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**Priyanka Kumari**High Altitude Regional Centre,  
Zoological Survey of India,  
Solan, Himachal Pradesh, India**Neelima R Kumar**Zoology department, Panjab  
University, Chandigarh, India**Avtar K Sidhu**High Altitude Regional Centre,  
Zoological Survey of India,  
Solan, Himachal Pradesh, India**Kailash Chandra**Zoological Survey of India,  
Kolkata, West Bengal, India

## Taxonomical and behavioural studies on *Megachile conjuncta* (Fabricius) (Hymenoptera: Megachilidae: *Cressoniella*)

**Priyanka Kumari, Neelima R Kumar, Avtar K Sidhu and Kailash Chandra**

### Abstract

The taxonomy and behaviour of *Megachile conjuncta* (Fabricius) is studied and presented in this paper. It was found to be gregarious while foraging as opposed to the solitary nature of bees in tribe Megachilini. Tribe Megachilini are also called solitary bees. Females construct nests alone, mass provision them, and lay eggs without any help. Hence, *Megachile* bees mostly are foraging singly while mass provisioning their cells. But *Megachile conjuncta* males and females were found to forage gregariously in good numbers.

Important taxonomic characters of both sexes were studied and photographed. Male external genital and sternal slides were prepared and photographed. All these characters were illustrated in plates. Thirty seven morphological characters were measured and presented in table. Floral associations, specimen examined and old distribution have been also presented.

**Keywords:** Megachilini, taxonomy, sternum 5, sternum 8, external genitalia

### 1. Introduction

*Megachile conjuncta* belongs to tribe Megachilini under the family Megachilidae. *Megachile* Latreille and *Coelioxys* Latreille are the two genera reported from India under tribe Megachilini by Michener<sup>[1]</sup>. 56 subgenera have been reported from all over the world out of which 17 subgenera are found in India. The females of the subgenus *Cressoniella* of the genus *Megachile* are moderately large sized (Table 1), abdomen is cordate or conical in shape, terga is flattened, sixth sternum is with dense scopal hairs, apex fringed; mandibles are 4 dentate with incomplete cutting edges.

*Megachile* bees are generally solitary living bees. They are not social like *Apis* spp. which has division of labour in different castes. In Megachilini there are two sexes male and female. Male does not bear any parenting responsibilities. Females construct their nests, carries out maternal duties, forage independently without the help of others. *Megachile conjuncta* differs from this general behaviour as it is gregarious in habit (personal observation). It was found to forage in small groups. They are also species specific in their floral associations as they were mostly collected from plants belonging to families Fabaceae, Lamiaceae making them strongly oligolectic.

### 2. Material and Methods

Collection tours were planned seasonally on various crops and vegetation keeping in mind the weather, topography and location of destination. Collection was done with the help of sweep nets, collection bottles and killing jars. During bright sunlight when bees were foraging they were collected with sweep nets and transferred to charged bottles activated with ethyl acetate. Freshly killed specimen were stretched, labelled and properly preserved for future studies. Stretching of specimens was done properly so that taxonomically important characters remained clearly visible for future studies. White nickel plated fine entomological pins of size 1 (38×0.40 mm) were used to pin up the specimens vertically through the mesothorax leaving enough space for holding it comfortably for future observations. Each specimen was labelled with a slip containing the location, date, time and source of collection. These were then placed in wooden insect boxes fumigated with naphthalene balls kept in all the four corners.

Identification keys given by Bingham<sup>[2]</sup>, Gupta<sup>[3]</sup> and Michener<sup>[4, 1]</sup> were used to identify specimens. Canon D60 digital camera was used to photograph adult specimens. Leica microscope was used for photographing external genital slides, sterna 5 and 8 slides.

A total of 37 characters were finalized for the morphological measurements studying Gupta<sup>[3]</sup> and Bzydk<sup>[5]</sup>. Measurements were made in mm with Radical Stereozoom microscope (model RSM 9 fitted with software Progres Capture Pro version 2.1.1 and CT5 Jenoptik camera, Table 1).

### 3. Observations

**3.1. Genus *Megachile* Latreille:** *Megachile* Latreille 1802, Histoire Naturelle des Fourmis, Vol. II, p.43. Type species: *Apis centuncularis* Linn.  
*Anthophora* Fabricius 1804, Mitt. der Deutsc. Entomol. Gesells. Vol. X, p. 372. Type species: *Apis centuncularis* Linn.

### Correspondence

**Priyanka Kumari**High Altitude Regional Centre,  
Zoological Survey of India,  
Solan, Himachal Pradesh, India

*Megachile* Smith 1853, Cat. Hym. Vol. I, p. 149.

*Megachile* Dalla Torre 1894a, Cat. Hym. Vol. X, p. 417.

*Megachile* Bingham 1897, Fauna of British India. Vol. I, p. 470.

