Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 1257-1261

Received: 09-09-2020
Accepted: 21-10-2020

Vidya KC
PG Student, Department of Agricultural Entomology, College of Agriculture, Dharwad, Karnataka, India

Subhash B Kandakoor
Assistant Professor, Farm Superintendent and Head ARS, Bailhongal

ST Prabhu
Professor and Head, Department of Agriculture Entomology, College of Agriculture, Hanumanamatti, Karnataka, India

SC Talekar
Assistant Professor and Head AICRP on Rice, ARS, Mugad

Corresponding Author:
Vidya KC
PG Student, Department of Agricultural Entomology, College of Agriculture, Dharwad, Karnataka, India

Diversity of *Apis* and non-*Apis* pollinators in University of Agricultural Sciences, Dharwad campus

Vidya KC, Subhash B Kandakoor, ST Prabhu and SC Talekar

DOI: https://doi.org/10.22271/j.ento.2020.v8.i6q.8006

Abstract
The data on bee fauna included 34 bee species of *Apis* and non- *Apis*. Among them 14 species belongs to the family Apidae, 7 species halictidae, 7 species Megachilidae, 3 species Scolidae and 3 species Vespidae. Among the different families recorded, Apidae constituted at higher per cent of 80.20 per cent followed by Halictidae 16.29 per cent, Scolidae 1.6 per cent, Megachillidae 1.52 per cent and Vespidae 0.29 per cent. The highest Simpson index, Shannon-Wiener index and Margalef's diversity index was observed during October month with 0.816, 2.023 and 2.815 respectively due to the availability of rich source of bee flora and favourable environmental conditions to the bees. Similarly highest evenness of 1 was observed during July month.

Keywords: *Apis*, Non-*Apis*, species, diversity

Introduction
Biodiversity is the foundation for all the services of natural ecosystem in which human beings and other organisms are living. Insect biodiversity contributes to large proportion among of all other biodiversity and are significant due to their role in ecology, agriculture, natural resources and human health. Among the insect pollinators, Lepidoptera is the most diversified group with more than 1,40,000 species followed by Coleoptera, Hymenoptera and Diptera (Ollerton *et al.,* 2017) [6]. Pollinators contribute a lot to agriculture for better seed set and realising higher yield as compare to any other agricultural management. Crops like cherries, blueberries depend on honey bee for their pollination up to 90 per cent. Globally, pollinators support the 87 major crops in enhancing their production. Pollination independent crops are five times less important than those of the crops that require pollination (Belavadi and Ganeshaiah, 2013) [2]. Richness of plant species has positive effect on richness of solitary bees, bumble bees and other pollinators (Ebeling *et al*., 2008) [3]. Higher plant diversity is an indication of increased bee diversity (Schleuning *et al*., 2011) [8].

Pollination is necessary to increase better seed set and to maintain crop diversity. A total of 35 per cent of the world food production is contributed from the pollinator dependent crops. One out of every 3 bites of food we eat depends on pollinator service. Complete pollinator decline would lead to current consumption deficit of 6 per cent in vegetables and 12 per cent in fruits (Gallai *et al*., 2009) [4]. No pollinators no food. Pollinators utilization especially honeybees are considered as one of the eco-friendly and cheapest way in increasing the yield. The bee pollinators are considered as a major contributor for doubling the farmers income initiated by central government. In this context, the scientists and policy makers given the importance to the bee pollination in Agriculture. The research in this aspect would help in correlating abiotic and biotic factors which will be useful to plan a strategy in pollinator conservation. By considering these facts, investigations are planned to assess the diversity of *Apis* and non-*Apis* pollinators in University of Agricultural Sciences Dharwad, Campus.

Materials and methods
Bee fauna visiting the flowers were recorded by visually and sweep net collections. Survey was carried out during bright sunshine hours from 7am to 12 noon according to the weather conditions at fortnight interval.

