Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(3): 1378-1384

Received: 18-03-2018
Accepted: 22-04-2018

Sornapriya J
Research Scholar, M.Sc Zoology, Department of Zoology, PSG College of arts and Science, Coimbatore, Tamil Nadu, India.

Dr. Varunprasath K
Assistant Professor, Department of Zoology, PSG College of arts and Science, Coimbatore, Tamil Nadu, India

Correspondence
Sornapriya J
Research Scholar, M.Sc Zoology, Department of Zoology, PSG College of arts and Science, Coimbatore, Tamil Nadu, India

Diversity and abundance of Ants in Periyanaickenpalayam village of Coimbatore district, Tamil Nadu

Sornapriya J and Dr. Varunprasath K

Abstract
The study examined the diversity of ants in the Periyanaickenpalayam village, Coimbatore District, Tamil Nadu, as there is no adequate information pertaining on ant diversity of this region. The present study was carried out during November 2017 to February 2018. We have sampled ants by employing intensive all out search method. The sampled specimens representing 35 species belonged to 12 genera and five subfamilies. The most diverse subfamily was Formicinae (4 genera with 16 species), followed by Myrmicinae (5 genera with 12 species), Pseudomyrmicinae (1 genera with 4 species) followed by Dolichoderinae (2 genera with 2 species). The smallest number of species belonged to the Ponerinae (1 genus with 1 species). Among the sampled genera, the highest number of species representation was *Camponotus* with 4 species. Few ant genera as *Crematogaster* and *Pheidole* of *Myrmicinae*, *Camponotus* of *Formicinae and Leptogenys* of *Ponerinae* were mostly found everywhere. Some genera viz; *Oecophylla*, *Anoplopsis*, *Paratrechina* of Formicinae subfamily and *Tetraponera* of Pseudomyrmicinae are represented by one species each.

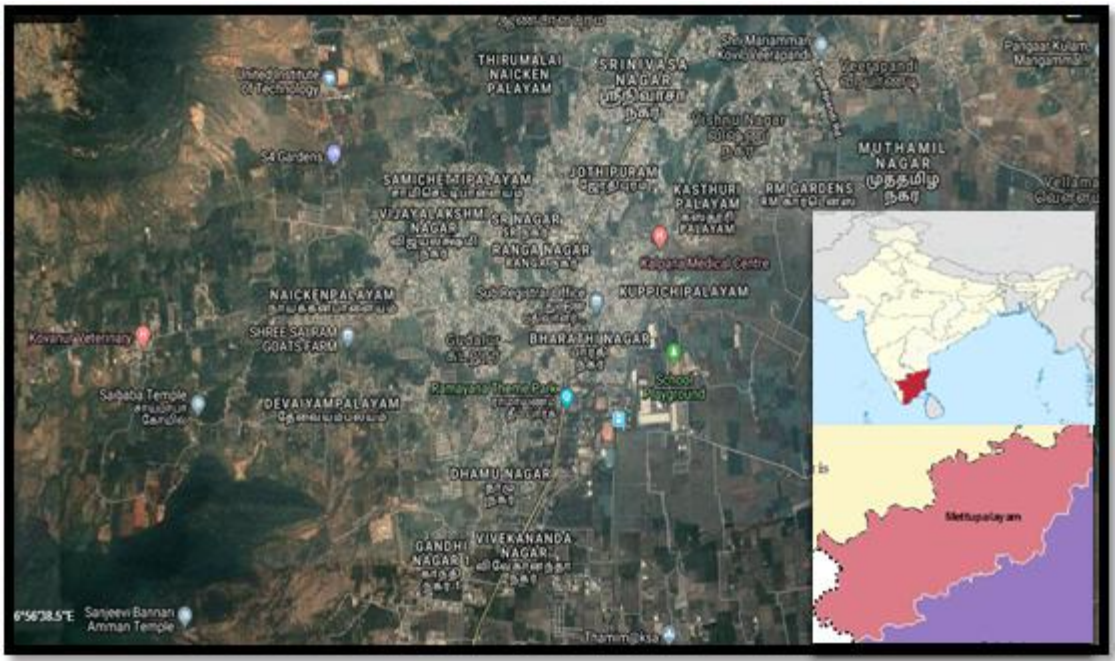
Keywords: Ants, Formicinae, Myrmicinae, Camponotus, Periyanaickenpalayam

1. Introduction
Ants are found everywhere, except in Iceland, green-land and Antarctica, [1]. But the number of species declines with increasing latitude, altitude and aridity [2]. Currently, they are 15,983 extant and species are subspecies as per the recent classification [3]. They are grouped in to 20 subfamilies, with 464 genera. Ants are conspicuous and important parts of virtually all terrestrial ecosystems [1, 4, 5]. Toward understanding the function of ant communities, ecologists have often used single linear measures of size [6].

