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The Great Indian Bustard Wildlife Sanctuary (M.S.), India, has a Wide Varietyof Ants (Hymenoptera: Formicidae) from both Natural and Man-Made Habitats

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ABSTRACT

The major focus of this piece is on the habitats, both undisturbed and degraded, that are found inside the Great Indian Bustard Wildlife Sanctuary, which is located in the Indian state of Maharashtra. Because of the speed with which they react to changes in their natural environment, ants serve as reliable indicators of the presence of disturbance. Ants were gathered using a range of techniques, such as pitfall traps, scented traps, and hand collection methods. The two habitats were quite different from one another in terms of the amount of human disturbance that occurred in each. There were a total of 19 distinct species of ants found in the forest, including those that were found in undisturbed areas as well as those that had been harmed. In the region that was the subject of the study, there were seven species of Myrmicinae, which accounted for thirty-five percent of the total, six species of Formicinae, three species of Pseudomyrmecinae, two species of Ponerinae, which accounted for ten percent, and one species each of Dolichoderinae and Dorylinae (representing 5 percent each). It was revealed that all three species of ants were not present in disturbed habitats; however, the Leptogenyschinesis ant was never seen in a forest environment that had not been disturbed. At the location of the undisturbed forest, the Shannon-Wiener diversity index (H') was much higher than the one at the location of the damaged forest, which was 2.76. (2.46). Between regions of damaged forest and parts of undisturbed forest, there was a considerable variation in the ant population as well as the species mix that was present.

INTRODUCTION

It is essential to keep in mind that disturbance is not the same thing as habitat change or stress, both of which either lessen the total quantity of resources that are accessible or alter the local climate or physical structure. Increasing human activities such as deforestation, urbanization, agricultural intensification, grazing, and mining have caused substantial damage to the plants and animals that inhabit these terrestrial eco systems around the world (Townsend and Hildrew, 1994). (Andersen 2000; Pickett and White 1985). Because they interact with so many different kinds of plants in so many different ways, ants play a significant role in the terrestrial ecosystems that they inhabit. Ants play an important role in pollination, the spread of

seeds, and the consumption of both leaves and seeds. Aside from Iceland, Greenland, and Antarctica, ants are distributed evenly throughout the surface of the whole world (Holldobler and Wilson, 1990). However, as altitude, height, and latitude increase, the number of distinct species of ants that may be found in a given area decreases.

dryness (Holldobler and Wilson, 1990). (Fowler and Claver, 1991; Farji-Brener and Rug giero, 1994; Samson et al., 1997). Some species of ants have developed symbiotic connections with a wide variety of different creatures, including both invertebrates and vertebrates. These associations may be found in a network. Ants provide protection for insects that create sugar-rich solutions, such as aphids and other homopterans, against their natural enemies, who are most often other insects. Aphids and other homopterans are two examples (Delfino and Buffa 2000). These organisms may create fungal gardens in the ground where they dwell in addition to building their homes in areas such as leaf litter, rotten logs, and the ground beneath rocks, woody branches, or mud. Other possible habitats for these organisms include rotting logs. The organic material is pushed into the soil during the process of gallery development by ants, which in turn enhances the soil's aeration and drainage capacity. Ants build their galleries in the soil (Luque et al. 2002). As a consequence of the fact that ants predominantly consume insects and other tiny animals, these critters have the potential to be employed as a kind of biological control for insect pests in terrestrial regions. Ants may be found almost everywhere (Suryanto, 1993). Because they are particularly sensitive to changes in their surroundings and to being disturbed, ants have acquired a lot of appeal as indicator species in environmental monitoring owing to the fact that they are very sensitive to these factors (Hoffmann and Andersen 2003). There is a chance that the diversity of ant species may decline as the intensity of grazing increases, particularly among species that live in litter, species that are cryptic, and species that are specialized as predators (Bestelmeyer and Wiens 1996). In addition to this, there is a possibility that there may be significant shifts in the species composition of the population. In spite of this, it seems that certain proportions of certain functional groups are able to tolerate the effects of grazing pressure (Hoffmann 2000). In addition to this, it is very necessary to have a big number of distinct kinds of ants living in a range of environments. Keeping all of this information in mind, our plan is to carry out research on ant populations in the current study area, with the intention of concentrating on both undisturbed and disturbed habitats. The Great Indian Bustard Wildlife Sanctuary is located in the state of Maharashtra in India, namely in the Ahmednagar and Solapur districts. It was named after the Great Indian Bustard bird. In addition to the numerous towns and villages that make up the sanctuary, the area also contains a large city, a network of highways and railways, an airport, reservoirs, agricultural regions, small industrial units, and "islands of forest land." All of these features can be found spread out across the territory. In addition, the Great Indian Bustard, a kind of bird that is very near to going extinct, finds its home in this sanctuary. The Great Indian Bustard is an endangered species. The different ecosystems that comprise the study area are still being impacted by human activity, despite the fact that the sanctuary zone is deteriorating as a direct consequence of such activity. However, at this time there is very little information that can be accessed on the many different types of disturbances, the extents to which they have occurred, or the effects that they have had on the flora and fauna of the region. In the location where the research is being done, there has never been another study just like this one carried out before this specific one.