*Megachile* Michener 1944, Bull. Amer. Mus. Nat. Hist. Vol. 82, pp. 151-326.

*Megachile* Mitchell 1962, N.C. Agri. Exp. Sta. Tech. Bull. Vol. 152, p. 158.

*Megachile* Michener 1965, Bull. Amer. Mus. Nat. Hist. Vol. 130, p. 206.

*Megachile* Pasteels 1965, Ann. Mus. R. Afr. Centr., Terrestrial Sci. Zool. Vol. 137, p.58.

**Diagnosis:** The genus *Megachile* includes an enormous diversity of bees both morphologically and behaviourally. They include mainly robust non-metallic black bees; variable size; tergal fasciae present either on apical or basal tergal margins; concave or incurved basal tergam; axillae not tapering and produced backwards.

**3.2. Subgenus *Cressoniella* Mitchell:** Genus *Megachile* Latr. Subgenus *Cressoniella* Mitchell 1934, Trans. of the Amer. Entomol. Soc. Vol. 59, pp. 295-361. Type species: *Megachile zapotica* Cresson.

Genus *Cressoniella* Mitchell 1980, *A Generic Revision of the Megachilinae Bees of the Western Hemisphere*. Raleigh: Department of Entomology, North Carolina State University, 95 pp. Type species: *Megachile zapotica* Cresson.

**3.3. *Megachile conjuncta* (Smith):** *Megachile conjuncta* Smith 1879, *Descriptions of New Species of Hymenoptera in the Collection of the British Museum*. Vol. VIII, p. 175.

*Megachile conjuncta* Dalla Torre, 1894a, Catalogue Hym. Vol. X, p. 427.

*Megachile conjuncta* Bingham, 1897, Fauna of Brit. Ind., Vol. I, p. 479.

### 3.3.1. Female (Plate 1, Figs. a-e):

**Diagnosis:** Integument black, tegulae slightly reddish. Pubescence on head and scutum black; gena, clypeus and vertex with golden yellow pubescence; tergum 2 entirely and tergum 3 apically reddish brown. Marginal fasciae on T3-T5 obscure and very finely confined to lateral extremities; legs dorsally pale golden. Morphological measurements given in Table 1.

**Head:** Slightly bulged clypeus, punctured sparsely at midline, smoothly at supraclypeal junction, incurved apical margin; supraclypeal area protuberant with sparse and coarse punctures; paraocular area sloping or declivous towards apex; compound eyes converging downwards; lateral ocelli nearer vertex than eyes; subocellar surface with punctures at circumference; vertex slightly swollen, closely and coarsely punctured; genae broader than eyes; mandibles 4 dentate with cutting edges both in 2<sup>nd</sup> and 3<sup>rd</sup> interspace.

**Mesosoma:** Scutum slightly punctured, parapsidal lines obscure due to dense pubescence; pronotal lobe lobed; mesepisterna finely and closely punctured; posterior surface produced into a blunt and small spine extending upto coxae; posterior margin of scutellum curved

and densely pubescent with fulvous down, swollen in profile, closely and finely punctured; axillae more punctured than scutellum; hyaline wings with brownish black veins; rugose tegulae; fore legs coxae convex, tubercles acute and broad, femora convex anteriorly and flattened posteriorly; hind basitarsi little more than half of the length of tibiae.

**Metasoma:** Terga 2-5 graduli linear and complete, basal margins of depressions distinct, apical margins of depressions narrowly depressed, pregradular area punctures close and fine; rims on T4 and T5 not depressed but closely punctured; tergum 6<sup>th</sup> apex narrowly rounded, sterna apical margin expanded apically and laterally with close and fine punctures, declivous sides, covered densely with scopal hairs, apex narrowly rounded, with dense fringe of hairs.

### 3.3.2. Male (Plate 2, Figs. a-h)

**Diagnosis-** Integument black, pubescence over face, clypeus, hypostome fuscous, first abdominal segment, scutum, scutellum, basal fasciae on terga 2-3 lightly reddish brown.

**Head:** Clypeus slightly swollen, finely punctured, with a smooth median line, incurved margin; flat hypostomal area with dense pubescence; mandibles 4 dentate with cutting edges in 2<sup>nd</sup> and 3<sup>rd</sup> interspace.

**Mesosoma:** Close punctures on scutum; scutellum slightly raised, finely punctured and outcurved posterior margin covered with dense fulvous fringe of hairs; ventral tubercles on mesepisterna; fore legs convex lacking spines and bristles; lower part of femur slightly raised; punctate; tibiae medially broad; tarsi simple; wings hyaline, lightly fuscous towards the apical margin.

**Metasoma:** Tergum 2<sup>nd</sup> heavily pubescent, terga 2-5 distinctly depressed along apical margins, depressed margins with transverse narrow bands, basal faciae fuscous only at lateral extremities; tergum 6<sup>th</sup> gradulus complete and linear, 4 sterna exposed, rim translucent.

