Volume : 3 | Issue : 12 | December 2014 • ISSN No 2277 - 8179

Research Paper

Diversity of Ants (Hymenoptera: Formicidae) From Undisturbed And Disturbed Habitats of Great Indian Bustard Wildlife Sanctuary, (M. S.), India

Zoology

KEYWORDS : Diversity, Ant, Disturbance, Great Indian Bustard Wildlife Sanctuary

N.B. Patkar Department of Zoology Dr. Babasaheb Ambedkar Marathwada University Aurangabad

R.J. Chavan Department of Zoology Dr. Babasaheb Ambedkar Marathwada University Aurangabad

ABSTRACT

The present communication deals with the study of ant diversity in undisturbed and disturbed habitats of Great Indian Bustard Wildlife Sanctuary located in Maharashtra state, India. Ants are good indicators of disturbance, because they show quick response to environmental changes. Ants were collected from two different habitats with varying disturbance levels with the help of pitfall traps, scented traps and hand collection methods. From undisturbed and disturbed forest sites total 19 and 16 ant species were collected respectively. Among the subfamilies reported from study area Myrmicinae were dominant with 7 species (35 %), followed by Formicinae with 6 species (30 %), Pseudomyrmecinae with 3 species (15 %), Ponerinae with 2 species (10 %) and lastly Dolichoderinae and Dorylinae with one species (5 %) each. Ant species Anochetus graffei, Meranoplus bicolor and Polyrhachis tibialis were found to be absent from disturbed sites whereas, Leptogenys chinesis were not reported from undisturbed forest site. Shannon-Wiener diversity index value (H') for undisturbed forest site (2.76) was slightly higher than that of disturbed forest site (2.46). Ant abundance and composition were significantly different from undisturbed and disturbed forest sites.

Introduction

Increased human activities like deforestation, urbanization, agricultural intensification, grazing, and mining were creating a serious problems to the flora and fauna of many terrestrial ecosystems various throughout the world. Disturbance is nothing but the any event that removes biomass (Townsend and Hildrew, 1994) and is distinguished from habitat transformation or stress, which minimizes the available resources or alters the microclimate or structure of the habitat (Andersen 2000; Pickett and White 1985).

Ants play an important role within the terrestrial ecosystems because they have numerous interactions with different plant species, including seed dispersers, leaf- and seed- predators, and in some cases, as pollinators (Vázquez 1998; Hernández 2005). Ants are found everywhere, except in Iceland, Greenland and Antarctica (Holldobler and Wilson, 1990), but the number of species declines with increasing latitude, altitude and aridity (Fowler and Claver, 1991; Farji-Brener and Ruggiero, 1994; Samson et al., 1997).Some ant species establish mutualistic relationships with a many other organisms including invertebrates and vertebrates. For example ants protect aphids and other homopterans from their predators, for obtaining sugar-rich solutions produced by them (Delfino and Buffa 2000).Ants can build their nests in leaf litter, rotting logs, underneath the soil, within woody stems or under the rocks and they can also establish fungal gardens in the soils. During activities associated with gallery building of nests by ants favor the mixing of organic matter in the soil, as well as increase the aeration properties of soils (Luque *et al.* 2002). Ants are among the leading predators in the terrestrial habitats because they feeding on other insects and small invertebrates, so that ants can be used as biological control of insect pests (Suryanto, 1993). Ants were considered to be very sensitive to habitat transformation and disturbance, and for this reason have been extensively used as indicator species (Hoffmann and Andersen 2003). Increases in grazing intensity may also result in declines of ant species richness, especially of litter inhabiting cryptic species and specialized predators (Bestelmeyer and Wiens 1996), and strong changes in species composition, although the relative proportions of different functional groups appear somewhat resilient to grazing pressure (Hoffmann 2000).Besides this diversity, composition and abundance of ants in the various habitats are urgently needed. By keeping this in mind we try to investigate the ant populations in the undisturbed and disturbed habitats of the present study area.

