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Checklist of non-*Apis* bees from eight districts of Karnataka

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Abstract
Studies conducted on non-*Apis* bee fauna in eight districts of Karnataka revealed 44 species and 20 unidentified morphospecies in 23 genera. Three families of the Apoidea superfamily viz. Apidae, Megachilidae, Colletidae and Halictidae were represented in eight districts of Karnataka. The family Apidae was represented by three subfamilies *viz*., Xylocopinae (three genera and 23 species, and four unidentified species), Apinae (five species two unidentified species and two genera) and Nomadinae (One species). The subfamily Xylocopinae was represented with three tribes Xylocopini, Ceratini, and Allodapini, and Apinae was represented with two tribes Anthophorini and Melectini. The family Megachilidae was represented with single subfamily Megachilinae (14 species under five genera with two unidentified species) with two tribes Megachilini and Anthidiini. Family Halictidae was represented with 2 species and 11 unidentified species under 11 genera. Family Colletidae with single species. A checklist was prepared of the species documented in the present study.

Keywords: Non-*Apis* bees, checklist, halictidae, apidae, megachilidae, colletidae

Introduction

The word "bee" to a general public draws the attention to the most famous and hardworking group of insects, the honey bees. However, most people are unaware of the existence of non-*Apis* bees and their role in pollination (Batra, 1997) [4]. The popularity of the honey bees is directly correlated with the economic benefits we derive in terms of honey, wax, etc. along with pollination of our crop plants. There are 20,473 bee species worldwide (Ascher and Pickering, 2016) [2] and honey bees make up only a fraction (0.05 %) of that total number. In India, Ascher and Pickering (2016) [2] have reported 722 bee species, out of which, six are *Apis* species and the remaining 716 species are non-*Apis* bees. Currently, farmers who depend on managed bees for pollination rely merely on a few species of honey bees.

The Food and Agriculture Organization (FAO) estimates that, of slightly more than 100 crop species that provide 90 *per cent* of the food supplies for 146 countries, 71 are mainly pollinated by bees (mostly by wild bees). A few other plant species are pollinated by honey bees, beetles, thrips, wasps, flies and other insects. The wild bee community is likely sufficient to provide services for multiple crops, including some that are not serviced by the honey bees (Kermen *et al.*, 2002) [8].

In the recent past, a drastic decline in honey bee availability because of the parasitic mite in some parts of the world led to concern over the pollinator shortfall. This led to a paradigm shift from sole dependence on honey bees to giving importance to the native pollinators (Buchmann and Nabhan, 1996) [5]. Management of bees for commercial pollination, *i.e.*, use of managed wild bees, began globally in the 1940s.

There have been a few studies in India to assess the diversity of non-*Apis* bee. Information on Indian bee diversity is scanty, even regional faunal lists are few and limited in nature. (Batra, 1977, 1997; Suma, 2006; Nayana, 2008; Dhanyavathi, 2009; Gupta, 2010, Arati 2010, Veereshkumar 2013, 2015, Prashantha, 2017) [3, 4, 10, 6, 7, 1, 11, 9].

India is home to rich diversity of flora and fauna, hence, it is one among the seventeen mega diverse countries. The role of pollinators, especially the bees is essential for the survival of several plant species. The lack of regional checklists has hindered the conservation efforts on non-*Apis* bees in several of these ecosystems. Hence, the present work aims to provide a checklist of non-*Apis* from eight districts in Western Ghats of Karnataka.

Material and Methods

Area of study

Non-*Apis* bees were collected from cropping ecosystems in eight districts of Karnataka i.e. Udupi, Dakshina Kannada, Uttara Kannada, Mysore, Kodagu, Hassan, Chikmagalur and Shivamogga. Farms owned by horticultural research stations, plantation estates and fruit orchards of farmers in selected districts were chosen for the collection. Intensive collections were made in Mudigere, Dakshina Kannada and nearby localities of Chikkamagalur district. The localities visited (Mysore: Kalalavadi; Kodagu: Ponnampet; Hassan: Shantigrama; Sakaleshpura; Hanabal; Chikkamagaluru: Mudigere; Banakkal; Udupi: Barkur; Karkala; Sanoor; Shivamogga: Teerthalli; Navile; Dakshina Kannada: Vittal; Uttara Kannada: Sirsi) for collection of non-Apis bees during the present study are shown in fig 1.

