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Diversity of bees along elevational gradient in different agro-climatic zones of Chhattisgarh

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Abstract

During July 2019 to February 2020, multiple surveys were conducted in the National Parks, various Wildlife Sanctuaries and different agro-ecosystems across different agro climatic zones of Chhattisgarh state situated at different altitudes to document the species diversity and abundance of bees. A total of 396 individuals belonging to three families were collected. Apidae was the most dominant family with 196 individuals followed by Halictidae with 143 individuals and Megachilidae with 30 individuals being the least. An irregular pattern of bee species diversity in relation to the altitude was observed and the number of captured individuals differed significantly between the low and high altitudes.

Keywords: Bees, fauna, altitude, Chhattisgarh

Introduction

The Chhattisgarh state, lying in the Vidhyan hills and Deccan Plateau in Central India owns one of the richest biodiversity repositories in India. The richness and abundance of invertebrate species provide a vast information base to assist in biodiversity conservation and forest reserve management (Pyle *et al.* 1981; Lewinsohn *et al.* 2005) ^[3, 1]. With over 44% of its land area under forests and residence of some rarest, wild and diverse flora and fauna, it offers an ideal region with immense potential for enhancing the biological diversity studies. The state possesses three National Parks (NP), 11 Wildlife Sanctuaries (WLS) and three Tiger Reserves (TR). Bees are the most important pollinators of many crops and are recorded visitors to 73% of the crop species that require pollinators worldwide (Nabhan and Buchmann 1997) ^[2]. This study aimed to determine the diversity and abundance of bee fauna from different agro climatic zones of Chhattisgarh along an altitudinal gradient.

Materials & Methods

The Chhattisgarh state lies between 17°46'N to 24°5'N latitude and from 80°15'E to 84°20'E longitude. The different places surveyed during the study are as follows (Fig. 1): IGKV, Raipur; KVK, Raipur; Barnawapara WLS; Mowa, Raipur; Farmer's field, Ambikapur; RMDARS, Ambikapur; KVK, Ambikapur; SGCARS, Jagdalpur; Kanger Valley NP; ATR; Potato & Temperate fruit Research Center, Mainpat; KVK, Balrampur; Boramdev WLS; Badalkhol WLS and Tamor Pingla WLS. The permission was obtained from the Office of the Principal Chief Conservator of Forests (Wildlife Management & Bio-diversity Conservation cum-Chief Wildlife Warden) Chhattisgarh for the sample collection *via* letter no. 4237, dated 27/07/2019. The bees were collected using different colored pan traps, malaise traps, sweep net and by manual scouting. The traps were filled with solution (salt, liquid dish wash, water) and were placed at a distance of approximately one meter away from each other. One Malaise trap was installed for 5-7 days at each location. The collected insects were preserved in 70% alcohol. Sweep net (SN) was used for catching bees in flight in the various ecosystems (natural and agro ecosystems). The bees were killed using ethyl acetate and were later preserved in 70% ethyl alcohol. All the specimens were deposited in the National Insect Museum of ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, India.

