

Research Article

Diversity and Composition of Beetles (Order: Coleoptera) of Durgapur, West Bengal, India

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A survey of beetle faunal diversity and composition was studied in Durgapur Municipal Corporation, Durgapur, West Bengal, from January to December 2012. Beetles were collected using standard trapping methods from three different sites selected on the basis of their specific habitat differences, identified up to the level of family, and counted monthly. A total of 9 families were reported from the study site. The second site, that is, Site B, showed the highest diversity. It is also noted that the highest diversity was found during monsoon in all the three sites.

1. Introduction

Coleoptera is an order of insects commonly called beetles. The word “coleoptera” is from the Greek *keleos*, meaning “sheath,” and *pteron*, meaning “wing,” thus “sheathed wing.” The reason for the name is that most beetles have two pairs of wings, the front pair, the “elytra,” being hardened and thickened into a sheath-like or shell-like protection for the rear pair and for the rear part of the beetle’s body. The order Coleoptera includes more species than any other order, constituting almost 25% of all known life-forms [1–3]. About 40% of all described insect species are beetles (about 400,000 species) [4] and new species are discovered frequently. Some estimates put the total number of species, described and undescribed, at as high as 100 million, but a figure of 1 million is more widely accepted [5]. The diversity of beetles is very wide. They are found in all major habitats, except marine and the Polar regions. There are particular species that are adapted to practically every kind of diet. The family Scarabaeidae is the largest family of insects which contains more than 30000 species in the world [6]. Coleoptera are found in nearly all natural habitats, that is, vegetative foliage, from trees and their bark to flowers, leaves, and underground near roots, even inside plants like galls, tissue, including

dead or decaying ones [7]. About 3/4 of beetle species are phytophagous in both the larval and adult stages, living in or on plants, wood, fungi, and a variety of stored products, including cereals, tobacco, and dried fruits. Because many of these plants are important for agriculture, forestry, and the household, the beetle can be considered a pest [8]. Beetles are not only pests but can also be beneficial, usually by controlling the populations of pests. One of the best, and widely known, examples is the ladybug or ladybird (family Coccinellidae). Both the larvae and adults are found feeding on aphid colonies. Other ladybugs feed on scale insects and mealybugs. If normal food sources are scarce, they may feed on other things, such as small caterpillars, young plant bugs, honeydew, and nectar [9]. Ground beetles (family Carabidae) are common predators of many different insects and other arthropods, including fly eggs, caterpillars, wireworms, and others [10]. Dung beetles (Coleoptera, Scarabaeidae) have been successfully used to reduce the populations of pestilent flies and parasitic worms that breed in cattle dung [9]. Dung beetles are taxonomically as well as functionally very important component of terrestrial ecosystem [11].

This study focuses on the diversity of beetles in Durgapur Municipal Corporation. The area is divided into three study sites in order to get an idea on the variety of beetles found.

The study is restricted to the family level of the order Coleoptera. 9 distinct families of beetles were reported from the three sites over a long one-year survey.

Usually diversity studies are conducted in ecologically sound areas with special focus on insects as they are the most diverse group among fauna. Durgapur is an industrial area of major importance in West Bengal. It has large power plants along with cement and iron factories. It has alarming pollution status. Thus it is important to survey the floral and faunal assemblage in this area. A study of the most diverse group of insects, that is, beetles, not only will help to assess the diversity of this area but also will help to carry out further studies to conserve the biodiversity of this industrial belt.

2. Materials and Method

2.1. Study Area. A study was conducted from January to December 2012 at three different sites of Durgapur Municipal Corporation, Durgapur City, West Bengal, India. The geographical location is 23.30 N and 87.20 E with an altitude of 68.9 meters. Durgapur is about 220 Km from Calcutta, capital city of West Bengal. Though Durgapur is an industrial belt, the industrial sector is strictly demarcated from the main city area, which supports good floral assemblage. The metropolitan area is divided into three basic sites for the present study.

Site A is the college campus and its surrounding area that is dominated by Shal tree (*Shorea robusta*). Thus the floral composition is specific and constant.

Site B is the township area that mainly has residential complexes with gardens that support diverse floral composition that usually changes with season.

