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DIVERSITY OF ANT FAUNA IN 30 KM RADIUS OF KUDANKULAM NUCLEAR POWER PLANT AREA, TAMIL NADU, INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A detailed study on the ground dwelling ant diversity was carried around 30 km radius of Kudankulam Nuclear Power Plant area, Tamil Nadu, India during 2011-2012. Pit-fall trap, bait trap and hand-picking methods were used to collect ants from core Zone, buffer Zone I and Buffer zone II and three habitat (sandy area, garden area and plain area), in a sampling sites. A total of 33 species, 18 genera, and 5 subfamilies of ants were recorded. The Formicinae were the most common, with 7 genera and 15 species, followed by the Myrmicinae (6 genera and 10 species), the Ponerinae (4 genera and 5 species) and the Pseudomyrmecinae was represented by only 1 Genera species and 3 species. The six most species rich genera were Camponotus, Paratrechina, Monomorium, Tetraponera, Pheidole and Leptogenys. Higher species abundance is due to the habitat heterogeneity is an important factor to determine the species distribution in the study area. Conservationists should take consider to conserve the ant fauna diversity for there are many direct and indirect contribution on earth.

Keywords: Diversity; kudankulam; pit-fall trap; abundance, conservation.

1. INTRODUCTION

"Biodiversity conservation is an applied science which involves several approaches to avoid species extinction and protect environment" [1]. "Conservation in a protected area forms an integral component of assessing their performance and providing the necessary information for effective management. Biodiversity is intrinsically valuable as a means of improving, understanding the structure and

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functioning of ecological communities" [2]. "Invertebrates constitute a significant proportion of terrestrial biodiversity" [3]. "Invertebrates are also useful, appropriate and often highly effective and informative indicators of biodiversity, ecosystem function, restoration, health and other associated threats" [4]. "Insects are particularly useful in the evaluation of biodiversity, particularly the ants have been used extensively as indicators of disturbance" [5].

"Ants are one of the most abundant insect groups and constituting 10–15% of the animal biomass" [6] and "most diverse and ubiquitous groups of the social insect" [7]. "It is one of the important part of ecosystems not only as they constitute a great role of the animal biomass but also because they act as ecosystem engineers" [8]. Ant species diversity can be used as indicators to environmental changes [9]. Ants are easy to sample, high biomass, diversity [10] abundant, easily found and consistently monitored [11,12]

"Biodiversity, distribution and ecology of ant species is still insufficient and very little information is available in India. Over the past decade, the inclusion of terrestrial invertebrates in biodiversity inventory and environmental assessment surveys has increased rapidly" [13]. However, there are some regional studies on ants which contribute to the understanding of species diversity of campus, cites and conservation areas of different biogeographic region in India [14,15].

The present study explore the inventory of ants and to provide a baseline for further research on seasonal patterns of diversity, various habitat-ant interaction and different zone- ant interaction in 30Km radius of Kudankulam Nuclear power plant area.

2. MATERIALS AND METHODS

2.1 Study Area

Ant specimens were collected from 30km radius of Kudankualm Nuclear Power plant area Fig. 1. The study area encompasses three different habitat (sandy area, garden area and plain area), three zones (core zone-from KKNPP site to 5KM radius, buffer zone 5-10KM radius and buffer zone II- 10-15KM radius) and four different season (North East Monsoon, South west Monsoon, Summer and Winter) during season (June 2011 to October 2012). Standard methods such as pitfall traps were used [8]. The hand-picking collection two observers walked randomly in transects line. The baiting trap consisted of a approximately 2 cm square of biscuits dipped with jaggery solution were deposited randomly. All the ants present on the trap after the 1hrs duration were captured and preserved for identification. Hand picking and bait trap methods were also used to collect qualitatively to cover overall species spectrum are not used to estimate the abundance, the collected specimens are not used for quantitative analysis. 15 pit-fall traps were installed in a straight transect line with each trap approximately 10mtrs apart. Pitfall trapping method permits foraging workers to be captured and provides information on the diversity and density of species present in the sampling area. The trap consisted of a 300ml of plastic jar with an opening of 6 cm in diameter and placed at ground level. Each jar contains 20 ml of 0.05% of methyl parathion and were collected on the next day evening. The insect trapped in the jars was preserved in labelled bottle of 90% alcohol. In handpicking collection, observer walked randomly around each location and the effort involved in this was kept consistent. No attempt was made to estimate abundance by this method. Collected ant specimens were identified using standard manuals. The interpretation of data was carried out to assess the relative abundance, species richness and rank abundance using statistical package, Biodiversity Pro Version 2 [16].

