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Pollen harvest by solitary bees (*Ptilothrix relata*, Hym. Apidae, Emphorini) in the Argentine pampas – preliminary results

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In order to determine the plants foraged by solitary *Ptilothrix relata*, the pollen content of food provisions was identified. The main pollen types confirm foraging by these bees on Malvaceae, Asteraceae and Onagraceae. Pollen sources belonging to Cucurbitaceae, Dipsacaceae and Portulacaceae families enrich the harvesting range of *P. relata*. According to the preliminary results, these bees can be considered more as narrowly polylectic than oligolectic because they collect pollen from a few unrelated species. Among the most abundant pollen collected, two major morphological types were recognized: (1) pollen with long spines (4–25 µm), many single apertures and large size (115–135 µm of diameter); and (2) tricolporate pollen with viscin threads.

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The food preference of introduced honeybees in the Pampas region is well known (Tellería 1993); however, little is known about the foraging behaviour of the Argentine native bees. The distribution of Emphorini tribe (Hym. Apidae) is exclusively American (Roig Alsina 1998). These bees are solitary and collect pollen and nectar for cell provisioning and self-maintenance. They nest in clay rich soils with scarce vegetation where each female digs a shallow harrow and constructs a brood chamber. Brood provisions consist of a firm mass of nectar and pollen. The nest is closed near the surface with a mud plug (Hazeldine 1997).

Emphorini tribe is considered oligolectic because nectar is collected from many different unrelated flowers, and collection of pollen is restricted to a few related flowers (Robertson 1925). The tribe is associated with Malvaceae, Convolvulaceae, Onagraceae, Cactaceae, Pontederiaceae and Asteraceae families (Linsley & Mac Swain 1957).

Ptilothrix relata Holmberg (Emphorini) occurs in South America, and there is little information available about pollen harvesting habits. Hazeldine (1997) verified that these bees collect pollen from *Hibiscus* sp. (Malvaceae) and *Ludwigia* sp. (Onagraceae) and forage nectar from *Teucrium vesicarium* (Lamiaceae).

The goal of this paper is to increase knowledge about pollen choice of the native *P. relata* in the Argentine pampas by identifying the pollen stored in their nests.

MATERIAL AND METHODS

Sampling location and field observations

Samples were taken near Junin city, Argentina (34° 42' S and 61° 6' W), which belongs to the Pampas Phytogeographical Region (Fig. 1). Sampling was done both in January 1998 and 1999. In the summer of 2000, only a few individuals were observed and no nests were found. The shortage of these bees coincided with the presence of “assassin flies” (*Mallophora ruficauda*). Most of the sampled area was located in a rural environment dominated by an introduced flora.

In order to locate the nests, field observations were made from December 1999 to February 2000. Nests of *P. relata* were removed from calcareous soils, where some of them remained near the seasonal pools formed by the accumulation of rain-water. *P. relata* needs water for softening the ground during nest building (Hazeldine 1997). The activities of the bees on the flowers were observed, and the distribution of plants visited is recorded (both dense populations and the isolated individuals).

Sample collection and laboratory studies

A total of 13 samples were collected from brood cells. The goal was to process each pollen-mass individually. However, there were cases, in which the total nest content had to be processed in one sample

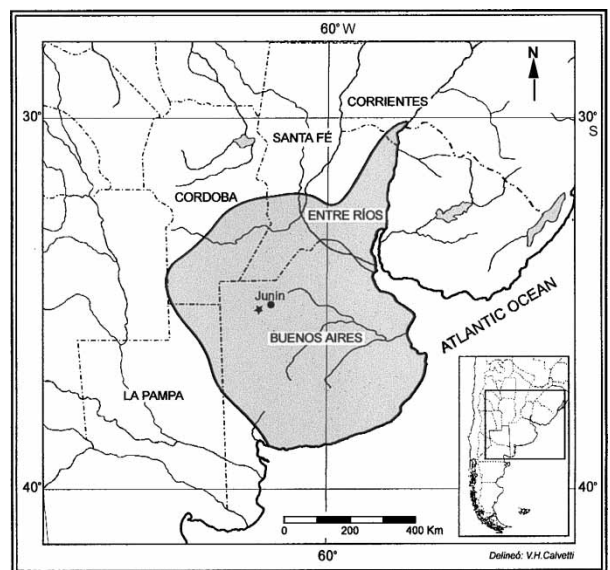


Fig. 1. Pampas Phytogeographical Region in Argentina. (* = sampling site).

