helichrysum Mill.						
cf. H. sp.	Y	F	1	Springbok	DWG	10-11.x.89
Aizoaceae: Mesembryanthema						
Leipoldtia L. Bol.						
L. sp.	Pi	F	1	Springbok	DWG	10-11.x.89
L. sp.	Pi	M	5	Springbok	DWG	10-11.x.89
Quartinia sp. G						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. pilosa Buek	V	F	1	Springbok	SKG	10-11.x.89
Quartinia sp. H						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. ecklonii Buek	V	F	1	Gydo Pass, Ceres	SKG	30.xi.89
Quartinia sp. I						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	F	7	Nieuwoudtville	FWG&SKG	28.ix.90
L. gnaphaloides (L.) L.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90

Quartiniella Schulthess						
Quartiniella watersoni Schulthess						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	SKG	2-3.xii.89
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	1	43 km ENE Ceres	RWG	2-3.xii.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F M	17 2	43 km ENE Ceres	FWG	2-3.xii.89
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	1	43 km ENE Ceres	SKG	2-3.xii.89

Quartinioides Richards						
Quartinioides antigone Richards						
Liliaceae						
Aloe L.						
A. striata Haw.	PiO	F	24	Prince Albert	FWG	26.xi.-5.xii.87
A. striata Haw.	PiO	M	5	Prince Albert	FWG	26.xi.-5.xii.87
Quartinioides basuto Richards						
Asteraceae (Compositae)						
Aster L.						
A. muricatus Thunb.	BV	F	1	Lesotho	CFJG	17.xi.52
Gazania Gaertn.						
G. linearis (Thunb.) Druce	Y	F	1	Lesotho	OWR	29.ix.52
G. linearis (Thunb.) Druce	Y	M	1		(in Richards, 1962)	
Quartinioides capensis (Schulthess)						
Aizoaceae: Mesembryanthema						
Mesembryanthemum	W	-	-	Cape Town	RET (Turner, 1939)	
Mesembryanthemum	W	-	-	Mossel Bay		
Quartinioides cyllene Richards						
Asteraceae						
Athanasia L.						
A. sp.	Y	F	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	3	Taaiboskraal	SKG	14.x.89
L. gnaphalodes (L.) L.	Y	F	2	Taaiboskraal	FWG	14.x.89
L. gnaphalodes (L.) L.	Y	F	15	Nieuwoudtville	FWG&SKG	28.ix.90
L. gnaphalodes (L.) L.	Y	M	6	Nieuwoudtville	FWG&SKG	28.ix.90
Relhania L'Herit. emend Bremer						
R. pumila Thunb.	Y	F	1	Nieuwoudtville	FWG	3-8.x.89
R. pumila Thunb.	Y	M	1	Nieuwoudtville	FWG	3-8.x.89
R. pumila Thunb.	Y	F	1	Nieuwoudtville	SKG	3-8.x.89
Senecio L.						
S. sp. prob. nivea Less.	W	F	3	Nieuwoudtville	FWG	3-8.x.89
S. sp. prob. nivea Less.	W	M	3	Nieuwoudtville	FWG	3-8.x.89
Quartinioides helichrysi Richards						
Asteraceae (Compositae)						
Helichrysum Mill.						
H. fruticans (L.) D.Don.	-	F	3	Lesotho	CFJG	28.xii.48
H. fruticans (L.) D.Don.	-	F	5	Lesotho	CFJG	28-31.xii.48 (in Richards, 1962)
Quartinioides metallescens (Schulthess)						
Asteraceae (Compositae)						
Gazania Gaertn.						
G. sp.	-	F	1	Lesotho	CFJG	3.xi.48
G. linearis (Thunb.) Druce	Y	F	2	Lesotho	CFJG	9.xi.48
Helichrysum Mill.						
H. sp.	-	F	1	Lesotho	CFJG	9-17.xi.52 (in Richards, 1962)
Quartinioides niveopicta (Schulthess)						
Aizoaceae: Mesembryanthema						
"Mesembryanthemum"	-	-	-		RET (Turner, 1939)	
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	F	1	43km ENE Ceres	SKG	2-3.xii.89

Quartinioides poecila Schulthess						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	-	-	-	Namibia	RET	
					(Turner, 1939, in Richards, 1962)	
Quartinioides propinqua (Schulthess)						
Asteraceae						
Gazania Gaertn.						
G. sp.	Y	F	1	Williston	DWG	1.x.89
Quartinioides senecionis Richards						
Asteraceae (Compositae)						
Aster L.						
A. muricatus Thunb.	BV	F	6	Lesotho	CFJG	12.xii.54
A. muricatus Thunb.	BV	M	1	Lesotho	CFJG	12.xii.54
A. muricatus Thunb.	BV	F	11	Lesotho	CFJG	12.xii.54
A. muricatus Thunb.	BV	M	7		(in Richards, 1962)	
Gazania Gaertn.						
G. sp.	-	-	-	Lesotho	CFJG	13.xi.48
					(in Richards, 1962)	
Senecio L.						
S. laevigatus Thunb.	-	F	9	OFS	CFJG	1.xii.52
S. laevigatus Thunb.	-	M	1	OFS	CFJG	1.xii.52
S. laevigatus Thunb.	-	F	27	OFS	CFJG	1.xii.52
S. laevigatus Thunb.	-	M	2		(in Richards, 1962)	
Quartinioides signata (Schulthess)						
Aizoaceae: Mesembryanthema						
Mesembryanthemum	-	-	-		RET (Turner, 1939)	
Quartinioides tarsata Richards						
Aizoaceae: Mesembryanthema						
Delosperma N.E.Br.						
D. acuminatum L.Bol.	-	-	12	Grahamstown	CFJG	24.iv.64
Drosanthemum Schwant.						
D. hispidum (L.) Schwant.	Pi	F	2	Grahamstown	EMcCC	18.x.52
D. hispidum (L.) Schwant.	Pi	F	1	Grahamstown	EMcCC	10.x.53
					(in Richards, 1962)	
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89
B. sp.	Y	F	2	Williston	FWG&SKG	26.ix.90
B. sp.	Y	M	1	Williston	FWG&SKG	26.ix.90
Gazania Gaertn.						
G. sp.	Y	F	1	Williston	DWG	1.x.89
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	BV	F	14	Grahamstown	FWG&SKG	13-30.x.81
Peliostomum Benth.						
P. leucorrhizum E. Mey. ex Benth.	BV	F	12	Twee Rivieren	FWG&SKG	8-11.iii.90
P. leucorrhizum E. Mey. ex Benth.	BV	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
P. leucorrhizum E. Mey. ex Benth.	BV	F	5	Kakamas	FWG&SKG	13.iii.90
P. leucorrhizum E. Mey. ex Benth.	BV	M	1	Kakamas	FWG&SKG	13.iii.90
P. leucorrhizum E. Mey. ex Benth.	BV	F	2	Williston	FWG&SKG	1.x.89
P. leucorrhizum E. Mey. ex Benth.	BV	F	5	Williston	DWG	1.x.89
P. virgatum E. Mey. ex Benth.	PV	F	3	Anenous	FWG&SKG	12.x.89

Quartinioides sp.A						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	1	Bitterfontein/ Garies	SKG	14.x.87
Quartinioides sp.B						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	1	Bitterfontein/ Garies	SKG	14.x.87
Quartinioides sp.C						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. hispidum (L.) Schwant.	Pi	F	1	Springbok	FWG&SKG	15-21.x.87
Quartinioides sp.D						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. hispidum (L.) Schwant.	Pi	F	1	Springbok	FWG&SKG	15-21.x.87
Psilocaulon N.E.Br.						
P. acutisepalum (Berger) N.E.Br.	WPi	-	1	Springbok	FWG&SKG	15-21.x.87
Quartinioides sp.E						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. hispidum (L.) Schwant.	Pi	F	2	Springbok	FWG&SKG	15-21.x.87
D. hispidum (L.) Schwant.	Pi	M	1	Springbok	FWG&SKG	15-21.x.87
Quartinioides sp.F						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. cf. articulatum (Th.) Schwant.	Pi	F	19	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	209	Prince Albert	FWG,SKG	26.xi-
S. cf. bijliae (N.E.Br.) L.Bol.	WPi	M	8		&RWG	5.xii.87
Quartinioides sp.G						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. cf. spinosa (L.f.) Druce	Y	F	1	Prince Albert	SKG	26.xi-5.xii.87
Quartinioides sp.H						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	15	Port Nolloth	FWG&SKG	2.x.85
D. sp.	Pi	F	1	Port Nolloth	FWG&SKG	11.x.88
D. sp.	Pi	F	1	Port Nolloth	DWG	11.x.88
Quartinioides sp. I						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	3	Anenous	FWG&SKG	11-13.x.88
Prenia N.E.Br.						
P. pallens (Ait.) N.E.Br.	-	F	3	Springbok	MS	27.x.89
"mesem"	Pi	F	1	Anenous	FWG	12.x.89
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	F	2	Springbok	DWG	10-11.x.89
"daisy"	Y	F	4	Springbok	FWG&SKG	10-12.x.88

Quartinioides sp.J						
Aizoaceae: Mesembryanthema						
"mesem"	Y	F	26	Oudtshoorn	FWG	7-8.xii.86
"mesem"	Y	F	10	Oudtshoorn	SKG	7-8.xii.86
"mesem"	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
"mesem"	W	F	2	Nieuwoudtville	FWG&SKG	27.ix.90
"mesem"	W	M	2	Nieuwoudtville	FWG&SKG	27.ix.90
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	F	5	60km ENE Ceres	FWG&SKG	3.xii.89
Quartinioides sp.K						
Aizoaceae: Mesembryanthema						
"mesem"	YW	F	1	Willowmore	CFJG	4.x.71
Quartinioides sp. M						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. pilosa Buek	V	F	1	Springbok	SKG	10-11.x.89
W. pilosa Buek	V	F	3	Springbok	SKG	14.x.89
W. prostrata A.DC.	V	F	3	Anenous	FWG&SKG	11-13.x.88
W. prostrata A.DC.	V	F	2	Anenous	DWG	11-13.x.88
W. prostrata A.DC.	V	F	11	Anenous	SKG	12.x.89
W. prostrata A.DC.	V	M	2	Anenous	SKG	12.x.89
Quartinioides sp. N						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb.) A.DC.	V	F	5	Clanwilliam	FWG&SKG	3-7.x.88
W. paniculata (Thunb.) A.DC.	V	F	1	Clanwilliam	FWG&SKG	5-6.x.88
W. sp.	V	F	16	Nieuwoudtville	FWG&SKG	29-30.ix.90
W. sp.	V	M	3	Nieuwoudtville	FWG&SKG	29-30.ix.90
Quartinioides sp. O						
Aizoaceae: Mesembryanthema						
Polymita N. E. Br.						
P. albiflora (L. Bol.) L. Bol.	-	F	1	Springbok	MS	31.x.87
Prenia N. E. Br.						
P. pallens (Ait.) N. E. Br.	-	F	1	Springbok	MS	27.x.87
Stoeberia Dinter & Schwant.						
S. sp.	Pi	F	3	Aggeneys	FWG&SKG	14.x.88
S. sp.	Pi	F	3	Aggeneys	DWG	14.x.88
Quartinioides sp. P						
Aizoaceae: Mesembryanthema						
Prenia N. E. Br.						
P. pallens (Ait.) N. E. Br.	-	F	4	Springbok	MS	27.x.87
P. sladeniana (L. Bol.) L. Bol.	-	F	1	Springbok	MS	17.x.87
Quartinioides sp. Q						
Aizoaceae: Mesembryanthema						
Stoeberia Dinter & Schwant.						
S. sp.	Pi	M	1	Aggeneys	DWG	14.x.88
Quartinioides sp. R						
Aizoaceae: Mesembryanthema						
Stoeberia Dinter & Schwant.						
S. sp.	Pi	M	1	Aggeneys	DWG	14.x.88
Quartinioides sp. S						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. paniculata (Thunb.) A.DC.	V	M	1	Clanwilliam	DWG	3-7.x.88

Quartinioides sp. T						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	1	Anenous	FWG&SKG	11-13.x.88
D. sp.	Pi	F	4	Anenous	SKG	12.x.89
D. sp.	Pi	M	1	Anenous	SKG	12.x.89
Scrophulariaceae						
Peliostomum Benth.						
P. virgatum E.Mey.	PuV	F	2	Anenous	SKG	12.x.89
Quartinioides sp. U						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. ecklonii Buek	V	F	4	Theronsberg Pass, Ceres	SKG	29.xi.89
W. ecklonii Buek	V	F	1	Theronsberg Pass, Ceres	HWG	29.xi.89
W. ecklonii Buek	V	M	1	Theronsberg Pass, Ceres	FWG	29.xi.89
Quartinioides sp. V						
Scrophulariaceae						
Peliostomum Benth.						
P. leucorrhizum E. Mey. ex Benth.	BV	F	3	Twee Rivieren	FWG&SKG	8-11.iii.90
Quartinioides sp. W						
Scrophulariaceae						
Peliostomum Benth.						
P. leucorrhizum E. Mey. ex Benth.	BV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Quartinioides sp. X						
Scrophulariaceae						
Peliostomum Benth.						
P. leucorrhizum E. Mey. ex Benth.	BV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Quartinioides sp. Y						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. sp.	Pi	F	5	Anenous	SKG	12.x.89
Scrophulariaceae						
Peliostomum Benth.						
P. virgatum E.Mey.	PuV	M	1	Anenous	SKG	12.x.89
Quartinioides sp. Z						
Asteraceae						
Gazania Gaertn.						
G. sp.	Y	F	2	Williston	FWG,SKG&DWG	1.x.89

POMPILIOIDEA
POMPILIDAE

Atopopompilus Arnold						
Atopopompilus jacens (Bingham)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.1.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	FWG	16.i.84
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	W	M	1	Grahamstown	HWG	14.xii.82
Auplopus Spinola						
Auplopus carinigena (Cameron)						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.		M	1	Adelaide	CFJG	20-22.xii.72
Auplopus pauperata (Arnold)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	3.i.77
Auplopus personata (Cameron)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Batozonellus Arnold						
Batozonellus capensis (Dahlbom)						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.		M	1	Grahamstown	FWG	10.i.73
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	4	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	4	Grahamstown	CFJG	23.i.70
F. vulgare A.W.Hill	Y	F	3	Grahamstown	FWG	24.i-5.ii.70
F. vulgare A.W.Hill	Y	M	6	Grahamstown	FWG	24.i-5.ii.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	SKG	25.i.72
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	DWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	SKG	16.i.84
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	DWG	6.xii.77
Selaginaceae						
Selago L.						
S. sp.	W	M	3	Grahamstown	CFJG	16.xii.69

<u>Batozonellus fuliginosus</u> (Klug)

Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	4	Grahamstown	FWG	20.1-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	M	5	Grahamstown	FWG	20.1-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	M	3	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	SKG	25.i.72
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. caffra</u> (Thunb.) Willd.	Y	F	2	Oudtshoorn	RWG	9-12.xii.86
<u>A. karroo</u> Hayne	Y	F	2	Oudtshoorn	RWG	9-12.xii.86
Rhamnaceae						
<u>Ziziphus</u> Mill.						
<u>Z. mucronata</u> Willd.		F	1	Adelaide	CFJG	20-22.xii.72
<u>Z. mucronata</u> Willd.		M	2	Adelaide	CFJG	20-22.xii.72

<u>Clavelia</u> H. Lucas

<u>Clavelia ramosa</u> Smith

Asclepiadaceae						
<u>Asclepias</u> L.						
<u>A. buchenaviana</u> Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
<u>Athanasia</u> L.						
<u>A. trifurcata</u> (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90

<u>Cryptochilus</u> Panzer

<u>Cryptochilus morosus</u> Arnold

Papilionaceae (Fabaceae)						
<u>Calpurnia</u> E. Mey.						
<u>C. glabrata</u> Brummitt	Y	F	4	Mamathes	CFJG	24-26.x.52
<u>C. glabrata</u> Brummitt	Y	M	2	Mamathes	CFJG	24-26.x.52

<u>Cyphononyx</u> Dahlbom

<u>Cyphononyx croceicornis</u> Erichson

Apiaceae (Umbelliferae)						
<u>Deverra</u> DC.						
<u>D. aphylla</u> (Cham.& Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90

<u>Cyphononyx decipiens</u> (Smith)

Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	6	Grahamstown	FWG	20-26.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	6	Grahamstown	FWG	20-26.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70

<u>Cyphononyx flavicornis antennatus</u> (Smith)

Aizoaceae: Mesembryanthema						
<u>Ruschia</u> Schwant.						
<u>R</u>. sp.	W	M	3	Grahamstown	FWG	6.xii.76
<u>R</u>. sp.	W	F	2	Grahamstown	FWG	22.xii.69
<u>R</u>. sp.	W	M	3	Grahamstown	FWG	22.xii.69

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	SKG	25.i.72
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	F	2	Grahamstown	FWG	20-22.i.70
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
Senecio L.						
S. sp.	Y	M	6	Grahamstown	FWG&SKG	1.xii.79
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	6	Grahamstown	FWG	9-11.xii.69
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	DWG	6.xii.77
M. linearis (L.f.) Marais	WY	M	4	Grahamstown	DWG	6.xii.77
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	6.xii.77
M. linearis (L.f.) Marais	WY	M	2	Grahamstown	FWG	6.xii.77
M. linearis (L.f.) Marais	WY	M	2	Grahamstown	DWG	9.xii.77
M. linearis (L.f.) Marais	WY	M	2	Grahamstown	FWG&SKG	16.xii.82
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	3	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Grahamstown	DWG	9.xii.76
A. karroo Hayne	Y	F	1	Grahamstown	HWG	3.i.77
A. karroo Hayne	Y	M	2	Grahamstown	DWG	11.i.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	20.xii.77
A. karroo Hayne	Y	M	2	Grahamstown	RWG	20.xii.77
A. karroo Hayne	Y	F	1	Grahamstown	FWG	2.i.78
A. karroo Hayne	Y	M	2	Grahamstown	HWG	2.i.78
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
A. karroo Hayne	Y	F	1	Grahamstown	FWG	21.xii.76
A. karroo Hayne	Y	F	1	Grahamstown	FWG	29.xii.76
A. karroo Hayne	Y	F	2	Grahamstown	DWG	21.xii.76
A. karroo Hayne	Y	F	1	Grahamstown	DWG	21.xii.76
A. karroo Hayne	Y	F	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	11.i.77
A. karroo Hayne	Y	F	1	Grahamstown	RWG	13.i.77
Cyphononyx optimus (Smith)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	11	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84

Dichragenia Haupt

Dichragenia jacob (Arnold)

Apiaceae (Umbelliferae)

Foeniculum Mill.

Dichragenia pulchricoma (Arnold)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	3	Grahamstown	FWG	6.xii.72
M. linearis (L.f.) Marais	WY	M	2	Grahamstown	DWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	11.i.77
Dicyrtomellus Gussakovskij						
Dicyrtomellus argenteodecoratus (Cameron)						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.	-	F	1	Grahamstown	FWG	10.i.73
Papilionaceae (Fabaceae)						
Calpurnia E. Mey						
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	26.xii.51
Dicyrtomellus rufofemoratus Bischoff						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Elaphrosyron Haupt						
Elaphrosyron insidiosus (Smith)						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43km ENE Ceres	HWG	2-3.xii.89
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	1	Grahamstown	FWG	17.iii.78
Episyron Schiödte						
Episyron bicinctus Bischoff						
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.78

Hemipepsis Dahlbom						
Hemipepsis brunniceps Taschenberg						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	M	3	Grahamstown	DWG	22.xi.81
"mesem"	Pi	F	3	Grahamstown	DWG	27.xi.81
"mesem"	Pi	F	1	Grahamstown	HWG	27.xi.81
"mesem"	Pi	F	1	Grahamstown	RWG	27.xi.81
Ruschia Schwant.						
R. sp.	W	M	1	Grahamstown	FWG	22.xii.69
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	3	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	10	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	8	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	F	6	Grahamstown	CFJG	23-24.i.70
F. vulgare A.W.Hill	Y	M	1	Riebeek East	FWG&SKG	22.xi.82
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	7	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. sp.	WY	M	1	43km ENE Ceres	RWG	2-3.xii.89
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	6	Grahamstown	FWG	9-11.xii.69
M. linearis (L.f.) Marais	WY	M	8	Grahamstown	FWG	9-11.xii.69
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG&SKG	11.xii.80
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	W	F	1	Grahamstown	HWG	14.xii.82
A. suaveolens Burch.	W	M	1	Grahamstown	HWG	14.xii.82
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	2	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	2	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	3	Grahamstown	DWG	21.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	13.i.77
A. karroo Hayne	Y	M	1	Oudtshoorn	SKG	9-12.xii.86
A. karroo Hayne	Y	M	2	Oudtshoorn	RWG	9-12.xii.86
Hemipepsis caelebs Arnold						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	WY	M	1	Grahamstown	RWG	14.xii.82

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	2	Grahamstown	FWG	27.xi.73
A. karroo Hayne	Y	M	1	Grahamstown	FWG	5.xii.73
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
Hemipepsis capensis Fabricius						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	3	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	18	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	M	7	Grahamstown	FWG	20.i-5.ii.70
F. vulgare A.W.Hill	Y	F	7	Grahamstown	CFJG	23-24.i.70
F. vulgare A.W.Hill	Y	M	3	Riebeek East	DWG	22.xi.82
F. vulgare A.W.Hill	Y	F	1	Grahamstown	DWG	15.i.84
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	4	Grahamstown	FWG	9.xii.69
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	DWG	18.xii.80
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Colesberg	DWG	16.i.85
Hemipepsis glabrata (Klug)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	22.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
Hemipepsis glabrata anchietae (Radoszkowski)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	12	Twee Rivieren	FWG&SKG	8-11.iii.90
Hemipepsis hilaris Smith						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Riebeek East	FWG&SKG	22.xi.82
F. vulgare A.W.Hill	Y	F	1	Grahamstown	DWG	15.i.84
Asclepiadaceae						
Asclepias L.						
A. sp.	YW	M	2	43km ENE Ceres	RWG	2-3.xii.89
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt		M	1	Mamathes	CFJG	24.x.52
Hemipepsis iodoptera Stål						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	12.ii.70
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	11.xii.69
M. linearis (L.f.) Marais	WY	M	4	Grahamstown	FWG	9.xii.69

Hemipepsis tamisieri Guérin-Méneville						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	SKG	25.i.72
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	4.i.78
Selaginaceae						
Selago L.						
S. sp.	W	M	3	Grahamstown	CFJG	16.xii.69
Hemipepsis vindex Smith						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Matroosberg	RWG	4.xii.86
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A. W. Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Euphorbiaceae						
Euphorbia L.						
E. mauritanica L.	Y	F	6	Clanwilliam	FWG&SKG	13.x.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Oudtshoorn	RWG	9-12.xii.86

Paraclavelia Haupt						
Paraclavelia crudelis (Smith)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	6	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	RWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	M	3	Riebeek East	FWG&SKG	22.xi.82
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.		F	1	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.		M	1	Adelaide	CFJG	20-22.xii.72

Paracyphononyx Gribodo						
Paracyphononyx difficilus (Bischoff)						
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	2	Mamathes	CFJG	29.xii.51
Paracyphononyx diversus (Dahlbom)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	3	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	RWG	16.i.84
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	21.xii.76
A. karroo Hayne	Y	M	2	Grahamstown	DWG	4.i.78

Paracyphononyx frustratus (Smith)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	2	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Paracyphononyx montanus Arnold						
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	26.xii.51
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	2.xi.52
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	17.xi.52
Paracyphononyx ruficrus (Klug)						
Elatinaceae						
Bergia L.						
B. glomerata L. f.	YW	F	1	Grahamstown	FWG&SKG	20.xi.90
B. glomerata L. f.	YW	M	3	Grahamstown	FWG&SKG	20.xi.90
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	WY	M	1	Grahamstown	HWG	14.xii.82
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.		M	2	Adelaide	CFJG	20-22.xii.78
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	M	1	Grahamstown	FWG	16.xi.81
Paracyphononyx zonatus (Illiger)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78

Paraferreola Sustera						
Paraferreola melanostoma Cameron						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	8			

Platyderes Guérin-Méneville						
Platyderes rhodesianus Bischoff						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	2			

Pompilus (Fabricius)
Pompilus cinereus Fabr.

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	24.i.70

Priocnemis Schiödte
Priocnemis braunsi Arnold

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	28.iv.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	3	Grahamstown	FWG	25.x.72

Psammochares Latreille
Psammochares decipiens Bischoff

Apiaceae (Umbelliferae)						
Deverra						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	12	Twee Rivieren	FWG&SKG	8-11.iii.90

Psammochares rutilus Klug

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	FWG	16.i.84

Psammoderes Haupt
Psammoderes major Haupt

Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	6	Grahamstown	FWG	23.i.70-5.ii.70
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	F	1	Riebeek East	FWG&SKG	22.xi.82
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	9.xii.69
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	6.xii.77
Elatinaceae						
Bergia L.						
B. glomerata L. f.	YW	F	1	Grahamstown	FWG&SKG	20.xi.90

Psammoderes mimicus Haupt

Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	1	Grahamstown	RWG	31.xii.86
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	M	1	Clanwilliam/Graafwater	FWG&SKG	3.x.90
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.		M	1	Adelaide	CFJG	20-22.xii.72

Pseudagenia Kohl						
Pseudagenia flavotegulata Bingham						
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	26.xii.51-
C. glabrata Brummitt	Y	M	3			12.i.52
Pseudagenia impavida Arnold						
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	9.xii.69
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	1.i.52
Pseudagenia nigro-aurantiaca Magretti						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
Pseudagenia spilocephala Cameron						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	2	Grahamstown	FWG	28.iv.70
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	FWG	16.i.84
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	W	F	1	Grahamstown	HWG	14.xii.82
Pseudagenia vaga sulcata Arnold						
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	1.i.52
Schistonyx Saussure						
Schistonyx umbrosus (Klug)						
Apiaceae (Umbelliferae)						
Deverra						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	2			
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43km ENE Ceres	HWG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	16.i.85
Tachypompilus Ashmead						
Tachypompilus ignitus (Smith)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	12	Grahamstown	FWG	20-26.i.70

Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. sp.	WY	F	1	43km ENE Ceres	RWG	2-3.xii.89
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	5	Grahamstown	FWG	11.xii.69
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	2	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	2	Grahamstown	DWG	4.i.78

SPHECOIDEA
AMPULICIDAE

Ampulex Jurine

Ampulex spp.

