



AN ACCOUNT OF DIVERSITY OF POLLINATORS FROM BANGLADESH

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ABSTRACT

This study explores the diversity, relative abundance, evenness, and richness of pollinators in the Rajshahi University Campus, in Bangladesh. A total of 625 individuals belonging to both invertebrates and vertebrates were recorded. Among the invertebrates, 44 insect species in five orders such as Hymenoptera, Diptera, Hemiptera, Coleoptera, and Lepidoptera were collected. The results revealed that the Lepidoptera and Hymenoptera were more abundant. Around 17 vertebrates in four orders, including Aves and Mammalia were also recorded. The diversity indices were: $H'=3.82$, with the Evenness ($E=0.93$), and Margalef's Richness Index ($d=9.32$). Also 59 pollinator-visiting plants were enlisted.

Key words: Bangladesh pollinators, arthropods, Aves, Mammalia, plants, blooming period, diversity, relative abundance, richness, evenness, diversity indices, host plants

Pollination is the process of shifting pollen grains from a flower's anthers to the female's stigma of the same species. Apart from plant species, animal pollination is a crucial component of their reproductive cycle. It is believed that 87.5% of flowering plant species globally are pollinated by animals (Ollerton et al., 2011). A wide variety of animal species, including birds, bats, other mammals, and insects, perform pollination services (Willmer et al., 1994; Buchmann and Gary, 1997). The most diverse pollinator species on the earth are insects, including beetles, butterflies, flies, wasps, and bees. Additional animal groups like reptiles, rodents, and marsupials play a role in pollination, yet they receive comparatively less focus than prominent pollinators such as bees and butterflies (Dellinger et al., 2019; Wester, 2019; Pastor et al., 2021). It is crucial to preserve the plant genetic material, which increases the diversity of both domesticated and wild flora and fauna (Thakur et al., 2010). The insect ecology provides pollination, which is required for human life support and food production (El-Kazafy and Yousry, 2009). Incomplete pollination prevents the proper development of fruits. Low yields and undersized, distorted, or malformed fruits result from inadequate pollination (Shah et al., 2015). The present study explore the relative abundance of species, diversity indices, richness, evenness, and list of pollinators visiting plants at Rajshahi University (RU) Campus, Bangladesh.

MATERIALS AND METHODS

The study was carried out at the Rajshahi University

(RU) Campus, Rajshahi, Bangladesh (24.3683° N, 88.6376° E). The specimens were collected from October 2021 to September 2022, including flower gardens, near ponds, mulberry orchards, crop and grasslands, shady ground, dense shrubs and vines, open forest, dry uncultivated land without grass or herbs. Every habitat was visited twice a week and eight days/ month. Sampling was carried out in the morning and afternoon. An aspirator was employed to suction any insect that was too small to capture into the vial. Forceps were used to capture the tiny, deadly organisms into vials to preserve the specimen. The flying insects were gathered from the foliage and above-ground vegetation with a sweeping net. A cloth bag supported by a robust metal frame and handle served as the foundation for the net. Additionally, the vertebrate pollinator data was collected by taking photographs. Statistical analysis was done with Microsoft Excel and biodiversity indices were calculated following standard methodology (Shannon and Wiener, 1949; Hill, 1973; Margalef, 1970).

RESULTS AND DISCUSSION

This results showed that the pollinators of Rajshahi University campus ecosystems included belonging to invertebrates and vertebrates (625 individuals). Invertebrates included around 550 individuals in five orders, 22 families, and 44 species (Table 1). Hymenoptera (43%) was the most prevalent. Devi et al. (2017) documented a total of 88 insect species across nine orders and 31 families on mustard in

Table 1. Species composition and relative abundance of pollinators at Rajshahi University Campus

