Bombus species and their associated flora in Argentina

A H Abrahamovich, M C Telleria and N B Díaz

Eight species of bumble bee (*Bombus* spp.) are found in Argentina. These bees are important pollinators of cultivated and native plants. Information on their distribution and forage requirements are scattered throughout the literature, and are brought together by the authors in his review.

Introduction

Four subfamilies are recognized among the representatives of the family Apidae: Apinae, Meliponinae, Euglossinae and Bombinae[15]. The subfamily Bombinae comprises the strictly social bees of the genus *Bombus*, including the subgenus *Psithyrus*, the cuckoo bumble bees, which are cleptoparasites in the nests. Of these, only *Bombus* occurs within South America. In Argentina, the genus is represented by eight neotropical species: *B.* (*Fervidobombus*) *atratus*, *B.* (*F.*) *bellicosus*, *B.* (*F.*) *brasiliensis*, *B.* (*F.*) *dahlbomii*, *B.* (*F.*) *morio*, *B.* (*F.*) *opifex*, *B.* (*Robustobombus*) *tucumanus* and *B.* (*Coccineobombus*) *baeri* and one introduced palaearctic species, *B.* (*Megabombus*) *ruderatus*[2].

Bumble bees are important pollinators in natural and agricultural ecosystems because they depend on pollen and nectar for feeding, being adapted both morphologically and ethologically to different plant species. Most of the Northern Hemisphere species are polylectic[22] (i.e. visiting a wide range of plants and flowers), and Moure & Sakagami[18] suggested a similar behaviour for the Brazilian species. In Argentina, despite their abundance, wide distribution[1] and economic significance, studies on their floral associations are scarce. Holmberg[10], Hudson[11], and Joergensen[12] supplied the first lists of flowers visited by species of *Bombus*. Later Tesón, *et al.*[27] and De Santis[8] related them to economically important crops; Cocucci[6], Sosa[25], Passarelli[21] and Tellería[26] have added to these records. Data provided by Milliron[16,17] in his papers on American species are also particularly interesting.

Identification of the plants visited by *Bombus* species is the starting point in studies on feeding behaviour and to assess their possible utilization as pollinators of crops of economic importance.

The purpose of this article is to compile and update the information about floral associations of the species of *Bombus* present in Argentina, except for *B.* (*C.*) *baeri* for which there is no available information.

Data were gathered from field observations made by the first author, by compiling information on more than 3000 specimens housed in the main Argentine entomological collections (Museo de La Plata and Museo Argentino de Ciencias Naturales, 'Bernardino Rivadavia', Buenos Aires, and Instituto Miguel Lillo, Tucumán), and from the available literature[3,4,6,8,9,10,11,12,13,14,16,17,19,20,21,23,24,25,26,27]. Biogeographical areas used here follow those of Cabrera & Willink[5]. Update of botanical names follows Zuloaga & Morrone[28,29,30].

Argentine *Bombus* species and their floral associations

Bombus (Fervidobombus) atratus

Bombus atratus is present in almost all South American countries, except for northern Brazil, Guyana and the Chilean trans-Andean sector. It is the most widely distributed and most abundant bumble bee species in Argentina, with great climatic and altitudinal tolerance. It inhabits most of the biogeographical provinces, except for Puneña, Altoandina and southern Patagonia.

Floral relationships: *B. atratus* is associated with plant species from 29 families (table 1). The largest number of visited species corresponds to the families Asteraceae (24) and Fabaceae (15); followed by Lamiaceae (5), Solanaceae (5), Cucurbitaceae (3), Lythraceae (3), Malvaceae (3), Verbenaceae (3), Caprifoliaceae (2) Liliaceae (2), Onagraceae (2), Rosaceae (2); with a single species, Aizoaceae, Bignoniaceae, Bombacaceae, Campanulaceae, Convolvulaceae, Dipsacaceae, Melastomataceae, Myrtaceae, Nyctaginaceae, Oleaceae, Passifloraceae, Plantaginaceae, Poaceae, Rutaceae, Styracaceae, Tiliaceae and Vitaceae.

