

Species of the Ants (Hymenoptera: Formicidae) In the Campus of Nakshatra Garden of Baramati India.

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Abstract

Ants have been around since the Cretaceous Period, thriving for 100 million years before ruining a single picnic. They not only survived the asteroid that killed the dinosaurs; they spread out of tropical forests to pretty much conquer the world. The attempt was to study the diversity of ants in the Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state. The present study was carried out during November, 2017 to March, 2018. The suitable and well established “All – Out – Search – Method” was employed for sampling the ants. Total of 978 individuals of the ants from study area were collected. The sampled specimens of the ant from the Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state are representing 20 species belonged to 12 genera and four subfamilies. The most diverse subfamily among the collected ants was Myrmicinae (5 genera with 7 species), followed by Formicinae (3 genera with 7 species) and Ponerinae (3 genera with 4 species). The smallest number of species belonged to the Pseudomyrmicinae (1 genus with 2 species). Among the sampled genera, one which showed the highest number of species representation was Camponotus with 4 species. Few ant genera as Crematogaster and Pheidole of Myrmicinae, Camponotus and Polyrhachis of Formicinae and Leptogenys of Ponerinae are mostly found everywhere. Some genera viz; Oecophylla, Meranoplus, Myrmecaria, Solenopsis, Anochetus and Diacamma are represented by lone species each. The attempt is trying it's best to document the ant species diversity in the Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state. The ants could survive against the odds. The “Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state”, study area in the present attempt served as a mini model to examine the persistence of ant species in a locality.

Keywords: Diversity; Ant Species; Myrmicinae; Formicinae; Ponerinae; Pseudomyrmicinae

INTRODUCTION

The ants have been around since the Cretaceous Period, thriving for 100 million years before ruining a single picnic. They not only survived the asteroid that killed the dinosaurs; they spread out of tropical forests to pretty much conquer the world.

Today, up to 10 quadrillion ants are alive on Earth at any given time. Their total biomass weighs about the same as all 7.4 billion humans put together, and they exist almost everywhere, except — ironically — Antarctica (<https://www.mnn.com/earth-matters/animals/blogs/amazing-antics-ants>). The ants are one of the most interesting and diverse group of insects. All known species of ants are eusocial. The branch of science which deals with the study of ants is called as “MYRMECOLOGY”. Currently, there are about 12,571 extant ant species as per the information given in antbase.org as on 26/8/09. As per the recent classification, all ants are grouped into 21 subfamilies (Bolton, 2003). Recently one more subfamily is added to the family formicidae under the name Martialinae (Rabeling et al. 2008). All of these fall into a single family, the formicidae. The family Formicidae is included in the Superfamily Vespoidea of the order Hymenoptera, which is placed in the class Insecta. The largest subfamily is Myrmicinae with 138 genera, followed by Formicinae having 39 genera and Ponerinae having 25 genera.

As per Bolton (1995), Oriental region is rich with 101 genera, 13 subfamilies, out of which 5 are endemic to our region. It is interesting to see that In India, we have roughly 631 species coming under 82 genera classified under 13 subfamilies.

A preliminary study shows that the Indian Institute of Science Campus is a rich store of diverse ants (Rastogi et al., 1997). They have reported 70 species of ants from the Indian Institute of Science Campus, coming under 32 genera and 6 subfamilies. Later, some more species were added to their list and Varghese (2003, 2004a) has given a revised list of ants of the Indian Institute of Science Campus. Subsequently, Varghese et al. (2004) has prepared a database on the list of all ants preserved in the Insect Museum, Centre for Ecological Sciences. Ants show various interesting behaviours like tending many species of coccids, pseudococcids, and aphids etc. Another interesting observation is that many species of ants enormously sophisticate their nests during rainy seasons.

