

Exploring the ecological diversity of ant species in the Nashik urban landscape

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Abstract

During a survey conducted in Nashik City, 11 species of ants were recorded, representing various subfamilies and genera. The different subfamilies and genera found indicate a rich ecosystem that supports a variety of ant species with unique behaviors and ecological roles. This comprehensive study provides valuable information about the distribution and abundance of ants in Nashik City, shedding light on their role in the local environment. Further research into the behavior, interactions, and ecological significance of these ants could provide valuable insights into the functioning of ecosystems in this region.

Keywords: Ant, diversity, formicidae, hymenoptera, insect, social, carpenter ant, ecology, arthropoda, formicinae, myrmicinae, dolichoderinae, pseudomyrmecinae

Introduction

Insects exhibit remarkable diversity and abundance, encompassing a vast array of over one million documented species, with a high probability of numerous additional species awaiting discovery. The Phylum Arthropoda, has the largest Class Insecta. The 12 subfamilies Aenictinae, Amblyponinae, Cerapachyinae, Dorylinae, Ectaminae, Formicinae, Leptanillinae, Myrmicinae, Ponerinae, Proceratiinae, and Pseudomyrmecinae (Bharti 2001) [5] are known to exist in India. These subfamilies are made up of 297 genera and 828 species that have been identified so far. An Order Hymenoptera and Family Formicidae, which comprise ants and their associated wasps and bees, are part of the Class Insecta. Around 99 million years ago in the Cretaceous period, ants branched off from their wasp-like ancestors, a period that coincided with the proliferation of flowering plants. Eusocial insects are ants (Gadagkar *et al.*, 1993) [12]. In the most current classification system, ants are sorted into 26 subfamilies with a total of 428 valid genera and an astounding number of 14,711 species that have been verified as valid. From soil to dead logs to trees, ants thrive in a variety of habitats (Bolton 2011) [7].

A notable increase has been observed in the incorporation of terrestrial arthropods in surveys of biodiversity and evaluations of the environment (Oliver and Beattie, 1996) [21]. When it comes to studies of species diversity, ants (Hymenoptera: Formicidae) offer many advantages over other arthropods. They exhibit a broad geographical distribution, are easily accessible for collection, hold a prominent place in the field of taxonomy, and contribute significantly to the overall biomass of animals within terrestrial environments. (Fittkau and Klinge, 1973; Hölldobler and Wilson, 1990) [10, 14]. Moreover, in contrast to vertebrates, their response to stress occurs at a much more precise level (Andersen 1997) [1]. According to Halldobler

and Wilson (1990) [14] and Folgarait (1998) [11], they play a variety of ecological activities, such as regulating the population of other insects, dispersing seeds, and cycling nutrients.

Bharti *et al.*, (2016) [3] has produced a list of 828 legitimate species that are now found in India, divided into 10 subfamilies and 100 genera. Ants act as agents of bioturbation due to their nesting habits, characterized by the creation of openings for water, a diverse soil horizon, and facilitation of gas exchange through intricate chambers and tunnels constituting their nest. The alterations in soil composition, productivity, and biological communities stem from these nesting behaviors (Surekha and Ramrao 2021) [27]. According to Helldobler and Wilson (1990) [14] and Shattuck (2000) [25], ants can range in size from 0.75 to 52 millimetres (0.030–2.0 in). Ant societies are able to divide labour, communicate among themselves, and find solutions to complicated issues (Dicke *et al.*, 2004) [9]. Pheromones, noises, and touch are the three ways that ants can interact with one another (Jackson and Ratnieks, 2006) [15]. Ants are used in many human societies' food, medicine, and rituals. Certain species are prized for their ability to act as biological pesticides (Hölldobler and Wilson, 1990) [14].

Material and Methods

Study area

Alongside the river Godavari, at the end of the Deccan Plateau, you will find Nashik settled in its ancient volcanic surroundings. The Nashik District is situated within the geographical coordinates of 18.33 degrees and 20.53 degrees North latitude, and 73.16 degrees and 75.16 degrees East Longitude, located in the North-western region of the Maharashtra state. This district is positioned at an altitude of 565 meters above the average sea level.