Common name	Scientific name	Number of individuals	Relative abundance (%)
Invertebrate			
Hymenoptera			
Apidae			
Giant honey bee	<i>Apis dorsata</i>	20	3.2
Eastern/Asian honey bee	<i>A. cerana</i>	10	1.6
European honey bee	<i>A. mellifera</i>	40	6.4
Blue-banded bee	<i>Amegilla</i> sp.	8	1.28
Carpenter bee	<i>Xylocopa</i> sp.	10	1.6
Tree bumble bee	<i>Bombus hypnorum</i>	5	0.8
Andrenidae			
Mining bees	<i>Andrena</i> sp.	10	1.6
Halictidae			
Sweat bee	<i>Augochlora</i> spp.	3	0.48
Sweat bee	<i>Halictus</i> sp.	8	1.28
Formicidae			
Pipra	<i>Formica</i> sp.	50	8
Pompilidae			
Spider wasp	<i>Anoplius</i> sp.	5	0.8
Vespidae			
Lesser banded hornet	<i>Vespa affinis</i>	5	0.8
Asian giant hornet	<i>V. manarina</i>	5	0.8
Yellow jackets	<i>Vespula</i> spp.	10	1.6
Paper wasps	<i>Polistes</i> spp.	5	0.8
Sphecidae			
Common thread waisted wasps	<i>Ammophila procera</i>	10	1.6
Black mud dauber wasp	<i>Sceliphron</i> sp.	10	1.6
Potter wasp	<i>Eumenes</i> spp.	4	0.64
Thread waisted wasps	<i>Ammophila</i> spp.	4	0.64
Diptera			
Muscidae			
House fly	<i>Musca domestica</i>	20	3.2
Syrphidae			
Hover fly	<i>Syrphus</i> spp.	30	4.8
Culicidae			
Male Mosquito	-	20	3.2
Tachinidae			
Tachinid fly	<i>Archytas</i> spp.	5	0.8
Hemiptera			
Lygaeidae			
Black-and-red-bug	<i>Lygaeus</i> spp.	10	1.6
Coleoptera			
Coccinellidae			
Ladybird beetle	-	10	1.6
Chrysomelidae			
Pumpkin beetle	<i>Aulacophora foveicollis</i>	25	4
Meloidea			
Blister beetle	-	3	0.48
Lepidoptera			
Erebidae			
Nine spotted moth	<i>Amata phegea</i>	20	3.2
Danaiidae			
Plain tiger	<i>Danaus chrysippus</i>	20	3.2
Monarch butterfly	<i>D. plexippus</i>	15	2.4
Common crow	<i>Euploea core</i>	15	2.4
Glassy tiger	<i>Parantica aglea</i>	15	2.4

(contd.)

(contd. Table 1)

Common name	Scientific name	Number of individuals	Relative abundance (%)
Pieridae			
Three spotted grass yellow	<i>Eurema blanda</i>	10	1.6
Tree Yellow	<i>Gandaca haryana</i>	10	1.6
Common jezebel	<i>Delias eucharis</i>	15	2.4
Common glass yellow	<i>Eurema hecabe</i>	10	1.6
Lycanidae			
Gram blue	<i>Euchrysops cnejus</i>	15	2.4
Hesperridae			
Common straight swift	<i>Parnara guttatus</i>	20	3.2
Nymphalidae			
Tawny coster	<i>Acraia violae</i>	5	0.8
Danaid eggfly	<i>Hypolimnas misippus</i>	10	1.6
Lemon pansy	<i>Junonia lemonias</i>	5	0.8
Common evening brown	<i>Melanitis leda ismene</i>	5	0.8
Papilionidae			
Lime butterfly	<i>Papilio demoleus</i>	10	1.6
Common mime	<i>P. clytia</i>	5	0.8
Vertebrate			
Aves			
Passeriformes			
Nectariniidae			
Purple sunbird	<i>Cinnyris asiaticus</i>	2	0.32
Purple-rumped sunbird	<i>Leptocoma zeylonica</i>	3	0.48
Pycnonotidae			
Red-Whiskered bulbul	<i>Pycnonotus jocosus</i>	5	0.8
White Throated bulbul	<i>Alophoixus flaveolus</i>	5	0.8
Sturnidae			
Jungle Mayna	<i>Acridotheres fuscus</i>	8	1.28
Chestnut-tailed starling	<i>Sturnia malabarica</i>	5	0.8
Pied starling	<i>Lamprotornis bicolor</i>	5	0.8
Brahminy starling	<i>S. pagodarum</i>	4	0.64
Oriolidae			
Black-hooded oriole	<i>Oriolus xanthornus</i>	2	0.32
Ploceidae			
Baya weaver	<i>Ploceus philippinus</i>	3	0.48
Chloropseidae			
Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	5	0.8
Corvidae			
Rufous treepie	<i>Dendrocitta vagabunda</i>	5	0.8
Piciformes			
Picidae			
Black-rumped flame back	<i>Dinopium benghalense</i>	4	0.64
Wood pecker	<i>Picidae</i> sp.	5	0.8
Psittaciformes			
Psittacidae			
Plum-headed parakeet	<i>Himalayapsitta cyanocephala</i>	2	0.32
Rose-ringed parakeet	<i>Psittacula krameri</i>	2	0.32
Mammalia			
Chiroptera			
Bat	<i>Chiroptera</i> sp.	10	1.6
Total		625	100