***Bombus atratus* foraging on a *Hibiscus syriacus* flower.**

Bombus (Fervidobombus) bellicosus

Bombus bellicosus is present in Uruguay, southern Brazil and most of Argentina. In Argentina, it is especially abundant in the central region; it inhabits the Pampeana biogeographic province, and part of the Paranense, Espinal and Chaqueña provinces, entering also the southern sector of the Monte province.

Floral relationships: *B. bellicosus* is associated with plant species from five families (table 1). The largest number of visited species belongs to the families Asteraceae (10) and Fabaceae (7), followed by Solanaceae (4) and Lamiaceae (3); with one species, Apiaceae.

Bombus (Fervidobombus) brasiliensis

Bombus brasiliensis is present in Brazil, Paraguay, Uruguay and Argentina. In Argentina, it is the least abundant species, probably restricted to the Paranense biogeographic province.

Floral relationships: *B. brasiliensis* is associated with two species of Solanaceae (table 1).

Bombus (Fervidobombus) dahlbomii

Bombus dahlbomii is present in Chile and Argentina. In Argentina, it is abundant, particularly in Patagonia. Its distribution comprises the Patagonian and part of the Monte and Pampeana biogeographic provinces.

Floral relationships: *B. dahlbomii* is associated with plant species from seven families (table 1). The largest number belong to the Fabaceae (3), with two species of the Myrtaceae and a single species from the Alstroemeriaceae, Eucryphiaceae, Loranthaceae, Onagraceae and Rosaceae.

TABLE 1. List of plant species, ordered in families, visited by the species of *Bombus* present in Argentina: *Bombus* (*Fervidobombus*) *atratus*; *B. (F.) bellicosus*; *B. (F.) brasiliensis*; *B. (F.) dahlbomii*; *B. (F.) morio*; *B. (F.) opifex*; *B.* (*Robustobombus*) *tucumanus*; *B.* (*Megabombus*) *ruderatus*. *, native species; numbers, literature references; +, personal and unpublished observations.

	***Bombus* species**							
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
AIZOACEAE								
Aptenia cordifolia	(26)							
ALSTROEMERIACEAE								
Alstroemeria aurea				(23)				(23)
APIACEAE								
Foeniculum vulgaris		(11)						
ASTERACEAE	(16)				(16)			
Ambrosia sp.	(26)							
Anthemidae	(26)							
Anthemis cotula						(25)		
*Aspillia montevidensis**	(3)							
*Baccharis pingraea**						(12,+)		
*B. salcifolia**						(12)		
*Bidens laevis**	(+)							
Carduus sp.	(+)	(+)						
C. acanthoides	(21,+)	(+)						
Centaurea sp.	(+)							
Cichoriae	(+)							
Cichorium intybus	(25)							
Cirsium lanceolatum	(+)	(11,+)				(12)		
C. vulgare	(26,+)	(25)			(25)	(25)		
Cynara cardunculus	(+)					(12)		
*Eclipta megapotamica**	(3)							
*Eupatorium hookerianum**					(25)	(25)		
*E. pedunculosum**		(3)						

TABLE 1. Continued.

	***Bombus* species**							
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
Helianthus sp.	(16)	(16)						
H. annuus	(+)	(+)						
*Hyalis argentea**						(12)		
Macrachaenium sp.	(16)							
Picris echioides	(26)	(+)						
Proustia ilicifolia						(12)		
Senecio sp.	(16)	(16)						
*S. subulatus**						(12,+)		
*S. pinnatus**						(12)		
Silybum marianum		(11)						
Taraxacum officinale		(25)				(25)		
Verbesina encelioides					(25)			
Vernonia sp.	(16)				(16)			
*V. nudiflora**	(3)				(3)			
*V. tweediana**	(3)							
*Zexmenia buphthalmiflora**	(+)							
BIGNONIACEAE								
Campsis radicans	(26)							
Catalpa sp.							(17)	
BOMBACACEAE								
Chorisia speciosa	(+)							
BORAGINACEAE								
Heliotropium amplexicaule						(25)		
BRASSICACEAE								
Cheiranthus cheiri						(12)		
BROMELIACEAE								
Pseudoananas sp.					(16)			
CACTACEAE								
Opuntia sulphurea						(12)		

Table 1: continues overleaf

TABLE 1. Continued.

