Flower visiting by masarid wasps in southern Africa (Hymenoptera: Vespoidea: Masaridae)

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ABSTRACT

Flower visiting records are given for 69 species belonging to six of the seven genera of southern African masarid wasps: *Ceramius* (14 spp.), *Jugurtia* (4 spp.), *Masarina* (3 spp.), *Celonites* (8 spp.), *Quartinia* (10 spp.) and *Quartinioides* (30 spp.).

The records, so far assembled, indicate that southern African masarids are most commonly associated with Mesembryanthemaceae (51%) and Compositae (28%), those species visiting flowers of other families such as Campanulaceae (12%), Scrophulariaceae (5%), Leguminosae (Papilionatae) (3%) and Liliaceae (2%) being the exceptions.

It is demonstrated that the majority of species exhibit fidelity to particular families or even genera of plants and that some species, at least, are probably of importance as pollinators to the plants which they visit.

INTRODUCTION

Studies of flower visiting by aculeate Hymenoptera have been concerned in the main with bees. General works on pollination such as Percival (1969), Proctor and Yeo (1973), Faegeri and van der Pijl (1979), Real (1983), and Barth (1985) have few references to flower visiting by aculeate wasps. Most aculeate wasps are, however, regular flower visitors, both adult male and female depending largely on nectar for nourishment. Though adult aculeate wasps are nectar feeders the larvae of the majority of species feed on spiders or insects supplied by their mothers. The Masaridae are exceptional in that the majority of species provision their larvae, bee-like, with pollen and nectar. Furthermore though short tongues are characteristic of the majority of wasps most masarids have long tongues (Figs 1 and 2), some considerably longer than the wasps' length from the frons to the tip of the abdomen, giving them the potential to obtain nectar from a wide range of flower forms including those in which the nectaries are inaccessible to short tongued wasps. They do not, however, get even a passing mention in Percival, Real, and Faegeri and van der Pijl and are mentioned only briefly in Proctor and Yeo (pages 367–368) and Barth (pages 33 and 61). Sufficient pollen, strategically placed is carried externally by masarid wasps to make them potential pollinators. Pollen for provisioning is ingested and is carried mixed with nectar in the crop. Richards (1962) in his world revision of the Masaridae reviewed the literature on flower visiting by these wasps and concluded that "The 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." Since then one such study has been conducted, the subjects of the study being a North American masarid, *Pseudomasaris vespoides* (Cresson), and flowers of the genus *Penstemon* (Scrophulariaceae) (Torchio, 1974). It has been stated in "A preliminary synthesis of pollination biology in the Cape flora" that Masaridae "are probably important floral visitors in southern Africa" (Whitehead, Giliomee and Rebelo in Rebelo, 1987), however, no indication is given of masarid/flower associations. The present authors have, during the past two decades, in the course of their studies of aculeate wasps and bees in the Cape Floral Region (more especially in the karroid areas of this region), kept records of flower visiting by wasps and bees (Gess and Gess, *Catalogue of flower visits by aculeate wasps*, unpublished). Some of these records have been published, those concerned with Masaridae being in Gess (1968, 1973 and 1981) and in Gess and Gess (1980, 1986, 1988a and 1988b). In the light of the current interest in pollination it seems useful to gather together all the available records of flower visiting by masarid wasps in southern Africa and those as yet unpublished and to assess the degree of fidelity exhibited by these wasps and their possible effectiveness as pollinators.

The family Masaridae (*sensu* Richards, 1962) is constituted of three sub-families, the Euparagiinae, Gayellinae and Masarinae. All three sub-families are represented in the New World but only the Masarinae are represented in the Old World. It is, however, in the Old World and in southern Africa in particular that the greatest speciation has occurred. Seven genera, *Ceramius* Latreille, *Jugurtia* Saussure, *Masarina* Richards, *Celonites* Latreille, *Quartinia* Ed. André, *Quartinioides* Richards and *Quartiniella* Schulthess are represented in southern Africa. *Masarina*, *Quartinioides* and *Quartiniella* are endemic to this region.

In the following account the genera are considered in order of decreasing body length which is associated with increasing relative tongue length (Table 1) (*Quartinia* and *Quartiniella* being the notable exceptions) and not following a systematic or phylogenetic sequence.

The flower visiting records are presented in tabular form necessitating the use of abbreviations. These are:

Colours:	B – blue; O – orange; Pi – pink; Pu – purple; PuPi – purplish pink; V – violet; W – white; Y – yellow; WY – cream.
Sex:	F – female; M – male.
Numbers:	digits – represent numbers of **specimens captured**; m – represents **many observations** of visits to flowers; p – pollen from **provision** representing an **unknown number of visits to flowers.**
Collectors:	CDM – C. D. Michener; CFJG – C. F. Jacot Guillarmod; DWG – D. W. Gess; EMCC – 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; WHRG – W. H. R. Gess.

In order to be consistent with earlier papers on Masaridae by Gess and Gess the names Compositae and Leguminosae are used rather than the presently favoured alternative names Asteraceae and Fabaceae. It should be noted that the plant here referred to as *Aspalathus spinescens* Thunb. *lepida* (E. Mey.) Dahlgren (det. J. Vlok, confirmed E. Brink) was previously referred to as *Aspalathus desertorum* Bol. (det. E. Brink following Bayliss BRI 618) (Gess and Gess, 1986, 1988a and 1988b).

Although full locality details are recorded on most specimen labels the localities are given in the tables by district, expressed as the name of the nearest town, as it is more informative for the purposes of this publication to group the localities.

FLOWER VISITING RECORDS

Ceramius Latreille

The genus *Ceramius* occurs in two widely separated geographical regions in the Old World, one being the extreme south west of the Afrotropical Region and the other that portion of the Palaearctic bordering on the Mediterranean Sea. In the Afrotropical Region the genus is in the main restricted to the Cape Province where it is found in Namaqualand, the South Western Cape, the Little Karoo, the southern parts of the Great Karoo and in the Eastern Cape as far east as the Great Fish River. Outside the Cape Province, one species, *C. damarinus* Turner, is endemic to the Kaokoveld and Ovamboland in Namibia (S. W. A.), and one Eastern Cape species, *C. capicola* Brauns, has been recorded from two localities (Kroonstad and Thaba Nchu) in the Orange Free State. The areas favoured by these wasps are in the main characterised by a predominantly winter rainfall and low, semi-arid vegetation. In southern Africa *Ceramius* favours those parts of the Karroid and False Karroid areas (Acocks, 1953 and 1975) which lie within the winter rainfall and spring/autumn rainfall regions. That is those karroid areas which fall within the Cape Floral Region (*sensu* Bond and Goldblatt, 1984) as defined in Rebelo (1987). The flight period in southern Africa is from September to March, the period for individual species being somewhat more limited.

The genus *Ceramius* has been divided on morphological characters into eight species groups (Richards, 1962; Gess and Gess, 1986) one of which has recently been sub-divided (Gess and

Fig. 1. *Ceramius clypeatus* Richards, an example of a relatively short tongued masarid wasp. Above: dorsal view of head with tongue extended (× 14). Below: short length of tongue (glossa) with the two halves separated (× 500).

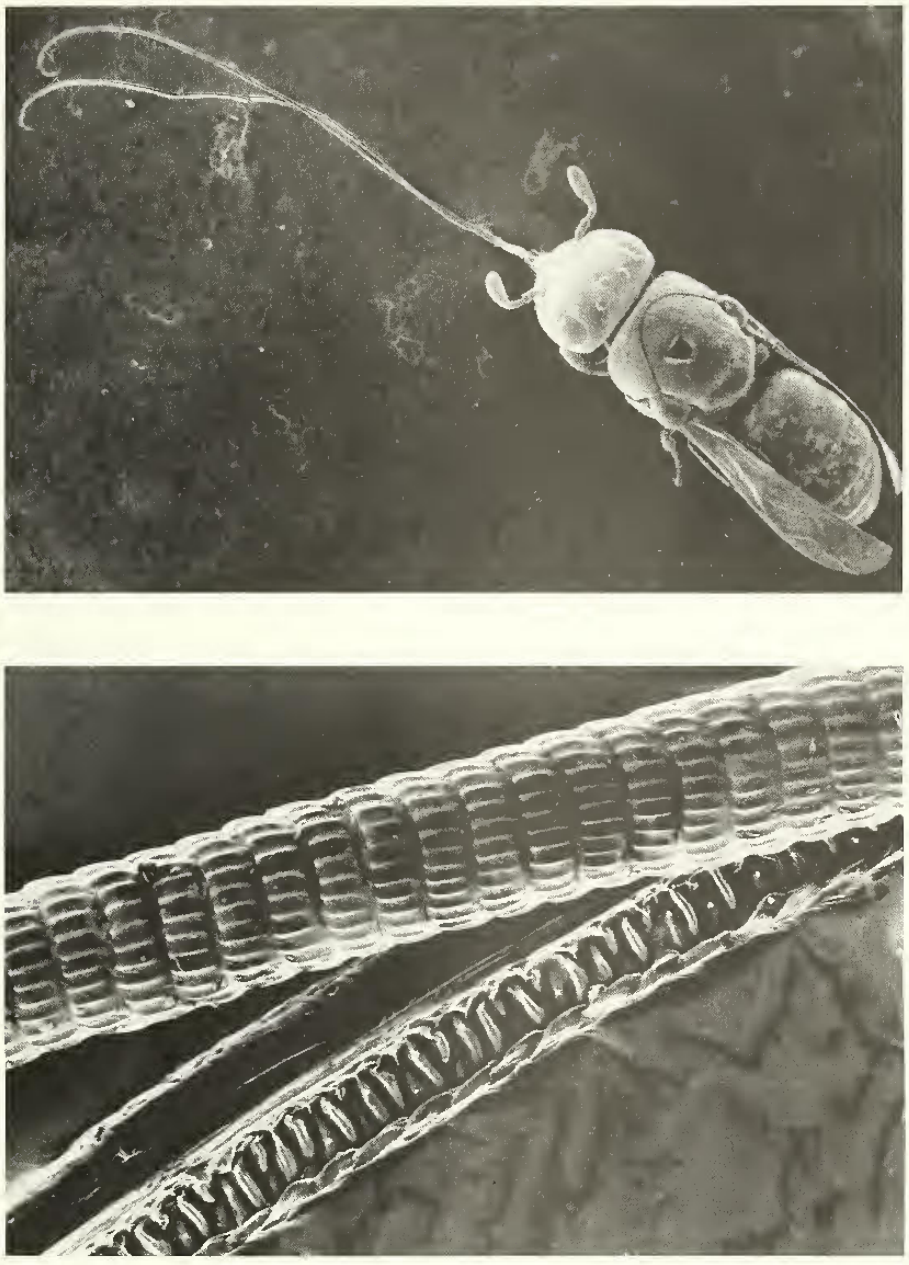

Fig. 2. *Quartinioides laeta* (Schulthess), an example of a relatively long tongued masarid wasp. Above: dorsal view with tongue extended (× 14). Below: short length of tongue (glossa) with the two halves separated (× 500).

Gess, 1988b). Six of these species groups are represented in southern Africa. Compared with other southern African masarids *Ceramius* spp. are medium to large wasps, females ranging in length from 11 mm (*C. bicolor* (Thunb.)) to 22 mm (*C. rex* Saussure). *Ceramius* species are relatively short tongued for masarid wasps (Table 1 and Fig. 1).

TABLE 1.