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	3	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	F	3	Grahamstown	DWG	13.i.77
A. karroo Hayne	Y	M	2	Grahamstown	DWG	13.i.77
A. karroo Hayne	Y	M	4	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	2.i.78
A. karroo Hayne	Y	M	2	Grahamstown	DWG	20.xii.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	--.xii.83
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	25.x.52

SPHECIDAE

Ammophila W. Kirby

Ammophila beniniensis (Palisot de Beauvois)

Asclepiadaceae						
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	F	1	Kommadagga	FWG	14.i.86
S. viminale (L.) R. Br.	Y	M	4	Kommadagga	FWG	14.i.86
S. viminale (L.) R. Br.	Y	F	1	Kommadagga	RWG	14.i.86
S. viminale (L.) R. Br.	Y	M	2	Kommadagga	RWG	14.i.86
S. viminale (L.) R. Br.	Y	M	12	Kommadagga	DWG	14.i.86
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	18.x.77
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	3.xi.77
Verbesina L.						
V. encelioides (Cav.) Benth. & Hook.	Y	F	1	Kudu Reserve/ Fort Brown	AJSW	8.ii.82
V. encelioides (Cav.) Benth. & Hook.	Y	M	3	Kudu Reserve/ Fort Brown	AJSW	8.iii.82
V. encelioides (Cav.) Benth. & Hook.	Y	F	1	Kudu Reserve/ Fort Brown	AJSW	1.xii.82
V. encelioides (Cav.) Benth. & Hook.	Y	M	4	Kudu Reserve/ Fort Brown	AJSW	1.xii.82
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	1	Grahamstown	FWG	18.xi.77
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	16.xi.77
M. linearis (L. f.) Marais	WY	M	2	Grahamstown	FWG	6.xii.77

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.xii.72
A. karroo Hayne	Y	M	2	Grahamstown	DWG	20.xii.77
A. karroo Hayne	Y	F	1	Colesberg	DWG	15.i.85
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	2	Grahamstown	FWG	13-17.iii.78
Solanaceae						
Lycium L.						
L. sp.	BV	M	1	Grahamstown	FWG	5.iv.78
L. sp.	BV	F	1	Grahamstown/ Fort Brown	AJSW	16.xi.82
Ammophila bonaespei Lepeletier						
Acanthaceae						
Monechma Hochst.						
M. sp.	PiV	F	2	Nossob	FWG&SKG	8.iii.90
M. sp.	PiV	M	5	Nossob	FWG&SKG	8.iii.90
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Chrysocoma L.						
C. ciliata L.	Y	F	1	Grahamstown	AJSW	16.iii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	SKG	14.x.87
"pea flower"	Y	F	1	Clanwilliam	FWG&SKG	6.x.90
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	1	Grahamstown	FWG	9.iii.78
Ammophila conifera Arnold						
Asteraceae (Compositae)						
Conyza Less.						
C. bonariensis (L.) Cronq.	W	F	1	Grahamstown	FWG	28.ii.78
C. bonariensis (L.) Cronq.	W	M	1	Grahamstown	FWG	28.ii.78
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	20.xii.77
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	1	Grahamstown	FWG	17.iii.78
P. cuneifolium (L.f.) Benth.	BV	M	1	Grahamstown	FWG	17.iii.78
P. cuneifolium (L.f.) Benth.	BV	M	1	Grahamstown	FWG	3.iii.78
Ammophila dolichodera Kohl						
Acanthaceae						
Monechma Hochst.						
M. sp.	PiV	M	1	Nossob	FWG&SKG	8.iii.90
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90

<u>Chalybion</u> Dahlbom						
<u>Chalybion tibiale</u> (Fabricius)						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	3	Grahamstown	FWG	20.i-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	M	3	Grahamstown	FWG	20.i-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	CFJG	23.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	1	Riebeek East	DWG	22.xi.82
Celastraceae						
<u>Maytenus</u> Molina						
<u>M. linearis</u> (L. <u>f</u>.) Marais	WY	F	1	Grahamstown	DWG	9.xii.77
Euphorbiaceae						
<u>Euphorbia</u> L.						
<u>E. mauritanica</u> L.	Y	M	1	Clanwilliam	FWG&SKG	11.x.90
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. karroo</u> Hayne	Y	F	1	Grahamstown	DWG	6.i.77
Rhamnaceae						
<u>Ziziphus</u> Mill.						
<u>Z. mucronata</u> Willd.		M	1	Adelaide	CFJG	20-22.xii.72
<u>Chalybion spinolae (Lepeletier)</u>						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	4	Grahamstown	FWG	21.i-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	M	4	Grahamstown	FWG	21.i-5.ii.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Riebeek East	FWG&SKG	22.xi.82
<u>F. vulgare</u> A.W.Hill	Y	M	2	Riebeek East	DWG	22.xi.82
Araliaceae						
<u>Hedera</u> Tourn. ex L.						
<u>H. helix</u> L.		F	1	Grahamstown	RWG	27.xii.81-4.i.82
Celastraceae						
<u>Maytenus</u> Molina						
<u>M. linearis</u> (L. <u>f</u>.) Marais	WY	F	8	Grahamstown	FWG	9-11.xii.69
<u>M. linearis</u> (L. <u>f</u>.) Marais	WY	M	5	Grahamstown	FWG	9-11.xii.69
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. karroo</u> Hayne		M	1	Grahamstown	DWG	3.i.77
Rhamnaceae						
<u>Ziziphus</u> Mill.						
<u>Z. mucronata</u> Willd.		F	1	Adelaide	CFJG	20-22.xii.72
<u>Z. mucronata</u> Willd.		M	1	Adelaide	CFJG	20-22.xii.72

<u>Isodontia</u> Patton						
<u>Isodontia pelopoeiformis</u> (Dahlbom)						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	CFJG&FWG	23-24.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	5	Grahamstown	CFJG&FWG	23-24.i.70

Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	3	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.78
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	CFJG	16.xii.69
Isodontia simoni (du Buysson)						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Grahamstown	DWG	22.xi.81
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz		F	1	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	3.xi.77
Senecio L.						
S. sp.		F	1	Grahamstown	FWG	29.xi.79

Parapsammophila Taschenberg						
Parapsammophila consobrina (Arnold)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	4	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Parapsammophila sp.						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	4	Twee Rivieren	FWG&SKG	8-11.iii.90

Podalonia Fernald						
Podalonia canescens (Dahlbom)						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	M	11	Vredendal	FWG&SKG	30.ix.85
"mesem"	W	M	1	Montagu/Matroosberg	RWG	4.xii.86
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	5	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	23	Grahamstown	FWG	20.i-5ii.70
F. vulgare A.W.Hill	Y	M	6	Grahamstown	FWG	20.i-5ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	SKG	25.i.72
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	5	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	4	Clanwilliam	FWG&SKG	9.x.90
Cirsium Mill. emend Scop.						
C. vulgare (Savi) Ten.	PiV	M	1	Grahamstown	FWG	9.iii.78

Conyza Less.						
C. bonariensis (L.) Cronq.		F	1	Grahamstown	FWG	28.i.78
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG&SKG	20.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG&SKG	18.x.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	10.xi-20.x.77
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	10.xi-20.x.77
Metalasia L.						
M. muricata (L.) D.Don	Pi	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
Pteronia L.						
P. sp. B	Y	F	2	Nababeep	FWG&SKG	12-13.x.89
Senecio L.						
S. rosmarinifolius L. f.		M	1	Oudtshoorn	FWG	7-8.xii.86
S. sp.		F	1	Grahamstown	FWG&SKG	2.xii.79
S. sp.		F	1	Grahamstown	FWG&SKG	7.xii.79
S. sp.	Y	F	1	Grahamstown	SKG	31.xii.86
S. sp.	Y	M	2	Grahamstown	FWG	28.xii.86
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	2	Grahamstown	FWG	18.xi.77
A. capensis Thunb.	B	M	3	Grahamstown	FWG	18.xi.77
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
Liliaceae						
Asparagus L.						
A. suaveolens Burch.	W	M	1	Grahamstown	HWG	14.xii.82
A. suaveolens Burch.	W	M	13	Grahamstown	HWG	14.xii.82
Malvaceae						
prostrate	Pi	F	2	Lamberts Bay	SKG	1.xii.89
prostrate	Pi	M	6	Lamberts Bay	SKG	1.xii.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	3	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	3	Colesberg	DWG	16.i.85
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.71
A. karroo Hayne	Y	M	1	Grahamstown	FWG	5.xii.80
A. karroo Hayne	Y	M	2	Grahamstown	DWG	5.xii.80
Calpurnia E. Mey						
C. glabrata Brummitt	Y	F	2	Mamathes	CFJG	19-25.x.52
C. glabrata Brummitt	Y	M	7	Mamathes	CFJG	19-25.x.52
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	M	1	60 km ENE Ceres	FWG&SKG	3.xii.89
Proteaceae						
?	-	F	1	Clanwilliam	FWG&SKG	4.x.90
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72

Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.)Benth.	BV	F	1	Grahamstown	FWG	9.iii.78
P. cuneifolium (L.f.)Benth.	BV	M	4	Grahamstown	FWG	9.iii.78
P. cuneifolium (L.f.)Benth.	BV	F	1	Grahamstown	FWG	3-17.iii.78

Prionyx Van der Linden						
Prionyx funebris (Berland)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	YW	F	1	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	M	2	Kommadagga	FWG	14.i.84
S. viminale (L.) R. Br.	Y	M	2	Kommadagga	RWG	14.i.84
S. viminale (L.) R. Br.	Y	M	1	Kommadagga	DWG	14.i.84
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Colesberg	DWG	16-19.i.85
A. karroo Hayne	Y	M	4	Colesberg	DWG	16-19.i.85
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Medicago Tourn. ex L.						
M. sativa L.	V	F	1	Grahamstown	FWG	5.ii.70
Prionyx inda (L.)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	2	Prince Albert	FWG,SKG	26.xi-
A. buchenaviana Schinz	WY	M	1		&RWG	5.xii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Prionyx kirbii (Van der Linden)						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	3.xi.77
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	3.xi.77
Elatinaceae						
Bergia L.						
B. glomerata L. f.	YW	F	1	Grahamstown	FWG&SKG	20.xi.90
B. glomerata L. f.	YW	M	3	Grahamstown	FWG&SKG	20.xi.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	FWG	2.i.78
Prionyx viduatus (Christ)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	17	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Sceliphron Klug						
Sceliphron spirifex (L.)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	7	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	3	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	DWG	15.i.84
Mimosaceae						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	M	3	Mamathes	CFJG	19-26.x.52
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	29.xii.51

Sphex L.						
Sphex decipiens Kohl						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Bloutoring	FWG	3.xii.86
"mesem"	Pi	M	3	Grahamstown	RWG	22.xi-3.xii.81
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	26.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	7	Prince Albert	FWG,SKG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	12		&RWG	
Sarcostemma R. Br.						
S. viminale (L.) R.Br.	Y	F	1	Kommadagga	DWG	14.i.86
S. viminale (L.) R.Br.	Y	M	7	Kommadagga	DWG	14.i.86
S. viminale (L.) R.Br.	Y	F	1	Kommadagga	RWG	14.i.86
S. viminale (L.) R.Br.	Y	M	3	Kommadagga	RWG	14.i.86
S. viminale (L.) R.Br.	Y	M	1	Kommadagga	FWG	14.i.86
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	3	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	3	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	3	Oudtshoorn	FWG	9-12.xii.86
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	2	Adelaide	CFJG	20-22.xii.72
Solanaceae						
Lycium L.						
L. sp.	V	F	1	Grahamstown	SKG	2.ii.81
L. sp.	V	M	1	Grahamstown	SKG	8.ii.81
L. sp.	V	F	1	Grahamstown	FWG	8.ii.81
L. sp.	V	M	1	Grahamstown	HWG	8.ii.81
L. sp.	V	M	1	Grahamstown	RWG	8.ii.81

<u>Sphex lanatus</u> Mocsáry						
Apiaceae (Umbelliferae)						
<u>Deverra</u> DC.						
<u>D. aphylla</u> (Cham. & Schlechtd.) DC.	Y	F	6	Twee Rivieren	FWG&SKG	8-11.iii.90

LARRIDAE

<u>Liris</u> Fabricius						
<u>Liris rufoscapa</u> (Cameron)						
Apiaceae (Umbelliferae)						
<u>Deverra</u> DC.						
<u>D. aphylla</u> (Cham. & Schlechtd.) DC.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
<u>Palarus</u> Latreille						
<u>Palarus latifrons</u> Kohl						
Asteraceae (Compositae)						
<u>Athanasia</u> L.						
<u>A</u>. sp.	Y	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
<u>Palarus pentheri</u> Brauns						
Apiaceae (Umbelliferae)						
<u>Deverra</u> DC.						
<u>D. aphylla</u> (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	1			
<u>Parapiagetia</u> Kohl						
<u>Parapiagetia capensis ferox</u> Arnold						
Apiaceae (Umbelliferae)						
<u>Deverra</u> DC.						
<u>D. aphylla</u> (Cham. & Schlechtd.) DC.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
<u>Pison</u> Jurine						
<u>Pison</u> sp.nov.						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	5	Grahamstown	FWG	24.i.70-5.ii.70
Celastraceae						
<u>Maytenus</u> Molina						
<u>M. linearis</u> (L.<u>f.</u>) Marais	WY	F	2	Grahamstown	FWG	11.xii.69
<u>M. linearis</u> (L.<u>f.</u>) Marais	WY	M	1	Grahamstown	FWG	6.xii.72
Mimosaceae						
<u>Acacia</u> Mill.						
<u>A. karroo</u> Hayne	Y	F	1	Grahamstown	DWG	13.i.77
<u>Tachysphex</u> Kohl						
<u>Tachysphex albocinctus</u> (Lucas)						
Apiaceae (Umbelliferae)						
<u>Foeniculum</u> Mill.						
<u>F. vulgare</u> A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
<u>F. vulgare</u> A.W.Hill	Y	F	2	Grahamstown	FWG	26.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
<u>F. vulgare</u> A.W.Hill	Y	M	1	Grahamstown	FWG	24.i.70

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Grahamstown	FWG&DWG	6.1.77
Tachysphex fugax (Radoszkowski)						
Papilionaceae (Fabaceae)						
Melolobium Eckl. & Zeyh.						
M. candicans (E. Mey.) Eckl. and Zeyh.	Y	M	1	Grahamstown	FWG	4.x.77
Tachysphex modestus Arnold						
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	5	Grahamstown	DWG	6-9.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
Tachysphex panzeri pentheri Cameron						
Selaginaceae						
Selago L.						
S. corymbosa L.	W	F	1	Grahamstown	DWG	13.xii.72
Tachysphex sericeus (F. Smith)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	3	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	2	Grahamstown	JGHL	17.25.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	CFJG	24-25.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	5.ii.70
Selaginaceae						
Selago L.						
S. sp.	W	M	1	Grahamstown	CFJG	16.xii.69
Tachysphex sp.nov.A						
Asteraceae (Compositae)						
Conyza Less.						
C. bonariensis (L.) Cronq.	W	F	1	Grahamstown	FWG	28.ii.78
Tachysphex sp.nov.D						
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	3	Grahamstown	DWG	6-9.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG&RWG	20.xii.77
Tachysphex sp. Kalahari A						
Aizoaceae: non-Mesembryanthema						
Limeum L.						
L. aethiopicum Burm.	W	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90
Tachysphex sp. Kalahari C.						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. &	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
Schlechtd.) DC.		M	2			
Tachysphex sp. Kalahari D.						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90

CRABRONIDAE

Belomicrus A. Costa						
Belomicrus ferrieri Kohl						
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	2	43km ENE Ceres	FWG&SKG	2-3.xii.89
E. crispa (Thunb.) Guerke	WY	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Belomicrus sp. B						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Clanwilliam	FWG&SKG	6.x.88
Belomicrus sp. C						
Asteraceae (Compositae)						
Anthanasia L.						
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xi.89
A. sp.	Y	M	1	43 km ENE Ceres	HWG	2-3.xi.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	1	60 km ENE Ceres	RWG	3.xi.89
Belomicrus sp. E						
Asteraceae (Compositae)						
Cotula L.						
C. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Belomicrus sp. F						
Asteraceae (Compositae)						
Helichrysum Mill.						
H. sp.	Y	M	1	Clanwilliam	FWG&SKG	11-13.x.90
Belomicroides Kohl						
Belomicroides sp. nov.						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. prostrata A.DC.	V	F	1	Anenous	DWG	11-13.x.88
W. prostrata A.DC.	V	M	2	Anenous	DWG	11-13.x.88
Oxybelus Latreille						
Oxybelus imperialis Gerstaecker						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	15.xi.77
Oxybelus lingula Gerstaecker						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	23.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	F	2	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	5.ii.70
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	22.xi.77

Oxybelus peringueyi Saussure						
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
Oxybelus rubrocaudatus Arnold						
Apiaceae (Umbelliferae)						
Berula Koch L.						
B. erecta (Hudson) Cov.	WY	M	3	Grahamstown	FWG	10.i.73
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	26.i.70
Celastraceae						
Maytenus Molina						
M. linearis (L. *f.*) Marais	WY	M	2	Grahamstown	FWG	16.xi.77
M. linearis (L. *f.*) Marais	WY	M	1	Grahamstown	FWG	6.xii.77
Oxybelus ruficaudis Cameron						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.	WY	M	1	Grahamstown	FWG	10.i.73
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	5.ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	5.ii.70
Celastraceae						
Maytenus Molina						
M. linearis (L. *f.*) Marais	WY	M	1	Grahamstown	FWG	16.xi.77
M. linearis (L. *f.*) Marais	WY	M	1	Grahamstown	FWG	6.xii.77
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	5	Mamathes	CFJG	
C. glabrata Brummitt	Y	M	4	Mamathes	CFJG	
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90

Dasyproctus Lepeletier & Brullé						
Dasyproctus bipunctatus bipunctatus Lepeletier						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	26.i.70
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	15	Grahamstown	FWG&DWG	12-25.x.72
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	13.i.77
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Dasyproctus dubiosus (Arnold)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
Dasyproctus immitus (Saussure)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	25.i.70
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Dasyproctus ruficaudis (Arnold)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.70
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Dasyproctus simillimus (Smith)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	5.ii.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	28.iv.70
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG	16.x.72

NYSSONIDAE

Bembecinus A. Costa						
Bembecinus braunsii (Handlirsch)						
Selaginaceae						
Selago L.						
S. corymbosa L.	W	F	1	Grahamstown	DWG&RWG	2.xii.77
S. corymbosa L.	W	M	2	Grahamstown	DWG&RWG	2.xii.77
S. corymbosa L.	W	M	2	Grahamstown	FWG	9.xii.77
S. corymbosa L.	W	F	1	Grahamstown	FWG	9.iii.78
Bembecinus cinguliger (Smith)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	2	Grahamstown	FWG	5.ii.74
Asteraceae (Compositae)						
Helichrysum Mill.						
H. ericifolium Less.	-	F	3	Grahamstown	FWG	2.i.74

Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	F	5	Grahamstown	FWG	11.xii.69
M. linearis (L. f.) Marais	WY	M	12	Grahamstown	FWG	11.xii.69
M. linearis (L. f.) Marais	WY	F	4	Grahamstown	FWG	6.xii.72
M. linearis (L. f.) Marais	WY	F	6	Grahamstown	DWG	6.xii.77
M. linearis (L. f.) Marais	WY	M	37	Grahamstown	DWG	6.xii.77
M. linearis (L. f.) Marais	WY	F	1	Grahamstown	FWG	6.xii.77
M. linearis (L. f.) Marais	WY	F	1	Grahamstown	DWG	9.xii.77
M. linearis (L. f.) Marais	WY	M	2	Grahamstown	DWG	9.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	3	Grahamstown	DWG&FWG	19.x.75-
A. karroo Hayne	Y	M	5	Grahamstown	DWG&FWG	11.i.77
A. karroo Hayne	Y	F	1	Grahamstown	FWG	20.xii.77
Selaginaceae						
Selago L.						
S. corymbosa L.	W	F	1	Grahamstown	DWG	2.xii.77
S. corymbosa L.	W	F	13	Grahamstown	FWG	2.i.74
Bembecinus haemorrhoidalis (Handlirsch)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.70
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	BV	F	1	Grahamstown	FWG	3.iii.78
Selaginaceae						
Selago L.						
S. corymbosa L.	W	M	2	Grahamstown	HWG&RWG	2.xii.77
Bembecinus mutabilis (Arnold)						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	F	2	Clanwilliam	FWG&SKG	13.x.90
A. trifurcata L. (L.)	Y	M	1	Clanwilliam	FWG&SKG	13.x.90
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Bembecinus oxydorcus (Handlirsch)						
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	F	1	Grahamstown	DWG	9.i.74
P. incana (Thunb.) Kuntze	Y	M	1	Grahamstown	FWG	28.i.74
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Selaginaceae						
Selago L.						
S. corymbosa L.	W	M	1	Grahamstown	FWG	2.i.74

Bembecinus rhopaloceroides (Arnold)						
Aizoaceae: Mesembryanthema						
"mesem"	PiVW	F	1	43 km ENE Ceres	RWG	2-3.xii.89
Zygophyllaceae						
Zygophyllum L.						
Z. retrofractum Thunb.	-	F	1	Oudtshoorn	FWG&SKG	9-12.xii.86
Z. retrofractum Thunb.	-	M	1	Oudtshoorn	FWG&SKG	9-12.xii.86
Bembecinus rhopalocerus (Handlirsch)						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Bembecinus sp. nov. A (rhopalocerus species group)						
Aizoaceae: non-Mesembryanthema						
Limeum L.						
L. aethiopicum Burm.	W	M	5	Twee Rivieren	FWG&SKG	8-11.iii.90
Bembecinus sp. nov. B (rhopalocerus species group)						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	M	1	Clanwilliam/ Klawer	FWG&SKG	9.x.90
A. trifurcata L. (L.)	Y	M	1	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Bembecinus sp. A (tridens species group)						
Aizoaceae: non-Mesembryanthema						
Coelanthum E.Mey. ex Fenzl						
C. grandiflorum E.Mey. ex Fenzl	W	M	1	Clanwilliam/ Graafwater	FWG&SKG	6.x.90
Asteraceae (Compositae)						
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Papilionaceae (Fabaceae)						
"pea flower"	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Bembecinus sp. B (tridens species group)						
Aizoaceae: non-Mesembryanthema						
Coelanthum E.Mey. ex Fenzl						
C. grandiflorum E.Mey. ex Fenzl	W	F	1	Clanwilliam Graafwater	FWG&SKG	2.x.90
C. grandiflorum E.Mey. ex Fenzl	W	M	6	Clanwilliam Graafwater	FWG&SKG	2.x.90
Asteraceae (Compositae)						
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	F	1	Clanwilliam	FWG&SKG	7.x.90

Bembix Fabricius						
Bembix albofasciata Smith						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	21	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	CFJG	24.i.70

Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	1.i.52
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	2.i.53
C. glabrata Brummitt	Y	M	1	Mamathes	CFJG	2.i.53
Medicago Tourn. ex L.						
M. sativa L.	PiV	F	2	Grahamstown	FWG	5.ii.70
Bembix cameronis Handlirsch						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	F	2	Clanwilliam/ Klawer	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	3.xi.77
Pteronia L.						
P. divaricata Less.	Y	F	1	Clanwilliam	DWG	6.x.91
P. divaricata Less.	Y	M	7	Clanwilliam	DWG	6.x.91
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. pulicifolia Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	F	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Bembix capensis Lepeletier						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	5	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	5			
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	2	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Bembix intermedia Dahlbom						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	27	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	27			
Bembix melanopa Handlirsch						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	2	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20-26.i.70
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	3	Clanwilliam/ Klawer	FWG&SKG	10.x.90

Bembix sibilans Handlirsch						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20-26.i.70
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG&SKG	20.ix.90
Chrysocoma L.						
C. ciliata L.	Y	M	1	Grahamstown	DWG	18.i.78
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	1	Grahamstown	FWG	18.xi.77
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	V	F	1	Grahamstown	DWG	9.xii.82
Bembix zinni Gess						
Aizoaceae: non-Mesembryanthema						
Limeum L.						
L. aethiopicum Burm.	W	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
L. aethiopicum Burm.	W	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Zygophyllaceae						
Tribulus L.						
T. cristatus Presl.	Y	F	1	Nossob	FWG&SKG	8.iii.90
Bembix sp.						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43km ENE Ceres	RWG	2-3.xii.89

Hoplisoides Gribodo						
Hoplisoides aglaia (Handlirsch)						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	4.i.78
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72

Hoplisoides thalia (Handlirsch)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	3	Grahamstown	DWG	29.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	2	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	F	2	Grahamstown	DWG	13.i.77
A. karroo Hayne	Y	F	2	Grahamstown	DWG	4.i.78
A. karroo Hayne	Y	M	2	Grahamstown	DWG	4.i.78
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	1	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72

Kohlia Handlirsch						
Kohlia cephalotes Handlirsch						
Aizoaceae: Mesembryanthema						
"mesem"	WV	M	1	43 km ENE Ceres	RWG	2-3.xii.89

Stizus Latreille						
Stizus atrox (Smith)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Stizus chrysorrhoeus Handlirsch						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	7	Alexandria/Salem	FWG,DWG&RWG	16.i.84
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	2	Prince Albert	FWG&SKG	26.xi-
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG&SKG	5.xii.87
Stizus dewitzii Handlirsch						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Matroosberg	FWG	4.xii.86
"mesem"	Pi	F	8	Grahamstown	DWG	22.xi.81
"mesem"	Pi	M	2	Grahamstown	DWG	22.xi.81
"mesem"	Pi	M	1	Grahamstown	SKG	22.xi.81
"mesem"	Pi	F	4	Grahamstown	FWG	27.xi.81
"mesem"	Pi	M	1	Grahamstown	FWG	27.xi.81
"mesem"	Pi	F	1	Grahamstown	FWG	3.xii.81
"mesem"	Pi	M	1	Grahamstown	SKG	30.xi.81
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	RWG	24.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	25.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	40	Prince Albert	FWG&SKG	26.xi-
A. buchenaviana Schinz	WY	M	18	Prince Albert	FWG&SKG	5.xii.87

Sarcostemma R.Br.						
S. viminale (L.) R.Br.	Y	M	2	Kommadagga	DWG	14.i.86
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Prince Albert	FWG,SKG&RWG	26.xi-
A. karroo Hayne	Y	M	1	Prince Albert	FWG,SKG&RWG	5.xii.87
A. karroo Hayne	Y	F	15	Colesberg	DWG	15-19.i.85
A. karroo Hayne	Y	M	5	Colesberg	DWG	15-19.i.85
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	8	Adelaide	CFJG	20-22.xii.72
Stizus imperialis Handlirsch						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	3	Grahamstown	JGHL	17-25.i.70
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	2	Prince Albert	FWG&SKG	26.xi-5.xii.87
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	2	Grahamstown	FWG	9-11.xii.69
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	2	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	1	Adelaide	CFJG	20-22.xii.72
Stizus marshalli Turner						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	4	Twee Rivieren	FWG&SKG	8-11.iii.90
Stizoides Guérin-Méneville						
Stizoides fenestratus (Smith)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90

PHILANTHIDAE

Cerceris Latreille						
Cerceris amakosa Brauns						
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	DWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	4.i.87
Cerceris armaticeps caffrariae Empey						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	23.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Cerceris curvitarsis Schletterer						
Aizoaceae: Mesembryanthema						
"mesem"	-	M	2	Oudtshoorn	SKG	7-8.xii.86
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	7	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	6	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	3	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	5	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	5	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Oudtshoorn	RWG	9-12.xii.86
Zygophyllaceae						
Zygophyllum L.						
Z. retrofractum Thunb.	WY	F	1	Oudtshoorn	SKG	9-12.xii.86
Cerceris diodonta diodonta Schletterer						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	F	2	Colesberg	DWG	17.i.85
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85
Cerceris discrepans discrepans Brauns						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	SKG	2-3.xii.89
A. sp.	Y	F	2	43 km ENE Ceres	FWG&HWG	2-3.xii.89
A. sp.	Y	M	5	43 km ENE Ceres	FWG&HWG	2-3.xii.89
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Cerceris dominicana Brauns						
Zygophyllaceae						
Zygophyllum L.						
Z. retrofractum Thunb.	WY	M	1	Prince Albert	FWG&SKG	26.xi-5.xii.86

Cerceris erythrosoma Schletterer						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	5	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	20-26.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	3	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	23.i.70
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Colesberg	DWG	17.i.85
Cerceris formosa nigrifemur Arnold						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	26.i.70
Cerceris gomphocarpi Brauns						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	6	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.86
A. buchenaviana Schinz	WY	M	9	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.86
Cerceris holconota holconota Cameron						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
A. sp.	Y	M	6	43 km ENE Ceres	FWG,HWG &RWG	2-3.xii.89
A. spp.	Y	M	1	43 km ENE Ceres	RWG	2-3.xii.89
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	M	1	43 km ENE Ceres	HWG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	2	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	FWG	4.i.78
Cerceris hypocritica Brauns						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.	-	F	1	Grahamstown	FWG	10.i.73
Celastraceae						
Maytenus Molina						
M. linearis (L. *f.*) Marais	WY	M	1	Grahamstown	FWG	6.xii.72
M. linearis (L. *f.*) Marais	WY	M	1	Grahamstown	DWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
Cerceris kilimandjaroensis capensis Arnold						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	24.i.70

Cerceris languida languida Cameron						
Apiaceae (Umbelliferae)						
Berula L.						
B. erecta (Hudson) Cov.	-	F	1	Grahamstown	FWG	10.i.73
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	4	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	F	2	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Senecio L.						
S. sp.	Y	F	1	Citrusdal	FWG&SKG	16.x.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Clanwilliam	FWG&SKG	8-13.x.87
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlgren	Y	F	1	Clanwilliam	FWG&SKG	4.x.90
A. spinescens Thunb.	Y	F	1	Citrusdal/ Paleisheuwel	FWG&SKG	6.x.90
Selaginaceae						
Selago L.						
S. sp.	W	M	1	Grahamstown	FWG	9.iii.78
Cerceris latifrons latifrons Bingham						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	43 km ENE Ceres	SKG	2-3.xii.89
A. sp.	Y	M	5	43 km ENE Ceres	FWG,HWG &RWG	2-3.xii.89
Senecio L.						
S. rosmarinifolius L. f.	Y	F	6	Oudtshoorn	FWG	7-12.xii.86
S. rosmarinifolius L. f.	Y	F	2	Oudtshoorn	RWG	7-12.xii.86
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
Cerceris lunigera Dahlbom						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	26.i.70
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	11.i.77
Cerceris multipicta multipicta Smith						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F M	8 2	Twee Rivieren	FWG&SKG	8-11.iii.90

Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	Y	F	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	Y	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	7	Oudtshoorn	FWG	9-12.xii.86
Cerceris nasidens obscura Schletterer						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Grahamstown	FWG	6.xii.72
Cerceris nigrifrons nigrifrons Smith						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.	WY	M	2	Grahamstown	FWG	10.i.73
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	6	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	7			
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	3	Grahamstown	CFJG	24-25.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	20-23.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	9.xii.69
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	11.xii.69
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	3	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	DWG	2.xii.76
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	F	2	Colesberg	DWG	16-20.i.85
A. karroo Hayne	Y	M	4	Colesberg	DWG	16-20.i.85
Cerceris pearstonensis pearstonensis Cameron						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
Papilionaceae (Fabaceae)						
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	4.xi.52
C. glabrata Brummitt	Y	M	9	Mamathes	CFJG	4.xi.52
Cerceris pictifacies Brauns						
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	F	1	Grahamstown	FWG	6.xii.77
Cerceris ruficauda ruficauda Cameron						
Apiaceae (Umbelliferae)						
Berula Koch						
B. erecta (Hudson) Cov.	WY	M	3	Grahamstown	FWG	10.i.73
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	3	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	23.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70

Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	2	Grahamstown	FWG	11.xii.69
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	CFJG	16.xii.69
S. sp.	W	M	1	Grahamstown	CFJG	16.xii.69
Cerceris rufocincta polychroma Gribodo						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	23.i.70
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	6.xii.72
M. linearis (L. f.) Marais	WY	M	2	Grahamstown	FWG	22.xi.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	F	3	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
Cerceris spinicaudata spinicaudata Cameron						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	23.i.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	FWG	26.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	SKG	25.i.72
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Celastraceae						
Maytenus Molina						
M. linearis (L. f.) Marais	WY	M	1	Grahamstown	FWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	4.i.78
A. karroo Hayne	Y	F	1	Grahamstown	FWG	20.xii.78
A. karroo Hayne	Y	F	1	Grahamstown	DWG	6.i.77
A. karroo Hayne	Y	F	1	Grahamstown	DWG	13.i.77
Cerceris sp. A (erythrosoma group)						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	3	Elim	FWG	4.xii.86
Asclepiadaceae						
Asclepias L.						
A. sp.	WY	F	1	43km ENE Ceres	RWG	2-3.xii.89

Philanthus Fabricius						
Philanthus capensis Dahlbom						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	5	Clanwilliam	FWG,SKG&DWG	3-7.x.88
A. spinescens Thunb.	Y	F	1	Algeria	DWG	19.x.89
A. spinescens Thunb.	Y	F	2	Clanwilliam/ Graafwater	FWG,SKG&DWG	3.x.90
Proteaceae						
Leucadendron R.Br.						
L. sp.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90

Philanthus fuscipennis Guérin-Méneville						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	24.i.70
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	DWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	SKG	16.i.84
Philanthus histrio Fabricius						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	5.ii.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	CFJG	24.i.70
Asteraceae (Compositae)						
Helichrysum Mill.						
H. sp.	Y	M	1	Bains Kloof	SKG	28.xi.89
Philanthus loeflingi Dahlbom						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	2	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	F	3	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	M	5	Grahamstown	CFJG	24.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	20.i.-5.ii.70
F. vulgare A.W.Hill	Y	M	12	Grahamstown	FWG	20.i.-5.ii.70
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG&SKG	16.xii.82
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	17.ii.83
Philanthus melanderi Arnold sp. complex						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	4	43 km ENE Ceres	FWG&SKG	3.xii.89
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43 km ENE Ceres	HWG	3.xii.89
Philanthus rugosus Kohl						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Clanwilliam/Klawer	FWG	14.x.87
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	FWG&SKG	19-20.x.89
A. trifurcata (L.) L.	Y	F	9	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	F	3	Clanwilliam/ Klawer	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	8	Clanwilliam/ Klawer	FWG&SKG	9.x.90

Philanthus triangulum diadema (Fabricius)

Aizoaceae: Mesembryanthema						
"mesem"	W	F	2	Montagu/Matroosberg	FWG	4.xii.86
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	3	Twee Rivieren	FWG&SKG	8-11.iii.90
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	5	Grahamstown	FWG	20.i.-5.ii.70
F. vulgare A.W.Hill	Y	M	13	Grahamstown	FWG	20.i.-5.ii.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	SKG	25.i.72
F. vulgare A.W.Hill	Y	M	2	Grahamstown	SKG	25.i.72
F. vulgare A.W.Hill	Y	F	1	Grahamstown	CFJG	23.i-15.ii.70
F. vulgare A.W.Hill	Y	M	2	Grahamstown	CFJG	23.i-15.ii.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Grahamstown	JGHL	17-25.i.70
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	FWG	16.i.84
F. vulgare A.W.Hill	Y	M	2	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	HWG	16.i.84
F. vulgare A.W.Hill	Y	M	3	Alexandria/Salem	RWG	16.i.84
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG &RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	8	Colesberg	DWG	17-19.i.85
A. karroo Hayne	Y	M	1	Colesberg	DWG	17-19.i.85
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlgren	Y	M	2	Clanwilliam	FWG	16.x.89
A. linearis (Burm. f.) Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	4.x.90