Table I. Pollen identified from provision cells of *Ptilothrix relata*.

In %; N – 300 acetolysed pollen grains; P – pollen <1% of the total.

TAXA/SAMPLES	6/1/98									26/1/98	6/1/99		
	1	2	3	4	5	6	7	8	9	10	11	12	13
Apiaceae													
<i>Eryngium</i> sp.	–	–	–	–	P	–	–	–	–	–	–	–	–
Asteraceae													
<i>Carduus</i> sp.	68	1	13	3	15	–	38	P	–	–	45	3	–
Cichorieae	–	–	P	2	–	–	–	–	–	–	P	1	–
<i>Cirsium vulgare</i>	–	–	–	–	–	–	8	–	–	–	–	–	–
<i>Helianthus annuus</i>	–	–	–	–	P	–	P	–	–	–	P	–	–
<i>Matricaria chamomilla</i>	–	–	–	–	P	–	P	–	–	–	–	–	–
Convolvulaceae													
<i>Ipomoea</i> sp.	–	–	–	–	–	–	P	–	–	–	P	2	–
Cucurbitaceae													
<i>Cucurbita</i> sp.	–	10	–	7	33	P	30	P	0,5	P	4,5	5	P
Dipsacaceae													
<i>Dipsacus fullonum</i>	–	–	–	–	–	–	3,5	–	–	–	42	–	–
Malvaceae													
<i>Hibiscus syriacus</i>	32	42	87	81	5	100	–	100	99	100	8,5	3	100
<i>Sida rhombifolia</i>	–	–	–	–	7	–	19	–	–	–	–	P	–
Onagraceae													
<i>Ludwigia</i> sp.	–	47	P	7	–	P	1,5	–	0,5	–	P	32	–
Oleaceae													
<i>Ligustrum</i> sp.	–	–	–	–	–	–	–	–	–	–	–	P	–
Portulacaceae													
<i>Portulaca oleracea</i>	–	–	–	–	40	–	–	–	–	–	–	54	–

because the cells were destroyed during the excavation (Table I: samples: 1, 5, 6, 9, 11 and 12).

Pollen provision masses (Fig. 2) were placed individually in open vials for 48 hrs to avoid fungi development. Afterwards the samples were placed in the refrigerator until they were processed. Each pollen mass was dissolved in 100 ml of distilled water at 80°–90°C, stirring for 15–20 minutes, first with a glass rod and then with a magnetic stirrer. 5 ml of the solution was centrifuged and the residue was analyzed (Tellería 2000). Microscopic samples with both acetolyzed (Erdtman 1960) and unacetolyzed pollen grains were dyed with fuchsin.

For scanning electron microscope (SEM), unacetolyzed pollen grains were disaggregated in alcohol, pipetted onto an unexposed common film, air-dried, transferred onto specimen stubs and coated with a thin layer of palladium-gold. Observations were made with a Jeol-JSMU SEM.

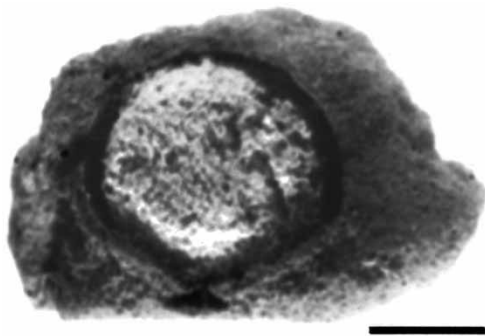


Fig. 2. Pollen provision mass surrounded by earth cell. Scale bar – 0.5 cm.

The identification of pollen grains was made with the help of a reference collection from the local flora.

A minimum of 300 acetolyzed pollen grains were counted randomly for each sample consisting of two slides with a minimum of 150 identified and counted pollen grains. The pollen size classification follows that of Erdtman (1969). Measurements of pollen size, and the length of the spines were taken from Tellería (1995). *Hibiscus syriacus* pollen was measured in the present study.

