

Diversity and distribution of ant species (Hymenoptera: Formicidae) at Bogadi village, Mysuru, Karnataka

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Received 19 Aug 2023; Accepted 26 Sep 2023; Published 3 Oct 2023

Abstract

Ants are considered as one of the most diverse, abundant and ecologically significant organisms on earth. The present study deals with the diversity and distribution of ant species in and around Bogadi Village, Mysuru. Observation on ant species was carried out from 6 to 9 AM and 4 to 6 PM by following All Out Search Method (AOSM) during June to August, 2023. Results revealed that a total of 16 ant species were distributed at the study area, among them *Pheidole meghacephala* was the most dominant. These ant species belonging to 4 Subfamilies Myrmicinae (with 7 species), Formicinae (6 species), Pseudomyrmicinae (2 species) and Dolichoderinae (1 species). Among the subfamilies Myrmicinae was the most abundant with 5 genera and 7 species. However, the ant species diversity varied significantly at the three study sites. The effect on the habitat and resources available for ants may lead to variation in their diversity and distribution. Thus, this pioneer study may suggest information of ant species availability at the study area and deserves further in depth studies which is important from Biodiversity conservation perspective.

Keywords: ant species, Myrmicinae, *Pheidole meghacephala*, Biodiversity indices, Mysuru

Introduction

Among all the insect varieties, ants are the most recognised and diverse group present on the earth. Their distribution is seen on almost every landmass except Antarctica and few Islands contributing about 15 to 25% of the total terrestrial animal biomass. Recently, one more sub-family 'Martialinae' has been included to family Formicidae [1]. Globally there are about 14,711 valid species and 428 valid genera, out of these, 152 species are listed by IUCN and from India, 10 subfamilies are represented by 100 genera with 828 species [2]. Ants play a dominant role and acts as conspicuous component within the terrestrial biodiversity and are the most divergent group among all social insects [3].

Ants show diversity, abundance and biomass dominance in all habitats in the world [4]. They act as "Ecosystem Engineers" [5] and have numerous interactions with different plants species, including seed disperses, leaf and seed predators, pollinators, improving the soil, assisting in the decomposition process and are considered as good biological indicators due to mutualistic behaviour with both flora and fauna [6]. Hence, this eusocial insect leads to high level of interactive lives assisting each other to survive and are highly evolved hymenoptera polymorphism in nature [7].

In India a few reports on ants ecology and diversity exist such as document on ants of the western Ghats – Sri Lanka hotspot [8]. Reports on the ant fauna from some areas of Bangalore city [9] etc. Recently, a list of 591 species of ants in India was released. carried out from this area. With this background, the objective of the present study was to find out distribution and diversity of ant species in three different habitats at Bogadi

village, Mysuru, Karnataka.

Materials and methods

Study area

The present study was aimed to study the Ants species distribution and diversity in selected areas of Bogadi Village, Mysuru. Bogadi Village is located on the western edge of Mysuru, 15 kms from the foothills of the Chamundi hills, beyond the first ring road surrounding the Mysuru city. It covers a total area of 32.35 Sq. Kms. Three places were randomly selected as follows for the present investigation.

Site 1 (S1): Bogadi 2nd Stage North, Mysuru
(12° 30' 57.49" N; 76° 60' 65.74" E).

Site 2 (S2): Near Hostel, Bogadi, Mysuru.
(12° 30' 57.32" N; 76° 60' 51.78" E).

Site 3 (S3): Near Bogadi Lake, Mysuru.
(12° 30' 89.86 N; 76° 59' 84.86" E).

Survey time

A regular survey was carried out on weekly basis between 6-8 AM and 4-6 PM in the selected study sites from June to August, 2023 as per the standard methods [7].

All-Out Search Method (AOSM)

The most common used method is all-out search method. The ants were collected using a brushes or forceps. Care should be taken to collect ant species in site1, site 2 and site 3. Photographed the collected ant species using mobile camera (Redmi series; 14.0 Megapixels) for further identification.

Preservation of ants

Collected ants were preserved directly using 70% alcohol (Wet preservation Technique) [2].

Identification of ant

The collected ants were identified by using Stereo microscope (Olympus: Model EZ4) and standard identification keys [10] [11] [12]. Different taxonomic traits such as Ants body colour, presence of petiole and post petiole, presence of spines and petiole, number of segment of antennae, position of antennae, etc were considered during identification for the collected ant species.

Data analyses

Ant species listed and the complete count of the number of species represented in each habitat (S1, S2 & S3) were done for species composition and distribution analysis. These results were used to indicate the ant species diversity, calculated using PAST software (Ver. 2.01) [13].



