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Cover: Common Keeled Skink *Eutropis carinata* in oil pastels, colour pencils, & micron pen adapted from photograph by H. Byju © Pooja Ramdas Patil.



A preliminary assessment of butterfly diversity from Mekhliganj town, Cooch Behar District, West Bengal, India

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Abstract: In the present study, butterfly diversity from Mekhliganj town, which is located on the Teesta River bank of Cooch Behar District, West Bengal, India was studied. A total of 55 species of butterflies were recorded from the two study sites, out of which 22 species were observed for the first time from Cooch-Behar District, not recorded earlier. Out of these, five recorded species were legally protected under the Wildlife (Protection) Act (WPA), 1972 like *Chliaria othona*, *Lampides boeticus*, and *Hypolimnas misippus*. Therefore, efforts should be made for habitat conservation of the Teesta River bank.

Keywords: Butterfly diversity, checklist, conservation, diversity and abundance, environment, India, indicator species, Lepidoptera, Mekhliganj, pollinator species

Abbreviations: M—Moderate | R—Rare | VC—Very Common | WPA—Wildlife Protection Act | TA—Town Area | RB—River Bank.

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Author contributions: Conceptualization: AS and DS, Data curation: AS, Formal analysis: AS and PD, Investigation: AS, Methodology: AS, Software: AS, Supervision: DS, Validation: AS and PD, Visualization: AS, DS and PD, Writing-original draft: AS and PD, Writing- review and editing: AS, PD and DS. All authors read and approved the final manuscript.

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INTRODUCTION

Butterflies play a number of critical roles in the maintenance of environmental quality in terrestrial ecosystems (Ghazoul 2002). Conservation biologists now utilize numerous species of butterflies to identify the important habitats that must be protected because they are highly sensitive to environmental parameters such as temperature, light, humidity, and rainfall (Spitzer et al. 1997; Thomas 2005; Bonebrake et al. 2010; Brereton et al. 2011). As an important pollinator, they face numerous conservation challenges as a result of the ongoing augmentation of anthropogenic activities such as industrialization, urbanization, usage of numerous pesticides in various agricultural, horticultural fields, deforestation along with monoculture plantation and overgrazing (Tiple et al. 2007; Roy et al. 2012, 2022).

There are over 18,000 species of butterflies worldwide, out of which around 1,300 butterfly species are found in India (Samanta et al. 2017; Smetacek 2017). The northern region of West Bengal, which includes the districts of Cooch-Behar, Jalpaiguri, Darjeeling, Dakshin Dinajpur, Uttar Dinajpur, Alipurduar, Malda, and Kalimpong is well-known for its diverse fauna and flora (Pal 2017). However, very few studies of butterfly diversity from this area have been documented.

In this present study, butterfly diversity was studied in the town of Mekhliganj, which is located in the Cooch Behar District. Some authors have previously reported 66 species of butterflies from other areas of the Cooch-Behar District (Das et al. 2020; Roy et al. 2022), however, their diversity from Mekhliganj town remains undocumented and hence the present study was taken up. For this study, two geographically distinct sites were chosen.

MATERIALS AND METHODS

The butterfly diversity was studied at two geographically different study locations in the Mekhliganj city. Mekhliganj is a municipal city in Cooch Behar District located in northern part of West Bengal, covering an area of 3.88 km², situated between 26.35°N and 88.92°E (Directorate of Census Operations V, West Bengal 2011). Field studies for butterfly diversity was conducted between January 2020 to August 2021. During this time each study site was visited twice a month from 0800 h to 1200 h. Butterflies were surveyed and photographed in these study areas. Butterfly survey and counting was conducted using the Pollard walk

method (Pollard 1977). Butterflies were counted within 5 m on both sides of the transect walk. Photographs of butterfly specimens were taken with a NIKON D3500 DSLR camera.

Site 1: Town area (TA) consisted of ephemeral water bodies, ponds, marshes, bushes, wetlands, trees and shrubs, tea gardens and agricultural lands that are adjacent to human populations. Site 2: River bank (RB) is located in the Teesta riverbank (120–130 m from the water), and comprised of shrubs, agricultural grounds, aquatic plants and grasses as well as a few human settlements. The study area locations are listed in the Table 1 and photographs are given in the Images 1 & 2.

Three short forms were used to examine the occurrence status of each butterfly species. Butterflies that were very common and plentiful were designated as VC (more than 100), moderately abundant butterflies were designated as M (more than 30) and rare butterflies were designated as R (less than 30). Not even a single butterfly was harmed or killed during this study.

