

Stingless Bees (Hymenoptera: Apidae: Meliponini): Diversity and Distribution in India

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Abstract: A five year survey was undertaken to explore the diversity and distribution of Stingless bees in India. Systematics study was made on specimens collected from different regions of India viz. North East, North West and South India. The area covered under the study longitude varies from the lowest 9.50° N (Kerala) to the highest 32.73° N (Jammu & Kashmir) and latitude varies from 74.50° E (Maharashtra) to 95.33° E (Arunachal Pradesh). The study revealed that the survey area had two genera and six different species of Indian stingless bees that had been explored and redescribed. The distribution pattern of stingless bees in India, four species of stingless bees were prevalent in South India except *Tetragonula bengalensis* and *T. ruficornis*. In case of North East India, five species i.e. *T. bengalensis*, *T. iridipennis*, *T. ruficornis*, *T. laeviceps* and *Lepidotrigona arcifera* were dominant where as *T. iridipennis* and *T. laeviceps* were present in the North West India. The study also revealed that *T. iridipennis* and *T. laeviceps* were most commonly available species in all selected zone of India. The nesting behavior of *Tetragonula iridipennis* was found to make nest in timber whereas *T. bengalensis* makes nest in bamboo and others make in cracks and crevices of stone and mud walls in India.

Keywords: Stingless bees, Diversity, Description, Keys, Distribution, India

1. Introduction

Stingless bees are highly evolved social insects and live in a colony with organized system of division of labour. Some species have clusters of as many as 80,000 individuals and other less than 100. The workers or the females possess weak or vestigial stingers but unable to inflict pain with them. Hence, the term “stingless” is being used to designate the species. Some species have mandibles sufficiently strong to inflict a mild bite, pull hairs or may crawl into ears or nostrils of the intruders. Others emit a caustic liquid from the mouth that in contact with the skin causes intense irritation. Most species do not disturb man and they may be manipulated safely and can be managed at ease in the homestead garden. Species of stingless bees produce honey around 200-500 g per season. Honey derived from stingless bees of high quality having medicinal value. On the other hand stingless bees are effective pollinators of many of our economic crops of the families like compositae, cruciferae and leguminosae etc. where honeybees fail to pollinate. Stingless bees belong to the order Hymenoptera under the family Apidae, sub-family Apinae of Tribe Meliponini which has two main genera viz. *Melipona* and *Trigona*. About 250 species have been identified throughout the Neotropical and Indo-Burma –Malayan and Australian region of the world. Stingless bees are distinguished from corbiculate Apinae by combination of reduced fore wing venation, the presence of a jugal lobe in the hind wing.

The present state of knowledge on stingless bees of India, their diversity and foraging plants are not clearly known. Bingham, (1897) described most of the Indian species under *Melipona* almost a century ago. There are sporadic information on stingless bees and only recent account was given by Sakagami (1978) and Rasmussen, (2013) for continental Asia and Indian subcontinent. Hence present study has been carried out to explore and redescribe the stingless bees along with their distribution in India.

2. Materials and Method

Location and area: Stingless bee foragers were collected from three different region of India viz., North East (Assam, Meghalaya, Nagaland, and Arunachal Pradesh), North West (Jammu & Kashmir and Maharashtra) and South India (Andhra Pradesh, Karnataka, Kerala and Tamil Nadu) (Figure 1). Collections were made by Assam Agricultural University, Jorhat in collaboration with University of Agricultural Sciences, Dharwad; Karnataka, Tamil Nadu Agricultural University, Bhavanisagar; Tamil Nadu; Vidya Pratisthan School of Biotechnology, Baramati; Maharashtra; Calicut University, Calicut, Kerala; Kerala Agricultural University, Vellayni, Kerala; Andhra University, Vishakhapatnam; Andhra Pradesh, Sher-e-Kashmir University of Agricultural Science and Technology, Jammu, Jammu & Kashmir during 2008-2012.

3. Collection, Preservation and Identification

Twenty bee specimens were collected from each locations foraging on different crop plants with the help of sweeping net along with GPS data of those locations. Minimum ten locations were selected from each region and ten specimens were taken for study.