which hymenopterans were the most abundant. Siregar et al. (2016) reported 43 pollinators in three orders (Hymenoptera, Diptera, and Lepidoptera) from agricultural land in Sumatera. According to

earlier studies (Kearns et al., 1998; Mitra et al., 2008; Subedi and Subedi, 2019), Coleoptera, Hemiptera, Thysanoptera, Diptera, Lepidoptera, and Neuroptera constituted the vast majority pollinators. Chowdhury

Table 2. List of pollinators visiting plants Rajshahi University Campus

SL	Common Name	Scientific Name	Types of plant	Blooming Season	Pollinators
1	Adenium	<i>Adenium</i> sp.	Shrub	Early spring to mid-summer	Butterfly, bees, ant
2	Allamanda	<i>Allamanda cathartica</i>	Shrub	Summer-first frost	Bees, ant
3	Apple of Sodom	<i>Calotropis procera</i>	Herb	Year round	Ant, beetle
4	Bean	<i>Phaseolus vulgaris</i>	Herb	Early fall	Bees, ant, wasp. Mosquito, moth, Butterfly, hover fly
5	Botam ful	<i>Gomphrena globose</i>	Herb	Summer-Early fall	Butterfly
6	Bottle Brush Flower	<i>Callistemon viminalis</i>	Tree	March-July	Bees
7	Bougainvillea	<i>Bougainvillea glabra</i>	Shrub	Year round	Bees, butterfly
8	Butterfly Pea Flower	<i>Clitoria ternatea</i>	Herb	Summer-Fall	Bees, butterfly, hover fly, ant
9	Catmint	<i>Anisomeles indica</i>	Herb	May-October	Bees, hoverflu, house fly
10	China rose	<i>Hibiscus rosa-sinensis</i>	Shrub	Late Summer-Autumn	Ant
11	Chrysanthemum Flower	<i>Chrysanthemum</i> sp.	Herb	Summer-Autumn	Bees, butterfly, hover fly, ant, wasp
12	Cosmos	<i>Cosmos bipinnatus</i>	Herb	April-late October	Bees, butterfly, hover fly, ant, wasp
13	Creeping Daisy	<i>Wedelia trilobata</i>	Herb	Year Round	Bees, hover fly, wasp, butterfly
14	Dahlia	<i>Dahlia pinnata</i>	Herb	June-October	Bees, butterfly, hover fly, ant, wasp
15	Dianthus Flower	<i>Dianthus caryophyllus</i>	Herb	Spring-early summer	Bees, butterfly
16	Doi Gota Flower	<i>Bixa orellana</i>	Shrub	October-December	Bees
17	Dolon Chapa	<i>Hedychium coronarium</i>	Herb	August-December	Butterfly, ant
18	Dopati Flower	<i>Impatiens balsamina</i>	Herb	Spring-Fall	Bees, butterfly, hover fly, ant, wasp
19	Frangipani	<i>Plumeria</i> sp.	Tree	Summer-Fall	Bees, butterfly, hover fly, ant, wasp
20	Hierba negra	<i>Lippia</i> sp.	Herb	December-March	Hover fly, butterfly
21	Indian Jasmine	<i>Jasminum officinale</i>	Shrub	June-August	Butterfly
22	Indian Shot	<i>Canna indica</i>	Herb	May- October	Sun bird, bees, ant, butterfly, hover fly
23	Jarul	<i>Lagerstroemia speciosa</i>	Tree	Two times a year	Bees, butterfly, hover fly, ant, wasp
24	Java apple	<i>Syzygium samarangense</i>	Tree	Late summer	Bees, house fly, butterfly, hover fly, ant
25	Kamini	<i>Murraya paniculata</i>	Shurb	Year round	Bees, house fly, butterfly, hover fly, ant
26	Kanchon	<i>Bauhinia acuminata</i>	Tree	February- April	Bees, ant
27	Kata mukut	<i>Euphorbia milli</i>	Shrub	Year round	Bees, ant
28	Kolke	<i>Narium oleander</i>	Shrub	April-late September	Bees, wasp