Body length, tongue length, and tongue length : 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 Latreille						
	bicolor (Thunberg)	F	4	10,83	2,96	0,27
		M	2	10,50	2,92	0,28
	braunsi Turner	F	10	17,28	4,70	0,27
	capicola Brauns	F	8	10,90	2,54	0,23
	clypeatus Richards	F	10	15,43	2,98	0,19
		M	10	15,48	3,18	0,21
	lichtensteinii (Klug)	F	6	17,78	5,56	0,31
		M	4	17,83	5,54	0,31
	nigripennis Saussure	F	6	14,86	4,08	0,27
	rex Saussure	F	1	20,86	5,83	0,28
Jugurtia Saussure						
	braunsi (Schulthess)	F	8	9,92	3,69	0,37
	braunsiella (Schulthess)	F	3	11,17	4,11	0,37
	confusa Richards	F	4	10,17	4,00	0,39
		M	4	10,08	4,23	0,42
Masarina Richards						
	familiaris Richards	F	8	10,09	3,54	0,35
		M	5	8,80	3,28	0,37
	mixta Richards	F	10	8,85	3,71	0,42
		M	8	7,45	2,92	0,39
Celonites Latreille						
	capensis Brauns	F	7	8,89	5,71	0,64
		M	2	8,75	5,04	0,58
	clypeatus Brauns	F	10	8,80	5,68	0,66
		M	2	7,63	4,96	0,65
	peliostomi Gess	F	20	6,76	4,73	0,70
		M	4	7,08	4,17	0,59
	wahlenbergiae Gess	F	6	7,47	4,29	0,57
		M	6	6,88	3,40	0,49
	bergenwahliae Gess	F	3	7,56	4,28	0,57
		M	7	6,56	3,35	0,51
Quartinia Ed. André						
	parcepunctata Richards	F	1	5,53	2,25	0,42
Quartinioides Richards						
	laeta (Schulthess)	F	3	3,69	4,88	1,32
	sp. F	F	2	3,94	5,40	1,37
	sp. M	F	1	4,20	1,76	0,42

Nesting is in burrows excavated with the aid of water in non-friable soil in horizontal or sloping but not vertical ground. As these wasps tend to nest in close proximity to their natal nests

they form nesting aggregations. These aggregations may themselves be extensive or may though small be abundant within an area so that where these wasps occur in large numbers there may be several thousand nests in close proximity (Gess and Gess, 1988b). The burrows are multicellular and are surmounted by a mud entrance turret (Gess and Gess, 1980, 1986 and 1988b). Each larva is provisioned with pollen and nectar presented in the form of a single firm loaf. Pairing at water seems to be most common for *Ceramius* species, however, *C. clypeatus* which has never been observed at water has been observed to pair on the forage plant, the male descending on a foraging female.

The only flower visiting records for Palaearctic *Ceramius* species seem to be few and casual and do not indicate any particular preferences (Richards, 1962 and 1963). Flower visiting records for Afrotropical *Ceramius* species, that is for *Ceramius* species in southern Africa, are listed in Table 2.

It should be noted that records in which digits are given in the column "number" are derived from samples of insects collected and are therefore in no way indicative of numbers of observed instances. This is particularly relevant in the cases of *C. capicola* Brauns, *C. linearis* Klug, and *C. lichtensteinii* (Klug) which, being species very familiar to the authors and common in the Grahamstown district, have been regularly observed by them foraging on "mesems" in large numbers. Similarly the sight of *C. lichtensteinii* foraging in large numbers on *Sphalmanthus cf. bijliae* (N.E.Br.) L.Bol. at Tierberg in the Prince Albert district in December 1987 was noted with interest but only a small number of voucher specimens was collected. *C. bicolor* (Thunberg), *C. clypeatus* Richards, *C. socius* Turner and *C. jacoti* Richards have similarly been observed foraging in greater numbers than the numbers of specimens collected would indicate. Such observations of large numbers of individuals visiting particular flowers are indicated in Table 2 by an "m" in the "numbers" column.

The results of analyses of pollen from pollen loaves, by comparing pollen obtained from these loaves with that from flowers growing in the vicinity of the nests, have been included in Table 2 and are indicated as visits to flowers of a particular species by a female but instead of a digit in the column "number" there is a "p" indicating "provision". In the cases of *C. clypeatus* Richards and *C. braunsi* Turner for which nests have not been found the pollen analysed was taken from the crops of female wasps. These records are also indicated in Table 2 by a "p" in the column "number". Apart from indicating fidelity in flower visiting for the purpose of collecting pollen for provisioning the pollen analyses serve to supplement and support flower visiting records. This is of particular interest for species such as *C. rex* Saussure and *C. nigripennis* Saussure for which flower visiting records are very few and for *C. braunsi* which has been recorded from forage plants of two families.

The records demonstrate that species and species groups within the genus *Ceramius* exhibit marked fidelity to flowers of a single family indicating that pollen and nectar are being obtained from the same plants. A possible exception is *C. braunsi* which has been recorded from both composite flowers and the flowers of *Aspalathus spinescens* Thunb. subsp. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae). Pollen from the crop of a female captured on *Aspalathus* flowers was found to be entirely composite, indicating a fidelity to Compositae when pollen gathering. Visits to *Aspalathus* flowers seem to have been solely for obtaining nectar. Records are too few to establish whether visits to flowers other than composites for obtaining nectar are habitual for *C. braunsi*. There are occasional records of casual visiting of flowers of another family by *C. lichtensteinii* (Group 5) which has been collected on *Blepharis*

(Acanthaceae) and *Senecio pterophorus* (Compositae) and by *C. capicola* (Group 8) which has been collected on *Berkheya* sp. (Compositae). However, pollen from pollen loaves of eight *Ceramius* species, *C. nigripennis* Saussure, *C. jacoti* Richards, *C. lichtensteinii* (Klug), *C. rex* Saussure, *C. bicolor* (Thunberg), *C. socius* Turner, *C. linearis* Klug and *C. capicola* Brauns, and from the crop of one species, *C. clypeatus* Richards, has never been found to contain pollen from mixed families (Gess and Gess, 1980, 1986, 1988b and present paper: Table 2). It is therefore considered that "mesems" are the habitual forage plants of *C. lichtensteinii* and *C. capicola* and that visits to other plants are casual in nature. This opinion is in keeping with that expressed by Cooper (1952) in a consideration of the records of flower visiting by *Pseudomasaris* in North America.

The flower visiting pattern of southern African *Ceramius* derived from the records at present available is:

Group 2a — Mesembryanthemaceae;
Group 2b — Leguminosae: Papilionatae;
Group 3 — Compositae;
Group 4 — Mesembryanthemaceae;
Group 5 — Mesembryanthemaceae;
Group 6 — Compositae;
Group 8 — Mesembryanthemaceae.

Gess (1965) when discussing the distribution of the genus *Ceramius* in southern Africa, at a time when no flower visiting records were available, stated that "it is likely that the flowers visited by *Ceramius* will prove to be low-growing Compositae and mesembryanthemums (Aizoaceae) which following the winter rains, are such a striking feature of the semi-desert areas inhabited by *Ceramius* in South Africa." This prediction has been upheld for the species occurring in karroid areas, of the 14 species for which records are available eight species are associated with Mesembryanthemaceae and five with Compositae. The exception, *C. clypeatus*, which forages on *Aspalathus* seems to be associated with Macchia (Fynbos) (Acocks, 1953 and 1975), more particularly Dry Mountain Fynbos and Mesic Mountain Fynbos (Moll *et al.*, 1984). It is notable that the "mesems" favoured by *Ceramius* species are most commonly white, pink or cream coloured. Dark pink to cerise, red and yellow "mesems" do not seem to be favoured. It is also of note that the composite flowers favoured by *Ceramius* species most commonly have entirely yellow or orange flower heads.

The posture of the wasp when gathering pollen or nectar on a "mesem" flower or a composite capitulum is to a large degree dependent on the relative sizes of the flower or capitulum and the wasp visitor. A flower or capitulum of greater diameter than the length of the wasp may readily be alighted upon (Fig. 3), however, when the diameter of the flower or capitulum is considerably smaller than the length of the wasp a more specialised technique is required. The flower or capitulum is grasped with the second and third pairs of legs and the abdomen is curved down and under to act as a balance.

The pollen gathering method employed by a *Ceramius* species was most clearly determined for *C. braunsi* Turner which was observed during the first week of October 1988 collecting pollen from flowers of *Arctotis laevis* Thunberg and *Athanasia trifurcata* (L.) L. (both Compositae) on a slope above the Clanwilliam Dam. The short curved fore legs were held beneath the wasps as they rotated them one over the other to agitate the anthers and draw the pollen towards the

Fig. 3. *Ceramius braunsi* Turner, collecting pollen, on a capitulum of *Arctotis laevis* Thunberg (Compositae) above the Clanwilliam Dam, October 1988.

mouth for ingestion. The wasp whilst thus engaged receives a coating of pollen on its undersurface (Fig. 4) and this is carried by it to the next capitulum which it visits.

Ceramius clypeatus Richards, when alighting on the small pea flowers of *Aspalathus spinescens* Thunb. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae) grasps the flower with the second and third pairs of legs and curves the abdomen down beneath the flower aiding its balance (Figs 5 and 6). The wasp always holds the alae whilst inserting its tongue at the base of the standard to reach the nectary. Whilst it is thus engaged the carina is forced open and the essential parts curve upwards to make contact with 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. 7) and as the wasp invariably positions itself in this manner it is ideally suited to transfer pollen from one flower to the stigma of another. During the second week of October 1987 and the first week of October 1988 *Ceramius clypeatus* with *Masarina familiaris* Richards (Masaridae) were found to be the commonest insects working the large number of *Aspalathus spinescens lepida* bushes on a hillside above the Clanwilliam Dam. Furthermore their daily period of foraging activity was remarkably long, being from 9.30 am to 5.30 pm. One individual of *C. clypeatus* alone was observed to visit forty flowers in a single foraging excursion.

When collecting pollen for provision *Ceramius clypeatus* grasps the alae with its second and third pair of legs and balances itself in much the same manner as it does when alighting on a flower preparatory to imbibing nectar. It ingests pollen directly from the anthers.

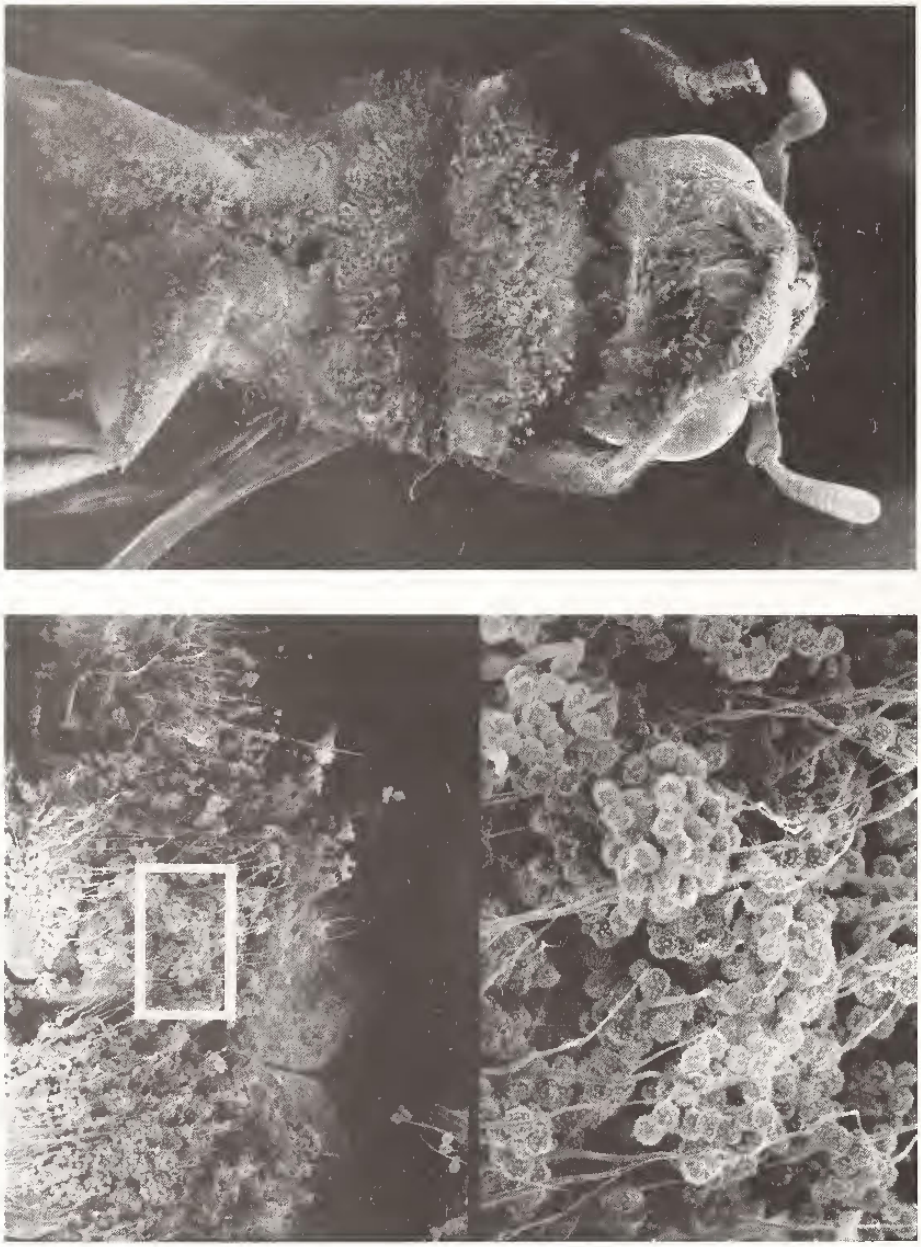

Fig. 4. *Ceramius braunsi* Turner. Above: ventral view of anterior half of wasp showing pollen of *Arctotis laevis* Thunberg (Compositae) on hairy underside (× 11). Below left: part of prosternum and base of front legs (× 30). Below right: boxed area × 150.