Ants, the eusocial insects are most dominant components of terrestrial ecosystem because of universal distribution. They constitute greater part of biomass on the earth. The ants contribute a conspicuous component of terrestrial biodiversity and they are the most divergent group among all social insects. The ants are supposed to act as engineers of the ecosystem. They play very crucial role in the ecosystem by improving the soil and assisting in the decomposition process. (Watanasit, *et al.*, 2000). The ants are considered as good biological indicators due to mutualistic behavior with both flora and fauna. Ants, the eusocial insects lead high level interactive lives assisting each other to survive and are highly evolved hymenopteran showing polymorphism. Ants belong to the family Formicidae, included in superfamily Vespoidea of order Hymenoptera placed under class Insecta of phylum Arthropoda. Ants are ubiquitous in distribution and occupy almost all terrestrial ecosystems. There are about 15000 species of ants (Andrade, 2007); only 11,769 species have been described (Agosti, 2004). The family Formicidae contains 21 subfamilies, 283 genera and about 15000 living ant species of which 633 ant species belonging to 82 genera, 13 subfamilies are reported from India. The aim of the present attempt was to conduct survey, to document the ant species diversity in the campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state India.

Materials and Methods

The fieldwork was conducted in the Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra state. Baramati is a city and a municipal council in Pune district in the state of Maharashtra, India. Baramati is located at 18.15°N 74.58°E. It has an average elevation of 538 meters (1765 feet). The Nakshatra Garden is the pace maker of Vidya Pratishthan, fondly synonymous with education in all its myriad forms and academic aspects. The Vidya Pratishthan Institution has majestically scaled the ladder of success with profundity that aptly reflects its commitment to accord educational facilities to all sections of society. The Nakshatra Garden is one of the resource centre to study the Biological Sciences.



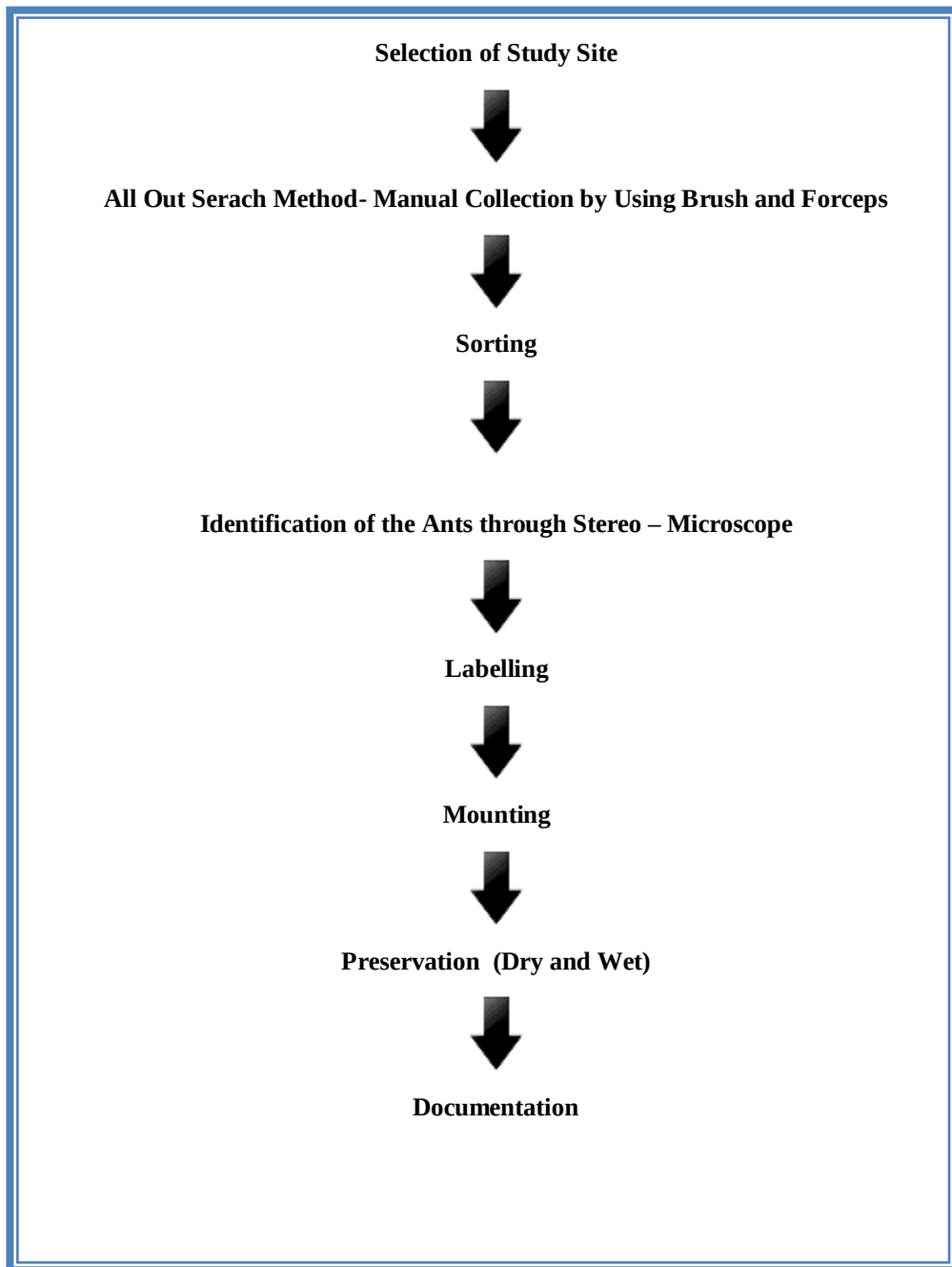
The Campus of Nakshatra Garden Baramati Dist. Pune Maharashtra State India
Coordinates: 18°10'24" N 74°36'36" E