Site C is a wetland located near Amravati, surrounded by grasslands supporting different vegetation.

2.2. Field Method. Beetle sampling was done fortnightly from the three sites. For good collection two distinct standard methods were used. Pitfall traps were set up in all the three sites and were monitored every day. Light traps were also used specially in Site B. Apart from these, handpicking is also done. Sometimes shrubs and tree branches were heavily shaken so that beetles may fall on already spread large white sheets. After collection each specimen was preserved in 4% formalin and stored in small vials with proper labeling. Identification up to the family level was done using standard identification manual [12, 13].

2.3. Data Analysis. As beetles are reported to be the diverse group of insects, main focus of the present study is to estimate the diversity of beetles in this region. Different diversity indices were calculated, of which the widely used Shannon diversity indices were the most important, as it is widely accepted that all species at a site, within and across systematic groups, equally contribute to its biodiversity [14, 15]. A comparison of the diversities in the three different sites was also evaluated. These estimates were calculated using the

TABLE 1: Presence and absence of beetle families in three sites.

	Site A	Site B	Site C
Scarabaeidae	+	+	-
Carabidae	+	+	+
Chrysomelidae	+	+	-
Coccinellidae	+	+	-
Borydae	-	+	-
Lycidae	-	+	-
Curculionidae	-	+	-
Hydrophilidae	-	-	+
Derodontidae	-	-	+

standard software PAST. Graphical representation of monthly variation of beetle diversity was done using MS Excel.

3. Results and Discussion

After a long one-year study, 9 distinct families were identified from the three study sites (Table 1). These are Scarabaeidae, Carabidae, Chrysomelidae, Coccinellidae, Borydae, Lycidae, Curculionidae, Hydrophilidae, and Derodontidae. The last two families were strictly restricted to Site C, that is, the wetland. Families Borydae, Lycidae, and Curculionidae are reported only from Site B.

The total numbers of beetle of each family for each site are given in Figures 1, 2, and 3.

Diversity analysis study reveals that in Site A the Shannon Diversity indices gradually increase from January (1.18) and reaches the peak by June-July (1.35) and then slowly decrease to the end of the year (Table 2). Lowest value of Shannon Diversity is noted in the month of November (1.10). Similarly the Simpson (D) index is highest in the months of June-July (0.73) and lowest in November (0.59). Evenness values are also in accordance with the other diversity indices.

Similar studies in Site B reveal that Shannon Diversity is highest in the month of July (1.85) and lowest in the months of October-November (1.75). The dominance and evenness values also indicate a similar trend, that is, higher values in July and lower values in the months of October-November (Table 3).

Diversity analysis of Site C predicts that the Shannon Diversity index is more or less within a range of 1.05–1.10 from January to August but is low in the winter months. The other indices are also similar for this site (Table 4).

When the diversity indices were compared for all three sites together (Table 5), it predicted that Site B has the highest diversity, that is, Shannon Diversity (1.81), is and low for site C (0.66); the Dominance_D is low in Site B and high in Site C.

The shared species statistics between the three sites is done by Bray-Curtis cluster analysis and the Bray-Curtis similarity index is also calculated (Table 6). The Bray-Curtis similarity index shows 69.3% similarity between Site A and Site B and 12% similarity between Site A and Site C, whereas minimal similarity is seen between Site B and Site C (7%).

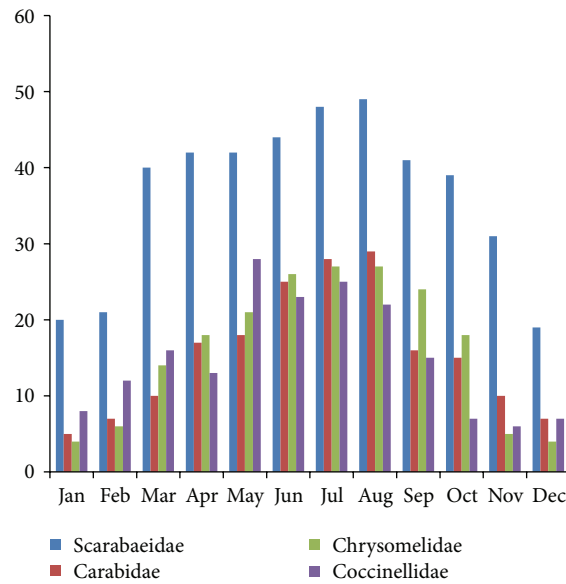


FIGURE 1: Total number of beetles of each family throughout the year at Site A (College Campus and surrounding).