**External genitalia:** Gonocoxites are broad and strong at emergence from gonobase. In the middle there is a sharp bend resulting in narrowing of gonocoxites till the apex. Gonostylus is furcated at a level little below apex in a small notch. Gonostylus is hairy at the apex. Penis valves are parallel and bend towards each other at the apex.

**3.3.3. Zoogeographic record:** Panchkula (30° 41' 42.7272" N, 76° 51' 15.0192" E), Una (20°49'23.45"N, 71°2'16.62"E), Ferozpur (30° 55' 24.3588" N, 74° 36' 36.7704" E).

**3.3.4. Specimen examined:** 2♂, 16 March 2013, 2♀, 18 March 2013, 4♀, 22 April 2014, 3♂, 11 May 2014, 3♀, 12 May 2014, 1♀, 17 April 2015.

**3.3.5. Floral associations:** Fabaceae: *Cajanus cajan* (L.), *Crotolaria juncea* (L.), *Milletia pinnata* L.; Lamiaceae: *Ocimum sanctum* L.; Rosaceae: *Rosa indica* L.

**3.3.6. Old distribution:** It was reported to be distributed around Bengal, Burma, Sikkim and Ceylon. Gupta [3] (1999) reported it around North West India in states of Rajasthan and Gujarat.



*Cajanus cajan* (L.)



*Crotolaria juncea* (L.)

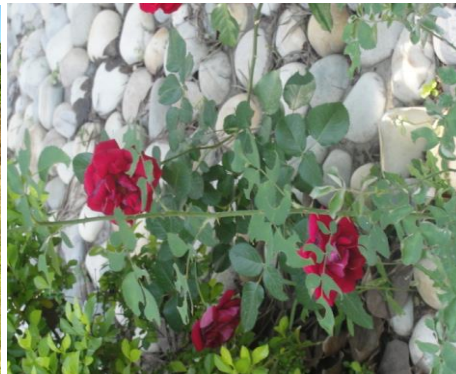


*Milletia pinnata* L.





*Ocimum sanctum* L.



*Rosa indica* L.