The Great Indian Bustard Wildlife Sanctuary is located in Ahmednagar and Solapur district of Maharashtra state, India. This sanctuary includes various villages, towns, city, network of roads and railway tracts, air port, reservoirs, agricultural fields, small industrial units, scattered "islands of forest land" and Drought Prone Area Programmes (DPAP) plots. Besides this sanctuary is home for critically endangered bird species Great Indian Bustard. But recently anthropogenic activities are increases in the sanctuary area and damaging the diverse habitats of the study area. But at present there is no any report on type, extent and effect of disturbance on the flora and fauna of the study area. So this is the first survey of this kind from the study area.

Material and Methods

Study Area

The Great Indian Bustard Wildlife Sanctuary lies in biogeographic zone Deccan Peninsula and coordinate ranges between Longitude 18.^{0} 21'00" and Latitude 75.^{0}11'.38"E. According to Champion and Seth (1968) the forest subtype is 6A/C1; Southern tropical thorn forest is reported from this sanctuary. This study was conducted from Jan 2010 to Dec 2010 at six sites from two forest fragments having various disturbance levels.

Undisturbed area – Three different plots of 110 hectare (Nannaj), 100 hectare (Nannaj) and 50 hectare (Mardi) were selected for ant collection as a representative. These plots are least disturbed area of sanctuary and also considered as nesting sites of Great Indian Bustard. Human activities are nearly nil from this area. This region of forest having large number of trees, shrubs, grasses and good canopy cover. Forest floor has high litter content as that of disturbed forest site.

Disturbed area – Similarly three plots 100 hectare (Mardi, Private land), 40 hectare (Mardi) and 90 hectare (Nannaj) were selected for collection of ants as a representative. These plots are heavily disturbed because of activities like over grazing, agricultural farming, mining, deforestation, forest fire etc. The habitat from this region is adversely affected by human activities. This habitat prominently includes grasses, shrubs and only few tree species like Neem, Glericidia are present. Because of roads and tracks, habitat was splits into patches.

Sampling protocols

The ants were collected by using Pitfall traps, Scented traps and Hand collection methods during from Jan 2010 to May

2010. A) The pit-fall traps consisted of a 0.5 liter plastic glass with an opening of 12 cm in diameter, buried at ground level. At least one pit-fall trap were placed in each of the five randomly chosen 20m x 20m quadrates of one hectare plot at each site. Each glass carried 25 ml of ethanol and glycerol mixture. The traps were set up between 15.00 and 17.00 hrs and were collected after 48 hrs. (Gadagkar et. al, 1993). B) Scented traps were applied similar to that of pitfall traps but instead of ethanol and glycerol mixture, 25 ml of sugarcane juice and ethanol mixture were added. C) Hand collection of ants from each sampling plot was carried out for 30 min to collect representative individuals of all species seen in the quadrate after laying the baits. For removal of sampling error we used three different ant collection methods to collect maximum number of ant species from study area.

Collected ant specimens were sorted, washed and preserved in 70% alcohol in separate plastic vials and brought to the laboratory for identification. Ants were photographed by using Sony digital camera and identified at species level with the help of stereo zoom trinocular microscope, based on taxonomic keys (Bolton, 1994) (Holldobler, and Wilson, 1990, Mathew and R. N. Tiwari, 2000, Sheela S.2008) etc.

Species diversity was calculated by using Shannon-Wiener and Simpson's diversity indices. Shannon-Wiener diversity index and Simpson's diversity index (D) were calculated by using standard formula given by standard statistical procedures.

Results and Discussion

In the present study area total 20 ant species (from 3527 individuals) with 14 genera from six subfamilies were reported. The distribution of species in the different subfamilies showed a dominance of Myrmicinae with 7 species (35 %), followed by Formicinae with 6 species (30 %), Pseudomyrmecinae with 3 species (15 %), Ponerinae with 2 species (10 %) and lastly Dolichoderinae and Dorylinae with one species (5 %) each.