Fig 1: Map showing the study sites (S1, S2 & S3) to record ant species at Bogadi Village, Mysuru, Karnataka

Results and discussion

From the different study sites (S1, S2 & S3) at Bogadi Village, Mysuru a variety of Ant species were identified (Table 1). Amongst the ant species identified, *Pheidole meghacephala* was the most abundant in the selected areas. During the period of the study from June to August 2023. While compared to the other species of ants. A total of 16 species of ants were recorded belonging to the 4 subfamilies. Myrmicinae (7 Species viz., *Monomorium minimum*, *Crematogaster*, *Meranoplus bicolor*, *Pheidole meghacephala*, *Pheidole watsoni*, *Solenopsis invicta*, *Solenopsis geminate*) followed by Formicinae subfamily with 6 species viz., *Camponotus camoressus*, *Camponotus irritans*, *Camponotus sericeus*, *Camponotus parius*, *Oecophylla smaragdina* and *Polyrchis rastellata*. Pseudomyrmicinae subfamily with 2 species viz., *Tetraponera rufonigra* and *Tetraponera nigra* and Dolichoderinae subfamily with 1 species i.e., *Tapinoma meghacephalum*. Among the subfamilies reported from the study area, Myrmicinae was the most abundant with 5 genera and 7 species, followed by Formicinae with 3 genera and 6 species. Pseudomyrmicinae with 1 genera and 2 species and Dolichoderinae represented by a single genus and 1 species.

In the present study, 16 species of ant representing 4 subfamilies Myrmicinae represents the highest percentage of species (44%) followed by Formicinae represents 37% of ant species. Whereas, Pseudomyrmicinae represents 13% and Dolichoderinae represents (6%) of ant species species respectively (Fig 2).

It was noted that comparatively lower number of ant species (09) were recorded in the Site 3 (Bogadi lake), high biodiversity of ant species (15) Site 2 (Hostel) and Moderate ant species diversity (12) in the Site1 (Bogadi North) (Table 2). This may be due to Site 3 is polluted than other 2 sites. Since, ants are sensitive to the pollution and it indicates the presence or absence of pollution its distribution varied accordingly. The alpha and beta biodiversity indices values (Table 3) suggests that ants species are less diverse and but their distribution varied significantly between the different study sites (S1, S2 & S3). So, overall it is an indication of moderate diversity of ant species from the study area. Thus, the present studied results are in agree with the researchers [1] [4] [6] [14-18] carried out similar type of studies on ants at different places in Mysuru, Karnataka, India.

Table 1: Systematic position of Ants species recorded at Bogadi Village, Mysuru (2023)

Ants					
Order	Family	Subfamily	Sl. No.	Common Name	Scientific Name
Hymenoptera	Formicidae	Myrmicinae	1.	Little black ant	<i>Monomorium minimum</i>
			2.	Crematogaster ant	<i>Crematogaster species</i>
			3.	Shield ant	<i>Meranoplus bicolour</i>
			4.	Big headed ant	<i>Pheidol megacephala</i>
			5.	Big headed ant	<i>Pheidole watsoni</i>
			6.	Red imported fire ant	<i>Solenopsis invicta</i>
			7.	Tropical fire ant	<i>Solenopsis germinate</i>
		Formicinae	8.	Carpenter ant	<i>Camponotus campressus</i>
			9.	Carpenter ant	<i>Camponotus iritans</i>
			10.	Carpenter ant	<i>Camponotus sericeus</i>
			11.	Carpenter ant	<i>Camponotus parius</i>
			12.	Weaver ant	<i>Oecophylla smaragdina</i>
			13.	Spiny ant	<i>Polyrhachis rastellata</i>

	Pseudomyrmicinae	14.	Bicoloured Arboreal ant	<i>Tetraoponera rufonigra</i>
		15.	Arboreal ant	<i>Tetraoponera nigra</i>
	Dolichoderinae	16.	Ghost ant	<i>Topinoma megacephala</i>
Total	4 Subfamilies	16 Species		

Table 2: Ant Species distribution in different study sites at Bogadi Village, Mysuru (2023)