Fig. 5. *Ceramius clypeatus* Richards withdrawing from a flower of *Aspalathus spinescens* Thunb. subsp. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae) above the Clanwilliam Dam, October 1988.

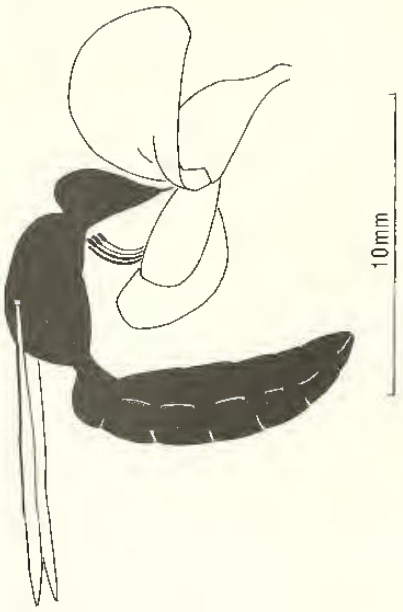

Fig. 6. Simplified diagrammatic representation of *Ceramius clypeatus* Richards (legs omitted) in nectar drinking position on flower of *Aspalathus spinescens* Thunb. subsp. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae).

TABLE 2.

Flower visiting records for *Ceramius* Latreille in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COLLEC-TOR	DATE
Ceramius Group 2a								
C. cerceriformis Saussure								
	Mesembryanthemaceae							
		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
C. peringueyi Brauns								
	Mesembryanthemaceae							
		Psilocaulon N.E.Br. *P. acutisepalum* (Berger) N.E.Br.	WPi	F	14	Vredendal	FWG&SKG	30.ix.85

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Group 2b								
C. clypeatus Richards								
	Leguminosae							
		Aspalathus L.						
		A. spinescens Thunb. subsp. *lepida* (E.Mey) Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	26.ix.85
		A. spinescens Thunb. subsp. *lepida* (E.Mey) Dahlgren	Y	M	1	Clanwilliam	FWG&SKG	28.ix.85
		A. spinescens Thunb. subsp. *lepida* (E.Mey) Dahlgren	Y	F	14	Clanwilliam	FWG&SKG	7–14.x.87
		A. spinescens Thunb. subsp. *lepida* (E.Mey) Dahlgren	Y	F	p	Clanwilliam	SKG	7–14.x.87
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	31	Clanwilliam	FWG&SKG	3–7.x.88
				M	9			
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	2	Clanwilliam	DWG	3–7.x.88
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F&M	m	Clanwilliam	FWG,SKG &DWG	3–7.x.88
Group 3								
C. nigripennis Saussure								
	Compositae							
		Dimorphotheca Vaill. ex. Moench.						
		D. sinuata DC	O	F	2p	Springbok	SKG	9.x.85
		Pentzia Thunb.						
		P. suffruticosa (L.) Hutch. ex. Merxm.	Y	F	1	Springbok	FWG&SKG	15–21.x.87
		Berkheya Ehrh.						
		B. sp.	Y	M	1	Springbok	FWG&SKG	15–21.x.87
		B. fruiticosa (L.) Ehrh.	Y	F	3	Springbok	MS	14–15.x.87
				M	3			
		Hirpicium Cass.						
		H. alienatus (Thunb.) Druce	Y	F	1	Springbok	MS	30.x.87
C. jacoti Richards								
	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
C. toriger Schulthess								
	Compositae							
		"blue rayed"	B	M	3	Clanwilliam	CDM	19.ix.66
C. braunsi Turner								
	Compositae							
		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
				M	4			
		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
		Pentzia Thunb.						
		P. sp	Y	—	1	Clanwilliam	DWG	3–7.x.88
		composite	—	F	p	Clanwilliam	SKG	3–7.x.88

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
	Leguminosae							
		Aspalathus L.						
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	2	Clanwilliam	FWG&SKG	3–7.x.88
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	2	Clanwilliam	DWG	3–7.x.88
				M	1			
Group 4								
C. beyeri Brauns								
	Mesembryanthemaceae							
		"mesem"	W	F	1	Grahamstown	FWG	16.i.69
		Sphalmanthus N.E.Br.						
		S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	1	Pr. Albert	FWG, SKG&RWG	26.xi.87–5.xii.87
Group 5								
C. lichtensteinii (Klug)								
	Mesembryanthemaceae							
		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	
		"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
				M	1		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
		Sphalmanthus N.E.Br.						
		S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	m	Pr. Albert	FWG,SKG &RWG	26.xi.87-5.xii.87
				M	m			
	Compositae (it was noted at the time that there were no mesems in flower)							
		Senecio L.						
		S. pterophorus DC	Y	F	2	Grahamstown		29.xi-2.xii.79
				M	4			
	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
				M	1			
Group 6								
C. rex Saussure								
	Compositae							
		Berkheya Ehrh.						
		B. spinosissima (Thunb.) Willd.	Y	F	1	Springbok	FWG	15–21.x.87
		B. spinosissima (Thunb.) Willd.	Y	F	3p	Springbok	SKG	15–21.x.87

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COLLEC-TOR	DATE
		"composite" including *B. spinosissima* (Thunb.) Willd.		F	p	Springbok	SKG	15–21.x.87
Group 8								
C. bicolor (Thunberg)								
	Mesembryanthemaceae							
		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	27.ix.85
				M	2			
		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
		"mesem"		F	p	Springbok	SKG	4.x.85
		"mesems"	W	—	—	Clanwilliam	CDM	19.ix.66
C. socius Turner								
	Mesembryanthemaceae							
		Psilocaulon N.E.Br.						
		P. acutisepalum (Berger) N.E.Br.	WPi	F&M	m	Clanwilliam	FWG&SKG	28.ix.85
		"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
		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
C. linearis Klug								
	Mesembryanthemaceae							
		Aridaria N.E.Br.						
		A. sp.	YW	F	11	Grahamstown	FWG&SKG	17.x.72
				M	10			
		A. dyeri L.Bol.	YW	F	3	Alicedale	FWG	2.xii.70
				M	5			
		A. plenifolia (N.E.Br.) Stearn	YW	F	4	Alicedale	JGHL	2.xii.70
				M	4			
		A. plenifolia (N.E.Br.) Stearn	YW	F	1	Alicedale	FWG	16.xii.71
				M	1			
		Malephora N.E.Br.						
		M. sp.	YW	F	22	Grahamstown	FWG&SKG	26.x.72
				M	44			
		Mesembryanthemum L.						
		M. aitonis Jacq.	W	F	4	Grahamstown	FWG	30.xii.71
				M	3			
		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
		Drosanthemum Schwant.						
		D. floribundum (Hw.) Schwant.	Pi	M	1	Grahamstown		29.xi.76

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
		D. floribundum (Hw.) Schwant.			p	Grahamstown	SKG	10.xii.74
		"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
				M	1			
		"mesems"		F&M	m	Grahamstown	FWG&SKG	
		"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
C. capicola Brauns								
	Mesembryanthemaceae							
		Aridaria N.E.Br.						
		A. plenifolia (N.E.Br.) Stearn	YW	—	—	Alicedale	FWG&JGHL	2.xii.70
		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
		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.-
				M	15			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
		Drosanthemum Schwant.						
		D. floribundum (Haw.) Schwant.	Pi	F	p	Grahamstown	SKG	
		"mesems"	—	—	m	Grahamstown	FWG&SKG	
		"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
				M	5			
	Compositae							
		Berkheya Ehrh.						
		B. sp.	Y	F	1	Thaba Nchu (Orange Free State)	CJFG	1.xii.52

Jugurtia Saussure

Jugurtia is an Old World genus occurring in the Palaearctic Region, bordering the Mediterranean and extending eastwards into Armenia and south western Persia, and in the Afrotropical Region, in Nigeria and southern Africa (Richards, 1962). In southern Africa its distribution parallels that of *Ceramius*. Similarly the flight period in this region is, like that of *Ceramius*, from September to March, the period for individual species being more limited.

Compared with other southern African masarids *Jugurtia* species are medium sized, ranging in length from 7–11 mm. The relative tongue length in *Jugurtia* is greater than in *Ceramius*, however, the actual tongue length is similar (Table 1).

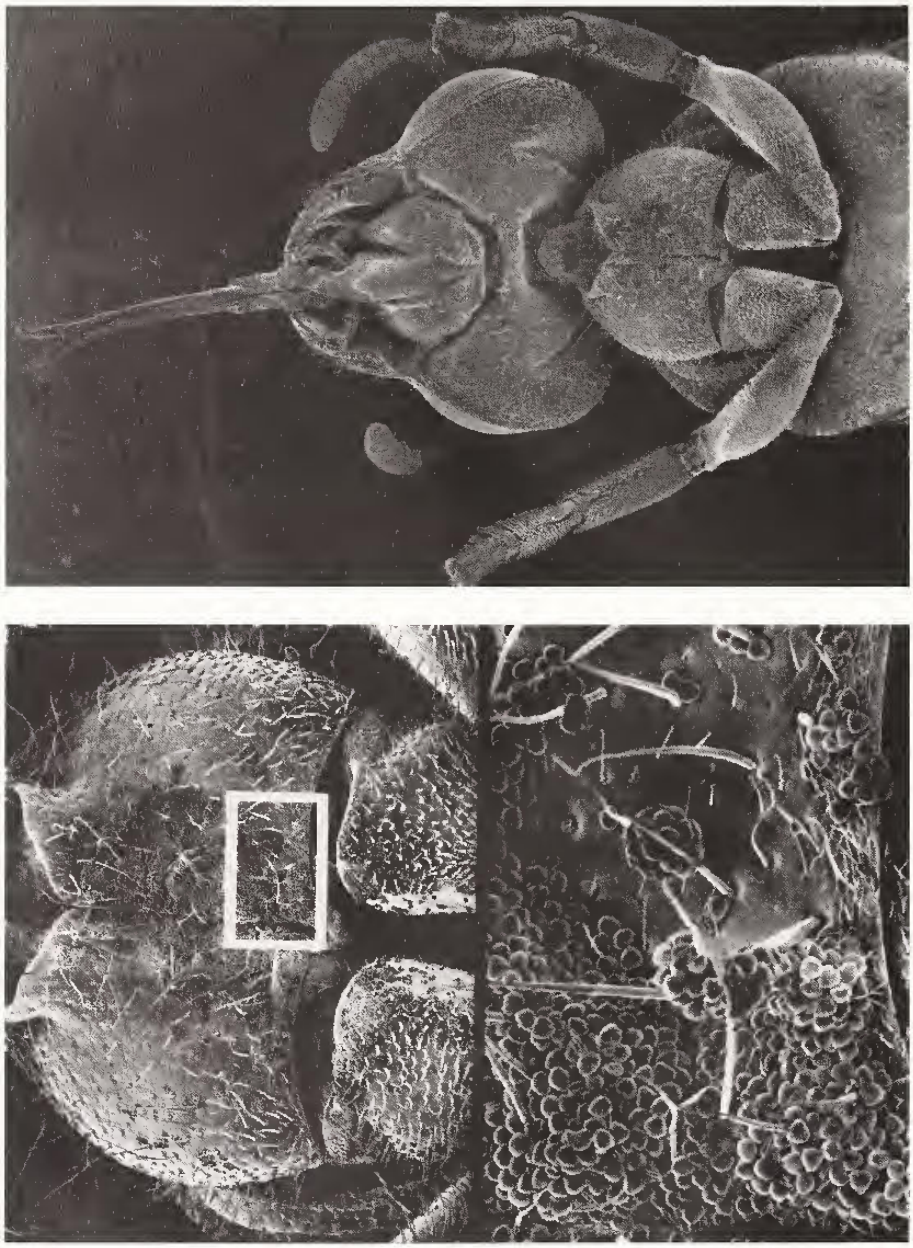

Fig. 7. *Ceramius clypeatus* Richards. Above: ventral view of anterior half of wasp showing area of impact with anthers of *Aspalathus spinescens* Thunb. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae) (× 12). Below left: prosternum and base of front legs (× 30). Below right: boxed area × 150.

Nesting of only one species, *Jugurtia confusa* Richards, has been investigated (Gess and Gess, 1980). This wasp nests in burrows excavated with the aid of water in horizontal ground. Like *Ceramius*, *Jugurtia* forms nesting aggregations. The burrows are multicellular and are surmounted by a mud entrance turret. Each larva is provisioned with pollen and nectar presented in the form of a single loaf.