RESULTS

A total of 14 pollen types were identified belonging to the following families: Apiaceae (*Eryngium* sp.) Asteraceae (*Carduus* sp., Cichorieae, *Cirsium vulgare*, *Helianthus annuus*, *Matricaria chamomilla*), Convolvulaceae (*Ipomoea* sp.), Cucurbitaceae (*Cucurbita* sp.), Dipsacaceae (*Dipsacus fullonum*), Malvaceae (*Hibiscus syriacus*, *Sida rhombifolia*), Onagraceae (*Ludwigia* sp.), Oleaceae (*Ligustrum* sp.) and Portulacaceae (*Portulaca oleracea*) (Table I, see also Fig. 3).

DISCUSSION

From the analysis of pollen stored in the nests of *Ptilothrix relata*, the pollen grains of *Hibiscus syriacus*, *Carduus* sp. and *Ludwigia* sp. appear to be the most important food source. The present results confirm the affinity of *P. relata* with the Malvaceae, Onagraceae and Asteraceae families (Linsley & Mac Swain 1957, Hazeldine 1997). Other pollen sources, such as *Cucurbita* sp. (Cucurbitaceae), *Dipsacus sativus* (Dipsacaceae) and *Portulaca oleracea* (Portulacaceae) enrich the harvesting range of *P. relata*. The presence of pollen types with concentration <1% of the total, such as

