COLEOPTERAN DIVERSITY AT THE THREE SELECTED AREAS IN DHAKA CITY, BANGLADESH

Sadia Afroz¹, Md. Aminul Islam^{2*}, Md. Abdul Alim¹ and Fatema-Tuz-Zohora¹

Department of Zoology, Faculty of Life and Earth Sciences, Jagannath University Dhaka 1100, Bangladesh

Abstract: The diversity of coleopteran species was studied at three different selected areas in Dhaka city from December 2016 to November 2017. A total of 11,397 individuals of 56 coleopteran species belonging to 50 genera, including 15 families, were recorded in the study areas during the study period. Of them, 47 species (4916 individuals) of 13 families were found at the Ramna Park, 48 species (2441 individuals) of 15 families at the National Botanical Garden, and 42 species (4040 individuals) of 11 families at the Atomic Energy Research Establishment (AERE) campus. A total of 30 species, 25 genera, and 11 families were common in these three study areas. At the Ramna Park, the highest species richness included the family Chrysomelidae (34.04%), and the lowest was under the six families including Staphylinidae, Bostrichidae, Nitidulidae, Geotrupidae, Erotylidae, and Scarabaeidae (2.13%). At the National Botanical Garden, the maximum number of species was recorded under the family Chrysomelidae (6.24%), and the lowest was under seven families including Staphylinidae, Bostrichidae, Nitidulidae, Geotrupidae, Erotylidae, Elateridae, and Dermestidae (2.08%). The maximum number of coleopteran species was identified under the family Chrysomelidae (35.71%), and the lowest was under six families including Staphylinidae, Cerambycidae, Nitidulidae, Geotrupidae, Elateridae, and Dermestidae (2.38%) at the AERE campus. The Shanon's Diversity Index (H') and Simpson's Index (λ) indicate high coleopteran diversity at the Ramna Park (H'=3.41, λ =0.05), the AERE Campus (H'=3.07, λ =0.06), and the National Botanical Garden (H'=2.93, λ =0.08). The high species evenness in the Ramna Park (J'= 0.89) and the AERE campus (J'= 0.82) indicates that the species were evenly distributed, whereas at the National Botanical Garden (J'= 0.76) they were comparatively less evenly distributed. The calculated Sorenson's Coefficient (CC) is 0.66, indicating that these three communities were fairly similar or overlapped. The Community Dominances were 21.03%, 32.16% and 18.66% for the Ramna Park, National Botanical Garden, and AERE campus, respectively.

Key Words: Coleopteran Diversity, Diversity Index, Species Evenness, Community Similarity and Dominance.

INTRODUCTION

Coleopterans (Insecta: Coleoptera) are the most diverse, species-rich and major ecosystem service providers than any other order, representing about 25% of all known type of animal life forms (Powell 2009, Foster and Rosenzweig 1995). Coleopterans are herbivores, predatory, scavengers and organic decomposers with highly specialized host range or life cycles (Thakare and Zade 2012). They

^{*}Author for correspondence: < aminul.ek@du.ac.bd>, ²Department of Zoology, Faculty of Biological Sciences, University of Dhaka, Dhaka 1000, Bangladesh

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distribute from forest to the desert, subterranean caverns and in freshwater habitats (Booth and Pope 1989). Study of the whole beetle component of forest diversity has been seriously hindered owing to the lack of identification manuals. Beetles are about 40% of all described insect species and new species are discovered regularly (Hammond 1992). About 500 families and subfamilies are recognized under four suborders (Powell 2009). About 1,50,88 species are known among 3,50,000 coleopteran species from Indian region (Kuschel 1990). Various colorful coleopterans are found in different places in Bangladesh. Environment factors such as vegetation, food availability, temperature and wind exposure always influence the patterns of coleopteran diversity (Khan et al. 2004). Begum and Oppenheimer (1981) observed seasonality, habitat, food, and partial distribution of 36 coleopteran species from different parts of Bangladesh. A total of 24 species of Scarabaeidae under three sub families (Rutelinae, Dynastinae and Aphodiinae) have been recorded by Kabir et al. (1990) in Bangladesh. In total, 395 Coleopterans were observed in four study areas of Chittagong University campus (Nasiruddin and Shiuli 2017). A total of 14 species have been listed of coleopterans at Chittagong University campus in Bangladesh by DNA barcoding of malaise trap collection (Mazumdar et al. 2021). Dhaka is the metropolis of Bangladesh having a tropical savanna climate which is very comfortable for coleopterans. However, no detail study has done on the coleopteran diversity in Dhaka city. The aim of this study was to investigate coleopteran abundance, species diversity, richness, evenness, community similarity, and dominance at the three selected areas in Dhaka city, Bangladesh.

MATERIAL AND METHODS

Study Area and sampling procedure: This research was carried out in the Ramna Park, National Botanical Garden and AERE campus (Fig.1). Several methods were used for sampling beetle. Sweep netting was used to collect insects from above-ground vegetation and foliage. Some species were collected by hand picking. Mostly aerial beetles were collected using sweep net. Ground dwelling beetles were collected with pitfall trap (Nayundo and Yarro 2007). Other types were collected by insect net. Collected insect were stored and killed by keeping them in killing jar filled with 70% alcohol. In every month in any type of weather beetles were counted diurnally at a constant time usually from 8 am to 1 pm and 2 pm to 4 pm. The survey was done in 15 days interval in a month. Collecting areas constitute 100 m area surrounding the spot facilities.

Preservation: After the collection of beetle from field, envelope or collecting jar had been used for temporary storage of the insects. Then they were carried to the Entomology Laboratory of the Department of Zoology, Jagannath University.

Then they placed in 70% alcohol or water for killing and keep outside as soon as possible for colour preservation. Each envelope was labeled with paper and permanent ink or marker pen. Then the specimen was stretched by a stretching board and preserved in wooden box by pinning for further taxonomic analysis. Other large beetles were dried by pinning in laboratory.



Fig.1. Map of the Dhaka district of the three study areas.