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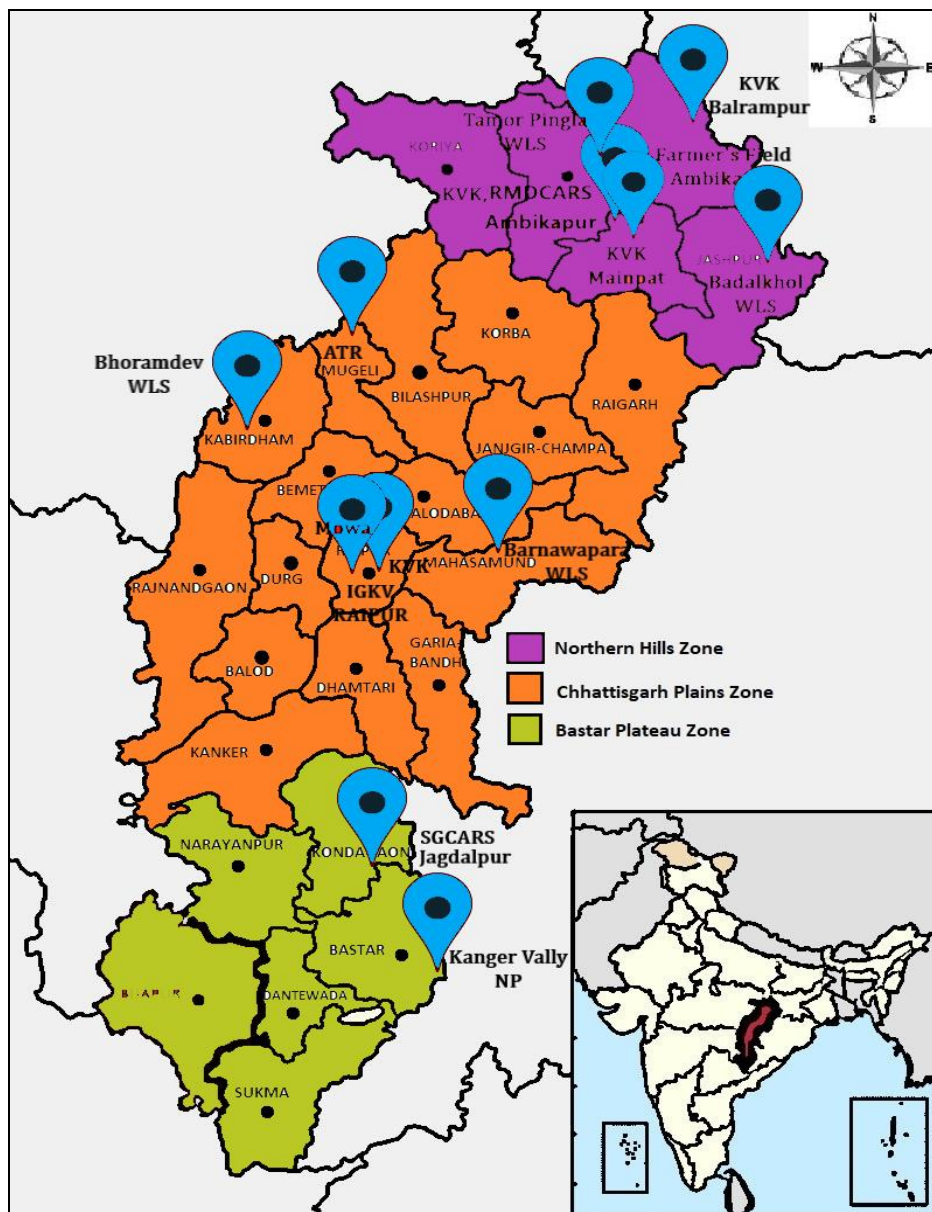


Fig 1: The collection site locations for studying bee diversity and abundance

Table 1: Family wise distribution along different altitudinal range

S. No.	Altitudinal Range (m asl)	Survey locations under range	Apoidea		
			Apidae	Megachilidae	Halictidae
1	270-370	IGKV, Raipur; KVK, Raipur; Barnawapara WLS; Mowa, Raipur	71	15	79
2	370-470	-----	0	0	0
3	470-570	Farmer's field, Ambikapur; RMD CARS, Ambikapur; KVK, Ambikapur; SGCARS, Jagdalpur; Kanger Valley NP	60	13	52
4	570-670	ATR; Potato & Temperate fruit Research Center, Mainpat; KVK, Balrampur	25	0	0
5	670-770	Bharamdev WLS; Badalkhol WLS	21	2	12
6	770-870	Tamor Pingla WLS	19	0	0

Results and Discussion

A total of 369 specimens from nine genera and 14 species of bees belonging to three families viz., Apidae (143), Megachilidae (30) and Halictidae (143) were collected. From subfamily Apinae, species collected were *Apis dorsata* Fabricius, *Apis cerana indica* Fabricius, *Thyreus histrio* (Fabricius), *Amegilla zonata* (Linnaeus) and *Amegilla dizona* Engel. From subfamily Xylocopinae, species collected were

Xylocopa fenestrata (Fabricius), *Xylocopa nasalis* Westwood, *Xylocopa (Zonohirsuta) sp. 1*, *Ceratina binghami* Cockerell and *Ceratina smaragdula* (Fabricius) (see Table 2). From family Halictidae and subfamily Nomiinae, *Nomia sp. 1* and *Nomia (Gnathonomia) thoracica* Smith were collected (see Table 3). From subfamily Megachilinae, *Megachile lanata* (Fabricius) was found (see Table 4).

