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Dr. Kusum Dang

Associate professor, Department of zoology, Govt. P.G. College, Kota, Rajasthan, India

Deoteema Doi

Student, Department of zoology, Govt. P.G. College, Kota, Rajasthan, India

Study of biodiversity of wasps and bees in Kota, Rajasthan, India

Dr. Kusum Dang and Deoteema Doi

Abstract

Studies on diversity and distribution of insects are pre-requisites for biodiversity conservation. Wasps and bees both play important roles in ecosystem. The present study forms a part of evaluation of hymenopteran fauna (wasps and bees) in selected areas of Kota. And provides information about a good assemblage of species of wasps and bees in Kota, Rajasthan. The present study was performed in two chosen sites. Site 1 was Government College Kota Campus, Kota and Site 2 was Herbal Park, Kota. The study was conducted from January 2019 to May 2019. A total of 11 species of wasps and bees belonging to 6 families were observed and identified during the study from both the sites. 9 of them were identified up to species level and 2 up to genus level. Out of 11 species identified, 4 were of bees and rest 7 were of wasps. Species were also classified as abundant, occasional and rare based on field observations. 4 species of them were abundant, 4 species were occasional and 3 species were rare. Results of college campus show that, among bees, Family Apidae was most dominant with highest number of individuals and *Apis dorsata* Fabricius was most abundant; and among wasps, Family Vespidae was most abundant and *Polistes hebraeus* was most abundant species. Results of Herbal Park show that, among bees, Family Apidae was most dominant with highest number of individuals and *Apis dorsata* Fabricius was most abundant species; and among wasps, Family Scoliidae and Family Vespidae were dominant with highest number of individuals and *Polistes hebraeus* was most abundant species. *Apis dorsata* Fabricius and *Polistes hebraeus* were found abundant in both the sites. At last, Diversity indices were calculated to compare species richness and evenness in both the selected sites. Simpson's index of diversity and Shannon-Weiner Index were calculated for both the sites. The results showed that diversity indices were higher for site 2: Herbal Park, Kota than for site 1: Government College Kota Campus, Kota.

Keywords: Biodiversity, Hymenoptera, Bees, Wasps, Kota, Rajasthan, India

1. Introduction

Insects, are the drivers of ecosystem functions. In terrestrial ecosystem insects play key ecological roles in diverse ecological processes such as nutrient cycling, seed dispersal, bioturbation, pollination, predation/parasitism and pest control. Hymenoptera being a large order of insects comprises the sawflies, wasps, bees and ants with over 150,000 living species. It contains agriculturally, ecologically and economically valuable species. They are also ecological indicators. Two groups of insects of order hymenoptera that hold an important place in ecosystem are – wasps and bees. As a group, wasps provide extraordinarily important ecological services, including pollination, predation and parasitism. Wasps prey on other insects and help keep pest insect populations under control. Bees are an inexorable part of ecosystem. They act as pollinators and strongly influence ecological relationships, ecosystem conservation and stability, genetic variation in the plant community, floral diversity, specialization and evolution. Over the past two decades many investigators recorded the decline in population of bee and wasp species and the colony numbers due to environmental problems like climate change, deforestation, fragmentation of natural and agriculture foraging habitats, pesticides and pollution. These difficulties cause direct threat to plant diversity of an area, thus leading a negative effect on natural ecosystem. In order to formulate effective conservation strategies there is an urgent need to generate information regarding the diversity of certain species.

2. Materials and Methods**2.1 Study area**

Kota city is located along the banks of the Chambal River in the southeast of western Indian state of Rajasthan.

Corresponding Author:**Dr. Kusum Dang**

Associate professor, Department of zoology, Govt. P.G. College, Kota, Rajasthan, India

The cartographic coordinates are 25.18°N 75.83°E. It covers an area of 527km². Kota has a semi-arid climate with high temperatures throughout the year. The temperature averages above 40° C in summers and between 27° C to 12° C in winters. The average annual rainfall in Kota is 660.6 mm. Two areas of Kota region were surveyed for the study of biodiversity of wasps and bees- Government college Kota campus and The Herbal Park, Kota.

2.2 Sampling and identification

The Hymenopterans were surveyed and collected from January 2019 to May 2019. The survey was conducted during the day time. The insects were collected by insect sweep net and hand picking method.