Identification: Photographs of the beetles were taken with the aid of a digital camera (Sony, DSC-W610). The identification was done with the standard keys (Bousquet 1991, Choate 2003), available literature (Caspers 1976) and the coleopteran related websites. The abundance of coleopteran status included in five categories. Species which observed a total of abundance exceeding 50 individuals were described as very common (VC, more than 50 sightings), common (CC: 11-50 sightings), rare (RR: 4–10 sightings), very rare (VR: 2 or 3 sightings), Single Specimen (SS) (Kuschel 1990).

Data analysis: Data were analyzed by making diversity and dominancy index. Species diversity (Shannon-Weiner index), Component of dominance (Simpson dominance index), Species Evenness (pielou index), Community Similarity and Dominance were analyzed. Comparative species diversity for three different locations to measure their dominancy was also analyzed. The recorded species in this research was ranked on the basis of relative abundance of the individuals. Sampling completeness was calculated as ratio of observed species richness to the average species richness estimate value and expressed as percentage. *Diversity Analysis:* As models as a measure of diversity the experiment used Shannon's Diversity Index (H') (Shannon and Weiner 1949) and Simpson's Index (λ) (Simpson 1949). The formulae for the two indices:

Shannon's Diversity Index (H') = $\sum_{i=1}^{S} pi \ln pi$, Simpson's Index (λ) = $\sum_{i=1}^{S} pi^2$ Where, p = the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), \ln = the natural log, Σ = the sum of the calculations and S = the number of species. The range of optimum values of H' are generally between 1.5 and 3.5 in the most ecological researches, and the value is rarely greater than 4.

Simpson's Index of Diversity (1- λ): It shows measurement of diversity by which the probability of two randomly selected individuals in a community belongs to different categories e.g. species can be recognized. Its value ranges between 0 and 1, where, high scores (close to 1) and low scores (close to 0) show high and low diversity, respectively (Simpson 1949).

Simpson's Reciprocal Index $(1/\lambda)$: It measures the relative biodiversity of a community which is used to compare communities to identify intrinsic qualities. A high index value indicates a stable site with many different richness and low competition. A low value of $1/\lambda$ represents a site with a few potential niches where only a few species dominate. This value may alter in response to the ecological interference (MacDonald *et al.* 2017).

Species Richness (SR): The following equation which was used for Species Richness, $SR = \frac{S-1}{\log N}$, Where, S= Total number of species in a sample, N= Total number of individuals of all species (Gleason 1922).

Species Evenness (J'): Species evenness (J) (equitability) was calculated using the formula of: $J' = H' / \ln S$, Where, J' = Species Evenness, H' = Species Diversity, S = Number of the species (Pielou 1966).

Community Similarity (CC): It is expressed by Sorenson's Coefficient (CC). The formula is: Sorenson's Coefficient (CC) = $\frac{3C}{S_1+S_2+S_3}$ (Sorenson 1948), Where, C= The number of common species in the three communities, S₁=Total number of species found in community 1, S₂= Total number of species found in community 2, S₃= Total number of species found in community 3.

Community Dominance (CD): Percentage of abundance contributed by two most abundant species is the simple community dominance index. The equation is: $CD(\%) = \frac{y_1+y_2}{y} \times 100$, Where, y_1 = number of individuals of most dominant species or the rank-1 species, y_2 = number of individuals of the 2nd dominant species or the rank -2 species.

y = Total number of individuals of all species (McNaughton 1968).

Results and Discussion

A total of 11,397 individuals of 56 species of 50 genera belonging to 15 families recorded from the Ramna Park, National Botanical Garden, and AERE campus (Table 1, 2 and 3). Of them 47 species (4916 individuals) under 13 families were found in the Ramna Park (Table 1), 48 species (2441 individuals) under 15 families were found in National Botanical Garden (Table 2), and 42 species (4040 individuals) under 11 families were found in Atomic Energy Research Establishment (AERE) (Table 3). In three study areas, a total of 30 species, 25 genera and 11 families were in common. Each of the study areas the highest species richness found under the family Chrysomelidae in which 16 species at the Ramna Park, 13 species at the National Botanical Garden, and 15 species at the AERE campus. An analogous study was conducted by Kalaichelvan *et al.* (2005) at Central India that revealed a total of 95 species under the family Chrysomelidae.

At the Ramna Park, family-wise coleopteran species richness and population are shown in the Fig. 4 and 5. The highest coleopteran species was under the family Chrysomelidae (16 spp., 34.04%) followed by Coccinellidae (14 spp., 29.79%), Curculionidae (3 spp., 6.38%), Carabidae, Cantharidae, Cerambycidae, Tenebrionidae (2 spp., 4.26%), and the lowest was in the 6 families included Staphylinidae, Bostrichidae, Nitidulidae, Geotrupidae, Erotylidae, Scarabaeidae (1 sp., 2.13%) (Fig. 4 and Table 1). The peak population was in the family Chrysomelidae (2199) and the minimum in the family Tenebrionidae (6) (Fig. 5). The maximum population was recorded in the month of March (14.04%) followed by April (12.71%), February (12.63%), May and January (10.80%), June (8.28%), July (7.20%), September (5.13%) December (7.16%), August (5.07%), October (3.42%), and the minimum was in the November (2.77%) (Fig.6). Among them, Aulacophara foveicollis (532) was the most dominant species followed by Altica chalybea (319) and Monolepta signata (313) (Table 1). On the other hand, Ambrosiodmus rubricollis and Amara ampicollis (1) were in the lowest population followed by Teragonothorax gyllenhali (2), Propylea dissecta, Crypticus quisquilius, Gonocephalum coriaceum (3), Amalusha emorrhous and Dicladispa testacea (6), Ocys harpaloides (10). Among observed species 24 were very common (VC), 13 were common (CC), 4 were rare (RR), 4 were very rare (VR), and 2 were single (SS) (Table 1). A preliminary study was conducted by Sharma et al. (2004) on beetles in kalatop-Khanjjiar Wildlife Sanctuary, Himachal Pradesh that recorded 18 species under 16 genera belonging to 9 families.