Table 2: Species wise distribution of Apidae in different altitudinal range

S. No.	Species	270-370	370-470	470-570	570-670	670-770	770-870
1	<i>Tetragonula</i> sp. 1	19	0	10	15	0	12
2	<i>A. dorsata</i>	17	0	12	8	5	0
3	<i>A. cerena</i>	6	0	4	2	9	0
4	<i>C. binghami</i>	12	0	2	0	3	3
5	<i>C. smaragdula</i>	13	0	3	0	2	2
6	<i>T. histrio</i>	0	0	4	0	0	0
7	<i>A. dizona</i>	1	0	3	0	0	0
8	<i>A. zonata</i>	0	0	2	0	2	0
9	<i>X. fenestrata</i>	3	0	8	0	0	0
10	<i>X. nasalis</i>	2	0	5	0	0	0
11	<i>X. (Zonohirsuta)</i> sp. 1	0	0	7	0	0	0

*Altitudinal range is in m asl

Table 3: Species wise distribution of Halictidae in different altitudinal range

S. no.	Species	270-370	370-470	470-570	570-670	670-770	770-870
1	<i>Nomia</i> sp. 1	12	0	22	0	7	0
2	<i>G. thoracica</i>	67	0	30	0	5	0

*Altitudinal range is in m asl

Table 4: Species wise distribution of Megachilidae in different altitudinal range

S. no.	Species	270-370	370-470	470-570	570-670	670-770	770-870
1	<i>M. lanata</i>	15	0	13	0	2	0

*Altitudinal range is in m asl

As indicated in Figs. 2 and 3 showing the distribution of Apoidea family along the altitudinal range from different agro climatic zones of Chhattisgarh, the maximum bee fauna was collected from the altitudinal range 270-370m asl (Halictidae (79) > Apidae (71) > Megachilidae (15)) followed by 470-570m asl (Apidae (60) > Halictidae (52) > Megachilidae (13)), 670-770m asl (Apidae (21), Halictidae (12) > Megachilidae (2)), 570-670m asl (Apidae (25)), 770-870m asl (Apidae (19)) and the altitude range 370-470m asl being the least with no individuals during the survey period. Fig. 3 shows that the number of collected specimens were maximum in the altitude range 270-370m asl with 165 individuals followed by 470-570m asl (125), 670-770m asl (35), 570-670m asl (25), 770-870m asl (17) and the altitude range 370-470m asl being the least with no individuals collected. Fig. 4 shows the distribution of different species of Apidae family in different altitudinal range from different agro-climatic zones of Chhattisgarh. The maximum number of *Tetragonula* sp.1 individuals were collected from the altitudinal range 270-370m asl (19) followed by 670-770m asl (15), 770-870m asl and 470-570m asl (10) respectively being the least. *Apis dorsata* was most predominant in the altitudinal range 270-370m asl (17) followed by 470-570m asl (12), 570-670m asl (8) and 670-770m asl (5), respectively. *Apis cerena* was found maximum in the altitudinal range 670-770m asl (9) followed by 270-370m asl (6), 470-570m asl (4) and 570-670m asl (2) respectively being the least. *Ceratina binghami* was most conspicuous in the altitudinal range 270-370m asl with 12 individuals followed by 67-770m asl and 770-870m asl each with three individuals and 470-570m asl with two individuals being the least. *Ceratina smaragdula* was predominant in the altitudinal range 270-370m asl with 13 individuals followed