	***Bombus* species**						
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
CAMPANULACEAE							
Campanula sp.	(21)						
CANNACEAE							
*Canna indica**					(3)		
CAPRIFOLIACEAE							
Abelia sp.	(+)						
Lonicera caprifolia	(26)						
CONVOLVULACEAE							
*Ipomoea cairica**					(3,25)		
Ipomoea sp.	(26)						
CUCURBITACEAE							
Cucurbitella scaberrima						(12)	
Cucumis sp.	(16)				(16)		
C. melo	(+)						
Cucurbita sp.	(26)						
DIPSACACEAE							
Dipsacus sativus	(26)						
D. silvestris						(12)	
EUCRYPHIACEAE							
Eucryphia cordifolia			(9,16)				
FABACEAE					(16)		
*Acacia bonaeriensis**	(+)						
Acacia sp.	(26)						
*Adesmia incana**	(+)	(+)					
*Caesalpinia exilifolia**					(25)		
*Cercidium praecox **						(12)	
Calliandra sp.	(16)						
Crotalaria sp.	(16)						
*Desmodium incanum**	(3)				(3)		

TABLE 1. Continued

	***Bombus* species**							
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
*Erythrina crista-galli**	(+)							
*Geoffroea decorticans**						(12)		
*Lathyrus maguellanicus**				(23)				(23)
Lotus sp.	(21, 27,+)	(27,+)						
Lupinus sp.					(16)			
Medicago sativa	(8, 27,+)	(8,27,+)				(12)		
Medicago sp.	(+)	(+)				(+)		
Melilotus sp.		(+)						
Phaseolus sp.	(16)							
Senna sp.	(16,+)				(14,16)			
*Senna scabriuscula**					(3)			
Sthyphnolobium japonicum	(+)							
Trifolium pratense		(27,+)		(4)		(25)		(4)
Trifolium sp.							(17)	
Vicia sp.	(27,+)	(27,+)						
*Vicia nigricans**				(23)				(23)
Vigna sp.	(+)							
LAMIACEAE								
*Hyptis mutabilis**	(3)				(25)	(25)		
*Leonurus sibiricus**	(3)	(25)			(3,25)	(25)		
Marrubium vulgare		(11,+)				(12)	(+)	
Salvia sp.	(16,26)	(16,25)						
S. coccinea	(+)							
*S. gilliesii**						(12)		
Teucrium sp.	(26)							
LILIACEAE	(26)							
Cordyline australis	(26)							

Table 1: continues overleaf

TABLE 1. Continued

	***Bombus* species**						
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
LORANTHACEAE							
Phrygilanthus sp.				(16)			
LYTHRACEAE							
*Cuphea fruticosa**		(+)					
*Heimia myrtifolia**		(3)					
*H. salicifolia**					(25)	(25)	
Lagerstroemia indica		(21,26)					
MALVACEAE		(21)					
Gossypium sp.		(+)			(+)		
Hibiscus sp.					(16)		
H. syriacus		(+)					
MELASTOMACEAE							
*Tibouchina gracilis**		(3)					
MYRTACEAE							
Eucalyptus sp.		(21,26,+)					
Myrceugenia pitra				(+)			
Myrthus sp.				(9,16)			
NYCTAGINACEAE							
Bougainvillea sp.		(+)					
ONAGRACEAE							
*Fuchsia maguellanica**				(+)			
*Ludwigia longifolia**		(3)					
*L. peruviana**		(3)					
OLEACEAE							
Ligustrum sp.		(26)					
PASSIFLORACEAE							
Passiflora sp.		(+)					