A total 19 and 16 ant species were collected from undisturbed and disturbed forest sites respectively. Out of 20 ant species almost 16 species (80 %) were common to both forest types, while another 3 species (15 %) were found exclusive to the undisturbed forest sites. From total 20 ant species *Anochetus graffei, Meranoplus bicolor* and *Polyrhachis tibialis* were not reported from disturbed sites whereas, *Leptogenys chinesis* were absent from undisturbed sites. The number of ants collected from undisturbed forest sites (2198) were more as compared to the disturbed forest sites (1329). In undisturbed forest sites subfamily Myrmicinae (7 species) was more diverse then followed Formicinae (6 species), Pseudomyrmecinae (3 species) and Ponerinae, Dolichoderinae, Dorylinae are to least diverse comprising only with one species each. Whereas in disturbed forest sites subfamily Myrmicinae (6 species) was more diverse then followed Formicinae (5 species), Pseudomyrmecinae (2 species) and Ponerinae, Dolichoderinae, Dorylinae are to least diverse comprising only with one species each. Subfamily Ponerinae, Dolichoderinae and Dorylinae comprised similar number of species in both type of forest sites but numbers of ants collected are varied. The three most abundant ant species from undisturbed forest site is *Monomorium indicum* (9.19 %), *Tapinoma melanocephalum* (9 %) and *Camponotus compressus* (8.69 %) and from disturbed forest site are *Paratrechina longicornis* (13.24 %), *Solenopsis gemonata* (11.73 %) and *Tapinoma melanocephalum* (9.55 %).Shannon-Wiener diversity index value (H') for undisturbed forest site (2.76) was slightly higher than that of disturbed forest site (2.46). Similarly, value of Simpson's index (D) for undisturbed forest site is 0.086 while, for disturbed forest site is 0.067. Species composition and abundance from both the habitats were significantly different.

From the above results it is concluded that species richness, diversity and abundance were higher in undisturbed forest site as compared to disturbed forest site. This is due to habitat destruction and increase in disturbance by various anthropogenic activities. Related studies on ants, birds and butterflies have shown that species richness and diversity decreases with increase in disturbance (Andersen 1995; Blair 1996; Ingalhallikar et al. 2000-2001; Kunte 2000-2001; Pachpor & Ghodke 2000-2001).Studies from different regions of world Many studies have shown that habitat degradation, disturbance and fragmentation have a negative effect on ant diversity and abundance where undisturbed forests has higher species richness than those in disturbed habitats (Greenslade and Greenslade, 1977; Olson, 1991; Suarez *et al.,* 1998; Vasconcelos, 1999; Watt *et al.,* 2002). Our results match with Kumar et al. (1997) and Pachpor & Ghodke (2000-2001) they mentioned that, habitats with abundant trees support high diversity of ants. Thus, habitat variables such as canopy cover and litter content in the soil can provide an appropriate habitat for ants. This is because of habitat complexity and heterogeneity was high in the undisturbed sites as compared to disturbed site. Habitat complexity provides hiding, nesting and foraging grounds to the many ant species, but disturbed sites are doesn't.

Overall relative abundance of Myrmicinae from disturbed sites was more because they may have high potential to adapt varying environmental conditions and they are found in different types of habitats worldwide, they are classified as Generalized Myemecinae (GM) functional group by Bestelmeyer and Wiens (1996), Andersen (2000). Similar results were drawn by Savitha, S. et al in 2008.

Relative abundance of *Paratrechina longicornis*, *Solenopsis geminata* and *Tapinoma melanocephalum* were high in the disturbed forest site. This is due presence of microhabitats which are ideal for above mentioned ant species. Similar results were drawn by Savitha, S. et al in 2008. *Tapinoma melanocephalum* is from Dominant Dolichodrinae (DD) functional group and they prefer hot and open habitats. They are exceptionally active, aggressive and posing a strong competitive influence on other ants. (Suriyapong, Y. 2003). *Solenopsis geminata* are categorized as Cryptic species functional group by Andersen (2000) and relative abundance is increased in vu1nerable to the establishment of introduced ant species (TschinkeI1988; Suarez et al. 1998). From species diversity indices it can be conclude that the ant diversity is varied in both type of habitats this is due to ant species richness and abundance may change with the canopy cover, habitat complexity and level of disturbance.