3. RESULTS AND DISCUSSION

Total of 33 species, twenty three species are identified species level and ten species from genus level in three habitats (sandy area, garden area and plain area) and three different zones like core Zone, buffer Zone I and Buffer zone II. *Camponotus* showed highest general record followed by *Paratrechina*, *Monomorium*, *Pheidole* and *Tetraponera* (Table 1). The results highlighted that the diversity of the keystone ant fauna in 30 Km Radius of Kudankulam Nuclear.

Power Plant relatively high species (33 species and 18 genera) due to the different habitats present in the study area. The same pattern showed that, Ribas and Schoereder [17] reported due to habitat heterogeneity is an important factor in determining ant species distribution. The high ant species diversity were recorded due to the biomass dominance in terrestrial habitat [18]. "The overall species number as compared to that of other regions of Tamil Nadu with a similar sampling effort and methodology. A total of 25 species and 14 genera recorded" by Rajagobal et al [19]. Atomic Energy Campus Kalpakkam, South India showed, 31 species and 15 genera were recorded [14,15]. Urban area of Mumbai, Maharastra showed 28 species and 6 sub family. The rural area showed that 35 species belonged to 12 genera [20]. The species abundance could possibly result from interactions existing between the ant fauna of the

surrounding vegetation, environmental variation like temperature in particular and associated fauna present at that specific geographical location. The Seasonal patterns of diversity and phonological ranges in ants are also play a main role in activity periods of ants.