The specimens of stingless bees were preserved as dry and wet in 70% alcohol for the systematics study. The preserved specimens were treated with relaxing fluid (75 per cent alcohol 106 ml, distilled water 98 ml, benzene 14 ml and ethyl acetate 38 ml.) for 2 -4 hours. Various body parts like wings, legs, sterna, mouth parts (mandibles) and metasoma were dissected after water bath boiling in 10 % KOH solution for 2 - 3 minutes. Then the parts were rinsed in water and placed in glacial acetic acid to neutralize the KOH and preserved in glycerin. The measurements of different species along with body parts like head length and width, mesosoma length and width, metasoma length and width and

the total length were taken. Similarly, the length and width of fore wing, hind wing, and penicillum were taken with the help of Leica stereoscopic microscope at different magnifications ranging from 10x4X to 10x8X. The length of head was measured along the median lines from the base of head to the apex of mandibles in a single vertical plane. Width of head was the greatest distance across the eyes; inter ocular distance was the shortest space between the eyes on dorsal surface of head; Vertex was measured from the base of head to the posterior margin of the eyes. The length of mesosoma was measured along the median line from the cervix to the propodeum *i.e.* 1st segment of the metasoma. The width of mesosoma is the greatest width. The metasomal length was measured from the propodeum to the tip of the metasoma and the width was measured as the greatest width of metasoma. The length of forewings and hind wings were measured from the base of the tip of the wing to the apical point. The width was measured as the maximum width of the wing. The distance between two dorsal ocelli, dorsal ocello-ocular distance and femur length were taken. Mean has been worked out for each species. All the measurements were expressed in millimeters (mm).

Description of different species, distinguishing characteristics and their distribution in different regions of India has been recorded. The term mesosoma instead of thorax and metasoma for abdomen has been used as coined by Michener (1944) and leg III denotes hind leg. Pilosity for hair arrangement as adopted by Sakagami (1978) was taken. The term penicillium and keirotrochia denote the specialized hairs found in stingless bees. Synonymy and description has been provided alongwith erecting dichotomous key for each species.

Type specimens were deposited in the National Pusa collection, Indian Agricultural Research Institute, New Delhi. Species were identified with the help of existing literature and taxonomic keys (Sakagami, 1978 and Rasmussen, 2013). Nesting habitat was also recorded while collecting the specimens.

4. Results and Discussion

Description

I. *Tetragonula iridipennis* (Smith, 1854)

Trigona iridipennis Smith, 1854. *British Museum Nat. Hist.* London, 197pp.

Bingham, 1897. *The Fauna of British India including Ceylon*. 1: 579 pp.

Trigona (Tetragonula) iridipennis Sakagami, 1978. *J. Facul. Sci. VI, Zoology*. 21: 165-247pp.

Tetragonula iridipennis, Rasmussen & Camarago, 2008. *Apidologie*. 39: 102-118

Lectotype *Trigona iridipennis* Smith Design. JS Moure 1961/ C Rasmussen 2013

Type locality: Sri Lanka, Central province, Kandy [ca. 7.27° N, 80.60° E].

Colour integument: Head and mesosoma black, metasoma brownish; antenna brownish, legs brownish black. **Pilosity:** Head devoid of pubescence, mesosomal pleuron with

brownish short keirotrochia; **Metasoma** with silvery white piles in the apical tergum; legs with brownish keirotrochia, brownish penicillum in the end of hind tibia, tarsal segment with silvery piles. **Head:** Black, smooth and shining, antenna brownish, head length 1.1 and width 1.24, mandible length 0.34 and width 0.12, tridentate. **Mesosoma:** Black, smooth and shining, the sides of the mesonotum and scutellum fringed with fuscus pubescence, median segment of mesosoma with silky piles; forewing hyaline and iridescent, legs testaceous, penicillum testaceous, mesosoma length 1.24 and width 1.29. **Metasoma:** Black, smooth and shining, darkening toward apex, apical tergum, more or less testaceous. Metasoma length 1.21 and width 1.12. **Total length:** 3.56.

Materials examined: ♀ ♀ 10 from each location, **Distribution:** North East, North West and South India (Table 1).

Nesting habitat: Normally prefers to make nest in the wood but other materials e.g. bamboo, earthen pot etc also they accept.

II. *Tetragonula bengalensis* (Cameron, 1897)

Tetragonula bengalensis (Cameron, 1897). *Memoirs and Proc Manchester Lit. & Philosop. Soc.*, 41, 15-144.

Lectotype *Trigona bengalensis* Camerron Design. C. Rasmussen, 2013.

Type locality: India, West Bengal, Kolkata [ca. 22.68°N, 88.38°E].

Colour Integument: Entirely black, head black, Mesosoma black and metasoma jet black. **Pilosity:** Pubescence generally whitish brown; head with brownish pubescence; antennae brownish; mesosoma with brownish pubescence in dorsum; legs black with dark brown pubescence, tarsus with brownish keirotrochia. **Metasoma:** Tergum (T₁-T₄) without pubescence except widely scattered, simple hairs also sparsely present on central discs T₅ – T₆ with hairs widely scattered on sterna. **Head:** Black, smooth and shining, antenna brownish, head length 1.23, width 1.27; mandible length 0.44 and width 0.11; tridentate. **Mesosoma:** Black, smooth and shining, the sides of the mesonotum and scutellum fringed with fuscus pubescence, median segment of mesosoma with silky piles; wings hyaline and iridescent, mesosoma length 1.26 and width 1.30. **Metasoma:** Jet black, smooth and shining, darkening toward apex; metasoma length 1.21 and width 1.20, **Total length:** 3.71,

Material examined: ♀ ♀ 10. **Distribution:** North East, (Table 1). **Nesting Habitat:** prefers to make nest in bamboo.