APOIDEA
COLLETIDAE

Colletes Latreille						
Colletes sp. A						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare Mill.	Y	M	1	Grahamstown	CFJG	25.i.70
F. vulgare Mill.	Y	M	1	Grahamstown	FWG	5.ii.70
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	3.xi.77
L. bipinnatum (Thunb.) Druce	W	M	3	Grahamstown	FWG	3.xi.77
L. bipinnatum (Thunb.) Druce	W	M	2	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	25.x.77
Senecio L.						
S. pterophorus DC.	Y	F	2	Grahamstown	FWG&SKG	1.xii.79
S. pterophorus DC.	Y	F	2	Grahamstown	FWG&SKG	2.xii.79
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Grahamstown	FWG&SKG	3.iii.78
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	FWG	11.xii.69
Colletes sp. B						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	1.xii.87
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG,SKG&RWG	5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
Senecio L.						
S. rosmarinifolius L. f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L. f.	Y	M	3	Oudtshoorn	FWG	9-12.xii.86
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	-	M	11	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2.xii.89
Colletes sp. C						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	M	2	Twee Rivieren	FWG&SKG	8-11.iii.90
Colletes sp. D						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Touws River	FWG	4.xii.86

Colletes sp. E						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Hylaeus Fabricius						
Hylaeus heraldicus (Smith)						
Liliaceae						
Aloe L.						
A. striatus Haw.	PiO	M	3	Prince Albert	FWG	26.xi-5.xii.87
Zygophyllaceae						
Zygophyllum L.						
Z. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	2.x.90
Hylaeus sp.						
Proteaceae						
Protea L.						
P. repens (L.) L.	R & WY	F	1	Grahamstown	FWG&SKG	7.iii.91
Scrapter Lepeletier						
Scrapter sp. A						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	WY	F	2	Nieuwoudtville	FWG&SKG	28.ix.90
H. sp. A	WY	F	1	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp. A	WY	F	2	Nieuwoudtville	FWG&SKG	27.ix.90
H. sp. B	WY	F	7	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
H. sp. B	WY	F	4	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	7	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	3	Paleisheuwel	FWG&SKG	6.x.90
H. sp. B	WY	F	13	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Rosaceae						
Grielum L.						
G. humifusum Thunb.	Y	F	2	Paleisheuwel	FWG&SKG	6.x.90
G. humifusum Thunb.	Y	F	1	Springbok	FWG&SKG	15-21.x.87
G. humifusum Thunb.	Y	F	1	Springbok	FWG&SKG	10-12.x.88
Scrapter sp. B						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	WY	F	3	Paleisheuwel	FWG&SKG	6.x.90
H. sp. B	WY	F	11	Paleisheuwel	FWG&SKG	6.x.90
?						
heads of fine white fls	W	F	1	Clanwilliam	FWG&SKG	1.x.90

Scrapter sp. C						
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	6	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
L. sp.	Y	F	7	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
?genus	-	F	4	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Scrapter sp. D						
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Scrapter sp. E						
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	F	3	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Scrapter sp. F						
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	F	6	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Scrapter sp. G						
Asteraceae (Compositae)						
Chrysocoma L.						
C. sp.	Y	F	6	Nieuwoudtville	FWG&SKG	29.ix.90
Euryops Cass.						
E. thunbergii B. Nordenstam	Y	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
Scrapter sp. H						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	9	Citrusdal	FWG&SKG	16.x.90
Scrapter sp. I						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	WY	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Scrapter sp. K						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	7	60km ENE Ceres	FWG,HWG&RWG	2-3.xii.89

Scrapter sp. L						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	3	43km ENE Ceres	FWG,SKG&RWG	2-3.xii.89
A. sp.	Y	M	1	43km ENE Ceres	FWG,SKG&RWG	2-3.xii.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	M	5	60km ENE Ceres	FWG,SKG&RWG	3.xii.89
Senecio L.						
S. rosmarinifolius L.*f*.	Y	M	3	Oudtshoorn	FWG&SKG	7-8.xii.86
Scrapter sp. M						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	3	Grahamstown	FWG	25.x.77
Scrapter sp. N						
Asteraceae						
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	M	2	60 km ENE Ceres	FWG&SKG	3.xii.89
Scrapter sp. O						
Asteraceae						
Helichrysum Mill.						
H. cf. hebelepis DC.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	2.x.90

ANDRENIDAE

Meliturgula Friese						
Meliturgula braunsi Friese						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	2	Grahamstown	FWG	16.xi.81
Meliturgula sp. A.						
Aizoaceae: non-Mesembryanthema						
Limeum L.						
L. sp.	Pi	F	33	Nossob	FWG&SKG	8.iii.90
Meliturgula sp. B.						
Scrophulariaceae						
Aptosimum Burch.						
A. sp.	BV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
A. sp.	BV	F	1	Kakamas	FWG&SKG	13.iii.90
Meliturgula sp. C.						
Zygophyllaceae						
Tribulus L.						
T. cristatus Presl.	Y	M	1	Nossob	FWG&SKG	8.iii.90

HALICTIDAE

Halictus Latreille

Halictus sp. A cf. jucundus Smith

Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Matroosberg	FWG	4.xii.86
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L.f.	Y	F	2	Grahamstown	FWG&SKG	2.xii.79
A. trifurcata (L.) L.	Y	F	1	Clanwilliam/Klawer	FWG&SKG	17.x.89
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	FWG&SKG	1-2.x.90
A. trifurcata (L.) L.	Y	F	6	Clanwilliam	FWG&SKG	9.x.90
A. sp.	Y	F	6	43 km ENE Ceres	FWG,HWG&RWG	2-3.xii.89
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	2	Grahamstown	FWG	12.x.72
B. sp.	Y	F	1	Riebeek East	FWG&SKG	22.xi.82
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	25.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	12.x.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	2.xi.77
Senecio L.						
S. sp. prob. nivea Less	W	F	2	Nieuwoudtville	FWG&SKG	17.x.89
S. pterophorus DC.	Y	F	5	Grahamstown	FWG	28.xii.86
S. pterophorus DC.	Y	F	1	Grahamstown	DWG	28.xii.86
S. pterophorus DC.	Y	F	4	Grahamstown	DWG	31.xii.86
S. pterophorus DC.	Y	M	1	Grahamstown	DWG	31.xii.86
S. pterophorus DC.	Y	F	1	Grahamstown	FWG&SKG	1.xii.79
S. rosmarinifolius L.f.	Y	F	2	Oudtshoorn	RWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	F	1	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	F	1	Oudtshoorn	HWG	7-8.xii.86
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	11.xii.69
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Act.	B	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	13.i.77
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
Plumbaginaceae						
Limonium Mill.						
L. sp.	V	F	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Rosaceae						
Grielum L.						
G. humifusum Thunb.	Y	F	1	Paleisheuwel	FWG&SKG	6.x.90

Halictus (Seladonia) sp. B						
Aizoaceae: Mesembryanthema						
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L.Bol.	Pi	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
"mesem"	Y	F	2	Oudtshoorn	SKG	7-8.xii.86
"mesem"	W	F	2	Matroosberg	FWG	4.xii.86
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	1	Clanwilliam/Klawer	FWG&SKG	17.x.89
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	2	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Senecio L.						
S. pterophorus DC.	Y	F	1	Grahamstown	DWG	28.xii.86
S. pterophorus DC.	Y	F	1	Grahamstown	DWG	31.xii.86
S. pterophorus DC.	Y	F	1	Grahamstown	SKG	31.xii.86
S. pterophorus DC.	Y	M	1	Grahamstown	FWG	28.xii.86
S. rosmarinifolius L.f.	Y	F	3	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	1	Oudtshoorn	HWG	7-8.xii.86
S. rosmarinifolius L.f.	Y	M	2	Oudtshoorn	RWG	7-8.xii.86
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A. DC.	V	F	2	Citrusdal	FWG&SKG	16.x.90
W. ecklonii Buek	V	F	2	Theronsberg Pass	FWG&SKG	29.xi.89
W. sp.	V	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	F	1	Grahamstown	FWG	22.xi.77
Rosaceae						
Grielum L.						
G. humifusum Thunb.	Y	F	1	Paleisheuwel	FWG&SKG	6.x.90
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	V	F	1	Grahamstown	FWG	9.iii.78
Selaginaceae						
Selago L.						
S. sp.	W	F	1	Grahamstown	FWG	2.xii.77
Halictus sp. Kalahari						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
		M	1			
Halictus spp.						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87

Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xii.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	3.xi.77
Senecio L.						
S. linifolius L.	Y	M	1	Grahamstown	CFJG	25.i.75
Celastraceae						
Maytenus Molina						
M. linearis (L.*f*.) Marais	WY	M	1	Grahamstown	FWG	11.xii.69
M. linearis (L.*f*.) Marais	WY	M	1	Grahamstown	FWG	77/78
Papilionaceae (Fabaceae)						
Psoralea L.						
P. pinnata L.	B	F	1	Grahamstown	CFJG	9.ii.75

Lasioglossum Curtis						
Lasioglossum sp. A						
Aizoaceae: Mesembryanthema						
Carpobrotus N.E.Br.						
C. edulis (L.) N.E.Br.	WY	F	1	Paleisheuwel	FWG&SKG	6.x.90
Herrea Schwant.						
H. sp. A	WY	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
H. sp. A	WY	F	11	Nieuwoudtville	FWG&SKG	30.ix.90
H. sp. A	WY	F	19	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp. A	WY	F	13	Nieuwoudtville	FWG&SKG	27.ix.90
H. sp. B	WY	F	2	Clanwilliam/ Graafwater	FWG&SKG	1.x.90
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	3	Clanwilliam/ Citrusdal	FWG&SKG	12.x.90
"mesem"	W	F	2	Touws River	FWG	4.xii.86
Lasioglossum sp. B						
Asteraceae (Compositae)						
Metalasia R. Br.						
M. muricata (L.) D. Don	Pi	F	2	Nieuwoudtville	FWG&SKG	29.ix.90
Lasioglossum sp. C						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	3	Theronsberg Pass, Ceres	FWG&SKG	29-30.xi.89
Lasioglossum sp. D						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	WY	F	1	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp. A	WY	F	3	Nieuwoudtville	FWG&SKG	30.ix.90
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	8	43 km ENE Ceres	HWG&RWG	2-3.xii.89
Senecio L.						
S. burchelli DC.	Y	F	2	43 km ENE Ceres	FWG&SKG	2-3.xii.89
S. rosmarinifolia L.*f*.	Y	F	2	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90

Lasioglossum sp. E						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	12.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	25.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	15.xi.77
Lasioglossum sp. F						
Solanaceae						
Lycium L.						
L. sp.	V	M	3	Grahamstown	FWG	29.ix.77
Lasioglossum sp. G						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	4.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	18.x.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	25.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	29.ix.77
Lasioglossum sp. H						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. ecklonii Buek	V	F	2	Theronsberg Pass, Ceres	SKG	29.xi.89
Lasioglossum sp. I						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.		F	1	Clanwilliam	FWG&SKG	3-7.x.88

Leuconomia Pauly						
Leuconomia sp. A						
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	1	Grahamstown	DWG	6.xii.77
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	4	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	21.xii.76
A. karroo Hayne	Y	M	4	Oudtshoorn	FWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	25.iii.92
Rhamnaceae						
Ziziphus Mill.						
Z. mucronata Willd.	-	F	6	Adelaide	CFJG	20-22.xii.72
Z. mucronata Willd.	-	M	3	Adelaide	CFJG	20-22.xii.72
Leuconomia sp. C						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92

Lipotriches Gerstaecker						
Lipotriches sp. A						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A. W. Hill	Y	M	1	Grahamstown	CFJG	25.i.70
F. vulgare A. W. Hill	Y	F	1	Grahamstown	FWG	5.ii.70
F. vulgare A. W. Hill	Y	M	1	Grahamstown	FWG	5.ii.70
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	F	1	Grahamstown	FWG	9.i.74
Senecio L.						
S. sp.	Y	F	1	Grahamstown	FWG	17.xi.78
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85
Lipotriches sp. B						
Asteraceae (Compositae)						
"composite"	Y	F	1	Grahamstown	RWG	6.i.81
Crassulaceae						
Cotyledon L.						
C. campanulata Marl.	Y	F	6	Grahamstown	FWG,DWG&RWG	9.xii.80
C. spp.	-	F	4	Grahamstown	DWG	11.xii.80
Liliaceae						
Aloe L.						
A. sp.	Y	F	1	Grahamstown	FWG	

Nomioides Schenck						
Nomioides cf. halictoides Bluthgen						
Celastraceae						
Maytenus Molina						
M. linearis (L.f.) Marais	WY	M	11	Grahamstown	FWG	16.xi.77
M. linearis (L.f.) Marais	WY	F	m	Grahamstown	FWG	22.xi.77
M. linearis (L.f.) Marais	WY	M	m	Grahamstown	FWG	22.xi.77
Nomioides cf. maculiventris (Cameron)						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	F	2	43 km ENE Ceres	HWG	3.xii.89
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. ecklonii Buek	V	F	1	Theronsberg Pass, Ceres	SKG	29.xi.89
Ebenaceae						
Euclea Murray						
E. crispa (Thunb.) Guerke	WY	F	1	43 km ENE Ceres	FWG	2.xii.89
Nomioides sp. A						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	12	Twee Rivieren	FWG&SKG	8-11.iii.90
Scrophulariaceae						
Aptosimum Burch.						
A. spinescens (Thunb.) Weber	PV	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Nomioides sp. B						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F M	10 4	Twee Rivieren	FWG&SKG	8-11.iii.90
Nomioides sp.						
Aizoaceae: Mesembryanthema						
Drosanthemum Schwant.						
D. hispidum (L.) Schwant.	Pi	F	4	Grahamstown	EMcCC	10.x.53
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Clanwilliam	FWG&SKG	3-7.x.88
Pachynomia Pauly						
Pachynomia glabriventris (Friese)						
Asclepiadaceae						
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	M	2	Kommadagga	FWG	14.i.86
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	3	Grahamstown	FWG&DWG	31.xii.86
Papilionaceae (Fabaceae)						
Melolobium Eckl. & Zeyh.						
M. candicans (E. Mey.) Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG	29.ix.77
M. candicans (E. Mey.) Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG	12.x.77
M. candicans (E. Mey.) Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG	3.iii.78
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	BV	F	1	Grahamstown	SKG	3.xii.81
Patellapis Friese						
Patellapis (Chaetalictus) sp. A						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	WY	F	4	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp. A	WY	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
H. sp. A	WY	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
H. sp. A	WY	F	5	Nieuwoudtville	FWG&SKG	30.ix.90
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Patellapis (Chaetalictus) sp. B						
Asteraceae						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	2	Clanwilliam	FWG&SKG	19-20.x.89
A. trifurcata (L.) L.	Y	F	1	Clanwilliam	DWG	19-20.x.89

Patellapis (Chaetalictus) sp. C						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	12.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	20.x.77
Solanaceae						
Lycium L.						
L. sp.	V	M	1	Grahamstown	FWG	29.ix.77
Patellapis (Chaetalictus) sp. D						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	4.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	3.xi.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	18.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	18.x.77
Pseudapis W.F.Kirby						
Pseudapis cinerea (Friese)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	15	Twee Rivieren	FWG&SKG	8-11.iii.90
Asteraceae (Compositae)						
Pentzia Thunb.						
P. incana (Thunb.) Kuntze ex Benth.	Y	F	2	Twee Rivieren	FWG&SKG	8-11.iii.90
Sphecodes Latreille						
Sphecodes sp.						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Alexandria/Salem	SKG	16.i.84
F. vulgare A.W.Hill	Y	M	1	Alexandria/Salem	SKG	16.i.84
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	29.xii.76
Proteaceae						
Leucadendron R. Br.						
L. sp.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Zonalictus Michener						
Zonalictus sp. A						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	5.ii.70
Asteraceae (Compositae)						
Senecio L.						
S. pterophorus DC.	Y	M	1	Grahamstown	DWG	5.xii.80
S. pterophorus DC.	Y	F	7	Grahamstown	FWG	17.xi.78
S. pterophorus DC.	Y	F	4	Grahamstown	FWG&SKG	2.xii.79
S. pterophorus DC.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
S. pterophorus DC.	Y	F	2	Grahamstown	FWG	29.xi.79

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	6.i.77
Selaginaceae						
Selago L.						
S. sp.	W	M	2	Grahamstown	DWG	2.xii.77
Zonalictus sp. C						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Die Koo	FWG,SKG,HWG&RWG	4.xii.86
Zonalictus sp. D						
Aizoaceae: Mesembryanthema						
M. sp. A	WY	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
Zonalictus sp. E						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43 km ENE Ceres	HWG	2-3.xii.89

MELITTIDAE

Capicola Friese						
Capicola braunsiana Friese						
Aizoaceae: Mesembryanthema						
Mesembryanthemum						
M. crystallinum L.	W	F	4	Vioolsdrif	FWG&SKG	9.x.88
M. crystallinum L.	W	M	10	Vioolsdrif	FWG&SKG	9.x.88
"mesem"	W	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Capicola sp. nov. A.						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A. DC.	V	F	6	Klipfontein	FWG&SKG	14.x.89
W. annularis A. DC.	V	M	2	Klipfontein	FWG&SKG	14.x.89
W. annularis A. DC.	V	M	3	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
W. annularis A. DC.	V	F	5	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. annularis A. DC.	V	M	26	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. annularis A. DC.	V	F	2	Clanwilliam	FWG&SKG	13.x.90
W. annularis A. DC.	V	M	1	Clanwilliam	FWG&SKG	13.x.90
W. annularis A. DC.	V	F	1	Citrusdal	FWG&SKG	16.x.90
W. annularis A. DC.	V	M	1	Citrusdal	FWG&SKG	16.x.90
W. sp.	W	M	2	Clanwilliam	FWG&SKG	19-20.x.89
Capicola sp. nov. C						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	M	1	Nieuwoudtville	FWG&SKG	30.ix.90
W. annularis A. DC.	V	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
W. annularis A. DC.	V	M	3	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
W. annularis A. DC.	V	F	1	Klipfontein	FWG&SKG	14.x.89
W. annularis A. DC.	V	F	5	Clanwilliam/ Graafwater	FWG&SKG	7.x.90

W. annularis A. DC.	V	M	9	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
W. annularis A. DC.	V	F	28	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. annularis A. DC.	V	M	17	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. annularis A. DC.	V	F	1	Clanwilliam	FWG&SKG	13.x.90
W. annularis A. DC.	V	F	3	Citrusdal	FWG&SKG	16.x.90
W. annularis A. DC.	V	M	2	Citrusdal	FWG&SKG	16.x.90
W. psammophila Schlr.	PuV	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
Capicola sp. E						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. prostrata A. DC.	V	F	1	Anenous	DWG	11-13.x.88

Haplomelitta Cockerell						
Haplomelitta ogilviei (Cockerell)						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	F	1	Clanwilliam/Klawer	FWG&SKG	17.x.89
Senecio L.						
S. sp.	Y	F	6	Citrusdal	FWG&SKG	16.x.90
S. sp.	Y	M	1	Citrusdal	FWG&SKG	16.x.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A. DC.	V	F	3	Citrusdal	FWG&SKG	16.x.90
W. pilosa Buek	V	M	2	Springbok	FWG&SKG	10-11.x.89
Lobeliaceae						
Monopsis Salisb.						
M. debilis (L. f.) Presl.	Pu	F	4	Springbok	FWG&SKG	10-11.x.89
M. debilis (L. f.) Presl.	Pu	F	1	Clanwilliam/ Graafwater	FWG&SKG	1.xii.89
M. debilis (L. f.) Presl.	Pu	M	3	Clanwilliam/ Graafwater	FWG&SKG	1.xii.89
M. debilis (L. f.) Presl.	Pu	M	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
M. debilis (L. f.) Presl.	Pu	F	10	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
M. debilis (L. f.) Presl.	Pu	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
M. debilis (L. f.) Presl.	Pu	F	21	Citrusdal	FWG&SKG	16.x.90
M. debilis (L. f.) Presl.	Pu	M	1	Citrusdal	FWG&SKG	16.x.90

Melitta Kirby						
Melitta capicola Friese						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. prostrata A. DC.	V	F	1	Anenous	DWG	11-13.x.88

Melitta sp. A						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	2.x.90
papilionate	Y	F	2	Piekenierskloof/ Paleisheuwel	FWG&SKG	6.x.90
Proteaceae						
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
Melitta sp.						
Papilionaceae (Fabaceae)						
Calpurnia E.Mey.						
C. glabrata Brummitt	Y	M	3	Mamathes	CFJG	10.i.52
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	12.i.52
C. glabrata Brummitt	Y	F	2	Mamathes	CFJG	2.i.52

Redeviva Friese						
Redeviva longimanus Michener						
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90

FIDELIIDAE

Fidelia Friese						
Fidelia braunsiana Friese						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	M	1	Nieuwoudtville	FWG&SKG	30.ix.90
Fidelia cf. braunsiana						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. canescens DC.	Y	F	1	Springbok	FWG&SKG	15-21.x.87

Parafidelia Brauns						
Parafidelia friesei Brauns						
Acanthaceae						
"acanth"	PiV	F	1	Nossob	FWG&SKG	8.iii.90
Parafidelia sp.						
Rosaceae						
Grielum L.						
G. humifusum Thunb.	Y	F	9	Paleisheuwel	FWG&SKG	6.x.90
G. humifusum Thunb.	Y	M	2	Paleisheuwel	FWG&SKG	6.x.90

MEGACHILIDAE

Anthidiini

Afranthidium Michener						
Afranthidium reicherti (Brauns)						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	F	1	Gydo Pass, Ceres	SKG	30.xi.89
A. divaricata Thunb.	Y	M	1	Gydo Pass, Ceres	SKG	30.xi.89
Anthidiellum Cockerell						
Anthidiellum spilotum (Cockerell)						
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	M	1	Grahamstown	DWG	11.xii.80
Anthidium Fabricius						
Anthidium pontis Cockerell						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	SKG	7.i.86
Branthidium Pasteels						
Branthidium braunsi (Friese)						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	F	1	Gydo Pass, Ceres	FWG	30.xi.89
A. divaricata Thunb.	Y	M	2	Gydo Pass, Ceres	FWG	30.xi.89
A. divaricata Thunb.	Y	M	2	Gydo Pass, Ceres	SKG	30.xi.89
A. linearis (Burm. f.)	Y	F	4	Clanwilliam	FWG	16.x.89
A. spinescens Thunb.	Y	F	2	Citrusdal	FWG&SKG	16.x.90
Capanthidium Pasteels						
Capanthidium capicola (Brauns)						
Asteraceae (Compositae)						
Anthanasia L.						
A. trifurcata (L.) L.	Y	F	2	Clanwilliam/Klawer	FWG	17.x.89
A. trifurcata (L.) L.	Y	M	1	Clanwilliam	FWG	19-20.x.89
A. trifurcata (L.) L.	Y	F	4	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	M	2	Clanwilliam	FWG&SKG	9.x.90
A. trifurcata (L.) L.	Y	F	1	Clanwilliam/Klawer	FWG&SKG	9-10.x.90
A. sp.	Y	M	2	43 km ENE Ceres	FWG	2-3.xii.89
A.sp.	Y	F	1	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	1	43 km ENE Ceres	HWG	2-3.xii.89
A. sp.	Y	M	1	43 km ENE Ceres	RWG	2-3.xii.89
Senecio L.						
S. burchellii DC.	Y	F	1	43 km ENE Ceres	SKG	2-3.xii.89
S. rosmarinifolia L. f.	Y	F	2	43 km ENE Ceres	FWG	2-3.xii.89
S. rosmarinifolia L. f.	Y	M	1	Oudtshoorn	FWG	7-8.xii.86

Carinanthidium Pasteels						
Carinanthidium cariniventre (Friese)						
Asteraceae (Compositae)						
Pteronia L.						
P. sp.	Y	F	1	Nababeep	FWG	12-13.x.89
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	3	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
"pea flower"	Y	M	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	1.x.90
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	F	1	Springbok	FWG&SKG	15-21.x.87
Zygophyllaceae						
Zygophyllum L.						
Z. sp.	Y	M	2	Nieuwoudtville	FWG&SKG	2.x.89
Immanthidium Pasteels						
Immanthidium junodi (Friese)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	1	Riebeek East	FWG&SKG	22.xi.82
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlg.	Y	F	3	Clanwilliam	FWG	16.x.89
Melolobium Eckl. & Zeyh.						
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG	29.ix.77
Immanthidium sjoestedti (Freise)						
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	-	1	Grahamstown	FWG	18.xi.71
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Nigranthidium Pasteels						
Nigranthidium concolor (Friese)						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp.A	WY	F	2	Nieuwoudtville	FWG&SKG	30.ix.90
Oranthidium Pasteels						
Oranthidium folliculosum (Buysson)						
Aizoaceae: non-Mesembryanthema						
Limeum L.						
L. sp.	Pi	F	2	Nossob	FWG&SKG	8.iii.90
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Chan.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
& Schlechtd.) DC.	Y	M	1			

Sterculiaceae						
Hermannia L.						
H. modesta (Ehrenb.) Mast.	Pi	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
H. modesta (Ehrenb.) Mast.	Pi	M	4	Twee Rivieren	FWG&SKG	8-11.iii.90
Oranthidium sp. nov.						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	M	3	Clanwilliam	FWG&SKG	3-7.x.88

Pachyanthidium Friese						
Pachyanthidium benguelense (Vachal)						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	M	1	Grahamstown	DWG	28.xii.86

Serapista Cockerell						
Serapista denticulata (Smith)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
Serapista rufipes Friese						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlg.	Y	M	1	Clanwilliam	FWG&SKG	16.x.89
A. linearis (Burm. f.) Dahlg.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	17.x.89
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	1	Nababeep	DWG	12-13.x.89
L. sericea Thunb.	Y	F	4	Nababeep	FWG&SKG	12-13.x.89
L. sericea Thunb.	Y	M	8	Nababeep	FWG&SKG	12-13.x.89
Sterculiaceae						
Hermannia L.						
H. trifurca L.	-	M	1	Springbok	SKG	10-11.x.89

Spinanthidium Mavromoustakis						
Spinanthidium callescens (Cockerell)						
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	2	Nieuwoudtville	FWG&SKG	28.ix.90
B. africana (L.) Benth.	V	M	4	Nieuwoudtville	FWG&SKG	28.ix.90
Sterculiaceae						
Hermannia L.						
H. sp.	Pi	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Spinanthidium neli (Brauns)						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. pulicifolia Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. spinescens Thunb.	Y	M	3	Clanwilliam	FWG	8-13.x.87
A. spinescens Thunb.	Y	M	2	Clanwilliam	SKG	8-13.x.87
A. spinescens Thunb.	Y	M	4	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	2	Piekenierskloof/ Paleisheuwel	FWG&SKG	6.x.90

A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Spinanthidium trachusiforme (Friese)						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. *f.*)	Y	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
A. spinescens Thunb.	Y	M	1	Clanwilliam	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	1	Piekenierskloof/	FWG&SKG	6.x.90
A. spinescens Thunb.	Y	M	3	Paleisheuwel		
Wiborgia Thunb.						
W. monoptera E. Mey	Y	F	1	Springbok	FWG&SKG	14.x.89
Sterculiaceae						
Hermannia L.						
H. sp.	Pi	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Spinanthidium volkmanni (Friese)						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	WY	M	1	Nieuwoudtville	FWG&SKG	26.ix.90
H. sp. A	WY	M	1	Nieuwoudtville	FWG&SKG	27.ix.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	M	1	Gydo Pass, Ceres	SKG	30.xi.89
A. linearis (Burm. *f.*)	Y	M	3	Clanwilliam	FWG	16.x.89
A. linearis (Burm. *f.*)	Y	M	3	Nieuwoudtville	FWG&SKG	29.ix.90
A. linearis (Burm. *f.*)	Y	M	3	Nieuwoudtville	FWG&SKG	30.ix.90
A. pulicifolia Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. spinescens Thunb.	Y	M	5	Clanwilliam	FWG	8-13.x.87
A. spinescens Thunb.	Y	F	1	Clanwilliam	SKG	8-13.x.87
A. spinescens Thunb.	Y	M	2	Clanwilliam	SKG	8-13.x.87
A. spinescens Thunb.	Y	F	2	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	2	Piekenierskloof/ Paleisheuwel	FWG&SKG	6.x.90
A. spinescens Thunb.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
A. spinescens Thunb.	Y	F	2	Citrusdal	FWG&SKG	16.x.90
A. spinescens Thunb.	Y	M	7	Citrusdal	FWG&SKG	16.x.90
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	1	Nababeep	FWG	12-13.x.89
Wiborgia Thunb.						
W. monoptera E. Mey.	Y	F	2	Narap, Springbok	SKG	14.x.89
"pea flower"	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
"pea flower"	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	M	1	Springbok	SKG&FWG	15-21.x.87

Sterculiaceae						
Hermannia L.						
H. sp.	Pi	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Tuberanthidium Pasteels						
Tuberanthidium tuberculiferum (Brauns)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	M	2	Nieuwoudtville	FWG&SKG	30.ix.90
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
Lithurgini						
Lithurge Latreille						
Lithurge spiniferus Cameron						
Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L. f.	Y	F	1	Grahamstown	FWG&SKG	2.xii.79
A. filiformis L. f.	Y	M	1	Grahamstown	FWG&SKG	2.xii.79
A. trifurcata (L.) L.	Y	F	4	Clanwilliam	FWG&SKG	9.x.90
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	3.xi.77
Senecio L.						
S. linifolius L.	Y	F	1	Grahamstown	CFJG	25.i.75
S. pterophorus DC.	Y	F	5	Grahamstown	FWG	29.xi.79
S. pterophorus DC.	Y	F	3	Grahamstown	FWG	2.xii.79
S. rosmarinifolius L. f.	Y	F	5	Oudtshoorn	FWG&RWG	7-8.xii.86
S. sp.	Y	F	2	Grahamstown	FWG&SKG	2.xii.79
S. sp.	Y	F	1	Grahamstown	DWG	31.xii.86
S. sp.	Y	M	2	Grahamstown	FWG	28.xii.86
Lamiaceae (Labiatae)						
"labiate"	V	F	1	Ouberg Pass, Montagu	FWG	3.xii.86
Megachilini						
Chalicodoma (Lepeletier)						
Chalicodoma aridissima Cockerell						
Crassulaceae						
Cotyledon L.						
C. campanulata Marl.	Y	F	3	Grahamstown	DWG	9.xii.80
C. campanulata Marl.	Y	M	1	Grahamstown	DWG	9.xii.80
C. campanulata Marl.	Y	F	1	Grahamstown	FWG	9.xii.80
C. campanulata Marl.	Y	F	1	Grahamstown	RWG	9.xii.80
C. campanulata Marl.	Y	F	1	Grahamstown	SKG	15.1.81
C. campanulata Marl.	Y	M	1	Grahamstown	SKG	15.1.81
C. sp.	Y	F	3	Grahamstown	DWG	11.xii.80
Lamiaceae (Labiatae)						
"labiate"	V	M	1	Ouberg Pass, Montagu	FWG	3.xii.86

Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Algeria	DWG	19.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	5.x.90
Chalicodoma bullata (Friese)						
Papilionaceae (Fabaceae)						
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	7	Nababeep	FWG&SKG	12-13.x.89
Chalicodoma cincta (Fabricius)						
Papilionaceae (Fabaceae)						
Rafnia Thunb.						
R. amplexicaulus Thunb.	Y	F	2	Klein Alexandershoek, Clanwilliam	FWG&SKG	8-13.x.87
R. amplexicaulus Thunb.	Y	M	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	8-13.x.87
R. amplexicaulus Thunb.	Y	F	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	26.ix.85
R. amplexicaulus Thunb.	Y	F	3	Klein Alexandershoek, Clanwilliam	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	M	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	F	1	Piekenierskloof/ Paleisheuwel	FWG&SKG	6.x.90
R. amplexicaulus Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	28.ix.85
Chalicodoma congruens (Friese)						
Lamiaceae (Labiatae)						
"labiate"	PiV	F	1	Ouberg Pass,	SKG&RWG	3.xii.86
"labiate"	PiV	M	2	Montagu		
Chalicodoma fulva (Smith)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Lamiaceae (Labiatae)						
"labiate"	PiV	F	1	Ouberg Pass, Montagu	FWG	3.xii.86
"labiate"	PiV	M	2	Ouberg Pass, Montagu	FWG	3.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. pulicifolia Dahlg.	Y	F	2	Clanwilliam	FWG&SKG	9.x.90
A. pulicifolia Dahlg.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. spinescens Thunb.	Y	F	1	Algeria	FWG&SKG	19.x.89
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	12.x.90
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	7	Nababeep	FWG&SKG	12-13.x.89
Wiborgia Thunb.						
W. monoptera E. Mey.	Y	F	1	Narap, Springbok	FWG&SKG	14.x.89
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	M	8	Springbok	FWG&SKG	15-21.x.87
P. virgata Thunb.	Pi	M	1	Springbok	FWG&SKG	10-11.x.87

Chalicodoma johannis (Friese)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. *f*) Pers.	W	F	2	Grahamstown	FWG&SKG	27.x.72
B. capensis (L. *f*) Pers.	W	M	1	Grahamstown	FWG&SKG	27.x.72
Chalicodoma karooensis Brauns						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. *f*.) Dahlg.	Y	F	1	Clanwilliam	FWG&SKG	16.x.89
A. linearis (Burm. *f*.) Dahlg.	Y	M	1	Nieuwoudtville	FWG&SKG	29.ix.90
A. linearis (Burm. *f*.) Dahlg.	Y	M	1	Nieuwoudtville	FWG&SKG	30.ix.90
A. pulicifolia Dahlg.	Y	M	1	Clanwilliam	FWG&SKG	9.x.90
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	14.x.87
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG	3-7.x.88
A. spinescens Thunb.	Y	F	2	Clanwilliam	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	M	2	Wuppertal	FWG&SKG	5.x.90
A. spinescens Thunb.	Y	F	1	Algeria	FWG&SKG	19.x.89
Lebeckia Thunb.						
L. sericea Thunb.	Y	M	1	Nababeep	FWG&SKG	12-13.x.89
papilionate	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1.x.90
papilionate	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	6.x.90
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	F	1	Springbok	FWG&SKG	15-21.x.87
P. virgata Thunb.	Pi	M	5	Springbok	FWG&SKG	15-21.x.87
P. virgata Thunb.	Pi	M	1	Springbok	FWG&SKG	10-11.x.89
Sterculiaceae						
Hermannia L.						
H. trifurca L.	-	M	1	Springbok	FWG&SKG	10-11.x.89
Chalicodoma laminata (Friese)						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	1	Prince Albert	SKG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	2	Prince Albert	FWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	3	Prince Albert	RWG	26.xi-5.xii.87
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2.xii.89
Chalicodoma maxillosa (Guérin-Méneville)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. *f*) Pers.	W	F	2	Grahamstown	FWG	15.i.81
B. capensis (L. *f*) Pers.	W	F	1	Grahamstown	DWG	3.ii.81
B. capensis (L. *f*) Pers.	W	M	4	Waterford	FWG	25.xi.87
B. capensis (L. *f*) Pers.	W	M	3	Waterford	RWG	25.xi.87
"acanth"	PiV	F	1	Nossob	FWG&SKG	8.iii.90

Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	SKG	26.xi-5.xii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Oudtshoorn	RWG	9-xii.86
Chalicodoma murina Friese						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlg.	Y	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
A. pulicifolia Dahlg.	Y	F	3	Clanwilliam	FWG&SKG	11.x.90
A. spinescens Thunb.	Y	F	3	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	F	1	Algeria	FWG&SKG	19.x.89
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	3	Springbok	FWG&SKG	10-11.x.89
L. sericea Thunb.	Y	F	16	Nababeep	FWG&SKG	12-13.x.89
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	F	1	Springbok	FWG&SKG	15-21.x.87
P. virgata Thunb.	Pi	F	3	Springbok	FWG&SKG	10-11.x.89
Chalicodoma niveofasciata Friese						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	SKG	26.xi-5.xii.87
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	F	3	43km ENE Ceres	FWG&SKG	2-3.xii.89
Chalicodoma perniciosa (Friese)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	2	Colesberg	DWG	17.i.85
Chalicodoma reicherti Brauns						
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. pulicifolia Dahlg.	Y	M	1	Clanwilliam	FWG&SKG	11.x.90
Chalicodoma schultessi (Friese)						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlg.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
Chalicodoma sinuata (Friese)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87

Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlg.	Y	F	1	Clanwilliam	FWG&SKG	16.x.89
A. pulicifolia Dahlg.	Y	F	1	Clanwilliam	FWG&SKG	11.x.90
A. pulicifolia Dahlg.	Y	M	1	Clanwilliam	FWG&SKG	11.x.90
A. spinescens Thunb.	Y	M	3	Citrusdal	FWG&SKG	16.x.90
Calpurnia E. Mey.						
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	10.i.52
Wiborgia Thunb.						
W. sp.	Y	F	2	43km ENE Ceres	FWG&SKG	2-3.xii.89
W. sp.	Y	M	6	43km ENE Ceres	FWG&SKG	2-3.xii.89
Chalicodoma sinuata latitarsis (Friese)						
Acanthaceae						
Blepharis Juss.						
B. capensis L.f. Pers.	W	F	1	Grahamstown	FWG	5.i.77
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG&SKG	20.xi.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	F	1	Grahamstown	FWG	3.xii.81
Tiliaceae						
Grewia L.						
G. occidentalis L.	Pi	F	1	Grahamstown	DWG	11.xii.80
Chalicodoma sp. A						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	4	Prince Albert	SKG	26.xi-5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG	26.xi-5.xii.87
Chalicodoma sp. C						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	SKG	26.xi-5.xii.87
Chalicodoma sp. D						
Polygalaceae						
Polygala L.						
P. virgata Thunb.	Pi	F	2	Springbok	FWG&SKG	15-21.x.87

Coelioxys Latreille						
Coelioxys bruneipes Pasteels						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG	26.xi-5.xii.87
Coelioxys coeruleipennis luteipes Friese						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	4	Prince Albert	FWG	26.xi-
A. buchenaviana Schinz	WY	M	1			5.xii.87
A. buchenaviana Schinz	WY	F	2	Prince Albert	RWG	26.xi-
A. buchenaviana Schinz	WY	M	3			5.xii.87

Coelioxys foveolata Smith						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. *f*) Pers.	W	F	1	Grahamstown	FWG	5.i.79
B. capensis (L. *f*) Pers.	W	F	1	Grahamstown	FWG	7.i.79
B. capensis (L. *f*) Pers.	W	F	2	Grahamstown	DWG	7.i.79
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	M	1	Grahamstown	FWG	18.xi.71
Coelioxys lativentris Friese						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. carlinifolia (DC.) Roessler	Y	M	1	Ceres	HWG	29-30.xi.89
Coelioxys penetratrix Smith						
Asteraceae (Compositae)						
Senecio L.						
S. pterophorus DC.	Y	M	1	Grahamstown	FWG&SKG	1.xii.79
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	24.iii.92
Melolobium Eckl. & Zeyh.						
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	4.x.77
Coelioxys rufispina Walker						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,RWG&SKG	26.xi-5.xii.87
Coelioxys torrida Smith						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	3	Colesberg	DWG	17.i.85

Creightoniella Cockerell						
Creightoniella cornigera (Friese)						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	DWG	2.i.78
A. karroo Hayne	Y	F	1	Grahamstown	DWG	5.xii.80
Creightoniella discolor (Smith)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.*f*.) Pers.	W	F	3	Grahamstown	DWG	7.i.79
B. capensis (L.*f*.) Pers.	W	F	3	Grahamstown	DWG	15.i.81
B. capensis (L.*f*.) Pers.	W	F	1	Grahamstown	FWG	15.i.81
B. capensis (L.*f*.) Pers.	W	F	1	Grahamstown	FWG	8.ii.81
B. capensis (L.*f*.) Pers.	W	F	1	Grahamstown	SKG	29.i.86
B. capensis (L.*f*.) Pers.	W	M	1	Waterford	RWG	25.xi.87
Asclepiadaceae						
A. buchenaviana Schinz	WY	F	9	Prince Albert	FWG,SKG&RWG	26.x-5.xii.87
A. buchenaviana Schinz	WY	M	36	Prince Albert	FWG,SKG&RWG	26.x-5.xii.87
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG&SKG	20.xi.90

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	3	Prince Albert	RWG	26.x-5.xii.87
A. karroo Hayne	Y	F	1	Grahamstown	AJSW	10.ii.84
A. karroo Hayne	Y	M	1	Grahamstown	DWG	17.ii.83
Creightoniella dorsata (Smith)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	4	Grahamstown	FWG	5.i.79
B. capensis (L.f.) Pers.	W	M	1	Grahamstown	DWG	5.i.79
B. capensis (L.f.) Pers.	W	F	12	Grahamstown	DWG	7.i.79
B. capensis (L.f.) Pers.	W	M	1	Grahamstown	DWG	7.i.79
B. capensis (L.f.) Pers.	W	F	9	Grahamstown	FWG	7.i.79
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	15.i.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	DWG	3.ii.81
B. capensis (L.f.) Pers.	W	F	2	Grahamstown	FWG&DWG	8.ii.81
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	21	Prince Albert	FWG,SKG&RWG	25.xi-
A. buchenaviana Schinz	WY	M	15			5.xii.87
Asteraceae (Compositae)						
Senecio L.						
S. pterophorus DC.	Y	M	1	Grahamstown	FWG	29.xi.79
S. pterophorus DC.	Y	M	1	Grahamstown	FWG&SKG	1.xii.79
Crassulaceae						
Cotyledon L.						
C. campanulata Marl.	Y	F	2	Grahamstown	DWG	9.xii.80
C. campanulata Marl.	Y	F	4	Grahamstown	DWG	11.xii.80
C. campanulata Marl.	Y	F	1	Grahamstown	FWG	30.i.86
Lamiaceae (Labiatae)						
Lasiocorys Benth.						
L. capensis Benth.	-	F	1	Grahamstown	SKG	15.i.81
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	6	Grahamstown	DWG	5.xii.80
Creightoniella ianthoptera (Smith)						
Papilionaceae (Fabaceae)						
Psoralea L.						
P. pinnata L.	B	F	3	Grahamstown	CFJG	2.ii.75
P. pinnata L.	B	M	2	Grahamstown	CFJG	2.ii.75
Creightoniella seewaldi (Strand)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.)	W	F	1	Grahamstown	FWG	13.i.81
B. capensis (L.f.)	W	F	2	Grahamstown	FWG	8.ii.81
B. capensis (L.f.)	W	F	2	Grahamstown	DWG	8.ii.81
B. capensis (L.f.)	W	F	2	Grahamstown	HWG	8.ii.81
Peristrophe Nees						
P. sp.	BV	F	1	Grahamstown	FWG	10.ii.86
Asclepiadaceae						
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	M	1	Kommadagga	DWG	14.i.86

Mimosaceae						
Acacia Mill						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	10.ii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	3.i.77
A. karroo Hayne	Y	M	2	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	DWG	5.xii.80
Megachile Latreille						
Megachile apiformis Smith						
Papilionaceae (Fabaceae)						
Lebeckia Thunb.						
L. sericea Thunb.	Y	F	1	Nababeep	FWG&SKG	12-13.x.89
Megachile curtula Gerstaecker						
Papilionaceae (Fabaceae)						
Melolobium Eckl. & Zeyh.						
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG	4.x.77
Megachile edwardsi Friese						
Papilionaceae (Fabaceae)						
Psoralea L.						
P. pinnata L.	B	F	3	Grahamstown	CFJG	2-9.ii.75
P. pinnata L.	B	M	4	Grahamstown	CFJG	2-9.ii.75
Megachile gratiosa Gerstaecker						
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	20.i.70
Elatinaceae						
Bergia L.						
B. glomerata L. f.	W	F	1	Grahamstown	FWG&SKG	20.xi.90
B. glomerata L. f.	W	M	1	Grahamstown	FWG&SKG	20.xi.90
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	M	1	Grahamstown	FWG	6.xii.72
A. karroo Hayne	Y	F	1	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Grahamstown	FWG	20.xii.77
A. karroo Hayne	Y	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	2	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	6	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	25.iii.92
Melolobium Eckl. & Zeyh.						
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG	4.x.77
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG	12.x.77
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	V	F	1	Grahamstown	SKG	27.xi.81

Megachile meadewaldoi (Brauns)						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	15.xi.77
Senecio L.						
S. sp.	Y	M	1	Grahamstown	FWG	28.xii.86
S. sp.	Y	M	1	Grahamstown	DWG	28.xii.86
S. sp.	Y	M	1	Grahamstown	DWG	31.xii.86
Megachile semiflava Cockerell						
Asteraceae (Compositae)						
Senecio L.						
S. sp.	Y	F	2	Grahamstown	FWG	28.xii.86
S. sp.	Y	F	2	Grahamstown	DWG	31.xii.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	2	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	25.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	25.iii.92
Melolobium Eckl. & Zeyh.						
M. candicans (E.Mey.) Eckl. & Zeyh.	Y	M	2	Grahamstown	FWG	29.ix.77
Megachile spinarum Cockerell						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	11	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	4	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	7	Grahamstown	FWG&SKG	25.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	4	Grahamstown	FWG&SKG	25.iii.92
Megachile stellarum Cockerell						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	5.i.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	7.i.81
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	DWG	7.i.81
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	SKG	8.ii.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	8.ii.81
B. capensis (L.f.) Pers.	W	F	2	Grahamstown	DWG	15.i.81
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	FWG	15.i.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	30.i.86
Peristrophe Nees						
P. sp.	V	M	1	Grahamstown	FWG	3.xii.81
P. sp.	V	F	1	Grahamstown	FWG	10.ii.86
Aizoaceae: Mesembryanthema						
"mesem"	W	F	2	Montagu/Matroosberg	FWG	4.xii.86
"mesem"	W	M	1	Montagu/Matroosberg	FWG	4.xii.86
"mesem"	W	F	1	Montagu/Matroosberg	SKG	4.xii.86
"mesem"	W	F	1	Montagu/Matroosberg	HWG	4.xii.86
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG,SKG&RWG	25.xi-
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	M	1	Kommadagga	FWG	14.i.86
S. viminale (L.) R. Br.	Y	M	1	Kommadagga	DWG	14.i.86
S. viminale (L.) R. Br.	Y	M	3	Kommadagga	RWG	14.i.86
						5.xii.87

Asteraceae (Compositae)						
Athanasia L.						
A. filiformis L.f.	Y	F	1	Grahamstown	FWG&SKG	2.xii.79
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	8	Grahamstown	FWG&SKG	20.xi.90
B. sp.	Y	F	1	Riebeek East	FWG&SKG	22.xi.82
B. sp.	Y	M	1	Riebeek East	FWG&SKG	22.xi.82
Senecio L.						
S. pterophorus DC.	Y	F	8	Grahamstown	FWG	29.xi.79
S. sp.	Y	M	1	Grahamstown	DWG	31.xii.86
S. sp.	Y	M	2	Grahamstown	FWG	28.xii.86
S. sp.	Y	M	1	Grahamstown	DWG	31.xii.86
S. sp.	Y	M	1	Grahamstown	FWG&SKG	27.xii.79
"composite"	Y	F	1	Grahamstown	SKG	8.ii.81
Lamiaceae (Labiatae)						
"labiate"	V	F	1	Ouberg Pass, Montagu	FWG	3.xii.86
Megachile ungulata Smith						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	15.ii.90
Melolobium Eckl. & Zeyh.						
M. candicans (E. Mey.) Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG	4.x.77
Psoralia L.						
P. pinnata L.	B	F	6	Grahamstown	CFJG	2.ii.75
P. pinnata L.	B	M	4	Grahamstown	CFJG	2.ii.75
P. pinnata L.	B	F	6	Grahamstown	CFJG	9.ii.75
P. pinnata L.	B	M	2	Grahamstown	CFJG	9.ii.75
Megachile sp. A						
Apocynaceae						
Carissa L.						
C. haematocarpa (Eckl.) DC.	W	M	1	Prince Albert	FWG	25.xi-5.xii.87
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	28	Prince Albert	FWG,SKG&RWG	25.xi-
A. buchenaviana Schinz	WY	M	18			5.xii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	2	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	F	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
W. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Megachile sp. B						
Papilionacae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	2	6km NW Algeria	FWG	19.x.89
Megachile sp. C						
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlgren	Y	F	2	Nieuwoudtville	FWG&SKG	29-30.ix.90
A. linearis (Burm. f.) Dahlgren	Y	M	1	Nieuwoudtville	FWG&SKG	29-30.ix.90

Megachile sp. D (= Kalahari sp. C)						
Acanthaceae						
Monechma Hochst.						
M. sp.	PiV	F	1	Nossob	FWG&SKG	8.iii.90
Megachile sp. E (= Kalahari sp. A)						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Osmiini

Heriades Spinola						
Heriades cf. freygessneri Schletterer						
Asteraceae						
Cotula L.						
C. sp.	Y	M	1	Grahamstown	FWG&SKG	22.x.81
Senecio L.						
S. sp.	Y	F	2	Grahamstown	FWG	17.xi.78
S. sp.	Y	F	1	Grahamstown	DWG	31.xii.86
Heriades cf. spiniscutis (Cameron)						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	12.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	20.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	25.x.77
L. bipinnatum (Thunb.) Druce	W	F	3	Grahamstown	FWG	3.xi.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	15.xi.77
Elatinaceae						
Bergia L.						
B. glomerata L.f.	W	M	1	Grahamstown	FWG&SKG	20.xi.90
Heriades sp. A.						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. acutisepalum (Berger)N.E.Br.	Pi	F	3	Clanwilliam/Klawer	FWG&SKG	27.ix.85
P. acutisepalum (Berger)N.E.Br.	Pi	M	1	Clanwilliam/Klawer	FWG&SKG	27.ix.85
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	2	43 km ENE Ceres	HWG	3.xii.89
Helichrysum Mill.						
H. sp.	Y	F	1	Clanwilliam/ Citrusdal	FWG&SKG	10.x.90
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	10.xi.77
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	M	1	Nieuwoudtville	FWG&SKG	27.ix.90
Senecio L.						
S. rosmarinifolius L.f.	Y	F	1	Oudtshoorn	FWG	7-8.xii.86
S. sp. prob. nivea Less.	W	M	1	Nieuwoudtville	FWG&SKG	7.x.89

Heriades sp. C						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata (L.) L.	Y	F	4	Clanwilliam	FWG&SKG	9.x.90
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	FWG&SKG	27.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Heriades sp. E						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	FWG&SKG	5.x.89
B. fruticosa (L.) Ehrh.	Y	F	2	Nieuwoudtville	FWG&SKG	27.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	FWG&SKG	6.x.89
P. divaricata (Berg.) Less.	Y	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
Heriades sp. F						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	F	4	Nieuwoudtville	FWG&SKG	28.ix.90
Osteospermum L.						
O. oppositifolia (Ait.) T. Norl.	Y	F	2	Nieuwoudtville	FWG&SKG	3.x.89
O. oppositifolia (Ait.) T. Norl.	Y	F	1	Nieuwoudtville	FWG&SKG	5.x.89
Senecio L.						
S. sp. prob. nivea Less.	W	F	4	Nieuwoudtville	FWG&SKG	7.x.89
Heriades sp. G						
Asteraceae (Compositae)						
Cotula L.						
C. cf. leptalea DC.	Y	M	1	Nieuwoudtville	FWG&SKG	7.x.89
Leysera L.						
L. tenella DC.	Y	M	1	Nieuwoudtville	FWG&SKG	3.x.89
Pentzia Thunb.						
P. suffruticosa (L.) Hutch. ex Merxm.	Y	F	6	Nieuwoudtville	FWG&SKG	27.ix.90
P. suffruticosa (L.) Hutch. ex Merxm.	Y	M	6	Nieuwoudtville	FWG&SKG	27.ix.90
P. suffruticosa (L.) Hutch. ex Merxm.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Senecio L.						
S. sp. prob. nivea Less.	W	M	1	Nieuwoudtville	FWG&SKG	7.x.89
Heriades sp. H						
Asteraceae (Compositae)						
Helichrysum Mill.						
H. sp.	Y	M	6	Clanwilliam	FWG&SKG	11.x.90
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Clanwilliam	FWG&SKG	3-7.x.88
W. sp.	V	M	1	Clanwilliam	FWG&SKG	3-7.x.88
W. sp.	V	M	3	Clanwilliam	FWG&SKG	11.x.90
Heriades sp. I						
Aizoaceae: Mesembryanthema						
Sphalmanthus N.E.Br.						
S. cf. bijliae (N.E.Br.) L.Bol.	Pi	F	2	Prince Albert	FWG&SKG	29.xi.89

Heriades sp. J						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
L. gnaphaloides (L.) L.	Y	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
Heriades sp. K						
Zygophyllaceae						
Tribulus L.						
T. cristatus Presl.	Y	F	1	Augrabies	FWG&SKG	6.iii.90
Heriades sp. L						
Asteraceae (Compositae)						
Athanasia L.						
A. sp.	Y	M	1	43 km ENE Ceres	FWG&SKG	2-3.xii.89
Heriades sp. M						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	18.x.77
L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	10.xi.77

Hoplitis Klug						
Hoplitis similis (Friese)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG	16.x.72
Senecio L.						
S. sp.	Y	F	1	Grahamstown	FWG	17.xi.78
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	2	Grahamstown	FWG	18.xi.77
Selaginaceae						
Selago L.						
S. sp.	-	F	1	Grahamstown	CFJG	16.xii.69
Hoplitis jansei (Brauns)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	3	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	DWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	7	Grahamstown	FWG	25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG&SKG	15.xi.77
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	18.x.77
Hoplitis schultzei (Friese)						
Asteraceae (Compositae)						
"composite"	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
Hoplitis sp. A						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	12.x.72
Geraniaceae						
Pelargonium L'Herit.						
P. myrrhifolium Ait.	-	F	3	Oudtshoorn	CFJG	10.x.72

Hoplitis sp. B						
Asteraceae (Compositae)						
Arctotheca Wendl.						
A. calendula (L.) Levyns	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Berkheya Ehrh.						
B. fruticosa (L.) Ehrh.	Y	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
Geraniaceae						
Pelargonium L'Herit.						
P. sp.	Pi	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Hoplitis sp. C						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A.DC.	V	F	1	Clanwilliam/ Graafwater	FWG&SKG	8.x.90
W. paniculata (Thunb.) A.DC.	V	F	4	Clanwilliam	SKG	16.x.89
W. pilosa Buek	V	F	1	SW Springbok	FWG	14.x.89
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam	FWG&SKG	3-7.x.88
Hoplitis sp. I						
Papilionaceae (Fabaceae)						
Indigofera L.						
I. sp.	PiR	F	4	Gydo Pass, Ceres	FWG&SKG	30.x.89
Hoplitis sp. J						
Asteraceae (Compositae)						
Athanasia L.						
A. trifurcata L. (L.)	Y	M	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	1.x.90
A. trifurcata L. (L.)	Y	F	1	Clanwilliam/ Klawer	FWG&SKG	9.x.90
Hoplitis sp. K						
Aizoaceae: Mesembryanthema						
Psilocaulon N.E.Br.						
P. acutisepalum (Berger)N.E.Br.	Pi	M	2	Clanwilliam	FWG&SKG	13.x.90
"mesem"	Pi	M	2	Nieuwoudtville	FWG&SKG	28.ix.90
Hoplitis sp. L						
Aizoaceae: non-Mesembryanthema						
Galenia L.						
G. africana L.	GY	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Asteraceae (Compositae)						
Leysera L.						
L. gnaphalodes (L.) L.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Pteronia L.						
P. divaricata (Berg.) Less.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	3	Nieuwoudtville	FWG&SKG	28.ix.90

Hoplitis sp. M						
Aizoaceae: Mesembryanthema						
Leipoldtia L. Bol.						
L. sp.	Pi	F	1	Springbok	FWG&SKG	11.x.89
Pseudoheriades Peters						
Pseudoheriades moricei (Friese)						
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	4	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	2	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	F	1	Oudtshoorn	FWG	9-12.xii.86
A. karroo Hayne	Y	M	3	Oudtshoorn	FWG	9-12.xii.86
Zygophyllaceae						
Tribulus L.						
T. cristatus Presl.	Y	M	1	Augrabies	FWG&SKG	6.iii.90
Pseudoheriades primus Peters						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphaloides (L.) L.	Y	F	3	Nieuwoudtville	FWG&SKG	28.ix.90
L. gnaphaloides (L.) L.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Osteospermum L.						
O. oppositifolia (Ait.) T. Norl.	Y	F	1	Nieuwoudtville	FWG&SKG	3.x.89

ANTHOPHORIDAE

NOMADINAE

Ammobatini

Pseudodichroa Bischoff						
Pseudodichroa capensis (Friese)						
Aizoaceae: non-Mesembryanthema						
Coelanthum E.Mey. ex Fenzl.						
C. grandiflorum E.Mey. ex Fenzl.	W	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Sphecodopsis Bischoff						
Sphecodopsis sp.						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. B	WY	F	3	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
H. sp. B	WY	F	1	Clanwilliam/ Graafwater	FWG&SKG	7.x.90
Asteraceae (Compositae)						
Helichrysum Mill.						
H. sp.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	2.x.90
Senecio L.						
S. cf. *arenarius* Thunb.	Pi	F	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90

Rosaceae						
Grielum L.						
G. humifusum Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90

Epeolini						
Epeolus Latreille						
Epeolus amabilis Gerstaecker						
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	F	1	43 km ENE Ceres	FWG&SKG	2.xii.89
Epeolus sp.						
Geraniaceae						
Pelargonium L'Herit						
P. myrrhifolium Ait.	-	F	1	Oudtshoorn	CFJG	10.x.72
P. myrrhifolium Ait.	-	M	1	Oudtshoorn	CFJG	10.x.72

Nomadini						
Nomada Scopoli						
Nomada gigas Friese						
Asteraceae (Compositae)						
Lasiospermum Lag.						
L. bipinnatum (Thunb.)	W	M	1	Grahamstown	FWG	25.x.77
Pteronia L.						
P. cf. divaricata (Berg.) Less.	Y	F	1	Nieuwoudtville	DWG	3-8.x.89

ANTHOPHORINAE						
Anthophorini						
Amegilla Friese						
Amegilla (Micramegilla) atrocincta (lepeletier)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	FWG	3.ii.81
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	DWG	3.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	FWG	15.i.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	15.i.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	RWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	FWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	FWG	7.i.81
B. capensis (L. f.) Pers.	W	M	4	Grahamstown	FWG	7.i.81
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	DWG	7.i.81
B. capensis (L. f.) Pers.	W	M	3	Grahamstown	DWG	7.i.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	FWG	8.ii.81
B. capensis (L. f.) Pers.	W	M	1	Grahamstown	FWG	5.i.79
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	7.i.79
B. capensis (L. f.) Pers.	W	M	2	Grahamstown	DWG	7.i.79
B. capensis (L. f.) Pers.	W	F	2	Waterford	RWG	25.xi.87
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG&SKG	20.xi.90

Amegilla (Amegilla) spp.						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	1	Waterford	RWG	25.xi.87
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Montagu/Matroosberg	RWG	4.xii.86
"mesem"	W	F	2	Montagu/Matroosberg	SKG	4.xii.86
"mesem"	W	F	2	Matroosberg	RWG	4.xii.86
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. carlinifolia (DC.) Roessler	Y	M	1	ENE Ceres	HWG	29-30.xi.89
Senecio L.						
S. rosmarinifolius L. f.	Y	F	1	Oudtshoorn	RWG	7-8.xii.86
S. rosmarinifolius L. f.	Y	F	1	Oudtshoorn	FWG	7-8.xii.86
Boraginaceae						
Lobostemon Lehm.						
L. sp.	B	F	4	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
Capparaceae						
Maerua Forssk.						
M. sp.	W	M	1	Vioolsdrif	FWG&SKG	3.x.85
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	B	F	2	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
"labiate"	V	F	2	Ouberg Pass, Montagu	FWG	3.xii.86
"labiate"	B	F	1	Nieuwoudtville	FWG&SKG	3-8.x.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
Proteaceae						
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	1	Nieuwoudtville	FWG&SKG	2-8.x.90
Zygophyllaceae						
Zygophyllum L.						
Z. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	2.x.89
Z. sp.	Y	M	3	Nieuwoudtville	FWG&SKG	28.ix.89
Amegilla (Zebramegilla) sp. A						
Acanthaceae						
Blepharis Juss.						
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	DWG	15.i.81
B. capensis (L.f.) Pers.	W	F	2	Grahamstown	FWG	10.ii.86
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	DWG	3.ii.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	3.ii.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	FWG	8.ii.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	SKG	8.ii.81
B. capensis (L.f.) Pers.	W	F	1	Grahamstown	RWG	15.i.81
B. capensis (L.f.) Pers.	W	F	3	Grahamstown	FWG	7.i.79
B. capensis (L.f.) Pers.	W	F	4	Grahamstown	DWG	7.i.79
B. capensis (L.f.) Pers.	W	M	1	Grahamstown	FWG&SKG	27.x.72
Aizoaceae: Mesembryanthema						
"mesem"	WY	M	1	Kommadagga	FWG&SKG	23.x.85

