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COMMUNICATION

Butterfly species richness and diversity in rural and urban areas of Sirajganj, Bangladesh

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Abstract: An appraisal of butterfly species diversity study was conducted in four selected parts of Sirajganj District, Bangladesh, as a part of an ecological research. The study was conducted from March 2015 to April 2016. A total of 19,343 butterflies belonging to five families and 12 subfamilies was recorded. A random sampling of forest, riverside rural, and urban areas in Sirajganj District revealed the presence of 65 butterfly species, dominated by Lycaenidae (37%) over Nymphalidae (33%) followed by Pieridae (19%), Hesperiidae (7%), and Papilionidae (4%). Butterfly fauna in Bangabandhu Sheikh Mujib Jamuna Ecopark (BJEP), compared with the percentage of other study sites, was very high (Hs= 4.03) and the percentage of hedge species was relatively higher (45%) than that of improved grassland and forest interior species. The relative abundance of the butterflies varied with the site, month, and family significantly. Considering the landscape of Sirajganj, steps to enhance riverside natural gardening should be adopted to maintain butterfly diversity and sustain the ecosystem services derived from them.

Keywords: Abundance, ecosystem, family, forest, natural gardening, landscape, riverside.

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Author contribution: All the authors have contributed equally to conduct this study; SMSI, MJR & MSH were responsible for the collection of data; AKN and SMSI did the analysis and write up of this manuscript.

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INTRODUCTION

Butterflies are known to be the indicator species for their interaction with the environment. Butterflies occupy a vital position in ecosystems, and their occurrence and diversity are considered to be good indicators of the health of terrestrial biota (Kunte 2000). They trigger some signal in response to the physical and chemical changes in the environment; they play a significant role in pollination and in community ecology. Evolutionary mechanism of pollination has largely depended on the scaly jewels (Pollard 1991). The compilation of species lists and identification of habitat preferences and abundances are the first steps in effectively conserving biodiversity through the establishment of species baselines and basic ecological requirements (Chowdhury et al. 2017). The butterfly fauna in the northeastern and southeastern parts of Bangladesh is relatively rich and diverse in contrast to favourable habitat, elevational gradients, and microclimatic regimes. Most of the studies on this group are primarily conducted on the evergreen and mixed evergreen forest areas of Bangladesh; however, other parts of Bangladesh lack baseline studies. Torban (2004) mentioned some locations in the northwestern and northern part of Bangladesh as potential territory for butterflies. Sirajganj is one of the 64 districts of Bangladesh situated in the northern part of this country, and this is an initial baseline for butterfly diversity in a mixed habitat setting where the urbanization process is prevalent.

MATERIAL AND METHODS

Study Area

Sirajganj District, situated in northern Bangladesh, has an area of about 2,497.92km². It is a part of Rajshahi Division, the gateway to northern Bengal. It is bordered on the north by Natore District and Bogura District by the Jamuna River on the east. In this current study, we chose four distinct study areas based on their floral diversity and distribution:

Bangabandhu Sheikh Mujib Jamuna Ecopark (BJEP)—this park was partially developed during the construction of the Jamuna Bangabandhu Sheikh Mujib Bridge on the Jamuna River. BJEP covers approximately 50.02ha and is situated in the western part of the Jamuna River. Natural vegetation, including small natural forests, is mainly covered with deciduous and semi-deciduous vegetation. This area has a rich diversity of weeds and bushes.

Belkuchi—this study site aligns with the catchment area of the Jamuna River. Embankments and some human settlements made the site stable. This area, with low disturbance from human interference, is composed of mixed vegetation lands cultivated for seasonal crops, grasses, flowers, and vegetables. The area consists of a variety of butterfly associate plants for nectaring, viz., *Pisum sativum*, *Brassica juncea*, *Ixora rosea*, *Catharanthus roseus*, *Clerodendrum viscosum*, *Atrocarpus lacucha, Citrus* spp., and *Tridax* spp.

