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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

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Abstract
A Study on the Diversity of Hymenoptera Insects Using Ants as a model in Pulppatta panchayat in Malappuram district of Kerala state was carried out for a period of April 2019 to June 2019 from four different ecosystem; paddy, banana, rubber, and coconut. A total 20 Species of ants belongs to five families have been recorded. Family Formicinae showed the maximum species richness, comprising of 9 species followed by family Myrmicinae (7 Species), Ponerinae (2 Species), Pseudomyrmecinae and Dolichoderinae (1 Species) only. Arecanut ecosystem is the richer ecosystem and *Camponotus* sp. are the most abundant species from the study sites.

Keywords: Formicidae, Diversity, *Camponotus*, Ecosystem.

Introduction
Ants are members of the Formicidae family, which, along with caterpillars and bees, belong to the order Hymenoptera. Ants evolved from common ancestors during the Cretaceous period, about 140 million years ago, and diversified after the emergence of flowering plants. Hymenoptera is a large order containing many beneficial insects for humans. Ants show diversity, abundance and biomass dominance in all habitats in the world (Fittkau and Klinge, 1973) [49]. EO Wilson (1971) [50] gave the total number of ants living simultaneously in the world between 1 and 10 quadrillion (short hours). According to this estimate, the total biomass of all ants in the world is approximately equal to the total biomass of humans (Wilson, 1971) [50]. Ants play an important role in terrestrial ecosystems as they interact with many plant species, such as seed dispersers, leaf and seed predators, and sometimes pollinators (Vázquez 1998; Hernández 2005) [51, 52]. Ants are found everywhere except Iceland, Greenland, and Antarctica (Holldobler and Wilson, 1990) [53], but their numbers decrease with increasing latitude, altitude, and drought (Fowler and Claver, 1991; Farji-Brener and Ruggiero, 1994; Samson *et al.*, 1997) [54-56].
Ants are very sensitive to habitat changes and disturbances and are therefore widely used as species markers (Hoffmann and Andersen 2003) [57]. Ant diversity differs in dispersed and undistributed areas in terms of species richness, abundance and composition. Undisturbed forest areas have more species richness, diversity and richness than degraded forest areas. This is due to habitat destruction and increased disturbance from various human activities. Today, ants work as an important channel of energy and organic matter in most soil environments.
For example, they are important tillers who match or exceed the actions of earthworms in this role.

Materials and Methods
Pulppatta is located on the northern side of Mongam, Valluvamburam, and Manjeri in Malappuram District, Kerala, India. (Latitude of Pulppatta is 11.147 and longitude is 76.083). Ants were collected from four locations using pit traps, odor traps, hand collection, full search and gas equipment between April 2019 and June 2019; fruit seeds, banana rubber and rice fields.

Samples are taken from the selected area using blunt forceps and collected in containers with dead personnel. The collected bacteria were identified, washed and stored in a plastic bottle in 70% alcohol and taken to the laboratory. The ants were photographed with a Nikon digital camera and analyzed at the species level with the aid of a stereo zoom microscope. Ants are identified by a numerical code (Mathew RN and Tiwari, 2000; Bolton B, 1994, 2003) [58-60] and with the help of experts. Field photography was done with NikonP530. Finally, for both assembled and unassembled images, unnecessary parts (unfocused attachments), content around or covering the target object are deleted and cleared. Adjust background, color balance, contrast and sharpness with Adobe Photoshop CS6

Observation and Results

Total of 20 ant species belonging to 5 families were recorded during sampling (Table 1). Formicinae is very species rich, there are 9 species, followed by Myrmicinae 7 species, Ponerinae 2 species, Pseudomyrmecinae and Dolichoderinae only 1 species.