TABLE 1. Continued

	***Bombus* species**							
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
PIPERACEAE								
Piper sp.					(16)			
PLANTAGINACEAE								
*Plantago australis**	(3)							
POACEAE								
Zea sp.	(16)							
PONTEDERIACEAE								
Pontederia cordata					(3)			
ROSACEAE								
Pyrus malus	(24)							
Rubus sp.	(16)							
R. ideaeus				(19)				(19)
RANUNCULACEAE								
Delphinium sp.						(12)		
RUBIACEAE								
Coffea sp.					(16)			
RUTACEAE								
Citrus limon	(+)							
SOLANACEAE								
Capsicum sp.					(16)			
Datura sp.			(16)					
*Lycium chilense**						(12)		
Solanum sp.	(16, 27,+)		(16)		(16)			
*S. adelphum**							(21)	
*S. argentinum**		(25)			(6,25)			
*S. bonariensis**	(+)							
*S. claviceps**		(6,25)			(25)	(6)		
*S. glaucophyllum**	(21)	(21)						
*S. stuckertii**	(21)					(21)		
*S. sublobatum**	(27,+)	(27,+)						
STYRACACEAE								
*Styrax leprosus**	(3)							

Table 1: continues overleaf

TABLE 1. Continued

	***Bombus* species**							
	atratus	*bellicosus*	*brasiliensis*	*dahlbomii*	*morio*	*opifex*	*tucumanus*	*ruderatus*
TILIACEAE								
*Luehea divaricata**	(3)				(3)			
VERBENACEAE								
*Glandularia dissecta**					(25)			
*Lantana camara**	(3)							
*Pitrae cuneato-ovata**						(+)		
*Priva boliviana**						(16)		
*Stachytarpheta cayennensis**	(3)							
*Verbena bonariensis**						(12)		
*V. lindmannii**	(3)							
VITACEAE								
Vitex sp.	(+)							
Total records	101	35	2	12	34	36	4	5

Bombus (Fervidobombus) morio

Bombus morio is present in Brazil, Bolivia, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela and Argentina. In Argentina, it is abundant mainly in the north. It is distributed in the Prepuneña, Yungas, Chaqueña and Paranense biogeographical provinces.

Floral relationships: *B. morio* is associated with plant species from 14 families (table 1). The largest number of visited species belongs to Asteraceae (6), Fabaceae (6) and Solanaceae (4); with two species from the Lamiaceae and, with a single one, Bromeliaceae, Cannaceae, Convolvulaceae, Cucurbitaceae, Lythraceae, Piperaceae, Pontederiaceae, Rubiaceae, Tiliaceae and Verbenaceae.

Bombus (Fervidobombus) opifex

Bombus opifex is present in the northern and central Andean regions of Argentina, the western strip of Bolivia and Peru, reaching northwards up to Ecuador and eastwards to western Paraguay. It is the most abundant Andean species in Argentina, comprising partly Monte, Prepuneña, Puneña, Yungas and Chaqueña biogeographic provinces.

Floral relationships: *B. opifex* is associated with plant species from 11 families (table 1). The largest number of visited species belongs to the Asteraceae (12); followed by

Fabaceae (5), Lamiaceae (4), Solanaceae (3); with a single species, Boraginaceae, Brassicaceae, Cactaceae, Cucurbitaceae, Dipsacaceae, Lythraceae, and Ranunculaceae.