Visual scanning
Observations were recorded on the bee species of insects visiting the flowers to record the variation in species composition and their abundance. Observations were repeated on different days during flowering season.

Sweep net collection of flower visitors
After complete record of flower details and the pollinator visitation, the pollinators were collected for further identification and processed the specimens for identification with insect taxonomist. After collection using sweep net, the specimens were transferred to a poison tube and killed for identification purpose.

Killing, pinning and processing of specimens
Killing jar containing chloroform was used and the bottle was recharged as per the requirement during the survey period. After the collection and killing, the bees were pinned (insect pins no. 3) through the thorax and all the body parts such as legs, antennae, wings were stretched properly which are taxonomically important for quick and easy identification. The bees were dried properly, to remove the moisture that may obscure body hairs and other identification features, that are of taxonomically important. This process caused the hairs of the bees to stiffen and erect aiding for easier identification. Each specimens were labelled by providing the site, date and collector information. All specimens were kept in special insect boxes supplied with foam plates for pinning and paradichlorobenzene (PDB) to enable long storage to get rid off pest damage. All specimens were deposited in the department of Entomology, UAS, Dharwad for future reference. The collected specimens were identified by the taxonomist Dr. Yeshwanth, Department of Entomology, UAS, GKVK, Bengaluru.

Diversity of bee
The collected bee fauna was used to measure their richness and evenness which were computed month wise with the following formulas (Magurran, 1988) [5].

Diversity indices
a. Shannon-Wiener diversity
The Shannon diversity index is calculated by using the following equation:

$H' = -\Sigma\ pi \ln pi$ ……. Eq.1

where pi is the proportion of individuals of the ith species found and

b. Simpson Index

$H' = 1-\Sigma pi2$…… Eq. 2

c. Species richness models
Margalef's diversity index

$Dmg = (S-1)/ \ln N$

Where, S is the number of species recorded and N is total number of individuals combined of all S species

d. Evenness
Relative abundance of each species in a particular habitat was calculated using the following formula

$E = H'/ \ln S$

Where H' the diversity index calculated from equation 1or/and 2, and 'S' is the total number of species present.

Results
***Apis* and non-*Apis* pollinators in UAS, Dharwad Campus**
The study aimed of investigating the diversity of *Apis* and non-*Apis* bees in UAS, Dharwad, Campus. During the study, totally 34 species were identified by the taxonomist belong to different families, genera of Hymenoptera. It was recorded that 14 identified specimens belongs to the family Apidae, 7 species to the family Halictidae, 3 to the Scolidae, 7 to the Megachillidae and 3 to the Vespidae. It was not astonished to find the most dominant bee family Apidae, followed by Megachillidae and Halictidae, Scolidae and Vespidae. Among the non- *Apis* bees, *Ceratina simillima, Ceratina lieftincki, Ceratina hieroglyphica, Ceratina binghami, Thyreus* sp., *Xylocopa nasalis, Xylocopa latipes, Xylocopa amethystine* and *Amegilla* sp. *belonging to the genus Apis* were recorded (Table 1).

Per cent contribution of bee families
The per cent contribution of bee families present in Table 2. Among the different families recorded, Apidae constituted at higher per cent of 80.20 per cent followed by Halictidae 16.29 per cent, Scolidae 1.6 per cent, Megachillidae 1.52 per cent and Vespidae 0.29 per cent.

Diversity indices of bees observed during survey at UAS, Dharwad campus from July 2019-2020
The dominance of species was observed by, Simpson index which recorded highest value during the October month of 0.816 followed by November month (0.778) and lowest during August month (0.701). The Shannon diversity index (2.023) and Margalef's index (2.815) registered highest values during fourth month of my research work (October) and least during January (1.514) and December (1.206). Evenness highest value 0.875 observed during July month followed by December and least during March month of 0.646 (Table 3).