III. *Tetragonula praeterita* (Walker 1860)

Tetragonula praeterita (Walker 1860) *Annals and Mag of Nat. Hist.* [3]5, 304-311.

Lectotype: BMNH 17b.1185, worker Design. J S Moure, 1961/ C. Rasmussen, 2013.

Type locality: Sri Lanka.

Colour Integument: Entirely black; head black, mesosoma brownish; antenna brownish; metasoma brownish black; legs chestnut brown; tarsus brownish.

Pilosity: Head with minute pubescence; mesosomal pleurite with brownish hairs; legs with brownish black keriotrichia, tarsus with brownish keriotrichia; Metasoma with silver white piles.

Head: Black, extremely minute and closely punctured, opaque, head length 1.14 and width 1.28; mandible length 0.43, width 0.12; tridentate.

Mesosoma: Black, extremely minute and closely punctured, opaque, median segment with short numerous pubescence, wings hyaline and iridescent forewing; testaceous penicillum; mesosoma length 1.17 and width 1.32.

Metasoma: Black and rest of the segments above dark, chestnut, basal segment above and beneath pale testaceous white; metasoma length 1.20 and width 1.17. **Total length:** 3.27

Materials examined: ♀♀ 10 from each location

Distribution: South India (Table 1).

Nesting habitat: *Tetragonula praeterita* is primarily found to make nest on wooden stem.

IV. *Tetragonula laeviceps* (Smith 1857)

Trigona laeviceps Smith 1858. *J. Linn. Soc.* II: 51pp., Sakagami, 1990. *Nat. Hist. Soc. Wasp & bees.* 201-217. Rasmussen & Cameron, 2007. *Sys. Ento.* 32: 26-29, Specimens resemble to *Trigona laeviceps* Smith, 1857. Design. Sakagami, 1978.

Type locality: Singapore, Upper Peiree Reservoir Park

Colour Integument: General colouration black, metasoma brownish, wings brownish, hyaline beyond stigma, antenna deep brownish in base and light in the apex; legs: trochanter brownish black, tibia black, femur black metatarsus brownish black in base and brownish tarsomere.

Pilosity: Head with sparse hairs; mesosomal hairs in the pleurite; metasoma very sparsely distributed hairs; legs: trochanter with long bristles like hairs, tibial spur present, femur without spur, metatarsus with rows of keriotrichia and tarsus with keriotrichia.

Head: Black, smooth and shining, minute puncture, antenna black, flagellar segment 10, clypeus anteriorly rufo testaceous, front and vertex with segment highly polished, face and clypeus covered with a thin cinerous pile; head length 1.06 and width 1.24; mandible length 0.34 and width 0.12, mandible tridentate.

Mesosoma: Black, smooth and shining, wings sub-hyaline and brilliantly iridescent, legs testaceous, penicillum testaceous; mesosoma length 1.29 and width 1.27.

Metasoma: Testaceous, darkening to castaneous brown on the three segments above, smooth and shining, darkening toward the apex, apical tergum more or less testaceous; metasoma length 1.18 and width 1.16.

Total length: 4.04.

Materials examined: ♀♀ 10 from each location.

Distribution: North East, North West and South India (Table1).

Nesting habitat: The species is discovered from underground nesting in the soil from North East India.

V. *Tetragonula ruficornis* (Smith 1870)

Tetragonula ruficornis (Smith 1870)
Trigona ruficornis Smith 1870. *Trans. Zool. Soc.* VII: 194
Trigona ruficornis Sakagami. 1978. *J. Facult. Sci. VI Zoology* 21: 165-247
Trigona ruficornis Smith, Design. C. Rasmussen 2013, Type locality: India, Varanasi [25.28°N, 82.96°E]

Colour: Integument: Head brownish; mesosoma brownish black; metasoma black; legs: trochanter, femur and tibia deep brown, tarsus brownish at base and light in apex.

Pilosity: Head with hairs on the cervix, mesosoma with pleural spur and metasoma without hairs; legs: trochanter without spur, tibia with bristle like keriotrichia, femur without spur, tarsus with rows of keriotrichia, metatarsus with sparsely distributed keriotrichia.

Head: Brownish, a deep abbreviated furrow in front of the anterior ocellus; face in front with a cinerous pile; antenna and the anterior tarsi brownish, head length 1.11 width 1.32, mandible tridentate.