In India, a few reports on ant ecology Ants diversity exit [7]. A significant focus for present-day myrmecologists is the assessment of biodiversity, community composition, biogeography, and other basic investigations of the ecology of a regional ant biota. The Myrmicinae is the largest subfamily of the Formicinae. With 138 genera followed by Formicinae that have 39 genera and Ponerinae which have 25 genera [8]. Indian ants fauna, represent diversity, includes 12 known subfamilies like; Aenictinae, Amblyoponinae, Cerapachyinae, Dolichoderinae, Dorylinae, Ectatomminae, Formicinae, Leptanillinae, Myrmicinae, Poneriae, Porceratiina and Pseudomyrmicinae. Rothney [9] worked on Indian ants and later on Forel [10] contributed comprehensive work on Formicidae of India and Ceylon. Bingham [11] published his valuable work in *Fauna of British India*, Hymenoptera, and VO'I. 2, including Burma and Ceylon and gave details about distribution of species included. Successive workers like Ali [12], Brown Jr [13], Bolton [14], Baroni Urbani [15], Chapman and Capco [16], Chhotani and Maity [17], Collingwood [18], Dutta and Raychaudhuri [19], Devi and Singh [20], Donisthorpe [21, 22], Ghosh [23], Imai *et al.* [24], JerdO'n [25], Kugler [26], Kurian [27], Karavaiev [28], Mathew and Tiwari [29], Reddy *et al.* [30], Roonwal [31], Ramdas *et al.* [32], Saunders [33], Smith, F. [34], Smith, M. R. [35], Sykes [36], Sheela and Narendran [37], Shivashankar [38], Taylor [39], Tiwari [40], Verghese *et al.* [41], Veeresh *et al.* [42] recorded 12 species under 10 genera from Orissa. No comprehensive work on Ants fauna of Coimbatore has been done since then, except a few scattered works. Recently, these subfamilies Martialinae has been added to the family Formicidae. All the ant species fall into the single family Formicidae. This family included in the super family vesipedae of the order hymenoptera, which is placed in the class insect.

2. Materials and Methods

2.1 Study area



The field work was conducted in the Periyanaickenpalayam village, Coimbatore district, Tamil Nadu. Coimbatore lies at 11°1′6″N, 76°58′21″E, in south India at 411 metres (1349 ft) above sea level on the banks of the Noyil River, in south western Tamil Nadu. The average annual rainfall is around 700 mm (27.6 in) with the northeast and the southwest monsoons contributing to 47% and 28% respectively to the total rainfall. Periyanaickenpalayam is a neighbourhood in Coimbatore in the Indian state of Tamil Nadu. It is located along National Highway NH 67, Mettupalayam road, an arterial road in Coimbatore.

2.2 Collection Method

We employed all out search method for the collection of ants in November 2017 to February 2018. Ants were collected using a brush and forceps during day time in between 11am to 4 pm twice in every month.

2.3 Preservation method

Ant's species were preserved in 70% ethanol in plastic vials at the Department of Zoology, PSG College of arts and science. The stored ant specimens were then counted and identified up to genus level (some to species level) using microscope. Species identification was carried out under the help of the keys of "Ants identification guide" [54], collected ants were identified up to the genus level by using based on literature [29, 14, 11, 1]. Identified specimens will be kept in the air tight insect wooden box. Ant species were listed and each species was counted to calculate and compared composition, richness, species diversity, trees association, habitat type and identification of ants.

2.4 Measurement of diversity

Relative density of the species was calculated by the formula,

Relative Density (%) = (Number of individuals of one species / Number of individuals of all species) X =100.

(SDI), and Shannon-Wiener index. SDI is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. SDI is calculated using the formula,

Where,

$D = \Sigma n (n-1)/ N (N-1)$

n=total number of organisms of a particular species and N=total number of organisms of all species. Subtracting the value of Simpson's index from 1, gives Simpson's Index of Diversity (SID).

Shannon-Wiener index (H') is another diversity index and is given as follows

$H' = -\Sigma Pi \ln (Pi)$,

Where,

Pi=S/N; S=number of individuals of one species, N=total number of all individuals in the sample, ln=logarithm to base e. Dominance index is a measure of how dominants (or similar), (D) follows the formula D=n (100/N), where n=individual number, N=total number of species.