The only flower visiting records for Palaearctic *Jugurtia* seem to be those of Bequaert (1940 in Richards, 1962) from Algeria. Richards states that "*Jugurtia* as far as the scrappy records go is not attached to any particular family". However, it can be seen from the flower visiting records for *Jugurtia* species from southern Africa listed in Table 3 that preferences similar to those of *Ceramius* are exhibited, Mesembryanthemaceae and Compositae appearing to be favoured. The single record of a male *J. confusa* on *Acacia karroo* may be considered as casual visiting. There is no evidence from pollen loaves examined that this species provisions with any pollen other than that obtained from "mesem" flowers (Gess and Gess, 1980).

The available records are at present too few for it to be possible to note any colour preferences for *Jugurtia* species.

TABLE 3.

Flower visiting records for *Jugurtia* Saussure in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COL-LECTOR	DATE
J. confusa Richards								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. parvifolium (Haw.) Schwant.	Pi	F	p	Grahamstown	SKG	8.xii.76
			—	M	1	Grahamstown	—	—
	Leguminosae: Mimosoidea							
		Acacia Mill.						
		A. karroo Hayne.	Y	M	1	Grahamstown	FWG	10.ii.77
J. braunsi (Schulthess)								
	Mesembryanthemaceae							
		"mesem"	Pi	F	1	Springbok	FWG&SKG	1.x. 85
		Drosanthemum Schwant.						
		*D.*sp.	Pi	F	1	Springbok	SKG	15–21.x.87
	Compositae							
		Senecio L.						
		S. sp.	Y	F	4	Springbok	FWG&SKG	10–12.x.88
J. braunsiella (Schulthess)								
	Compositae							
		Lasiospermum Lag.						
		L. bipinnatum (Thunb.) Druce	W	M	1	Grahamstown	FWG&SKG	12.x.77
		Pteronia L.						
		P. paniculata Thunb.	Y	F	1	Grahamstown	FWG&SKG	27.x.72
		Senecio L.						
		S. rosmarinifolius L.f.	Y	F	5	Oudtshoorn	FWG&RWG	7–12.xii.86
		S. rosmarinifolius L.f.	Y	F	p	Oudtshoorn	SKG	
		Felicia Cass.						
		F. sp.	B'	F	1	Springbok	SKG	15–21.ix.87
J. polita Richards								
	Compositae							
		Senecio L.						
		S. sp.	—	M	1	Cradock	OWR (Richards, 1962)	25.ix.52

***Masarina* Richards**

The genus *Masarina* is endemic to southern Africa and includes only four described species (Gess and Gess, 1988a). In distribution it seems to be centred in the South Western Cape, only one species, *M. familiaris* Richards, extending to the east as far as Willowmore.

Compared with other southern African masarids *Masarina* species are medium sized, ranging in length from 7,0–11,5 mm. The tongue length is, for masarids, moderate (Table 1).

Nesting is known only for *M. familiaris* (Gess and Gess, 1988a). There seems to be a tendency for an individual wasp to nest in close proximity to her natal nest and therefore for the development of nesting aggregations though at the two nesting sites where the investigations were made the numbers of nests were not great. It is possible that the time of the study, which was opportunistic, was not at the peak nesting period. The nests are burrows excavated with the aid of water in non-friable vertically presented soil. The burrows are multicellular and a downwardly curved mud turret is constructed at the entrance. The provision which is composed of pollen and nectar is moist and sticky and although it forms a single mass it does not form a discrete loaf as does the drier provision of *Ceramius* and *Jugurtia*.

Flower visiting records are available for three species of *Masarina*, *M. familiaris*, *M. mixta* Richards and *M. strucki* Gess. These records are given in Table 4. All the records for *M. familiaris* are for yellow flowered *Aspalathus* species (Leguminosae: Papilionatae). Pollen from the provision of *M. familiaris* was found to be exclusively of the *Aspalathus* type (Gess and Gess, 1988a).

During the second week of October 1987 and the first week of October 1988 *Masarina familiaris* and *Ceramius clypeatus* were found to be the commonest insects working the large number of *Aspalathus spinescens* Thunb. subsp. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae) bushes on a hillside above the Clanwilliam Dam. The daily period of foraging activity was remarkably long, being from 9.30 am to 5.30 pm. This wasp adopts a completely different stance on the small "pea flowers" from that adopted by the larger wasp *C. clypeatus* (Figs 5 and 6). 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 8 and 9). When imbibing nectar the wasp 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 (Fig. 9) so that it receives a considerable load of pollen (Fig. 10). As the wasp always positions itself in the same manner it is ideally suited to transfer pollen from one flower to the stigma of another.

When collecting pollen for provision *M. familiaris* ingests it directly from the anthers.

Although *M. familiaris* was observed in abundance on flowers of *Aspalathus* spp. in the second week of October 1987 and the first week of October 1988 and samples of 43 and 57 specimens were taken only one instance of *Masarina mixta* Richards visiting *Aspalathus* flowers was recorded. However, in October 1988 *M. mixta* was found to be a not uncommon visitor to flowers of *Wahlenbergia* sp. A, a sample of 24 specimens having been taken. More records are required, however, a possible preference for *Wahlenbergia* is indicated.

As only one record is available for *M. strucki* no comment can be made.

Fig. 8. *Masarina familiaris* Richards on flower of *Aspalathus spinescens* Thunb. subsp. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae).

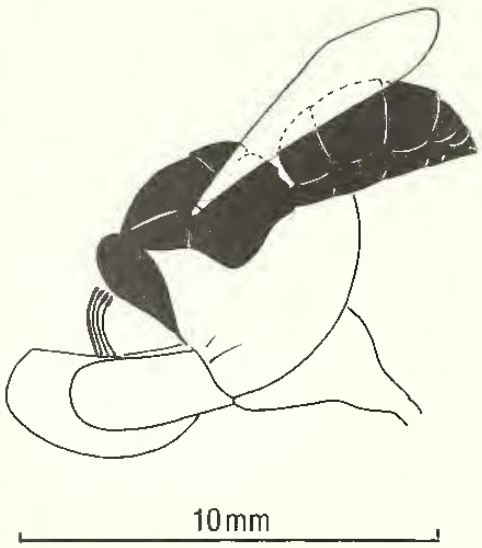

Fig. 9. Simplified diagrammatic representation of *Masarina familiaris* Richards (legs omitted) in nectar drinking position on flower of *Aspalathus spinescens* Thunb. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae).

TABLE 4.

Flower visiting records for *Masarina* Richards in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
M. familiaris Richards								
	Leguminosae: Papilionatae							
		Aspalathus L.						
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	22	Clanwilliam	FWG&SKG	8–13.x.87
				M	7			
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	3	Paleisheuvel	FWG&SKG	8–13.x.87
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	43	Clanwilliam	FWG&SKG	3–7.x.88
			M	4				
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	6	Clanwilliam	DWG	3–7.x.88
			M	4				

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COL-LECTOR	DATE
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F&M	m	Clanwilliam	FWG,SKG &DWG	3–7.x.88
		A. vulnerans Thunb.	Y	F	1	Clanwilliam	FWG&SKG	8–13.x.87
		A. sp.	Y	F	6	Clanwilliam	FWG&SKG	8–13.x.87
				M	4			
		A. sp./spp.		F	p	Clanwilliam	SKG	8–13.x.87
M. mixta Richards								
	Campanulaceae							
		Wahlenbergia						
		W. sp. A	V	F	19	Clanwilliam	DWG	3–7.x.88
				M	4			
		W. sp. A	V	M	1	Clanwilliam	FWG&SKG	3–7.x.88
	Leguminosae: Papilionatae							
		Aspalathus L.						
		A. spinescens Thunb. subsp. *lepida* (E.Mey.) Dahlgren	Y	F	1	Clanwilliam	FWG&SKG	8–13.x.87
M. strucki Gess								
	Sterculiaceae							
		Hermannia L.						
		H. disermifolia Jacq.	—	F	1	Springbok	MS	20.viii.85

***Celonites* Latreille**

Celonites is an Old World genus occurring in the Palaearctic Region in the countries bordering the Mediterranean Sea, northwards to Switzerland and southern Germany and eastwards to Transcaspia and south western Persia, and in the Afrotropical Region in north east Africa and the Cape Province of South Africa (Richards, 1962). In the Cape Province its distribution seems to be similar to that of *Ceramius* and *Jugurtia*: Namaqualand, the South Western Cape, the Little Karoo, the southern parts of the Great Karoo and the Eastern Cape, no further east than the Great Fish River and north to Aliwal North on the Orange River. One species, *C. promontorii* Brauns has been recorded from Thaba Nchu (Orange Free State) (collector C.F.Jacot Guillarmod recorded in Richards, 1962). Collecting records indicate a flight period in the Cape Province of October to December.

Compared with other southern African masarids *Celonites* species are medium sized ranging in length from 7–11,5 mm. The tongue length is relatively long (Table 1).

Little is known concerning the nesting behaviour of *Celonites* due undoubtedly to the cryptic nature of its nests. Brauns (1913) recorded that *Celonites andrei* Brauns constructs fragile mud cells in groups attached to each other lengthwise and situated on the underside of stones and on twigs. Only one group of *Celonites* cells has been discovered by the authors. This group, attached to a stem of a *Peliostomum* plant, consists of three robust mud cells cemented together lengthwise and enclosed in a mud envelope.

Richards (1962) lists flower visiting records for seven Palaearctic species of *Celonites* and one Afrotropical species. He comments that "*Celonites* does not seem to be attached to any one family of plants but nearly all records so far have been made very casually". A few additional records are given in Richards (1969), which might indicate some preference for Labiatae. Flower visiting records for seven southern African species are given in Table 5. Records for *C. capensis* Brauns certainly do not indicate any specificity in flower visiting. Those available for *C. wheeleri*

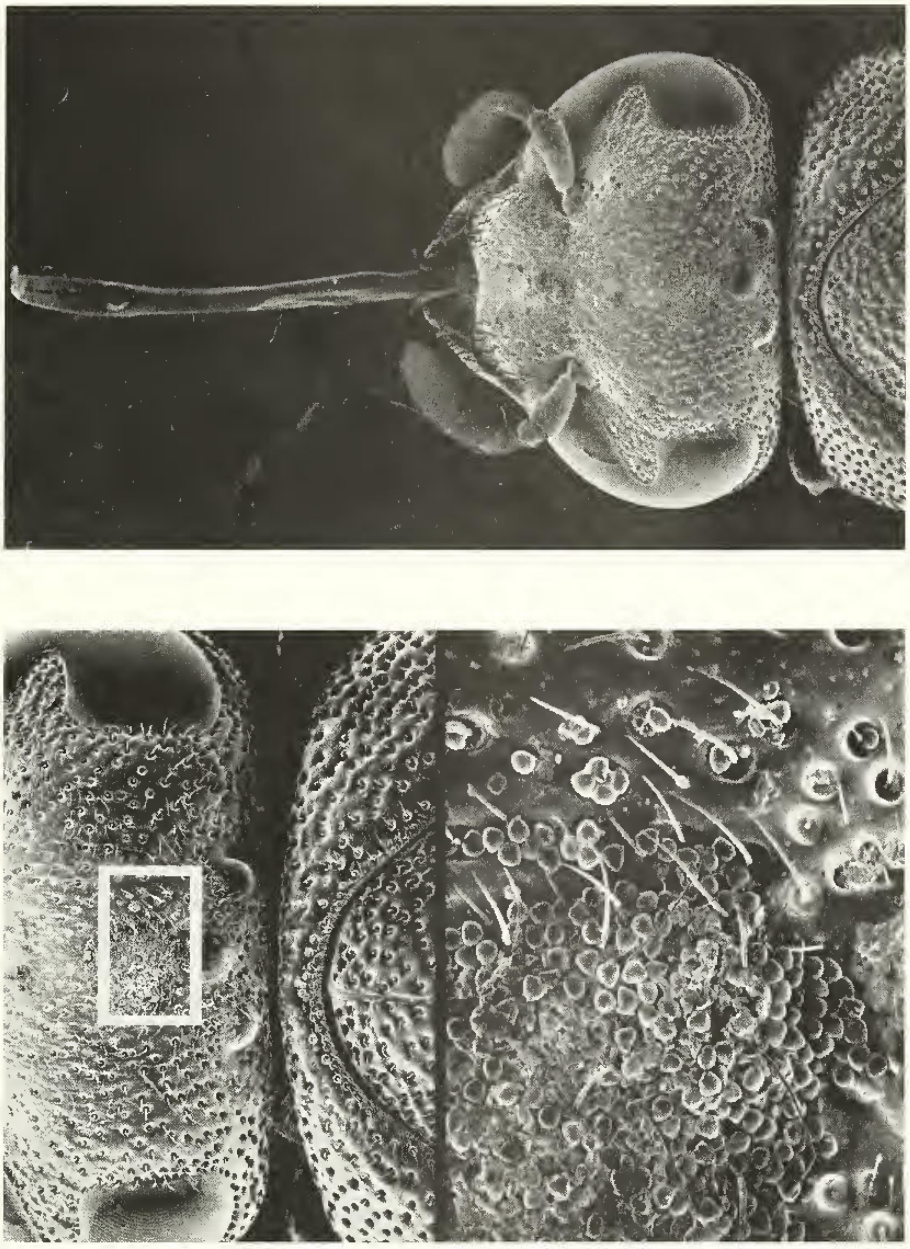

Fig. 10. *Masarina familiaris* Richards. Above: dorsal view of head showing area of impact with anthers of *Aspalathus spinescens* Thunb. *lepida* (E.Mey.) Dahlgren (Leguminosae: Papilionatae) (× 20). Below left: area of impact × 30. Below right: boxed area × 150.