Family-wise coleopteran species richness and population at the National Botanical Garden are shown in Fig. 4 and 5. The highest coleopteran species was in the family Chrysomelidae (13 spp., 6.24%) followed by Coccinellidae (10 spp., 20.83%), Curculionidae (5 spp., 10.42%), Carabidae (4 spp., 8.33%), Cantharidae, Cerambycidae, Tenebrionidae, Scarabaeidae (2 spp., 4.17%,), and the lowest was in the 7 families included Staphylinidae, Bostrichidae, Nitidulidae, Geotrupidae, Erotylidae, Elasteridae, dermestidae(1 sp., 2.08%)(Fig 4 and Table 2). The peak population was in the family Coccinellidae (892) and the minimum in the family Dermestidae (4) (Fig 5). The maximum population was recorded in the month of April (12.86%) followed by February (11.43%), January (11.14%), March (10.86%), May (10.77%), December (8.32%), June (8.11%) July (6.39%), September (5.78%), October (5.49%), August (5.00%), and the minimum was in the November (3.85%) (Fig.6). Cheilomenes sexmaculata (502) was the most dominant species followed by Atrecus affinis (283) and Coccinella transversalis (191) (Table 2). While A. emorrhous and T. gyllenhali (1) were in the lowest population followed by O. harpaloides and Exochomus flavipes (3), Acalles aubei, Henosepilachna pusillanima, Oenopia quadripunctata and Dermestes lardarius (4). Among observed species, 11 were very common (VC), 24 were common (CC), 9 were rare (RR), 2 were very rare (VR) and 2 were single specimen (SS) (Table 2). McCormack et al. (2021) represented 21 diverse families including Curculionidae, Scarabaeidae, Carabidae, Tenebrionidae, and Cerambycidae, whereas the family Staphylinidae comparatively less diverse in Lizard Island of Great Barrier Reef Australia.

At the AERE campus, family-wise coleopteran species richness and population are shown in Fig. 4 and 5. The highest coleopteran species was in the family Chrysomelidae (15 spp., 35.71%) followed by Coccinellidae (12 spp., 28.57%), Curculionidae (4 spp., 9.52%), Tenebrionidae (3 spp., 7.14%), Cantharidae (2 spp., 4.76%), and the lowest was in the 6 families included Staphylinidae, Cerambycidae, Nitidulidae, Geotrupidae, Elateridae, Dermestidae (1 sp., 2.38%) (Fig 4 and Table 3). The peak population was in the family Chrysomelidae (1878), and the minimum in the family Dermestidae (2) (Fig. 5). The maximum population was recorded in the month of March (14.85%) followed by April (13.64%), February (12.65%), January (11.26%), May (10.50%), Dec (9.06%) June (8.04%), July (5.89%), August (4.95%) September (3.71%), October (3.00%), and the minimum was in the November (2.45%) (Fig.6). In this study area, Aulacophara foveicollis (381) was the most dominant species followed by Cheilomenes sexmaculata (373) and Atrecus affinis (335) (Table 3). Whereas, Dicladispa testacea (1) was in the lowest population followed by Dermestes lardarius (2), Platydema sp. (3), Aspidomorpha sanctaecrucis and Amalus haemorrhous (4). Among recorded species, 18 were very common (VC), 12 were common (CC), nine were rare (RR), two were very rare (VR) and one was single (SS) (Table 1). Similar work carried out by Khan et al. (2007).

The current findings were concurred with those of Kazmi and Ramamurthy (2004), who found 99 species of Coleoptera from Rajasthan's Thar desert, belonging to 60 genera in 13 families. In the present investigation, the three research locations illustrate the various diversity and abundance of Coleoptera. While Chandra (2012) described 24 species of scarabaeid beetles from Madhya Pradesh, only two scarabaeids were included in the current study. Begum and Oppenheimer (1981) also identified 35 species under eight genera, of which 20 species belong to the genus Onthophagous, three species of each of the genus Caccobious and Oniticellus, and one species each of the genus Copris, Heliocopris, Onitis, and Gymnopleurous from various regions of Bangladesh. Moreover, 24 species of Scarabaeidae were discovered in Bangladesh by Kabir et al. (1990). Bouchard et al. (2005) counted 73 species of weevils from southern Quebec, Canada, while the current study only included five species of weevils. Whereas the current study had a total of 16 leaf eaters, Kalaichelvan and Verma (2005) surveyed and collected 95 species of leaf beetles from Bhilai-Drug, Central India. Several families of beetles, including the Carabidae and Tenebrionidae, were noted by Irshad and Hag (2010). Similar to that, the current survey contained three species of Tenebrionidae and four species of Carabidae. During a thorough investigation of predatory Coccinellid beetles conducted by Khan et al. (2007) over a period of seven months in the Chitral District of Pakistan, a total of 12 species belonging to nine genera were recorded from 12 different sites. According to Hava (2005), the UAE is home to nine Dermestidae species. Three new species were also discovered at that time. In total, 14 different species of ladybird beetle were identified in the current investigation. Environmental factors like vegetation, food availability, temperature, and wind exposure, as per Khan et al. (2004), consistently affect the patterns of coleopteran diversity. In a New Zealand case study carried out by Kuschel (1990), he referred to 982 beetle species from 65 families, of which 753 were found endemic in that region. In contrast, in Bangladesh, proper scientific work on coleopteran species needed to be explored.