Table 1: The checklist of Formicidae from selected habitats of Pulppatta Panchayat of Malappuram District, Kerala A

Table 1: Number of species collected from selected sites

SL No	Sites	Number of subfamily	Number of genus	Number of species
1	Arecanut	3	10	13
2	Banana	3	11	12
3	Rubber	2	8	10
4	Paddy	3	6	9

Table 2: List of identified species

SL No	Subfamily	Genus	Species
1	Formicinae	*Camponotus*	*C.mitis*
2	Formicinae	*Camponotus*	*C.parius*
3	Formicinae	*Camponotus*	*C.sericeus*
4	Formicinae	*Camponotus*	*C.angusticollis*
5	Formicinae	*Camponotus*	*Camponotus sp*
6	Formicinae	*Paratrechina*	*Paratrechina sp.*
7	Formicinae	*Anoplolepis*	*A.gracilipes*
8	Formicinae	*Polyrhachis*	*Polyrhachis sp.*
9	Formicinae	*Oecophylla*	*O.smaragdina*
10	Myrmicinae	*Tetramorium*	*Tetramorium sp.*
11	Myrmicinae	*Tetramorium*	*T.simillimum*
12	Myrmicinae	*Solenopsis*	*Solenopsis sp.*
13	Myrmicinae	*Crematogaster*	*Crematogaster sp.*
14	Myrmicinae	*Pheidole*	*Pheidole sp.*
15	Myrmicinae	*Monomorium*	*M.pharaonis*
16	Myrmicinae	*Myrmicaria*	*M.brunnea*
17	Ponerinae	*Pachycondyla*	*Pachycondyla sp.*
18	Ponerinae	*Odontomachus*	*O.haematodes*
19	Pseudomyrmecinae	*Tetraponera*	*T.allaborans*
20	Dolichoderinae	*Tapinoma*	*Tapinoma sp.*

Separate collection list of species from each ecosystem

Table 3: List of identified species from Arecanut

SL No	Subfamily	Genus	Species
1	Formicinae	*Camponotus*	*Camponotus sp.*
2	Formicinae	*Camponotus*	*C.parius*
3	Formicinae	*Camponotus*	*C.mitis*
4	Formicinae	*Camponotus*	*C.angusticollis*
5	Formicinae	*Paratrechina*	*Paratrechina sp.*
6	Formicinae	*Anoplolepis*	*A.gracilipes*
7	Formicinae	*Polyrhachis*	*Polyhachis sp.*
8	Formicinae	*Oecophylla*	*O.smaragdina*
9	Myrmicinae	*Pheidole*	*Pheidole sp.*
10	Myrmicinae	*Solenopsis*	*Solenopsis sp*
11	Myrmicinae	*Myrmicaria*	*brunnea*
12	Myrmicinae	*Tetramorium*	*Tetramorium sp.*
13	Ponerinae	*Odontomachus*	*O.haematodes*

Table 4: List of identified species from Banana

SL No	Subfamily	Genus	Species
1	Formicinae	*Camponotus*	*C. Mitis*
2	Formicinae	*Camponotus*	*C. Augusticollis*
3	Formicinae	*Tetraponera*	*T. Allaborans*
4	Formicinae	*Oecophylla*	*O. Smaragdina*
5	Formicinae	*Anoplolepis*	*A.gracilipes*
6	Myrmicinae	*Pheidole*	*Pheidole sp.*
7	Myrmicinae	*Tetramorium*	*T. Simillimum*
8	Myrmicinae	*Solenopsis*	*Solenopsis sp.*
9	Myrmicinae	*Myrmicaria*	*brunnea*
10	Myrmicinae	*Crematogaster*	*Crematogaster sp.*
11	Ponerinae	*Pachycondyla*	*Pachycondyla sp.*
12	Ponerinae	*Odontomachus*	*O. Haematodes*