Brauns and C. promontorii Brauns are too few for comment. The sample of specimens of *C. wahlenbergiae* Gess and *C. bergenwahliae* Gess taken from *Wahlenbergia* flowers is small, however, during intensive collecting at various sites in the Clanwilliam district during the periods 8–14.x.1987 and 3–7.x.1988 these wasps were seen to be relatively common in association with flowering *Wahlenbergia* spp. (samples of 28 specimens of *C. wahlenbergiae* and 17 specimens *C. bergenwahliae* were taken) but were found no where else indicating a probable association. Records for *C. andrei* Brauns, *C. clypeatus* Brauns and *C. peliostomi* Gess indicate a clear preference by these species for blue/violet flowers of *Aptosimum* spp. (Scrophulariaceae) (Figs 11 and 12) and the purple/violet flowers of the closely related *Peliostomum virgatum* (Scrophulariaceae) (Figs 13, 14 and 15). Particularly noteworthy is the record of 38 females of *C. peliostomi* collected in flowers of *Peliostomum virgatum* in the Hester Malan Nature Reserve, Springbok (FWG and SKG, 15–21.x.87) and the record of 24+ females of *C. clypeatus* collected in flowers of *Aptosimum depressum* 28 km from Grahamstown (FWG, SKG, DWG and RWG, 13.x.- 3.xii.81). Also of note is the record of the latter species collected in flowers of *Peliostomum virgatum* in the Hester Malan Nature Reserve, showing a constancy of preference between two very widely separated populations.

Flowers of *Aptosimum spinescens* (Thunberg) Weber in the Hester Malan Nature Reserve, Springbok were observed by the authors for an hour, from 10.30–11.30 am on 20.x.87 and visiting insects were recorded. During this period 12 instances of *Celonites* entering flowers were recorded and one instance of an *Anthophora*, which was of too great a diameter to enter these flowers, hovering at the mouth of a flower. A sample of six specimens of *Celonites* was taken as was the *Anthophora*. No other insects approached the flowers. The *Celonites* taken were 5 females of *C. peliostomi* and 1 female of *C. andrei*. On the same day flowers of *Peliostomum virgatum* E.Mey were observed from 12.30–1.15 pm. During this period 22 instances of *Celonites* entering flowers were recorded. No other insects approached the flowers. A sample of 16 specimens was taken. In all during the period 15–21.x.87 a sample of 45 *Celonites* entering flowers of *P. virgatum* was taken. These were 38 female and 3 male *C. peliostomi*, one female *C. andrei* and one female and two male *C. clypeatus*. No other insects were observed in, on or approaching these flowers although they were observed at all times of the day. Flowers of *Aptosimum depressum* in the Grahamstown district observed on various occasions for lengthy periods were found to be visited only by *C. clypeatus* and the very small *Quartinioides tarsata* Richards.

Pollen from the crops and backs of two females of *C.peliostomi*, one from a flower of *A. spinescens* and one from a flower of *P. virgatum* was examined. All the pollen was of the same type and when compared with that from the two flowers was found to match. Similarly pollen from the crop of a female *C. clypeatus* was compared with pollen from *Aptosimum depressum* which it was found to match. These records are indicated in the relevant table with a "p", as were provision records for the other genera.

The flowers of *Aptosimum* species and *Peliostomum* species are gullet flowers (Figs 16 and 17). The corolla is very narrow in the basal region protecting the nectaries from all but minute or long tongued visitors. The greater part of the corolla tube is wider but again restricts the size of visitors wishing to enter 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 which has its long axis horizontal. The style lies in a grove dorsally and when fully

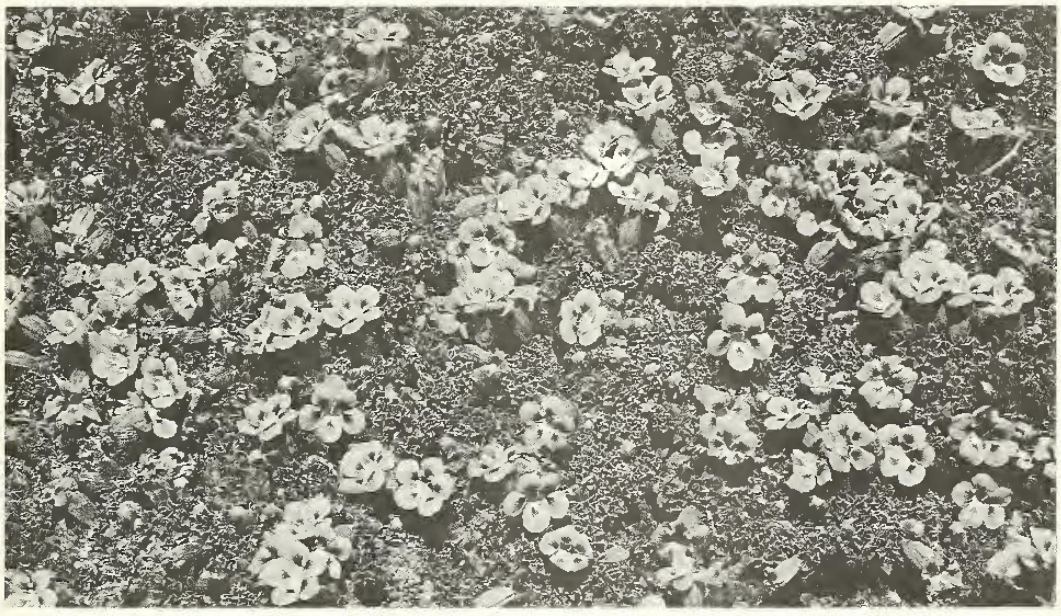

Fig. 11. *Aptosimum depressum* Burch. ex Benth. (Scrophulariaceae).

Fig. 12. *Aptosimum depressum* Burch. ex Benth. (Scrophulariaceae).

Fig. 13. *Peliostomum virgatum* E.Mey. ex Benth. (Scrophulariaceae).

Fig. 14 and 15. *Peliostomum virgatum* E.Mey. ex Benth. (Scrophulariaceae).

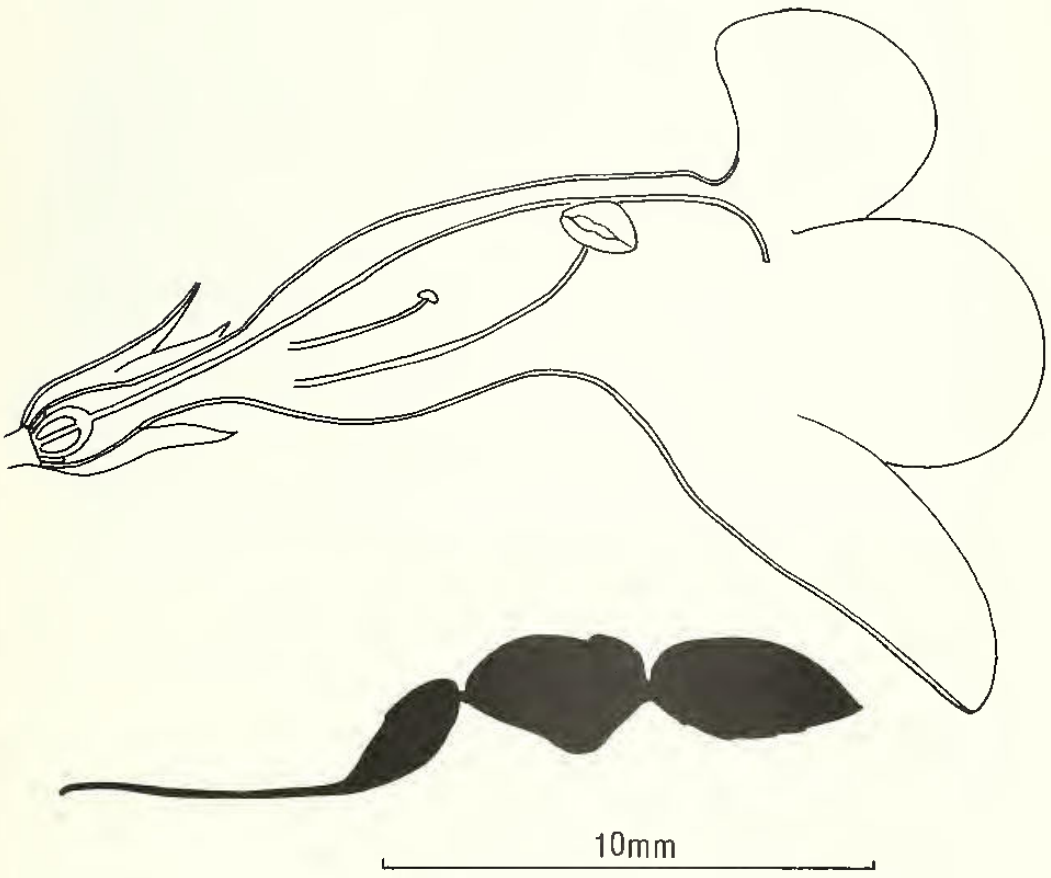

Fig. 16. Simplified diagrammatic representation of longitudinal section of flower of *Aptosimum depressum* Burch. ex Benth. (Scrophulariaceae) and profile of *Celonites clypeatus* Brauns (legs and wings omitted) to demonstrate flower/wasp fit.

extended projects at the mouth of the flower. The tip curves downwards so that the stigmatic surface is downwardly presented.

Celonites spp. when entering these flowers, especially those of *Peliostomum*, fit snugly so that they brush against the stigma and also receive a pollen load, particularly on the hind end of the thorax (Fig. 18). It is even likely that in entering a flower with ripe but not yet dehisced anthers these wasps trigger the dehiscence of the anthers. Having reached the base of the wide portion of the corolla tube they are well able to reach the nectaries. The narrow basal portion

of the corolla tube of *P. virgatum* is 4 mm long, that of *A. spinescens* 4,5 mm long and that of *A. depressum* is 5 mm long. The tongue of *C. peliostomi* which visits *P. virgatum* and *A. spinescens* is 4,8–5 mm long and that of *C. clypeatus* which visits *P. virgatum* and *A. depressum* is 5,8 mm long.

Barth (1985: 61, Fig. 16) gives a short description illustrated with line drawings of the alleged pollen collecting apparatus of *Celonites abbreviatus* (Villers) and the manner in which it is used. The story is ingenious but unfortunately when the authors examined a specimen of *C. abbreviatus* they found that there were no "button-ended collecting bristles on the front surface" of the head. The frons is hairy but the hairs taper towards their tips which are curved.

It seems most likely that as has been observed for *Ceramius* and *Quartinioides* (present paper) and for a pollen ingesting paracolletine bee (Houston, 1981) pollen is simply drawn towards the mouth by the front legs and that it is then ingested. Pollen from dehisced anthers of *Aptosimum* and *Peliostomum* flowers would be freely available for collection from the "floor" of the horizontal corolla tube. Similarly as the flowers of the *Wahlenbergia* spp. visited by *Celonites* spp. are erect pollen from dehisced anthers would be freely available for collection being retained within the cup-like corolla. The description of pollen collecting by *Celonites* in Barth, disregarding the inaccurate description of the hairs, is surely related to grooming behaviour rather than deliberate pollen collection.