The values of various indices of species diversity at the Ramna Park, National Botanical Garden, and AERE campus are shown in Tables 1, 2, and 3, respectively. In this study, Shanon's Diversity Index appears to have a high value and Simpson's Index provides the low value in this study, indicating plenteous diversity richness for coleopteran species in these three selected areas. Ganeshaih *et al.* (1997) stated that the diversity index H' appears useful because it incorporates species richness. As per Ludwing and Reynolds (1988), the value of λ decreased as diversity increased. Simpson's Index of Diversity and Simson's Reciprocal Index of these three areas represent high coleopteran diversity. The evenness index provides insight into the relative abundance of the

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Cays huspinoides (Audin Cast hubaris narrotations (Audin Cantharis narrotan (Audin Staphylinidae Arreus arginis (Payskul), Chilonentes speamaculat Chilonentes propingua ni Chilonentes propingua ni Coccinella septempurea (Li Cycloneda scruguinea (Li Excohomute famoles pusillari Henoseptiachua pusillari	net-Serville, 1821) uller, O.F 1776) ooli, 1763) , 1789)	Dark brown Ground beetle Soldier beetle	1	SS	0.000203417413	4.13786439e-8	-8.50025047	-0.00172909896
Cantharidae Cantharis nigricans (Mu Rhagorycha Julus (Seop Rhagorycha Julus (Seop Areaus affinis (Febri Coccinellidae Cheilomenes sexmaculat Cheilomenes sexmaculat Cheilomenes proprigua Cheilomenes proprigua Cheilomenes proprigua Cheilomenes proprigua Cheilomenes anguinen (Liebu Cycloneda sanguinen (Lie Cycloneda sanguinen (Lie Henoseptiachun pusillan Henoseptiachun udintio	uller, O.F 1776) 201i, 1763) 1789)	Soldier beetle	10	RR	0.00203417413	4.13786439e-6	-6.19766538	-0.0126071306
Rhagonycha fulva (Scopo Staphylinidae Arreusa stramartis (Paykull, Coccinelidae Crhitonenes stramarular Chilonenes propingua ni Chilonenes propingua ni Coccinella septempancta Coccinella rensversatis (Cycloneda sanguinea (Li Exodomus faupes (Thi Exodomus faupes (Thi Exodomus progradrap pusillar	ooli, 1763) , 1789) 4. 1781)		88	VC	0.0179007323	0.000320436217	-4.02291366	-0.0720131005
Staphylinidae Atrecus diffnis (Paykalli, Coccinelidae Cheliomenes sexumaculat Chilomenes sexumaculat Chilomenes proprigua ni Coccinella aspenymuncta Coccinella transversalis (Cycloneda sanguinea (Li Exochomus flavipes (Thu Henoseptachna pusiltan	, 1789) 44 (Polynic 1781)	Common red soldier beetle	197	VC	0.0400732303	0.00160586379	-3.21704674	-0.128917455
Cooccinellidae Cheilomeres sexmacular Chiacons ingrid. (Febri) Chiacons ingrid. (Febri) Chiamenes proprigua in Coccinella septempuncta Coccinella ransversatis) Cycloneda sanguinea (Li Exochomus flaujees (Thu Henoseptachna pusillari Henoseptachna viorityco	the Interior 1781)	Rove beetle	138	VC	0.0280716029	0.000788014889	-3.57299679	-0.100299747
Chiloconts nigrito. (Febri Chiloconts nigrito. (Febri Chilomenes progragua ta Coccinella septempuraca Coccinella transversatiis Cycloneda scraguinea (II Exochomus faunges (ITIL Henoseptlachta uidmitoc	nu [raunuus, 1/01]	6 spotted zigzag lady bird	502	VC	0.102115541	0.0104275837	-2.28165035	-0.23299196
Chilomenes propringua ni Coccinella rensuersalis Coccinella transuersalis Cycloneda sanguinea (Li Exochomus flavipes (Thu Henosepilachna pusillaan Henosepilachna vianitos	ricius. 1798)	Black ladvbird	20	CC	0.00406834825	1.65514575e-5	-5.5045182	-0.022394297
Coccinella septempuncta Coccinella rerausersalis) Cycloneda songuinea (lla Exochomus flaupes (Thu Henoseptachna pusillarn Henoseptachna vionitoi	nilitica (Mulsant, 1850)	No English name found	123	VC	0.0250203417	0.000626017499	-3.68806612	-0.0922766745
Coccinella transversalis (Cycloneda sanguinea (Li Exochonne flavines (Thu Henosepilachna pusillan Henosepilachna vlaritioc	ata (Linnaeus, 1758)	7 spotted lady beetle	280	VC	0.0569568755	0.00324408567	-2.86546087	-0.163207698
Cycloneda sanguinea (Li Exochomus fiavipes (Thu Henosepilachna usailtan Henosepilachna utaintio	(Febricius, 1781)	Tranverse lady beetle	242	VC	0.0695687551	0.00483981169	-2.66543973	-0.185431324
Exochomus flavipes (Thu Henosepilachna pusillan Henosepilachna viaintioc	innaeus, 1763)	Orange spotless lady beetle	60	VC	0.0122050448	0.000148963119	-4.4059059	-0.0537742789
Henosepilachna pusillan Henosepilachna viaintioc	unberg. 1781)	No English name found	40	cc	0.0081366965	6.62058299e-5	-4.81137102	-0.0391486657
Henosepilachna viaintioc	nima (Mulsant, 1850)	Epilachnine beetle	171	VC	0.0347843775	0.00120995292	-3.35858692	-0.116826355
	ctopunctata (Fabricius,	28 spotted potato lady bird	87	VC	0.0176973149	0.000313194955	-4.03434235	-0.071397027
1775)								
Illeis koebelei (Timberlak	ke, 1943)	Yellow spotless lady beetle	16	cc	0.0032546786	1.05929328e-5	-5.72766175	-0.0186416981
Micraspis discolor (Febri	ricius, 1798)	Spotless lady beetle	214	VC	0.0435313263	0.00189497637	-3.13427446	-0.136439124
Micraspis hirashimai (Sa	amuelson, 1965)	No English name found	175	VC	0.0355980472	0.00126722096	-3.3354645	-0.118736023
Oenopia quadripunctata	z (Kapur, 1963)	Yellow spotted lady beetle	31	2	0.00630593979	3.97648766e-5	-5.06626327	-0.0319475511
Propylea dissecta (Mulsa	ant, 1850)	Aphidophagus lady beetle	3	VR	0.000610252238	3.72407794e-7	-7.40163818	-0.00451686626
Cerambycidae Graphisurus sp. (Kirby,	, 1837)	Gray longhorn beetle	18	CC	0.00366151343	1.34066806e-5	-5.60987871	-0.205406462
Trachysida mutabilis (Ne	(ewman, 1841)	Black longhorn beetle	36	S	0.00732302685	5.36267222e-5	-4.91673153	-0.036005357
Tenebrionidae Crypticus quisquilius (Lir	innaeus, 1760)	No English name found	3	VR	0.000610252238	3.72407794e-7	-7.40163818	-0.00451686626
Gonocephalum coriaceun	m (Motschulsky, 1857)	Darkling beetle	e	VR	0.000610252238	3.72407794e-7	-7.40163818	-0.00451686626
Bostrichidae Sinoxylon anale (Lesne,	1897)	Auger beetle	23	S	0.00467860049	2.18893025e-5	-5.36475625	-0.0250995512
Nitidulidae Stelidota geminate (Say	7 1825)	Sap beetle	45	CC	0.00915378356	8.37917535e-5	-4.69358798	-0.0429640885
Geotrupidae Anoplotrupes stercorosus	<i>us</i> (Scriba, 1791)	Earth boring Dung beetle	42	cc	0.00854353133	7.29919276e-5	-4.76258085	-0.0406892587
Erotylidae Megalodacne fasciata (Fa	abricius, 1777)	Fungus beetle	10	RR	0.00203417413	4.13786439e-6	-6.19766538	-0.0126071306
Scarabaeidae Phyllophaga crinite (Bur	(rmeister, 1855)	White grub scarab	30	cc	0.00610252238	3.72407794e-5	-5.09905309	-0.0311170856
Total 47			N=4916		-	0.052802625	-224.8163913	-3.413330073