Haidarpur—this study site is an urban area. It is a highly human-disturbed area. Urbanization process is prevalent in this study site. Most people run hand looms and power looms in their dwelling areas. Vegetation, mainly seedlings of fruit and flowering plants, are of mixed types.

Kodomtoli—Kodomtali is situated in the low-lying catchment area of the Brahmaputra-Jamuna river basin. Large low-lying paddy fields were found at this site. Vegetation mostly consists of *Brassica* sp. in addition to some areas for cultivating shrubs and vegetables. The soil is mostly muddy in texture. The present study was conducted during March 2015 to April 2016.

Data collection and identification of butterflies

The study has been conducted by line transect method. The authors covered one permanent transect at every study site each month. Observations were taken between 08.00h and 16.00h. Butterflies were primarily identified directly by watching and taking photographs using Canon-600D camera. Sometimes specimens were caught for identification and then released after photographing, viz., *Parnara* sp., *Pelopidus* sp., *Mycalesis* sp., and *Telicota* sp. In a few cases, specimens were collected with sweep nets and carried to the laboratory for further identification processes. Climatic conditions such as temperature, humidity were measured by Thermo Hygrometer (model 288 - ATH). Butterflies were identified based on physical features with the help of reference books viz., Evans (1932), Kehimkar (2013). The scientific name and common name of butterflies were followed by Larsen (2004).

RESULTS AND DISCUSSION

Over the study period, 65 species belonging to 50 genera and five families were recorded. Among those four areas, BJEP represented all the species (65 species) because of its high floral diversity and deep vegetation, followed by Haiderpur with 58 species, Belkuchi with 37