3. Results

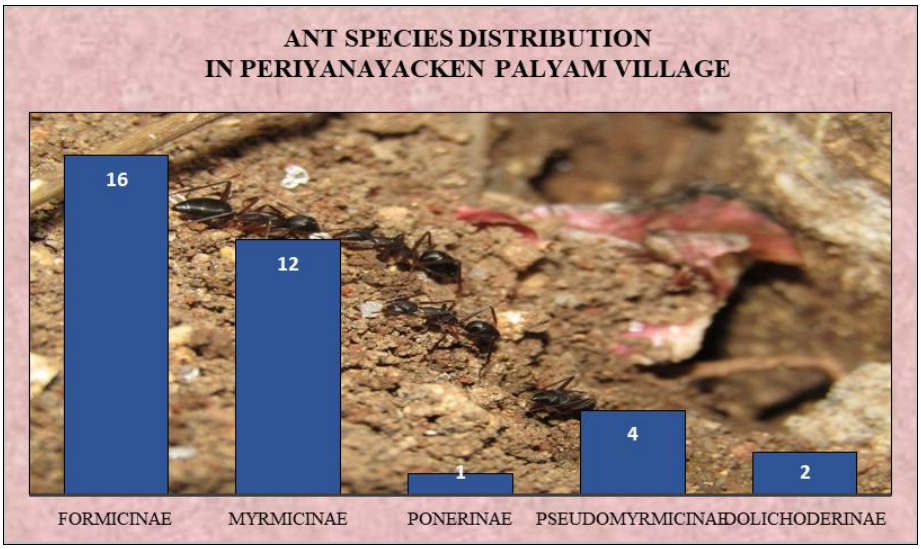
Ant diversity in the Periyanaickenpalayam village, Coimbatore district, Tamil Nadu has been analysed in this study. During this study a total of 35 ant species are belonging to 12 genera and five subfamilies. Subfamily Formicinae were represented by 16 species and 4 genera followed by Myrmicinae were 12 species and 5 genera, Subfamily Pseudomyrmicinae consists of 4 species and 1 genera and Doilchoderinae represented by 2 species and 1 genus. The most number of genus was *Camponotus* with 13 species were observed.

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. 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 35 ant species were recorded in the study area during this study. Among them *Polyrhachis* spp, *Crematogaster* spp, *My*rmicinae, *Pheidole*sp., (Forel 1902), *Leptogenys*sp.3 and *Tetraponera*sp.2 are rarely found the study area are represented in the and listed in Table 3.

Table 1: Showing the list of identified ant species and their distribution in periyanaickenpalayam village, Coimbatore district

