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A preliminary study on the bee (Insecta: Hymenoptera: Apoidea) diversity in Christ college (Autonomous), Irinjalakuda, Thrissur, Kerala

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Abstract
Fourteen species of bees were collected from various sites of the Christ College campus, Irinjalakuda, Thrissur, Kerala during the study period from October 2022 to February 2023. Genus *Tetragonula* Moure is the most abundant and Genus *Lasioglossum* Curtis is least abundant.

Keywords: Diversity, floral interactions, bees, Hymenoptera

Introduction
The order Hymenoptera contains Apoidea (bees), Vespoidea (wasp) and Formicidae (ants). All the bees belong to the superfamily Apoidea. There are 7 families of bees which include Apidae, Megachilidae, Andrenidae, Colletidae, Halictidae, Melittidae and Stenotritidae (Mason and Huber, 1993) [2]. Bees are the primary pollinators. Major work on the bee fauna of the world by Michener (2007) [3] titled, "The bees of the world" treated around 16,000 species under 1200 genera. There are four distinct social behaviours among bees. They are solitary bees, social bees, brood parasites, and social parasites. Almost 20,759 bees are known from the world and majority of them are solitary (Ascher and Pickering, 2023) [1]. In social colonies, numerous bees share a nest and each female has a specific job to do. Workers cannot breed but they gather pollen and nectar for the colony and protect it from invaders. The queen gives birth but doesn't leave the colony or go foraging. There are two kinds of social bees, highly social bees and primitively social bees. These highly social bees, both stingless bees and honey bees, always live in big colonies with a queen who lays the majority of will feed and tend to the growing larvae of the nest the eggs and large number of workers who produce honey. Kerala is rich in bee diversity. Sheeja and Jobiraj (2017) [6] conducted studies on the bee fauna of the Vanaparvam biodiversity park, Kozhikode, Kerala and identified 18 species belong to 9 genera. Prakash *et al.* (2020) [5], published checklist of bees of Kerala, which reported 86 species of bees under 19 genera.

Materials and methods
Study area and period
The study was conducted in the campus of Christ College (Autonomous), Irinjalakuda, Thrissur from October 2022 to February 2023.

Collection and preservation of bees
Two collections were taken per month between 9 am to 12 pm on each collection days. The specimens collected were killed using ethyl acetate vapour in the killing bottles, pinned and dried. The air tight insect wooden boxes were used to preserve the specimens. Identification keys, standard reference books and available literature were used for identifying various species of collected bees.

Statistical Analysis
PAST (Paleontological Statistics Software Package) version 4.03 was used to calculate diversity indices. The formula was also used to calculate the relative abundance of the species.

$$Relative\ abundance\ of\ species\ A = \frac{Number\ of\ individuals\ of\ species\ A}{Total\ number\ individulas\ collected} \times 100$$

Results and discussion
A total of 412 bees belonging to 14 species were collected during the study period. Collected specimens were identified up to species/morphospecies level which includes *Amegilla zonata*, *Megachile lerma*, *Tetragonula* sp., *Lasioglossum* sp.1, *Lasioglossum* sp.2, *Ceratina* sp., *Xylocopa fenestrata*, *Xylocopa ruficornis*, *Xylocopa* sp.3, *Lipotriches* sp., *Pseudapis oxybeloides*, *Thyreus* sp., *Apis cerana* and *Nomia (Hoplonomia) elliotii*. *Xylocopa* is the most speciose genus of the study area with 3 species. Species like *Amegilla zonata*, *Tetragonula* sp., *Lasioglossum* sp.1, *Nomia (Hoplonomia) elliotii* and *Xylocopa ruficornis* is found throughout the study period. Month wise data of bees collected from the site is provided in Table 1. Most number of bees were collected in January 2023, and the least number of bees were found in October 2022. The study outcome highlights that *Tetragonula* sp. has the highest relative abundance and *Lasioglossum* sp. 2 has the least relative abundance among the bees collected from college campus (Table 3). *Tetragonula* bees which has the highest relative abundance was found mostly in *Calotropis gigantea* flower. *Amegilla zonata* was found on *Stachytarpheta jamaicensis*, and *Lasioglossum* sp. 1 on *Turnera ulmifolia.* These observations show the floral relationship of bees. A study conducted on bee diversity on ash gourd from Kerala also indicated high relative abundance of *Tetragonula* bees (Prakash and Bijoy, 2021) [4]. From the collected data, species diversity indices were calculated (Table 3). Simpson (0.8642) and Shannon-weaver (2.124) diversity indices are high in the month of November 2022. Similarly, Simpson (0.6392) and Shannon-weaver (1.504) diversity indices are lowest in the month of January 2023.

Table 1: Month wise data of bees collected from college

Bee species	October	November	December	January	February
Amegilla zonata	11	16	8	11	10
Megachile lerma	-	-	-	3	-
Tetragonula sp.	26	14	36	62	63
Lasioglossum sp.1	3	5	4	5	1
Lasioglossum sp.2	-	1	-	-	-
Ceratina sp.	2		3	-	-
Lipotriches sp.	-	13		-	-
Pseudapis oxybeloides	-	3	3	11	21
Thyreus sp.	-	-	1	2	3
Apis cerana	2	-	-	-	-
Nomia (Hoplonomia) elliotii	2	5	15	5	3
Xylocopa fenestrata	1	3	2	1	-
Xylocopa ruficornis	1	9	6	7	2
Xylocopa sp. 3	2	4	1	-	-

Table 2: Diversity indices of bees collected from college campus

Diversity indices	October	November	December	January	February
Taxa(S)	9	10	10	9	7
Individuals	50	73	79	107	103
Simpson(1-D)	0.6841	0.8642	0.7433	0.6392	0.5783
Shannon(H)	1.593	2.124	1.761	1.504	1.208
Evenness(c^H/S)	0.5467	0.8364	0.5821	0.5001	0.4781

Table 3: Relative abundance of bees collected from Christ College campus

Bees Species	Relative Abundance
Tetragonula sp.	48.79%
Amegilla zonata	13.59%
Pseudapis oxybeloides	9.22%
Nomia (Hoplonomia) elliotii	7.28%
Xylocopa ruficornis	6.07%
Lasioglossum sp.1	4.37%
Lipotriches sp.	3.16%
Xylocopa fenestrata	1.70%
Xylocopa sp. 3	1.70%
Thyreus sp.	1.46%
Ceratina sp.	1.21%
Megachile lerma	0.73%
Apis cerana	0.49%
Lasioglossum sp. 2	0.24%

Conclusion

The major objective of this work was to study the bee diversity of Christ College campus. From the analysis of data, it is clear that Christ College campus has a wide variety of bee species. The availability of plants, trees, flowers, and weather conditions play a major role in the presence of various bee species. January (2023) and October (2022) are the months in which we got highest and lowest number of bees respectively. This variation in bee diversity is because of the fluctuations in weather conditions.

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