The insects collected by the above methods were transferred to killing bottles, killed and preserved. Hymenopterans were then stretched in insect boxes, their wings, antennae and legs spread for proper identification through diagnostic morphological characters. After a few days of dry preservation they were pinned directly by piercing entomological pin through the thorax and care was taken to choose the correct size and number of pins to avoid damage. Identification was achieved by observing certain morphological diagnostic characters of the species with the help of standard keys and available literature. For observing morphological characters of minute parts of insects (such as tarsi and clypeus), help of microscope and hand lens was taken. Identification labels were then put under each specimen. The labels include biological name of the species, common name, site of collection, date of collection, time of collection and the number of individuals observed at the time of collection. The abundance of each species in both the sites was calculated separately using the formula:-

(No. of individuals of a species/ total no. of individuals)*100.
Diversity indices were calculated using the following formulas:-

1. Simpson's Diversity Index $D = \frac{\sum n(n-1)}{N(N-1)}$
2. SUM= summation
3. n= total number of individuals of each species
4. N= total number of hymenopterans of all species
5. Shannon- Weiner Diversity Index $H = -\sum [(pi) * \ln(pi)]$
6. SUM= Summation
7. Pi= number of individuals of species

3. Result and Discussion

In the present study, from these two sites, 11 species of wasps and bees were collected and identified belonging to six families and eight genera (table 1). Of the total 11 species, 9 were identified up to species level and 2 were identified up to genus level. On the basis of field observations and specimens collected, insects were divided into three broad categories viz. Abundant (commonly distributed in the area), occasional (distributed in some of the pockets) and rare (few in numbers). Out of the 11 species recorded in both the sites 4 species were abundant, 4 species were occasional and 3 were rare (table 2, graph1).

Results of site 1 (Government College Kota Campus, Kota): Wasps belonging to two families with one genus each were recorded. Family Vespidae being dominant is followed by Pompilidae. Family Vespidae has *Polistes hebraeus* as its representative and Family Pompilidae is represented by genus *Cyphononyx* in the College Campus. Bee community is

represented by one family, two genus and three species. Three species of Family Apidae were recorded in the college campus namely *Apis dorsata* Fabricius, *Apis florea* and *Xylocopa pubescence*. The wasp species observed in maximum number was *Polistes hebraeus* of family Vespidae and the Bee species that was observed in maximum was *Apis dorsata* Fabricius. Results of site 2(The Herbal Park, Kota): wasps belonging to three families, four genus and six species were recorded. Family Scoliidae was dominant among them followed by family Vespidae and family Chrysididae. Members of family Vespidae found in the premises of herbal college were- *Polistes hebraeus* and *Ropalidia brevita* (Das and Gupta). Representative members of family Scoliidae observed were *Campsomeriella annulata* Fabricius, *Campsomeris trifasciata* and *Campsomeriella collaris*. In Family Chrysididae, *Stilbum sp.* was observed. Bee diversity of Herbal Park included two families, three genus and four species. Family Apidae was dominant followed by family Megachilidae. Family Apidae included *Apis dorsata* Fabricius, *Apis florea* and *Xylocopa pubescence*. Whereas family Megachilidae included single species *Megachile bicolor*.

Present study reveals a good number of wasp population at survey sites of Kota, Rajasthan. This might be correlated to the fact that Kota region has good amount of light due to longer day periods, and sufficient amount of water resources. This therefore supports wasp activities and accounts for their successful thriving here. Kannagi *et al.* (2013) ^[16] conducted a study on hymenopteran diversity in a deciduous forest from south India. 38 species were collected. Dominant families included Vespidae, Apidae, Formicidae, Sphecidae and Megachilidae respectively. Hymenopterans like carpenter bees, honey bees, leaf cutter bees and ants were abundantly seen during March, April and May. Their findings support the present study as Families Apidae and Vespidae were found to be dominant in the study period which included the months of March, April and May. Honey bees and carpenter bees were abundantly seen during these months. Another study was performed by Sharmah *et al.* (2014) ^[27] on diversity and distribution pattern of hymenopteran insects in Jorhat district, Assam. Hymenopteran insects belonging to 21 families, 42 genera and 50 species were tabulated and documented. Family Apidae was found to be dominant with 8 species followed by Formicidae and Vespidae with 6 species each. In the present study as well, Family Apidae was found to be dominant with 3 species followed by Vespidae with 2 species. Sheeja and Jobiraj (2017) ^[35] studied Bee diversity of Vanaparvam Biodiversity Park, Kerala, India (Hymenoptera: Apoidea). Among the 21 collected species, the identified 18 species belonged to 9 genera and 3 families. Maximum number of species recorded belong to the family Apidae. *Apis cerana* Fabricius, *Catarina heiroglyphica* Smith and *Apis dorsata* Fabricius were the most observed species. Results of present investigation show much the same results. *Apis dorsata* Fabricius was the most observed species in both the study sites. Simpson's index of diversity and Shannon-Weiner Index of Herbal Park (0.72 and 1.36 respectively) are more than that of college campus (0.86 and 2.06 respectively) which shows more species richness, evenness and equitable distribution of organisms of a species there. This result is supported by research work of Schuepp *et al.* (2012) ^[32] upon high bee and wasp diversity in a heterogeneous tropical farming system compared to protected forest. It showed that mean species richness per site, as well as spatial and temporal

community variations of bees and wasps were equal or higher in farming areas compared to protected forests. Results also suggest that small scale farming system adjacent to protected forest may not only conserve, but even favour, biodiversity of