The Nakshatra Garden is situated at the heart of the Baramati city (18°10'24"N 74°36'36"E) covering four and half hectare of land area encompasses Baramati (MIDC Bhigwan Road). The unique interaction throws biological consortia peculiar to this ecosystem. It spreads through the biologically diverse and productive habitat of native flora aesthetically blended with introduced heritage buildings all around the campus of Nakshatra Garden, Baramati.

Habitat characterization

The main type of vegetation in Nakshatra Garden is dry evergreen and scrub comprising of members predominantly belonging to the families: Poaceae, Fabaceae, Cyperaceae, Asteraceae, Euphorbiaceae, Verbenaceae, Solanaceae, Rubiaceae, Convolvulaceae, Amaranthaceae and Asteraceae plants, grass covered land patches and a small garden of mulberry germ plasma, addition to this rest benches arranged at space intervals.

Design of Sampling:



Method of Ant Sampling:

Field work was carried out in the Nakshatra Garden situated at the heart of the Baramati city (18°10'24"N 74°36'36"E). Ant field sampling was done during November, 2017 to March, 2018. The method of "Intensive all out search method" was employed. That is to say Manual collection by using a brush and forceps during daytime from 9 AM to 6 PM every day. Generally, mornings and evenings gave best results for "Intensive all out search method" (Gadagkar *et al.*, 1993). The information about Date and time of collection, habitat, locality, was also recorded at the time of collection. The collected specimens of the ants were then transferred into vials containing 70% ethyl alcohol. Then ants were brought to the laboratory of Department of Zoology, Vidya Pratishthan's Arts, Science & Commerce College, Vidyanagari, Bhigwan Road, Baramati. Dist-Pune -413133 for identification, labeling and preservation.

Method for Cleaning and Sorting of the Collected Ant specimens:

The method explained by Varghese (2003) was followed for cleaning and sorting of the collected ant specimens in the attempt. Any dirt or adhered material to the body of the ant specimen was removed, cleaned with the help of brush then dipped in water. Sorting is most fundamental step in the taxonomic studies. It needs to be done carefully. Samples specimens of the ants were segregated from debris and washing in alcohol before preserving them. Immediately after collection all specimens were sorted out first into similar groups and each group was labeled as group 1, group 2 etc. More than one species were not kept into the same vial. There was use separate vial for each species of the ants collected. The ant species were kept in separate vials with appropriate labels in order to avoid confusion.

