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Diversity of Ants (Hymenoptera: Formicidae) at St. Xavier's College Campus, Palayamkottai, Tamil Nadu, India

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Abstract: Ant species are ecologically dominant in most terrestrial ecosystems. The present study deals with the diversity of ants at St. Xavier's College Campus, Palayamkottai, Tamil Nadu, India. Ants were sampled in four different locations from November, 2019 to February, 2020 with the help of different collection methods such as All-out Search Method (AOSM), baits trap (BT), Hand Collection Method (HCM), and Pitfall trap (PT). A total of eight species of ants belonging to three subfamilies-- Pseudomyrmicinae, Myrmicinae and Formicinae were recorded in the study area. Indices of relative abundance and density are commonly used to assess the status of species. The relative abundance of ant species was calculated. The most dominant subfamily was Myrmicinae (4 genera with 4 species), which is followed by Formicinae (2 genera with 3 species). Pseudomyrmicinae was found in small number (one genus with only one species). The relative abundances of subfamilies *Oecophylla smaragdina*, *Tertaponera rufonigra* and *Solenopsis geminata* were 22.7%, 15.95%, 15.6%, respectively.

Keywords: Ants survey, Diversity, Distribution, Species abundance, Formicidae, Species diversity

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Introduction

The Formicidae consists of hymenopterans commonly called Ants. Ants are found everywhere. Ant communities show an excellent difference within the number of species and colony density from place to place (Brian, 1956; and Herbers, 1985) Ant species are ecologically dominant in most terrestrial ecosystems (Bruhl *et al*., 1998).

The Hymenoptera is a significant order of holometabolous insects. That is, they undergo an entire metamorphosis with distinct egg, larvae, pupa, and adult stages. (Quicke, 2009). All the known species of ants belong to Formicidae and are social insects. Ants are most important invertebrates which play a dynamic role in the alteration of soil ecosystem diversity (Gadagkar *et al*., 1993).

The role of ants in the ecosystem with special prominence on ground-dwelling ants in soil processing and performance as ecosystem engineers was discussed by Folgarait (1998). Ants

in particular are ecologically diverse, relatively well-described, and have a wide variety of impacts as competitors, predators, scavengers, and seed-dispersers among others (Hölldobler and Wilson, 1990; Lach *et al.*, 2010).

Indices of relative abundance and density are commonly used to assess the status of fish and wildlife species (William *et al*., 1998). The relative abundances of equilibrium species are of considerable ecological interest and frequently can be deduced from the assumption that increase in one species population results in approximately equal decrease in the populations of other species. To make the formula definite it is essential to assume that the census-taker has sampled a small area and thus succeeded a certain sort of randomness (MacArthur, 1960).

Ant diversity varies among continents and biogeographic regions. India is one of the world's most biodiverse geographical areas. Ants are represented by 26 extant subfamilies with 16,284 valid species and 464 valid genera (Bolton, 2011). Tiwary *et al.* (1998) published an inventory of 591 species of ant from India. Bharti *et al*. (2016) listed 828 species and subspecies, representing 100 genera grouped in 10 subfamilies. Ramesh *et al.* (2009) recorded 31 species, 15 genera, and five subfamilies of ants from Atomic Energy Campus, Kalpakkam.

Azhagu Raj *et al.* (2017) recorded ten species belonging to nine genera and four subfamilies during the post-monsoon season from Pachaiyappa's College for Men Campus Kanchipuram, Tamil Nadu. Anusiyadevi *et al.* (2018) identified ten species belonging to three subfamilies in the Anjac Campus, Sivakasi, Virudhunagar district, Tamil Nadu. Karthick *et al.* (2019) recorded three subfamilies, eight genera and twelve ant species from Samugarengapuram village Radhapuram taluk, Tirunelveli district. The main aim of the present study was to survey and document the ant species diversity, distribution, and composition at St. Xavier's College Campus, Palayamkottai, Tirunelveli district, Tamil Nadu, India.