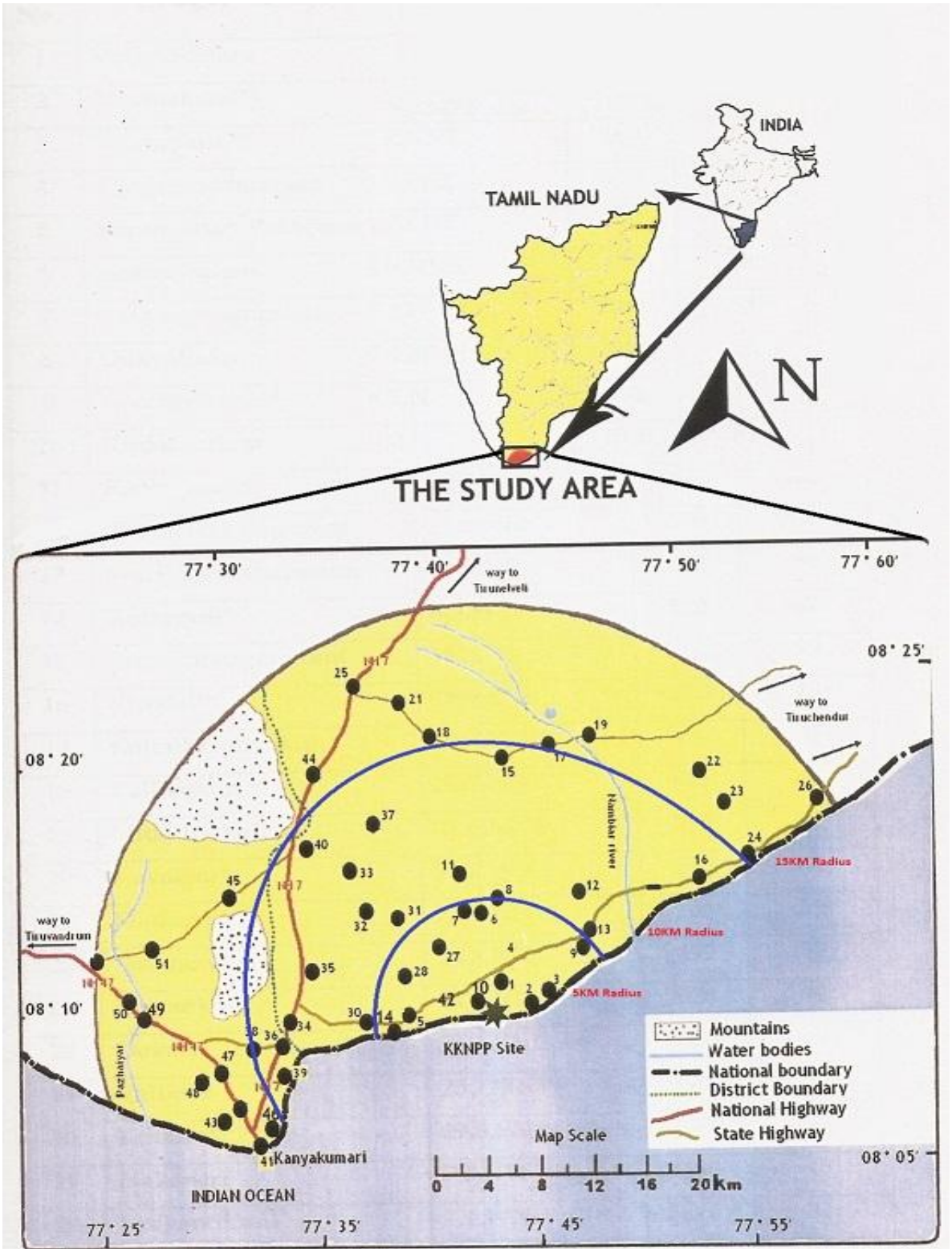

Fig. 1. Map showing 30KM radius of KKNPP and different zonal sampling sites

Table 1. List of ant species in 30KM radius of Kudankulam Nuclear Power Project area

S. No	Sub Family	Genera	Species
1	Formicinae	*Aenictus*	*aratus* (Forel,1900)
2		*Anoplolepis*	*gracilipes* (Smith, 1857)
3		*Camponotus*	*compressus* (Fabricius, 1787)
4		*Camponotus*	*rufoglaucus* (Jerdon,1851)
5		*Camponotus*	*sericeus* (Mayr, 1879)
6		*Camponotus*	Sp. 1
7		*Camponotus*	Sp. 2
8		*Camponotus*	*variegates* (Emery, 1889)
9		*Componotus*	*parius* (Emery, 1877)
10		*Oecophylla*	*smaragdina* (Fabricius, 1775)
11		*Paratrechina*	*longicornis* (Motschulsky, 1863)
12		*Paratrechina*	Sp. 1
13		*Paratrechina*	Sp. 2
14		*Plagiolepis*	*longipes* (Latreille, 1802)
15		*Pseudomyrmex*	Sp. 1
16	Myrmicinae	*Crematogaster*	*rogenhoferi* (Mayr, 1879)
17		*Meranoplus*	*bicolour* (Guerin- Meneville,1884)
18		*Monomorium*	*pharaonis* (Linnaeus, 1758)
19		*Monomorium*	Sp. 1
20		*Monomorium*	Sp. 2
21		*Pheidole*	Sp. 1
22		*Pheidole*	Sp. 2
23		*Pheidole*	Sp. 3
24		*Pheidologeton*	*affinis* (Jerdon, 1851)
25		*Solenopsis*	*geminata* (Fabricius, 1808)
26	Ponerinae	*Diacamma*	*rugosum rugosum* (Leguilou, 1842)
27		*Herpegnathos*	*saltator* (Jerdon, 1851)
28		*Leptogenys*	*chinensis* (Mayr, 1870)
29		*Leptogenys*	*diminuta* (Forel,1900)
30		*Pachycondyla*	*tesserinoda* (Emery, 1877)
31	Pseudomyrmicinae	*Tetraponera*	*allaborans* (Walker,1857)
32		*Tetraponera*	*nigra* (Fabricius, 1804)
33		*Tetraponera*	*rufonigra* (Jerdon, 1851)

Table 2. The relative abundance of ant in a species, genera and individuals level

Sub Family	Genera		Species		Individuals	
	Number	%	Number	%	Number	%
Formicinae	7	38.88	15	42.46	1269	33.20
Myrmicinae	6	33.33	10	33.31	2369	61.98
Ponerinae	4	22.23	5	15.15	117	3.06
Pseudomyrmicinae	1	5.56	3	9.09	67	1.75
Total	**18**	**100**	**33**	**100**	**3822**	**100**