Identification of the Collected Ant specimens:

Ant specimens were tentatively identified up to the genus level by using stereo microscope based on taxonomic keys prepared by Balton in 1994. In cases where identification of species was not possible, specimens were then sent to experts for identification. Species level identification was confirmed by the Research Group of Agricultural Development Trust's through Department of Zoology, Shardabai Pawar Mahila Mahavidyalaya, Shardanagar Tal. Baramati Dist. Pune – 413115 Maharashtra State India.

Labelling the Collected Ant specimens:

The permanently preserved specimens were provided with identification and data labels. They are written on good quality paper with India ink. The "Data Label" was containing the information about date and time of collection, name of collector, the habitat and locality. The "Identification Label" was containing the common name for the ant species; Scientific Name with author; Name for Genus; Name for Family; Name for Order and the Species Name.

Preservation of the Collected Ant specimens:

Recommendations by King and Porter (2004) on the use of alcohols for preservation of ant specimens (Hymenoptera, Formicidae) were employed. The collected ants were preserved for a long time by both wet preservation in 70% ethyl alcohol and dry preservation. It is recommended that general collections of adult ant specimens should be killed and stored in 95 % ethanol. Following this recommendation will result in ant specimens that are easier to mount for museum collections and better preserved for molecular studies.

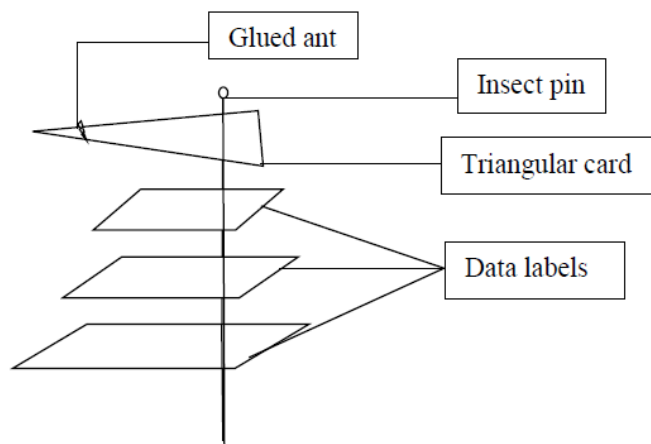
Wet preservation/ Liquid preservation of the Collected Ant specimens:

Dry preservation is not suitable for the adults of some insects and the larvae and nymphs of most insects as their bodies are soft and will easily decay. These are preserved in ethanol in containers with a tightly sealed lid. Any soft bodied arthropods can be treated in this way. Labels must be written with an alcohol-proof pen if specimens are to be kept in this manner.

The ants were directly put into separate vials containing 70% ethyl alcohol. All vials were invariably contain small labels showing details of the locality, date of collection, name of the collector, habitat (whether it is arboreal or ground dwelling) and all other possible information about the species. More than one species are not put into the same vial. Use separate vials for different species.

Dry preservation of the Collected Ant specimens:

It is the most advisable method of preservation for ants. In this method ants can be glued down to the apex of a small triangular strip of paper or card, in the region between the fore and middle coxae. Finally push one insect pin through the base of the card. The labels are attached to this insect pin. Pinned specimens should be stored in standard insect boxes. Insect pins of various sizes and insect boxes are available in various scientific supply houses (King and porter, 2004).