Materials and Methods

Study area:

This study was carried out at St. Xavier's College (Autonomous) Campus lying between latitudes of 8°42' 57'' N, and longitudes of 77°.44' E), in Palayamkottai, Tirunelveli District, Tamil Nadu (Fig. 1). St. Xavier's College campus, divided into four zones (XIBA Block campus, CARE lab, Main campus, and CPRC lab), was selected for finding the diversity, distribution, and composition of ant species.

Collection of ants:

Ants were collected using a brush and forceps during day time in between 7.30 am to 4 pm twice in every month from November, 2019 to February, 2020.

Pitfall trap (PT):

The pitfall trap technique was adopted to measure the ant fauna in the study area during the study period. Sites were chosen to represent the three different localities. At each site, 20 pitfall traps (10 cm depth for each trap) were distributed. Each individual trap remained in exactly the same position during the study period. Traps were left open for 48 h (Manikandan *et al.*, 2018).

Bait Trap (BT):

Six bait types such as Egg yolk, fried coconut, honey, un-boiled rice, millet and dead insects were used and placed in SXC campus. The baits were left undisturbed for 4 h and later ant species were collected for a period of 20 min from all the six baits (Gadagkar *et al.*, 1993; Azhagu Raj *et al.*, 2017).

All-Out Search Method (AOSM):

An intensive all- out search method was carried out to collect ant species at SXC campus. (Gadagkar *et al.*, 1993; Alonso, 2000; Azhagu Raj *et al.*, 2017). The captured specimens in each trap were counted and then identified.

Preservation Method:

Ant species were preserved in 70% ethanol in

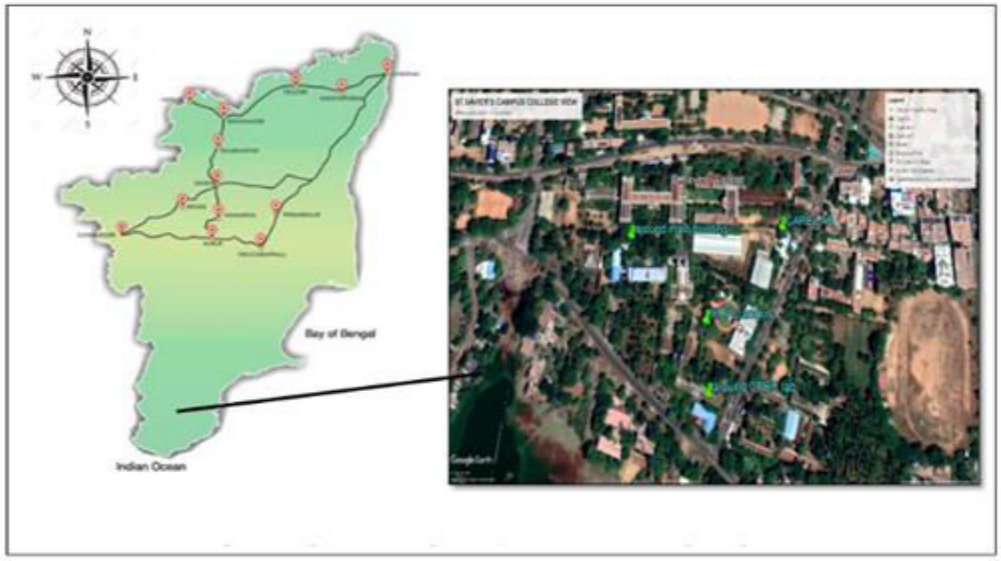

Fig. 1: Study area and sampling collection site

plastic vials. The stored ant specimens were then counted and identified up to genus level using microscope.