Table 1: *Apis* and non-*Apis* pollinators recorded at UAS, Dharwad, July 2019 to March 2020

Sl. No.	Common name	Scientific name	Family
1	Rock bee	*Apis dorsata*	Apidae
2	Indian bee	*Apis cerana indica*	Apidae
3	Little bee	*Apis florea*	Apidae
4	Stingless bee	*Melipona irridipennis*	Apidae
5	Small carpenter bee	*Ceratina simillima*	Apidae
6	Small carpenter bee	*Ceratina lieftincki*	Apidae
7	Small carpenter bee	*Ceratina hieroglyphica*	Apidae
8	Small carpenter bee	*Ceratina binghami*	Apidae

9	Cuckoo bees	*Thyreus* sp.	Apidae
10	Oriental carpenter bee	*Xylocopa nasalis*	Apidae
11	Tropical carpenter bee	*Xylocopa latipes*	Apidae
12	Blue banded bee	*Amegilla cingulata*	Apidae
13	Carpenter bee	*Xylocopa amethystine*	Apidae
14	Banded bee	*Amegilla* sp.	Apidae
15	Sweat bee	*Lasioglossum* sp.	Halictidae
16	Sweat bee	*Lipotriches* sp.	Halictidae
17	Sweat bee	*Gnathonomia*	Halictidae
18	Alkali bee	*Nomia* sp.	Halictidae
19	Halictid	*Hoplonomia* sp.	Halictidae
20	Halictid	*Nomioides* sp.	Halictidae
21	Halictid	*Homalictus* sp.	Halictidae
22	Scoliid wasp	*Scolia affinis*	Scolidae
23	Scoliid wasp	*Scolia binotata*	Scolidae
24	Scoliid wasp	*Scolia* sp.	Scolidae
25	Leaf cutter bee	*Megachile lerma Cameron*	Megachilidae
26	Wooly wall bee	*Megachile lanata*	Megachilidae
27	Leaf cutting bee	*Megachile anthracina*	Megachilidae
28	Disjunct Resin bee	*Megachile disjuncta*	Megachilidae
29	Leaf cutter bee	*Megachile* sp. 1	Megachilidae
30	Leaf cutter bee	*Megachile* sp. 2	Megachilidae
31	Leaf cutter bee	*Megachile* sp. 3	Megachilidae
32	Potter wasp	*Rhynchium brunneum*	Vespidae
33	Potter wasp	*Delta pyriforme pyriforme* (fabricius)	Vespidae
34	Paper wasp	*Ropalidia* sp.	Vespidae

Table 2: Per cent contribution of bee families

Bee family	Per cent contribution
Apidae	80.20
Halictidae	16.29
Scolidae	1.6
Megachilidae	1.52
Vespidae	0.29
Total	100

Table 3: Diversity indices of Bees observed during survey at UAS, Dharwad campus, July 2019 to March 2020

Months	Simpson index	Shannon diversity index	Margalef's diversity index	Evenness
July	0.762	1.569	1.189	0.875
August	0.701	1.543	1.731	0.793
September	0.766	1.87	2.808	0.674
October	0.816	2.023	2.815	0.729
November	0.778	1.733	1.726	0.788
December	0.787	1.668	1.206	0.857
January	0.704	1.514	1.429	0.727
February	0.707	1.561	1.938	0.678
March	0.739	1.75	2.509	0.646
Total	0.816	2.053	4.34	0.592