Sl. No.	Scientific Name	Site 1	Site 2	Site 3
1.	<i>Monomorium minimum</i>	+	+	+
2.	<i>Crematogaster species</i>	+	+	+
3.	<i>Meranoplus bicolour</i>	-	+	-
4.	<i>Pheidol megacephala</i>	+	+	+
5.	<i>Pheidole watsoni</i>	-	+	-
6.	<i>Solenopsis invicta</i>	+	+	+
7.	<i>Solenopsis germinata</i>	+	+	-
8.	<i>Camponotus campressus</i>	+	+	+
9.	<i>Camponotus iritans</i>	+	+	-
10.	<i>Camponotus sericeus</i>	+	+	+
11.	<i>Camponotus parius</i>	+	+	+
12.	<i>Oecophylla smaragdina</i>	+	+	+
13.	<i>Polyrhachis rastellata</i>	+	+	-
14.	<i>Tetraoponera rufonigra</i>	-	+	-
15.	<i>Tetraoponera nigra</i>	-	-	+
16.	<i>Topinoma megacephala</i>	+	+	-

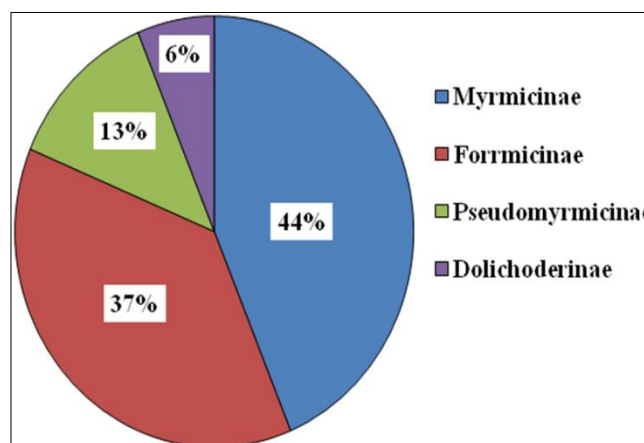


Fig 2: Percent occurrence of Ant species recorded under different Subfamilies at Bogadi Village, Mysuru (2023)

Table 3: Alpha and Beta Diversity index values for ant species recorded at Bogadi village, Mysuru

Dataset Totals			
Total Number of Organisms	16		
Average population size	4		
Total Number of Regions	1 (Bogadi area; 3 = Study sites)		
Alpha Biodiversity [α]			
Simpson Index $\frac{\sum_i n_i(n_i - 1)}{N(N - 1)}$	0.3083		
Dominance Index $1 - \left(\frac{\sum_i n_i(n_i - 1)}{N(N - 1)}\right)$	0.6917		
Reciprocal Simpson Index $\frac{1}{\left(\frac{\sum_i n_i^2}{N^2}\right)}$	3.243		
Shannon Index $-\sum_i \left(\frac{n_i}{N} \cdot \log_2 \left(\frac{n_i}{N}\right)\right)$	1.677		
Menhinick Index $\frac{S}{\sqrt{\sum_i n_i}}$	1.000		
Berger-Parker Dominance Index $\frac{n_{max}}{N}$	0.4375		
Margalef Richness Index $\frac{S - 1}{\ln N}$	1.082		
Buzas and Gibson's Index $\frac{e^{-\sum_i \left(\frac{n_i}{N} \cdot \ln \left(\frac{n_i}{N}\right)\right)}}{S}$	0.7996		
Equitability Index $\frac{-\sum_i \left(\frac{n_i}{N} \cdot \ln \left(\frac{n_i}{N}\right)\right)}{\ln N}$	0.8387		
Beta Biodiversity [β] (Comparing sample areas S1, S2 & S3)			
Absolute beta Value:(S0-c)-(S1-c)-(S2-c)	3	Whittaker's Index (S/alpha):	1
Sørensen's similarity index:	1	Alternate Whittaker's Index (S/alpha-1):	0
Sørensen's similarity index (%):	100%	Jaccard Index:	1
Routledge beta-R Index:	1.333	Jaccard Index (%):	100%
Mountford Index:	1	Number of Common Species:	4
Mountford Index (%):	100%	Bray Curtis dissimilarity	60%



1. *Monomorium minimum*, 2. *Crematogaster* sp., 3. *Meranoplus bicolor*, 4. *Pheidole megacephala*, 5. *Pheidole watsoni*, 6. *Solenopsis invicta*, 7. *Solenopsis germinate*, 8. *Camponotus campressus*, 9. *Camponotus irritans*, 10. *Camponotus sericeus*, 11. *Camponotus parius*, 12. *Oecophylla smaragdina*, 13. *Polyrhachis rastellata*, 14. *Tetraponera rufonigra*, 15. *Tetraponera nigra* and 16. *Topinoma megacephala*

Fig 3: Documentation of Ant Species at Bogadi Village, Mysuru (2023)

Conclusion

Ants, the largest family under the order Hymenoptera acts as an ecological indicators and ecosystem engineers. A total of 16 species represented by 4 subfamilies followed by Myrmicinae with 7 species, Formicinae with 6 species, Pseudomyrmicinae with 2 species and Dolichoderinae with 1 species have been recorded from Bogadi village, Mysuru substantiated with ecological indices values. Thus, this pioneer study will yield valuable information of ants availability from the study area deserves further in depth studies from Biodiversity conservation perspective.