Relative abundance:

The difference between the total number of individuals of all species and the total number of individuals of the species indicates the relative abundance. Relative abundance (RA) was calculated using the following formula (Pennington, 1986):

$$RA\ (\%) = \frac{\text{Total number of individuals of the species}}{\text{Total number of individuals of all species}} \times 100$$

Diversity Indices:

The ant species diversity data were converted to fourth-root square transformed before analysis to reduce the weight of common species using the computer program PRIMER-E (ver.6.1.10)

Statistical analysis:

The ant species composition at different sites of SXC Campus, Palayamkottai was subjected to diversity analysis by using statistical package, PAST software. The collected ant species were identified and confirmed by Himender Bharti, Department of Zoology and Environmental Sciences, Punjabi University, Patiala, India.

Results and Discussion

In this study, a total of eight species of ants was identified from four different zones of St. Xavier's College Campus, Palayamkottai. A total of 8 species of ants belonging to 3 subfamilies which included Pseudomyrmicinae, Myrmicinae and Formicinae was recorded from different habitats of the study area. (Table 1, Fig. 2). Collected samples were identified and placed in three subfamilies. Amongst these subfamilies, Myrmicinae was represented by four species under four genera; subfamily Formicinae had 3 species under 2 genera, and subfamily Pseudomyrmicinae had one species. Among the species *Oecophylla smaragdina* was high in abundance compared to other species. The species of *Oecophylla* were dominant on mango trees**.** Ant species densities (mean+SE) from SXC campus (stations 1 to 4) were counted (Fig. 3B).

The ant fauna diversity (Shannon-Weiner index- H'), Species richness (d) and species evenness (Pielous evenness-J) were calculated. Species evenness (J) ranged from 0.8257 to 0.9752. Shannon-Weiner index- H' at stations I to

Table 1: List of identified Ant species and their distribution in SXC Campus

Subfamily	Ant species
Pseudomyrmicinae	*Tetraponera rufonigra* (Jerdon, 1851)
Formicinae	*Paratrechina longicornis* (Latreille, 1802)
	Camponotus mitis (Smith, 1858)
	Camponotus barbatus taylori Forel, 1892
Myrmicinae	*Solenopsis geminata* (Fabricius, 1804)
	Myrmicaria brunnea Saunders, 1842
	Trichomyrmex glaber (Andre, 1883)
	Oecophylla smaragdina (Fabricius, 1775)

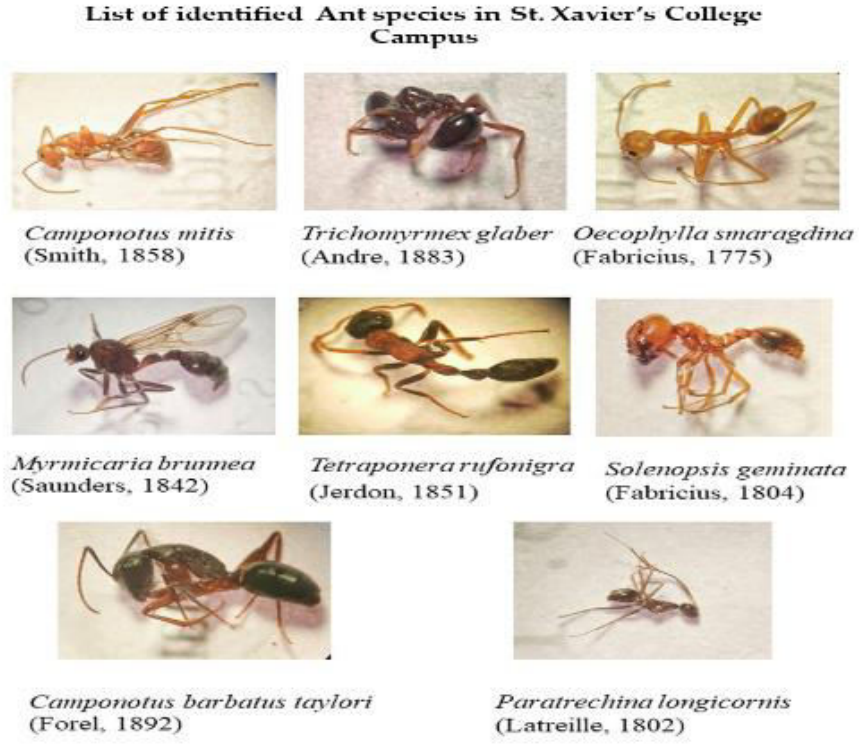

Fig. 2: List of Identified Ant species.