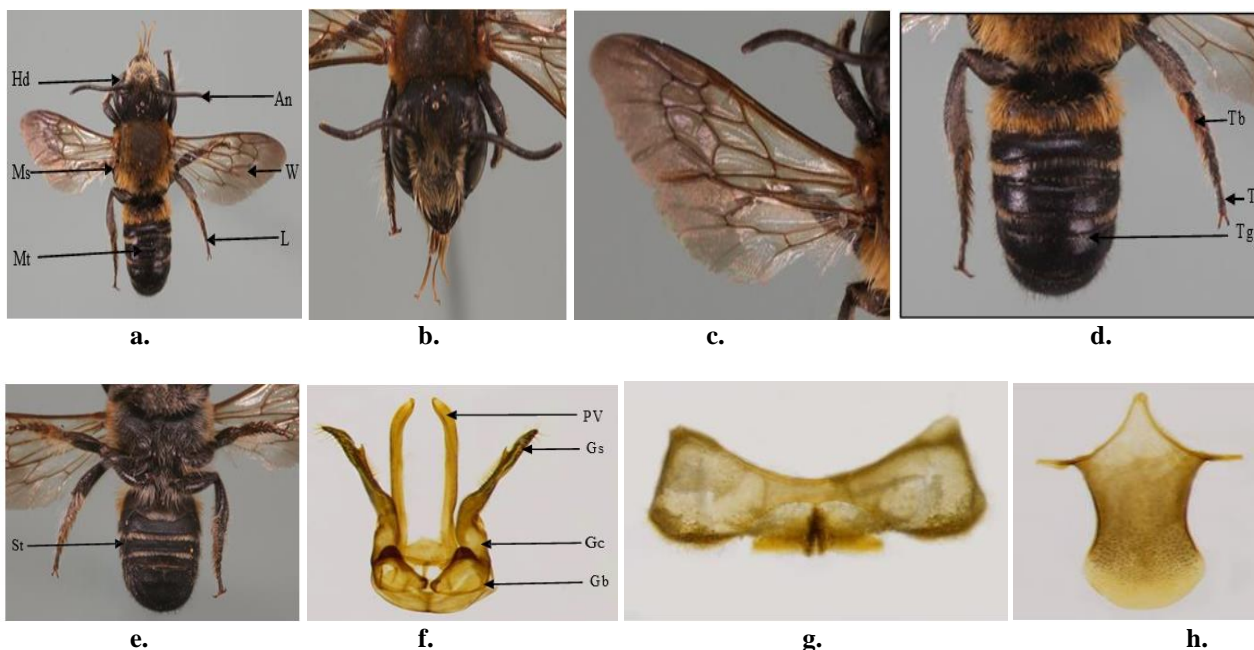
**4. Discussion**

*M. conjuncta* was described by Smith [6], later came redescriptions by Dalla Torre [7] and Bingham [2] in 1894 and 1897 respectively. *Cressoniella* was designated as subgenus of *Megachile* Latrielle in 1934 by Mitchell [8] with type species *M. zapotica*. The biodiversity and behavior of these bees has not been studied in detail so far. Males come out of the nests before the females as the cells most near the opening develop into males. They efficiently trip the flowers, mate with the females and die. All the parenting duties are carried out solely by the females. They mostly forage during bright sunny days and don't come out in rainy season. They were mostly collected between 10 am to 4pm in the months of March, April, September and October and between 8 am to 5 pm in the months of June to August.

Gregarious behaviour of *Megachile* bees was before reported by Kumari, P. and Kumar, N.R [9] for *Megachile bicolor*. *Megachile bicolor* belongs to genus *Megachile* and subgenus *Amegachile*. Michener [1], synonymised subgenus *Callochile* under subgenus *Amegachile*. This subgenus resembles the subgenus *Cressoniella* most closely. The body shape and size of bees of both subgenera are similar to each other. It consists of bees large and broad in body shape (Table 1) which have terga covered with dense pubescence superficially. Females of both subgenera have broad quadridentate mandibles with sharp cutting edges especially in second and third interspace. Basitarsi is shorter than tibiae; metasoma is broad and there is presence of concave sixth tergum. As there are morphological similarities there are also behavioural similarities between the species of both subgenera.



**Plate 2200:** *Megachile conjuncta* (Smith) female (a) Habitus, dorsal view (b) Head and Mesosoma, dorsal view (c) Wing (d) Metasoma, dorsal view (e) Sterna (Scopae) ventral view



**Plate 2200:** *Megachile conjuncta* (Smith) male (a) Habitus, dorsal view (b) Head and Mesosoma, dorsal view (c) Wing (d) Metasoma, dorsal view (e) Sterna, ventral view (f) Genitalia (g) Sternum 5 (h) Sternum 8

**Table 1:** Morphological (mm) measurements of *Megachile conjuncta* (Fabricius)

S.no.	Characters	mag.	<i>M. conjuncta</i>	
			♀	♂
1	BdL	4X	14.50	11.87
2	HdL	10X	4.98	3.63
3	HdB	10X	3.67	2.97
4	IaD	10X	1.02	0.83
5	AnD	10X	1.89	1.18
6	AoAsD	10X	1.07	0.94
7	UcD	10X	2.67	1.73
8	LcD	10X	2.99	1.43
9	VW	10X	1.29	0.80
10	CbW, CaW	20X	0.90, 1.26	0.67, 1.00
11	CmL	20X	1.09	0.98
12	LL	20X	0.87	0.69
13	WL	20X	1.45	.92
14	Ms	20X	0.26	0.17
15	MnL	20X	1.62	1.06
16	ScL	20X	0.67	0.63
17	PdL	20X	0.21	0.18
18	AnL	20X	0.25, 0.27, 0.26, 0.28, 0.23, 0.24, 0.27, 0.24, 0.23	0.27, 0.26, 0.25, 0.25, 0.28, 0.24, 0.23, 0.23, 0.26, 0.23, 0.20
19	AnW	20X	0.28, 0.26	0.26, 0.19
20	FwL	7.5X	8.26	6.93
21	McL	7.5X	1.22	1.09
22	ScL	7.5X	0.87	0.64
23	HwL	7.5X	6.90	5.16
24	JIL	7.5X	1.23	.78
25	VIL	7.5X	2.50	1.78
26	ScL	7.5X	3.01	2.64
27	ScW	7.5X	4.21	3.63
28	SuL	7.5X	1.28	1.03
29	MsL	7.5X	4.83	3.79
30	TgW	7.5X	4.02, 4.98, 5.02, 4.78, 4.52, 3.92	3.89, 4.05, 4.83, 3.67, 3.33, 2.45
31	MtL	7.5X	6.05	5.15
32	CxL	7.5X	1.21	0.83
33	TrL	7.5X	0.52	0.34
34	FmL	7.5X	2.16	2.11
35	TbL	7.5X	1.78	1.32
36	BtL	7.5X	1.02	.92
37	DtL	7.5X	0.50	0.70

## 5. Conclusion

Both male and female are efficient pollinators as they fly very energetically in the reproductive parts of the flowers aiding in pollination. They are efficient pollinators because they are ineffective in gathering pollen in the scopa. Hence they have to repeatedly make visits to the flower. Since these bees are foraging gregariously they can artificially nested near the crops they pollinate. They will increase the pollination of crops hence their yield and fruit quality.

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