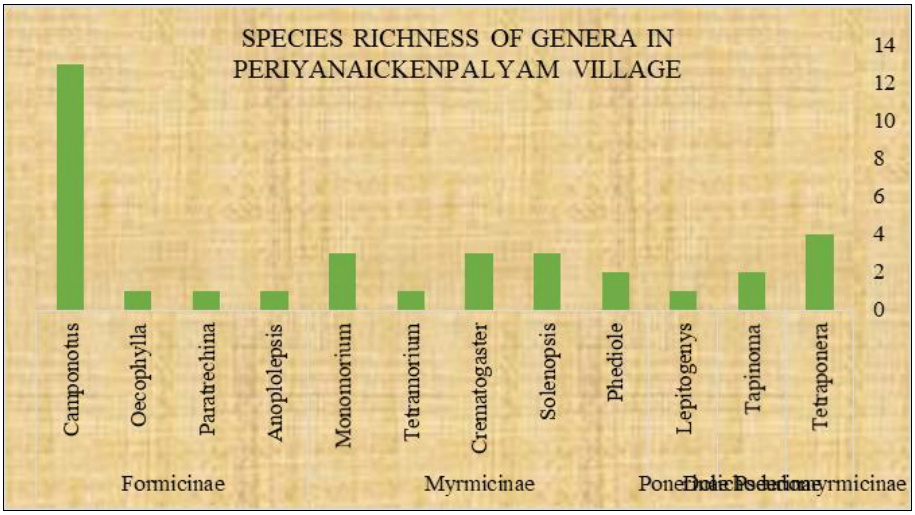
S. No	*Genera*	*Species*	Common Name	Ecological Status
Sub family-Formicinae				
1.	*Camponotus*	*Radiates* Forel,1892	Carpenter ant	Common
2.	*Camponotus*	*Compressus*(Fabricus,1787)	Common Godzilla ant	Common
3.	*Camponotus*	*Irritans (*Smith F(1957)	Giant honey ant	Common
4.	*Camponotus*	*Spe*	Carpenter ant	Common
5.	*Camponotus*	*Spe*	Flying ant	Rare
6.	*Camponotus*	*Parius* (Emery, 1925d)	Shiny black sugar ant	Common
7.	*Camponotus*	*Sericeus* (Fabricus,1789)	Golden backed ant	Common
8.	*Camponotus*	*Maculatus*	Carpenter ant	Common
9.	*Camponotus*	*spe(flying)*	Flying ant	Rare
10.	*Camponotus*	*Fabricius* (Fabricus,)	Carpenter ant	Common
11.	*Camponotus*	*Spe*	Carpenter ant	Rare
12.	*oecophylla*	*Smargdina* (Fabricus, 1775)	Weaver ant	Common
13.	*Anoplolepis*	*Gracillipes* (smith)	Yellow crazy ant	Common
14.	*Paratrechina*	*Logicornis* (Latreille, 1802)	Crazy ant	Common
15.	*Camponotus*	*Spe*	Flying ant	Rare
16.	*Camponotus*	*Spe*	Flying ant	Rare
Sub family-Myrmicinae				
17.	*Monomorium*	*Minimum* (Buckely, 1867)	Little black ant	Common
18.	*Monomorium*	*Pharaonis* (Linnaeus, 1758)	Pharaoh ant	Common
19.	*Monomorium*	*Destructor* (Jerdon,)	carpenter ant	Common
20.	*Tetramorium*	*Spe*	carpenter ant	Common
21.	*Crematogaster*	*Spe*	Acrobat ant	Common
22.	*Crematogaster*	*Subnuda*(Mayr,1879)	Carpenter ant	Common
23.	*Crematogaster*	*Spe*	Carpenter ant	Common
24.	*Solenopsis*	*Invicta* (Burren, 1972)	Red imported fire ant	Common
25.	*Solenopsis*	*Germinate* (Fabricus, 1804)	Fire ant	Common
26.	*Solenopsis*	*Diplorhoptom* (Mayr 1855)	Thief ant	Rare
27.	*Phediole*	*Spe*	Big headed ant	Rare
28.	*Phediole*	*Magacephala* (Fabricus)	African bigheaded ant	Rare
Sub family-Ponerinae				
29.	*Lepitogenys*	*Processionalis*(Jerdon,1851)	Procession ant	Rare
Sub family-Dolichoderinae				
30.	*Tapinoma*	*Indicum (*Forel, 1895)	Ghost ant	Common
31.	*Tapinoma*	*Sessile* (Say, 1836)	Odour ant	Common
Sub family-Pseudomyrmicinae				
32.	*Tetraponera*	*Nigra* (jerdon,)	Ant	
33.	*Tetraponera*	*nigra(male)* (Jerdon, 1851)	Ant	
34.	*Tetraponera*	*Rufonigra* (Jerdon, 1851)	Arboreal bicoloured ant	Common
35.	*Tetraponera*	*Allaborans* (walker,1859)	Polished leaf border ant	Common



Graph 1: Showing the species distribution in periyanaickenpalayam village, coimbatore district.

Table 2: Species richness of genera in Periyanaickenpalayam village, coimbatore district

Subfamily	*Genera*	Number of Species	Relative abundance %	H	D
Formicinae	*Camponotus*	13	37.14	0.36786	7.2496
	Oecophylla	1	2.85	0.10012	1282.05
	Paratrechina	1	2.85	0.10012	1282.05
	Anoplolepis	1	2.85	0.10012	1282.05
Myrmicinae	*Monomorium*	3	8.57	0.21055	136.239
	Tetramorium	1	2.85	0.10012	1282.05
	Crematogaster	3	8.57	0.21055	136.239
	Solenopsis	3	8.57	0.21055	136.239
	Phediole	2	5.71	0.02949	306.74
Ponerinae	*Lepitogenys*	1	2.85	0.10012	1282.05
Dolichoderinae	*Tapinoma*	2	5.71	0.0249	306.74
Pseudomyrmicinae	*Tetraponera*	4	11.42	0.24779	76.923
Total	12	35			



Graph 2: Species richness of genera in Periyanaickenpalayam village, Coimbatore district.

4. Discussion

In the present study, 35 species of ants in 12 genera representing five subfamilies namely Formicinae, Myrmicinae, Ponerinae, Dolichoderinae and Pseudomyrmicinae were recorded. Out of five subfamily, Formicinae is the most abundant having 16 species in 3 genera. This subfamily is widely distributed in all geographic regions. This correlated with the present study, because, we similarly collected the utmost number of ant species from Formicinae subfamily in Periyanaickenpalayam village.

The Formicinae and Myrmicinae are the largest ant subfamilies in the world and the dominant groups in most terrestrial habitats. The prevalence of these subfamilies has been reported to increase with increasing aridity [44, 45]. 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 show a significant difference between the seasons. Humidity may influence the 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" [46].