The collections maintained at Department of Entomology, College of Horticulture; Mudigere, Mysore and Sirsi, College of Forestry; Ponnampet and Sirsi and Department of Entomology, University of Agricultural and Horticultural Sciences,

Shivamoga, were sorted for non-*Apis* bee specimens collected from study area and curated for further study.

Collection and preparation of specimens for the study

Bees were collected with different sampling methods. The relative performance of these methods varied and biased towards certain taxa of bees. In this study the active method used for bee collection was sweep net method and passive methods followed were using bee bowls.

The habitats in cultivated and adjacent ecosystems were chosen for non-*Apis* bee collection based on richness of flower diversity in Western Ghats of Karnataka. Transect walks (500 m) were made twice in such chosen ecosystems for sweep net collection.

Bee bowls were prepared by colouring disposable plastic bowls of 10 cm diameter and 3.5cm depth with acrylic paints (yellow and blue). For white, bowls were used without painting. Before placing the bowl, each bowl was half filled with 1 per cent soap solution, to make the attracted bees drown. Seventy-five bee bowls (25 of each colour) were set out in the field (approximately 5 m apart) along the transact walk path randomly in the morning and were removed by the end of the day. While removing the bowls the content was strained in the field and specimens collected in jars.

Processing of the collected bee specimens

The specimens collected using sweep net were killed in bottles charged with ethyl acetate and were later individually pinned using appropriate entomological pins. The pinned specimens were properly stretched and dried in hot air oven prior to subsequent use. Each specimen was labelled by giving information on locality, date, collector's name, host plant etc.

The preserved specimens from the various institutes were cleaned for any fungal growth on the specimens using 70 per cent alcohol. Old and rusted pins were carefully removed and replaced with the new ones. For re-pinning the specimens were dipped in the 70 per cent alcohol for few minutes and old pins were carefully removed without damaging the specimen and new insect pins were inserted. Student collected specimens were relabelled and labels of old collection specimens were retained as such considering their historical significance. These were later stored in the cabinet boxes with unit trays and used for the further studies.

Specimens are deposited in Department of Entomology, Biosystematics Laboratory, University of Agricultural Sciences, GKVK, Bengaluru and also in the Department of Entomology, College of Horticulture, Mudigere.

Results and Discussion

A total of 788 bee specimens belonging to four families representing 23 genera were examined. Out of which, 428 specimens were collected during this study period and rest of the 360 specimens were procured from the department of Entomology of different institutes mentioned previously. The bees were identified to their respective subfamilies, generic, sub generic and species levels. In this collection, a total of 44 species were identified and 20 were identified only up to genus level. The unidentified species were given numbers based on morphospecies.

The family Apidae is represented by two subfamilies viz. Apinae and Xylocopinae. A total of 31 species and 5 genera are represented in the family Apidae *viz.*, *Braunsapis* Michener, *Ceratina* (Latreille), *Xylocopa* Latreille, *Amegilla* Friese, *Thyreus* Panzer. Family Megachilidae was represented by one subfamily *viz*., Megachilinae with two tribes and five genera. The family Halictidae is represented with two subfamily Halictinae and Nomiinae with four genera under Halictinae and six genera under Nomiinae.

Checklist is given in Table 1

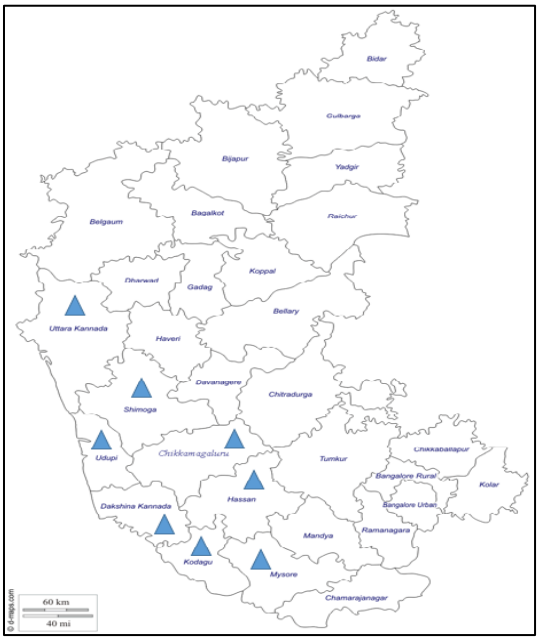

Fig 1: Karnataka map showing places visited for non-*Apis* bees collection in the present study