IV ranged from (1.918 to 2.037; 1.941 to 2.054; 1.888 to 2.03 and 1.902 to 2.031, respectively. Species richness (d) ranged from 1.348 to 1.405 (Table 2).

The relative abundance of subfamilies Formicinae, Pseudomyremicinae and Myremicinae were 62.05%, 21.98%, 15.95%, respectively. Ant species such as *Oecophylla smaragdina* (22.7%), *Tertaponera rufonigra* (15.95%), *Solenopsis geminata* (15.6%) and *Paratrechina longicornis* (6.03%) were recorded (Table 3; Fig. 4).

To study the similarity/dissimilarity, (Bray-Curtis Similarity) the data (Square root) of baits and ant compositions were also taken for cluster

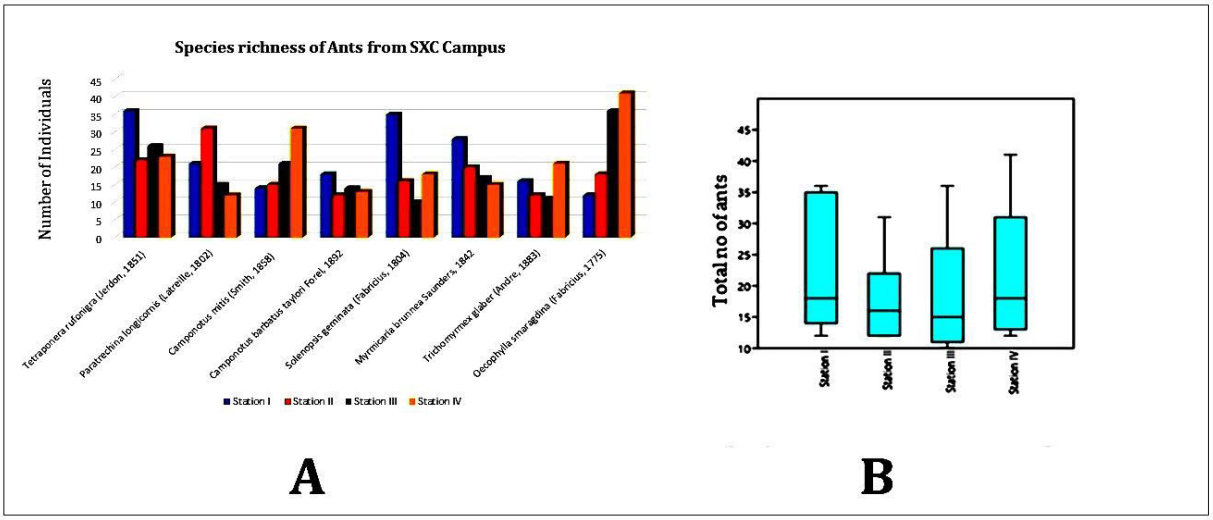

Fig. 3: (A) Species richness of ant species at study area; (B) Ant species density at four stations (mean±SD).

Table 2: Diversity indices for Ants species in St. Xavier's College Campus

Diversity indices	November (2019)	December (2019)	January (2020)	February (2020)
Individuals	180	146	150	174
Dominance_D	0.144	0.1378	0.1486	0.1478
Simpson_1-D	0.856	0.8622	0.8514	0.8522
Shannon_H	2.005	2.031	1.992	1.995
Evenness_e^H/S	0.9283	0.9531	0.9163	0.9189
Brillouin	1.916	1.926	1.89	1.904
Menhinick	0.5963	0.6621	0.6532	0.6065
Margalef	1.348	1.405	1.397	1.357
Equitability_J	0.9642	0.9769	0.958	0.9593
Fisher_alpha	1.716	1.819	1.805	1.732
Berger-Parker	0.2	0.2123	0.24	0.2356