The subfamily Myrmicinae, having 12 species in five genera, subfamily Dolichoderinae and Pseudomyrmicinae were recorded only the one genera for each with two and four species respectively, while the subfamily Ponerinae subfamily were one genera and one species reported in Periyanaickenpalayam village. Overall abundance pattern in different sites varied considerably due to their habitat - heterogeneity and species composition. This was evident in certain sampling sites 1, 11 and 14 were common species viz., *Dolichoderinae*, *Camponotus* variegates, *Myrmicaria brunnea*, *Pheidole spp* dominated. As observed by many workers [47] species abundance pattern indicated a relatively small proportion of abundant species against large number of rare species.

Secondly, the subfamilies such as Myrmicinae, Ponerinae, Formicinae were dominant. As observed by many workers [48] species abundance pattern indicated a relatively small proportion of abundant species against large number of rare species. Species richness is typically recorded to change across tropical forest disturbance gradients [49-51]. In Periyanaickenpalayam village, four types of habitats were survey to find out the suitable area for ant species. Ant species abundant and equal in concrete, and footpaths habitat, and agriculture area.

Few ant genera as *Crematogaster* with most abundant record of seven species and genera *Aphaenogaster*, *Myrmicaria* and *Monomorium* of Myrmicinae, *Camponotus* and *Polyrchis* of Formicinae and *Leptogenys* of Ponerinae are mostly found everywhere, commonly found in all the habitats and most localities. The workers of *L. umbratus* live entirely subterranean in symbiosis with root aphids [52] and S. debile forages mostly underground or in the litter layer with a small home range [53]. Subfamily Formicinae under genera *Camponotus, spp* which contains 37.14%, *Oecophylla, spp* which contains 2.85%, *Paratrechina spp* among with 2.85% and *Anoplolepis spp* contains 2.85%. In Formicinae subfamily, genera *Camponotus* was maximum in

Periyanaickenpalayam village followed by Myrmicinae subfamily into five genera including *Monomorium spp* with 8.57%, *Tetramorium spp* with 2.85%, *crematogaster spp* consists of 8.57%, *Solenopsisspp* with 8.57% and *phediole spp* with consists of 5.27%. In Dolichoderinae and Pseudomyrmicinae subfamily, genera were *tapinoma spp* with 5.71% and *tetraponera* constitute 11.42%. *Tetramoriumspp*, *Lepidogenys spp* also noted in minimum level. During comparison of *tapinoma and tetraponera* species *tetraponera* species were rich in Periyanaickenpalayam village. Ponerinae subfamily, genera *lepidogenys spp* which contains 2.85% were observed during the present study.

5. Conclusion

The present investigation on diversity of ants in the Periyanaickenpalayam village, Coimbatore district clearly indicated that the richness of ants fauna in the city. The present study showed that the 35 species of ants belonging under the 5 subfamilies and 12 genera of Ants species and also large number of *Camponotus and monomorium genera* were observed in Periyanaickenpalayam village.

Plate 1: 1. *Componotus radiates*, 2. *Componotuscompressus*, 3. *Componotus irritans*, 4. *Componotus species*, 5. *Componotus parius*, *6. Componotus species*, 7. *Componotus sericeus*, *8. Componotus maculatus*, 9. *Componotus species (queen flying spe)*, 10. *Componotusfabricius*, 11. *Componotus species*, 12. *Oecophyllas maragidina*, 13. *Anoplolepis gracillipes*, 14. *Paratrechina logicornis*, 15. *Camponotusspe (flying ant)*, 16. *Monomorium minimum*, 17. *Monomorium pharaonis*, 18. *Componotus spp*, 19. *Monomorium destructor*, *20. Tetramorium spe*, 21. *Crematogaster spp*, 22. *Crematogaster subnuda*, 23. *Crematogaster spp*, 24. *Solenopsis invicta*