Discussion

During the study period, totally 34 bee species were identified with the help of the taxonomist. The identified bees were belongs to different families, genera of Hymenoptera. It was recorded that 14 species belongs to the family Apidae, 7 species to the family halictidae, 3 species to the Scolidae, 7 species to the Megachillidae and 3 species to the Vespidae. It was not astonished to find the most dominant bee family as Apidae, followed by Megachillidae and Halictidae, Scolidae and Vespidae. These findings were supported by Arati (2010), who grouped collected bees into three families, 20 genera, 65 species. The recorded families included Apidae, Megachilidae, Halictidae under the Apoidea super family. It was recorded that 16 species belong to the Megachilidae family in 5 genera, 22 species to the Halictidae in 8 genera and 27 species to the Apidae in 7 genera. Yogeshkumar (2012) [10] also reported the diversity of pollinators with 49 species of insect pollinators in and around Pantnagar. Satyanarayana and Seetharam (1982) [7] also reported the diversity of pollinators in sunflower capitulum and observed Honey bees (*Apis dorsata*, *Apis cerana indica*, *Apis florea*) contributed 85 per cent of the total flower visitors.

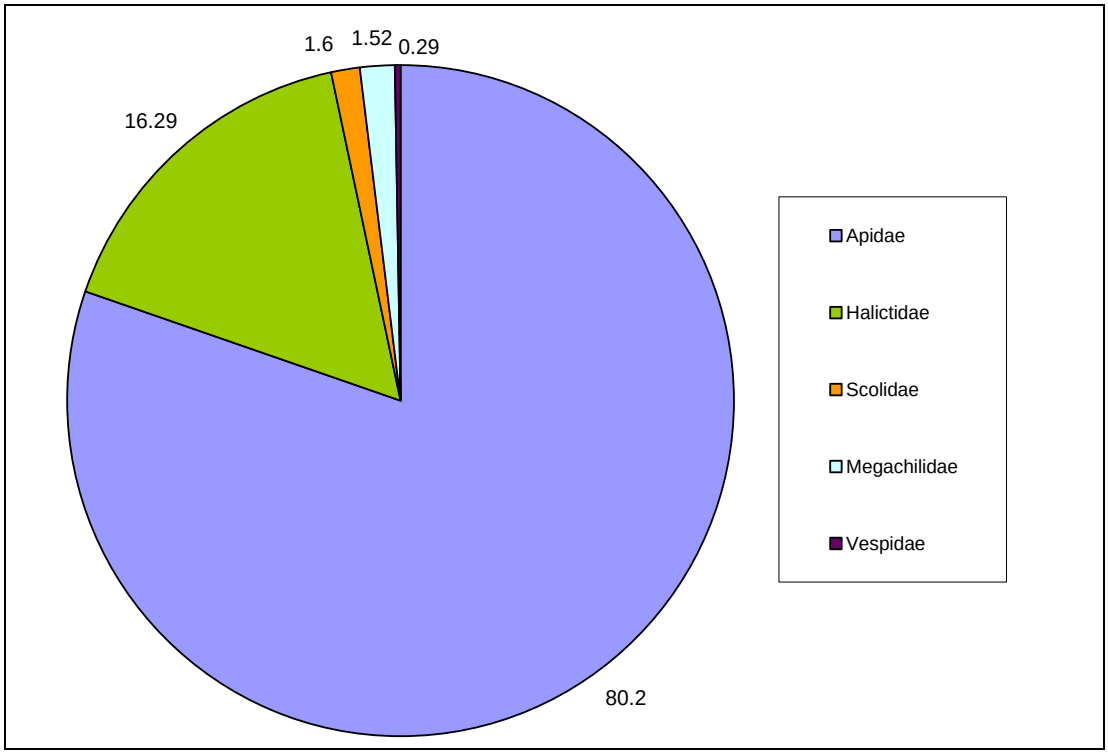

Fig 1: Bee family Contribution (%)

Including all the floral groups of field crops, horticultural crops, ornamental flowers, trees and weeds, the dominance of species *i.e*, Simpson index (0.816) recorded highest value during the October month, Shannon diversity index and Margalef"s index registered highest with 2.023 and 2.815 respectively, also during the October month, Evenness highest value of 0.875 observed during July month. The findings corroborate with the results of Arati (2010) [1] in medicinal and Aromatic plant which reported the highest value of Simpson index, Shanon index, Margalef's diversity index during the November month and eveness during the November and June months. Similarly Siregar *et al*. (2016) [9] reported highest Shanon diversity index and eveness in rubber plantation of 2.28 and 0.73 followed by palm oil plantation of 2.25, 0.66 and least in jungle- rubber forest of 0.88, 2.28.