Number of species (S) = 47, Total number of individual (N) = 4916, Shannon Diversity Index (H) = 3.413330073, Simpson's Index (A) = 0.052802625, Simpson's Index of Diversity (1 – A) = 0.94719735; Simpson's Index (¹/₂) = 18.9384524, Species Richness = 12.46, Species Revenues (J) = 0.89, and Community Donnance (C) = 21.06%. The number of species with percentage nuclear the above familiars (Chrysoneliae (16 spp., 24.04%), Concineliadae (14 spp., 29.79%), Curculionidae (3 spp., 6.38%), Carabidae, Carabidae, Creambrer of species with 4.26% included in each of the 6 families), and Staphylinidae, Bostrichidae, Revirupidae, Bostrichidae, Kridulidae, Geotrupidae, Bostrichidae, Scarabaeidae (1 sp., 21.3%), included in each of the 6 families).

Family	Scientific name	Common name	N	Status	$P_{i-n/N}$	P_{1^2}	In P _i	P _i In P _i
	Alticacha lybea (Illiger, 1807)	Grape flea beetle	23	CC	0.00942236788	8.87810165e-5	-4.66466885	-0.0439522259
	Aspidimorpha miliaris (Fabricius, 1775)	Spotted tortoise beetle	ŝ	RR	0.00204834084	4.1957002e-6	-6.19072516	-0.0126807152
	Aspidomorpha sanctaecrucis (Fabricius, 1792)	Golden tortoise beetle	36	CC	0.0147480541	0.0002175051	-4.21664413	-0.0621872957
	Audaconhara foueicollis (Latcas 1849)	Red numbin heetle	166	NC	0.068004916	0 0046246686	-2 68817528	-0 182809134
	Creeda airwindata (Harbet 1700)	Green toutoise heatle	80		0 01 14707087	0 000131577158	4 46705856	0.0510506510
	Discuttobe on (Champlet in Dataset 1926)	Dick 8. White stringed flac heatle	176	001	0.070101000	0.00510064020	0 60067000	0 100604062
	Disoriguna sp. (Creations in Defeat, 1000)	DIACK OF WILLIES SUITCH THE DECUE	011		116010121000		COLUCIOL 2002	00100001-0-
	caleraceua sagutariae (cyliciniai, 1013)	Colden loosesune peede	10	NKK SO	0.000000000000000000000000000000000000	C-3600020101	06/10164-0-	1/2012022010-
	Lema exiementiaa Limaeus, 1700	Lear beeue	17	25	0.00000000000	C-a/TCTZT0+'/	-4.10004003	+076707070-0
	Lema incognita (Linnaeus, 1738)	Leaf beetle	0	ХY.	0.00204834084	4.195/002e-b	-0.190/2510	-0.0126807152
	Monolepta signata (Olivier, 1808)	White spotted leaf beetle	131	VC	0.0536665301	0.00288009645	-2.92496575	-0.156972762
	Oulema melanopus (Linnaeus, 1758)	Cereal leaf beetle	27	CC	0.0110610406	0.000122346619	-4.5043262	-0.049822535
	Phyllotreta nemorum. (Linnaeus, 1758)	Yellow spotted flea beetle	102	VC	0.0417861532	0.0017460826	-3.17519026	-0.132678987
Chrysomelidae	Podontia quatuordec impunctata (Linnaeus 1758)	14 spotted lady beetle	34	CC	0.0139287177	0.000194009177	-4.27380255	-0.0595285892
	Acalles sp. (Boheman, 1837)	No English name found	4	RR	0.00163867268	2.68524815e-6	-6.41386871	-0.0105102314
	Amalusha emorrhous (Herbst. 1795)	No English name found	T	SS	0.000409668169	1.67828009e-7	-7.80016307	-0.00319547852
	Ambrosiodmus rubricollis (Eichhoff, 1875)	Ambrosia beetle	33	CC	0.0135190496	0.000182764702	-4.30365551	-0.0581813323
	Macranculus linearis (LeConte. J.L. 1876)	No English name found	18	00	0.00737402704	5 43762748e-5	-4 90979131	-0.0362049339
Currentionidae	Tetranonothorar millenhali (Fanst 1804)	Cleonine weevil		55	0 000409668169	1 67828009=.7	-7 80016307	-0 00319547852
	Amara ampicollis (Gvllenhal, 1810)	No English name found	47	00	0.0192544039	0.00037073207	-3.95001547	-0.0760551933
	Bemhidion tetracolum (Sav 1825)	Ground heetle	28		0 0114707087	0 000131577158	-4 46795856	-0.0512506512
	Chining fossor [Linnaeus 1758]	Grannd heetle	16		0.0065546907	4 29639702e-5	-5.02757435	-0.0329541948
Carabidae	Ocus hamaloides (Audinet-Serville 1821)	Dark brown Ground heetle	e.	VR	0 00122900451	1 51045209e-6	-6 70155078	-0 00823623613
	Cantharis niaricans (Muller O F 1776)	Soldier heatle	10	RR	0 00409668169	1 67828000e-5	-5 49757798	-0.025218271
Conthonidos	Dhamman nightanis (manu) on 1110) Dhamminha fulua (Somoli 1762)	Common red soldiar hastle			010000000000000000000000000000000000000	2 0000000000	001101010101	00220090000