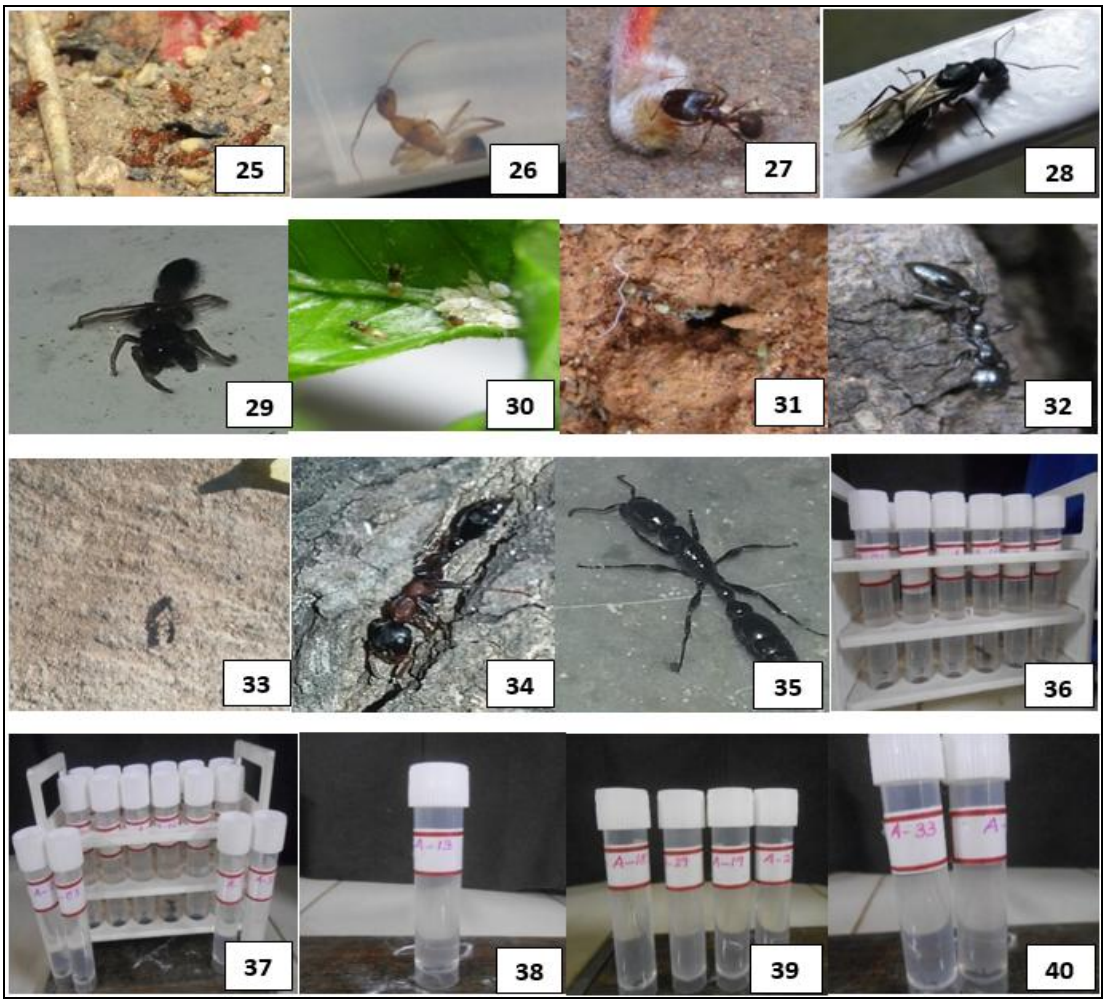


Plate 2: 25. *Solenopsis germinata,* 26. *Solenopsis diplorhoptom,* 27. *Phediole spp,* 28. *Phediole megacephala,* 29. *Lepitogenys processionalis,* 30. *Tapinoma indicum,* 31. *Tapinoma sessile,* 32. *Tetraponera nigra,* 33. *Tetraponeranigra (male), 34. Tetraponera rufonigra,* 35. *Tetraponera allaborans,* 36. Subfamily Formicinae 37. Subfamily Myrmicinae, 38. Subfamily Ponerinae, 39. Subfamily Pseudomyrmicinae, 40. Subfamily Dolichoderinae