Table 5: List of identified species from Rubber

SL No	Subfamily	Genus	Species
1	Formicinae	*Camponotus*	*C. Angusticollis*
2	Formicinae	*Camponotus*	*C. Parius*
3	Formicinae	*Camponotus*	*C. Mitis*
4	Formicinae	*Odontomachus*	*O. Haematodes*
5	Formicinae	*Oecophylla*	*O. Smaragdina*
6	Formicinae	*Anoplolepis*	*A. Gracilipes*
7	Formicinae	*Tetraponera*	*T. Allaborans*
8	Myrmicinae	*Myrmicaria*	*brunnea*
9	Myrmicinae	*Solenopsis*	*Solenopsis sp.*
10	Myrmicinae	*Monomorium*	*M. Pharaonis*

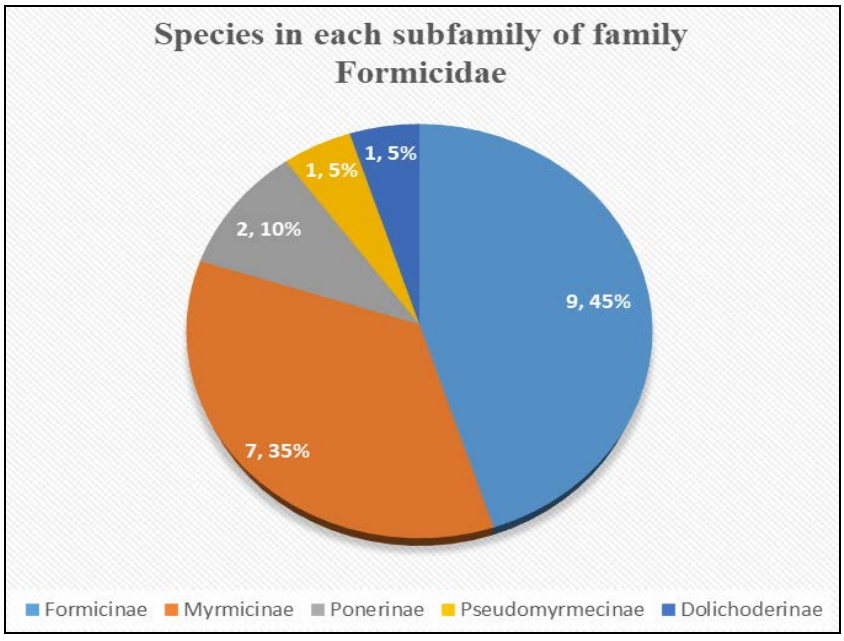
Table 6: List of identified species from Paddy

SL No	Subfamily	Genus	Species
1	Formicinae	*Camponotus*	*C. Parius*
2	Formicinae	*Camponotus*	*C. Angusticollis*
3	Formicinae	*Camponotus*	*C. Mitis*
4	Formicinae	*Camponotus*	*C. Sericeus*
5	Formicinae	*Anoplolepis*	*A. Gracilipes*
6	Myrmicinae	*Monomorium*	*M. Pharaonis*
7	Dolichoderinae	*Tapinoma*	*Tapinoma sp.*
8	Myrmicinae	*Tetramorium*	*Tetramorium sp.*
9	Myrmicinae	*Pheidole*	*Pheidole sp.*