Mounting (Pinning) of ants

RESULTS AND DISCUSSION

Ant diversity in the campus of Nakshatra Garden situated at the heart of the Baramati city has been analyzed in the present attempt. During this study a total of 978 sampled specimens were captured in the study area. The 20 ant species are belonging to 12 genera and four subfamilies. These are as follows, the Myrmicinae were represented by 7 species and 5 genera. The Formicinae were represented by 7 species and 3 genera. The Ponerinae represented by 4 species and 3 genera. The Pseudomyrmicinae represented

by 2 species and 1 genus. The most speciose genus of these 4 subfamilies was *Camponotus* with 4 species.

Among these species *Camponotus compressus* was high compare to other species and noticeably found in everywhere in study site. The species of *Oecophylla* and *Crematogaster* were dominant on tree trunk which nested on trees.

Few ant genera as *Crematogaster* and *Pheidole* of Myrmicinae, *Camponotus* and *Polyrhachis* of Formicinae and *Leptogenys* of Ponerinae are mostly found everywhere. Some genera such as *Oecophylla*, *Meranoplus*, *Myrmicaria*, *Solenopsis*, *Anochetus* and *Diacamma* were represented by lone species each.

The **Tables 1 and 2 (Figures 1 and 2)** shows detailed distribution of diversity of ants. A number of factors seem to be involved in the increased diversity. It includes food resources, nesting habit etc. The environs of the study area are rich in ant species deserve. To date, no research has been conducted on the diversity of ants. The above information will be useful for the preparation of a management plan for the myrmecologists. Total 20 ant species were recorded in the study area during this study. Among them *Polyrhachis* sp.2, *Crematogaster* sp.1, *Myrmicaria brunnea* (Saunders 1842), *Pheidole* sp., *Pheidole watsoni* (Forel 1902), *Leptogenys* sp.3 and *Tetraponera* sp.2 are rarely found the study area are listed in Table 1.

Nakshatra Garden of the Baramati city is about 10 – 20 years old the campus area has undergone several modifications in the form of floral cultivations extension of permanent structures, which has become more rapid in the past few years. Campus is located on the edge busy road (Baramati - Bhigwan Road) with high rate of vehicular traffic this imminently has increased air pollution around compared to years past, also noise of vehicles and vibration of the vehicular movement has raised to a disturbing level. On the campus gardening has been done each year as a regular process leading to digging, change of soil, replacement of soil, additional manuring, burning of litter, change of plants and grass that has resulted change of topological profile of ant 's ecosystem in this campus.

It seems none of the factors related to air or soil pollution has affected existence of the ants and their abundance in the campus as these could be collected from this campus each year without any visible changes in their availability. A total of 4 subfamilies, 12 genera and 20 species of ants were recorded from the campus of Nakshatra Garden of the Baramati city. The majority of species were in the Myrmicinae (35%) and Formicinae (35%) followed by Ponerinae (20%). At the genus level, *Camponotus*, *Polyrhachis*, *Pheidole* and *Crematogaster* were the most speciose genera in this study with 4, 2, 2 and 2 respectively. Myrmicinae were the most abundant in numbers of ants and the most diverse group (7 Species) in this study area. This family showed a significant difference between seasons (Watanasit *et al.*, 2000) as recorded by other elsewhere. The number of individuals was higher in the wet season. They nested in soil humus, in hollow twigs, under bark, inside galls or in nuts of woody plants. It is therefore not surprising that we collected them in greater numbers. These ants were more specific due to availability of food and nesting sites. These are also the exclusively arboreal and terrestrial taxa. *Pheidole* nested in soil, *Crematogaster* nested in dead wood on trees, *Myrmicaria* nested at tree base, *Meranoplus* had nests in open canopy areas and *Solenopsis* nested under rocks and rotten logs, these findings also coincide with our observations in the campus. The Formicinae were the most abundant in the study area. The extreme dominance exhibited by Formicinae sub family with seven species in this study. Formicinae did not show a significant difference between seasons. Humidity may influence nest building. The genus