Conclusion

Totally 34 specimens were identified by the taxonomist which included both *Apis* and *non-Apis* bees in UAS, Dharwad, Campus belonging to different families of hymenoptera. It was recorded that 14 species belongs to the family Apidae, 7 species to the family Halictidae, 3 species to the Scolidae, 7 species to the Megachillidae and 3 species to the Vespidae. 80.20 per cent contribution from the family Apidae. Dominance of a species, richness of a species and Shannon diversity index found highest during October month and eveness found maximum during July month.

Acknowledgement

First and foremost, I would like to thank God Almighty for giving me the strength, knowledge, ability and opportunity to undertake this research study and to persevere and complete it successfully. At this moment I express my heartfelt gratitude to my affectionate as well as honourable guide Dr. Subhash B. Kandakoor, Assistant professor, Farm Superintendent and Head ARS, Bailhongal, University of Agricultural Sciences, Dharwad for heartfelt support, invaluable guidance at all times and suggestions in my quest for knowledge and all the freedom to pursue my research. With extreme pleasure, I extent my heartfelt thanks to my advisory committee Dr. S. T. Prabhu, Professor and Head, Department of Agriculture Entomology, College of Agriculture, Hanumanamatti, University of Agricultural Sciences, Dharwad and S. C. Talekar Assistant professor and Head AICRP on Rice, ARS, Mugad for their excellent guidance, suggestions and regular encouragement during the course of investigation. I honestly confess with gratitude to all teaching and non- teaching staff members who supported me in the course of my study and also I acknowledge the University of Agricultural Sciences Dharwad for letting my dreams come true.

References

1. Arati P. Diversity of bee pollinators in micro-landscape element of GKVK farming system in Eastern Dry Zone of Karnataka. M.Sc (Agri.) Thesis, University of Agricultural Sciences, Bengaluru, 2001.
2. Belavadi VV, Ganeshaiah KN. Effects of climate change on pollinator populations. Insect Pollinat. Manual 2013, 1-47.
3. Ebeling A, Klein AM, Schumacher J, Weisser WW, Tscharntke T. How does plant richness affect pollinator richness and temporal stability of flower visits?. Oikos 2008;117(12):1808-1815.
4. Gallai N, Salles JM, Settele J, Vaissière BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecological Econ.* 2009;68(3):810-821.
5. Magurran AE. Ecological diversity and its measurements. Princeton University, Princeton, N. J. 1988, 179.
6. Ollerton J. Pollinator diversity: distribution, ecological function, and conservation. Ann. Rev. Ecol. Evol. S 2017;48:45-52.
7. Satyanarayana AR, Seetharam A. Studies on the method of hybrid seed production in oilseed sunflower (*Helianthus annuus*), 3: role and activity of insect visitors in pollination and seed set. Seed Sci. Tech.,

(Netherlands), 1982.
8. Schleuning M, Farwig N, Peters MK, Bergsdorf T, Bleher B, Brandl R *et al*. Forest fragmentation and selective logging have inconsistent effects on multiple animal-mediated ecosystem processes in a tropical forest. PloS One. 2011;6(11):e27785.
9. Siregar EH, Atmowidi T, Kahono S. Diversity and abundance of insect pollinators in different agricultural lands in Jambi, Sumatera. HAYATI J. Biosciences 2016;23(1):13-17.
10. Yogeshkumar. Biodiversity of insect pollinators and genetic variability in *Apis mellifera* L. in Tarai region of Uttarkhand. Ph.D. Thesis, G. B. Pant University of Agriculture and Technology, Uttarakhand, 2012.