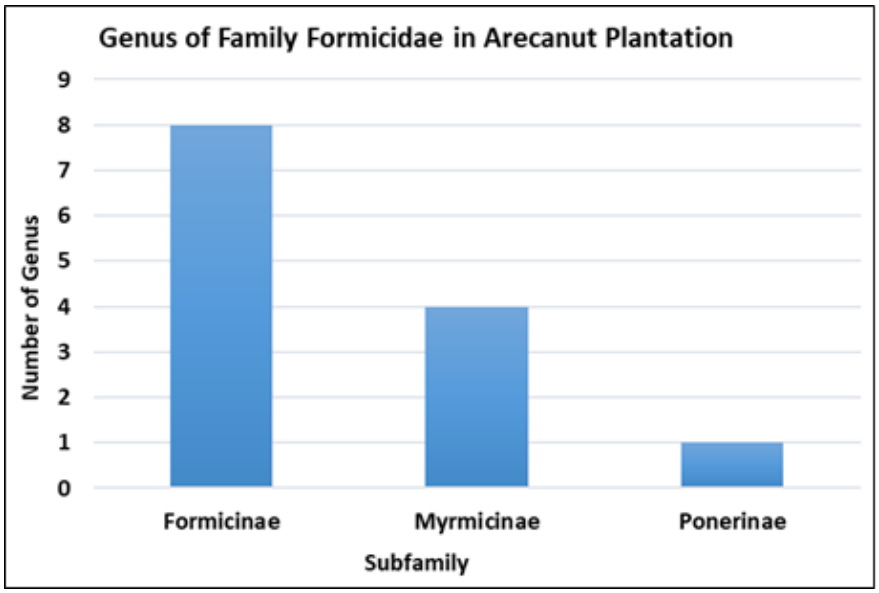
Discussion

Ants are an important part of ecosystems; their biodiversity is incredibly high, and these organisms are very sensitive to human interference, which would clearly reduce their abundance. Diversity of ants differedin these four habitats in respect of species diversity. Several ant species' populations in particular habitats showed significantly increase due to condition favourable over their as nesting sites, food and foraging etc.

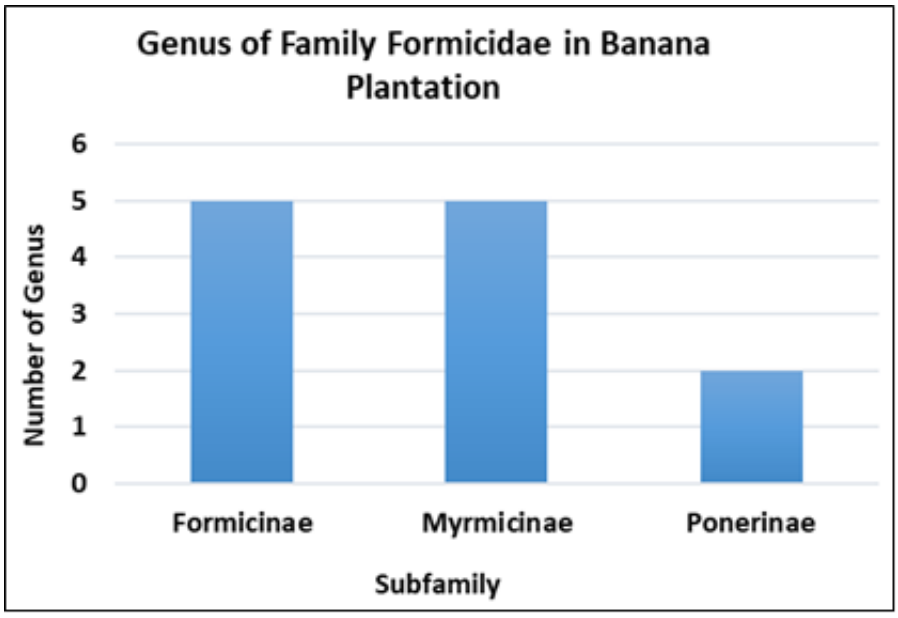
According to the study, Arecanut ecosystem is the richer ecosystem. Most recorded Formicidae belongs to Family Formicinae (45%) with 9 Species, Myrmicinae (35%) were recorded with 7 Species, Ponerinae (10%) with 2 Species, Pseudomyrmecinae (5%) and Dolichoderinae (5%) with 1 Species. Least species were recorded from the, Pseudomyrmecinae and Dolichoderinae comprising of only 1 Species. The distribution of species in the different subfamilies showed a dominance of Formicinae with 5 genus (9 Species: Camponotus angusticollis, *Camponotus mitis, Camponotus parius, Camponotus sp., Camponotus sericeus, Anoplolepis gracilipes, Oecophylla smaragdina, Polyrachis sp.* And *Paratrechina sp.* Followed by Myrmicinae with 6 genera (7 species: *Pheidole, Crematogaster sp., Myrmicaria brunnea* (Saunders) and S*olenopsis, Tetramorium* sp., *Monomorium pharaonis, Tetramorium simillimum*). Ponerinae with 2 genera (2 species: *Odontomachus haematodus, Pachycondyla*) and Pseudomyrmecinae with 1 genera (1 species: *(Tetraponera allaborans*). Dolichoderinae with 1 genus (1 species: *Tapinoma sp.*The dominance of Formicinae in different ecosystems is due to their ability to adapt to different ecological niches with different nutrients. Out of the different habitat surveyed the Arecanut plantation was the most species diverse region (13 species, Graph: 2), followed by Banana (12 species, Graph: 3), Rubber (10 species, Graph: 4), Paddy (7 species, Graph: 5). The most frequently observed genus of Ants in Pulppatta region are *Camponotus sp., Pheidole sp., Anoplolepis sp* and followed by the genus *Myrmicaria sp., Tetraponera sp.* and *Pachychondyla sp.* Of these twenty species of ants 2 species where common in all the four habitats. The genus *Camponotus* was the most abundant genera with 5 species. The genus Camponotus is the most diverse with 5 species. Camponotus species are found in all ecosystems and are among the most diverse groups. Previous studies on ant families in Kerala from other regions have also reported that the genus Camponotus is a diverse group (Nayana *et al.* (2016) [32].