Amegilla (Zebramegilla) sp. B.						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	M	2	Grahamstown	FWG&SKG	27.x.72
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Montagu/Matroosberg	FWG	4.xii.86
Asteraceae (Compositae)						
Senecio L.						
S. linifolius L.	Y	F	2	Grahamstown	CFJG	27.i.75
S. linifolius L.	Y	M	2	Grahamstown	CFJG	27.i.75
S. linifolius L.	Y	M	2	Grahamstown	CFJG	2.ii.75
Campanulaceae						
Cyphia Berg.						
C. sp.	PiV	M	1	Grahamstown	FWG	21.iii.78
Crassulaceae						
Cotyledon L.						
C. campanulata Marl.	Y	F	3	Grahamstown	DWG	9.xii.80
Geraniaceae						
Pelargonium L' Herit						
P. myrrhifolium Ait.	-	F	1	Oudtshoorn	CFJG	10.x.72
Lamiaceae (Labiatae)						
Acrotome Benth.						
A. inflata Benth.	BV	M	4	Grahamstown	SKG	17.iii.78
"labiate"	B	F	2	Nieuwoudtville	FWG&SKG	3-8.x.89
"labiate"	B	M	1	Nieuwoudtville	FWG&SKG	3-8.x.89
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karroo Hayne	Y	M	1	Colesberg	DWG	19.i.85
Papilionaceae (Fabaceae)						
Psoralea L.						
P. pinnata L.	B	M	2	Grahamstown	CFJG	2.ii.75
P. pinnata L.	B	F	2	Grahamstown	CFJG	9.ii.75
P. pinnata L.	B	M	3	Grahamstown	CFJG	9.ii.75

Anthophora Latreille						
Anthophora braunsiana Friese						
Solanaceae						
Lycium L.						
L. sp.	V	M	2	Grahamstown	FWG	9.iii.78
Anthophora diversipes Friese						
Boraginaceae						
Lobostemon Lehm.						
L. trichotomus DC.	B	F	1	E Pakhuis Pass	DWG	3.x.91
L. trichotomus DC.	B	M	2	E Pakhuis Pass	DWG	3.x.91
L. sp.	B	F	1	Clanwilliam	FWG&SKG	3.x.90
Anthophora labrosa Friese						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG&SKG	15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	DWG	16.x.72
B. sp.	Y	F	2	Riebeek East	FWG&SKG	22.xi.82
B. sp.	Y	F	1	Clanwilliam	FWG&SKG	9.x.90

Senecio L.						
S. linifolius L.	Y	F	1	Grahamstown	CFJG	25.i.75
S. linifolius L.	Y	F	1	Grahamstown	CFJG	2.ii.75
Lamiaceae (Labiatae)						
"labiate"	V	M	5	Ouberg Pass, Montagu	FWG	3.xii.86
Anthophora praecox Friese						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. carlinifolia (DC.) Roessler	Y	M	1	Theronsberg Pass, Ceres	FWG	29-30.xi.89
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG&SKG	15.xi.77
B. sp.	Y	F	4	Riebeek East	FWG&SKG	22.xi.82
B. sp.	Y	F	1	Clanwilliam	FWG&SKG	9.x.90
Pentzia Thunb.						
P. incana (Thunb.) Kuntze	Y	F	p	Prince Albert	SKG	26.xi-5.xii.87
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	1	Grahamstown	FWG	18.xi.77
A. capensis Thunb.	B	M	2	Grahamstown	FWG	18.xi.77
Anthophora rufolanata Dours						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	4	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	4	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	DWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	3	Grahamstown	FWG	25.x.72
Senecio L.						
S. linifolius L.	Y	F	4	Grahamstown	CFJG	1.i.75
S. linifolius L.	Y	F	4	Grahamstown	CFJG	2.ii.75
S. linifolius L.	Y	F	7	Grahamstown	CFJG	25.i.75
S. linifolius L.	Y	F	2	Grahamstown	CFJG	31.i.75
S. linifolius L.	Y	M	1	Grahamstown	CFJG	27.i.75
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	M	3	Grahamstown	FWG	18.xi.77
Anthophora vestita Smith						
Acanthaceae						
Peristrophe Nees						
P. sp.	-	F	1	Grahamstown	FWG	3.xii.81
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	8	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown	FWG&SKG	20.ix.90
B. heterophylla (Th.) O.Hoffm.	Y	M	3	Grahamstown	FWG&SKG	20.ix.90
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	DWG	16.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	5	Grahamstown	FWG	25.x.72
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG&SKG	15.xi.77
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG&SKG	15.xi.77
B. sp.	Y	F	1	Riebeek East	DWG	22.xi.82
Cirsium Mill. emend. Scop.						
C. vulgare (Savi) Ten.	Pu	F	1	Grahamstown	SKG	9.iii.78
C. vulgare (Savi) Ten.	Pu	M	2	Grahamstown	SKG	9.iii.78

Senecio L.						
S. linifolius L.	Y	F	1	Grahamstown	CFJG	25.i.75
S. linifolius L.	Y	M	1	Grahamstown	CFJG	25.i.75
S. linifolius L.	Y	F	2	Grahamstown	CFJG	27.i.75
S. linifolius L.	Y	F	1	Grahamstown	CFJG	31.i.75
S. linifolius L.	Y	M	1	Grahamstown	CFJG	31.i.75
S. linifolius L.	Y	M	2	Grahamstown	CFJG	2.ii.75
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	3	Grahamstown	FWG	18.xi.77
A. capensis Thunb.	B	M	8	Grahamstown	FWG	18.xi.77
Lamiaceae (Labiatae)						
Acrotome Benth.						
A. inflata Benth.	BV	M	1	Grahamstown	FWG	3.iii.78
A. inflata Benth.	BV	M	2	Grahamstown	SKG	17.iii.78
A. inflata Benth.	BV	M	1	Grahamstown	FWG	9.iii.78
Anthophora wartmanni Friese						
Asteraceae (Compositae)						
Arctotis L.						
A. laevis Thunb.	Y	F	1	Clanwilliam	FWG&SKG	5.x.90
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	1	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG	16.x.72
Metalasia R. Br.						
M. muricata (L.) D.Don	Pi	F	1	Nieuwoudtville	FWG&SKG	29.ix.90
Pteronia L.						
P. sp. B	Y	F	1	Nababeep	FWG	12-13.x.89
P. sp. B		M	1	Nababeep	FWG	12-13.x.89
Senecio L						
S. linifolius L.	Y	M	1	Grahamstown	CFJG	25.i.75
S. linifolius L.	Y	F	1	Grahamstown	CFJG	31.i.75
S. linifolius L.	Y	F	1	Grahamstown	CFJG	2.ii.75
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Nieuwoudtville	FWG&SKG	30.ix.90
Iridaceae						
Homeria Vent.						
H. sp.	Y	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Wachendorfia Burm.						
W. sp.	Y	F	2	Nieuwoudtville	FWG&SKG	29.ix.90
Anthophora sp.						
Asteraceae (Compositae)						
Leysera L.						
L. gnaphalodes (L.) L.	Y	M	1	Nieuwoudtville	FWG&SKG	28.ix.90
Pteronia L.						
P. sp.	Y	M	1	Nieuwoudtville	FWG&SKG	29.ix.90

Eucerini

Tetraloniella Ashmead						
Tetraloniella apicalis (Friese)						
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	M	1	Grahamstown	FWG	5.xii.80

Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	1	Grahamstown	FWG	18.xi.77
Lamiaceae (Labiatae)						
"labiate"	PiV	F	1	Ouberg Pass, Montagu	FWG,SKG&RWG	3.xii.86
"labiate"	PiV	M	7	Ouberg Pass, Montagu	FWG,SKG&RWG	3.xii.86
Thyreus axillaris (Vachal)						
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	M	1	Grahamstown	FWG	18.xi.77
Thyreus caffra (Lepeletier)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	M	2	Grahamstown	FWG&SKG	20.xi.90
Thyreus calceatus (Vachal)						
Asteraceae (Compositae)						
Cirsium Mill. emend. Scop.						
C. sp.	PiV	F	1	Grahamstown	SKG	9.ii.78
Senecio L.						
S. rosmarinifolius L. f.	Y	M	2	Oudtshoorn	FWG	7-8.xii.86
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	2	Grahamstown	FWG	18.xi.77
A. capensis Thunb.	B	M	6	Grahamstown	FWG	18.xi.77
Lamiaceae (Labiatae)						
"labiate"	PiV	F	2	Ouberg Pass, Montagu	FWG&RWG	3.xii.86
"labiate"	PiV	M	3	Ouberg Pass, Montagu	FWG&RWG	3.xii.86
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd	WY	F	1	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd	WY	M	1	Oudtshoorn	RWG	9-12.xii.86
A. karoo Hayne	Y	F	1	Grahamstown	RWG	20.xii.77
A. karoo Hayne	Y	F	1	Grahamstown	RWG	13.i.77
A. karoo Hayne	Y	M	1	Colesberg	DWG	16.i.85
Thyreus delumbatus (Vachal)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	8.ii.79
Apocynaceae						
Carissa L.						
C. haematocarpa (Eckl.) DC.	W	F	1	Prince Albert	FWG,SKG&RWG	26.xi-
C. haematocarpa (Eckl.) DC.	W	M	1			5.xii.87
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	3	Prince Albert	FWG&SKG	26.xi-
A. buchenaviana Schinz	WY	M	5			5.xii.87
Lamiaceae (Labiatae)						
"labiate"	PiV	F	2	Ouberg Pass, Montagu	FWG&SKG	3.xii.86
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	Y	F	6	Oudtshoorn	RWG	9-12.xii.86

Plumbaginaceae						
Limonium Mill.						
L. sp.	V	M	1	43km ENE Ceres	FWG&SKG	2-3.xii.89
Thyreus pica (Strand)						
Acanthaceae						
Monechma Hochst.						
M. sp.	V	M	1	Twee Rivieren	FWG&SKG	8-11.iii.90
Thyreus plumifer (Brauns)						
Lamiaceae (Labiatae)						
"labiate"	PiV	F	1	Ouberg Pass, Montagu	RWG	3.xii.86
Thyreus vachali (Friese)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	5.i.79
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	RWG	26.xi-5.xii.87
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Colesberg	DWG	16.i.85
A. karroo Hayne	Y	F	1	Colesberg	DWG	19.i.85
Thyreus sp.						
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	5	Grahamstown	FWG	18.xi.77
A. capensis Thunb.	B	M	14	Grahamstown	FWG	18.xi.77
Thyreus sp.						
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	2	Prince Albert	FWG	26.xi-
A. buchenaviana Schinz	WY	M	4			5.xii.87
A. buchenaviana Schinz	WY	F	3	Prince Albert	SKG	26.xi-
A. buchenaviana Schinz	WY	M	2			5.xii.87
A. buchenaviana Schinz	WY	M	1	Prince Albert	FWG,SKG&RWG	26.xi-5.xii.87
Thyreus sp.						
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Grahamstown	RWG	13.i.77

XYLOCOPINAE

Allodapini

Allodape Lepeletier & Serville						
Allodape friesei Strand						
Asclepiadaceae						
Asclepias L.						
A. sp.	WY	F	2	43km ENE Ceres	RWG	2-3.xii.89
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	F	1	Gydo Pass, Ceres	FWG&SKG	30.xi.89

Allodape pictifrons Smith						
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	BV	F	12	Clanwilliam/ Graafwater	FWG&SKG	13.x.87
Allodape quadrilineata (Cam.)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	2	Grahamstown	FWG&SKG	20.xi.90
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	2	Grahamstown	FWG	18.xi.77
Allodape rufogastra Lep. & Serv. and/or A. exoloma Strand						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O.Hoffm.	Y	F	1	Grahamstown	FWG&SKG	20.xi.90
Boraginaceae						
Anchusa L.						
A. capensis Thunb.	B	F	6	Grahamstown	FWG	18.xi.77
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	2	Grahamstown	FWG&SKG	25.iii.92
Proteaceae						
Protea L.						
P. repens (L.) L.	C&WY	F	1	Grahamstown	FWG&SKG	7.iii.91
Allodape sp.						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	3	Grahamstown	FWG&SKG	22.xi.82

Allodapula Cockerell						
Allodapula variegata (Smith)						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	4.x.77
L. bipinnatum (Thunb.) Druce	W	F	3	Grahamstown	FWG	20.x.77
Ebenaceae						
Diospyros L.						
D. sp.	WY	F	1	Grahamstown	FWG	10.xi.77
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	24.iii.92
A. subtingens Eckl. & Zeyh.	Y	F	2	Grahamstown	FWG&SKG	25.iii.92
Scrophulariaceae						
Phyllopodium Benth.						
P. cuneifolium (L.f.) Benth.	V	F	5	Grahamstown	FWG	9-17.iii.78

Allodapula sp.								
	Apiaceae (Umbelliferae)							
		Foeniculum Mill.						
		F. vulgare A.W.Hill	Y	F	1	Grahamstown	FWG	16.i.84
		F. vulgare A.W.Hill	Y	F	1	Grahamstown	SKG	16.i.84
		F. vulgare A.W.Hill	Y	F	2	Grahamstown	HWG	16.i.84
		F. vulgare A.W.Hill	Y	F	1	Grahamstown	RWG	16.i.84
Braunsapis Michener								
Braunsapis otavica (Cockerell)								
	Apiaceae (Umbelliferae)							
		Deverra DC.						
		D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90
				M	2			
Braunsapis sp.								
	Ebenaceae							
		Diospyros L.						
		D. sp.	WY	F	1	Grahamstown	FWG	10.xi.77
Halterapis Michener								
	Celastraceae							
		Maytenus Molina						
		M. linearis (L. f.) Marais	WY	F	1	Grahamstown	DWG	6.xii.77
Halterapis nigrinervis (Cameron)								
	Papilionaceae (Fabaceae)							
		Aspalathus L.						
		A. subtingens Eckl. & Zeyh.	Y	F	2	Grahamstown	FWG&SKG	25.iii.92
		A. subtingens Eckl. & Zeyh.	Y	M	1	Grahamstown	FWG&SKG	25.iii.92
Halterapis sp.								
	Apiaceae (Umbelliferae)							
		Foeniculum Mill.						
		F. vulgare A.W.Hill	Y	F	6	Grahamstown	FWG	16.i.84
		F. vulgare A.W.Hill	Y	M	1	Grahamstown	FWG	16.i.84
		F. vulgare A.W.Hill	Y	F	1	Grahamstown	SKG	16.i.84
		F. vulgare A.W.Hill	Y	F	3	Grahamstown	HWG	16.i.84
Xylocopinae								
Ceratinini								
Ceratina Latreille								
Ceratina sp. A								
	Asteraceae (Compositae)							
		Lasiospermum Lag.						
		L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	4.x.77
		L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG	3.xi.77
Ceratina sp. C								
	Asteraceae (Compositae)							
		Berkheya Ehrh.						
		B. heterophylla (Th.) O. Hoffm.	Y	F	4	Grahamstown	FWG	12.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	M	1	Grahamstown	FWG	12.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	F	5	Grahamstown	FWG	16.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	M	3	Grahamstown	FWG	16.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	M	1	Grahamstown	FWG	25.x.72
		B. heterophylla (Th.) O. Hoffm.	Y	M	1	Grahamstown	FWG	16.x.72

Cirsium Mill. emend Scop.						
C. vulgare (Savi) Ten.	Pu	F	1	Grahamstown	SKG	9.iii.78
Senecio L.						
S. sp.	Y	M	1	Grahamstown	RWG	31.xii.86
Papilionaceae (Fabaceae)						
Psoralea L.						
P. pinnata L.	B	F	1	Grahamstown	CFJG	2.ii.75
P. pinnata L.	B	F	2	Grahamstown	CFJG	9.ii.75
Ceratina sp. F						
Aizoaceae: Mesembryanthema						
"mesem"	W	M	1	Grahamstown	FWG&SKG	22.x.81
"mesem"	W	F	5	Grahamstown	FWG&SKG	22.x.81
"mesem"	W	F	1	Grahamstown	FWG&SKG	30.x.81
"mesem"	Y	F	1	Grahamstown	FWG&SKG	22.x.81
"mesem"	WY	F	1	Grahamstown	FWG&SKG	16.xi.81
"mesem"	Pi	F	1	Grahamstown	SKG	3.xii.81
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	4	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	16.x.72
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	DWG	16.x.72
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
Chrysocoma L.						
C. ciliata L.	Y	F	1	Grahamstown	SKG	17.ii.90
Lasiospermum Lag.						
L. bipinnatum (Thunb.) Druce	W	F	2	Grahamstown	FWG	25.x.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	10.xi.77
L. bipinnatum (Thunb.) Druce	W	F	1	Grahamstown	FWG	4.x.77
Senecio L.						
S. pterophorus DC.	Y	F	1	Grahamstown	FWG&SKG	25.xi.79
S. pterophorus DC.	Y	F	1	Grahamstown	FWG	28.xii.86
S. pterophorus DC.	Y	M	1	Grahamstown	DWG	28.xii.86
S. sp.	Y	F	1	Grahamstown	FWG	28.xii.86
S. sp.	Y	M	3	Grahamstown	DWG	31.xii.86
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Grahamstown	SKG	17.ii.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Clanwilliam/ Graafwater	FWG&SKG	5-6.x.88
Scrophulariaceae						
Aptosimum Burch.						
A. procumbens (Lehm.) Steud.	V	F	2	Grahamstown	FWG&SKG	13.x.81
Selaginaceae						
Selago L.						
S. corymbosa L.	W	F	1	Grahamstown	FWG	9.xii.77
Ceratina sp. G						
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Nieuwoudtville	FWG&SKG	28.ix.90
Lamiaceae (Labiatae)						
Ballota L.						
B. africana (L.) Benth.	V	F	13	Nieuwoudtville	FWG&SKG	28.ix.90

Ceratina sp. H						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. annularis A.DC.	V	F	5	Citrusdal	FWG&SKG	16.x.90
W. sp.	V	F	12	Nieuwoudtville	FWG&SKG	29-30.ix.90
Lobeliaceae						
Lobelia L.						
L. sp.	Pu	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	3	Clanwilliam/ Graafwater	FWG&SKG	2-8.x.90
A. spinescens Thunb.	Y	F	8	Citrusdal	FWG&SKG	16.x.90
Ceratina sp. I						
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	12.x.72
B. heterophylla (Th.) O. Hoffm.	Y	F	1	Grahamstown	FWG	25.x.72
Ceratina sp. J						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. sp.	V	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. divaricata Thunb.	Y	F	1	Gydo Pass, Ceres	FWG&SKG	30.xi.89
Ceratina sp. K						
Campanulaceae						
Wahlenbergia Schrad. ex Roth						
W. cf. constricta V. Brehmar	V	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1-2.x.90
W. paniculata (Thunb.) A.DC.	V	F	2	Clanwilliam	DWG	3-7.ix.88
W. sp.	V	F	1	Nieuwoudtville	FWG&SKG	29-30.ix.90
Ceratina sp. L						
Aizoaceae: Mesembryanthema						
Herrea Schwant.						
H. sp. A	Y	F	1	Nieuwoudtville	FWG&SKG	26-30.ix.90
Ceratina sp. Kalahari						
Apiaceae (Umbelliferae)						
Deverra DC.						
D. aphylla (Cham. & Schlechtd.) DC.	Y	F	1	Twee Rivieren	FWG&SKG	8-11.iii.90

Xylocopini

Xylocopa Latreille						
Xylocopa caffra (Linnaeus)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	RWG	8.ii.81
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	RWG	15.i.81
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	FWG	15.i.81
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	FWG	2.ii.81
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	DWG	8.ii.81
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	FWG	7.i.79
B. capensis (L. *f.*) Pers.	W	F	1	Grahamstown	FWG	30.i.86

Aizoaceae: Mesembryanthema						
Ruschia Schwant.						
R. sp.	W	M	1	Vioolsdrif	FWG&SKG	3.x.85
Asclepiadaceae						
Asclepias L.						
A. buchenaviana Schinz	WY	F	1	Prince Albert	FWG	26.xi-5.xii.87
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	1	Grahamstown	DWG	22.xi.82
Boraginaceae						
Lobostemon Lehm.						
L. trichotomus DC.	B	M	1	E Pakhuis Pass	DWG	3.x.91
L. sp.	B	M	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
Capparaceae						
Maerua Forssk.						
M. schinzii Pax	W	F	3	Vioolsdrif	FWG&SKG	3.x.85
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	BV	F	8	Clanwilliam/ Graafwater	FWG&SKG	13.x.87
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.x.86
A. karroo Hayne	Y	F	1	Oudtshoorn	RWG	9-12.x.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlgren	Y	F	1	Clanwilliam/Graafwater	SKG	17.x.89
A. spinescens Thunb.	Y	M	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	26.ix.85
A. sp.	Y	F	1	Ceres/Tulbagh	FWG	8.xi.89
Rafnia Thunb.						
R. amplexicaulus Thunb.	Y	F	2	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	26.ix.85
R. amplexicaulus Thunb.	Y	F	2	Clanwilliam	FWG&SKG	12.x.87
Proteaceae						
Paranomus Salisb.						
P. bracteolaris Salisb. ex Knight	Pi	F	4	Nieuwoudtville	FWG&SKG	29.ix.90
Solanaceae						
Lycium L.						
L. sp.	V	F	1	Grahamstown	FWG	8.ii.81
L. sp.	V	F	1	Grahamstown	HWG	8.ii.81
L. sp.	V	F	1	Grahamstown	DWG	8.ii.81
Nicotiana L.						
N. glauca R. C. Grah.	Y	F	1	Oudtshoorn	SKG	7-8.xii.86
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	F	1	Grahamstown	DWG	5.xii.80

Xylocopa capitata Smith						
Boraginaceae						
Lobostemon Lehm.						
L. trichotomus DC.	B	M	1	E Pakhuis Pass	DWG	3.x.91
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. spinescens Thunb.	Y	F	1	Algeria	SKG	19.x.89
Rafnia Thunb.						
R. amplexicaulus Thunb.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	M	4	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	28.ix.85
R. amplexicaulus Thunb.	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1.x.90
R. amplexicaulus Thunb.	Y	F	3	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	8-13.x.87
R. amplexicaulus Thunb.	Y	M	3	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	26.x.85
"pea flower"	Y	F	1	Clanwilliam	FWG&SKG	1.x.90
Xylopcopa flavicollis (De Geer)						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	SKG	8.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	RWG	8.ii.81
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	3	Grahamstown	FWG	20.i.70
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70
Papilionaceae (Fabaceae)						
Medicago Tourn. ex L.						
M. sativa L.	V	F	1	Grahamstown	FWG	5.ii.70
Solanaceae						
Lycium L.						
L. sp.	V	F	8	Grahamstown	FWG	8.ii.81
L. sp.	V	F	7	Grahamstown	DWG	5.xii.80
L. sp.	V	F	2	Grahamstown	HWG	8.ii.81
L. sp.	V	F	4	Grahamstown	RWG	8.ii.81
L. sp.	V	F	2	Grahamstown	SKG	8.ii.81
Solanum L.						
S. sp.	V	F	1	Riebeek East	FWG&SKG	16.x.83
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	F	6	Grahamstown	DWG	11.xii.80
G. occidentalis L.	PiV	M	1	Grahamstown	DWG	11.xii.80
G. occidentalis L.	PiV	F	2	Grahamstown	FWG	11.xii.80
G. occidentalis L.	PiV	M	1	Grahamstown	FWG	11.xii.80
G. occidentalis L.	PiV	F	1	Grahamstown	FWG	5.xii.80
Xylocopa flavorufa (De Geer)						
Caesalpinaceae						
Cassia L.						
C. spp. cultivated	Y	F&M	m	Grahamstown	FWG&SKG	
Apiaceae (Umbelliferae)						
Foeniculum Mill.						
F. vulgare A.W.Hill	Y	F	1	Grahamstown	JGHL	17-25.i.70

Xylocopa io Vachal						
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Montagu/Matroosberg	FWG	4.xii.86
"mesem"	W	F	1	Montagu/Matroosberg	RWG	4.xii.86
"mesem"	W	M	1	Montagu/Matroosberg	HWG	4.xii.86
Xylocopa lugubris Gerstaecker						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	3	Grahamstown	FWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	DWG	8.ii.81
Aizoaceae: Mesembryanthema						
"mesem"	W	F	1	Bloutoring	FWG	3.xii.86
"mesem"	Pi	M	1	Grahamstown	HWG	3.xii.81
Asclepiadaceae						
Sarcostemma R. Br.						
S. viminale (L.) R. Br.	Y	F	1	Kommadagga	RWG	14.i.86
Boraginaceae						
Lobostemon Lehm.						
L. trichotomus DC.	B	M	1	E Pakhuis Pass	DWG	3.x.91
Lamiaceae (Labiatae)						
Peristrophe Nees						
P. sp.	-	F	1	Grahamstown	FWG	3.xii.81
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	1	Oudtshoorn	RWG	9-12.x.86
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm.f.) Dahlgren	Y	M	1	Clanwilliam/ Graafwater	DWG	17.x.89
A. spinescens Thunb.	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
"pea flower"	Y	F	1	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	1.x.90
Solanaceae						
Solanum L.						
S. sodomaeodes Kuntze	V	F	1	Grahamstown	DWG	22.XI.81
Lycium L.						
L. sp.	V	M	1	Grahamstown	FWG	3.xii.81
L. sp.	V	M	1	Grahamstown	FWG	27.xii.81
L. sp.	V	F	1	Grahamstown	FWG	8.ii.81
L. sp.	V	F	3	Grahamstown	DWG	8.ii.81
L. sp.	V	F	1	Grahamstown	SKG	8.ii.81
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	M	1	Grahamstown	DWG	9.xii.86
Xylocopa rufitarsis Lepeletier						
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	BV	F	5	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	13.x.87
S. dentata Ait.	BV	M	3	Klein Alexanders-hoek, Clanwilliam	FWG&SKG	13.x.87
"labiate"	V	M	1	Montagu	FWG	3.xii.86

Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	M	1	Colesberg	DWG	17.i.85
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. linearis (Burm. f.) Dahlgren	Y	F	1	Clanwilliam	FWG	16.x.89
A. linearis (Burm. f.) Dahlgren	Y	M	1	Clanwilliam/Graafwater	DWG	17.x.89
A. spinescens Thunb.	Y	F	3	Clanwilliam	FWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	1	Clanwilliam	DWG&SKG	3-7.x.88
A. spinescens Thunb.	Y	M	1	Clanwilliam/ Graafwater	FWG&SKG	3.x.90
A. spinescens Thunb.	Y	F	1	Piekenierskloof/ Paleisheuwel	FWG&SKG	6.x.90
Calpurnia E. Mey						
C. glabrata Brummitt	Y	F	6	Mamathes	CFJG	10.i.52
C. glabrata Brummitt	Y	F	1	Mamathes	CFJG	28.i.52
"pea flower"	Y	F	1	Klein Alexanders- hoek, Clanwilliam	FWG&SKG	2.x.90
"pea flower"	Y	F	2	Clanwilliam/ Graafwater	FWG&SKG	4.x.90
Xylocopa scioensis Gribodo						
Aizoaceae: Mesembryanthema						
Ruschia Schwant.						
R. sp.	W	F	6	Vioolsdrif	FWG&SKG	3.x.85
R. sp.	W	M	3	Vioolsdrif	FWG&SKG	3.x.85
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	1	Grahamstown	DWG	22.xi.82
Senecio L.						
S. rosmarinifolius L. f.	Y	F	1	Oudtshoorn	RWG	7-8.xii.86
S. rosmarinifolius L. f.	Y	M	6	Oudtshoorn	RWG	7-8.xii.86
Capparaceae						
Maerua Forssk.						
M. schinzii Pax	W	F	3	Vioolsdrif	FWG&SKG	3.x.85
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	BV	F	1	Klein Alexanders- hoek, Clanwilliam	FWG&SKG	13.x.87
Mimosaceae						
Acacia Mill.						
A. caffra (Thunb.) Willd.	WY	F	20	Oudtshoorn	RWG	9-12.xii.86
A. caffra (Thunb.) Willd.	WY	M	6	Oudtshoorn	RWG	9-12.xii.86
Papilionaceae (Fabaceae)						
Wiborgia Thunb.						
W. sp.	Y	F	1	43 km ENE Ceres	SKG	2-3.xii.89
Solanaceae						
Lycium L.						
L. sp.	V	F	2	Grahamstown	FWG	8.ii.81
L. sp.	V	F	1	Grahamstown	FWG	5.xii.80
L. sp.	V	F	1	Grahamstown	RWG	8.ii.81
Tiliaceae						
Grewia L.						
G. occidentalis L.	PiV	F	1	Grahamstown	DWG	11.xii.80
G. occidentalis L.	PiV	F	1	Grahamstown	FWG	11.xii.80

Zygophyllaceae						
Sisyndite E. Mey.						
S. spartea E. Mey.	Y	F	21	Vioolsdrif	FWG&SKG	3.x.85
Tribulus L.						
T. cristatus Presl.	Y	F	2	Augrabies	FWG&SKG	6.iii.89
Xylocopa sicheli Vachal						
Acanthaceae						
Blepharis Juss.						
B. capensis (L. f.) Pers.	W	F	6	Grahamstown	HWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	9	Grahamstown	DWG	3.ii.81
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	DWG	8.ii.81
B. capensis (L. f.) Pers.	W	M	2	Grahamstown	DWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	8	Grahamstown	RWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	10	Grahamstown	FWG	3.ii.81
B. capensis (L. f.) Pers.	W	F	2	Grahamstown	FWG	8.ii.81
B. capensis (L. f.) Pers.	W	M	4	Grahamstown	FWG	8.ii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	HWG	3.xii.81
B. capensis (L. f.) Pers.	W	F	1	Grahamstown	FWG	10.ii.86
Aizoaceae: Mesembryanthema						
"mesem"	Pi	F	1	Grahamstown	HWG	3.xii.81
Asteraceae (Compositae)						
Berkheya Ehrh.						
B. sp.	Y	F	6	Springbok	FWG&SKG	15-21.x.87
Crassulaceae						
Cotyledon L.						
C. campanulata Marloth	Y	F&M	m	Grahamstown	FWG&SKG	xii.80
C. orbiculata L.	PiO	F&M	m	Grahamstown	FWG&SKG	xii.80
Lamiaceae (Labiatae)						
"labiate"	V	F	1	Springbok	FWG&SKG	15-21.x.87
"labiate"	V	M	1	Springbok	FWG&SKG	15-21.x.87
Liliaceae						
Aloe L.						
A. sp.	-	F	2	Grahamstown	DWG	6.i.81
Mimosaceae						
Acacia Mill.						
A. karroo Hayne	Y	F	1	Prince Albert	FWG,SKG&RWG	25.xi-5.xii.87
Papilionaceae (Fabaceae)						
Aspalathus L.						
A. subtingens Eckl. & Zeyh.	Y	F	1	Grahamstown	FWG&SKG	25.iii.92
"pea flower"	Y	F	1	Clanwilliam	FWG&SKG	2.x.90
Xylocopa watmoughi Eardley						
Lamiaceae (Labiatae)						
Salvia L.						
S. dentata Ait.	BV	F	1	Klein Alexandershoek, Clanwilliam	FWG&SKG	13.x.87
Zygophyllaceae						
Sisyndite E. Mey.						
S. spartea E. Mey.	Y	F	2	Vioolsdrif	FWG&SKG	3.x.85

APPENDIX 2

List of extra-southern African records of flower visiting by masarid wasps.