Table 1

Sl. No.	Family	Sub Family	Tribe	Genus	Subgenus	Species
1	Apidae	Xylocopinae	Allodapini	Braunsapis		*Braunsapis mixta* (Smith, 1852)
2	Apidae	Xylocopinae	Allodapini	Braunsapis		*Braunsapis picitarsis* (Cameron, 1902)
3	Apidae	Xylocopinae	Allodapini	Braunsapis		*Braunsapis puangensis* (Cockerell, 1929)
4	Apidae	Xylocopinae	Allodapini	Braunsapis		*Braunsapis* sp 1
5	Apidae	Xylocopinae	Ceratini	Ceratina	*Ceratinidia*	*Ceratina bryanti* Cockerell, 1919
6	Apidae	Xylocopinae	Ceratini	Ceratina	*Ceratinidia*	*Ceratina hieroglyphica* Smith, 1854
7	Apidae	Xylocopinae	Ceratini	Ceratina	*Ceratinidia*	*Ceratina lieftincki* Van der Vecht, 1952
8	Apidae	Xylocopinae	Ceratini	Ceratina	*Ceratinidia*	*Ceratina simillima* Smith, 1854
9	Apidae	Xylocopinae	Ceratini	Ceratina	*Neocerarina*	*Ceratina propinqua* Cameron, 1897
10	Apidae	Xylocopinae	Ceratini	Ceratina	*Pithitis*	*Ceratinabinghami* Cockerell, 1908
11	Apidae	Xylocopinae	Ceratini	Ceratina	*Pithitis*	*Ceratina indica* (Hirashima, 1969)
12	Apidae	Xylocopinae	Ceratini	Ceratina	*Pithitis*	*Ceratina smaragdula* (Fabricius, 1787)