Stonbulinidae	Atractic offinic (Doubuil, 1700)	Communities source beene	285	20	001000000000000000000000000000000000000	0.0134411774	71501101.C	C22008070 0
apprintinge	Chollomanas saumasulata (Echnicius 1791)	6 anotted aimmed helds hind	200		76002620000 0 002655701	200660000000	1101/401.2-	210600642.0-
	Cremmenes sexmacutata (Fabricius, 1/01)	o spotted zigzag lady bird	200		12400002.0	0626662240.0	027001001-	100007070707070
	Controllerles propugue numera (muisaint, 1030)	7 months indine tound	11	22	11240000000000	2.000110012	0/07704.0-	1000446470.0-
	Coccinetta septempunctata (Linnaeus, 1755)	/ spotted lady beetle	26	22	0.03/680/20.0	0.0061005020	-3.2/83/449	-0.123360202
	Coccineua transversaus (reprictus, 1/61)	Iranverse lady beetle	161	2	0.0/82406202	/000270121	+00682/10-7-	-0.199303/55
	Exocromus frampes (Inunberg, 1/81)	No English name lound	ŋ	22	10400622100.0	0-920264016.1	8/0ccT0/.0-	-0.00823023013
	Henosepilachna pusilianima (Mulsant, 1850)	Epuachnine beeue	4	KK	0.00163867268	2.68524815e-6	-6.41386871	-0.0105102314
	Henosepilachna vigintioctopunctata(Fabricius, 1775)	28 spotted potato lady bird	18	S	0.00737402704	5.43762748e-5	-4.90979131	-0.0362049339
	Micraspis discolor (Febricius, 1798)	Spotless lady beetle	53	VC	0.0225317493	0.000507679727	-3.79282988	-0.085459092
	Micraspis hirashimai (Samuelson, 1965)	No English name found	12	20	0.00491601803	2.41672333e-5	-5.31525642	-0.0261298964
Coccinellidae	Oenopia quadripunctata (Kapur, 1963)	Yellow spotted lady beetle	4	RR	0.00163867268	2.68524815e-6	-6.41386871	-0.0105102314
	Graphisurus sp. (Kirby, 1837)	Gray longhorn beetle	12	S	0.00491601803	2.41672333e-5	-5.31525642	-0.0261298964
Cerambycidae	Trachysida mutabilis (Newman, 1841)	Black longhorn beetle	26	S	0.0106513724	0.000113451734	-4.54206653	-0.0483792421
	Crypticus quisquilius (Linnaeus, 1760)	No English name found	11	22	0.00450634986	2.03071891e-5	-5.4022678	-0.0243445087
	Gonocephalum coriaceum (Motschulsky, 1857)	Darkling beetle	12	S	0.00491601803	2.41672333e-5	-5.31525642	-0.0261298964
Tenebrionidae	Platydema sp. (Laporte & Brulle 1831)	No English name found	62	VC	0.0253994265	0.000645130867	-3.67302868	-0.093292822
Elateridae	Aeolus mellilius (Say 1836)	Sweet click beetle	00	RR	0.00327734535	1.07409925e-5	-5.72072153	-0.0187487801
Bostrichidae	Sinoxylon anale (Lesne, 1897)	Auger beetle	28	CC	0.0114707087	0.000131577158	-4.46795856	-0.0512506512
Nitidulidae	Stelidota geminate (Say 1825)	Sap beetle	29	CC	0.0118803769	0.000141143355	-4.43286724	0.0526641336
Geotrupidae	Anoplotrupes steroorosus (Scriba, 1791)	Earth boring Dung beetle	36	CC	0.0147480541	0.0002175051	-4.21664413	-0.0621872957
Erotylidae	Megalodacne fasciata (Fabricius, 1777)	Fungus beetle	55	VC	0.0225317493	0.000507679727	-3.79282988	-0.085459092
	Dyscinetus morator (Fabricius 1798)	Rice beetle	23	20	0.00942236788	8.87810165e-5	-4.66466885	-0.0439522259
Scarabacidae	Phyllophaga crinite (Burmeister, 1855)	White grub scarab	21	20	0.00860303154	7.40121517e-5	-4.75564063	-0.0409129264
Dermestidae	Dermestes lardarius (Linnaeus, 1758)	Larder beetle	4	RR	0.00163867268	2.68524815e-6	-6.41386871	-0.0105102314
Total	48		N = 24	=	-	0.082031813	-229.4385564	-2.9275245
Number of specie	s (S) = 48, Total number of individual (N) = 2441, Shann	on Diversity Index (H') = 2.9275245	i, Simpson's	Index $(\lambda) = 0$.082031813, Simpsoi	n's Index of Diversity	$(1 - \lambda) = 0.917968$	187, Simpson's
Reciprocal Index	$\left(\frac{1}{2}\right) = 12.1903925$, Species Richness = 13.90, Species Ev	enness (J') = 0.76, and Community	Dominance	: (CD) = 32.1	5%. The number of sp	becies with percentag	te under the above	families:
Chrvsomelidae (1	3 spn. 6.24%). Coccinellidae (10 spn. 20.83%). Curculi	midae (5snn., 10.42%). Carahidae (4 snn. 8.33	%). Canthari	lae. Cerambveidae. To	enebrionidae. Scarał	paeidae (2 snn. 4.	17% included in
each of the 4 fan	nilies), and Staphylinidae, Bostrichidae, Nitidulidae, Geo	trupidae, Erotylidae, Elasteridae, de	ermestidae(l sp., 2.08%	included in each of t	he 7 families).		