The genera and species of the wasps are arranged alphabetically within geographic region. The flowers visited are presented with families, genera, and species in alphabetical order. Source references are given.

note

The abbreviations should be understood as follows:

F - female; FF - females; M - male; MM - males; m - many observations of visits to flowers; p - pollen from provision representing an unknown number of visits to flowers.

The numbers refer to the number of specimens in a sample where this is recorded.

AUSTRALIAN REGION

Ammoparagia Snelling			
Ammoparagia hua Snelling			
Goodeniaceae			
Goodenia			
G. berardiana	F	2	Western Australia Howard and Houston in Snelling 1986
G. berardiana	M	1	Western Australia Howard and Houston in Snelling 1986
G. berardiana	M	1	Western Australia Houston and Hanich in Snelling 1986
Paragia Shuckard			
Paragia confluens Snelling			
Goodeniaceae			
Goodenia			
G. berardiana	F	1	Western Australia Howard and Houston in Snelling 1986
Paragia decipiens Shuckard			
Myrtaceae			
Eucalyptus			
E. camaldulensis	F	m	New South Wales Naumann and Cardale 1987
E. camaldulensis	F	p	New South Wales Naumann and Cardale 1987
Paragia monocesta Snelling			
Myrtaceae			
Calythrix			
C. oldfieldii	F	10	Western Australia Howard and Houston in Snelling 1986
Verticordia			
V. forrestii	F	1	Western Australia Howard and Houston in Snelling 1986
Paragia nasuta F.Smith			
Myrtaceae			
Melaleuca			
M. fulgens	F	5	Western Australia Houston in Snelling 1986
M. fulgens	M	4	Western Australia Houston in Snelling 1986
Proteaceae			
Grevillea			
G. paradoxa	M	1	Western Australia Houston in Snelling 1986

Paragia oligomera Snelling					
Bromeliaceae					
Regelia					
R. ciliata		F	1	Western Australia	Houston in Snelling 1986
Paragia sobrina F.Smith					
Myrtaceae					
Beaufortia					
B. bracteosa		F	2	Western Australia	Houston in Snelling 1986
Paragia tricolor Smith					
Myrtaceae					
Eucalyptus					
E. calophylla		F	10p	South Western	Houston 1984
E. cylindriflora	W	F	m	South Western	Houston 1984
Paragia vespiformis Smith					
Mimosaceae					
Acacia		F	p	Western Australia	Houston 1986
A. blakelyi				Western Australia	Houston 1986
Myrtaceae					
Eucalyptus					
E. oldfieldii				Western Australia	Houston 1986
Melaleuca					
M. nematiphylla				Western Australia	Houston 1986
M. scabra				Western Australia	Houston 1986
M. uncinata				Western Australia	Houston 1986
Scholtzia					
S. drummondi				Western Australia	Houston 1986
Proteaceae					
Grevillea					
G. teretifolia				Western Australia	Houston 1986

Riekia Richards					
Riekia sp. (Snelling)					
Goodeniaceae					
Goodenia					
G. berardiana		M	1	Western Australia	Houston and Hanich in Snelling 1986
Riekia sp. (Richards 1)					
Goodeniaceae					
Goodenia					
G. cycloptera					Richards 1968 cited in Houston 1984
Riekia sp. (Richards 2)					
Goodeniaceae					
Goodenia					
G. cycloptera					Richards 1968 cited in Houston 1984

Rolandia Richards					
Rolandia angulata (Richards)					
Goodeniaceae					
Goodenia					
G. cycloptera				Queensland	Richards, 1968
Rolandia borreriae Snelling					
Rubiaceae					
Borreria					
B. exserta		F	4	Northern Territory Australia	Cardale in Snelling 1986
B. exserta		M	3	Northern Territory Australia	Cardale in Snelling 1986

Rolandia houstoni Snelling				
Goodeniaceae				
Goodenia				
G. berardiana	F	6	Western Australia	Howard and Houston in Snelling 1986
G. berardiana	M	5	Western Australia	Howard and Houston in Snelling 1986
Myrtaceae				
Pileanthus				
P. peduncularis	M	1	Western Australia	Howard and Houston in Snelling 1986

NEOTROPICAL REGION

Gayella Spinola				
Gayella araucana Willink				
Apiaceae				
Homalocarpus				
H. dichotomus	F	1	Chile	Perez, 1989
Gayella eumenoides Spinola				
Anacardiaceae				
Schinus				
Schinus dependens			Chile	Claude-Joseph 1930 in Richards 1962
Asteraceae (Compositae)				
Baccharis				
B. sp.			Chile	Claude-Joseph 1930 in Richards 1962
Rosaceae				
Quillaja				
Q. saponica			Chile	Claude-Joseph 1930 in Richards 1962
Gayella reedi Willink				
Papilionaceae				
Adesmia				
A. melanthes	M	2	Chile	Perez, 1989

Microtrimeria Bequaert				
M. atacama Fritz				
Bignoniaceae				
Argylia				
A. radiata	F	1	Chile	Perez, 1979
Boraginaceae				
Heliotropum				
H. sp.	M	4	Chile	Perez, 1979
Malvaceae				
Cristaria				
C. inconspicua	F	1	Chile	Perez, 1979

Trimeria Saussure				
Trimeria americana (Saussure)				
Boraginaceae				
Heliotropum				
H. vernonifolium	F	5	Argentina	Neff and Simpson 1985
H. vernonifolium	M	2	Argentina	Neff and Simpson 1985
Trimeria buyssoni Brethes				
Boraginaceae				
Heliotropium				
H. mendocinum	F	1	Argentina	Neff and Simpson 1985
H. mendocinum	M	2	Argentina	Neff and Simpson 1985

Malvaceae				
Sphaeralcea				
S. sp.	M	1	Argentina	Neff and Simpson 1985
Verbenaceae				
Glandularia				
G. hookeriana	F	9	Argentina	Neff and Simpson 1985
G. hookeriana	M	4	Argentina	Neff and Simpson 1985
Lantana				
L. aristata	F	1	Argentina	Neff and Simpson 1985
Lippia				
L. nodiflora			Argentina	Joergenson 1912
Verbena				
V. sp.	F	2	Argentina	Neff and Simpson 1985
Trimeria howardi Bert.				
Portulacaceae				
Talinum				
T. patens		m	Paraguay	Bertoni 1911
Trimeria monrosi				
Asteraceae (Compositae)				
A	F	1	Argentina	Neff and Simpson 1985
B	F	1	Argentina	Neff and Simpson 1985

NEARCTIC REGION

Pseudomasaris Ashmead				
Pseudomasaris basirufus Rohwer				
Hydrophyllaceae				
Phacelia spp.	FF&MM		western North America	from Richards 1963
Pseudomasaris coquilletti Rohwer				
Hydrophyllaceae				
Eriodyction spp.			western North America	from Cooper and Bequaert 1951
Phacelia spp.			western North America	from Cooper and Bequaert 1951
Phacelia spp.	FF&MM		western North America	from Richards 1963
Onagraceae				
Oenothera sp.	F		western North America	from Richards 1963
Papaveraceae				
Escholtzia	M		western North America	from Richards 1966
Rhamnaceae				
Ceanothus sp.	M		western North America	from Richards 1963
Pseudomasaris edwardsii (Cresson)				
Boraginaceae				
Cryptantha spp.	FF		western North America	from Richards 1966
Caprifoliaceae				
Symphoricarpos sp.	M		western North America	from Richards 1963
Asteraceae (Compositae)				
Chaenactis	F		western North America	from Richards 1963
Hydrophyllaceae				
Eriodyction spp.			western North America	from Cooper and Bequaert 1951
Eriodyction sp.	FF&MM		western North America	from Richards 1966
Phacelia spp.			western North America	from Cooper and Bequaert 1951
Phacelia spp.	FF&MM		western North America	from Richards 1963
Phacelia spp.	FF&MM		western North America	from Richards 1966
Phacelia spp.		p	western North America	Torchio 1970
Lamiaceae (Labiatae)				
Salvia sp.	F		western North America	from Richards 1966
Mentha sp.	F		western North America	from Richards 1963

Onagraceae		
Oenothera sp.	F	western North America from Richards 1963
Oenothera sp.	M	western North America from Richards 1966
Rhamnaceae		
Ceanothus spp.	M	western North America from Richards 1963
Tamaricaceae		
Tamarix sp.	F	western North America from Richards 1963
Pseudomasaris macneilli R.M.Bohart		
Hydrophyllaceae		
Hydrophyllum		western North America from Richards 1963
Phacelia		western North America from Richards 1963
Pseudomasaris maculifrons (Fox)		
Boraginaceae		
Cryptantha sp.	FF	western North America from Richards 1963
Hydrophyllaceae		
Phacelia spp.	FF&MM	western North America from Richards 1963
Phacelia spp.		western North America from Richards 1966
Loasaceae		
Eucnide sp.	M	western North America from Richards 1963
Malvaceae		
Sphaeralcea sp.	F	western North America from Richards 1963
Papilionaceae (Fabaceae)		
Astragalus sp.	F	western North America from Richards 1963
Rosaceae		
Prunus sp.	M	western North America from Richards 1963
Pseudomasaris marginalis (Cresson)		
Hydrophyllaceae		
Phacelia spp.		western North America from Cooper and Bequaert 1951
Pseudomasaris occidentalis		
Scrophulariaceae		
Penstemon		western North America from Cooper and Bequaert 1951
Pseudomasaris phaceliae Rohwer		
Hydrophyllaceae		
Phacelia		western North America from Cooper and Bequaert 1951
Phacelia spp.		western North America from Richards 1966
Pseudomasaris rohweri Bradley		
Hydrophyllaceae		
Phacelia spp.		western North America from Cooper and Bequaert 1951
Pseudomasaris texanus (Cresson)		
Hydrophyllaceae		
Phacelia spp.		western North America from Cooper and Bequaert 1951
Pseudomasaris vespoides (Cresson)		
Asteraceae (Compositae)		
Aster sp.	F	western North America from Richards 1963
"thistle"	F	western North America from Richards 1963
Hydrophyllaceae		
Nama sp.	F&M	western North America from Richards 1963
Phacelia	F	western North America from Richards 1963
Lamiaceae (Labiatae)		
Salvia		
S. carduacea		western North America from Richards 1966
Onagraceae		
Clarkia sp.	F	western North America from Richards 1963
Papaveraceae		
Platystemon sp.	MM	western North America from Richards 1963
Ranunculaceae		
Ranunculus sp.	FF&MM	western North America from Richards 1963

Scrophulariaceae		
Penstemon spp.		western North America from Cooper and Bequaert 1951
Penstemon spp.		western North America Torchio 1974
Penstemon spp.		western North America from Richards 1966
Penstemon spp.	FF&MM	western North America from Richards 1963
Pseudomasaris wheeleri J. Bequaert		
Asteraceae (Compositae)		
Peucephyllum sp.	FF&MM	western North America from Richards 1963
Peucephyllum sp.	FF	western North America from Richards 1966
Hydrophyllaceae		
Eriodictyon		western North America from Cooper and Bequaert 1951
Eriodictyon spp.	MM	western North America from Richards 1966
Eriodictyon spp.	FF&M	western North America from Richards 1963
Lamiaceae (Labiatae)		
Hyptis sp.	MM	western North America from Richards 1966
Liliaceae		
Yucca sp.	F	western North America from Richards 1963
Scrophulariaceae		
Penstemon		western North America from Cooper and Bequaert 1951
Penstemon	FF&MM	western North America from Richards 1963
Penstemon	FF&MM	western North America from Richards 1966
Zygophyllaceae		
Larrea sp.	F	western North America from Richards 1966
Pseudomasaris zonalis (Cresson)		
Asteraceae (Compositae)		
Arnica sp.	F	western North America from Richards 1963
Encelia sp.	F	western North America from Richards 1963
Grindelia sp.	F	western North America from Richards 1963
Hydrophyllaceae		
Phacelia sp.		western North America from Cooper and Bequaert 1951
Phacelia spp.	FF&MM	western North America from Richards 1963
Ranunculaceae		
Ranunculus sp.	F	western North America from Richards 1963
Rhamnaceae		
Ceanothus sp.	F&M	western North America from Richards 1963
Scrophulariaceae		
Bessya sp.		western North America from Cooper and Bequaert 1951
Penstemon sp.	F	western North America from Richards 1963

PALAEARCTIC REGION

Celonites Latreille		
Celonites abbreviatus (Vill.)		
Boraginaceae		
Echium		
E. sp.		Austria Schremmer
Crassulaceae		
Sedum		
S. reflexum		Southern Germany Friese cited in Blüthgen, 1961
S. sp.		Bequaert 1940 cited in Richards 1962
Geraniaceae		
Erodium		
E. circutaria		Southern Germany Bluthgen, 1961
Lamiaceae (Labiatae)		
Ballota		
B. sp.		Southern Germany Klein cited in Blüthgen, 1961

Calamintha		
C. acinos		Southern Germany Bluthgen, 1961
C. alpina		Bequaert 1940 cited in Richards 1962
Origanum		
O. vulgare		Southern Germany Bluthgen, 1961
Prunella		
P. grandiflora		Southern Germany Enslin 1922 cited in Richards 1962
Salvia		
S. officinalis	m	Yugoslavia Schremmer
Thymus		
T. sp.		Southern Germany, Blüthgen, 1961
Teucrium		
T. montanum		Bequaert 1940 cited in Richards 1962
Celonites afer Lep.		
Asteraceae (Compositae)		
Microlonchus		
M. salmanticus		North Africa Bequaert 1940 cited in Richards 1962
Boraginaceae		
Echium		
E. confusum		North Africa Bequaert 1940 cited in Richards 1962
E. humile		North Africa Bequaert 1940 cited in Richards 1962
E. italicum		North Africa Bequaert 1940 cited in Richards 1962
E. sp.		North Africa Bequaert 1940 cited in Richards 1962
Apiaceae (Umbelliferae)		
Bupleurum		
B. maritimum		North Africa Bequaert 1940 cited in Richards 1962
Celonites cyprius Saussure		
Boraginaceae		
Heliotropum		
?villosum	m	Cyprus Richards 1962
Celonites hystrix Kost.		
Boraginaceae		
Anchusa		
A. italica		Kondara Popov 1948 in Richards 1962
Celonites jousseaumei Buyss.		
Boraginaceae		
Heliotropum		
H sp.		Sudan Richards 1962
Celonites mayeti Spinola		
Lamiaceae (Labiatae)		
Teucrium		
T. aureum		S. France Bequaert 1940 cited in Richards 1962
Celonites modestus bisinterruptus Kost.		
Boraginaceae		
Anchusa		
A. italica		Kondara Popov 1948 in Richards 1962
Celonites octoannulatus hissaricus Kost.		
Boraginaceae		
Anchusa		
A. italica		Kondara Popov 1948 in Richards 1962
Celonites rugiceps Bisch.		
Boraginaceae		
Heliotropum		
europaeum	m	Cyprus Richards 1962

Ceramius Latreille			
Ceramius Group 1			
Ceramius caucasicus Andre			
Plumbaginaceae			
Acantholimon			
A. venustum			Asia Minor Fahringer 1922 in Richards 1962
Ceramius oraniensis Lep.			
Resedaceae			
Reseda			
R. sp.			Algiers Bequaert 1940 in Richards 1962
Ceramius Group 7			
Ceramius bischoffi Richards			
Papilionaceae (Fabaceae)			
Lotus			
L. religinosus	F	1	Spain van Heijningen in Richards 1963
Apiaceae (Umbelliferae)			
Oenanthe			
O. lachenalii	F	1	Spain van Heijningen in Richards 1963
Ceramius lusitanicus			
Papilionaceae (Fabaceae)			
Anthyllis			
A. cytisoides	M	2	Spain van der Vecht in Richards 1962
Bonjeania			
B. hirsuta	M	1	Spain van der Vecht in Richards 1962
Ceramius vechti Richards			
Lamiaceae (Labiatae)			
Thymus			
T. mastighina	M	1	Spain van Heijningen in Richards 1963

Jugurtia Saussure	
Jugurtia algerica (Schulthess)	
Apiaceae (Umbelliferae)	
Ammi	
A. visnaga	Algeria Bequaert 1940 in Richards 1962
Jugurtia biskrensis J. Beq.	
Apiaceae (Umbelliferae)	
Ammi	
A. visnaga	Algeria Bequaert 1940 in Richards 1962
Jugurtia oraniensis Lep.	
Asteraceae (Compositae)	
Centaurea	
C. sp.	Algeria Bequaert 1940 in Richards 1962
Boraginaceae	
Echium	
E. sp.	Algeria Bequaert 1940 in Richards 1962
Convolvulaceae	
Convolvulus	
C. arvensis	Algeria Bequaert 1940 in Richards 1962
Malvaceae	
Malva	
M. sylvestris	Algeria Bequaert 1940 in Richards 1962
Scrophulariaceae	
Scrophularia	
S. sp.	Algeria Bequaert 1940 in Richards 1962

Apiaceae (Umbelliferae)
    Bupleurum
    B. maritumum — Algeria Bequaert 1940 in Richards 1962
    Daucus
    D. setifolius — Algeria Bequaert 1940 in Richards 1962

Masaris Fabricius
Masaris carli Schulthess
  Tamaricaceae
    Tamarix
    T. sp. — Kazakhstan Popov 1948 in Richards 1962
Masaris vespiformis Fab.
  Boraginaceae
    Echium
    E. sp. — Algeria Bequaert 1940 in Richards 1962
    E. sp. — Egypt Bequaert 1940 in Richards 1962
  Lamiaceae (Labiatae)
    species with long corolla, violet — Israel Bequaert 1940 in Richards 1962

Quartinia Ed. Andre
Quartinia cincta Ben.
  Asteraceae (Compositae)
    Anacyclus
    A. sp. — Morocco Bequaert 1940 cited in Richards 1962
Quartinia dilecta Andre
  Asteraceae (Compositae)
    Picridium
    P. tingitanum — Algeria Bequaert 1940 cited in Richards 1962
Quartinia major Kohl
  Asteraceae (Compositae)
    Asteriscus
    A. maritimus — Algeria Bequaert 1940 cited in Richards 1962
    Calendula
    C. sp. — Algeria Bequaert 1940 cited in Richards 1962
    Chrysanthemum
    C. myconis — Algeria Bequaert 1940 cited in Richards 1962
Quartinia shestakovi Kost.
  Chenopodiaceae
    Horaninowia
    H. ulicina — Samarkand Popov 1948 cited in Richards 1962
    Salsola
    S. sp. — Tadjikistan Popov 1948 cited in Richards 1962
Quartinia soikai Richards
  Asteraceae (Compositae)
    Senecio
    S. sp. — Iran Gusenleitner, 1973
Quartinia thebaica Buyss.
  Asteraceae (Compositae)
    Senecio
    S. sp. — Egypt Bequaert 1940 cited in Richards 1962
Quartinia tricolorata G. Soika
  Asteraceae (Compositae)
    Senecio
    S. sp. — Egypt Morice 1900 cited in Richards 1962

Quartinia tuareg G. Soika

Asteraceae (Compositae)

Senecio

S. sp.	Egypt	Morice 1900 cited in Richards 1962

APPENDIX 3

(compiled by extraction from Appendix 1)

Lists of plants of the groups associated with masarid wasps in southern Africa together with their recorded solitary aculeate wasp and bee visitors

AIZOACEAE

The Aizoaceae are here presented in two groups, the non-Mesembryanthema and the Mesembryanthema. The Mesembryanthema are divided into flower form categories, those represented in the list being: stamen carpet flowers; central cone flowers; and cup flowers (adapted from Vogel, 1954 and Hartmann, 1991 and emended in the present study). Those "mesems" for which insufficient information was available for categorization are listed separately at the end.

AIZOACEAE - NON-MESEMBRYANTHEMA

Coelanthum				
Coelanthum grandiflorum				
	Clanwilliam/Graafwater	VESPOIDEA	Masaridae	Celonites bergenwahliae
				Celonites latitarsis
				Celonites wahlenbergiae
		SPHECOIDEA	Nyssonidae	Bembecinus sp. A
				Bembecinus sp. B
		APOIDEA	Anthophoridae	Pseudodichroa capensis
Galenia				
Galenia africana				
	Nieuwoudtville	APOIDEA	Megachilidae	Hoplitis sp. L
Galenia filiformis				
	Springbok	VESPOIDEA	Masaridae	Quartinia jocasta
Galenia. sp.				
	Anenous	VESPOIDEA	Masaridae	Quartinia vagepunctata
Limeum				
Limeum sp.				
	Nossob	APOIDEA	Andrenidae	Meliturgula sp. A
			Megachilidae	Oranthidium folliculosum
Limeum aethiopicum				
	Twee Rivieren	SPHECOIDEA	Larridae	Tachysphex sp. Kalahari A
			Nyssonidae	Bembecinus sp. nov. A
				Bembix zinni

AIZOACEAE - MESEMBRYANTHEMA

stamen carpet flowers

Aridaria				
Aridaria dyeri				
	Alicedale	VESPOIDEA	Masaridae	Ceramius linearis

Aridaria plenifolia				
	Alicedale	VESPOIDEA	Masaridae	*Ceramius capicola*
				Ceramius linearis
Aridaria sp.				
	Clanwilliam/Klawer	VESPOIDEA	Masaridae	*Ceramius cerceriformis*
	Grahamstown	VESPOIDEA	Masaridae	*Ceramius lichtensteinii*
				Ceramius linearis
Carpobrotus				
Carpobrotus sp.				
	Paleisheuwel	SCOLIOIDEA	Scoliidae	*Cathimeris capensis*
		APOIDEA	Halictidae	*Lasioglossum* sp. A
Drosanthemum				
Drosanthemum floribundum				
	Grahamstown	VESPOIDEA	Masaridae	*Ceramius linearis*
				Ceramius capicola
Drosanthemum hispidum				
	Grahamstown	VESPOIDEA	Masaridae	*Quartinioides tarsata*
		APOIDEA	Halictidae	*Nomioides* sp.
	Springbok	VESPOIDEA	Masaridae	*Quartinioides* sp. C
				Quartinioides sp. D
				Quartinioides sp. E
Drosanthemum parvifolium				
	Grahamstown	VESPOIDEA	Masaridae	*Jugurtia confusa*
Drosanthemum sp. Pi				
	Nieuwoudtville	BETHYLOIDEA	Chrysididae	*Allocoelia glabra*
				Jugurtia braunsi
		VESPOIDEA	Masaridae	*Ceramius bicolor*
Drosanthemum sp. PuPi				
	Grahamstown	SCOLIOIDEA	Scoliidae	*Cathimeris capensis*
Drosanthemum sp. Pi				
	Springbok	VESPOIDEA	Masaridae	*Jugurtia braunsi*
Drosanthemum sp. Pi				
	Anenous	VESPOIDEA	Masaridae	*Quartinioides* sp. I
				Quartinioides sp. T
				Quartinioides sp. Y
Drosanthemum sp. Pi	Bitterfontein/Garies	VESPOIDEA	Masaridae	*Quartinioides* sp. A
				Quartinioides sp. B
Drosanthemum sp. Pi	Port Nolloth	VESPOIDEA	Masaridae	*Quartinioides* sp. H
Malephora				
M. sp.				
	Grahamstown	VESPOIDEA	Masaridae	*Ceramius linearis*
Mesembryanthemum				
M. aitonis				
	Grahamstown	VESPOIDEA	Masaridae	*Ceramius capicola*
				Ceramius linearis
				Ceramius lichtensteinii

M. crystallinum				
	Aus	VESPOIDEA	Masaridae	Quartinia punctulatum
	Matjesfontein	VESPOIDEA	Masaridae	Quartinia punctulatum
	Prince Albert Road	VESPOIDEA	Masaridae	Quartinia punctulatum
	Vioolsdrif	APOIDEA	Melittidae	Capicola braunsiana
	Willowmore	VESPOIDEA	Masaridae	Ceramius cerceriformis
Platythyra				
P. haeckeliana				
	Colchester, Port Elizabeth	VESPOIDIA	Masaridae	Ceramius capicola
"mesem" W				
	Touws River	BETHYLOIDEA	Tiphiidae	Meria sp. H
		VESPOIDEA	Eumenidae	Delta emarginatum
		APOIDEA	Colletidae	Colletes sp. D
"mesem" W				
	Matroosberg	BETHYLOIDEA	Chrysididae	Stilbum cyanurum
		SCOLIOIDEA	Tiphiidae	Meria sp. H
		VESPOIDEA	Eumenidae	Delta caffer
				Raphiglossa natalensis
		POMPILOIDEA	Pompilidae	Hemipepsis vindex
		SPHECOIDEA	Nyssonidae	Stizus dewitzii
		APOIDEA	Halictidae	Halictus sp A cf. jucundus
				Halictus (Seladonia) sp. B
				Lasioglossum sp. A
				Tetraloniella junodi
			Anthophoridae	Amegilla (Amegilla) sp.
"mesem" W				
	Montagu/Matroosberg	SCOLIOIDEA	Tiphiidae	Anthobosca erythrosoma
				Meria sp. H
			Scoliidae	Cathimeris capensis
				Scolia chrystotricha
		SPHECOIDEA	Sphecidae	Podalonia canescens
			Philanthidae	Philanthus triangulum
		APOIDEA	Megachilidae	Megachile stellarum
			Anthophoridae	Amegilla (Zebramegilla sp. B
				Amegilla (Amegilla) sp.
				Xylocopa io
"mesem"				
	Bloutoring	SPHECOIDEA	Sphecidae	Sphex decipiens
		APOIDEA	Anthophoridae	Xylocopa lugubris
central cone flowers				
Leipoldtia				
Leipoldtia. sp.				
	Springbok	VESPOIDEA	Masaridae	Jugurtia braunsi
				Quartinia sp. A
				Quartinia sp. F
			Megachilidae	Hoplitis sp. M

Mestoklema				
Mestoklemia tuberosum				
	Grahamstown	VESPOIDEA	Masaridae	Ceramius capicola
Polymita				
Polymita albiflora				
	Springbok	VESPOIDEA	Masaridae	Quartinia sp. A
				Quartinioides sp. O
Prenia				
Prenia sladeniana				
	Springbok	VESPOIDEA	Masaridae	Quartinia sp. B
				Quartinioides sp. P
Prenia pallens				
	Springbok	VESPOIDEA	Masaridae	Quartinioides sp. I
				Quartinioides sp. O
				Quartinioides sp. P
Psilocaulon				
Psilocaulon acutisepalum				
	Springbok	VESPOIDEA	Masaridae	Ceramius bicolor
				Ceramius cerceriformis
				Quartinioides sp. D
	Clanwilliam	VESPOIDEA	Masaridae	Ceramius socius
		APOIDEA	Megachilidae	Hoplitis sp. K
	Clanwilliam/Klawer	VESPOIDEA	Masaridae	Ceramius cerceriformis
				Quartinia persephone
		APOIDEA	Megachilidae	Heriades sp. A
	Klawer	VESPOIDEA	Masaridae	Ceramius bicolor
	Vredendal	VESPOIDEA	Masaridae	Ceramius peringueyi
Psilocaulon cf. articulatum				
	Prince Albert	VESPOIDEA	Masaridae	Quartinioides sp. F
Ruschia				
Ruschia sp. W				
	Grahamstown	VESPOIDEA	Masaridae	Ceramius capicola
				Ceramius lichtensteinii
				Ceramius linearis
			Eumenidae	Delta caffer
		POMPILOIDEA	Pompilidae	Hemipepsis brunniceps
				Cyphononyx flavicornis
Ruschia sp. W				
	Vioolsdrif	APOIDEA	Anthophoridae	Xylocopa caffra
				Xylocopa scioensis
Ruschia sp. PuPi				
	Alicedale	VESPOIDEA	Masaridae	Ceramius lichtensteinii
				Ceramius linearis
	Grahamstown	VESPOIDEA	Eumenidae	Alastor sp. 4

Sphalmanthus Sphalmanthus cf. bijliae				
	43 km ENE Ceres	VESPOIDEA	Masaridae	Ceramius bicolor
		APOIDEA	Halictidae	Halictus (Seladonia) sp. B
	Prince Albert	VESPOIDEA	Masaridae	Ceramius beyeri
				Ceramius lichtensteinii
				Quartinioides sp. F
		APOIDEA	Megachilidae	Heriades sp. I
Sphalmanthus. sp.				
	Clanwilliam/Klawer	VESPOIDEA	Eumenidae	Delta caffer
	Nieuwoudtville	VESPOIDEA	Masaridae	Ceramius bicolor
Stoeberia				
Stoeberia. sp.				
	Aggeneys	BETHYLOIDEA	Chrysididae	Allocoelia mocsaryi
		VESPOIDEA	Masaridae	Quartinioides sp. O
				Quartinioides sp. Q
				Quartinioides sp. R
cup flowers				
Herrea				
Herrea sp. A				
	Nieuwoudtville	VESPOIDEA	Masaridae	Jugurtia braunsi
		APOIDEA	Colletidae	Scrapter sp. A
				Scrapter sp. I
			Halictidae	Lasioglossum sp. A
				Lasioglossum sp. D
				Patellapsis sp. A
				Zonalictus sp. D
			Melittidae	Melitta sp. A
			Megachilidae	Nigranthidium concolor
				Spinanthidium volkmanni
			Anthophoridae	Ceratina sp. L
Herrea sp. B				
	Clanwilliam/Citrusdal	APOIDEA	Halictidae	Lasioglossum sp. A
	Clanwilliam/Graafwater	SCOLIOIDEA	Scoliidae	Cathimeris capensis
		VESPOIDEA	Masaridae	Celonites bergenwahliae
				Celonites wahlenbergiae
		APOIDEA	Colletidae	Colletes sp. E
				Scrapter sp. A
			Halictidae	Lasioglossum sp. A
				Lasioglossum sp. D
			Anthophoridae	Sphecodopsis sp.
	Paleisheuwel	APOIDEA	Colletidae	Scrapter sp. A
				Scrapter sp. B

"mesems" not specified

Anenous	VESPOIDEA	Masaridae	Quartinioides sp. I
Aus	VESPOIDEA	Masaridae	Quartinia ochraceopicta
43 km ENE Ceres	SPHECOIDEA	Nyssonidae	Bembecinus rhopaloceroides
Clanwilliam/Klawer	SPHECOIDEA	Philanthidae	Philanthus rugosus
Die Koo	APOIDEA	Halictidae	Zonalictus sp. C
Elim	SPHECOIDEA	Philanthidae	Cerceris sp. A
Garies	VESPOIDEA	Masaridae	Ceramius cerceriformis
Grahamstown		Eumenidae	Alastor sp. 1
			Delta caffer
			Euodynerus sp.
			Katamenes macrocephalus
			Parachilus capensis
	VESPOIDEA	Masaridae	Ceramius beyeri
			Ceramius capicola
			Ceramius lichtensteinii
			Ceramius linearis
	POMPILOIDEA	Pompilidae	Hemipepsis brunniceps
	SPHECOIDEA	Sphecidae	Isodontia simoni
			Sphex decipiens
			Stizus dewitzi
	APOIDEA	Andrenidae	Meliturgula braunsi
		Anthophoridae	Ceratina sp. F
			Xylocopa lugubris
			Xylocopa sicheli
Hofmeyr	VESPOIDEA	Masaridae	Ceramius capicola
Kommadagga	VESPOIDEA	Masaridae	Ceramius lichtensteinii
			Ceramius linearis
	APOIDEA	Anthophoridae	Amegilla (Zebramegilla) sp. A
Montagu/Touws River	VESPOIDEA	Masaridae	Ceramius socius
Mossel Bay	VESPOIDEA	Masaridae	Quartinioides capensis
Nieuwoudtville	VESPOIDEA	Masaridae	Jugurtia braunsi
			Quartinia sp. A
			Quartinioides sp. J
	APOIDEA	Melittidae	Capicola braunsiana
		Megachilidae	Hoplitis sp. K
		Anthophoridae	Ceratina sp. G
Oudtshoorn	VESPOIDEA	Masaridae	Quartinioides sp. J
	SPHECOIDEA	Philanthidae	Cerceris curvitarsis
	APOIDEA	Halictidae	Halictus (Seladonia) sp. B

Springbok	VESPOIDEA	Masaridae	Jugurtia braunsi
Touws River	APOIDEA	Colletidae	Colletes sp. D
		Halictidae	Lasioglossum sp. A
Vrenendal	SPHECOIDEA	Sphecidae	Podalonia canescens
Worcester	VESPOIDEA	Masaridae	Quartinia media
Willowmore	VESPOIDEA	Masaridae	Quartinioides sp. K
?	VESPOIDEA	Masaridae	Quartinioides niveopicta
?	VESPOIDEA	Masaridae	Quartinioides signata

ASTERACEAE

The Asteraceae (Compositae) are here presented grouped in tribes following Hilliard (1977).