The relative abundance values suggest a great dominance exhibited by the family Myrmicinae. The Formicinae and Myrmicinae are the largest ant subfamilies followed by Ponerinae and *Pseudomyrmicinae*. The Formicinae were the most abundant in the study area. The extreme dominance exhibited by Formicinae sub family with seven species and Myrmicinae showed six species in this study. Interestingly, relative abundance of Myrmicinae showed higher individuals 2369 (33.20 followed by Formicinae 1269 (33.20%), Ponerinae 117 (3.06%) and Pseudomyrmicinae 67 (1.75%). The relative abundance of Formicinae showed higher species 15 (42.46%) followed by Myrmicinae 10 (33.31%), Ponerinae 5 (15.15%) and Pseudomyrmicinae 3 (9.09%) Table 2. A total of 33 species, 18 genera, and 4 subfamilies of ants were recorded. The Formicinae were the most common, with 7 genera and 15 species, followed by the Myrmicinae (6 genera and 10 species), the Ponerinae

(4 genera and 5 species) and the Pseudomyrmicinae (1 genus, 3 species). The relative abundance of recorded genera species and individuals belonged to three subfamilies like Formicinae, Myrmicinae and Ponerinae showed 94.44%, 90.92 and 98.24% respectively. The other state of India showed higher number of individuals of different ecological habitat in semi arid areas for about 40 species 25 genera [21]; "Whereas comparatively high diversity was reported from western Ghats in 173 species belonging to 65 genera" [22]. A total of 84 species representing 31 genera were recorded in Sharavathi River Basin, Central Western Ghats [23].

"The Myrmicinae and Formicinae are the largest ant family and the dominant and group in the most terrestrial habitats" [24]. The similar pattern observation that Formicinae, Myrmicinae and Ponerinae were the most species rich subfamilies [8 and 25]. The high proportion of Myrmicinae species found in South East Asian leaf litter ant communities [26]. Myrmicinae is widely distributed in all geographical regions [27]. Associations between ant species and particular habitat types are poorly know for many ecoregions and the several studies have investigated the relationship between the habitats [28], abiotic factors [29], The greatest number ants in the study area might be the adequate distribution plant diversity, vegetation cover, good food sources for many habitat association [30,31].

"The highest diversity was recorded in the subfamily Myrmicinae with eleven ant species represented by seven genera. The species diversity is less in subfamily Ponerinae and Pseudomyrmicinae. The species diversity was greatly reduced when ant communities were subjected to periodic perturbation by a man in nature" [27]. The above results show a similarity with this global pattern.

The six most species-rich genera were showed in 30KM radius of KKNPP site showed Camponotus (7 species; 21.21%), Tetraponera, Paratrechina and Pheidole (3 species; 9.09%) and *Leptogenys* (2 species; 6.06%) shown in the Table 3. The analysis of rank abundance arrangements showed against total number of species and individuals in a study area. "The abundance common species displayed on the left and the rare species are on the right. While ranging overall abundance 7 species were more common followed by few abundance species and more abundance and rare species was also observed Fig. 2. The abundance patterns showed, relatively small proportion of abundant species against large number of rare species" [32].

Table 3. Species richness of genera

Sub Family	Genera	Species	
		No	%
Formicinae	*Camponotus*	7	21.21
	Aenictus	1	3.03
	Anoplolepis	1	3.03
	Oecophylla	1	3.03
	Paratrechina	3	9.09
	Plagiolepis	1	3.03
	Pseudomyrmex	1	3.03
Myrmicinae	*Crematogaster*	1	3.03
	Meranoplus	1	3.03
	Monomorium	3	9.09
	Pheidole	3	9.09
	Pheidologeton	1	3.03
	Solenopsis	1	3.03
Ponerinae	*Diacamma*	1	3.03
	Herpegnathos	1	3.03
	Leptogenys	2	6.06
	Pachycondyla	1	3.03
Pseudomyrmicinae	*Tetraponera*	3	9.09
Total		33	100