Bombus (Robustobombus) tucumanus

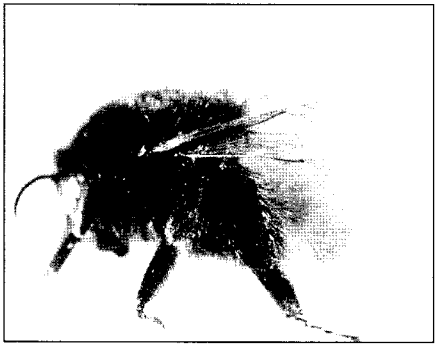
Bombus tucumanus is present in south-western Bolivia and north-western Argentina. It is found in the Andean region, with a wide vertical tolerance, reaching 4000 m above sea level. It is a rarely frequent species, distributed within the Puneña, Prepuneña and Yungas biogeographic provinces.

Floral relationships: *B. tucumanus* is associated with four plant species of the families Bignoniaceae, Fabaceae, Lamiaceae and Solanaceae (table 1).

Bombus (Coccineobombus) baeri

Bombus baeri is present from south-eastern Peru and western Bolivia to northwestern Argentina. In Argentina, it is scarce, occurring in regions between 3200 m and 4000 m above sea level. It is distributed in part of the Puneña, Prepuneña and Yungas biogeographical provinces.

No records of floral visits are available.



Queen *Bombus baeri*.

Bombus (Megabombus) ruderatus

A native of Eurasia, this species was introduced into Chile from New Zealand in order to improve pollination of red clover (*Trifolium pratense*) in the region of Temuco during 1982 and 1983[4]. A few years ago, it migrated into Argentina, probably from Chile. In the summers of 1993 and 1994 it was recorded in San Carlos de Bariloche, Río Negro[16] province.

Floral relationships: *B. ruderatus* is associated with plant species of the families Fabaceae (3), Alstroemeriaceae (1) and Rosaceae (1) (table 1).

Conclusions

A total of 229 records that referred to floral visits by the Argentine species of the genus *Bombus* have been compiled here, some of these records being scattered in the literature. From the 56 unpublished records, 38 are new and 18 confirm previous observations (table 1).

Analysis of the information suggests that *B. atratus* visits the widest range of plants and has the widest geographic distribution and the largest number of records. This species followed in order by *B. bellicosus*, *B. opifex* and *B. morio*, whose distributions are relatively less extensive. *B. opifex* and *B. morio*, also visit plants typical of their habitats, i.e., Bromeliaceae and Cactaceae, respectively. The range of species visited by *B. dahlbomii* is smaller, with an especially conspicuous relationship with Eucryphidiaceae and Onagraceae (*Fuchsia maguellanica*), which inhabit the Patagonian region. It is noteworthy that the recently introduced *B. ruderatus*, shares floral preferences with the native species *B. dahlbomii*. This behaviour may involve competition between them. *B. tucumanus* and *B. brasiliensis* are the least fre-

quent species, with the smallest range of plants visited.

The diversity of plants visited shows that most of the species of *Bombus* recorded in Argentina, as well as in Brazil and in the Northern Hemisphere, are polylectic. Within the spectrum of visits, 42 Angiosperm families, those mostly widely distributed, are represented (52 native species and 178 exotic species). The diversity of Fabaceae and Asteraceae, both of significance as bee forage in diverse latitudes[7], and the constant presence of Solanaceae must be noted. The use of economically important cultivated plants such as *Capsicum* sp., *Citrus* sp., *Coffea* sp., *Cucumis* sp., *Cucurbita* sp., *Gossypium* sp., *Lotus* sp., *Helianthus annuus*, *Medicago sativa*, *Phaseolus* sp., *Rubus* sp., *Solanum* sp. and *Trifolium* sp., as well as different ornamental plants is also noteworthy.

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A H ABRAHAMOVICH[1]; M C TELLERÍA[2] AND N B DIAZ[1]

[1]Departamento Científico de Entomología, Museo de La Plata, Universidad Nacional de La Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina (e-mail: albertoa@museo.fcnym.unlp.edu.ar)

[2]Depto de Paleobotánica, Faciltad de Ciencias Naturales y Museo, Universidad Nacional de la Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina

[1,2]Investigadores del Consejo Nacional de Investigaciones Científicas y Tecnicas, Argentina (CONICET)