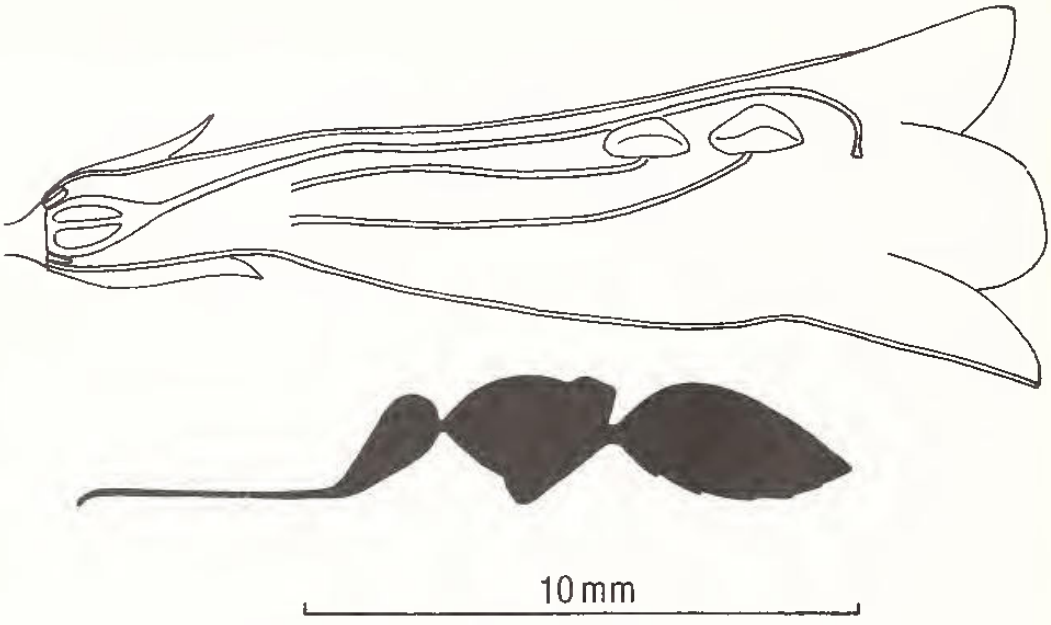

Fig. 17. Simplified diagrammatic representation of longitudinal section of flower of *Peliostomum virgatum* E.Mey. ex Benth. (Scrophulariaceae) and profile of *Celonites peliostomi* Gess (legs and wings omitted) to demonstrate flower/wasp fit.

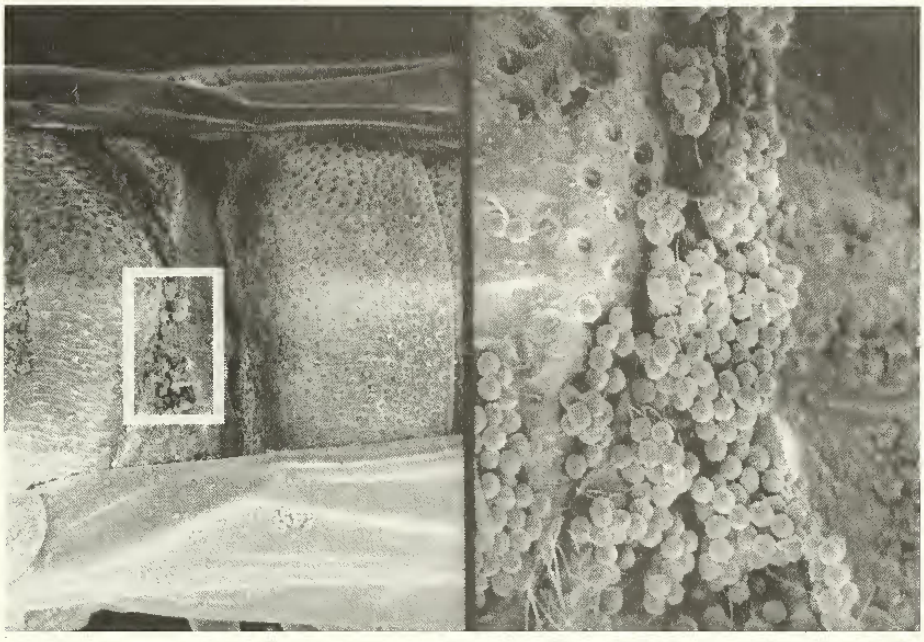

Fig. 18. *Celonites peliostomi* Gess. Left: dorsal view of posterior end of thorax and anterior end of abdomen showing deposition of pollen (× 30). Right: boxed area × 150.

TABLE 5.

Flower visiting records for *Celonites* Latreille in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	FORAGE PLANT GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COL-LECTOR	DATE
C. andrei Brauns								
	Scrophulariaceae							
		Aptosimum Burch.						
		A. spinescens (Thunb.) Weber	BV	F	1	Springbok	SKG	15–21.x.87
		Peliostomum Benth.						
		P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	FWG&SKG	15–21.x.87
C. peliostomi Gess								
	Scrophulariaceae							
		Aptosimum Burch.						
		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. lineare Marloth & Engl.	BV	M	1	Springbok	SKG	15–21.x.87

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COL-LECTOR	DATE
		Peliostomum Benth.						
		P. virgatum E.Mey ex Benth.	PV	F	38	Springbok	FWG&SKG	15–21.x.87
				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.1987
C. clypeatus Brauns								
	Scrophulariaceae							
		Aptosimum Burch.						
		A. depressum Burch. ex Benth.	BV	F	24+	Grahamstown	FWG,SKG DWG&RWG	13.x-3.xii.81
		A. depressum Burch. ex Benth.	BV	M	4	Grahamstown	FWG&SKG	22–30.x.81
		A. depressum Burch. ex Benth.	BV	F	p	Grahamstown	FWG&SKG	30.x.81
		Peliostomum Benth.						
		P. virgatum E.Mey ex Benth.	PV	F	1	Springbok	FWG&SKG	15–21.x.87
				M	2	Springbok	SKG	15–21.x.87
C. capensis Brauns								
	Scrophulariaceae							
		Phyllopodium Benth.						
		P. cuneifolium (L.f.) Benth.	BV	F	3	Grahamstown	DWG	9–14.xii.82
	Boraginaceae							
		Ehretia P.Br.						
		E. rigida (Thunb.) Druce	BV	M	1	Grahamstown	FWG&SKG	26.x.77
	Geraniaceae							
		Pelargonium L'Herit.						
		P. myrrhifolium (L.) L'Herit.	WR	F	11	Oudtshoorn	CFJG	10.x.72
				M	1			
	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
C. wheeleri Brauns								
	Compositae							
		Berkheya Ehrh.						
		B. cf. spinosa (L.f.) Druce	Y	F	2	Pr. Albert	FWG&SKG	26.xi-5.xii.87
C. promontorii Brauns								
	Compositae							
		Berkheya Ehrh.						
		B. sp.	—	F	4	Thaba Nchu (OFS)	CFJG (Richards, 1962)	1.xi.52
		B. cf. spinosa (L.f.) Druce	Y	F	6	Pr. Albert	SKG	26.xi.-5.xii.87
		Senecio L.						
		S. rosmarinifolius L.f.	Y	F	2	Oudtshoorn	FWG	7–8.xii.86
C. wahlenbergiae Gess								
	Campanulaceae							
		Wahlenbergia Schrad. ex Roth.						
		W. sp. A	V	M	2	Clanwilliam	FWG&SKG	14.x.87
		W. sp. A	V	F	4	Clanwilliam	FWG&SKG	3–7.x.88
		W. sp. A	V	M	3	Clanwilliam	DWG	3–7.x.88

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COL-OUR	SEX	NUM-BER	LOCALITY	COL-LECTOR	DATE
C. bergenwahliae Gess	Campanulaceae	*Wahlenbergia* Schrad. ex Roth.						
		W. sp. B	V	F	2	Clanwilliam	FWG&SKG	6.x.88
				M	7	Clanwilliam	FWG&SKG	6.x.88

***Quartinia* Ed. André**

The genus *Quartinia* Ed. André is an Old World genus occurring in the Palaearctic Region bordering the Mediterranean Sea and extending eastwards into Asiatic Russia and India, and in the Afrotropical Region in the South Western Cape, Southern to South Eastern Cape, Namaqualand and Namibia (S. W. A.) (Richards, 1962 and label data, Albany Museum). In numbers it is a relatively large genus.

Compared with other southern African masarids *Quartinia* species are small ranging in length from 2,5–6,5 mm. The tongue is moderately long. It is folded only once on itself as the glossal sac is relatively long.

There are no nesting accounts for *Quartinia*. Of interest, therefore, is the observation that *Quartinia* species have been observed "making burrows in the ground" (C. F. Jacot Guillarmod, pers. com.).

In the Palaearctic Region six species have been collected on Compositae and two species on Chenopodiaceae (Richards, 1962). Flower visiting records for the Afrotropical Region are given in Table 6. Seven of the ten species for which records are available have been recorded from Mesembryanthemaceae only, one species from Aizoaceae, one from Mesembryanthemaceae and Campanulaceae and one from Campanulaceae only. Records of particular interest are those for species which were visiting *Wahlenbergia* spp. (Campanulaceae). Patches of low growing *Wahlenbergia* sp. A at the Clanwilliam Dam were observed for insect visitors during the period 3–7.x.88. The most common visitors were *Quartinia* spp. and *Quartinioides* spp. The plants which were in full flower were approximately 10 cm high. The deep violet flowers which are held erect are 5 mm high with the upper part of the corolla tube 1,6 mm wide and the lower part 0,8 mm wide (Fig. 19). In the bud and the newly opened flower the receptive surfaces of the three stigmatic lobes are closely adpressed to 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. 19a). The anthers dehisce introrsely before the bud opens. When the flower opens the pollen coats the upper part of the style being supported by the collar and giving the whole a club-like appearance. After the flower has been open some little while the hairs supporting the pollen disappear and the pollen falls being retained within the corolla. The style lobes then separate presenting their receptive surfaces (Fig. 19b). The wasps 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 and pollen is lodged principally on the hind end of the thorax and the anterior end of the abdomen. When a wasp 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. *Quartinia* spp. are particularly well suited to effect pollination as they fit the flowers very snugly (Fig. 19c).

TABLE 6.

Flower visiting records for *Quartinia* Ed. André in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	FORAGE PLANT GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. persephone Richards								
	Mesembryanthemaceae							
		Psilocaulon N.E.Br.						
		P. acutisepalum (Berger) N.E.Br.	Pi	F	1	Clanwilliam/ Klaver	FWG&SKG	27.ix.65
	Campanulaceae							
		Wahlenbergia Schrad. ex Roth.						
		W. sp. A	V	F	1	Clanwilliam	DWG	3–7.x.88
		W. sp. D	V	F	1	Clanwilliam	DWG	5–6.x.88
				M	2			
		W. sp. D	V	M	1	Clanwilliam	FWG&SKG	5–6.x.88
Q. parcepunctata Richards								
	Campanulaceae							
		Wahlenbergia Schrad. ex. Roth.						
		W. sp. A	V	F	13	Clanwilliam	DWG	3–7.x.88
				M	1			
		W. sp. A	V	F	5	Clanwilliam	FWG&SKG	3–7.x.88
				M	1			
		W. sp. D	V	F	4	Clanwilliam	FWG&SKG	5–6.x.88
Q. ochraceopicta Schulthess								
	Mesembryanthemaceae							
		"mesem"	W	—	—	Aus (Namibia)	RET	(Turner, 1939)
Q. punctulatum Schulthess								
	Mesembryanthemaceae							
		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)
Q. media Schulthess								
	Mesembryanthemaceae							
		Mesembryanthemum	crimson	—	—	Worcester	RET	(Turner, 1939)
Q. vegipunctata Schulthess								
	Mesembryanthemaceae		—	—	—	—	RET	(Turner, 1939)
Q. atra Schulthess								
	Mesembryanthemaceae							
		Mesembryanthemum	—	—	—	—	RET	(Turner, 1939)
Q. sp. A								
	Mesembryanthemaceae							
		Polymita N.E.Br.						
		P. albiflora (L.Bol.) L.Bol.	—	F	1	Springbok	MS	6.xi.87
Q. sp. B								
	Mesembryanthemaceae							
		Prenia N.E.Br.						
		P. sladeniana (L.Bol.) L.Bol.	—	F	1	Springbok	MS	17.x.87

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. jocasta Richards	Aizoaceae	*Galenia* L. *G. filiformis* (Thunb.) N.E.Br.	—	F	2	Springbok	MS	3.xi.87