Conclusion

From the present study it can be concluded that diversity of ants is different in these two habitats in terms of species richness, abundance and composition. Ants can be effectively used in indictor studies because they immediately respond to any alteration in the surrounding environment. When assessing different taxa as disturbance indicators ants were better performed as compared to other invertebrates such as spiders and hemipterans (Crist, 2009).The number of certain ant species in disturbed habitat were considerably increased because they get ideal conditions over their such as nesting sites, food availability, open grounds for foraging etc. Detailed studies of disturbed habitats are urgently needed according to extent of disturbance, type of disturbance, physicochemical properties of soil, climatic factors, exotic flora and fauna etc.

Table no. 1. Table showing total number of Ants collected from Undisturbed and disturbed sites of GIB Wildlife Sanctuary by using Pitfall trap (PT), Scented trap (ST) and Hand collection method (HC) during March 2010 to May 2010.

Study Site	Undisturbed									Total (A)	Disturbed									Total (B)	Grand Total (A+B)
Species	March			April			May				March			April			May				
Collection Methods	PT	ST	HC	PT	ST	HC	PT	ST	HC		PT	ST	HC	PT	ST	HC	PT	ST	HC		
Myrmecinae																					
Monomorium indicum	22	34	18	23	29	17	13	33	13	202	15	13	9	10	15	11	8	12	10	103	305
Monomorium destructor	12	15	14	9	13	13	13	11	15	115	15	17	8	13	16	11	12	19	9	120	235
Monomorium scabriceps	22	30	12	20	30	11	18	26	13	182	11	22	9	8	19	11	10	17	7	114	296
Meranoplus bicolor	13	11	16	11	12	13	10	12	13	111	-	-	-	-	-	-	-	-	-	-	111
Crematogaster subnuda	10	13	22	13	16	20	11	14	23	142	14	11	16	12	10	14	6	7	12	102	244
Solenopsis geminata	3	6	7	2	4	8	2	2	6	40	15	21	14	16	18	13	19	25	15	156	196
Pheidole sp.	19	37	16	15	30	14	13	29	11	184	9	12	6	13	9	10	11	14	7	91	275
Formicinae																					
Camponotus anguisticolis	14	26	23	11	28	20	15	23	20	180	11	14	12	9	10	8	10	13	9	96	276
Camponotus compressus	15	29	25	14	27	22	13	25	21	191	11	14	9	10	13	11	8	10	9	95	286
Camponotus sericeus	11	11	28	10	10	28	8	10	25	141	8	10	7	6	8	5	9	10	7	70	211
Oecophylla smaragdina	-	-	13	-	-	12	-	-	11	36			18			16			15	49	85
Paratrechina longicornis	18	23	9	17	21	9	18	20	12	147	17	24	12	19	27	14	21	30	12	176	323
Polyahachis tibialis	7	12	8	4	9	6	3	8	4	61	-	-	-	-	-	-	-	-	-	-	61
Dolichoderinae																					
T. melanocephalum	22	33	13	20	30	12	19	31	12	192	11	15	12	13	19	10	15	21	11	127	319
Ponerinae																					
Leptogenys chinesis											1	-	5	2	-	4	2	-	3	17	17
Anochetus graffei	2	4	-	3	2	-	3	4	-	18	-	-	-	-	--	-	-	-	-	-	18
Pseudomyrmecinae																					
Tetraponera nigra	7	7	20	6	7	20	6	3	18	94	-	-	1	-	-	3	-	-	-	4	98
Tetraponera allaborans	4	5	16	3	5	17	4	6	17	77	-	-	-	-	-	-	-	-	-	-	77
Tetraponera rufonigra	4	6	20	4	5	19	5	1	20	84	-	-	1	-	-	1	-	-	-	2	86
Dorylinae																					
Dorylus laevigatus			1							1	-	-	2	-	-	1	-	-	4	7	8
Total Ants Collected	202	305	279	177	279	258	174	254	252	2198	138	173	141	131	164	143	131	178	130	1329	3527

Table no. 2. Species richness, Shannon's-Wiener diversity index, Simpson's diversity index (D) and abundance of ants from undisturbed and disturbed forest sites of GIB Wildlife Sanctuary, India.