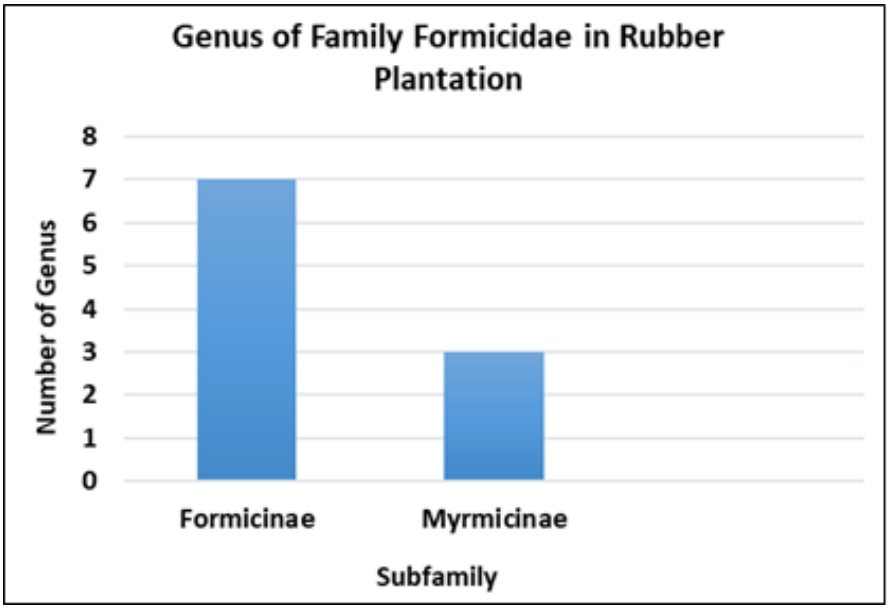
Graph 1: Representation of Species in each Subfamily of Family Formicidae