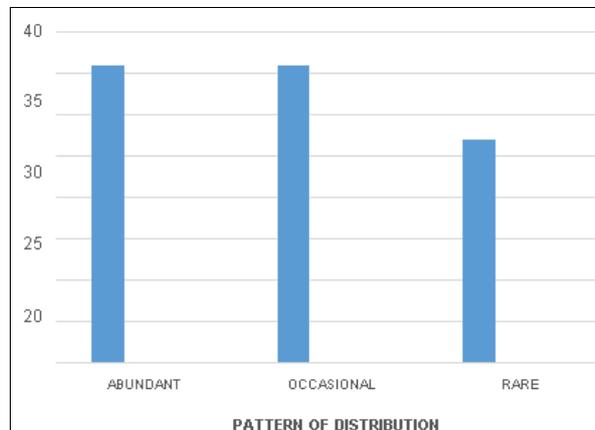
some taxonomic groups. As there are no such small scale farming systems near Government College Kota Campus, Kota, it does not favour much diversity of wasps and bee species.

Table 1: List of identified species of wasps and bees (hymenoptera) from two survey sites of kota (raj.)

Family	Species	Common Name	Habit	Area of Collection
Apidae	<i>Apis dorsata</i> (Fabricius)	Giant honey bee	Pollinator	College campus, Herbal park
	<i>Apis florea</i>	Dwarf honey bee		College campus, Herbal park
	<i>Xylocopa pubescence</i>	Carpenter bee		College campus, Herbal park
Vespidae	<i>Polistes hebraeus</i>	Paper wasp	Predatory	College campus, Herbal park
	<i>Ropalidia brevita</i> (Das and Gupta)	Paper wasp		Herbal park
Scollidae	<i>Campsomeriella (Campsomeris) annulata</i> (Fabricius)	Scollid wasp	Parasitic	Herbal park
	<i>Campsomeris trifasciata</i>	Scollid wasp		Herbal park
	<i>Campsomeriella collaris</i>	Scollid wasp		Herbal park
Megachilidae	<i>Megachile bicolor</i>	Leafcutter bee	Pollinator	Herbal park
Chrysididae	<i>Stilbum sp.</i>	Cuckoo wasp or Emerald wasp	Parasitic	Herbal park
Pompilidae	<i>Cyphononyx sp.</i>	Spider hunting wasp	Predatory	College campus

Table 2: Distribution pattern of wasps and bees in two survey sites of kota, rajasthan

Family	Abundant	Ocassional	Rare
Apidae	√ √ √		
Vespidae	√	√	
Scollidae		√ √	√
Megachilidae		√	
Chrysididae			√
Pompilidae			√
Total	4 species	4 species	3 species
Percent Distribution	36%	36%	27%



Graph 1: Percent species distribution of wasps and bees in survey sites of kota, rajasthan

4. Conclusion

Overall, the study shows more diversification of wasp species over bees in Kota region, considering the two sites chosen for study. In the present study, out of 11 hymenopterans (wasps and bees), 7 species were of wasps followed by 4 species of bees. However, the abundance of bees is more over wasps, in terms of their numbers. At site1 Government College Kota Campus, 3 species of bees and 2 species of wasps were observed. More diversification of bees in college campus can be accounted to presence of large number of tall trees and buildings. Both of them are suitable sites for construction of bee hives in a peaceful environment in college campus. Presence of some flowering plants favour foraging and nectar collection by bees. Lesser availability of diversified feeding habitats at college campus might be responsible for less

diversification of wasp species. *Polistes hebraeus* was found abundant because of its social nesting behaviour. Most of its nests are made on buildings and under shelters at college campus which is suitable for making and growth of its colony. At site 2- Herbal Park, Kota, out of 10 species encountered, 6 species were of wasps and 4 species were of bees. In general, vegetation is the main substrate for finding wasps. Therefore, rich vegetation in herbal park, Kota appears to favour wasp diversity. In addition, diversified feeding habitat and their ability to adopt in changing environmental conditions and availability of wide range of hosts might be the other factors responsible for their diversity in herbal park, Kota. The abundance of Apidae members noticed in the present study might be accounted to presence of more number and different varieties of flowers at Herbal Park which triggers foraging behaviour of bees and their nesting activity. The diversity indices clearly indicated that the diversity of hymenoptera (wasps and bees) was in a good state at Herbal Park study area as compared to Government College Kota Campus, Kota. This might be due to healthy climatic conditions and availability of natural resources necessary for their life processes and existence. Government College Kota Campus, Kota has less diversification due to maximum anthropogenic disturbances and lesser availability of diversified feeding habitats. Furthermore extensive research work is recommended at Kota region of Rajasthan to find out remaining wasp and bee fauna. For the conservation of wasp and bee fauna in this region, it is necessary to develop diversified feeding habitats which favours bee and wasp population respectively. The present study therefore forms a good basis to take up necessary precautions and measures to conserve insect diversity in certain regions of Kota.

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