by 470-570m asl with three individuals and 670-770m asl and 770-870m asl altitude range with two individuals each and being the lowest. *Thyreus histrio* was only found in the altitudinal range 470-570m asl with four individuals. *Amegilla zonata* was represented with mere two samples collected each in the altitudinal range 470-570m asl and 670-770m asl. Only one specimen of *Amegilla dizona* was collected in the altitudinal range 270-370m asl and three from 470-570m asl. The numbers of specimens of *Xylocopa fenestrata* were 8 in the altitudinal range 470-570m asl and three in the altitudinal range 270-370m asl. *Xylocopa nasalis* Westwood was represented by five individuals in the altitudinal range 470-570m asl and two in the altitudinal range 270-370m asl. *Xylocopa (Zonohirsutai)* sp. 1 was only found in the altitudinal range 470-570m asl with seven individuals. Fig. 5 shows the distribution of different species of Halictidae family in different altitudinal range from different agro-climatic zones of Chhattisgarh. The maximum number of *Nomia* sp. 1 specimens was found in the altitudinal range 470-570m asl with 22 individuals followed by 270-370m asl (12) and 670-770m asl (7) respectively being the least. Presence of *Nomia (Gnathonomia) thoracica* was maximum in the altitudinal range 270-370m asl with 67 individuals followed by 470-570m asl (30) and 670-770m asl with five individuals being the least. Fig. 6 shows the distribution of *Megachile lanata* of Megachilidae family in different altitudinal range from different agro-climatic zones of Chhattisgarh. The maximum abundance of Megachilidae was in the altitudinal range 270-370m asl with 15 individuals followed by 470-570m asl with 13 individuals and 670-770m asl with two individuals being the least.

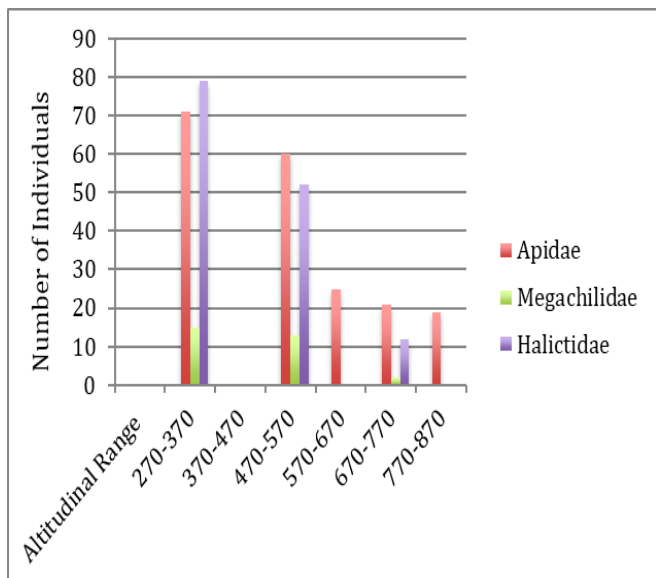


Fig 2: Family wise distribution of Apoidea members along different altitudinal range from different agro climatic zones of Chhattisgarh

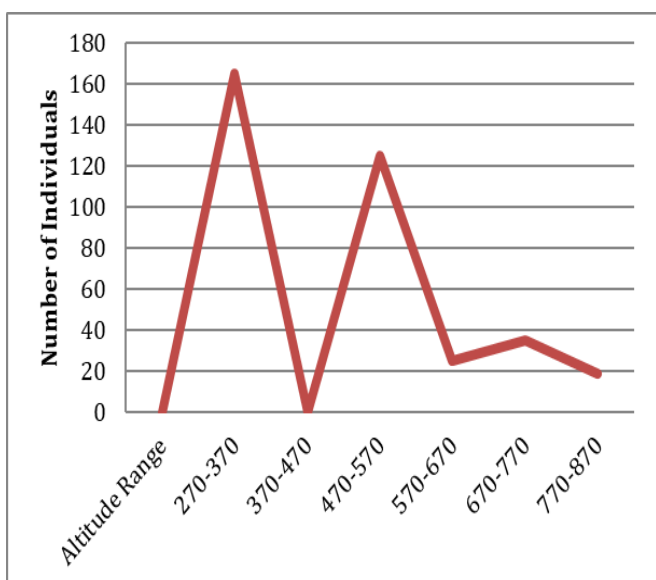


Fig 3: Total number of individuals of Apoidea collected from different altitudinal range