(contd.)

(contd. Table 2)

29	Korobi	<i>Narium indicum</i>	Shrub	April-late September	Bees, house fly, butterfly, hover fly
30	Lantana	<i>Lantana</i> sp.	Herb	May-October	Bees, house fly, butterfly, hover fly, ant
31	Lily	<i>Lilium</i> sp.	Herb	Summer and Fall	Bees
32	Litchi	<i>Litchi chinensis</i>	Tree	February-March	Bees, house fly, butterfly, hover fly, ant, wasp
33	Madhabi Lata	<i>Quisqualis indica</i>	Shrub	Summer-Autumn	Ant
34	Mango	<i>Mangifera indica</i>	Tree	Mid-late Winter	Bees, house fly butterfly, hover fly, ant, wasp
35	Marhatitiga Flower	<i>Wedelia chinensis</i>	Herb	July- October	Butterfly, moth
36	Marigold	<i>Tagetes</i> sp.	Herb	Early summer-frost	Bees, house fly butterfly, hover fly, ant, wasp
37	Mesta Joba	<i>Hibiscus sabdariffa</i>	Shrub	End of August- late September	Ant, bees, hover fly
38	Mussaenda	<i>Mussaenda erythrophylla</i>	Shrub	Almost year-round	Moth
39	Mutha grass	<i>Cyperus rotundus</i>	Herb	Autumn to Winter	Mosquito
40	Palash	<i>Butea monosperma</i>	Tree	February-April	Birds, bees, ants
41	Peacock flower	<i>Caesalpinia pulcherrima</i>	Shrub	Year round	Hover fly, butterfly
42	Petunia	<i>Petunia integrifolia</i>	Herb	May-First frost	Ants, bees, house fly
43	Portulaca	<i>Portulaca</i> sp.	Herb	Summer-First frost	Ant, house fly, mosquito
44	Pumpkin Flower	<i>Benincasa hispida</i>	Herb	June- late September	Bees, house fly, butterfly, hover fly, ant, wasp, beetle
45	Purple Heart	<i>Tradescantia pallida</i>	Herb	Year round	Mosquito
46	Broome Raintree	<i>Albizia lebbeck</i>	Tree	September-October	Bees, butterfly
47	Rakto Kanchan	<i>Bauhinia variegata</i>	Tree	February- April	Parrot, bees
48	Rongoon	<i>Ixora</i> sp.	Shrub	Year round	Butterfly, ant
49	Shimul	<i>Bombax</i> sp.	Tree	February- early May	Bats, birds
50	Shiv Jota	<i>Acalypha hispida</i>	Herb	Year round	Ant
51	Shiyal Kata	<i>Argemone mexicana</i>	Herb	May-November	Bees
52	Sunflower	<i>Helianthus annuus</i>	Herb	July-late October	Bees, butterfly, hover fly, ant, wasp, beetle
53	Thunbergia	<i>Thunbergia grandiflora</i>	Shrub	April- July	Carpenter bee
54	Verbenaceae	<i>Verbena hybrida</i>	Herb	Late spring to early fall	Ant, butterfly
55	<i>Vernonia</i>	<i>Vernonia cinerea</i>	Herb	March-May	Butterfly, bees
56	Water Hyacinth	<i>Eichhornia crassipes</i>	Herb	Late summer- early fall	Mosquitos
57	Wild Petunia Flower	<i>Ruellia prostrata</i>	Herb	During rainy season	Bees
58	Wood Champa	<i>Magnolia champaca</i>	Tree	June- late September	Bees, beetle
59	Zinnia	<i>Zinnia elegans</i>	Herb	July-October	Bees, butterfly, hover fly, ant, wasp, beetle