6. References

1. Holldobler B, Wilson EO. The Ants. Harvard University Press Cambridge, Massachusetts, 1990.
2. Kusnezov A, Tscharntke T. Habitat fragmentation species loss and biological control Science (Washington). 1994; 264(5165):1581-1584.
3. Ant web. https://www.antweb.org/world.jsp, 06 January, 2012.
4. Andersen AN. Parallels between ants and plants: implications for community ecology Ant–Plant Interactions (ed. by C. R. Huxley and D. F. Cutler) Oxford University Press Oxford, 1991, 539-553.
5. Kaspari M, Majer JD. Using Ants to Monitor Environmental Change, In: Agosti, D., Majer, J.D., Alonso, L.E. & Schultz, T.R. (eds.). Ants: Standard Methods for Measuring and Monitoring Biodiversity, Washington, Biological Diversity Handbook Series, Smithsonian Institution Press, 2003; 280:89-98.
6. Cushman JH, Lawton JH, Manly BFJ. Latitudinal patterns in European ant assemblages: variation in species richness and body size Oecologia. 1993; 95:30-37.
7. Gunawardene NR, Daniels AE, Dulip G, Springer-Verlag, Gunatilleke CV, Karunakaran PV *et al*. Ants in Mallis A.(Ed.) overview of the Western Ghats-Sri Lanka Handbook of pest control, The behavioour, life biodiversity hotspot, Current Sci. 1997; 93(11):1567-1572.
8. Samson DA, Rickart EA, Gonzales PC. Ant diversity and abundance along an elevational gradient in the Phillippines, Biotropica, 1997; 29:349-363.
9. Rothney GAJ. The aculeate Hymenoptera of Barrackpore, Bengal, Trans. Entomol. Soc. London, 1903, 93-116.
10. Forel A. Quelques Fourmis des Indes, du Japan etd' Afrique Rev. Suisse Zool. 1913; 21:659-673.
11. Bingham CT. The Fauna of British India including Ceylon and Burma Hymenoptera, Ants and Cuckoo-wasps London Taylor and Francis. 1903; 2:1-506.
12. Ali TMM. Ant fauna (Hymenoptera: Fonnicidae) of Bangalore with observations on their nesting and foraging habit M.Sc Thesis ISA Bangalore, 1981, 208.
13. Brown WL Jr. *Neoclystopsenella* (Bethylidae) a synonym of Tapinoma (Formicidae) Psyche, 1988; 94:337.
14. Bolton B. A new general catalogue oj' the ants 0. (The world, Cambridge, Mass: Harvard University Press, 1995b, 11-504.
15. Baroni Urbani C. Ergebnisse der Bhutan Expedition des Naturhistorischen MUSeUlTI in Basel Hymenoptera: Fam. Fonnici Fonnicidae Genus *Stenamma*, Con unanuova species Del Kashmir Entomology. Base. 1972-1977c; 2:415-422.
16. Chapman JW, Capco SR. Checklist of the ants (Hymenoptera: Formicidae) of Asia Mongr. Inst. Sci. Tech. Manila, 1951; 1:1-327.
17. Chhotani OB, Maiti PK. Contribution to the knowledge of Formicidae of the Andaman Islands (Abstract) Proc. Indian. Sci. Congr. 1970, 57-438.