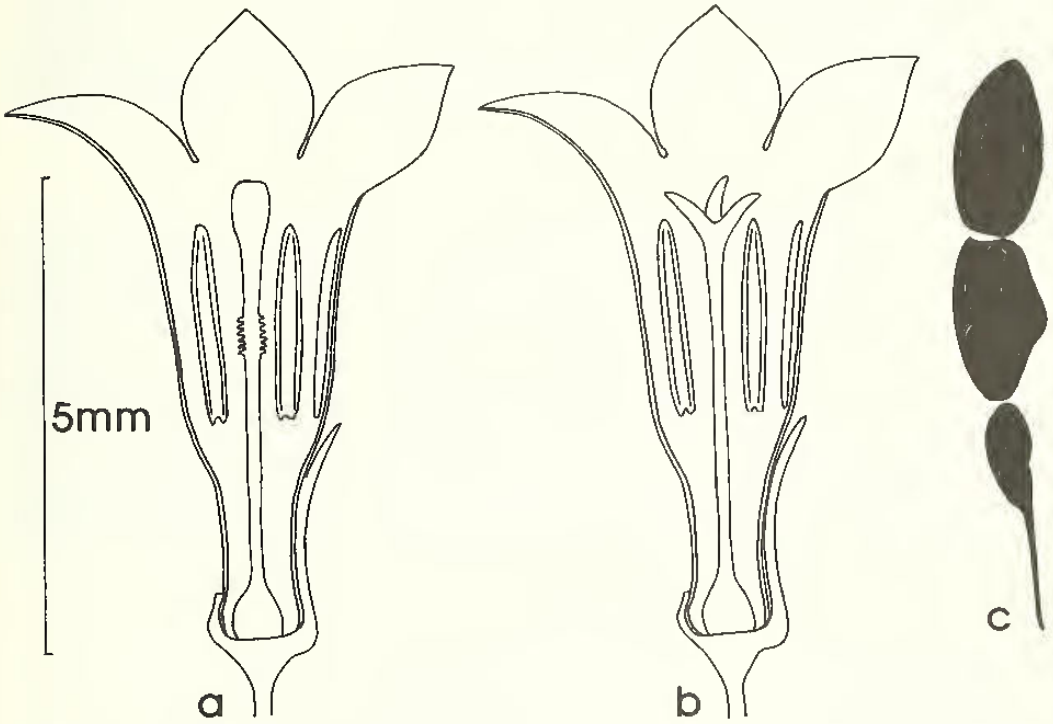

Fig. 19. (a and b). Simplified diagrammatic representations of longitudinal sections of two flowers of *Wahlenbergia* sp. A: (a) freshly opened with stigmatic lobes closely adpressed and pronounced collar of hairs and (b) open for some time with stigmatic lobes separated and collar of hairs withered away. (c). Simplified diagrammatic representation of *Quartinia parcepunctata* Richards (legs and wings omitted) to demonstrate flower/wasp fit.

Quartinioides Richards

The genus *Quartinioides* Richards is endemic to southern Africa where it is recorded from the South Western Cape, the Southern Cape, the Eastern Cape, Namaqualand, Namibia (S. W. A.), Lesotho (Basutoland) and Bulawayo, Zimbabwe (Southern Rhodesia) (Richards, 1962). In numbers of species it is a relatively large genus. Richards (1962) lists 38 species but states that he expects that there are many more species. The species here listed by letter from A–T represent species which could not be determined and must include many undescribed species. Clearly a revision of the genus is required, however, for the present purpose, that of determining the flower visiting pattern of the genus, names are not essential.

Figs 20—22. *Quartinioides* sp. I in flower of *Drosanthemum* sp. (Mesembryanthemaceae) at Anenous, Namaqualand, October 1988.

Figs 23–25. *Quartinioides laeta* (Schulthess) in flower of *Stoeberia* sp. (Mesembryanthemaceae) at Aggeneys, Bushmanland, October 1988.

Figs 26–28. *Quartinioides* sp. M in flower of *Wahlenbergia* sp. C (Campanulaceae) at Anenous, Namaqualand, October 1988.

Compared with other southern African masarids *Quartinioides* species are small, 2,5–5,0 mm in length. The greatest relative tongue length (1,37 × body length) is found in *Quartinioides* (Table 1 and Fig. 2). As the glossal sac is relatively short the tongue when retracted is folded several times upon itself. That not all species of *Quartinioides* have remarkably long tongues is demonstrated by *Q.* sp. M in which the tongue is less than half the body length (Table 1). This remarkable variation in tongue length seems to be related to the nature of the flowers visited, the two remarkably long tongued species listed being visitors to "mesems" and the relatively shorter tongued species being a visitor to *Wahlenbergia*.

There are no nesting accounts for *Quartinioides*. Of interest, therefore is the observation of *Quartinioides* sp. H excavating burrows in sand in the coastal dunes at McDougal Bay near Port Nolloth on the west coast (Gess and Gess, 1985, unpublished field notes). The nests as might be expected were not surmounted by entrance turrets. Pairing on flowers has been observed.

Flower visiting records for 30 species of *Quartinioides* are listed in Table 7. There appears to be, as also noted for *Ceramius* and *Jugurtia*, a marked association between these wasps and flowers of the families Mesembryanthemaceae (18 spp.) (Figs 20–25) and Compositae (7 spp.), favoured colours seeming to be light shades for the Mesembryanthemaceae and yellow to orange for Compositae. Also of interest is a possible preference by some species for *Wahlenbergia* spp. (Campanulaceae) (3 spp.) (Figs 26–28), a preference which is also indicated for some species of *Celonites* (Table 5) and *Quartinia* (Table 6). Of particular interest is the association of *Q. antigone* Richards with *Aloe striata* (Liliaceae), 24 females and 5 males being indicative of more than casual visiting.

When collecting nectar from "mesem" flowers *Quartinioides* insert themselves deeply into the flower being visited, however, when collecting pollen from these and composite capitula they stand on their second and third pairs of legs on the "surface" of the flower or capitulum with the first pair of legs beneath them being rotated in such a manner that the anthers are agitated and the pollen is drawn forwards for ingestion in a similar manner to that observed for *Ceramius braunsi*. When visiting *Wahlenbergia* flowers they alight on the lip of the corolla and then enter. Being smaller than *Quartinia* they are able to turn around in the flower and may therefore emerge head first. Although they do not "fit" the flowers as snugly as *Quartinia*, through their activities in the flowers they probably serve effectively as agents transfering pollen from one flower to the stigma of another.

Quartinioides are generally the commonest visitors to the plants which they patronize and this combined with their usually being very numerous makes them potentially of importance as pollinators to their forage plants.

TABLE 7.

Flower visiting records for *Quartinioides* Richards in southern Africa.

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. antigone Richards	Liliaceae	*Aloe* L.						
		A. striata Haw.	PiO	F M	24 5	Pr. Albert	FWG	26.xi- 5.xii.87

WASP SPECIES	FORAGE PLANT FAMILY	FORAGE PLANT GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. helichrysi Richards								
	Compositae							
		Helichrysum Mill.						
		H. fruticans (L.) D.Don.	—	F	3	Lesotho	CFJG	28.xii.48
		H. fruticans (L.) D.Don.	—	F	5	Lesotho	CFJG (in Richards, 1962)	28–31.xii.48
Q. metallescens (Schulthess)								
	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 (in Richards, 1962)	9–17.xi.52
Q. senecionis Richards								
	Compositae							
		Senecio L.						
		S. laevigatus Thunb.	—	F	9	OFS	CFJG	1.xii.52
				M	1			
		S. laevigatus Thunb.	—	F	27	OFS	CFJG	1.xii.52
				M	2		(in Richards, 1962)	
		Aster L.						
		A. muricatus Thunb.	BV	F	6	Lesotho	CFJG	12.xii.54
				M	1			
		A. muricatus Thunb.	BV	F	11	Lesotho	CFJG	12.xii.54
				M	7		(in Richards, 1962)	
		Gazania Gaertn.						
		G. sp.	—	—	—	Lesotho	CFJG (in Richards, 1962)	13.xi.48
Q. poecila (Schulthess)								
	Compositae							
		Berkheya Ehrh.						
		B. sp.	—	—	—	Namibia	RET (Turner, 1939, in Richards, 1962)	
Q. basuto Richards								
	Compositae							
		Gazania Gaertn.						
		G. linearis (Thunb.) Druce	Y	F	1	Lesotho	OWR	29.ix.52
				M	1		(in Richards, 1962)	
		Aster L.						
		A. muricatus Thunb.	BV	F	1	Lesotho	CFJG	17.xi.52
Q. propinqua (Schulthess)								
	Compositae							
		Hirpicium Cass.						
		H. echinus Less.	Y	F	7	Aggeneys	FWG&SKG	14.x.88
Q. sp. G								
	Compositae							
		Berkheya Ehrh.						
		B. cf. spinosa (L.f.) Druce	Y	F	1	Pr. Albert	SKG	26.xi-5.xii.87
Q. sp. I								
	Compositae							
		"daisy"	Y	F	4	Springbok	FWG&SKG	10–12.x.88
	Mesembryanthemaceae							
		Prenia N.E.Br.						
		P. pallens (Ait.) N.E.Br.	—	F	3	Springbok	MS	27.x.87
		Drosanthemum Schwant.						
		D. sp.	Pi	F	3	Anenous	FWG&SKG	11–13.x.88

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. tarsata Richards								
	Mesembryanthemaceae							
		Delosperma N.E.Br.						
		D. acuminatum L.Bol.	—	—	12	Grahamstown	CFJG	24.iv.64
		Drosanthemum Schwant.						
		D. hispidum (L.) Schwant.	Pi	F	2	Grahamstown	EMCC	18.x.52
		D. hispidum (L.) Schwant.	Pi	F	1	Grahamstown	EMCC (in Richards, 1962)	10.x.53
	Scrophulariaceae							
		Aptosimum Burch.						
		A. depressum Burch. ex Benth.	BV	F	14	Grahamstown	FWG&SKG	13–30.x.81
Q. sp. A								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. sp.	Pi	F	1	Bitterfontein/ Garies	SKG	14.x.87
Q. sp. B								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. sp.	Pi	F	1	Bitterfontein/ Garies	SKG	14.x.87
Q. sp. C								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. hispidum (L.) Schwant.	Pi	F	1	Springbok	FWG&SKG	15–21.x.87
Q. laeta (Schulthess)								
	Mesembryanthemaceae							
		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
		Stoeberia Dinter & Schwant.						
		S. sp.	Pi	F	275	Aggeneys	FWG&SKG	14.x.88
				M	10			
		S. sp.	Pi	F	62	Aggeneys	DWG	14.x.88
				M	25			
		Prenia N.E.Br.						
		P. sladeniana (L.Bol.) L.Bol.	—	F	1	Springbok	MS	17.x.87
Q. sp. E								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. hispidum (L.) Schwant.	Pi	F	2	Springbok	FWG&SKG	15–21.x.87
				M	1			
Q. sp. F								
	Mesembryanthemaceae							
		Sphalmanthus N.E.Br.						
		S. cf. bijliae (N.E.Br.) L.Bol.	WPi	F	209	Pr. Albert	FWG,SKG &RWG	26.xi-5.xii.87
				M	8			
		Psilocaulon N.E.Br.						
		P. cf. articulatum (Thunb.) Schwant.	Pi	F	19	Pr. Albert	FWG,SKG &RWG	26.xi-5.xii.87

WASP SPECIES	FORAGE PLANT FAMILY	FORAGE PLANT GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. sp. H								
	Mesembryanthemaceae							
		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
Q. sp. K								
	Mesembryanthemaceae							
		"mesem"	YW	F	1	Willowmore	CFJG	4.x.71
Q. sp. J								
	Mesembryanthemaceae							
		"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
Q. capensis (Kohl)								
	Mesembryanthemaceae							
		Mesembryanthemum	W	—	—	Cape Town	RET	(Turner, 1939)
			W	—	—	Mossel Bay	RET	(Turner, 1939)
Q. niveopicta (Schulthess)								
	Mesembryanthemaceae							
		Mesembryanthemum	—	—	—	—	RET	(Turner, 1939)
Q. signata (Schulthess)								
	Mesembryanthemaceae							
		Mesembryanthemum	—	—	—	—	RET	(Turner, 1939)
Q. sp. O								
	Mesembryanthemaceae							
		Stoeberia Dinter & Schwant.						
		S. sp.	Pi	F	3	Aggeneys	FWG&SKG	14.x.88
		S. sp.	Pi	F	3	Aggeneys	DWG	14.x.88
		Prenia N.E.Br.						
		P. pallens (Ait.) N.E.Br.	—	F	1	Springbok	MS	27.x.87
		Polymita N.E.Br.						
		P. albiflora (L.Bol.) L.Bol.	—	F	1	Springbok	MS	31.x.87
Q. sp. P								
	Mesembryanthemaceae							
		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
Q. sp. Q								
	Mesembryanthemaceae							
		Stoeberia Dinter & Schwant.						
		S. sp.	Pi	M	1	Aggeneys	DWG	14.x.88
Q. sp. R								
	Mesembryanthemaceae							
		Stoeberia Dinter & Schwant.						
		S. sp.	Pi	M	1	Aggeneys	DWG	14.x.88
Q. sp. T								
	Mesembryanthemaceae							
		Drosanthemum Schwant.						
		D. sp.	Pi	F	1	Anenous	FWG&SKG	11–13.x.88
Q. sp. M								
	Campanulaceae							
		Wahlenbergia Schrad.						
		W. sp. C	V	F	3	Anenous	FWG&SKG	11–13.x.88
		W. sp. C	V	F	2	Anenous	DWG	11–13.x.88

WASP SPECIES	FORAGE PLANT FAMILY	GENUS AND SPECIES	COLOUR	SEX	NUMBER	LOCALITY	COLLECTOR	DATE
Q. sp. N								
	Campanulaceae							
		Wahlenbergia Schrad.						
		W. sp. A	V	F	5	Clanwilliam	FWG&SKG	3–7.x.88
		W. sp.	V	F	1	Clanwilliam	FWG&SKG	5–6.x.88
Q. sp. S								
	Campanulaceae							
		Wahlenbergia Schrad.						
		W. sp. A	V	M	1	Clanwilliam	DWG	3–7.x.88

***Quartiniella* Schulthess**

The genus *Quartiniella* Schulthess is endemic to southern Africa where it is recorded from the South Western Cape; Southern Cape in the Little Karoo east to Willowmore; and in Namibia (S. W. A.) (Richards, 1962 and label data, Albany Museum). In numbers it appears to be a small genus.