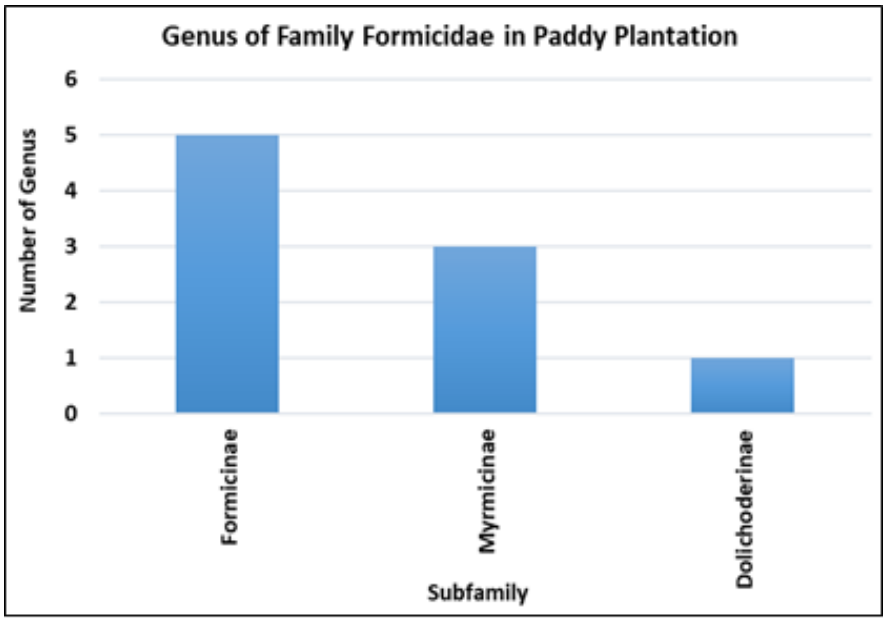
Graph 2: Representation of Genus of Family Formicidae in Arecanut Plantation



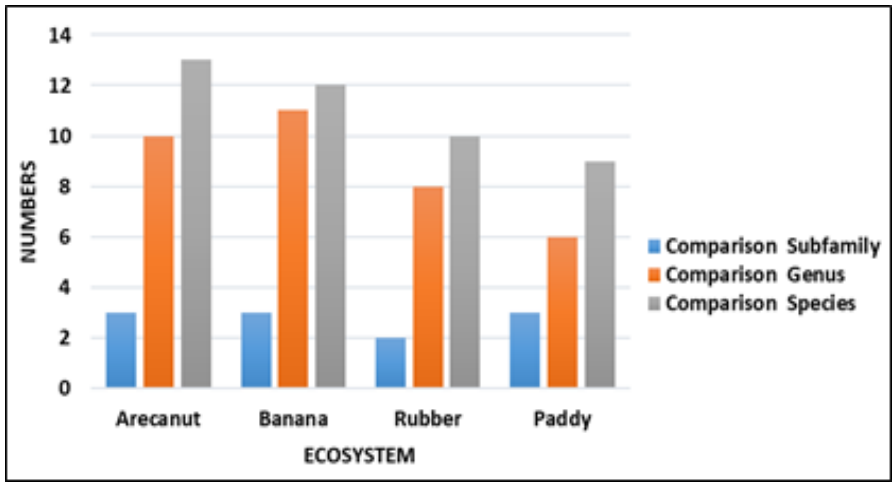
Graph 3: Representation of Genus of Family Formicidae in Banana Plantation



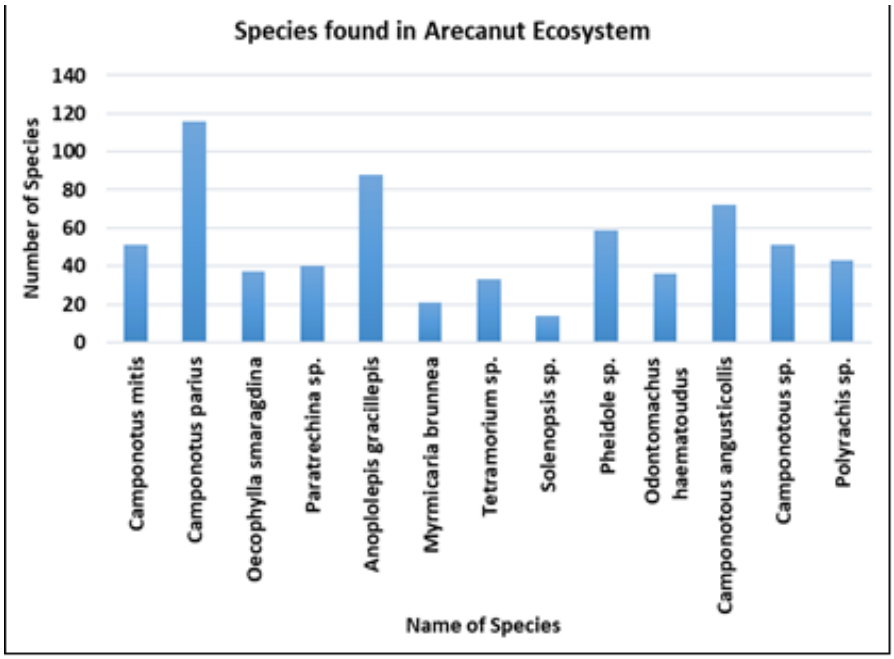
Graph 4: Representation of Genus of Family Formicidae in Rubber Plantation