18. Collingwood CA. Himalayan ants of genus *Lasius* (Hymenoptera: Formicidae) Syst. Entomot. 1982; 7:283-296.
19. Dutta SK, Raychaudhuri D. Taxonomy of aphidocolous ants (Hymenoptera: Fonnicidae) of Sikkim and hilly areas of West Bengal (1) subfamily: MyrmicinaeAKITU N Ser, 1983; 56:1-14.
20. Devi CM, Singh TK. Aphidocolous ants (Hymenoptera: Fonnicidae) in Manipur. Journal Entomology. 1987; 12(4):309-313.
21. Donisthorpe H. A new species of *Acanthomyops* (Hymenoptera: Fonnicidae) from Kashmir Ann. Mag, Nat. Hist. 1930; 10 (6):225-226.
22. Donisthorpe H. Ants from the Colombo Museum Expedition to Southern India Sept.-Oct 1938 Ann. Mag, Nat. Hist London, 1943; (11)10:196-208.
23. Ghosh SN, Chattopadyyay A, Bhattacharyya DK. Population abundance, seasonal fluctuation of ants (Hymenoptera: Formicidae) in automobile exhaust fed road side soil of Calcutta Rec. Zool. Surv. India. 1999; 97(2):139-148.
24. Imai HT *et al*. Karyological survey of Indian ants Jpn. J Genet, 1984; 59:1-32.
25. Jerdon TC. Untitled. Introduced by reliable information has at last been supplied by Dr. Jerdon regarding workers of one of the Indian species of Dorylus J. Asiat. Soc. Bengal, Part II Phys. Sci. 1865b; 34:189-190.
26. Kugler J. The *Leptanillinae* (Hymenoptera-Formicidae) of Israel and a description of a new species from India Isr. J Entomology, 1987; 20:45-57.
27. Kurian C. Bethyloidea (Hymenoptera) from India, Agra Univ. J Res. 1955; 4:67-155.
28. Karavaiev W. Ameisenausdem Indo-AustralischenGebiet IV Uber Ameisennester, hauptsachlinch von Polyrhachis Arten. Trav. Mus. Zool Kieff. 1928; 5:3-24.
29. Mathew R, Tiwari RN. Insecta: Hymenoptera: Formicidae. Zool. Surv. India Fauna of Meghalaya, State Fauna Series, 2000, 4.
30. Reddy DNR, Viswanath BN, Belavadi VVA. Preliminary study of ant fauna of Bisthenhatti, Dharwad In G. K. Veeresh (eds) Progress in soil Biology and Ecology in India, U.S.A 1981b; 37:200-205.
31. Roonwal ML. Plant pest status of root eating ant Dorylusorientalis, with notes on Taxonomy, distribution and habits (Insecta: Hymenoptera) Bomb. Nat. Hist. Soc. 1975; 72:305-313.
32. Ramdas Menon, Panjabo GM. Some observations and new records of ants from Delhi Indian 1. Entoln. 1961-07; 22:133-135.
33. Saunders WW. Description of two Hymenopterous insects from Northern India Trans. Entomol Soc. Lond. 1842; 3:57-58.
34. Smith F. Scientific results of the second yark and Mission; based upon the collections and notes of the Late Ferdin and Stoliczka, Ph.D Hymenoptera Calcutta superindent of Government printing (Government of India), 1878, 22.
35. Smith MR. A new genus and species of ant from India (Hymenoptera: Formicidae J.N.Y. Enlomol. Soc. 1949; 56:205-208.
36. Sykes WH. Description of new species of Indian ants Trans. Enlomol. Soc. Lond, 1835, 99-107.
37. Sheela S, Narendran TC. On five new species of *Tetramorium* (Hymenoptera: Formicidae: Myrmicinae) from India Entomology. 1998b; 23(1):37-44.
38. Shivashankar T. Studies on the ecology and foraging behaviour of *Leplogenysprocessionalis* Jerdon, (Hymenoptera: Fonnicidae) M.Sc. thesis UAS Bangalore, 1985, 97.
39. Taylor RW. Notes on the Indo-Australian basicerotine ants (Hymenoptera: Formicidae) Ausl. J Zool. 19681; 6:333-348.
40. Tiwari RN, Kundu BG, Sheela S, Ghosh SN. Insecta: Hymenoptera: Formicidae Zool. Surv. India, State Fauna Series 10: Fauna of Manipur. 2001b; 1:1-23. (In Press).
41. Verghese A, Veeresh OK. Ants of India-a brief review In C. A. Edwards and '0. K. Veeresh (eds.) Sent Biology and Ecology in India US.A. Tech. ser. No. 1981; 22:172-181.
42. Veeresh GK, Musthak Ali TM. The present status of our knowledge on Indian ants In G. K. Veeresh, A. R. V. Kumar and T. Shivashankar (eds.) social Insects An Indian Perspective Publ. IUSSI-Indian Chapter, UAS Bangalore, 1990, 231.
43. Rabeling CJM, Brown M. Newly discovered sister lineage sheds light on Press. Early ant evolution" Verhaagh, Genera of World. Cambridge: Harvard University Bingham, C.T., 1903. Fauna of British India, Ant Taylor Francis, London, Vol. II. i:10.1073/pnas.0806187105. PMID 18794530, 2008, 106.
44. Marsh AC. Ant species richness along a climatic gradient in the Namib Desert Journal of Arid Environments, 1986; 11: 235-241.
45. Lindsey PA, Skinner JD. Ant composition and activity patterns as determined by pitfall trapping and other methods in three habitats in the semi-arid Karoo Journal of Arid Environments. 2001; 48:551-568.
46. Chavhan A, Pawar SS. Distribution and Diversity of ant species in and around Amravati city of Maharashtra, India. 2011, 395-400.
47. Malsch A. Investigation of the diversity olbaf' litter inhabiting ants in Pasoh Malaysia. ln: Agosti' D., Majer, J. D., Alonso, L. and Schultz, T. (eds.) Sampling Ground-dwelling Ants, Case Studies from the World's Rain Forests. Curtin School of Environmental Biology Bulletin, Perth' Australia, 2007, 31-40.
48. Ramesh T. Biodiversity Abundance and documentation of ants in Alagar Hills, Madurai Tamil Nadu, India M.Phil thesis submitted to Madurai Kamaraj Universi$, Madurai, 2007.
49. Fayle TM, Turner EC, Snaddon JL, Chey VK, Chung AC, Eggleton P *et al*. Oil palm expansion into rain forest greatly reduces ant biodiversity in canopy, epiphytes and leaf-litter Basic and Applied Ecology. 2010; 11:337-345.
50. Folgarait PJ. Ant biodiversity and its relationship ecosystem functioning: review Biodiversity conservation, 2005.
51. Bruhl C, Eltz T. Fuelling the biodiversity crisis species loss of ground-dwelling forest ants in oil palm plantations in Sabah, Malaysia (Borneo) Biodiversity and Conservation. 2010; 19:519-529.
52. Czechowski W, Rotkiewicz W. Common activities of female sexuals of *Lasius umbratus* (Nyl.) and *Formica sanguinea* Latr or *Polyergus rufescensann* Zool. 1997; 47:465-467.
53. Buschinger A. Stenammadebile (Hymenoptera, Formicidae) Facultative polygyny and an extreme 1997 sex ratio Insect. Soc, 1999; 46:53-57.
54. Bayer. Ant identification guide, Bayer environmental science, 2010.