Camponotus were record of four species. *Camponotus* was a frequently occurring species in everywhere. The *Camponotus* had the greatest individual numbers. These ants are called as carpenter ants because of their "Nesting behaviours" (Chavhan et al., 2011). Food sources may have been important (Watanasit et al., 2000). The most common among them were *Oecophylla smaragdina*, a truly arboreal species. These ants nested in shady places and require broad leaves to stitch their nest. All the recorded species of *Polyrhachis* were arboreal and found in undisturbed areas. These ants nested on the ground such findings were also recorded in this study though not to such an extent of work. Ponerinae subfamily was more specific about its niche and food habits (Ramachandra et al., 2012). They feed on a wide range of food. Food resources may have played an important role influencing numbers of Ponerinae (Watanasit et al., 2000). *Anochetus* and *Diacamma* were nested in soil or even in rotten logs. *Leptogenys* prefer cavities in logs or large branches to construct their nests. Only one genus *Tetraponera* representing Pseudomyrmicinae has been recorded. Neither seasonal change nor did physical factors influence the numbers of this group. These are solitary foragers and make their nests in fallen dead wood and rotten logs. *Tetraponera rufonigra* was dominant compared to *Tetraponera* sp.2 in the study area.

Ants exhibit a greater resistance to pollutants in comparison to other invertebrates (Torrassian and Causse, 1998; Le Masne and Cougourdan, 1972) even to industrial pollutants (Petal et al., 1995). This kind of resistance and adaptability has been assigned to two reasons first being that only 10% of the ants are outside the during active phase of the day and the other reason that ants change the pattern of activity on exposure to pollutants, often the density of reduce with increase in pollution (Folgarite, 1998). The richness has been correlated with the composition of the plant species invertebrate and microbial biomass (Majer et al., 1982; Anderson 1997; Anderson and Sparling, 1997).

With all the atrocities on the habitat of in Nakshatra Garden of Baramati, the ants have showed continued existence and have persisted through the years and generations. The rich diversity of the ants documented during this study may be because of adequate nesting sites and availability of food as well foraging. The high diversity of ants in this area is showed that this area is good habitat for ants. This study has shown the ants could survive against the odds and this study area served as a mini model to examine the persistence of ant species in a locality.

However, exactly what it is about that context that causes this different response of ant species diversity remains unknown. Based on the preliminary studies, the present attempt is labeling the Nakshatra Garden of Baramati as "hotspots of ant diversity." The results are highlighting the immediate need for conservation of the natural habitats in the Nakshatra Garden of Baramati. There should be care of "Non-Baramati Ant Fauna" in the Nakshatra Garden of Baramati. This is because the species richness of any ecosystem depends on their exchange among the other ecological groups. Species diversity takes into account both species richness and species evenness. Biodiversity appears to be the global ecological need. The present attempt on diversity of ants in the Nakshatra Garden of Baramati clearly shows the richness of ants fauna in the city. The attempt recorded 20 species of ants belonging to 4 subfamilies. The campus of in the Nakshatra Garden of Baramati city has gone several changes through years embodies ant diversity and could be considered as a mini model of habitat persistence by ant species. The present attempt tried it's best to yield valuable information of ant availability in the Nakshatra Garden of Baramati. This Nakshtra Garden Baramati with excellent flora and fauna open a new "Myrmecological" avenue.

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<https://www.mnn.com/earth-matters/animals/blogs/amazing-antics-ants>

Table 1: Checklist of Ants in the Nakshatra Garden Baramati Dist. Pune Maharashtra State India (coordinates: 180° 10' 24" N 74° 36' 36" E).