Table 2: Illustration how the various indices change as relative number of each Coleopteran species change at the National Botanical Garden

ERE Campus	
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es change as tl	
e various indic	
tration how the	
Table 3: Illus	

Family	Scientific name	Common name		Status	$\mathbf{P}_{\mathbf{i}=\mathbf{n}/\mathbf{N}}$	P ₁ 2	In P.	Pi In Pi
Chrysomelidae	Alticacha luhea (Illiger, 1807)	Grane flea beetle	261	VC	0.0646039604	0.0041736717	-2.73947956	-0.176981229
annual first							0 66161020	243040201 0
	upunious explicit our occur ally, 1101		207			11+000/6+00.0	SINTETEN-Z-	1406401010-
	Aspidimorph miliaris (Fabricius, 1775)	Spotted tortoise beetle	(-	RR	0.00173267327	3.00215666e-6	-6.35808982	-0.0110164923
	Aspidimorph sanctaecrucis(Fabricius, 1792)	Golden tortoise beetle	4	RR	0.00099009901	9.8029605e-7	-6.91770561	-0.00684921348
	Aulacophara foveicollis (Lucas, 1849)	Red numbin beetle	381	VC	0.0943069307	0.00889379718	-2.3612006	-0.222677581
	Conside minumdate (ILoubet 1700)	Green tortoise heetle	130	NC	0 0344059406	0 00118376875	-3 36952604	-0 115931713
	Cussian circumatia (nerusi, 1799)			2 0				
	Chardotella sexpunctata (Fabricius, 1781)	Golden tortoise beetle	16	S	0.0047029703	2.21179296e-5	-5.35956099	-0.0252058562
	Diciadispa testacea (Linnaeus, 1767)	Rockrose prickly leaf beetle		SS	0.000247524752	6.12685029e-8	-8.30399997	-0.00205544553
	Disonucha sp. (Chevrolat in Dejean, 1836)	Black & White striped flea beetle	13	20	0.00321782178	1.0354377e-5	-5.73905061	-0.018467242
	Lema externevittata (Linnaeus, 1758)	Leaf beetle	48	S	0.0118811881	0.000141162631	-4.43279896	-0.0526669183
	Loma incomita (Linnaeus 1758)	Leaf heatle	30	55	0 00065346535	0 318030320-5	4 64043830	0.0447963105
	Monologicute algorate (Alimiae 1909)	White anothed leef headle						
	wormepu signutu (Onviet, 1000)	while sported real peetle	2007	2	550055000.0	2066666200.0	00710/6.7-	14070/TOT-0-
	Oulema melanopus (Linnaeus, 1758)	Cereal leaf beetle	100	VC	0.0262376238	0.000688412903	-3.64056088	-0.0955196668
	Phyllotreta nemorum. (Linnaeus, 1758)	Yellow spotted flea beetle	256	VC	0.0633663366	0.00401529261	-2.75882253	-0.174816477
	Podontia quatuordec impunctata (Linnaeus	14 spotted lady beetle	113	VC	0.027970297	0.000782337514	-3.57661215	-0.100038904
	1758)							
Curculionidae	Amalushaemorrhous(Herbst, 1795)	No English name found	4	RR	10660066000.0	9.8029605e-7	-6.91770561	-0.00684921348
	Ambrosiodmus rubricollis (Eichhoff, 1875)	Ambrosia beetle	16	CC	0.0047029703	2.21179296e-5	-5.35956099	-0.0252058562
	Macranculus linearis (LeConte. J.L., 1876)	No English name found	14	CC	0.00346534653	1.20086266e-5	-5.66494264	-0.0196309893
	Tetraconothorar aultenhali (Faust 1804)	Cleonine weevil		22	0 00173067307	3 002156660-6	-6 35808980	-0.0110164923
Continued on	Conthonic viscions (Mullon O B 1776)	Coldian basela	LV F			0.0000120000	10021070 0	2000020110
Сапциалове	Cantrians nighcans (muller, U.F. 1110)		147	2	0.0301403140	101400710000	167/1040-0-0	CO2500/11.0-
	Rhagonycha Juwa (Scopoli, 1763)	Common red soldier beetle	96	VC	0.0237623762	0.000564650523	-3.73965178	-0.0888630125
Staphylinidae	Atrecus affinis (Paykull, 1789)	Rove beetle	335	VC	0.0829207921	0.00687585776	-2.48986944	-0.206461946
Coccinellidae	Cheilomenes sexmaculata (Fabricius, 1781)	6 spotted zigzag lady bird	373	VC	0.0923267327	0.00852422557	-2.38242155	-0.219961198
	Chilomenes propingua nilitica (Mulsant,		133	VC	0.0329207921	0.00108377855	-3.41365084	-0.11238009
	1850)	No English name found						
		7 snotted lady beetle	196	VC	0.0485148515	0.00235369082	-3.02588531	-0.146800376
	Coccinella septempunctata(Linnaeus, 1/38)	anone from pounds a)			* 00000	
	Coccinella transversalis (Febricius, 1781)	Tranverse lady beetle	234	VC	0.0579207921	0.00335481816	-2.84867886	-0.164997736
	Exochomus flavipes (Thunberg, 1781)	No English name found	19	CC	0.0047029703	2.21179296e-5	-5.35956099	-0.0252058562
	Henosepilachna pusillanima (Mulsant, 1850)	Epilachnine beetle	22	VC	0.0180693069	0.000326499852	-4.01354053	-0.0725218956
	Henosepilachna vigintioctopunctata	28 spotted potato lady bird	[-	RR	0.00173267327	3.00215666e-6	-6.35808982	-0.0110164923
	(Fabricius, 1775)	•						
	Illeis koebelei (Timberlake, 1943)	Yellow spotless lady beetle	00	RR	0.00198019802	3.9211842e-6	-6.22455843	-0.0123258583
	Micrashis discolor (Febricius, 1798)	Snotless lady heetle	206	VC:	0 050990099	0.0025999902	-2.9761238	-0.151752847
	Micrashis hirashimai (Samuelson, 1965)	No English name found	4	RR	0.00099009901	9.8029605e-7	-6.91770561	-0.00684921348
	Denonia mudrimmetata (Kamur 1963)	Vellow snotted ladv heatle	16	UU	0 00306030604	1 568473680-5	5 53141125	0.0010065700
	Providen dissecta (Mulsant 1850)	Anhidonhamis lady beetle	10		0.00668316832	4 466473886-5	-5 0081631	-0.033470307
Communitier	Combine on With 1021	Control and and and and a control of the second sec	4		200010000000000000000000000000000000000	2 2000 1001 COL	TOOTOOOO	CO01910110 0
Translation of the	Oruprusurus sp. (NILUY, 1001)	Ne Realist accur		NN NN	12010201100.0	0-20000170010	206000000-0-	-CUBUUCSULU U
I enebrionidae	Crippneus quisquinus (Linnaeus, 1700)	No English name lound	Ite	2	0.0045604500	c-900202007.1	+07+6400.C-	S2489029910.0-
	Gonocephalum coriaceum (Motschulsky, 1857)	Darkling beetle	157	VC	0.0388613861	0.00151020733	-3.24775417	-0.126212229
	Platudema en fl'anorte & Bruille 1831)	No Fridish name found		an	0 000749574957	5 514165070-5	7 20538768	-0.0053505354
Distandan	Considence on (Eachachelter 1000)	Click heatle	, ,			0.0110011010 e	6 10455040	
Dialettuae	CONDUCTUAS Sp. (ESCLISCIDILE, 1023)			NN CO	2006100610000	0-27101770	01000177.0-	COCOC70710.0-
Nitidulidae	Stelidota geminate (Say 1825)	Sap beetle	50	22	8026/026/00/0	6-27/3894/2e-0	-4.83826407	-0.0383228837
Geotrupidae	Anoplotrupes stercorosus (Scriba, 1791)	Earth boring Dung beetle	26	20	0.00643564356	4.1417508e-5	-5.04590343	-0.0324736359
Dermestidae	Dermestes lardarius (Linnaeus, 1758)	Larder beetle	CA.	VR	0.000495049505	2.45074012e-7	-7.61085279	-0.00376774891
Total	42		N =4040		-	0.056320765	-199.959017	-3.0701943