	Study site	
Subfamily	Undisturbed	Disturbed
Myrmicinae	7 (951)	6 (686)
Formicinae	6 (779)	5 (486)
Pseudomyrmecinae	3 (267)	2 (6)
Ponerinae	1 (18)	1 (17)
Dolichoderinae	1 (204)	1 (127)
Dorylinae	1 (3)	1 (10)
Species richness	19 (2232)	16 (1329)
Shannon-Wiener diversity index (H')	2.76	2.46
e^H	15.83	11.70
Simpson's index (D)	0.067	0.086

Note: indicated Figures in bracket indicates abundance of ants.

Volume : 3 | Issue : 12 | December 2014 • ISSN No 2277 - 8179

REFERENCE

1.Andersen A. N. (2000). A global ecology of rainforest ants: functional groups in relation to environmental stress and disturbance. In: Ants: Standard Methods for Measuring and Monitoring Biodiversity (eds. D. Agosti, J. D. Majer, L. E. Alonso & T. R. Schultz);25-34. | 2.Andersen, A.N. (1995). A classification of Australian ant communities based on functional groups which parallel plant life-forms in relation to stress and disturbance. Journal of Biogeography 22: 15-29. | 3.Bestelmeyer, B. T. and K. Wiens. (1996). The effects of land use on the structure of ground-foraging ant communities in the Argentine Chaco. Ecol. Appl. 6: 1225Ð1240. | 4.Blair, R.B. (1996). Land use and avian species diversity along an urban gradient. Ecological Applications 6:506-519. | 5.Bolton, B. (1994).Identification guide to the ant genera of the world .Cambridge, Mass: Harvard University Press, 222 pp. | 6.Champion, H. and Seth, S.K. (1968). A revised survey of the forest types of India. Govt. of India Publication, New Delhi. | 7.Crist, T.O. (2009). Biodiversity, species interactions and functional roles of ants (Hymenoptera: Formicidae) in fragmented landscapes: a review- Myrmecological news. 12:3-13 pp. | 8.Delfino and Buffa (2000). Algunas interacciones planta-hormiga en Córdoba (Argentina). Zool. Baetica 11: 3-15. | 9.Farji-Brener and Ruggiero (1994). Leaf cutting ant (Atta Acromyrmex) Inhabiting Argrntina:patterns in species richness and geographical range sizes. J. Biogeog.21:391-399. | 10.Fowler, H.G. and Claver, S. (1991) Leaf-cutter ant assemblies: effects of latitude, vegetation, and behaviour. In Ant-plant interactions (C.R. Huxley and D.F. Cutler, eds.) pp. 51-59 pp. | 11.Gadagkar, R. P. Nair, K. Chandrashekhar and D.M. Bhat, (1993). Ant species richness in some selected localities in Western Ghats, India. Hexapoda, 5: 70-94. | 12.Greenslade, P., and P. J. M. Greenslade. (1977). Some effects of vegetation cover and disturbance on a tropical ant fauna. Insectes Sociaux 24:163-182. | 13.Hernández, C.O. (2005). Polinización y Hormigas. - Cambridge University Press. | 14.Hoffmann B.D. and Andersen A.N. (2003). Responses of ants to disturbance in Australia with particular reference to functional groups. Austral Ecology. 