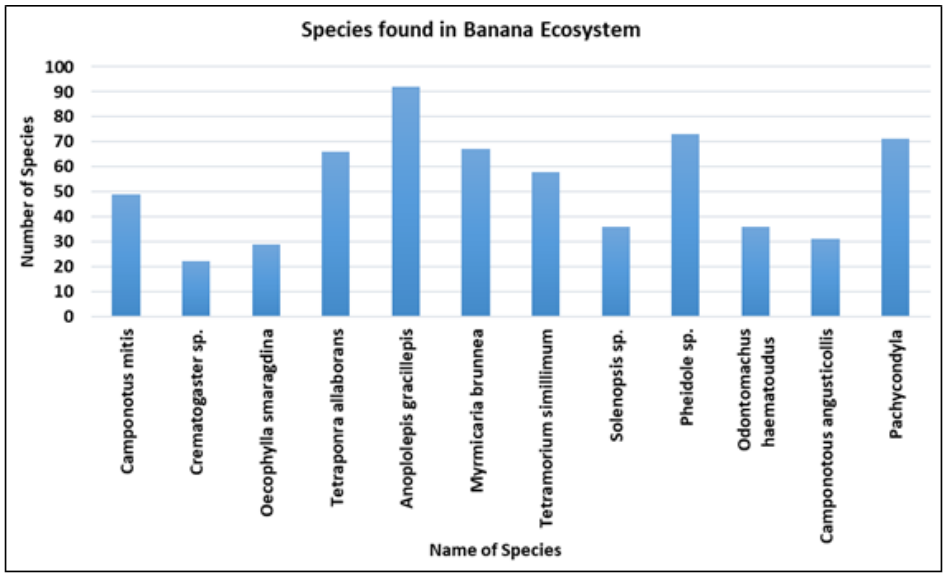
Graph 5: Representation of Genus of Family Formicidae in Paddy Plantation



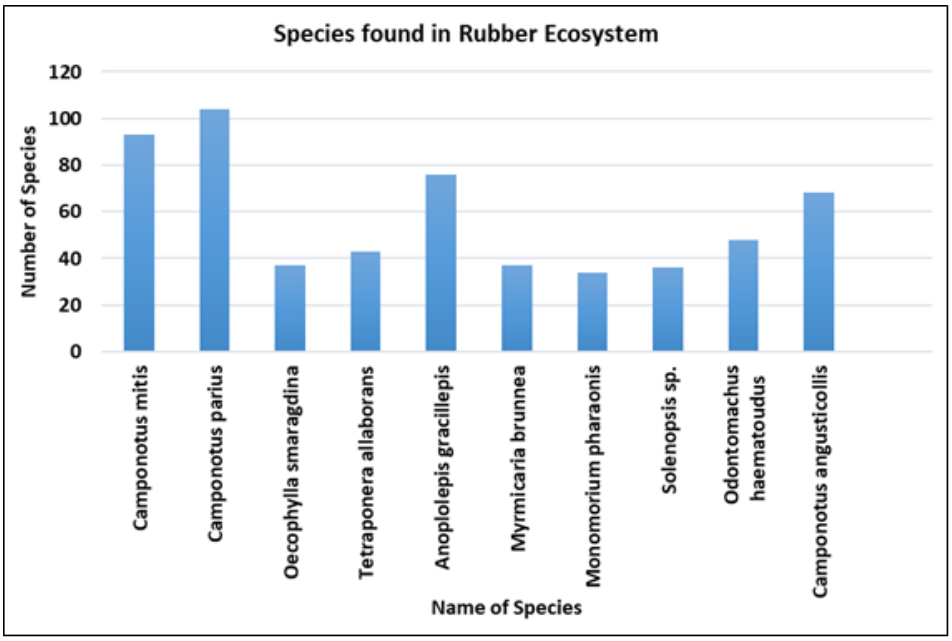
Graph 6: Comparison of Diversity of Family Formicidae in Pulppatta Region