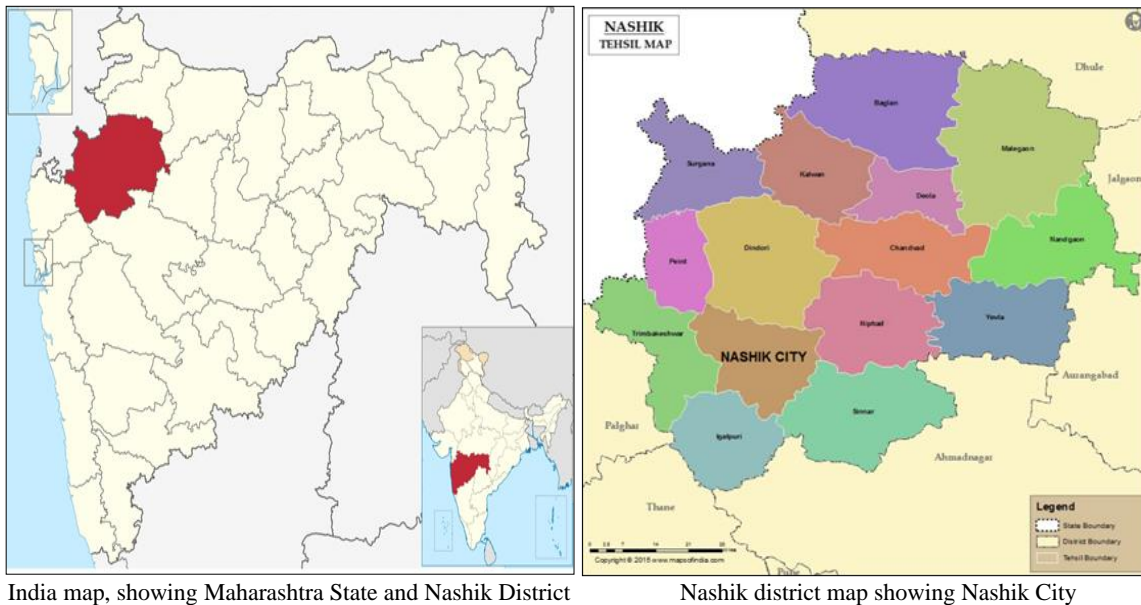


Fig 1: Geographical Location of study area

Ant Sampling, preservation and identification

Using an exhaustive and intensive search strategy, ants were meticulously collected both in the morning and evening. Pitfall traps were employed to capture ants from various microhabitats, such as tree cracks, beneath stones, and through sifting leaf litter. The pitfalls consisted of plastic glasses, 8 cm deep with a 5.7 cm diameter opening, filled with water and a small amount of colorless detergent. Additionally, ants were collected manually using forceps and honey bait traps. All collected specimens were

identified to the most precise taxonomic level possible. Regardless of the scheduled times, ants were collected opportunistically from diverse habitats within the study area throughout the study period. Standard methods for collection and preservation were followed as described by Sivadasan *et al.*, (2013) [26]. Specimens were observed and identified using a stereoscopic microscope and identification keys (Bolton 1994, 1995; Hölldobler and Wilson, 1990, Mathew and Tiwari 2000) [8-6, 14, 19].

Observation

Table 1: Ant diversity observed showing Taxonomic details

| Sr.no | Sub-family | Genus | Species | Common name |
|-------|------------------|----------------------|-----------------------|--------------------------|
| 1 | Formicinae | <i>Paratrechina</i> | <i>longicornis</i> | Crazy black house ant |
| 2 | | <i>Camponotus</i> | <i>rufoglaucus</i> | Carpenter ant |
| 3 | | <i>Monomorium</i> | <i>pharaonis</i> | Pharaoh’s ant |
| 4 | | unknown | unknown | little black ant |
| 5 | | <i>Oecophylla</i> | <i>smaragdina</i> | Asian weaver ant |
| 6 | | <i>Camponotus</i> | <i>sericeus</i> | Carpenter ant |
| 7 | Myrmicinae | <i>Solenopsis</i> | <i>geminata</i> | fire ant |
| 8 | | <i>Crematogaster</i> | <i>rothneyi</i> | acrobat ant |
| 9 | | <i>Pheidole</i> | <i>megacephala</i> | big-headed ant |
| 10 | Dolichoderinae | <i>Tapinoma</i> | <i>melanocephalum</i> | Ghost ant |
| 11 | Pseudomyrmecinae | <i>Tetraopnera</i> | <i>rufonigra</i> | Bi-coloured Arboreal ant |