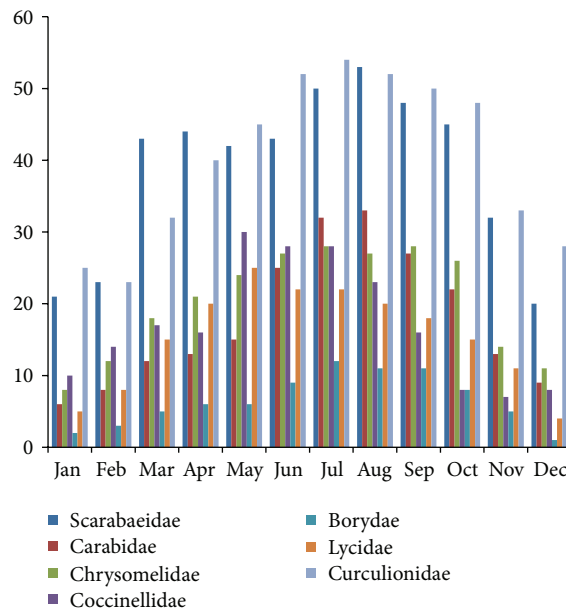


FIGURE 2: Total number of beetles of each family throughout the year at Site B (residential area).

TABLE 2: Diversity indices of Site A.

Site A	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Families	4	4	4	4	4	4	4	4	4	4	4	4
Individuals	37	46	80	90	109	118	128	127	86	79	52	37
Dominance_D	0.37	0.32	0.34	0.31	0.28	0.27	0.27	0.28	0.32	0.34	0.41	0.35
Simpson_1-D	0.63	0.68	0.66	0.69	0.72	0.73	0.73	0.72	0.68	0.66	0.59	0.65
Shannon_H	1.18	1.26	1.23	1.27	1.33	1.35	1.35	1.34	1.27	1.22	1.10	1.21
Evenness_e^H/S	0.81	0.88	0.86	0.89	0.95	0.96	0.96	0.95	0.89	0.84	0.75	0.84

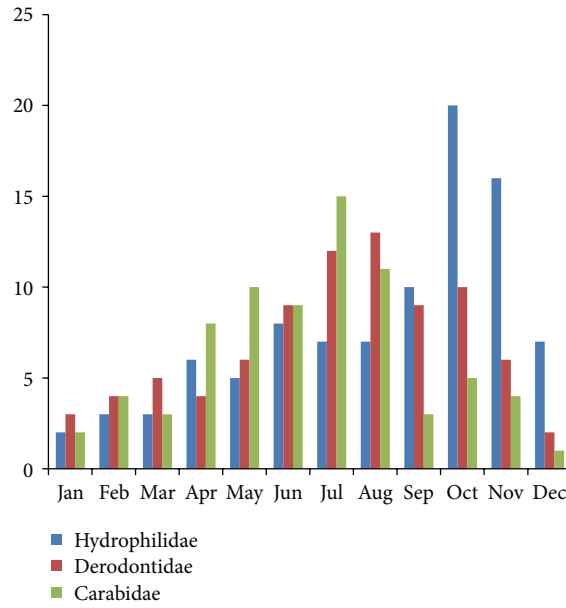


FIGURE 3: Total number of beetle of each family throughout the year at Site C (wetland).