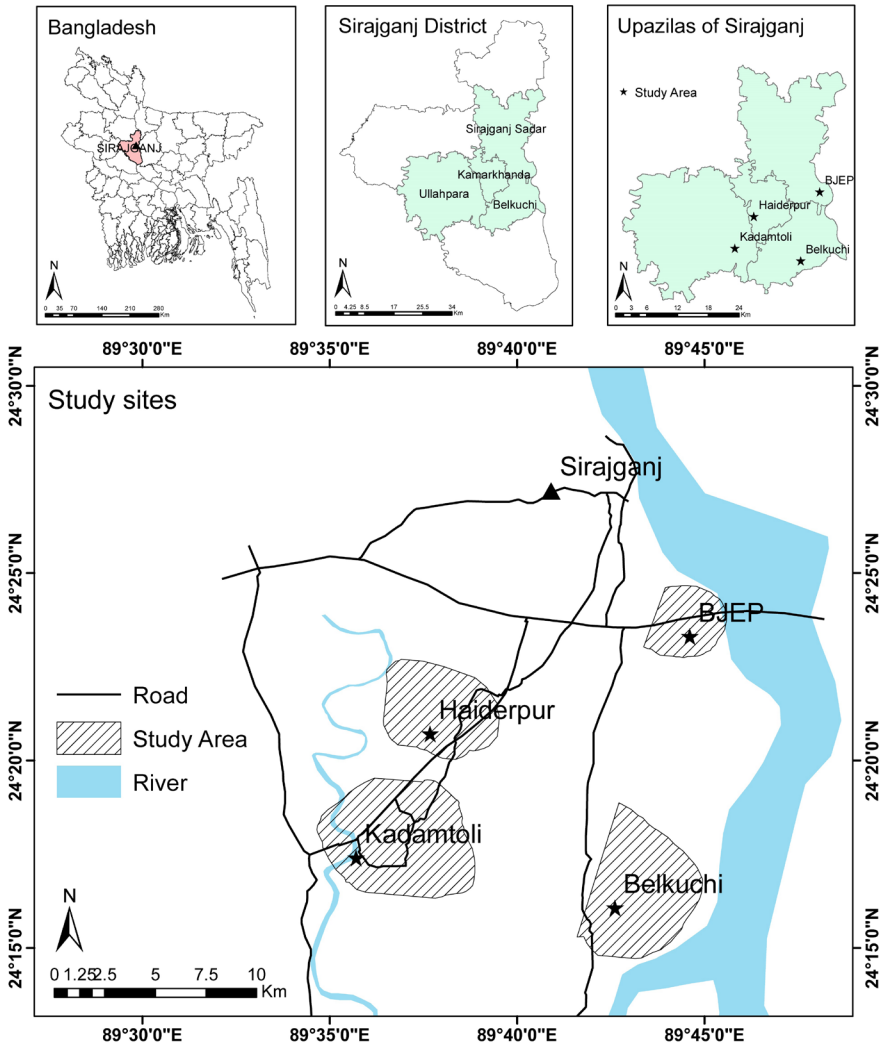

Figure 1. Sirajganj District including four study areas

species, and Kodomtoli with 33 species. All observed species and counted numbers are given in Table 1.

In this current study, we gave precedence to richness of butterfly species as our primary response variable. Changes in habitat quality caused by urbanization might alter insect richness, resulting in either a decrease or more rarely in increases, in the richness of specific insect groups (McKinney 2008). Among the four sites, BJEP and Haiderpur showed significant differences in species composition. Butterflies are found in both rural and urban habitats; diversity and richness are much lower in urban areas than in natural ones (Raupp et al. 2010). Overall, recorded species richness of this study showed how butterfly abundance and diversity remained low in the urban areas compared to the forest lands.

Among the five families of the observed species from Sirajganj District, the most dominant family was Lycaenidae having covered 37% of the total species (24, out of 65). Papilionidae was the least abundant family, with four species. The diversity profile of butterflies showed variations in the four sampling sites (Figure 3). In general, the four sampling sites showed richness in high species and high evenness of distribution (Table 2). Specifically, BJEP showed maximum diversity (Hs= 4.03) of butterflies, whereas Haiderpur showed minimum diversity (Hs = 3.74). Evenness of distribution in all the study sites was found to be high (e $H/\hat{S}$ = 0.7198 to 0.8653). Greater flowering resources increases species richness as well as survivability in an ecosystem (Wix et al. 2019). Floral diversity of BJEP has different flowering understory vegetation during the dry season (November–March) resulting in the most significant number of Lycaenidae accounted from this semi-natural forest (24 species out of 65, 37%), and hence, *Zesius chrysomallus* Hübner, 1819 was sighted as a new distributional record for Bangladesh from BJEP (Rahman et al. 2016).

Table 1. List of butterfly species sampling site-wise and their abundance at Serajganj District.

Family	Sub-family	Common name	Scientific name
Nymphalidae	Danainae	Plain Tiger	*Danaus chrysippus* Linnaeus, 1758
		Striped Tiger	*Danaus genutia genutia* (Cramer, 1779)
		Blue Tiger	*Tirumala limniace* (Cramer, 1775)
		Common Crow	*Euploea core* (Cramer, 1780)
	Nymphalinae	Common Eggfly	*Hypolimnas bolina* Linnaeus, 1758
		Common Leopard	*Phalanta phalantha* Drury, 1773
		Common Castor	*Ariadne merione* (Cramer, 1777)
		Common Baron	*Euthalia aconthea* (Cramer, 1777)
		Common Sailor	*Neptis hylas* Linnaeus, 1758
		Common Sergeant	*Athyma perius* Linnaeus, 1758
		Grey Pansy	*Junonia atlites* Linnaeus, 1763
		Peacock Pansy	*Junonia almana* Linnaeus, 1758
		Lemon Pansy	*Junonia lemonias* Linnaeus, 1758
	Satyrinae	Common Palmfly	*Elymnias hypermnestra* Linnaeus, 1763
		Common Five-ring	*Ypthima baldus* Fabricius, 1775
		Common Four-ring	*Ypthima huebneri* Kirby, 1871
		Common Bushbrown	*Mycalesis perseus* (Fabricius, 1775)
		Dark-branded Bushbrown	*Mycalesis mineus* Linnaeus, 1758
		Common Evening Brown	*Melanitis leda* Linnaeus, 1758
	Heliconiinae	Tawny Coster	*Acraea terpsicore* Linnaeus, 1758
Papilionidae	Papilioninae	Common Rose	*Pachliopta aristolochiae* Fabricius, 1775
		Common Mormon	*Papilio polytes* Linnaeus, 1758
		Common Jay	*Graphium doson* Felder & Felder, 1864
		Tailed jay	*Graphium agamemnon* Linnaeus, 1758
Pieridae	Coliadinae	Mottled Emigrant	*Catopsilia pyranthe* Linnaeus, 1758
		Common Emigrant	*Catopsilia pomona* Fabricius, 1775
		Three-Spot Grass Yellow	*Eurema blanda* (Boisduval, 1836)
		Common Grass Yellow	*Eurema hecabe* Linnaeus, 1758
	Pierinae	Common Gull	*Cepora nerissa* Fabricius, 1775
		Cabbage White	*Pieris canidia* (Sparrman, 1768)
		Psyche	*Leptosia nina* Fabricius, 1793
		Common Jezebel	*Delias eucharis* (Drury, 1773)
		Red-Spot Jezebel	*Delias descombesi* (Boisduval, 1836)
		Common Wanderer	*Pareronia hippia* (Fabricius, 1787)