Number of species [S] = 42, Total number of individual [N] = 4040, Shannon Diversity Index (H] = 3.0701943, Simpson's Index (A] = 0.056320765, Simpson's Index of Diversity (1 – λ) = 0.943679235, Simpson's Reciprocal Index $\frac{1}{\lambda}$] = 17.7554406, Species Richness = 11.37, Species Evenness (J) = 0.82, and Community Dominance (CD) = 18.66%. The number of species, their percentage under the above families: Chrysomelidae (15 spp., 35.71%). Coccinellidae (12 spp., 28.57%), Curculionidae (4spp., 9.52%) Tenebrionidae (3 spp., 7.14%), Cantharidae (2 spp., 4.76%), and Staphylinidae, Cerambycidae, Nitidulidae, Geotrupidae, Easteridae, Dermestidae (1 sp., 2.38% included in each of the 6 families).

species in the community. Sanjayan *et al.* (1995) showed that the value of E tends to be zero, which indicates that the species has become more dominant in a community. In this study, the value of E for the Ramna Park (0.89) and AERE campus (0.82) is high, which shows the species are evenly distributed, while at the National Botanical Garden (E = 0.76) is comparatively low, which means the National Botanical Garden is less evenly distributed than the two other areas. Community similarity among the Ramna Park, National Botanical Garden, and AERE campus is shown in Table 4. The value of Sorenson's Coefficient (CC) of these communities is 0.66. Sorensen (1948) stated that its range is from 0 to 1. The closer the value is to 1, the more the communities have in common. These three communities are fairly similar in terms of Sorenson's Coefficient. The simple Community Dominance index represents the percentage of abundance contributed by the two most abundant species, which is the maximum at the National Botanical Garden compared to the other two study areas.

Table 4. Community Similarity among the Ramna Park, the National Botanical Garden, and the Atomic Energy Research Establishment (AERE)

Community Similarity is measured by Sorenson's Coefficient (CC).
The equation is Summary's $Coefficient (CO) = \frac{3C}{3C}$
The equation is: Sorenson's Coefficient (CC) – $S_1+S_2+S_3$
Where, the number of species at the three communities (Ramna Park, National Botanical
Garden and Atomic Energy Research Establishment) have in common (C) = 30, the total
number of species found at the Ramna Park $(S_1) = 47$, the total number of species found at
National Botanical Garden (S_2) = 48, and the total number of species found in the Atomic
Energy Research Establishment (AERE) $(S_3) = 42$.
Second 2 Coefficient (CO) = $\frac{3C}{3} = \frac{3x30}{90} = \frac{90}{90} = 0.66$
Sorenson's Coefficient (CC) = $\frac{1}{s_1 + s_2 + s_2} - \frac{1}{47 + 48 + 42} - \frac{1}{137} = 0.06$



Fig. 2. Species richness of coleoptera for pooled data over 12 months.



Fig. 3. Month-wise population cumulative curve of faunal assemblage of coleoptera at the three selected areas of Dhaka city.



Fig. 4. Family-wise coleopteran species at three selected areas of Dhaka city.



Fig. 5. Family-wise populations of coleoptera at the three selected areas of Dhaka city.

Coleopteran diversity at the three selected



Fig.6. Month-wise cole opteran population (%) at the three selected areas of Dhaka city.



Fig.7. Coleopteran species at the three study areas of the Dhaka city.

CONCLUSION

The present study provides the checklist of Coleopterans in the three areas of Dhaka city. In the current study the species accumulation curve could not attain asymptote after twelve sampling in twelve month indicated that most of the probable species have not been encountered during the inventorying process. In this study better knowledge of the abundance, species richness, seasonal composition and comparative diversity of Coleopteran communities has been achieved, which should be very useful for improving predictive models and developing management guidelines for their control measures. It also provides baseline data for upcoming researchers and gives wide scope for further study. A long term study is needed to observe the species occurrence in all seasons and their interaction with the environmental changes, in order to get better and comprehensive information.

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