28:444–464 pp | 15.Hoffmann, B. D. (2000). Changes in ant species composition and community organisation along grazing gradients in semi-arid rangelands of the northern territory. Rangel. J. 22(2) 2000, 171-89 pp | 16.Holldobler, B. & Wilson, E. O. (1990).The Ants. Cambridge, Belknap of Harvard University Press: 732 pp. | 17.Ingalhallikar, S., R. Purandare, S. Nalavade & S. Dhole. (2000-2001). Avifauna around Pune. Journal of Ecological Society 13&14: 59-70. | 18.Kumar, S. K. T. Shrihari, P., Nair, Varghese, T. & Gadagkar, R. (1997). Ant species richness at selected localities of Bangalore. Insect Environment 3: 3-5. | 19.Kunte, K. (2000-2001). Butterfly diversity of Pune city along human impact gradient. Journal of Ecological Society 13&14: 40-45. | 20.Luque, G.G., Reyes-López, J.L. and Fernández, H.J. (2002). Estudio Faunístico de las Hormigas (Himenóptera: Formicidae) de la cuenca del Río Guadiamar: Primeras aportaciones. - Boletin de la Sociedad Entomológica Aragonesa 30:153-159 | 21.Mathew, R. and Tiwari, R. N. (2000).Insects: Hymenoptera: Formicidae State Fauna Series 4: Fauna of Meghalaya 7: 251- 409 pp. | 22.Olson, D. M. (1991). A comparison of the efficacy of litter sifting and pitfall traps for sampling leaf litter ants (Hymenoptera, Formicidae) in a tropical wet forest. Biotropica 23:166-172. pp | 23.Pachpor, T. & Y. Ghodke. 2000-2001. Ant genera distribution across Pune city. Journal of Ecological Society 13&14: 18-22. | 24.Pickett S. T. A. and White P. S. (1985). The ecology of natural disturbance and patch dynamics. Academic Press, New York. | 25.Samson, D.A., Rickart, E.A. and Gonzales, P.C. (1997). Ant diversity and abundance along an elevational gradient in the Phillippines. Biotropica 29, 349-363 pp. | 26.Savitha S., Barve,N. & Davidar, P. (2008). Response of ants to disturbance gradients in and around Bangalore, India. Tropical Ecology 49(2): 235-243 pp | 27.Sheela, S. (2008).Handbook on Hymenoptera: Formicidae Z.S.I.; 1-55 pp. | 28.Suarez, A.V., Bolger, D.T., Case, J.T., (1998). Effects of fragmentation and invasion on native ant communities in coastal southern California. Ecology 79, 2041–2056 | 29.Suriyapong, Y. (2003). Study of ground dwelling ant populations and their relationship to some ecological factors in Sakaerat Environmental Research Station, Nakhon Ratchasima. Ph. D. thesis, Suranari University and Technology, Thailand. | 30.Suryanto, D.W.I. (1993). A survey of ants as candidates for potential biology control of pear psylla (Cacopsylla pyricola Foerster) in Michigan[Online](Michigan State University) Dissertation Abstracts MAI32/03. | 31.Townsend, C. R., and Hildrew, A. G. (1994). Species traits in relation to a habitat templet for river systems. Freshwater Biology 31(3):265–275 pp. | 32.Tschinkel, W. R. (1988). Distribution of the fire ants Solenopsis invicta and Solenopsis geminata (Hymenoptera: Formicidae) in northern Florida in relation to habitat and disturbance .Annunals of the Entomological Society of America 81: 76-81.pp | 33. Vasconcelos, H.L. (1999). Effects of forest disturbance on the structure of ground-foraging ant communities in central Amazonia. Biodiversity and Conservation 8: 409-420. | 34.Vázquez, B. M. (1998). Hormigas (Hymenoptera:Formicidae) colectadas en necrotrampas, en tres localidades de Jalisco, México. - Tesis de Licenciatura, centro universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara. Zapopan, Jalisco. | 35.Watt A.D., Stork N.E. and Bolton, B. (2002). The diversity of ant in relation to forest disturbance and plantation establishment in southern Cameroon. J. App. Ecol. 39:18-30. |