analysis (Fig. 5). Most of the ant species such as *Oecophylla smaragdina; Camponotus mitis and Camponotus barbatus taylori* grouped at the highest level of similarity followed by ants *Paratrechina longicornis* and *Myrmicaria brunnea*. In addition, a cluster of ants such as *Solenopsis geminata,* and *Tetraponera rufonigra* formed close similarity. *Trichomyrmex glaber* and *Oecophylla smaragdina* formed a single cluster at the next level of similarity. A cluster of *Camponotus mitis*, *Camponotus barbatus taylori*, *Tetraponera rufonigra and Solenopsis geminata* grouped successively at the next level of similarity. Cluster analysis is useful in finding the grouping of samples, such that samples within a group are more similar to each other than the samples in distinct groups. (Fig. 6).

Table 3: Relative abundance of Subfamilies and Ant Species

Ants Species	Relative abundance
	%
Tetraponera rufonigra (Jerdon, 1851)	15.95
Paratrechina longicornis (Latreille, 1802)	6.03
Camponotus mitis (Smith, 1858)	6.74
Camponotus barbatus taylori (Forel, 1892)	9.21
Solenopsis geminata (Fabricius, 1804)	15.6
Myrmicaria brunnea (Saunders, 1842)	13.82
Trichomyrmex glaber (Andre, 1883)	9.93
Oecophylla smaragdina (Fabricius, 1775)	22.7

Subfamily	Relative abundance
	%
Myrmicinae	15.95
Pseudomyrmicinae	21.98
Formicinae	62.05

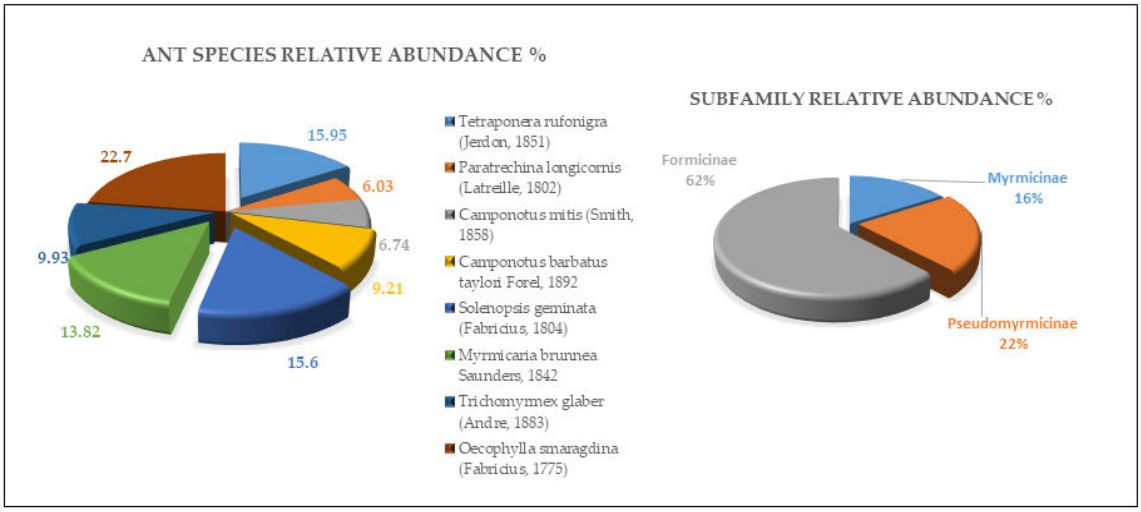

Fig.4: Relative abundance.