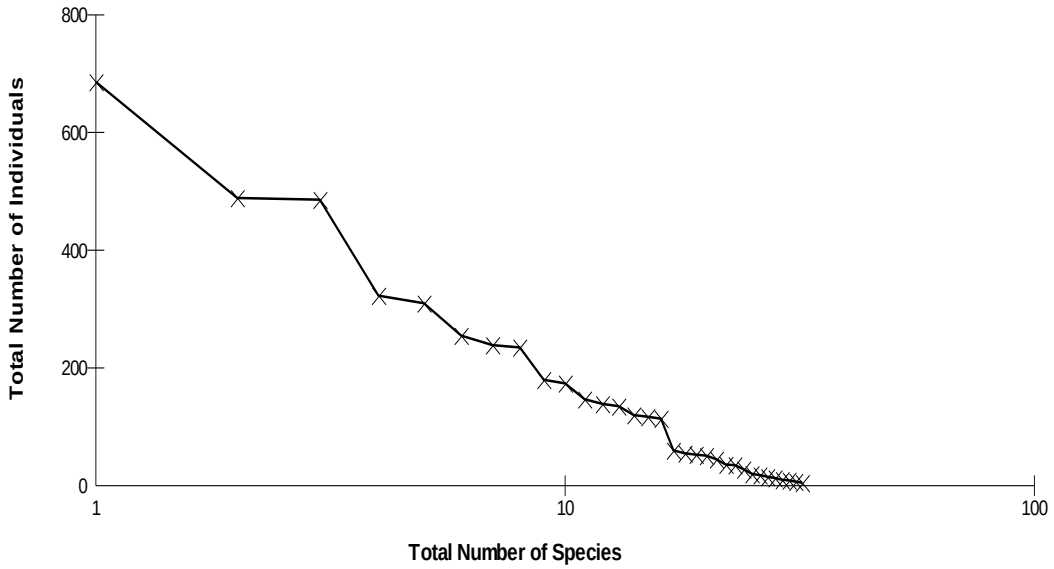

Fig. 2. Species rank abundance plots for total number of ant individuals

4. CONCLUSION

The ants abundance pattern in the area showed generally higher may be due to their habitat heterogeneity, biotic and abiotic factors, plant communities, increased vegetation in seasons and soil assemblages in the study area. Invertebrate are exhibit many types of relationships with other soil biota but also in their importance to functioning ecosystems. There is an urgent need to quantify this contribution as ants are very diverse and abundant in terrestrial environments. There are many direct and indirect contribution ants are improve the soil health integrity, food for predators, act as predators, immediate response to human disturbance, use as a soil bioindicators. Conservationists should take advantage of this knowledge and design experiments to conserve the ants diversity.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Pressey R, Bottrill M. Approaches to landscape- and seascape-scale conservation planning: Convergence contrasts and challenges. Oryx. 2009;43(4):464–475.
2. McArthur and Kitchen ED. Applicability of Montreal Process Criterion 2-productive capacity—to rangeland sustainability International Journal of Sustainable Development and World Ecology. 2000;7: 97–106.
3. Mound LA, Gaston KJ. Conservation and systematics - the agony and the ecstasy', in K.J. Gaston, T.R. New & M.J. Samways (eds.), Perspectives on insect conservation.1993;185-196.
4. McGeoch MA, Insects and bioindication: Theory and practice. in Stewart AJ, New TR, Lewis OT, (eds.), Insect conservation biology. 2007;144-174.
5. Kremen C. Terrestrial arthropod assemblages: their use in conservation planning. Conservation Biology. 1993;7: 796-808.
6. Agosti D, Majer JD, Alonso LE, Schultz TR. Ants: Standard Methods for Measuring and Monitoring Biodiversity; 2000. Smithsonian Inst. Press, Washington.
7. Bolton B. A New General Catalogue of the Ants of the World. Cambridge: Harvard University Press; 1995.
8. Gadakgar R, Padmini N, Chnadrashekara K. Ant species richness and diversity in some

selected licalities in Western Ghats, India. Hexapoda, 1993;5(2):79-94.