Family	Sub-family	Common name	Scientific name
Lycaenidae	Polyommatinae	Common Pierrot	*Castalius rosimon* Fabricius, 1775
		Common Cerulean	*Jamides celeno* (Cramer, 1775)
		Pale Grass Blue	*Pseudozizeeria maha* Kollar, 1844
		Lesser Grass Blue	*Zizina otis* (Fabricius, 1787)
		Tiny Grass Blue	*Zizula hylax* (Fabricius, 1775)
		Dark Grass Blue	*Zizeeria karsandra* Moore, 1865
		Forget-me-not	*Catochrysops strabo* (Fabricius, 1793)
		Quaker	*Neopithecops zalmora* Butler, 1870
		Slate Flash	*Rapala manea* (Hewitson, 1863)
		Indigo Flash	*Rapala varuna* (Horsfield, 1829)
		Plains Cupid	*Chilades pandava* Horsfield, 1829
		Gram Blue	*Euchrysops cnejus* (Fabricius, 1798)
		Lime Blue	*Chilades lajus* Stoll, 1780
		Pea Blue	*Lampides boeticus* Linnaeus, 1767
		Common Lineblue	*Prosotas nora* (Felder, 1860)
		Tailless Lineblue	*Prosotas dubiosa* (Semper, 1879)
		Common Ciliate Blue	*Anthene emolus* (Godart, 1823)
		Pointed Ciliate Blue	*Anthene lycaenina* (Felder, 1868)
		Centaur Oakblue	*Arhopala centaurus* (Fabricius, 1775)
	Theclinae	Yamfly	*Loxura atymnus* Stoll, 1780
		Monkey Puzzle	*Rathinda amor* Fabricius, 1775
		Redspot	*Zesius chrysomallus* Hübner, 1819
		Chocolate Royal	*Remelana jangala* (Horsfield, 1829)
		Common Silverline	*Spindasis vulcanus* Fabricius, 1775
Hesperiidae	Hesperiinae	Straight Swift	*Parnara guttatus* Moore, 1865
		Dark Palm Dart	*Telicota bambusae* Moore, 1878
		Pale Palm Dart	*Telicota colon* Fabricius, 1775
		Bengal Swift	*Pelopidas agna agna* (Wallace, 1866)
		Conjoined Swift	*Pelopidas conjuncta* Herrich-Schäffer, 1869
	Pyrginae	Common Snow Flat	*Tagiades japetus* (Stoll, 1781)
	Coliadinae	Brown Awl	*Badamia exclamationis* (Fabricius, 1775)