Tribe 1 : VERNONIEAE
Flowers purple, violet or white, rarely yellowish; tropical and sub-tropical.

Tribe 2 : EUPATORIEAE
Corolla purplish, rose or white, never distinctly yellow; mostly American.

Tribe 3 : ASTEREAE
Disc flowers usually yellow, yellowish or white; ray flowers variously coloured; worldwide, mostly in temperate and montane areas.

Chrysocoma				
Chrysocoma ciliata				
	Grahamstown	SPHECOIDEA	Sphecidae	Ammophila bonaespei
			Nyssonidae	Bembix sibilans
		APOIDEA	Anthophoridae	Ceratina sp. F
Chrysocoma sp.				
	Nieuwoudtville	APOIDEA	Colletidae	Scrapter sp. G
Conyza				
Conyza bonariensis				
	Grahamstown	SPHECOIDEA	Sphecidae	Ammophila conifera
				Podalonia canescens
			Larridae	Tachysphex sp. nov. A
Felicia				
Felicia sp.				
	Springbok	VESPOIDEA	Masaridae	Jugurtia braunsiella
"blue rayed"				
	Die Bos	VESPOIDEA	Masaridae	Ceramius toriger
Pteronia				
Pteronia divaricata (including P. cf. divaricata)				
	Clanwilliam	VESPOIDEA	Masaridae	Jugurtia braunsi
	Nieuwoudtville	SCOLIOIDEA	Tiphiidae	Mesa sp. C
		VESPOIDEA	Masaridae	Celonites promontorii
				Ceramius toriger
				Jugurtia braunsi
				Jugurtia braunsiella
				Jugurtia sp. A
		SPHECOIDEA	Nyssoninae	Bembix cameronis
		APOIDEA	Megachilidae	Heriades sp. C
				Heriades sp. E
				Hoplitis sp. B
				Hoplitis sp. L
			Anthophoridae	Nomada gigas

Pteronia incana				
	Barrydale	VESPOIDEA	Masaridae	Ceramius jacoti
Pteronia paniculata				
	Grahamstown	VESPOIDEA	Masaridae	Jugurtia braunsiella
Pteronia sp. B				
	Springbok	SPHECOIDEA	Sphecidae	Ammophila punctaticeps
				Podalonia canescens
		APOIDEA	Megachilidae	Carinanthidium cariniventre
			Anthophoridae	Anthophora wartmanni
				Tetraloniella sp.
Pteronia sp.				
	Nieuwoudtville	APOIDEA	Anthophoridae	Anthophora sp.
Pteronia sp.				
	Springbok	VESPOIDEA	Masaridae	Ceramius rex
				Jugurtia braunsiella

Tribe 4 : INULEAE
Flowers usually yellow, occasionally whitish or red; worldwide.

Helichrysum				
Helichrysum ericaefolium				
	Grahamstown	SPHECOIDEA	Nyssonidae	Bembecinus cinguliger
Helichrysum cf. hebelepis (including Helichrysum sp.)				
	Clanwilliam/Graafwater	BETHYLOIDEA	Chrysididae	Hedychrum coelestinum
		SCOLIOIDEA	Tiphiidae	Meria sp. H
		VESPOIDEA	Masaridae	Celonites wahlenbergiae
		SPHECOIDEA	Nyssonidae	Bembecinus mutabilis
				Bembecinus sp. A
				Bembecinus sp. B
			Crabronidae	Belomicrus sp. F
			Philanthidae	Cerceris languida
		APOIDEA	Colletidae	Scrapter sp. F
				Scrapter sp. O
			Anthophoridae	Sphecodopsis sp.
Helichrysum sp.				
	Bains Kloof	SPHECOIDEA	Philanthidae	Philanthus histrio
Helichrysum sp.				
	Clanwilliam	APOIDEA	Megachilidae	Heriades sp. H
Helichrysum sp.				
	Clanwilliam/Citrusdal	APOIDEA	Megachilidae	Heriades sp. A
Helichrysum sp.				
	Anenous	VESPOIDEA	Masaridae	Quartinia vagepunctata
	Springbok	VESPOIDEA	Masaridae	Quartinia sp. F
Leysera				
Leysera gnaphalodes				
	Anenous	VESPOIDEA	Masaridae	Quartinia vagepunctata
				Quartinioides cyllene

	Nieuwoudtville	VESPOIDEA	Eumenidae	Raphiglossa flavo-ornata
			Masaridae	Jugurtia polita
				Jugurtia sp. C
				Quartinia vagepunctata
				Quartinia sp. I
				Quartinia sp. D
		APOIDEA	Megachilidae	Heriades sp. F
				Hoplitis sp. L
	Springbok	VESPOIDEA	Eumenidae	Raphiglossa flavo-ornata
			Masaridae	Jugurtia braunsi
				Quartinia iocaste
				Quartinia vagepunctata
				Quartinia sp. D
		APOIDEA	Megachilidae	Heriades sp. J
				Pseudoheriades primus
			Anthophoridae	Anthophora sp.
	Taaiboskraal	VESPOIDEA	Masaridae	Quartinioides cyllene
Leysera tenella				
	Nieuwoudtville	VESPOIDEA	Masaridae	Quartinia artemis
				Quartinia vagepunctata
				Quartinia sp. D
		APOIDEA	Megachilidae	Heriades sp. G
Metalasia				
Metalasia muricata				
	Nieuwoudtville	SPHECOIDEA	Sphecidae	Ammophila ferrugineipes
				Podalonia canescens
		APOIDEA	Halictidae	Halictus sp. B
				Lasioglossum sp. B
			Anthophoridae	Anthophora wartmanni
Relhania				
Relhania pumila (including Relhania sp.)				
	Nieuwoudtville	VESPOIDEA	Masaridae	Quartinia artemis
				Quartinioides cyllene
				Quartinia vagepunctata
				Quartinia sp. D

Tribe 5 : HELIANTHEAE
Flowers usually yellow; mostly American.

Verbesina				
Verbesina encelioides				
	Fort Brown	SPHECOIDEA	Sphecidae	Ammophila beniniensis

Tribe 6 : HELENIEAE
Flowers yellow; warm parts of America, particularly Mexico and the Pacific coast of N. America.

Tribe 7 : ANTHEMIDEAE

Disc flowers usually yellow; rays white, yellow or rarely purplish; mostly extra-tropical Old World, particularly the Mediterranean region and South Africa.

Athanasia

Athanasia filiformis (including A. sp. Grahamstown)

Plant	Locality	Superfamily	Family	Species
	Grahamstown	SCOLIOIDEA	Tiphiidae	Anthobosca erythrosoma
				Meria cf. limata
				Meria sp. H
		POMPILOIDEA	Pompilidae	Cyphononyx flavicornis
				Hemipepsis tamisieri
		APOIDEA	Anthophoridae	Tetraloniella minuta
			Halictidae	Halictus sp cf. jucundus
			Megachilidae	Lithurge spiniferus
				Megachile stellarum
Athanasia trifurcata				
	43 km ENE Ceres	VESPOIDEA	Masaridae	Ceramius toriger
				Jugurtia turneri
				Quartiniella watersoni
		SPHECOIDEA	Philanthidae	Cerceris discrepans
				Cerceris holconota
				Cerceris latifrons
		APOIDEA	Halictidae	Zonalictus sp. E
			Anthophoridae	Tetraloniella nanula
	Clanwilliam	BETHYLOIDEA	Chrysididae	Allocoelia minor
				Chrysis catagrapha
				Pseudospinolia ardoris
		SCOLIOIDEA	Tiphiidae	Meria sp. H
		VESPOIDEA	Masaridae	Ceramius braunsi
				Masarina mixta
				Quartinia persephone
		POMPILOIDEA	Pompilidae	Clavelia ramosa
				Schistonyx umbrosus
		SPHECOIDEA	Sphecidae	Podalonia canescens
			Nyssonidae	Bembecinus mutabilis
				Bembix cameronis
				Bembix melanopa
			Philanthidae	Cerceris languida
				Philanthus rugosus
				Philanthus triangulum
		APOIDEA	Halictidae	Halictus sp. cf jucundus
				Halictus sp. B
				Patellapis sp. B
			Megachilidae	Capanthidium capicola
				Heriades sp. C
				Lithurge spiniferus
	Klein Alexandershoek, Clanwilliam	VESPOIDEA	Masaridae	Quartinia persephone
		APOIDEA	Megachilidae	Hoplitis sp. J

	Clanwilliam/Klawer	BETHYLOIDEA	Chrysididae	*Allocoelia minor*
				Pseudospinola ardoris
		SCOLIOIDEA	Tiphiidae	*Meria* sp. H
			Scoliidae	*Cathimeris capensis*
		VESPOIDEA	Masaridae	*Ceramius metanotalis*
		SPHECOIDEA	Nyssonidae	*Bembecinus* sp. nov. B
				Bembecinus rhopalocerus
				Bembix cameronis
				Bembix capensis
				Bembix melanopa
			Philanthidae	*Cerceris languida*
				Philanthus rugosus
		APOIDEA	Halictidae	*Halictus* sp. B
			Melittidae	*Haplomelitta ogilvei*
			Megachilidae	*Capanthidium capicola*
				Hoplitis sp. J
			Anthophoridae	*Tetraloniella karooensis*
	Theronsberg Pass, Ceres	APOIDEA	Halictidae	*Lasioglossum* sp. C
Athanasia sp.	Clanwilliam/ Klaver	VESPOIDEA	Masaridae	*Jugurtia braunsiella*
Athanasia spp.	43 km ENE Ceres	BETHYLOIDEA	Chrysididae	*Chrysis porphyrophana*
				Spintharosoma chrysonota
				Spintharosoma destituta
		SCOLIOIDEA	Tiphiidae	*Meria cf. limata*
				Meria sp. H
			Scoliidae	*Cathimeris capensis*
				Scolia chrysotricha
				Treilis braunsi
		VESPOIDEA	Masaridae	*Jugurtia turneri*
				Quartiniella watersoni
				Quartinioides cyllene
		POMPILOIDEA	Pompilidae	*Elaphrosyron insidiosus*
		SPHECOIDEA	Crabronidae	*Belomicrus* sp. C
			Nyssonidae	*Bembix* sp.
			Philanthidae	*Cerceris discrepans*
				Cerceris holconota
				Cerceris latifrons
				Palarus latifrons
				Philanthus melanderi
		APOIDEA	Colletidae	*Colletes* sp. B
				Scrapter sp. L
			Halictidae	*Halictus* sp. A *cf. jucundus*
				Lasioglossum sp. D
				Nomioides cf. maculiventris
			Megachilidae	*Capanthidium capicola*
				Heriades sp. A
				Heriades sp. L
			Anthophoridae	*Tetraloniella nanula*
	60 km ENE Ceres	APOIDEA	Colletidae	*Scrapter* sp. K

Cotula				
Cotula leptalea				
	Nieuwoudtville	VESPOIDEA	Masaridae	Quartinia vagepunctata
		APOIDEA	Megachilidae	Heriades sp. G
Cotula sp.				
	Nieuwoudtville	BETHYLOIDEA	Chrysididae	Allocoelia glabra
		VESPOIDEA	Masaridae	Quartinia vagepunctata
		SPHECOIDEA	Crabronidae	Belomicrus sp. E
Cotula sp.				
	Anenous	VESPOIDEA	Masaridae	Quartinia vagepunctata
Cotula sp.				
	Grahamstown	APOIDEA	Megachilidae	Heriades cf. freygessneri

Lasiospermum				
Lasiospermum bipinnatum				
	Grahamstown	BETHYLOIDEA	Chrysididae	Stilbum cyanurum
		VESPOIDEA	Eumenidae	Antepipona scutellaris
				Antepipona sesqucincta
				Antepipona sp.
				Antodynerus spoliatus
				Eumenes acuminatus
			Masaridae	Jugurtia braunsiella
		SCOLIOIDEA	Tiphiidae	Meria sp. A
				Meria sp. B
				Meria cf. basutorum
			Scoliidae	Cathimeris capensis
				Scolia chrysotricha
		SPHECOIDEA	Crabronidae	Oxybelus imperialis
			Sphecidae	Ammophila beniniensis
				Ammophila ferrugineipes
				Isodontia simoni
				Podalonia canescens
				Prionyx kirbii
			Nyssonidae	Bembix cameronis
		APOIDEA	Colletidae	Colletes sp. A
				Scrapter sp. M
			Halictidae	Halictus sp. cf. jucundus
				Halictus spp.
				Lasioglossum sp. E
				Lasioglossum sp. G
				Patellapis sp. C
				Patellapis sp. D
			Megachilidae	Heriades cf. spiniscutus
				Heriades sp. A
				Heriades sp. M
				Hoplitis jansei
				Lithurge spiniferus
				Megachile meadewaldoi
			Anthophoridae	Allodapula variegata
				Ceratina sp. A
				Ceratina sp. F
				Nomada gigas

Plant	Locality	Superfamily	Family	Species
Pentzia				
Pentzia incana				
	Grahamstown	SPHECOIDEA	Nyssonidae	Bembecinus oxydorcus
		APOIDEA	Halictidae	Lipotriches sp. A
	Twee Rivieren	BETHYLOIDEA	Chrysididae	Parnopes fischeri
		SCOLIOIDEA	Scoliidae	Treilis stigma
		SPHECOIDEA	Nyssonidae	Bembix zinni
		APOIDEA	Halictidae	Pseudapis cinerea
	Prince Albert	BETHYLOIDEA	Chrysididae	Allocoelia capensis
		APOIDEA	Anthophoridae	Anthophora praecox
Pentzia suffruticosa				
	Springbok	VESPOIDEA	Masaridae	Ceramius nigripennis
	Wildeperdehoek Pass	VESPOIDEA	Masaridae	Quartinia vagepunctata
	Nieuwoudtville	SCOLIOIDEA	Tiphiidae	Mesa sp. C
		VESPOIDEA	Masaridae	Jugurtia braunsi
				Quartinia vagepunctata
		APOIDEA	Halictidae	Halictus sp. B
			Megachilidae	Heriades sp. A
				Heriades sp. G
	43 km ENE Ceres	BETHYLOIDEA	Chrysididae	Parnopes fischeri
		VESPOIDEA	Masaridae	Quartiniella watersoni
	60 km ENE Ceres	SPHECOIDEA	Crabronidae	Belomicrus sp. C
		APOIDEA	Colletidae	Scrapter sp. L
				Scrapter sp. N
Pentzia sp.				
	Clanwilliam	VESPOIDEA	Masaridae	Ceramius braunsi

Tribe 8 : SENECIONEAE

Flowers usually yellow, sometimes white, red, purple or violet; worldwide.

Plant	Locality	Superfamily	Family	Species
Euryops				
Euryops thunbergii				
	Nieuwoudtville	APOIDEA	Colletidae	Scrapter sp. G
Senecio				
Senecio cf. arenarius				
	Clanwilliam/Graafwater	VESPOIDEA	Masaridae	Celonites bergenwahliae
		APOIDEA	Anthophoridae	Sphecodopsis sp.
Senecio burchellii				
	43 km ENE Ceres	VESPOIDEA	Masaridae	Jugurtia braunsiella
		APOIDEA	Halictidae	Lasioglossum sp. D
			Megachilidae	Capanthidium capicola

Senecio linifolius			
Grahamstown	APOIDEA	Halictidae	Halictus spp.
		Megachilidae	Lithurge spiniferus
		Anthophoridae	Amegilla (Zebramegilla)
			Anthophora labrosa
			Anthophora rufolanata
			Anthophora vestita
			Anthophora wartmanni
			Thyreus albomaculatus
Senecio prob. nivea			
Nieuwoudtville	VESPOIDEA	Masaridae	Jugurtia polita
			Quartinia sp. D
			Quartinioides cyllene
	APOIDEA	Halictidae	Halictus sp. cf. jucundus
		Megachilidae	Heriades sp. A
			Heriades sp. F
			Heriades sp. G
Senecio pterophorus			
Grahamstown	VESPOIDEA	Masaridae	Ceramius lichtensteinii (exceptional)
	SCOLIOIDEA	Tiphiidae	Meria sp. H
	APOIDEA	Colletidae	Colletes sp. A
		Halictidae	Halictus sp. A cf. jucundus
			Halictus sp. B
			Zonalictus sp. A
		Megachilidae	Coelioxys penetratrix
			Creightoniella dorsata
			Lithurge spiniferus
			Megachile stellarum
		Anthophoridae	Ceratina sp. F
Senecio rosmarinifolius			
Oudtshoorn	BETHYLOIDEA	Chrysididae	Allocoelia bidens
			Allocoelia capensis
			Chrysis oxygona
			Chrysis splendens
			Parnopes fischeri
			Spinantharina sp. nr. bispinosa
			Spintharosoma chrysonota
	SCOLIODEA	Tiphiidae	Meria sp. H
		Scoliidae	Scolia chrysotricha
			Scolia fulvofimbriata
	VESPOIDEA	Masaridae	Celonites promontorii
			Ceramius jacoti
			Jugurtia braunsiella
	SPHECOIDEA	Sphecidae	Podalonia canescens
		Philanthidae	Cerceris latifrons
	APOIDEA	Colletidae	Colletes sp. B
			Scrapter sp. L
		Halictidae	Halictus sp. cf. jucundus
			Halictus sp. B
		Megachilidae	Capanthidium capicola
			Lithurge spiniferus
			Heriades sp. A

			Anthophoridae	Amegilla (Amegilla) sp.
				Tetraloniella minuta
				Thyreus calceatus
				Xylocopa scioensis
	43 km ENE Ceres	VESPOIDEA	Masaridae	Jugurtia braunsiella
				Jugurtia turneri
		SPHECOIDEA	Sphecidae	Podalonia canescens
		APOIDEA	Halictidae	Lasioglossum sp. D
			Megachilidae	Capanthidium capicola
Senecio sp.				
	Citrusdal	SPHECOIDEA	Sphecidae	Cerceris languida
		APOIDEA	Colletidae	Scrapter sp. H
			Melittidae	Haplomelitta ogilviei
Senecio sp.				
	Cradock	VESPOIDEA	Masaridae	Jugurtia polita
Senecio sp.				
	Grahamstown	BETHYLOIDEA	Chrysididae	Chrysis alternans
				Chrysis catagrapha
				Chrysis mionii
				Chrysis wahlbergi
				Hedychrum coelestinum
		SCOLIOIDEA	Tiphiidae	Meria rufifrons
				Meria sp. H
		VESPOIDEA	Eumenidae	Antepipona scutellaris
				Delta caffer
				Euodynerus sp.
				Raphiglossa natalensis
				Raphiglossa flavo-ornata
				Zetheumenidion femoratus
				Zethus sp.
		POMPILOIDEA	Pompilidae	Cyphononyx flavicornis
				Psammoderes mimicus
		SPHECOIDEA	Sphecidae	Isodontia simoni
				Podalonia canescens
		APOIDEA	Halictidae	Lipotriches sp. A
				Pachynomia glabriventris
			Megachilidae	Heriades cf. freygessneri
				Hoplitis similis
				Lithurge spiniferus
				Megachile meadewaldoi
				Megachile semiflava
				Megachile stellarum
				Pachyanthidium benguelense
			Anthophoridae	Tetraloniella junodi
				Ceratina sp. C
				Ceratina sp. F
Senecio sp.				
	Nieuwoudtville	VESPOIDEA	Eumenidae	Raphiglossa natalensis
			Masaridae	Jugurtia braunsi
				Quartinia persephone
				Quartinia vagepunctata
Senecio sp.				
	Prince Albert	BETHYLOIDEA	Chrysididae	Parnopes fischeri

Senecio sp.

Springbok	VESPOIDEA	Masaridae	Jugurtia braunsi

Tribe 9 : CALENDULEAE

Flowers often yellow, sometimes white, blue or pink; Old World, particularly the Mediterranean region and South Africa.

Osteospermum

Osteospermum oppositifolia (including O. cf. oppositifolia)

Nieuwoudtville	SCOLIOIDEA	Tiphiidae	Mesa sp. C
	VESPOIDEA	Masaridae	Jugurtia polita
			Quartinia vagepunctata
	APOIDEA	Megachilidae	Heriades sp. F
			Pseudoheriades primus

Tribe 10 : ARCTOTEAE

Flowers yellow or purple, occasionally white; Old World, chiefly Spouth Africa.

Arctotheca

Arctotheca calendula

Springbok	VESPOIDEA	Masaridae	Ceramius nigripennis
			Jugurtia braunsi
			Quartinioides sp. 1
Clanwilliam	VESPOIDEA	Masaridae	Ceramius braunsi
Clanwilliam/Graafwater	VESPOIDEA	Masaridae	Ceramius braunsi
	APOIDEA	Colletidae	Scrapter sp. E
			Scrapter sp. F
		Megachilidae	Hoplitis sp. B
		Anthophoridae	Tetraloniella junodi

Arctotis

Arctotis laevis

Clanwilliam	VESPOIDEA	Masaridae	Ceramius braunsi
	APOIDEA	Anthophoridae	Anthophora wartmanni

Berkheya

Berkheya canescens

Springbok	VESPOIDEA	Masaridae	Ceramius rex
	APOIDEA	Fideliidae	Fidelia cf. braunsiana

Berkheya carlinifolia

Ceres	VESPOIDEA	Masaridae	Ceramius caffer
	APOIDEA	Megachilidae	Coelioxys lativentris
		Anthophoridae	Amegilla (Amegilla) sp.
			Anthophora praecox

Berkeya fruticosa

Springbok & Nababeep	VESPOIDEA	Masaridae	Ceramius nigripennis
		Eumenidae	Raphiglossa flavo-ornata

	Nieuwoudtville	VESPOIDEA	Masaridae	Celonites promontorii
				Ceramius toriger
				Quartinioides tarsata
			Sphecidae	Ammophila ferrugineipes
		APOIDEA	Fideliidae	Fidelia braunsiana
				Heriades sp. E
				Hoplitis sp. B
				Tuberanthidium tuberculiferum
			Megachilidae	Heriades sp. C
Berkheya heterophylla				
	Grahamstown	VESPOIDEA	Eumenidae	Allepipona erythrospila
				Raphiglossa natalensis
		POMPILOIDEA	Pompilidae	Priocnemis braunsi
		SPHECOIDEA	Crabronidae	Dasyproctus bipunctatus
				Dasyproctus simillimus
			Nyssonidae	Bembix sibilans
		APOIDEA	Halictidae	Halictus sp. cf. jucundus
				Halictus sp. B
			Megachilidae	Chalicodoma sinuata
				Creightoniella discolor
				Hoplitis similis
				Hoplitis jansei
				Hoplitis sp. A
				Megachile stellarum
				Serapista denticulata
			Anthophoridae	Allodape rufogastra and/or exoloma
				Allodape quadrilineata
				Allodapula variegata
				Amegilla atrocincta
				Anthophora labrosa
				Anthophora praecox
				Anthophora wartmanni
				Anthophora rufolanata
				Anthophora vestita
				Ceratina sp. C
				Ceratina sp. F
				Ceratina sp. I
				Tetraloniella karooensis
				Thyreus albomaculatus
				Thyreus caffra
Berkheya cf. spinosa				
	Prince Albert	VESPOIDEA	Masaridae	Celonites promontorii
				Celonites wheeleri
				Quartinioides sp. G
Berkheya sp.				
	Bot River	VESPOIDEA	Masaridae	Ceramius caffer
Berkheya sp.				
	Clanwilliam	APOIDEA	Anthophoridae	Anthophora labrosa
				Anthophora praecox
Berkheya sp.				
	Grahamstown	APOIDEA	Anthophoridae	Allodape sp.
				Xylocopa caffra
				Xylocopa scioensis
Berkheya sp.				
	Oudtshoorn	VESPOIDEA	Masaridae	Celonites capensis

Plant	Locality	Superfamily	Family	Species
Berkheya sp.				
	Riebeek East	VESPOIDEA	Eumenidae	Raphiglossa natalensis
			Masaridae	Celonites capensis
		APOIDEA	Halictidae	Halictus sp. A cf. jucundus
			Megachilidae	Immanthidium junodi
				Megachile stellarum
			Anthophoridae	Anthophora labrosa
				Anthophora praecox
				Anthophora vestita
Berkheya sp.				
	Springbok	VESPOIDEA	Masaridae	Ceramius nigripennis
		APOIDEA	Anthophoridae	Xylocopa sicheli
Berkheya sp.				
	Williston	VESPOIDEA	Masaridae	Quartinioides tarsata
		APOIDEA	Anthophoridae	Tetraloniella karooensis
Hirpicium				
Hirpicium alienatus				
	Springbok	VESPOIDEA	Masaridae	Ceramius nigripennis
Hirpicium sp.				
	Springbok	VESPOIDEA	Masaridae	Ceramius nigripennis
Gazania				
Gazania sp.				
	Williston	VESPOIDEA	Masaridae	Quartinioides propinqua
				Quartinioides tarsata
				Quartinioides sp. Z

Tribe 11 : CARDUEAE

Flowers blue, purple or reddish, white or sometimes yellow, mostly Eurasian, particularly the Mediterranean region and the Near East.

Plant	Locality	Superfamily	Family	Species
Cirsium				
C. vulgare				
	Grahamstown	VESPOIDEA	Eumenidae	Raphiglossa natalensis
		SPHECOIDEA	Sphecidae	Podalonia canescens
		APOIDEA	Anthophoridae	Anthophora vestita
				Ceratina sp. C
				Thyreus calceatus

Tribe 12 : MUTISEAE

Flowers often purple or red; mostly southern hemisphere, particularly in the Andes.

Tribe 13 : LACTUCEAE

Flowers yellow, occasionally blue, purple or white; mostly northern hemisphere.

PAPILIONACEAE (Fabaceae)

Only members of the Cape Group of the tribe Crotalarieae are listed as it is only papilionates from this group which are recorded as being visited by masarines.