9. Tiede T, Schlautmann J, Donoso DA, Christine IB. Bendi, WJ, Brandl R, Farwig N. Ants as indicators of environmental change and ecosystem processes. Ecological Indicators. 2017;83:527-537.
10. Alonso LE. Ants as indicators of diversity. Ants: Standard methods for measuring and monitoring biodiversity. Smithsonian Institution Press, Washington, DC. 2000;80–88.
11. Andersen AN. Measuring invertebrate biodiversity surrogates of ant species richness in the Australian seasonal tropics. Memoirs of Museum Victoria. 1997;56:355-359.
12. Majer JD. Ants: bio-indicators of minesite rehabiliation, land-use and land conservation. Journal of Environmental Management. 1983; 7:375-383.
13. Oliver I, Beattie AJ. Designing a cost-effective invertebrate survey: A test of methods for rapid assessment of biodiversity. Ecological Applications. 1996;6:594-607.
14. Ramesh T, Jahir Hussain K, Satpathy KK, Selvanayagam M, Prasad MVR, Diversity, distribution and species composition of ants fauna at department of Atomic Energy (DAE) campus Kalpakkam, South India, World journal of Zoology. 2010;5(1):56-65.
15. Ramesh T, Jahir Hussainl K, Selvanayagam M, Satpathyr KK. Diversity of the ground inhabiting ant fauna at Department of Atomic Energy campus, Kalpakkam (Tamil Nadu), Halteres. 2009;1:1.
16. Neli Mc Aleece N, Lambshead PJD, Paterson PLJ. Biodiversity Pro (Version 2). The Natural History Museum,London; 1997.
17. Ribas CR, Schoereder JH, Ant communities, environmental characteristics and their implications for conservation in the Brazilian Pantanal. *Biodiversity and Conservatio.* 2007;16: 1511-1520.
18. Agosti D, Alonso LE. The All Protocol: A Standard Protocol forthe Collection of Ground-Dwelling Ants, In: Agosti D, Majer JM, Alonso LE and Schultz TR. (eds.). Ants: Standard Methods for Measuring and Monitoring Biodiversity. Smithsonian Institution, Washington and London: 2000: 2M-206.
19. Rajagopal T, Sevarkodiyone SP, Manimozhi A. Ant diversity in some selected localities of Saftur taluk, Virudunagar district, Tamil Nadu' Journal Zoo's Print. 2005;20(6): 1887-1888.
20. Sornapriya J , Varunprasath. Diversity and abundance of Ants in Periyanaickenpalayam village of Coimbatore district, Tamil Nadu K Journal of Entomology and Zoology Studies 2018;6(3):1378-1384.
21. Begum R, Majagi SH, Vijaykumar K. Ants species richness and diversity in relation to different ecological habitat in selected localities of the semi-arid region of Karnataka, India Environmental Monitoring and Assessment. 2021;193:145.
22. Dad JM, Akbar SA, Bharti H,Wachkoo AA. Community structure and ant species diversity across select sites of Western Ghats, India, Acta Ecologica Sinica. 2019;39(3): 219-228.
23. Ramachandra TV, Subash Chandran MD, Joshi NV. Ant Species Composition and Diversity in the Sharavathi River Basin, Central Western Ghats. ENVIS Technical Report: 2012; Centre for Ecological Sciences, Indian Institute of Science, Bangalore – India.
24. Marsh AC. Ants species richness along a climatic gradient in the Namib desert. J. Arid Environ.1986;11: 235-241.
25. 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.
26. Ward PS. Broad-scale patterns of diversity in leaf litter ant communities. In: Agosti, D., Majer, J.D., Alonso, L.E. and Schultz, T.R. (eds.). Ants: Standard methods for measuring and monitoring biodiversity. Smithonian Institute Press, Washington. 2000: 99-121.
27. Chavhan A, Pawar SS. Distribution and diversity of ant species (Hymenoptera: Formicidae) in and around Amravati City of Maharashtra. India. World Journal of Zoology. 2011;6(4):395-400.
28. Hill JG, Summerville KS, Brown RL. Habitat Associations of Ant Species (Hymenoptera: Formicidae) in a Heterogeneous Mississippi Landscape, Environmental Entomology. 2008; 37:2: 43-463.
29. Cardoso DC, Schoereder JH. Biotic and Abiotic Factors Shaping Ant (Hymenoptera: Formicidae) Assemblages in Brazilian Coastal Sand Dunes). Florida Entomologist, 2014; 97(4):1443-1450.
30. Ramarajan S, Murugesan AG. Checklist of Angiosperms in 30Km radius of Kudankulam Nuclear power Project. Indian Forester. 2019: 145(3):279-292.

31. Kumar P, Murugesan AG. Species diversity and habitat association of butterflies around 30 km radius of Kudankulam Nuclear Power Plantarea of Tamil Nadu, India. International Journal of Biodiversity and Conservation. 2014: 6(8), 608-615.

32. Malsch A. Investigation of the diversity of leaf litter inhabiting ants in Pasoh, Malaysia. ln: Agosti D, Majer JD, Alonso L, Schultz T. (eds.). Sampling Ground-dwelling Ants: Case Studies from the World's Rain Forests. Curtin University School of Environmental Biology Bulletin, Perth, Australia. 2000;31-40.