MATERIAL AND METHODS

The Great Indian Bustard Wildlife Sanctuary may be found in the biogeographical zone that is characterized by the Deccan Peninsula, and its coordinates are between that region and the Arabian Sea. 75.0 degrees of latitude, and 18.0 degrees of longitude. According to Champion and Seth, this protected area is a Southern Tropical Thorn Forest. [Citation needed] (1968). For the purpose of this investigation, two different forest portions with differing degrees of disturbance were divided up into six different places, and these locations were investigated from January to December of 2010. For the purpose of ant collection, undisturbed regions representative of the region were selected. There was additional consideration given to plots of 110 ha (Nannaj), 100 ha (Nannaj), and 50 ha (Mardi). The Great Indian Bustard chooses to set up its nest in these particular parts of the sanctuary because they are the least disturbed. There is hardly any sign of human habitation in this area. The understory of this forest is filled with a rich diversity of large trees, shrubs, and grasses. The amount of litter that is present on the forest floor is comparable to that of a forest site that has been disturbed. The following three ant plots were selected to represent each of the three sections of disturbed land: 100 hectares (Mardi, Private property), 40 hectares (Mardi), and 90 hectares (Nannaj). These areas have been destroyed by a variety of activities including excessive grazing and agricultural production, mining, deforestation, and forest fires. The natural environment in this region is being negatively affected by human activity. The majority of this ecosystem is made up of grass, shrubs, and a few different tree species, such as neem and glericidia trees. Highways and railways have cut up the environment into smaller and smaller pieces.

SAMPLLING PROTOCOL

In order to collect the ants from January 2010 to May 2010, a number of different collecting strategies, such as manual collection, pitfall traps, and scented traps, were used. A) The pit-fall traps comprised of a plastic glass container with a capacity of 0.5 liters and an entrance that was 12 centimeters in diameter. The container was buried in the ground. B) The pit-fall traps were designed to catch rats. At least one booby trap was set up in each of the five randomly selected quadrates that comprised the one hectare plot at each location. These traps were set up to catch people who were unaware of their presence. Every one of the quadrates measured 20 meters by 20 meters. Ethanol and glycerol were mixed together in glasses that measured 25 milliliters each, and the mixture was swirled. Between the hours of fifteen and seventeen o'clock, the traps were first set, and then collected. Gadagkar et al. were the ones who were responsible for carrying out the study in 1993. (1993). Sugarcane juice to the volume of 25 milliliters was used in lieu of the combination of ethanol and glycerol that was usually used in scent traps. This change was made in order to improve the accuracy of the test. These scent traps were arranged in a manner that was comparable to that of pitfall traps. After baiting the quadrates, the ants in each sample plot were collected by hand for a period of thirty minutes in order to acquire a sample that was representative of all species. By collecting ants in three distinct methods, each of which was carried out in isolation from the others, we were able to limit the likelihood of sampling error. It was necessary to thoroughly clean and preserve the ant specimens in advance of presenting them to the lab in order to have them identified. This was a necessary precondition. Ants were photographed with a Sony digital camera using taxonomic keys (Bolton, 1994; Holldobler and Wilson, 1990; Mathew and R. N. Tiwari, 2000; Sheela S. 2008) prior to being identified at the species level using a stereo zoom trinocular microscope. The taxonomic keys were developed by Bolton, 1994; Holldobler and Wilson, 1990; Mathew and R. N. Tiwari, 2000; Bolton (1994), Holldobler and Wilson (1990), and Mathew and R. N. Tiwari (2000) were the ones who came up with the taxonomic keys. Both the Shannon-Wiener and Simpson's diversity indexes were used in order to provide an accurate reading on the species' genetic make-up. Conventional approaches to statistical analysis were used in order to compute the Shannon-Wiener and Simpson's diversity indices (D).