Quartiniella falls within the same size range as *Quartinioides* from which, however, it differs markedly in being relatively short tongued.

Nothing seems to be known of the nesting of *Quartiniella*.

Flower visiting records for *Quartiniella* seem to be almost entirely lacking. According to Turner (1939) two species "are found on *Athanasia* sp. (Compositae) and do not visit *Mesembryanthemum*".

DISCUSSION

Masarid wasps differ from all other wasps in that they depend on flowers not only for nectar for adult nourishment but also for both nectar and pollen for the nourishment of the young. It is therefore important to bear in mind that, though visits by males are solely for imbibing nectar for their own nourishment, visits by females to particular flowers may be for this purpose or to collect nectar and/or pollen for provisioning.

Generally speaking wasps are attracted in large numbers and great diversity to whatever suitable plants may be in flower, extremely popular are plants with small, white, cream or yellow flowers presented in heads. Amongst those plants especially favoured in southern Africa are *Acacia* spp. (Leguminosae: Mimosoidea), *Maytenus* spp. (Celastraceae), *Asclepias* spp. (Asclepiadaceae) and the roadside weed *Foeniculum vulgare* A. W. Hill (Umbelliferae) (Gess and Gess, *Catalogue of flower visits by aculeate wasps*, to date including in excess of 4 000 records for *circa* 420 species, unpublished). It is noteworthy that masarid wasps are almost entirely absent from samples of wasps from such plants.

From the available flower visiting records it appears that southern African masarids as a whole are most commonly associated with Mesembryanthemaceae (51%) and Compositae (28%), those species visiting flowers of other families such as Campanulaceae (12%), Scrophulariaceae (5%), Leguminoseae (Papilionatae) (3%) and Liliaceae (2%) being the exceptions. Furthermore, that individual species on the whole show extreme fidelity to flowers of a single family of plants suggests that both nectar and pollen are generally obtained from the same source. A possible exception is *Ceramius braunsi* which, as already discussed, appears to provision entirely with composite pollen but has been observed taking nectar from *Aspalathus*

flowers. Casual nectar gathering by a species which normally exhibits marked fidelity has been noted for *Ceramius lichtensteinii*.

Clearly the considerable fidelity shown by masarids in their choice of provision is indicative of the importance of particular families or even genera of plants to these wasps. What is more difficult to assess is the importance of the wasps as pollinators to the plants which they visit.

Certainly where masarids are abundant they are probably the commonest and most dependable visitors to certain species of relatively small to medium flowered light coloured "mesems" although bees are not uncommon visitors to these flowers. It is of interest that these "mesem" flowers are not favoured by monkey beetles of the genus *Anisonyx* (Scarabaeidae: Hopliini) which, however, are particularly attracted to "mesem" flowers of the darker shades of purplish pink to magenta, not favoured by masarids. Some at least of the composite flowers visited by masarid wasps are also visited by other insects, non-masarid wasps, bees, flies, beetles and butterflies, which may pollinate these flowers. Generally speaking they are, however, probably less dependable visitors than the masarids where these are abundant. A notable exception is *Fidelia braunsiana* Friese (Hymenoptera: Apoidea: Fideliidae) which is restricted to the genus *Berkheya* (Compositae) (Whitehead, 1984). Certainly the dependence of certain masarid wasps on the flowers of Mesembryanthemaceae and of others on Compositae and the nature of their behaviour in and on these flowers makes them ideally suited to being dependable pollinators.

Evidence is building up to suggest that *Wahlenbergia* spp. are of importance to some species of the smaller masarids. Furthermore, when the frequency of and nature of their visits is compared to that of other insect visitors the impression is gained that masarids may prove to be of importance in the pollination of these flowers.

Collecting data and observations indicate that amongst those species which do not visit Mesembryanthemaceae, Compositae or Campanulaceae there are species which are probably of paramount importance to the plants which they patronize. Indications are that amongst these relationships there is a considerable degree of mutualism. Most notable are the relationships between *Aptosimum* and *Peliostomum* (both Scrophulariaceae) and some *Celonites* spp. *A. spinescens*, *A. lineare*, *A. depressum* and *Peliostomum virgatum* appear to be most commonly, indeed almost exclusively, to be visited by *Celonites* spp. Furthermore it has been demonstrated that *Celonites* obtaining nectar from these flowers are ideally suited to trigger the dehiscence of the anthers and to transfer pollen from one flower to another.

Also of particular interest are the relationships between *Aspalathus* (Leguminosae: Papilionatae) and *Ceramius clypeatus* and *Masarina familiaris*. Although *Aspalathus spinescens lepida* is visited by other insects including honey bees *C. clypeatus* and *M. familiaris* appear, in the Clanwilliam district at least, to be the commonest and most dependable visitors. Honey bees, for example, are not restricted to *Aspalathus* and therefore, if there is in the vicinity some plant in flower which is equally attractive or more attractive to them, they will not necessarily visit the *Aspalathus* flowers. Furthermore honey bees, when visiting the *Aspalathus* flowers, do not adopt a set stance such as do *C. clypeatus* and *M. familiaris*. It has been demonstrated that *C. clypeatus* and *M. familiaris* obtaining nectar from *Aspalathus* flowers are ideally suited to trigger the dehiscence of the anthers and to transfer pollen from one flower to another.

The present account is in its nature a preliminary review of flower visiting by masarid wasps in southern Africa. It is the authors' intention, however, to investigate further the role that masarid wasps play in the pollination of the flowers which they visit.

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REFERENCES

Acocks, J. P. H. 1953. Veld Types of South Africa. *Mem. bot. Surv. S. Afr.* **29:** i-iv, 1–192.

Acocks, J. P. H. 1975. Veld Types of South Africa. *Mem. bot. Surv. S. Afr.* **40:** i-iv, 1–128.

Barth, F. G. 1985. *Insects and Flowers: The Biology of a Partnership*. London: Allen and Unwin.

Brauns, H. 1913. Dritter Beitrag zur Kenntnis der Masariden (Hym.) von Südafrika. *Entomol. Mitteilungen* **2** (7/8): 193–209.

Cooper, K. W. 1952. Records of flower preferences of masarid wasps. II. Politrophy or oligotrophy in *Pseudomasaris*? (Hymenoptera: Vespidae). *Amer. Midland Nat.* **48:** 103–110.

Faegri, K. and van der Pijl, L. 1979. *The priciples of pollination biology*. Oxford: Pergamon.

Gess, F. W. 1965. Contribution to the knowledge of the South African species of the genus *Ceramius* Latreille (Hymenoptera: Masaridae). *Ann. S. Afr. Mus.* **48** (11): 219–231.

Gess, F. W. 1968. Further contribution to the knowledge of the South African species of the genus *Ceramius* Latreille (Hymenoptera: Masaridae). *Novos Taxa ent.* **57:** 29–33.

Gess, F. W. 1973. Third contribution to the knowledge of the South African species of the genus *Ceramius* Latreille (Hymenoptera: Masaridae). *Ann. Cape Prov. Mus. (nat. Hist.)* **9** (6): 109–122.

Gess, F. W. 1981. Some aspects of an ethological study of the aculeate wasps and the bees of a karroid area in the vicinity of Grahamstown, South Africa. *Ann. Cape Prov. Mus. (nat. Hist.)* **14** (1): 1–80.

Gess, F. W. and Gess, S. K. 1980. Ethological studies of *Jugurtia confusa* Richards, *Ceramius capicola* Brauns, *C. linearis* Klug and *C. lichtensteinii* (Klug) (Hymenoptera: Masaridae) in the Eastern Cape Province of South Africa. *Ann. Cape Prov. Mus. (nat. Hist.)* **13** (6): 63–83.

Gess, F. W. and Gess, S. K. 1986. Ethological notes on *Ceramius bicolor* (Thunberg), *C. clypeatus* Richards, *C. nigripennis* Saussure and *C. socius* Turner (Hymenoptera: Masaridae) in the Western Cape Province of South Africa. *Ann. Cape Prov. Mus. (nat. Hist.)* **16** (7): 161–178.

Gess, F. W. and Gess, S. K. 1988a. A contribution to the knowledge of the taxonomy and ethology of the genus *Masarina* Richards (Hymenoptera: Masaridae). *Ann. Cape Prov. Mus. (nat. Hist.)* **16** (14): 351–363.

Gess, F. W. and Gess, S. K. 1988b. A further contribution to the knowledge of the ethology of the genus *Ceramius* Latreille (Hymenoptera: Masaridae) in the southern and western Cape Province of South Africa. *Ann. Cape Prov. Mus. (nat. Hist.)* **18** (1): 1–29.

Houston, T. F. 1981. Alimentary transport of pollen in a paracolletine bee (Hymenoptera: Colletidae). *Aust. ent. Mag.* **8** (4): 57–59.

Moll, E. J., Campbell, B. M., Cowling, R. M., Bossi, L., Jarman, M. L. and Boucher, C. 1984. A description of major vegetation categories in and adjacent to the fynbos biome. *South African National Scientific Programmes Report* **83:** i-iv, 1–29.

Percival, M. S. 1969. *Floral Biology*. Oxford: Pergamon.

Proctor, M. and Yeo, P. 1973. *The pollination of flowers*. London: Collins.

Real, L. 1983. *Pollination Biology*. London: Academic Press.

Rebelo, A. G. 1987. Introduction. In: Rebelo, A. G. *ed*, A preliminary synthesis of pollination biology in the Cape flora. *South African National Scientific Programmes Report* **141:** 1–5.

RICHARDS, O. W. 1962. *A revisional study of Masarid wasps (Hymenoptera: Vespoidea)*. London: British Museum (Natural History).

RICHARDS, O. W. 1963. New species of *Ceramius* Latreille (Hymenoptera, Vespoidea) allied to *Ceramius lusitanicus* Klug. *Zoöl. Meded., Leiden* **38** (13): 213–220.

RICHARDS, O. W. 1969. Records of Masarid wasps with descriptions of two new species of *Quartinia* Ed. André (Hymenoptera). *J. nat. Hist.* **3:** 79–83.

TORCHIO, P. F. 1974. Mechanisms involved in the pollination of *Penstemon* visited by the masarid wasp, *Pseudomasaris vespoides* (Cresson) (Hymenoptera: Vespoidea). *The Pan Pacific Entomologist* **50** (3): 226–234.

TURNER, R. E. 1939. Notes on the masarid wasps of the genus *Quartinia*. *Ann. Tvl. Mus.* **20** (1): 1–4.

WHITEHEAD, V. B. 1984. Distribution, biology and flower relationships of fideliid bees of southern Africa (Hymenoptera, Apoidea, Fideliidae). *S. Afr. J. Zool.* **19** (2): 87–90.

WHITEHEAD, V. B., GILLIOMEE, J. H. and REBELO, A. G. 1987. Insect pollination in the Cape flora. In: Rebelo, A. G. *ed*, A preliminary synthesis of pollination biology in the Cape flora. *South African National Scientific Programmes Report* **141:** 52–82.