Conflict of interest

The authors declare that they have no competing interests.

Acknowledgement

Authors are grateful to the Principal, Maharani's Science College for women, Autonomous, JLB Road, Mysuru for permission to carry out the research project work. Sincere thanks to the Co-ordinator, Postgraduate Department of Applied Zoology, MSCWM for providing laboratory facilities.

References

1. Akshaya TS, Sajani Jose. Ant Diversity from Nandapuram area of Kozhikode District, Kerala. India. Int. J. Multidiscipl. Edu. Res. 2021;10(5):134-136.
2. Azhagu Raj R, Sathish R, Prakasam A, Krishnamoorthy D, Balachandar M. Diversity and Distribution of Ant species (Hymenoptera: Formicidae), in Pachaiyappa's College, Kanchipuram, Tamil Nadu, India. J. Entomol. Zool. Stud. 2017;5(1):459-564.
3. Mahalakshmi BR, Channaveerappa H. Diversity of ant species (Hymenoptera: Formicidae) in the campus of maharani's science college for women: a mini model of habitat persistence. International Journal of Pure and Applied Zoology. 2016 Jan 1;4(3):277-81.
4. Fittkau EJ, Klinge H. On biomass and trophic structure of the central Amazonian rain Forest ecosystem. Biotropica, 1973 Apr 1, 2-14.
5. Gayathri G, Roopavathy J. A survey on ant diversity in two different areas of Thrissur district, Kerala. International Journal of Advanced Research in Medical & Pharmaceutical Sciences. IJARMPS. 2019 May;4(5):1-4.
6. Akila A, Manjunatha B, Poornima, Vishal N, Keshamma E. Study on Ants Distribution, Density and Diversity in

- Undisturbed and Disturbed Habitats. IJCRT. 2022;10(1):380-388.
7. Gadagkar R, Nair P, Chandrashekara K, Bhat DM. Ant species richness and diversity in some selected localities of Western Ghats. Hexapoda. 1993;5(2):79-94.
 8. Gunawardene NR, Daniels AE, Gunatilleke IA, Gunatilleke CV, Karunakaran PV, Nayak KG, *et al.* A brief overview of the Western Ghats-Sri Lanka biodiversity hotspot. Current Science (00113891), 2007 Dec 10, 3(11).
 9. Sunil Kumar M, Srihari KT, Nair P, Varghese T, Gadagkar R. Ant species richness at selected localities of Bangalore. Insect Environment. 1997;3(1):3-5.0
 10. Bolton B. Synopos and classification of Formicidae. Memoirs of the American entomological Institute. 2003;71:11-370.
 11. Tiwari RN, Kundu BG, Roychowdhury S, Ghosh SN. Insecta: Hymenoptera: Formicidae. State Fauna Series. 1998;3:211-94.
 12. Varghese T. Ants of the Indian Institute of science campus. Technical report, 2003.
 13. Hammer O, Harper DAT, Ryan PD. PAST: Palaeontological Statistics software package for education and Data analysis. Palaeontologia Electronica. 2001;4(1):9.
 14. Chavhan A, Pawar SS. Distribution and diversity of ant species (Hymenoptera: Formicidae) in and around Amravati City of Maharashtra, India. World Journal of Zoology. 2011;6(4):395-400.
 15. Gokulakrishnan S, Ramakrishnan N, Roopavathy J. Ant diversity in three selected localities of Thanjavur and Cuddalore Districts of Tamilnadu. Indian Journal of Applied Research. 2014;4(9):561-5.
 16. Khot K, Quadros G, Somani V. Ant Diversity in an urban garden at Mumbai, Maharashtra. In National Conference on Biodiversity: Status and Challenges in Conservation- 'FAVEO, 2013 Nov.
 17. Ramachandra TV, Subash Chandran MD, Joshi NV. Ant Species Diversity in the Sharavathi River Basib, Central Western Ghats, 2012, 1-51.
 18. Nimisha NK, Lakshmi Devi Menon P, Presty John, Rabeesh TP, Resmi R, Rajasree KM, *et al.* The abundance and diversity of ants in a few selected ecosystems of a suburban micro region in Kerala state, India: A future model to biodiversity conservation. J. Entomol. Zool. Stud. 2023;11(3):33-41.