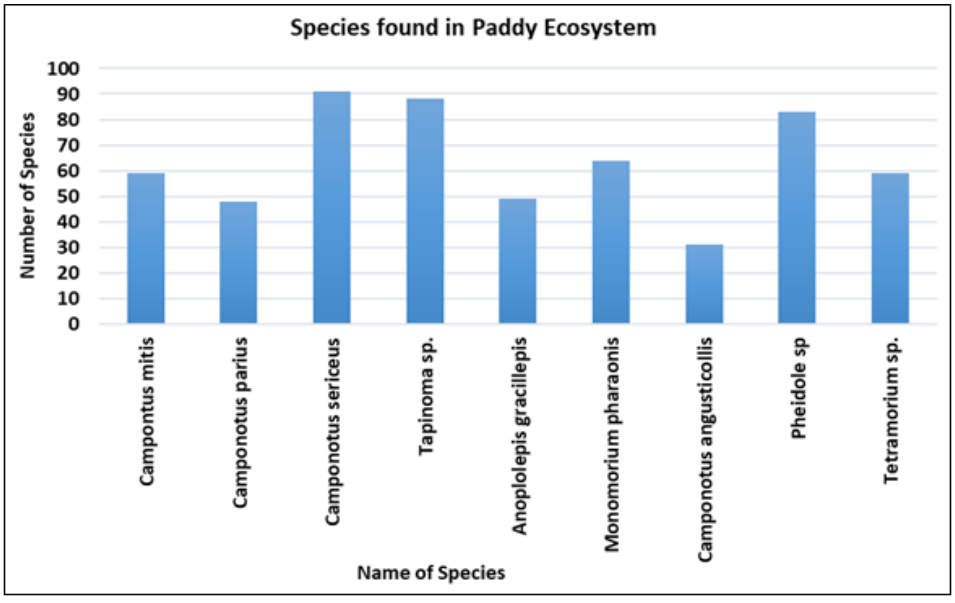
Graph 7: Representation of Genus of the Family Formicidae in Arecanut Ecosystem



Graph 8: Representation of Genus of the Family Formicidae in Banana Ecosystem



Graph 9: Representation of Genus of the Family Formicidae in Rubber Ecosystem



Graph 10: Representation of Genus of the Family Formicidae in Paddy Ecosystem

Conclusion

The Species are highly specific to habitat. During the study period, a total 20 individuals were recorded. Most diverse group belongs to Family Formicinae (45%) with 9 Species, Myrmicinae (35%) were recorded with **7** Species, Ponerinae (10%) with 2 Species, Pseudomyrmecinae (5%) and Dolichoderinae (5%) with 1 Species. Least Species were recorded from the, Pseudomyrmecinae and Dolichoderinae comprising of only 1 Species. Arecanut ecosystem is the richer ecosystem and *Camponotus sp*. are the most abundant species from the study sites. The p study revealed important information about ants and the diversity of ants in the study area, and this will help future researchers studying this group. Future research can build on this information so that research can further classify this group of insect and potentially discover new species in the process.

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