RESULTS AND DISCUSSION

In the region that was the focus of the research, a total of 3527 individuals from a total of 20 distinct ant species were recognized as having been present. These individuals were from 14 different genera and six different subfamilies. According to a study that investigated the diversity of species, seven Myrmicinae species accounted for 35 percent of the total, which was followed by six Formicinae species, three Pseudomyrmecinae species, two Ponerinae species, one species from the Dolichoderinae family, one species from the Dorylinae family, and one Dorylinae species. Ant species were collected from both intact and damaged portions of the forest. The undamaged areas of the forest had a total of 19 species of ants, whereas the damaged areas only had 16 species. There were a total of 20 different species of ants that were researched, and out of them, 16 different species, which is about 80 percent, were found in both disturbed and undisturbed woodlands. On the other hand, undisturbed woods were home to three of the species, which accounts for fifteen percent of the total. There have been a total of twenty unique species of ants found; however, only three of those species were discovered in disturbed areas. Anochetus graffei, Meranoplus bicolor, and Polyrhachis tibialis were the names of these three different species. According to the results of this study, the total number of ants counted in areas of forest that lacked human habitation (2298) was much more than the total number of ants counted in areas of forest that had been destroyed (1329). Only one species of insect belongs to the subfamilies Myrmicinae, Formicinae, Pseudomyrmecinae, Ponerinae, Dolichoderinae, and Dorylinae in areas of undisturbed forest. This is true for all of the other subfamilies as well. As a result, they are the subfamilies with the lowest level of diversity. Each of the subfamilies Myrmicinae, Formicinae, Pseudomyrmecinae, Ponerinae, Dolichoderinae, and Dorylinae in disturbed forest zones only include one species of insect. As a result, they have the lowest level of diversity compared to the other subfamilies. The total number of ant species that can be found in each kind of forest is the same, but the quantity of ants that can be gathered from one type of forest is quite different from the other. At the location in the forest that has not been disturbed, the three species of ants that are found the most often are Monomoriumindicum (9.19 percent), Tapinomamelanocephalum (9 percent), and Camponotiscompressus (8.69 percent). On the other hand, at the location in the disturbed forest, the species Paratrechinalongicornis has a frequency of 13.24 percent, making it the most frequent, while Camponotuscompressus has a frequency of 11.73 percent, making it the least common, and Tapinoma has no frequency at all (9.55 percent). At the location of the undisturbed forest, the Shannon-Wiener diversity index (H') was much higher than the one at the location of the damaged forest, which was 2.76. (2.46). A forest site that has not been disturbed has a Simpson's index (D) value of 0.086, while a forest site that has been destroyed has a value of 0.067. The compositions and densities of species in these habitats are quite different from one another. It is plausible to assume, in light of these results, that the richness of species, diversity of species, and number of species in the undamaged estuary were much greater than in the degraded forest. This is the result that is brought about not just by the degradation of habitat but also by an increase in the amount of disturbance that is brought about by people. According to research carried out on ants, birds, and butterflies, the species richness and variety of a region both suffer when there is an increase in the total amount of disturbance in that area (Andersen 1995; Blair 1996; Ingalhallikar et al. 2000-2001; Kunte 2000-2001; Pachpor&Ghodke 2000-2001). Research that has been conducted in a variety of countries all across the world According to the findings of various research, habitat degradation, disturbance, and fragmentation have a detrimental influence on the variety of ant species as well as the quantity of those species. The variety of ant species in undisturbed forests is far higher than in habitats that have been disturbed (Greenslade and Greenslade, 1977; Olson, 1991; Suarez et al., 1998; Vasconcelos, 1999; Watt et al., 2002). The research of Kumar et al. (1997) and Pachpor & Ghodke (2000-2001) as well as our own results support the hypothesis that a diverse range of ant species are able to thrive in ecosystems that have an abundance of trees. A range of environmental conditions, such as the quantity of canopy cover and the amount of soil litter, may create the ideal habitat for ants. Ants' preferred habitat may be given by several environmental parameters. This is due to the fact that the places that had not been affected had greater levels of habitat variability and complexity than the ones that had been damaged. In disturbed regions, on the other hand, there are less locations for the various kinds of ants to hide, nest, and seek for food. Myrmicinae found in disturbed environments showed a higher overall relative abundance. This is likely due to the fact that these insects are able to adapt to a broad variety of environmental circumstances and may be discovered in many different habitats all over the globe. According to Bestelmeyer and Wiens (1996) and Andersen (1998), they belong to the Functional Group Generalized Myemecinae (GM) (2000). The same findings were discovered by Savitha, S. et al. in the year 2008. Large quantities of the plant species Paratrechinalongicornis, Solenopsisgeminata, and Tapinomamelanocephalum were found in the degraded forest site. This may be explained by the presence of microhabitats that the aforementioned ant species find to be ideal for their needs. In 2008, researchers Savitha, S. et al. came at the same results as previous studies. Tapinomamelanocephalum is one of the most common species of Dolichodrinae (DD), and it favors warm habitats with plenty of open space. This particular species of ant is very active, hostile, and a significant threat to the survival of the other species found in the colony. That is the basis for this (Suriyapong Y. 2003). Andersen (2000) places Solenopsisgeminata in the Cryptic species functional category. The relative abundance of this species is found to be higher in regions that are more receptive to the arrival of fresh ant swarms (TschinkeI1988; Suarez et al. 1998). It is possible for the richness and abundance of ant species to change based on the canopy cover, the complexity of the ecosystem, and the degree to which it is disturbed, as shown by species diversity indices.