Aspalathus				
Aspalathus divaricata				
	Gydo Pass, Ceres	VESPOIDEA	Masaridae	Masarina familiaris
				Masarina sp. nov.
		APOIDEA	Megachilidae	Afranthidium reicherti
				Branthidium braunsi
				Spinanthidium volkmanni
			Anthophoridae	Allodape friesei
				Ceratina sp. J
Aspalathus linearis				
	Clanwilliam			
		VESPOIDEA	Masaridae	Ceramius clypeatus
				Masarina familiaris
		SPHECOIDEA	Philanthidae	Cerceris languida
				Philanthus triangulum
		APOIDEA	Megachilidae	Branthidium braunsi
				Chalicodoma karooensis
				Chalicodoma sinuata
				Immanthidium junodi
				Serapista rufipes
				Spinanthidium volkmanni
			Anthophoridae	Xylocopa rufitarsis
	Clanwilliam/ Graafwater	SCOLIOIDEA	Tiphiidae	Mesa sp. A
		VESPOIDEA	Eumenidae	Delta caffer
			Masaridae	Masarina familiaris
		APOIDEA	Megachilidae	Chalicodoma schultessi
				Serapista rufipes
			Anthophoridae	Xylocopa caffra
				Xylocopa rufitarsis
	Nieuwoudtville	VESPOIDEA	Masaridae	Masarina familiaris
		APOIDEA	Megachilidae	Chalicodoma karooensis
				Chalicodoma murina
				Megachile sp. C
				Spinanthidium trachusiforme
				Spinanthidium volkmanni
Aspalathus pulicifolia				
	Clanwilliam	VESPOIDEA	Masaridae	Ceramius clypeatus
				Ceramius micheneri
				Masarina familiaris
		SPHECOIDEA	Sphecidae	Bembix cameronis
		APOIDEA	Megachilidae	Chalicodoma fulva
				Chalicodoma karooensis
				Chalicodoma murina
				Chalicodoma reicherti
				Chalicodoma sinuata

Aspalathus spinescens

Clanwilliam	BETHYLOIDEA	Chrysididae	Elampus guillarmodi
	SCOLIOIDEA	Tiphiidae	Mesa sp. A
			Mesa sp. C
		Scoliidae	Cathimeris capensis
	VESPOIDEA	Eumenidae	Delta caffer
			Delta emarginatum
		Masaridae	Ceramius braunsi (atypical)
			Ceramius clypeatus
			Ceramius micheneri
			Masarina familiaris
			Masarina mixta (atypical)
	SPHECOIDEA	Sphecidae	Ammophila bonaespei
		Philanthidae	Philanthus capensis
	APOIDEA	Megachilidae	Carinanthidium cariniventre
			Chalicodoma aridissima
			Chalicodoma fulva
			Chalicodoma karooensis
			Chalicodoma murina
			Hoplitis sp. C
			Oranthidium sp. nov.
			Spinanthidium neli
			Spinanthidium trachusiforme
			Spinanthidium volkmanni
		Anthophoridae	Xylocopa rufitarsis
Clanwilliam/ Graafwater	SCOLIOIDEA	Scoliidae	Cathimeris capensis
	VESPOIDEA	Eumenidae	Delta caffer
		Masaridae	Ceramius clypeatus
			Masarina hyalinipennis
			Masarina familiaris
	SPHECOIDEA	Sphecidae	Podalonia canescens
		Philanthidae	Philanthus capensis
	APOIDEA	Megachilidae	Carinanthidium cariniventre
			Megachile sp. B
			Spinanthidium neli
			Spinanthidium volkmanni
		Anthophoridae	Ceratina sp. F
			Ceratina sp. H
			Xylocopa lugubris
			Xylocopa rufitarsis
Clanwilliam/ Citrusdal (including Algeria & Nieuwoudt Pass)	VESPOIDEA	Eumenidae	Delta caffer
		Masaridae	Ceramius clypeatus
			Masarina familiaris
	SPHECOIDEA	Philanthidae	Philanthus capensis
	APOIDEA	Megachilidae	Chalicodoma aridissima
			Chalicodoma fulva
			Chalicodoma karooensis
			Chalicodoma murina
			Megachile sp. B
		Anthophoridae	Xylocopa capitata
Citrusdal	VESPOIDEA	Masaridae	Ceramius clypeatus
	APOIDEA	Megachilidae	Branthidium braunsi
			Spinanthidium volkmanni

			Anthophoridae	Ceratina sp. H
	Citrusdal/ Paleisheuwel (including Piekenierskloof)	VESPOIDEA	Eumenidae	Delta caffer
			Masaridae	Ceramius clypeatus
				Masarina familiaris
		APOIDEA	Megachilidae	Spinanthidium neli
				Spinanthidium trachusiforme
				Spinanthidium volkmanni
				Xylocopa rufitarsis
	Klein Alexandershoek, Clanwilliam	VESPOIDEA	Eumenidae	Raphiglossa flavo-ornata
			Masaridae	Ceramius clypeatus
				Masarina familiaris
		APOIDEA	Megachilidae	Spinanthidium volkmanni
			Anthophoridae	Xylocopa caffra
	Wuppertal	APOIDEA	Megachilidae	Chalicodoma karooensis
Aspalathus subtingens				
	Grahamstown	VESPOIDEA	Eumenidae	Antepipona sesquicincta
				Delta hottentottum
		APOIDEA	Halictidae	Leuconomia sp. A
				Leuconomia sp. C
			Megachilidae	Coelioxys penetratrix
				Megachile gratiosa
				Megachile semiflava
				Megachile spinarum
				Megachile ungulata
			Anthophoridae	Allodape rufogastra/exoloma
				Allodapula variegata
				Halterapis nigrinervis
				Xylocopa sicheli
Aspalathus vulnerans				
	Paleisheuwel	VESPOIDEA	Masaridae	Masarina familiaris
Lebeckia				
Lebeckia sericea				
	Springbok (including Nababeep)	VESPOIDEA	Masaridae	Masarina familiaris
				Masarina hyalipennis
				Quartinia vagepunctata
		APOIDEA	Megachilidae	Chalicodoma bullata
				Chalicodoma fulva
				Chalicodoma karooensis
				Chalicodoma murina
				Megachile apiformis
				Serapista rufipes
				Spinanthidium volkmanni
	Kamieskroon	VESPOIDEA	Masaridae	Masarina hyalinipennis
		APOIDEA	Megachilidae	Chalicodoma karooensis
				Chalicodoma murina
				Spinanthidium volkmanni
Lebeckia spinescens				
	Springbok	VESPOIDEA	Masaridae	Masarina hyalipennis
		APOIDEA	Megachilidae	Chalicodoma karooensis
				Spinanthidium volkmanni

Wiborgia				
Wiborgia monoptera				
	Springbok	VESPOIDEA	Eumenidae	Zethus yarrowi
		APOIDEA	Megachilidae	Chalicodoma fulva
				Spinanthidium trachusiforme
				Spinanthidium volkmanni
	Kamieskroon	VESPOIDEA	Masaridae	Masarina hyalinipennis
		APOIDEA	Megachilidae	Chalicodoma karooensis
				Chalicodoma murina
				Spinanthidium volkmanni
Wiborgia sp.				
	43 km ENE Ceres	VESPOIDEA	Eumenidae	Delta caffer
				Delta emarginatum
				Delta hottentottum
		APOIDEA	Colletidae	Colletes sp. B
			Megachilidae	Chalicodom laminata
				Chalicodoma niveofasciata
				Chalicodoma sinuata
				Megachile sp. A
			Anthophoridae	Epeolus amabilis
				Xylocopa scioensis
	Klein Alexandershoek, Clanwilliam	APOIDEA	Melittidae	Melitta capicola
Rafnia				
Rafnia amplexicaulus				
	Clanwilliam	APOIDEA	Anthophoridae	Xylocopa caffra
	Clanwilliam/Graafwater	APOIDEA	Megachilidae	Chalicodoma cincta
	Klein Alexandershoek, Clanwilliam	VESPOIDEA	Eumenidae	Synagris maxillosa
		APOIDEA	Megachilidae	Chalicodoma cincta
			Anthophoridae	Xylocopa caffra
				Xylocopa capitata
	Piekenierskloof/ Paleisheuwel	APOIDEA	Megachilidae	Chalicodoma cincta

CAMPANULACEAE

Plant	Locality	Superfamily	Family	Species
CAMPANULOIDEAE				
Wahlenbergia				
Wahlenbergia annularis				
	Citrusdal	APOIDEA	Halictidae	Halictus (Seladonia) sp. B
			Melittidae	Capicola sp. A
				Capicola sp. C
				Haplomelitta ogilviei
			Anthophoridae	Ceratina sp. H
	Clanwilliam	VESPOIDEA	Masaridae	Masarina mixta
		APOIDEA	Melittidae	Capicola sp. A
				Capicola sp. C
	Clanwilliam/ Graafwater	APOIDEA	Melittidae	Capicola sp. A
				Capicola sp. C
	Springbok (including Klipfontein)	APOIDEA	Melittidae	Capicola sp. A
				Capicola sp. D
Wahlenbergia cf. constricta				
	Klein Alexanders-hoek, Clanwilliam	VESPOIDEA	Masaridae	Celonites bergenwahliae
				Quartinia parcepunctata
		APOIDEA	Anthophoridae	Ceratina sp. K
Wahlenbergia ecklonii				
	Ceres	VESPOIDEA	Masaridae	Celonites capensis
				Quartinia parcepunctata
				Quartinioides sp. U
				Quartinioides sp. H
		APOIDEA	Halictidae	Halictus (Seladonia) sp. B
				Lasioglossum sp. H
				Nomioides cf. maculiventris
Wahlenbergia macra				
	Grahamstown	VESPOIDEA	Eumenidae	Parachilus capensis
		APOIDEA	Colletidae	Colletes sp. A
			Anthophoridae	Ceratina sp. F
Wahlenbergia paniculata				
	Clanwilliam	BETHYLOIDEA	Tiphiidae	Mesa sp. A
		VESPOIDEA	Masaridae	Ceramius socius
				Celonites wahlenbergiae
				Masarina mixta
				Quartinia parcepunctata
				Quartinia persephone
				Quartinioides sp. N
				Quartinioides sp. S
		APOIDEA	Megachilidae	Hoplitis sp. C
			Anthophoridae	Ceratina sp. K

Wahlenbergia pilosa				
	Springbok	VESPOIDEA	Masaridae	Quartinia sp. E
				Quartinia sp. G
				Quartinioides sp. M
				Jugurtia braunsi
		SPHECOIDEA	Sphecidae	Ammophila punctaticeps
		APOIDEA	Melittidae	Haplomelitta ogilviei
			Megachilidae	Hoplitis sp. C
Wahlenbergia prostrata				
	Anenous	VESPOIDEA	Masaridae	Quartinioides sp. M
		SPHECOIDEA	Sphecidae	Belomicroides sp. nov.
		APOIDEA	Melittidae	Capicola sp. E
				Melitta capicola
Wahlenbergia psammophila				
	Clanwilliam/ Graafwater	VESPOIDEA	Masaridae	Celonites wahlenbergiae
				Celonites latitarsis
				Celonites bergenwahliae
				Masarina mixta
		APOIDEA	Melittidae	Capicola sp. C
Wahlenbergia sp. N				
	Nieuwoudtville	VESPOIDEA	Masaridae	Masarina mixta
				Quartinioides sp. N
		SPHECOIDEA	Sphecidae	Podalonia canescens
		APOIDEA	Halictidae	Halictus (Seladonia) sp. B
			Melittidae	Capicola sp. C
			Anthophoridae	Anthophora wartmanni
				Ceratina sp. H
				Ceratina sp. J
				Ceratina sp. K
Microcodon				
Microcodon sparsiflora				
	Clanwilliam	VESPOIDEA	Masaridae	Celonites wahlenbergiae
				Quartinia parcepunctata
				Quartinia persephone
LOBELIOIDEAE				
Lobelia				
Lobelia linearis				
	Nieuwoudtville	VESPOIDEA	Masaridae	Celonites sp. nov. E
		APOIDEA	Anthophoridae	Ceratina sp. H
Monopsis				
Monopsis debilis				
	Springbok	APOIDEA	Mellitidae	Haplomelitta ogilviei
	Clanwilliam/ Graafwater	APOIDEA	Mellitidae	Haplomelitta ogilviei
	Citrusdal	APOIDEA	Mellitidae	Haplomelitta ogilviei

Five records for miscellaneous unspecified Wahlenbergia species from the Clanwilliam District and a single record for a Cyphia species (CYPHIOIDEAE) from the Grahamstown District included in Appendix 1 have been omitted.

SCROPHULARIACEAE

Aptosimum				
Aptosimum procumbens				
	Grahamstown	BETHYLOIDEA	Tiphiidae	Meria sp. H
		VESPOIDEA	Masaridae	Celonites clypeatus
				Quartinioides tarsata
		APOIDEA	Halictidae	Pachynomia glabriventris
			Megachilidae	Megachile gratiosa
			Anthophoridae	Ceratina sp. F
Aptosimum lineare				
	Springbok	VESPOIDEA	Masaridae	Celonites peliostomi
Aptosimum spinescens				
	Springbok	VESPOIDEA	Masaridae	Celonites andrei
				Celonites peliostomi
	Twee Rivieren	VESPOIDEA	Masaridae	Celonites andrei
				Celonites clypeatus
		APOIDEA	Halictidae	Nomioides sp. A
Aptosimum sp.				
	Kakamas	APOIDEA	Andrenidae	Meliturgula sp. B
	Twee Rivieren	VESPOIDEA	Masaridae	Celonites clypeatus
		APOIDEA	Andrenidae	Meliturgula sp. B
Peliostomum				
Peliostomum leucorrhizum				
	Kakamas	VESPOIDEA	Masaridae	Quartinioides tarsata
	Twee Rivieren	VESPOIDEA	Masaridae	Quartinioides tarsata
				Quartinioides sp. V
				Quartinioides sp. W
				Quartinioides sp. X
	Williston	VESPOIDEA	Masaridae	Quartinioides tarsata
Peliostomum virgatum				
	Anenous	VESPOIDEA	Masaridae	Celonites peliostomi
				Quartinioides tarsata
				Quartinioides sp. T
				Quartinioides sp. Y
	Nieuwoudtville	VESPOIDEA	Masaridae	Celonites peliostomi
	Springbok	VESPOIDEA	Masaridae	Celonites andrei
				Celonites clypeatus
				Celonites peliostomi

Phyllopodium				
Phyllopodium cuneifolium				
	Grahamstown	VESPOIDEA	Masaridae	Celonites capensis
		POMPILOIDEA	Pompilidae	Elaphrosyron insidiosus
		SPHECOIDEA	Sphecidae	Ammophila beniniensis
				Ammophila bonaspei
				Ammophila conifera
				Ammophila ferugineipes
				Ammophila insignis litoralis
				Podalonia canescens
			Nyssonidae	Bembecinus haemorrhoidalis
				Bembix sibilans
		APOIDEA	Halictidae	Halictus (Seladonia) sp. B
			Anthophoridae	Allodapula variegata
Polycarena				
Polycarena sp.				
	Clanwilliam/ Graafwater	VESPOIDEA	Masaridae	Celonites bergenwahliae
				Celonites wahlenbergiae

Appendix 4

List of the described species of masarid wasps.

Within subfamilies and tribes the genera and species are arranged in alphabetical order.

MASARIDAE

Gayellinae

Gayella Spinola, 1851

araucana Willink, 1956; Chile
eumenoides Spinola, 1851; Argentina, Chile
    sicheliana Schulthess, 1910
luispenai Willink and Ajmat de Toledo, 1979; Argentina, Bolivia
mutilloides Saussure, 1855; Argentina, Chile
    mutilloides nigerrima Giordani Soika, 1956
patagonica Willink, 1956; Argentina, Chile
    cerceroides Giordani Soika, 1958
reedi Willink, 1963; Chile

Paragayella Giordani Soika, 1974

richardsi Giordani Soika, 1974; Brazil

Paramasaris Cameron, 1901

brasiliensis Giordani Soika, 1974; Brazil
cupreus Giordani Soika, 1974; Columbia
fuscipennis Cameron, 1901; Guatemala, Panama, USA: New Mexico
    flavolineatus Cameron, 1904 (Zethoides)
    flavolineatus Cameron, 1905 (Plesiozethus)
    flavolineatrus Schulz, 1906 (Metazethoides)

Masarinae: Paragiini

Ammoparagia Snelling, 1986

hua Snelling, 1986; W. Australia

Metaparagia Meade-Waldo, 1911

doddi Meade-Waldo, 1911; Queensland
pictifrons (Smith), 1857 (Paragia); W. Australia

Paragia Shuckard, 1837

australis Saussure, 1853; New South Wales
    ssp. borealis Richards, 1962; Queensland
bicolor Saussure, 1853; New South Wales
calida Smith, 1865; S. Australia, W. Australia
confluens Snelling, 1986; W. Australia
deceptrix Smith, 1862; New South Wales, Queensland

decipiens Shuckard, 1837; New South Wales, S. Australia, Victoria
ssp. aliciae Richards, 1962; Northern Territories, Queensland
generosa Richards, 1962; Queensland
hirsuta Meade-Waldo, 1911; Queensland
magdalena Turner, 1908; Queensland
mimetica Richards, 1968; W. Australia
monocesta Snelling, 1986; W. Australia
morosa Smith, 1868; W. Australia
nasuta Smith, 1868; Queensland, W. Australia
odyneroides Smith, 1850; New South Wales, Queensland, S. Australia, Victoria
bidens Saussure, 1855
praedator Saussure, 1855
oligomera Snelling, 1986; W. Australia
perkinsi Meade-Waldo, 1911; Queensland
propodealis Richards, 1968; New South Wales
schulthessi Turner, 1936; W. Australia
smithii Saussure, 154; S. Australia, Victoria
tricolor Smith, 1850 (not female)
sobrina Smith, 1869; W. Australia
excellens Smith, 1869
tricolor Smith, 1850 (not male); W. Australia
saussurei Smith, 1857
venusta Smith, 1865; W. Australia
concinna Smith, 1865
vespiformis Smith, 1865; W. Australia
walkeri Meade-Waldo, 1910; Northern Territories, Queensland

Riekia Richards, 1962

nocatunga Richards, 1962; New South Wales

Rolandia Richards, 1962

angulata (Richards), 1968 (Riekia); New South Wales, Queensland
borreriae Snelling, 1986; Northern Territory
houstoni Snelling, 1986; W. Australia
maculata (Meade-Waldo), 1910 (Paragia); W. Australia

Masarinae: Masarini

Celonites Latreille, 1802

abbreviatus (Villers), 1789 (Vespa); Albania, Corfu, Cyprus, Dalmatia, S. France, S. Germany, Greece, Italy, Portugal, Switzerland, Morocco
apiformis (Fabricius), 1793 (Masaris)
ssp. engadinensis Schulthess, 1923; Switzerland
ssp. invitus Gusenleitner, 1973; Armenia, Turkey
afer Lepeletier, 1841; Algeria, Libya, Morocco, Tunis
andrei Brauns, 1905; Cape Province
bergenwahliae Gess, 1989; Cape Province
capensis Brauns, 1905; Cape Province
clarus Gusenleitner, 1973; Iran
clypeatus Brauns, 1913; Cape Province

crenulatus Morawitz, 1888; USSR: Transcaspia, Turkestan, Turkmenia
cyprius Saussure, 1854; Cyprus
ssp. smyrnensis Richards, 1962; Armenia, Iran, Israel, Turkey
davidi Gess, 1989; Cape Province
discretus Gusenleitner, 1973; Iran
fischeri Spinola, 1838; Algeria, Cyprus, Egypt, Israel, Libya, Saudi Arabia, Tunis
foveolatus Kostylev, 1935; USSR: Transcaspia
ssp. nigrior Richards, 1962; Israel
guichardi Richards, 1962; Libya
hamanni Gusenleitner, 1973; Turkey
hystrix Kostylev, 1940; USSR: Tadjikistan
humeralis Richards, 1962; Cape Province
jousseaumei du Buysson, 1906; Algeria, Arabia (Aden, Oman, Yemen, Saudi Arabia, United Arab Emirates, Qatar) French Somaliland, Palestine, Sudan
asrensis Giordani Soika, 1957
ssp. senegalensis Richards, 1962; Senegal
kostylevi Panfilov, 1961; USSR: Kirghizia
kozlovi Kostylev, 1935; USSR: Mongolia
laetus Panfilov, 1968; USSR
latitarsis Gess, 1992; Cape Province
longipilis Gusenleitner, 1973; Iran
mayeti Richards, 1962; France, Spain
michaelseni Schulthess, 1923; Namibia
modestus Kostylev, 1935; USSR: Pamir
ssp. bisinterruptus Kostylev, 1940; USSR: Tadjikistan
mongolicus Morawitz, 1889; USSR: Mongolia
montanus Mocsáry, 1906; Alai Mts
nursei Dover, 1925; Quetta
octoannulatus Kostylev, 1927; USSR: Turkestan
ssp. hissaricus Kostylev, 1940; USSR: Tadjikistan
osseus Morawitz, 1888; USSR: Transcaspia, Turkmenistan
peliostomi Gess, 1989; Cape Province
persicus Richards, 1962; South West Iran
phlomis Gusenleitner, 1973; Turkey
pictus Richards, 1962; Senegal
promontorii Brauns, 1905; Cape Province
purcelli Brauns, 1905; Cape Province
rothschildi du Buysson, 1906; ?Kenya
rudesculptus Kostylev, 1935; Armenia
rugiceps Bischoff, 1928; Crete, Cyprus, Greece, Jugoslavia, Turkey
semenovi Kostylev, 1935; Iran
spinosus Gusenleitner, 1966; Turkey
tristiculus Kostylev, 1935; USSR
ssp. karatauicus Kostylev, 1935; USSR: Kazakhstan
turneri Richards, 1962; Cape Province
varipennis Richards, 1962; Libya
wahlenbergiae Gess, 1989; Cape Province
wheeleri Brauns, 1905; Cape Province
yemenensis Giordani Soika, 1957; Saudi Arabia, Yemen
ssp. ethiopicus Richards, 1962; Ethiopia
zavattarii Giordani Soika, 1944; Ethiopia

Ceramiopsis Zavattari, 1910

gestroi Zavattari, 1910; Argentina, Bolivia, Brazil
?paraguayensis Bertoni, 1923

Ceramius Latreille, 1810

beaumonti (Giordani Soika), 1957 (Paraceramius); Algeria, Morocco
beyeri Brauns, 1903; Cape Province
bicolor (Thunberg), 1815 (Philanthus); Cape Province
    karooensis Brauns, 1902
bischoffi Richards, 1963; Spain
braunsi Turner, 1935; Cape Province
bureschi Atannasov, 1938; Greece, Turkey
    bureschi lycaonius Blüthgen, 1952
caffer Saussure, 1855; Cape Province
    consobrinus Saussure, 1855
capicola Brauns, 1902; Cape Province, Orange Free State
caucasicus Ed. André, 1884; Iran, Russian Armenia, Turkey
cerceriformis Saussure, 1853; Cape Province
    schulthessi Brauns, 1902
    vespiformis Saussure, 1855
clypeatus Richards, 1962; Cape Province
damarinus Turner, 1935; Namibia
fonscolombei Latreille, 1810; France, Portugal, Spain
  ssp. oraniensis Lepeletier, 1841; Algeria, Morocco
    doursii Ed. André, 1884
hispanicus Dusmet, 1909; Spain
jacoti Richards, 1962; Cape Province
lichtensteinii (Klug), 1810 (Gnatho); Cape Province
    macrocephalus Saussure, 1854
    rufomaculatus Cameron, 1906
linearis Klug, 1824; Cape Province
    fumipennis Brauns, 1902
lusitanicus Klug, 1824; Gibraltar, Portugal, Spain
maroccanus (Giordani Soika), 1957 (Paraceramius); Morocco
metanotalis Richards, 1962; Cape Province
micheneri Gess, 1968; Cape Province
nigripennis Saussure, 1854; Cape Province
    hessei Turner, 1935
peringueyi Brauns, 1913; Cape Province
rex Saussure, 1855; Cape Province
richardsi Gess, 1965; Cape Province
socius Turner, 1935; Cape Province
spiricornis Saussure, 1854; France, Spain
toriger Schulthess, 1935; Cape Province
tuberculifer Saussure, 1853; France, Portugal, Spain
vechti Richards, 1963; Spain

Jugurtia Saussure

alfkeni (du Buysson), 1904 (Masaris); Kalahari
algerica (Schulthess), 1929 (Masariella ?); Algeria, Tripolitania
biskrensis Bequaert, 1937; Algeria, Morocco
braunsi (Schulthess), 1922 (Ceramiellus); Cape Province, Namibia
braunsiella (Schulthess), 1930 (Masaris); Cape Province, Namibia
calcarata Richards, 1962; Cape Province
confusa Richards, 1962; Cape Province
discrepans (Brauns), 1913 (Masaris); Cape Province
dispar (Dufour), 1851 (Celonites); Gibraltar, Portugal, Spain
duplicata Richards, 1962; Cape Province
escalerae Meade-Waldo, 1910; S. W. Iran
eurycara Kostylev, 1935; Iran, USSR: Armenia

irana Kostylev, 1935; Iran
jemenensis Kostylev, 1935; Algeria, Oman, Palestine, Saudi Arabia, United Arab Emirates, Yemen
hoggarica Giordani Soika, 1954
nadigorum Bequaert, 1937; Morocco, Tanger
oraniensis (Lepeletier), 1841 (Celonites); Algeria, Morocco, Tunisia
numida Saussure, 1854
polita Richards, 1962; Cape Province
saussurei (Brauns), 1905 (Masaris); Cape Province
simpsoni Meade-Waldo, 1911; Gambia, ? Haute Volta, N. Nigeria, Senegal
testaceopicta (Schulthess), 1929 (Masariella ?)
spinolae (Saussure), 1855 (Masaris); Cape Province
turneri (Schulthess), 1929 (Masariella ?); Cape Province
ssp. eburnea Turner, 1935; Cape Province
zarudnyi Kostylev, 1935, Iran, USSR: Chorassan

Masarina Richards, 1962

familiaris Richards, 1962; Cape Province
hyalinipennis Richards, 1962; Cape Province
mixta Richards, 1962; Cape Province
strucki Gess, 1988; Cape Province

Masaris Fabricius, 1793

aegyptiacus Meade-Waldo, 1911; Egypt, Israel
ssp. arabicus Giordani Soika, 1957; Saudi Arabia
carli Schulthess, 1922; USSR: Turkestan
saussurei Carl, 1921
smirnovi Kostylev, 1925
gussakovskii Kostylev, 1935; USSR: Turkestan
longicornis (Kuznetzov), 1923 (Saryara); USSR: Tashkent and Buchara
tiashanicus Panfilov, 1968; USSR: Tyan-Shan
vespiformis Fabricius, 1793; Algeria, Morocco
hylaeiformis (Klug), 1824 (Ceramius)
romandi (Saussure), 1853 (Erynnis)

Microtrimeria Bequaert, 1928

atacama Fritz, 1968; Chile
cockerelli Bequaert, 1928; Peru

Pseudomasaris Ashmead, 1902

basirufus Rohwer, 1912; USA: Arizona, California
zonalis basirufus Rohwer, 1912
bariscipus Bradley, 1922
coquilletti Rohwer, 1911; USA: Arizona, California, Oregan, Utah
edwardsii (Cresson), 1872 (Masaris); Mexico: Baja California, USA: Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, Washington, Wyoming
macneilli Bohart, 1963; USA: California, Utah
macswaini Bohart, 1963; USA; California

maculifrons (Fox), 1894 (Masaris); Mexico: Baja California, Sonora, USA: Arizona, California, Nevada, New Mexico

albifrons Rohwer, 1912
zonalis neomexianus Rohwer, 1912
rohweri Bradley, 1922

marginalis (Cresson), 1864 (Masaris); Canada: Alberta, B.C., USA: Colorado, Montana, Nevada, New Mexico, Utah, Wyoming
micheneri Bohart, 1963; USA: California
occidentalis (Cresson), 1871 (Masaris); USA: Kansas, New Mexico, Texas
phaceliae Rohwer, 1912; USA: New Mexico
texanus (Cresson), 1871 (Masaris); USA: Arizona, New Mexico, Texas
vespoides (Cresson), 1863 (Masaris); Mexico: Baja California, USA: Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, S. Dakota, Utah, Washington, Wyoming

vespoides robertsoni Cockerell, 1913

wheeleri Bequaert, 1929; Mexico: Baja California, USA: California
zonalis (Cresson), 1864 (Masaris); Canada: B.C., USA: California, Colorado, Idaho, Montana, Nebrasca, Nevada, Oregon, Utah, Washington, Wyoming

zonalis albopictus Bohart, 1950

Quartinia Ed. André

affinis Richards, 1962; Algeria
alcestis Richards, 1962; Cape Province
antennata Schulthess, 1935; Cape Province
araxana Giordani Soika, 1960; Caucasus
artemis Richards, 1962; Cape Province
atra Schulthess, 1929; Cape Province
breyeri Richards, 1962; ?Transvaal
canariensis Blüthgen, 1958; Canary Islands
cincta Benoist, 1929; Morocco
chlorotica (Morawitz), 1888 (Jugurtia); USSR: Transcaspia
dilecta Ed. André, 1884; Algeria, Morocco, Tunisia
eremobia Richards, 1962; Algeria; Tripolitania
funebris Kostylev, 1935; USSR: Transcaspia
goleana Richards, 1962; Algeria
guichardi Richards, 1969; Canary Islands
haemmorrhoa ?
ssp. frontalis Blüthgen, 1961; Afganistan
halicticeps Giordani Soika, 1939; Egypt
hypatia Richards, 1962; Cape Province
indica Cameron, 1904; India (Deesa)
jocasta Richards, 1962; Cape Province
lesnei Benoist, 1929; Algeria
libanica Richards, 1964; Cyprus, Lebanon
major Kohl, 1898; Algeria, Morocco
media Schulthess, 1929; Cape Province
medusa Richards, 1962; Namibia

mochii Giordani Soika, 1939; Egypt
mongolica Morawitz, 1889; USSR: S. Mongolia
nilotica Fischer, 1964; Egypt
nubiana Richards, 1962; Egypt, Libya, Saudi Arabia,Sudan, Tunisia
ochraceopicta Schulthess, 1932; Namibia
orientalis Gusenleitner, 1973; Afganistan, Turkey
paradoxa Brauns, 1905; Cape Province
parcepunctata Richards, 1962; Cape Province
parvula Dusmet, 1909; Portugal, Spain
perone Richards, 1962; Cape Province
persephone Richards, 1962; Cape Province
pluto Richards, 1962; Cape Province
popovi Gussakovskii, 1936; USSR
proserpina Richards, 1962; Cape Province
punctulata Schulthess, 1930; Cape Rrovince
pusilla Kostylev, 1935; USSR: Turkmenistan
shestakovi Kostylev, 1935; USSR (Asiatic Russia)
soikai Richards, 1964; Turkey
syriaca Richards, 1964; Lebanon, Syria
  ssp. nitens Gusenleitner, 1973; Iran
thebaica du Buysson, 1902; Algeria, Egypt, Tripolitania
tricolorata Giordani Soika, 1954; Egypt
tripolitana Richards, 1962; Cyrenaica, Egypt, Tripolitania
  ssp. sinaitica Richards, 1964; UAR: Sinai
tuareg Giordani Soika, 1954; Algeria, Egypt
uzbeka Kostylev, 1935; USSR (Asiatic Russia)
vagepunctata Schulthess, 1929; Cape Province

Quartiniella Schulthess, 1929

flava Richards, 1962; Cape Province
minuscula Turner, 1939; Cape Province
striata Richards, 1962; Cape Province
turneri Schulthess, 1932; Namibia
waterstoni Schulthess, 1929; Cape Province

Quartinioides Richards, 1962

albopicta Richards, 1982; Namibia
andromeda Richards, 1962; Cape Province
antigone Richards, 1962; Cape Province
arsinoe Richards, 1962; Cape Province, Namibia
basuto Richards, 1962; Lesotho
capensis (Kohl), 1898 (Quartinia); Cape Province
    scutellimacula Schulthess, 1929 (Quartinia) (in part)
ceres Richards, 1962; Cape Province
cressida Richards, 1962; Cape Province, Namibia
cyllene Richards, 1962; Cape Province
cynara Richards, 1962; Cape Province
diana Richards, 1962; Namibia
dryope Richards, 1962; Cape Province
elissa Richards, 1962; Cape Province
eurydice Richards, 1962; Cape Province
galataea Richards, 1962; Cape Province
hecuba Richards, 1962; Cape Province, ?Natal
helena Richards, 1962; Cape Province
helichrysi Richards, 1962; Lesotho

hetaira Richards, 1962; Cape Province
interrupta (Turner), 1939 (Quartinia); Cape Province, Namibia
iphigenia Richards, 1962; Namibia
laeta (Schulthess), 1935 (Quartinia); Namibia
latona Richards, 1962; Cape Province
maerens (Schulthess), 1935 (Quartinia); Cape Province
matabele (Turner), 1939 (Quartinia); Zimbabwe
metallescens (Schulthess), 1929 (Quartinia); Cape Province, Lesotho
metope Richards, 1962; Namibia
minima (Schulthess), 1932 (Quartinia); Namibia
multipicta Richards, 1962; Cape Province
niveopicta (Schulthess), 1930 (Quartinia); Cape Provincce
philomela Richards, 1962; Cape Province
phoebe Richards, 1962; Cape Province
poecila (Schulthess), 1930 (Quartinia); Namibia
propinqua (Schulthess), 1932 (Quartinia); Cape Province, Namibia
senecionis Richards, 1962; Lesotho, Orange Free State
signata (Schulthess), 1929 (Quartinia); Cape Province
signatifrons (Turner), 1932 (Quartinia); Cape Province
tarsata Richards, 1962; Cape Province
titania Richards, 1962; Cape Province

Trimeria Saussure, 1854

americana (Saussure), 1853 (Erynnis); Brazil
bequaerti Willink, 1951; Argentina, Bolivia
buyssoni Brèthes, 1904; Argentina, Paraguay
howardi Bertoni, 1912; Argentina, Paraguay
joergenseni Schrottky, 1909; Argentina
monrosi Willink, 1959; Argentina
neotropica (Mocsáry), 1906 (Jugurtia); Paraguay