The Whittaker plot according to the abundance of different butterfly species is shown in Figure 4. *Melanitis leda* and *Eurema blanda* show relative abundances of 4.02% and 3.91% respectively. Both these species account for 8.03% of total individuals encountered in this current study from the four areas. Species accumulation/ rarefaction curves as a function of the number of samples shown in Figure 5 represent that most common species are found in the sampling area, where curves generally grow rapidly at first. The red solid curve represents samples in the BJEP followed by Kadamtoli with light blue, Belkuchi with blue, and Haiderpur with green. Correspondence analysis has greatly simplified the story in the data (Figure 6); formed with family-wise species abundance consisting of 65 species, representing four different habitat/sampled sites. Each curve represents a different butterfly species richness level in four different locations.

Some representative groups, viz., grass yellows (*Eurema* spp.) and bush browns (*Mycalesis* spp.), are

Table 2. Different diversity parameters measured based on the number of counts of butterfly's species compare to four study sites of Sirajganj District.

Diversity parameters	BJEP	Belkuchi	Haiderpur	Kodomtoli
Simpson (1-D)	0.9805	0.9738	0.9723	0.9764
Shannon (H)	4.03	3.8	3.74	3.89
Evenness (e^H/S)	0.8653	0.7578	0.7198	0.7986
Menhinick	0.7443	0.9277	1.08	0.8911
Chao-1	65	59	60.5	61

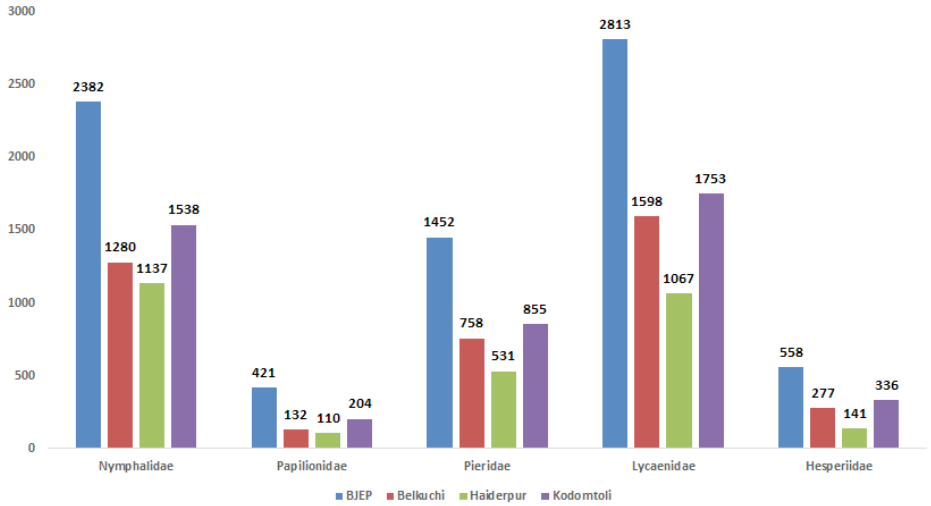

Figure 2. Family-wise trend of butterfly's species in four different habitats of Sirajganj District.