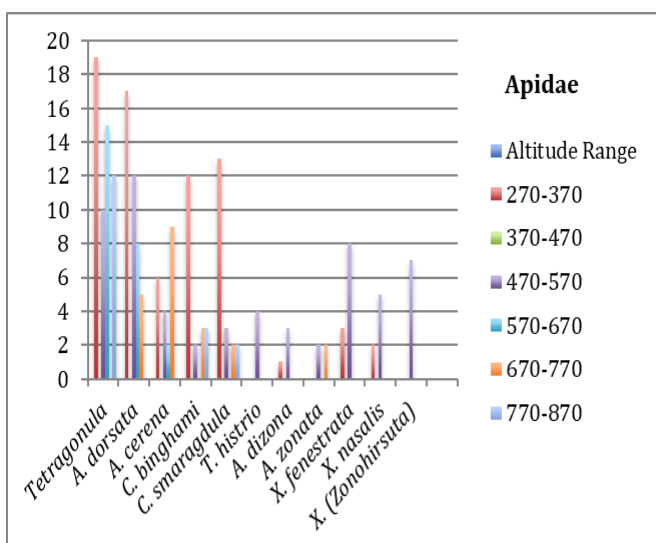


Fig 4: Species wise distribution of Apidae family in different altitudinal range

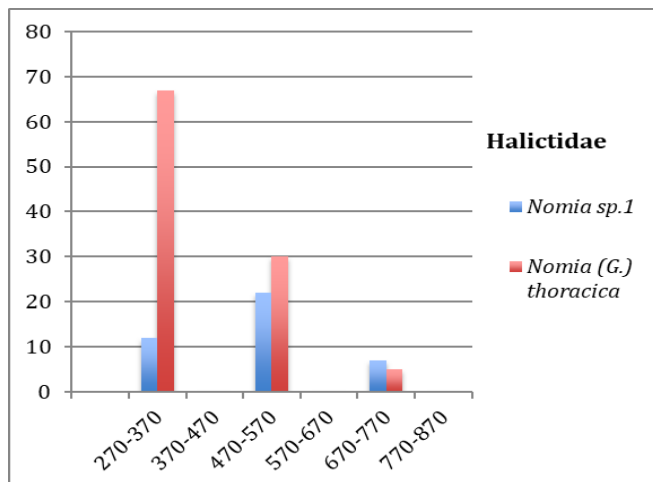


Fig 5: Species wise distribution of Halictidae family in different altitudinal range

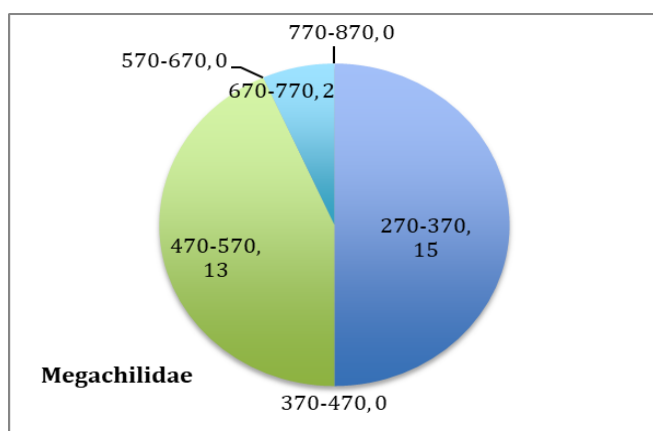


Fig 6: Distribution of megachilids in different altitudinal range

Conclusion

The abundance of superfamily Apoidea was maximum in the altitudinal range 270-370m asl and the least in the altitudinal range 770-870m asl. The diversity of Apidae was observed highest in the altitudinal range 270-370m asl and was least in the altitudinal range 770-870m asl. Halictidae was conspicuous in the altitudinal range 270-370m asl and was least in the altitudinal range 670-770m asl with 12 individuals. Megachilidae family was predominant in the altitudinal range 270-370m asl.

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