Serial No.	Scientific Name	Common Name	Status
1.	<i>Camponotus compressus</i> (Fabricius, 1787)	Carpenter ant	Common
2.	<i>Camponotus</i> sp.2		Common
3.	<i>Camponotus</i> sp.3		Common
4.	<i>Camponotus sericeus</i> (Fabricius, 1798)		Common
5.	<i>Oecophylla smaragdina</i> (Fabricius, 1775)	Weaver ant	Common
6.	<i>Polyrhachis</i> sp.1	Spiny ant	Common
7.	<i>Polyrhachis</i> sp.2		Rare
8.	<i>Crematogaster</i> sp.1		Rare
9.	<i>Crematogaster</i> sp.2		Common
10.	<i>Meranoplus bicolor</i> (Guerin-Meneville, 1844)	Shield ant	Common
11.	<i>Myrmecaria brunnea</i> (Saunders, 1842)	Harvester ant	Rare
12.	<i>Pheidole</i> sp.	Big headed ant	Rare
13.	<i>Pheidole watsoni</i> (Forel, 1902)		Rare
14.	<i>Solenopsis geminate</i> (Fabricius, 1804)	Fire ant /thief ant	Common
15.	<i>Anochetus</i> sp.	Trap jaw ant	Common
16.	<i>Diacamma ceylonense</i> (Emery, 1897)	Queenless ant	Common
17.	<i>Leptogenys</i> sp.3	Long legged ant	Rare
18.	<i>Leptogenys processionalis</i> (Jerdon, 1851)		Rare
19.	<i>Tetraponera</i> sp.2	Arboreal ant	Rare
20.	<i>Tetraponera rufonigra</i> (Jerdon, 1851)		Common

Table 2: Summary of ant species collected from Nakshatra Garden Baramati Dist. Pune Maharashtra State India (coordinates: 180° 10' 24" N 74° 36' 36" E).

Sub Families	Genera	No. of Species Recorded
Formicinae	<i>Camponotus</i>	4
	<i>Oecophylla</i>	1
	<i>Polyrhachis</i>	2
Myrmicinae	<i>Meranoplus</i>	1
	<i>Myrmicaria</i>	1
	<i>Pheidole</i>	2
	<i>Crematogaster</i>	2
	<i>Solenopsis</i>	1
Ponerinae	<i>Anochetus</i>	1
	<i>Leptogenys</i>	2
	<i>Diacamma</i>	1
Pseudomyrmicinae	<i>Tetraponera</i>	2
Total	12	20

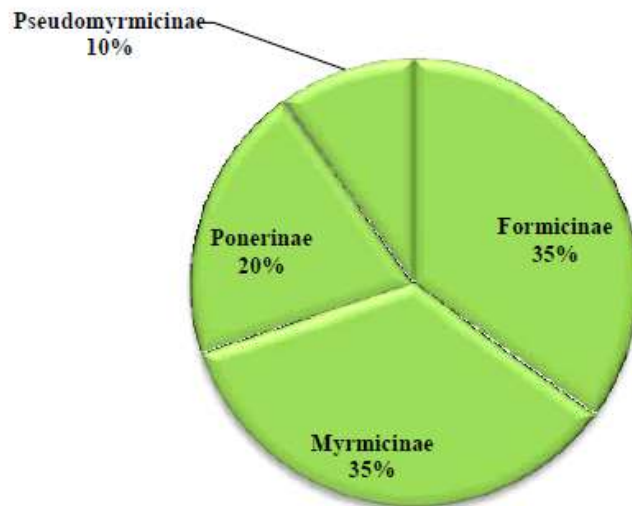


Figure 2: Subfamily wise distribution of ants found at study area.

Ecological status of ants

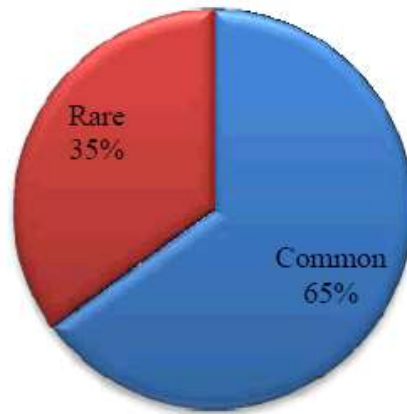


Figure 3: Ecological status of ant fauna of study area.