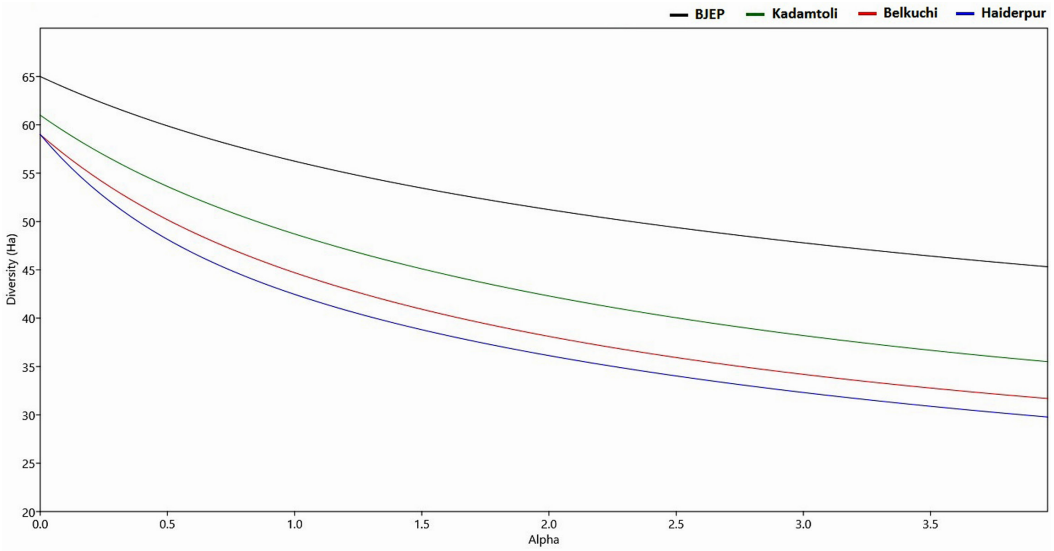

Figure 3. Diversity profile of butterflies' variations in the four sampling sites

observed to have high population in all seasons except in the monsoons, depending on the habitat. Most of the species of family Nymphalidae, viz., *Junonia* sp. and *Danaus* sp., are found in different stratification of forests due to their polyphagous character.

The compilation of species lists and identification of habitat preferences and counting of abundances are the first steps for effective conservation of biodiversity

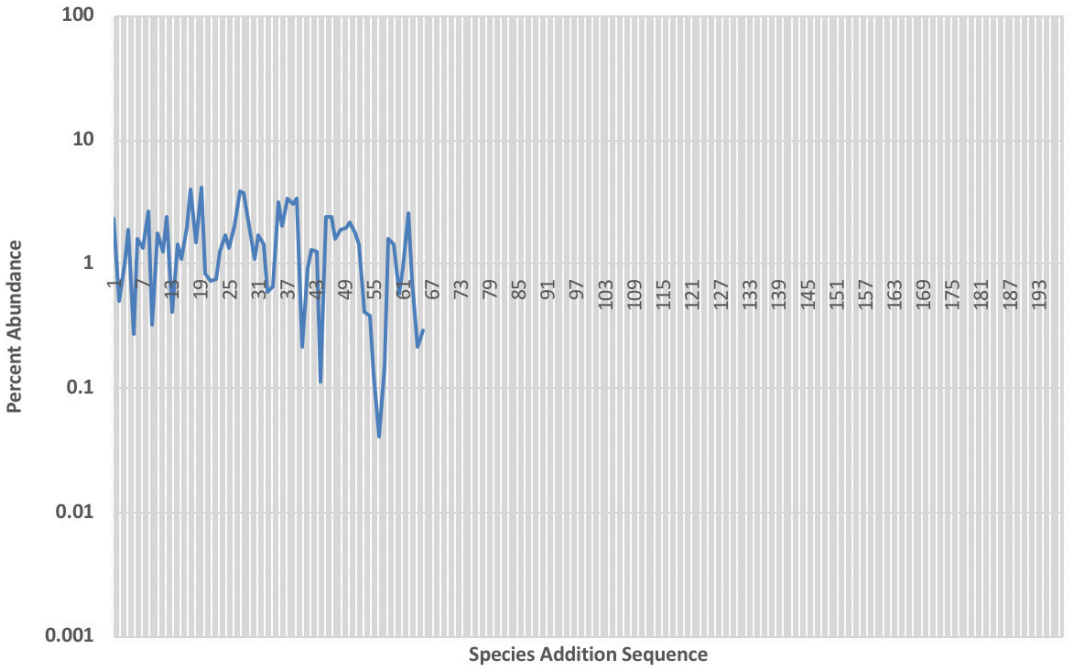

Figure 4. Rank abundance curve based on family-wise species abundances at four different sampled sites.