(2020) reported that butterflies are effective pollinators of forest plants; and lepidopterans (butterflies) were very important Vertebrates, included Aves and Mammalia; 75 individuals in 17 species, 10 families, and 4 orders of vertebrates were observed. In Mammalia, only bats were observed as pollinators. Whelan et al. (2008) reported that over 920 species of birds including Nectarinidae, Trochilidae, Meliphagidae, and Loridae families are known to pollinate plants. According to Fleming and Muchhala (2008), bats are the most significant mammalian pollinators.

The most dominant of invertebrates was Hymenoptera (43%). The most dominant vertebrate order was the avian order Passeriformes (70%). The only mammalian pollinator order was Chiroptera which occupied about 13% (Fig. 1). Shannon-Wiener Diversity Index (H'), Evenness (E), and Margalef's Richness Index (d) were computed, which revealed the following: Shannon index (H) for species diversity 3.82, Margalef's index

(d) for species richness 9.32 and evenness index (E) 0.93. The diversity indices obtained in the current study are consistent with values reported in various agroecosystems (Deeksha et al., 2022; Usha and John, 2015; Subedi and Subedi, 2019). In this study, around 60 common pollinator visiting plants were observed in three group viz., herb, shrub, and tree (Table 2). The diversity of pollinators fluctuates across seasons. Insects that serve as pollinators were abundant in spring, summer, and the rainy season but were less in number during winter due to the cold weather conditions.

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AUTHOR CONTRIBUTION STATEMENT

Md. Aslam Khan, Collection of primary data, statistical analysis, and drafting the manuscript. Nahid Sultana, Collection of secondary data and statistical analyses. Nelufa Yasmin, Drafting manuscript. Nujhat Ara, Research Supervisor, and finalization of the manuscript.

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No conflict of interest.

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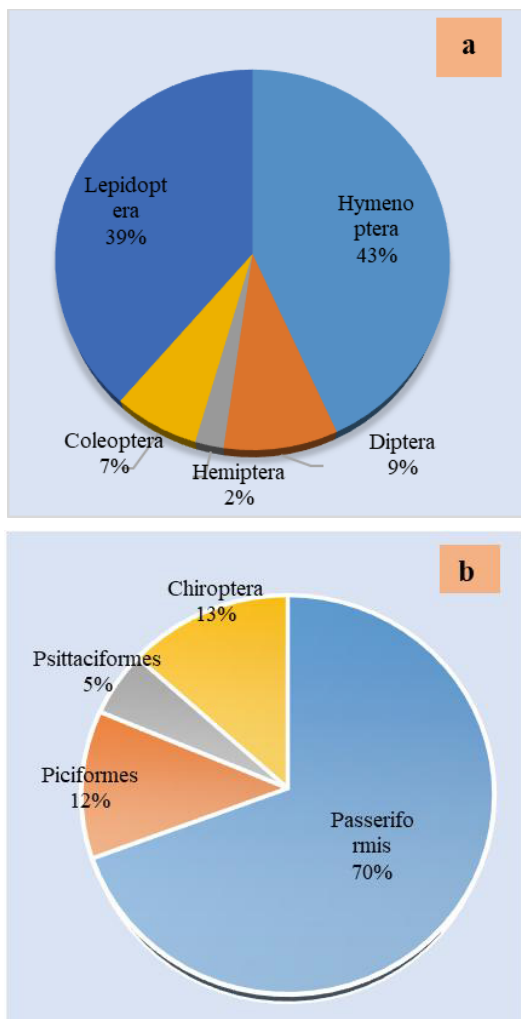


Fig. 1. Diversity (%) invertebrates and vertebrates

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