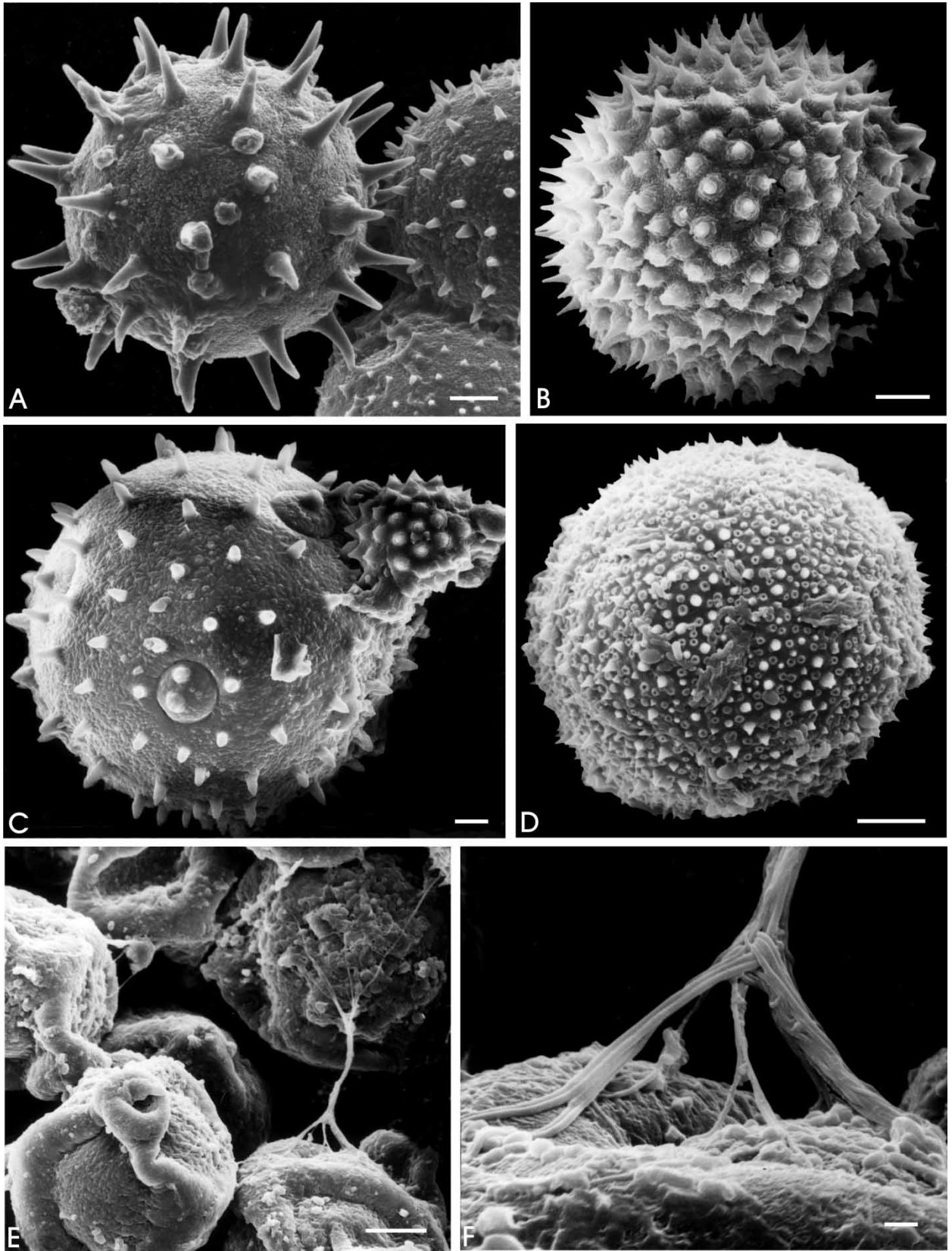


Fig. 3. SEM micrographs of pollen identified from provision cells. (A) *Hibiscus syriacus* along with *Dipsacus fullonum*. (B) *Sida rhombifolia* (?) (C) *Cucurbita* sp. with an adhered *Carduus* sp. pollen grain. (D) *Portulaca oleracea*. (E) *Ludwigia* sp. (F) details of viscin threads. Scale bars – 25 μ m (A); 10,5 μ m (B, D); 17 μ m (C, E); 4 μ m (F).

Eryngium sp., *Helianthus annuus*, *Matricaria* sp., *Ipomoea* sp. and *Ligustrum* sp., may be a result from an accidental contamination while the bees were visiting other flowers for nectar (Linsley 1958). Because *Ptilothrix relata* collects pollen from a few unrelated species, these bees can be viewed as narrowly polylectic rather than oligolectic (Michener 1979).

Oligolectic bees frequently display morphological and behavioural adaptation, which facilitate the collection of pollen from their preferred hosts (Linsley 1958). The plumose hairs of the scopa in *P. relata* (Roig Alsina 1998) facilitate the collection of pollen with long spines such as the pollen of *Hibiscus syriacus*, *Carduus* sp. and *Cucurbita* sp. or pollen with viscin threads, such as *Ludwigia* pollen (Robertson 1925, Michener et al. 1978, Gimenes 1991, Thorp 2000).

Other bees within the Emphorini tribe also have the tendency to collect pollen with long spines, for example, *Melitoma euglossoides* is dependent on *Ipomoea* flowers; *Peponapis* sp. and *Xenoglossa* sp. are dependent on *Cucurbita* flowers. The lack of these plants near the nests may be a factor de-limiting the population growth of *M. euglossoides*, *Peponapis* sp. and *Xenoglossa* sp. (Michener & Lange 1958).

Despite the long spines, most of the pollen types collected by *P. relata* are large and multiaperturate. The presence of many apertures might be related to pollen digestion of *P. relata* larvae. It has been shown earlier, that during the pollen digestion by some solitary bee larvae, the content of the pollen grains is gradually emptied through the germination pores (Suárez Cervera et al. 1994, Roulston & Cane 2000). Digestive efficiency along with an efficient foraging strategy may play a role in the maintenance of the oligolectic type of living (Strickler 1979, Neff & Simpson 1997).

The present investigation supports the relationship between *P. relata* and spiny pollen and pollen with viscin threads (Fig. 3 F). However, the main flora does not depend on the pollination services of *P. relata* because of a diversity of other insects are present (pers. obs). This observation agrees with Michener (1979) and Neff & Simpson (1997) in the sense that some oligolectic bees seem to play no role in the pollination of their host plants. Bees show signs of adaptation to their floral hosts, but there is little evidence for reciprocal adaptation of flowers to their oligolectic visitors.

The preferences of *P. relata* for the above mentioned pollen types probably reduces competition for pollen resources with honeybees, which are very common in the region studied. Although honeybees forage on a wide range of plants species, the pollen spectrum shows that the large types with long spines have little importance, and that pollen with viscin threads are absent (Tellería 1993). Morphological characteristics of scopa in both types of bees contribute to explain the differences in pollen collection. It was experimentally shown that *Apis mellifera* is unable to pack large pollen grains with long spines into its corbiculae (Vaissière & Vinson 1994). It is suggested that the plumose hair of scopa of *P. relata* facilitate the collection of large pollen with long spines.

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