Results

Nashik city is situated in the northwest region of the state of Maharashtra, between 18.33 and 20.53 degrees North latitude and 73.16 and 75.16 degrees East longitude. From the month of January to the month of April of the year 2023 which is the summer season in the study area. The sampling was carried out using the Standard ground insect collection method.

Total 11 different species were identified from the 32 field visit and 127 samples collected. These ant species are distributed in four sub families. In sub family Formicinae, six genera were recorded, in Myrmicinae three genera, namely *Solenopsis*, *Crematogaster*, *Pheidole*. In Dolichoderinae one genus where observed whereas in Pseudomyrmecinae only one genus, *Tetraopnera* where

recorded. In genus *Camponotus* two species were recorded as *C. rufoglaucus* and *C. sericeus*.

Discussion

Ants are an essential part of the ecological food web, serving as food for many native birds. The great diversity of insects has been observed in various reported studies. Among these, ant diversity is particularly significant in the Western Ghats region due to favorable climatic conditions. It is a diversity-rich zone with ecological importance. In the Indian subcontinent, Myrmicinae exhibits the highest species diversity at 42.7%, followed by Formicinae at 29.1%, while Dolichoderinae accounts for approximately 3.6% of the species (Bharti *et al.*, 2016) [3]. With 83 species, the largest ant genus in India is *Camponotus*, followed by

Pheidole with 58 species, constituting 7.0% of all known Indian species (Bharti *et al.*, 2016) ^[3]. Ant diversity in Maharashtra and neighboring southern regions has been documented by several studies (Kumar *et al.*, 1997; Gunawardene *et al.*, 2007; Khan, *et al.*, 2013) ^[18, 13, 16]. Among these, *Crematogaster rothneyi* (acrobat ants) and *Camponotus* (carpenter ants) were noted as significant pests. Studies in the Western Ghats reported 29 species (Sabu *et al.*, 2008) ^[24] and 37 species (Anu and Sabu, 2007) ^[2], emphasizing ant diversity. Myrmicinae, exhibit a wide range of feeding behaviors including specialized predation, scavenging, seed harvesting, and nectar feeding. The coexistence of Myrmicinae with opportunistic species in disturbed habitats has been noted where Dolichoderinae are absent (Pfeiffer *et al.*, 2003; Morrison, 1996) ^[22, 20]. Research highlighted the adaptability of Formicinae and Myrmicinae to diverse niches due to their less specific feeding habits and easy access to resources (Anu and Sabu, 2007; Varghese 2009; Ramesh *et al.*, 2010). Sabu *et al.* (2008) ^[2, 28, 23, 24] found a distinct elevation pattern in litter ant diversity in Wayanad forests, where Myrmecinae and Ponerinae dominated at lower and middle elevations, and Formicinae and Myrmicinae prevailed at higher elevations, with Ponerinae notably absent. Dolichoderinae, although dominant globally, were represented by only two species in the Nashik region (Sabu *et al.*, 2008) ^[24]. The family Formicinae exhibited the highest diversity, with *Tapinoma* sp. particularly noted as an indicator species of human interference (Viswanathan and Narendra, 2000) ^[29]. Khot *et al.* (2013) ^[17] recorded 28 ant species in Mumbai, Maharashtra, from the subfamilies Myrmicinae, Formicinae, Aenictinae, Dolichoderinae, Ponerinae, and Pseudomyrmicinae, with all subfamilies represented except Ponerinae.

Conclusion

This study investigates the diverse insect class within the Nashik region, focusing specifically on ants, which are ubiquitous social organisms in temperate habitats. Here, we present findings from a study conducted in and around Nashik city, aiming to assess ant diversity. Through our investigation, we identified 11 ant species representing various sub-families and genera. These findings contribute valuable insights into the ecological dynamics and species composition of ants in this region.

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