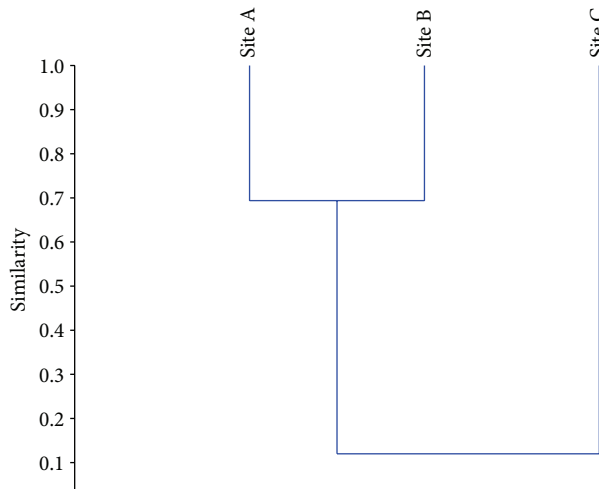


FIGURE 4: Bray-Curtis cluster analysis (single linkage).

The Bray-Curtis cluster analysis data shows that Site A and Site B form a small cluster and Site C is joined to it through a bigger cluster (Figure 4). This also suggests that Site A and Site B are similar in faunal composition rather than Site C.

4. Conclusions

It can be concluded that Durgapur though being an industrial city harbors a diverse variety of beetles. The most obvious reason is that being an industrial city, Durgapur has rich floral diversity that can support large growth of fauna. Even the municipality is well aware of the threats of an industry. As a result, the industrial belt is totally cut off from the main city centre.

The present study demonstrates that Site A and Site B are much diverse than Site C. Each of the sites shows highest diversity (as obtained from the calculated diversity indices) in June-July (monsoon) compared to Site C. Thus monsoon is the time when maximum beetles are found. It is known that most animals prefer monsoon as their breeding season as it is favorable and resourceful for their proper growth and survival. This study predicts that beetles are no exception to this occurrence. It is also true that insects usually avoid harsh winter through diapause, thus diversity of beetles in all three sites are least in winter months.

The floral composition of Site C is distinct from the other two sites. Only three families, namely, Hydrophilidae, Derodontidae, and Carabidae, are reported. The diversity indices also demonstrate a low diversity profile with high

TABLE 3: Diversity indices of Site B.

Site B	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Families	7	7	7	7	7	7	7	7	7	7	7	7
Individuals	77	91	142	160	187	206	225	220	198	172	115	81
Dominance_D	0.22	0.19	0.19	0.19	0.18	0.17	0.17	0.17	0.18	0.20	0.20	0.22
Simpson_1-D	0.78	0.81	0.81	0.81	0.82	0.83	0.83	0.83	0.82	0.80	0.80	0.78
Shannon_H	1.69	1.79	1.78	1.79	1.82	1.84	1.85	1.84	1.82	1.75	1.75	1.66
Evenness_e^H/S	0.78	0.86	0.85	0.85	0.88	0.90	0.91	0.90	0.88	0.83	0.82	0.75

TABLE 4: Diversity indices of Site C.

Site C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Families	3	3	3	3	3	3	3	3	3	3	3	3
Individuals	7	11	11	18	21	26	34	31	22	35	26	10
Dominance_D	0.35	0.34	0.36	0.36	0.37	0.33	0.36	0.35	0.39	0.43	0.46	0.54
Simpson_1-D	0.65	0.66	0.64	0.64	0.63	0.67	0.64	0.65	0.61	0.57	0.54	0.46
Shannon_H	1.08	1.09	1.07	1.06	1.05	1.10	1.05	1.07	1.00	0.96	0.93	0.80
Evenness_e^H/S	0.98	0.99	0.97	0.96	0.96	1.00	0.96	0.97	0.90	0.87	0.84	0.74

TABLE 5: Comparison of diversity indices of three sites.

	Site A	Site B	Site C
Families	4	7	3
Individuals	999	1881	252
Dominance_D	0.30	0.18	0.34
Simpson_1-D	0.70	0.82	0.66
Shannon_H	1.30	1.81	1.09
Evenness_e^H/S	0.92	0.87	1.00

TABLE 6: Similarity index for three sites.

Sample 1	Sample 2	Bray-Curtis index
Site A	Site B	0.693
Site A	Site C	0.120
Site B	Site C	0.070

dominance. Beetles belonging to this site are water beetles and dominate the wetland area thus hindering other beetle families from flourishing. Thus Site C has a different beetle composition from the other two sites. This is also shown in the similarity index and cluster analyses. The only common family of these three sites is Carabidae. The only possible and reasonable conclusion will be that Carabids can explore different habitats. Site B has the highest diversity. It is a residential area and was thought to harbor the least number of beetles, but results obtained were just the opposite. Though being an area of concrete jungle, each and every house has a large expanse of gardens with diverse floral composition, that is, varieties of trees, shrubs, and bushes providing diverse habitat that can support a large variety of beetles.