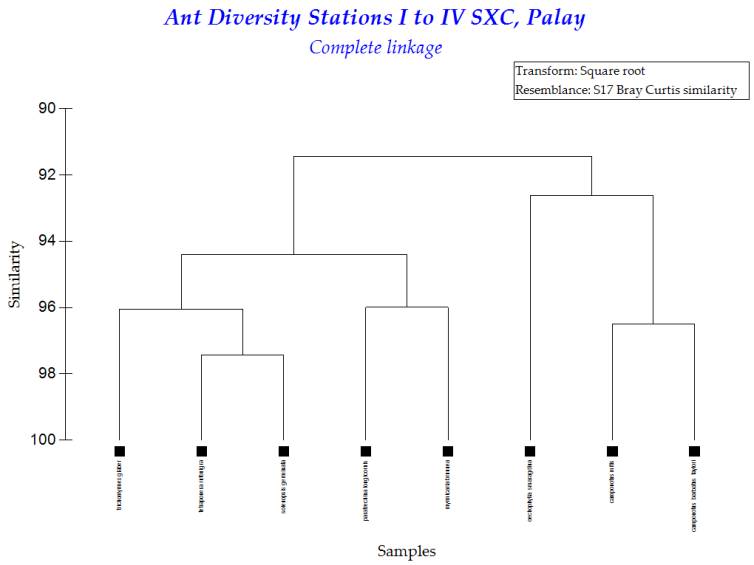

Fig. 5: Hierarchical Cluster analysis (Complete linkage Square root- D1 Bray-Curtis similarity) for ant species diversity.

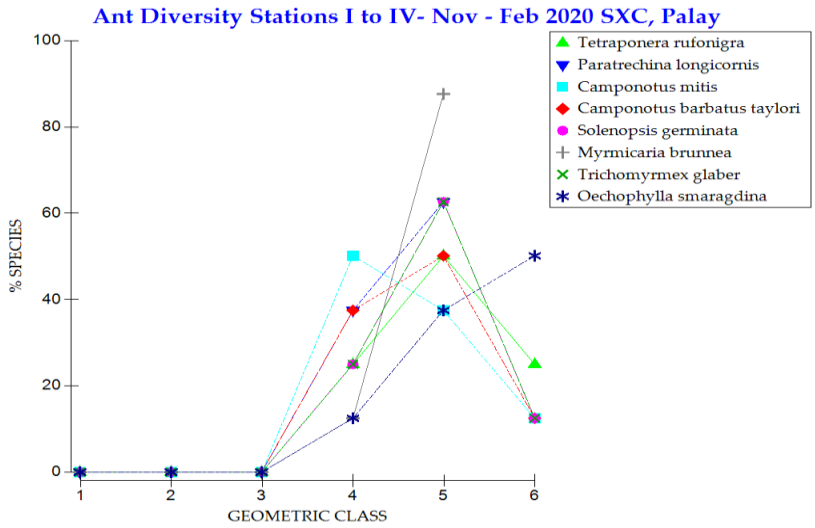

Fig. 6: Geometric Class Plot (Species abundance distribution) for ant species diversity.

Chavhan and Pawar (2011) identified 34 species and 20 genera belonging to 5 subfamilies of ants from Amravati city of Maharastra. Mahalakshmi and Channaveerappa (2016) recorded the diversity of ant species belonging to 4 subfamilies, 12 genera and 20 species from the campus of Maharani Science College for Women, Mysuru. Manikandan *et al*. (2018) studied the relative abundance of ant subfamilies such as Formicinae (21%) and Myremicinae (59%) from Thiruthangal, Sivakasi region, Tamilnadu. Karthick *et al*. (2019) recorded the relative abundance of *Oecophylla smaragdina* (27%), and *Tetraponera rufonigra* (16.66%) from Samugarengapuram Village, Tirunelveli district, Tamil Nadu.

Conclusion

The present investigation deals with diversity of ants in St. Xavier's College Campus, Palayamkottai, Tamil Nadu. We recorded 8 species of ants belonging to 3 subfamilies which included Pseudomyrmicinae, Myrmicinae and Formicinae. The present study revealed significant information on ant diversity in the study area. This will definitely be helpful for upcoming researchers to study this group in depth.

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