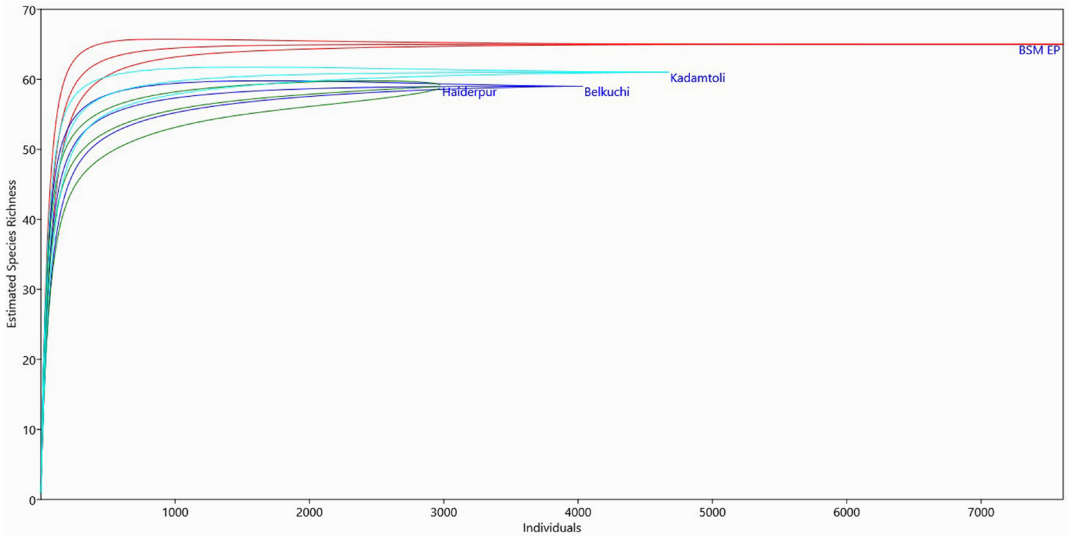

Figure 5. Species accumulation/rarefaction curves at four different sampled site.

through information of species baselines related data. Early successional forests have some valuable ecosystem services for insect population growth. It can support biodiversity at large (Chazdon 2008). BJEP covers some natural forests in the western part of the river Yamuna which support a good number of butterfly species throughout the seasons. The presence of their host plant may have resulted in the high species diversity. Butterflies show a strong response to the vegetation of their habitat (Oostermeijer & van Sway 1998). Besides, the use of chemicals causes damage to the natural environment (Sharma & Singhvi 2017). In urban areas, modification of landscape, establishment of factories, random cleanup of bushes reduces the potential habitat for butterflies. Thus, the chance of natural pollination decreases.

Butterflies in four habitats showed a highly seasonal trend in pre-monsoon (March–May) and winter season (October–November). Some species, viz., *Rapala manea*,

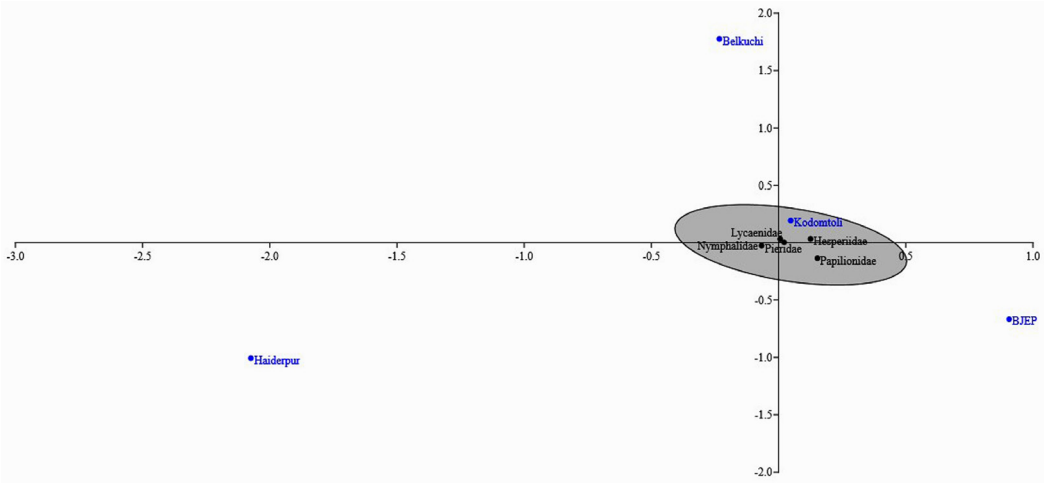

Figure 6. Corresponding analysis represents species richness level in four different locations