Though the beetle varieties seen in Site A and Site B are more or less similar, diversity indices are high in Site B. This can be explained as Site A has a fixed floral range, mostly Shal trees (*Shorea robusta*) that can support selective variety of beetles only.

Due to expansion of urban areas, more sites that protect biodiversity are required. This study suggests that an industrial town with high pollution threats, Durgapur, can nonetheless harbor a large number of beetles. Keeping this in mind, further studies can be conducted at other industrial sites for different floral and faunal groups.

Conflict of Interests

The author declares that there is no conflict of interests.

References

- [1] J. A. Powell, "Coleoptera," in *Encyclopedia of Insects*, H. Vincent Resh and T. Ring Cardé, Eds., p. 199, Academic Press, New York, NY, USA, 2nd edition, 2009.
- [2] M. L. Rosenzweig, *Species Diversity in Space and Time*, Cambridge University Press, 1995.
- [3] T. Hunt, J. Bergsten, Z. Levkanicova et al., "A comprehensive phylogeny of beetles reveals the evolutionary origins of a superradiation," *Science*, vol. 318, no. 5858, pp. 1913–1916, 2007.
- [4] P. M. Hammond, "Species inventory," in *Global Biodiversity, Status of the Earth's Living Resources*, B. Groombridge, Ed., pp. 17–39, Chapman & Hall, London, UK, 1992.
- [5] A. D. Chapman, *Numbers of Living Species in Australia and the World*, Department of the Environment, Water, Heritage and the Arts, 2nd edition, 2009.
- [6] G. T. Fincher, W. G. Monson, and G. W. Burton, "Effect of cattle faeces rapidly buried by dung beetles on yield and quality of Bermudagrass," *Agronomy Journal*, vol. 73, pp. 775–779, 1981.
- [7] P. J. Gullan and P. S. Cranston, *The Insects: An Outline of Entomology*, John Wiley & Sons, Oxford, UK, 4th edition, 2010.
- [8] C. Gilliott, *Entomology*, Springer, New York, NY, USA, 2nd edition, 1995.
- [9] J. Brown, C. H. Scholtz, J.-L. Janeau, S. Grellier, and P. Podwojewski, "Dung beetles (Coleoptera: Scarabaeidae) can improve soil hydrological properties," *Applied Soil Ecology*, vol. 46, no. 1, pp. 9–16, 2010.

- [10] B. Kromp, "Carabid beetles in sustainable agriculture: a review on pest control efficacy, cultivation impacts and enhancement," *Agriculture, Ecosystems and Environment*, vol. 74, no. 1-3, pp. 187-228, 1999.
- [11] N. Kakkar and S. K. Gupta, "Temporal variations in dung beetle (Coleoptera: Scarabaeidae) assemblages in Kurukshetra, Haryana, India," *Journal of Threatened Taxa*, vol. 1, no. 9, pp. 481-483, 2009.
- [12] P. M. Choate, "Introduction to the Identification of Beetles (Coleoptera). Dichotomous Keys to Some Families of Florida Coleoptera," pp. 23-33, 1999.
- [13] *Beetles Associated With Stored Products in Canada: An Identification Guide*, Yves Bousquet Biosystematics Research Centre Ottawa, Ontario, Canada, 1990.
- [14] K. N. Ganeshaiyah, K. Chandrashekara, and A. R. V. Kumar, "Avalanche index: a new measure of biodiversity based on biological heterogeneity of the communities," *Current Science*, vol. 73, no. 2, pp. 128-133, 1997.
- [15] V. G. Thakare, V. S. Zade, and K. Chandra, "Diversity and abundance of scarab beetles (Coleoptera: Scarabaeidae) in kolkas region of Melghat Tiger Reserve (MTR), District Amravati, Maharashtra, India," *World Journal of Zoology*, vol. 6, no. 1, pp. 73-79, 2011.



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