13	Apidae	Xylocopinae	Ceratini	Ceratina	*Pithitis*	*Ceratina waini* (Shiokawa and Sakagami, 1969)
14	Apidae	Xylocopinae	Ceratini	Ceratina	*Pithitis*	*Ceratina* sp1
15	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Biluna*	*Xylocopa auripennis* Westwood, 1838
16	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Ctenoxylocopa*	*Xylocopa auripennis* Westwood, 1838
17	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Koptortosoma*	*Xylocopa hafizii* Ma, 1938
18	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Koptortosoma*	*Xylocopa pubescens* (Spinola, 1838)
19	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Koptortosoma*	*Xylocopa ruficornis* Fabricius, 1804
20	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Nodula*	*Xylocopa amethystina* (Fabricius, 1793)
21	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Nodula*	*Xylocopa nigrotarsata* Ma, 1938
22	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Nodula*	*Xylocopa prashadi* Ma, 1938.
23	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Nodula*	*Xylocopa* sp1
24	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Nyctomelitta*	*Xylocopa tranquebarica* (Fabricius, 1804)
25	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Platynopoda*	*Xylocopa latipes* (Drury, 1773)
26	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Platynopoda*	*Xylocopa magnifica* (Cockerell, 1929)
Sl. No.	Family	Sub Family	Tribe	Genus	Subgenus	Species
27	Apidae	Xylocopinae	Xylocopini	Xylocopa	*Zonohirsuta*	*Xylocopa* sp1
28	Apidae	Apinae	Anthophorini	Amegilla	*Dizonamegilla*	*Amegilla dizona* Engel, 2009
29	Apidae	Apinae	Anthophorini	Amegilla	*Zonamegilla*	*Amegilla niveocincta* (Smith, 1854)
30	Apidae	Apinae	Anthophorini	Amegilla	*Glossamegilla*	*Amegilla violacea* (Lepeletier, 1841)
31	Apidae	Apinae	Anthophorini	Amegilla		*Amegilla* sp1
32	Apidae	Apinae	Melectini	Thyreus		*Thyreus histrio (Fabricius,1775)*
33	Apidae	Apinae	Melectini	Thyreus		*Thyreus* sp1
34	Apidae	Nomadinae	Nomadini	Nomada		*Nomada adusta Smith, 1875*
35	Megachilidae	Megachilinae	Megachilini	Megachile	*Amegachile*	*Megachile bicolor* (Fabricius, 1781)
36	Megachilidae	Megachilinae	Megachilini	Megachile	*Callomegachile*	*Megachile disjuncta* (Fabricius, 1781)
37	Megachilidae	Megachilinae	Megachilini	Megachile	*Callomegachile*	*Megachile lerma* (Cameron, 1908)
38	Megachilidae	Megachilinae	Megachilini	Megachile	*Callomegachile*	*Megachile stirostoma* Cameron, 1913
39	Megachilidae	Megachilinae	Megachilini	Megachile	*Creightonella*	*Megachile albifrons* Smith, 1853
40	Megachilidae	Megachilinae	Megachilini	Megachile	*Eutricharaea*	*Megachile* sp1
41	Megachilidae	Megachilinae	Megachilini	Megachile	*Eutricharaea*	*Megachile* sp2
42	Megachilidae	Megachilinae	Megachilini	Megachile	*Pseudomegachile*	*Megachile lanata* (Fabricius, 1775)
43	Megachilidae	Megachilinae	Megachilini	Megachile	*Xanthosarus*	*Megachile anthracina* Smith, 1853
44	Megachilidae	Megachilinae	Megachilini	Coelioxys	*Allocoelioxys*	*Coelioxys capitata* Smith, 1854
45	Megachilidae	Megachilinae	Megachilini	Coelioxys	*Liothyrapis*	*Coelioxys fuscipennis* Smith, 1854
46	Megachilidae	Megachilinae	Megachilini	Coelioxys	*Torridapis*	*Coelioxys basalis* Smith, 1875
47	Megachilidae	Megachilinae	Anthidiini	Anthidium	*Anthidium*	*Anthidium ardens* Smith, 1879
48	Megachilidae	Megachilinae	Anthidiini	Eoanthidium	*Hemidiellum*	*Eoanthidium semicarinatum* Pasteels, 1972
49	Megachilidae	Megachilinae	Anthidiini	Euaspis	*Parevaspis*	*Euaspis carbonaria* (Smith, 1854)
50	Megachilidae	Megachilinae	Anthidiini	Euaspis	*Parevaspis*	*Euaspis edentata* Baker, 1995
51	Halictidae	Halictinae	Halictini	Halictus		*Halictus* sp1
52	Halictidae	Halictinae	Halictini	Lasioglossum		*Lasioglossum* sp1
Sl. No.	Family	Sub Family	Tribe	Genus	Subgenus	Species
53	Halictidae	Halictinae	Halictini	Lasioglossum		*Lasioglossum* sp2
54	Halictidae	Halictinae	Halictini	Seladonia		*Seladonia* sp1
55	Halictidae	Halictinae	Halictini	Sphecodes		*Sphecodes* sp1
56	Halictidae	Nomiinae		Curvinomia		*Curvinomia* sp1
57	Halictidae	Nomiinae		Gnathonomia		*Gnathonomia* sp1
58	Halictidae	Nomiinae		Gnathonomia		*Gnathonomia thoracica* Smith, 1875
59	Halictidae	Nomiinae		Hoplonomia		*Hoplonomia westwoodi* (Gribodo, 1894)
60	Halictidae	Nomiinae		Macronomia		*Macronomia* sp1
61	Halictidae	Nomiinae		Maynenomia		*Maynenomia* sp1
62	Halictidae	Nomiinae		Nomia		*Nomia crassipes* (Fabricius, 1789)
63	Halictidae	Nomiinae		Steganomus		*Steganomus* sp1
64	Colletidae	Colletinae		Colletes		*Colletes* sp1

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