Chilades pandava, *Euchrysops cnejus*, *Chilades lajus*, *Lampides boeticus*, *Prosotas nora*, *Prosotas dubiosa*, and *Anthene emolus*, appeared abundant during post-monsoon and were not seen during the monsoon.

CONCLUSION

The present study address several unreported aspects of butterfly and their diversity in the study area as well as northern part which was not well explored previously. More detailed study is required to evaluate the habitat condition through butterfly diversity in the northern part of Bangladesh. The vegetation of the riverside area allows a functional variety of flora that are sources of host plants and nectar plants for butterflies, even home to different wild animals viz., birds, reptiles, and so on. The conservation of habitat and wild fauna remains a daunting task in Bangladesh due to overpopulation and a lack of knowledge about habitat conservation. It is suggested that greater emphasis be given on sustainable forest management and integrated conservation approaches in riverside rural as well as urban habitats to maintain the natural balance.

REFERENCES

Chazdon, R.L. (2008). Beyond deforestation: restoring forests and ecosystem services on degraded lands. *Science* 320: 1458–460.

Chowdhury, S., T. Hesselberg, M. Bohm, M.R. Islam & U. Aich (2017). Butterfly diversity in a tropical urban habitat (Lepidoptera: Papilionoidea). *Oriental Insects* 2157–8745.https://doi.org/10.1080/00305316.2017.1314230

Evans, W.H. (1932). *The Identification of Indian Butterflies*. Bombay Natural History Society, Bombay, 454pp.

Kehimkar, I. (2013). *The Book of Indian Butterflies*. Bombay Natural History Society, 497pp.

Kunte, K. (2000). Project life scape. *Resonance* 5: 86–97.

Larsen, T.B. (2004). *Butterflies of Bangladesh - an annotated checklist*, IUCN Bangladesh Country Office, Dhaka, Bangladesh, 104pp.

McKinney, M.L. (2008). Effects of urbanization on species richness: a review of plants and animals. *Urban Ecosystems* 11: 161–176.

Oostermeijer, J.G.B. & C.A.M. van Sway (1998). The Relationship Between Butterflies and Environmental Indicator Values: Tools for Conservation in a Changing Landscape. *Biological Conservation* 86: 271–280.

Pollard, E. (1991) *Monitoring butterfly numbers*, 87–111. In: Goldsmith, B. (eds) *Monitoring for Conservation and Ecology. Conservation Biology, Vol 3*. Springer, Dordrecht i-xv+275pp. https://doi.org/10.1007/978-94-011-3086-8_6

Rahman, M.S., I.K.A. Haidar, A.K. Neogi, M.A.U. Hasan, M.M. Rahman & S.M.S. Imam (2016). First record of six butterfly species in Bangladesh. *Journal of Insect Biodiversity and Systematics* 02(3): 373–380.

Raupp, M.J., P.M. Shrewsbury & D.A. Herms (2010). Ecology of herbivorous arthropods in urban landscapes. *Annual Review of Entomology* 55: 19–38.

Sharma, N. & R. Singhvi (2017). Effects of chemical fertilizers and pesticides on human health and environment: a review. *International Journal of Agriculture, Environment and Biotechnology* 10(6): 675–679.

Wix, N., M. Reich & F. Schaarschmidt (2019). Butterfly richness and abundance in flower strips and field margins: the role of local habitat quality and landscape context. *Heliyon* 5(5): e01636. https://doi.org/10.1016/j.heliyon.2019.e01636

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