Mesosoma: Brownish black, dull and opaque, deep brown for more than half of their length from base, milky white beyond, legs testaceous; penicillum testaceous, mesosoma length 1.14 and width 1.11

Metasoma: Smooth and shining, apical tergum more or less testaceous, metasoma length 1.18 and width 1.11

Total length: 3.43

Materials examined: ♀♀ 10 from each location

Distribution: North East (Table1).

Nesting habitat: The specimens were found to make nest in timber.

VI. *Lepidotrigona arcifera* (Cockerell 1929)

Trigona arcifera (Cockerell 1929) *Annals and Mag. of Nat. Hist.*, (10)4, 584-592
Lepidotrigona arcifera (Cockerell 1929) *American Museum Novitates*, 346, 1-18

Type locality: India, Sikkim [27.11°N, 88.47°E]

Clour Integument: Head black; mesosoma black; metasoma brownish; legs brownish black, tarsus deep brown at base, metatarsus brown.

Pilosity: Head with distribution of hairs; mesosoma with spurs; metasoma without hairs; trochanter with mild hairs, tibia and basitarsus with dense keriotrichia, femur with no keriotrichia, tersomere with rows of piles.

Head: Black, smooth and shining, antenna black, head length 1.09 width 1.27, mandible tridentate.

Mesosoma: Black, smooth and shining, the sides of the mesonotum and scutellum with a few punctures, the anterior legs pale reddish yellow, the posterior part jet black, the apical joints of the tarsi ferruginous; wings reddish brown, milky white beyond the stigma; the sides of the mesosoma with short pale thin pubescent; the scutellum fringed with fuscous hairs, wings hyaline; mesosoma length 1.27 width 1.34

Metasoma: Pale reddish yellow, smooth and shining, broad at base and somewhat short in apex; metasoma length 1.25 and width 1.16.

Total length: 3.48.

Distribution: North East and South India (Table1).

Nesting habitat: The specimens were collected both from Western and Eastern ghat of India making nest in timber.

Table 1. Distribution of Stingless bee in India.

Zones	South India	North East India	North West India
	Andhra Pradesh, Tamil Nadu, Kerala, Karnataka	Assam, Arunachal Pradesh, Nagaland, Meghalaya	Jammu & Kashmir, Maharashtra
Species			
<i>Tetragonula bengalensis</i>	-	+	-
<i>T. iridipennis</i>	+	+	+
<i>T. praeterita</i>	+	-	-
<i>T. laevicepes</i>	+	+	+
<i>T. ruficornis</i>	-	+	-
<i>Lepidotrigona arcifera</i>	+	+	-

Note: Data from 10 locations of each Zone

Stingless bees are found in all three tropical regions. The Indo-Pacific fauna extend transoceanically from India through South East Asia and Guinea to Australia. The genus *Tetragonula* Moure, 1961 which was erected from *Trigona* Jurine is the largest group of Indo-pacific stingless bees includes some most common and wide spread forms. Most *Tetragonula* are more or less dark coloured but there are some mostly or partly pale coloured forms. The main difficulty in segregating *Tetragonula* is the virtual absence of reliable structural characters in workers. Hence, the identification must depend on size, proportion, colouration and pilosity.



Source: Google map

Figure 1: Distribution of stingless bees in India

Males are more easily distinguished by structural characters but are poorly represented and therefore, workers are used for taxonomic purpose. *Tetragonula* species groups of the “*Iridipennis*” are characterized by having dark mesoscutum with four distinct hair bands separated by broad glabrous interspaces and by their smaller body size. Besides *Iridipennis*, the group includes *Tetragonula bengalensis*, *T. praeterita* and *T. ruficornis* from India. Some of the characteristics such as structural variation in mandibles, apical tergum and VI sterna confer the distinction among the species. Morphometrics and description given by Rasmussen (2013) was compared which fairly supported the identity of Indian Stingless bees of the genus *Tetragonula* and *Lepidotrigona*. The information on distribution and nesting habitats have been included in the text.

Keys for Identification:

Keys

1. Wings hyaline and iridescent -----2a&b Wings dark brown at base, milky white or hyaline beyond stigma-----3
- 2a. Metasoma jet black, darkening towards apex ,apical tergum black----- *Tetragonula bengalensis* Metasoma black, darkening towards apex, apical tergum more or less testaceous-----*T. iridipennis*
- 2b. Vertex of head and front highly polished, shining, legs rufo-testaceous.....*T. laeviceps* Head and face in front slightly pubescent, legs fuscous towards apex---*T. ruficornis*
3. Metasoma pale reddish, smooth, shining and broad at base, basal darkening towards apex -----*Lepidotrigona arcifera*
 Metasoma pale brownish, testaceous at basal and beneath markedly testaceous white and legs chestnut brown-----*T. praeterita*

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