CONCLUSION

The results of this research lead one to the conclusion that the species richness, abundance, and composition of ant populations in urban areas and wetland habitats are highly different from one another. This conclusion may be reached on the basis of the data of this study. Because of the speed with which they adapt to different conditions in their habitat, ants are especially good indicators because of their versatility. When compared to other kinds of invertebrates, such as spiders and hemipterans, ants proved to be an excellent choice for the role of disturbance indicators (Crist, 2009). As a direct consequence of the advantageous circumstances that they have found there, the population of some species of ants has surged in ecosystems that have been disrupted. These favorable situations include: These ideal circumstances include, among other things, locations for nesting, food supply, and open grounds that may be used for foraging. It is essential to carry out in-depth study on disturbed habitats in order to assess their degree of disturbance, the type of the disturbance, the physicochemical qualities of the soil, the climatic conditions, as well as the presence of non-native plant and animal species.

Table 1. The Pitfall trap (PT), the Scented trap (ST), and the Hand collection technique (HC) were used to capture ants in both undisturbed and disturbed areas of the GIB Wildlife Sanctuary during the months of March and May of 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 2. In this research, the amount of ants as well as the different kinds of ants that may be found in both undisturbed and damaged parts of the GIB Wildlife Sanctuary in India are investigated.

Subfamily	Study site	
	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

It should be noted that indicated The numbers included in parentheses contain a significant number of ants.

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

2. 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.

4. 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).

5. 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). Algunasinteraccionesplanta-hormigaen Córdoba (Argentina). Zool. Baetica 11: 3-15. | 9.Farji-Brener and Ruggiero (1994).

6. 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.

7. 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).

8. Some effects of vegetation cover and disturbance on a tropical ant fauna. InsectesSociaux 24:163-182. | 13.Hernández, C.O. (2005). Polinización y Hormigas. - Cambridge University Press. | 14.Hoffmann

9. 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.

10. 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.

11. 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).

12. EstudioFaunístico de lasHormigas (Himenóptera: Formicidae) de la cuenca del Río Guadiamar: Primerasaportaciones. - 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.

13. 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).

14. 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).

15. 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).

16. Effects of fragmentation and invasion on native ant communities in coastal southern California. Ecology 79, 2041–2056 | 29.Suriyapong, Y. (2003).

17. 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).

18. A survey of ants as candidates for potential biology control of pear psylla(CacopsyllapyricolaFoerster) in Michigan[Online](Michigan State University) Dissertation Abstracts MAI32/03. | 31.Townsend, C. R., and Hildrew, A. G. (1994).

19. 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 Solenopsisinvicta and Solenopsisgeminata (Hymenoptera: Formicidae) in northern Florida in relation to habitat and disturbance

20. 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.
21. Biodiversity and Conservation 8: 409-420. | 34.Vázquez, B. M. (1998). Hormigas (Hymenoptera:Formicidae) colectadasennecrotrampas, entreslocalidades de Jalisco, México. - Tesis de Licenciatura, centrouniversitario de CienciasBiológicas y Agropecuarias, Universidad de Guadalajara.
22. 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.

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