The colour patterns and wing designs of common butterflies were used to identify them on the spot. Other butterflies were carefully identified through photographs. Standard guides of entomological specialists, published literatures (Samanta et al. 2017; Mukherjee & Mondal 2020), field guide books (Smetacek 2017) and some websites (Know your insects 2022; Butterflies of India 2022) were used to confirm the identification of the butterfly species. Data analysis & all the diversity indices like Shannon Weiner index, Margalef index, and evenness index were calculated using PAST software version 4.10.

RESULTS

In the present study, a total of 55 species were recorded belonging to 44 genera of five families namely, Papilionidae, Hesperidae, Pieridae, Lycaenidae, and Nymphalidae. Most number of species belonged to the family Nymphalidae (22 species) whereas least number of species belonged to the family Papilionidae (three species) (Image 3–5). A total of 53 species of butterflies were observed from TA whereas, 42 species were observed from RB (Table 2).

In both the study sites, family Nymphalidae was the most abundant: 21 species from TA (39%) & 19 species from RB (45%), followed by Lycaenidae: 11 species from TA (21%) & seven species from RB (17%), Pieridae: 10 species from TA (19%) & eight species from RB (19%), Hesperidae: eight species from TA (15%) & six species

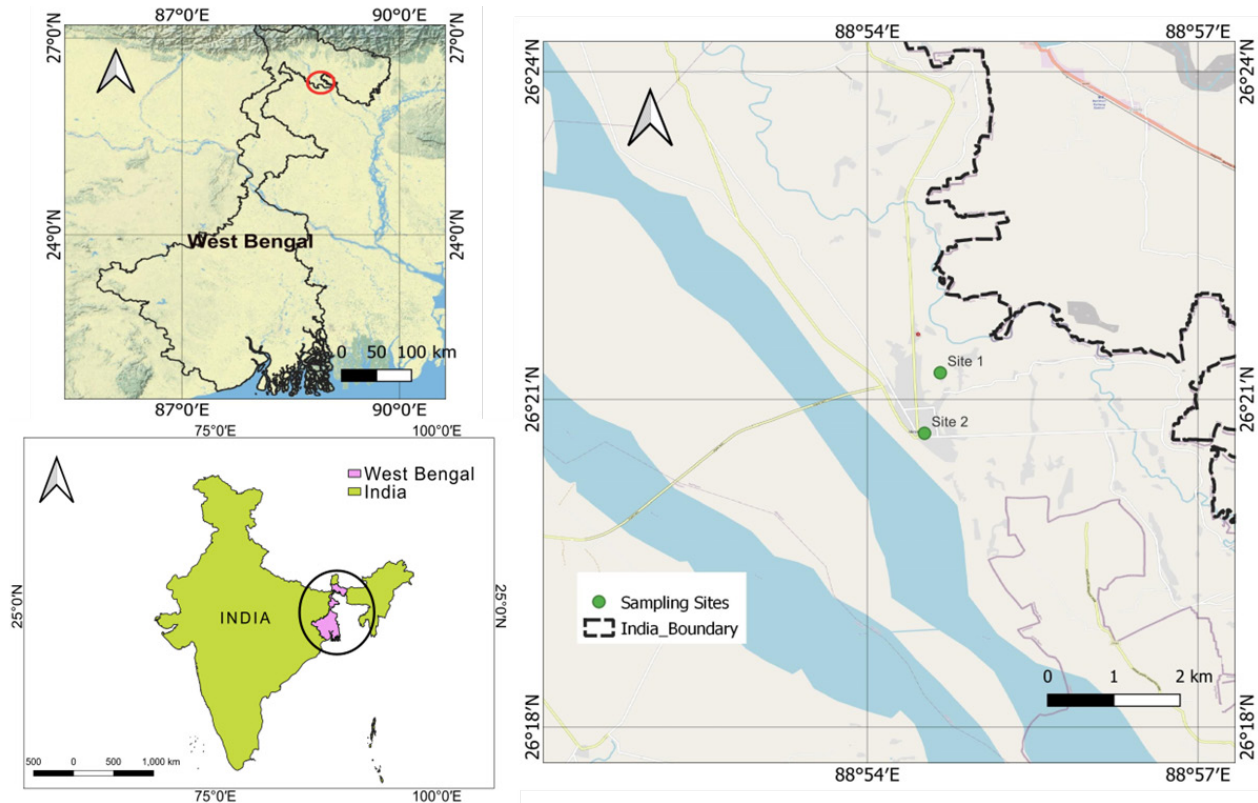


Image 1. Locations and study sites in Mekhliganj. (Site 1 = Town Area and Site 2 = River Bank) (This map was created using QGIS software version 3.22. Shape files of India and West Bengal were downloaded from: <https://www.naturalearthdata.com/downloads/10m-cultural-vectors/>).

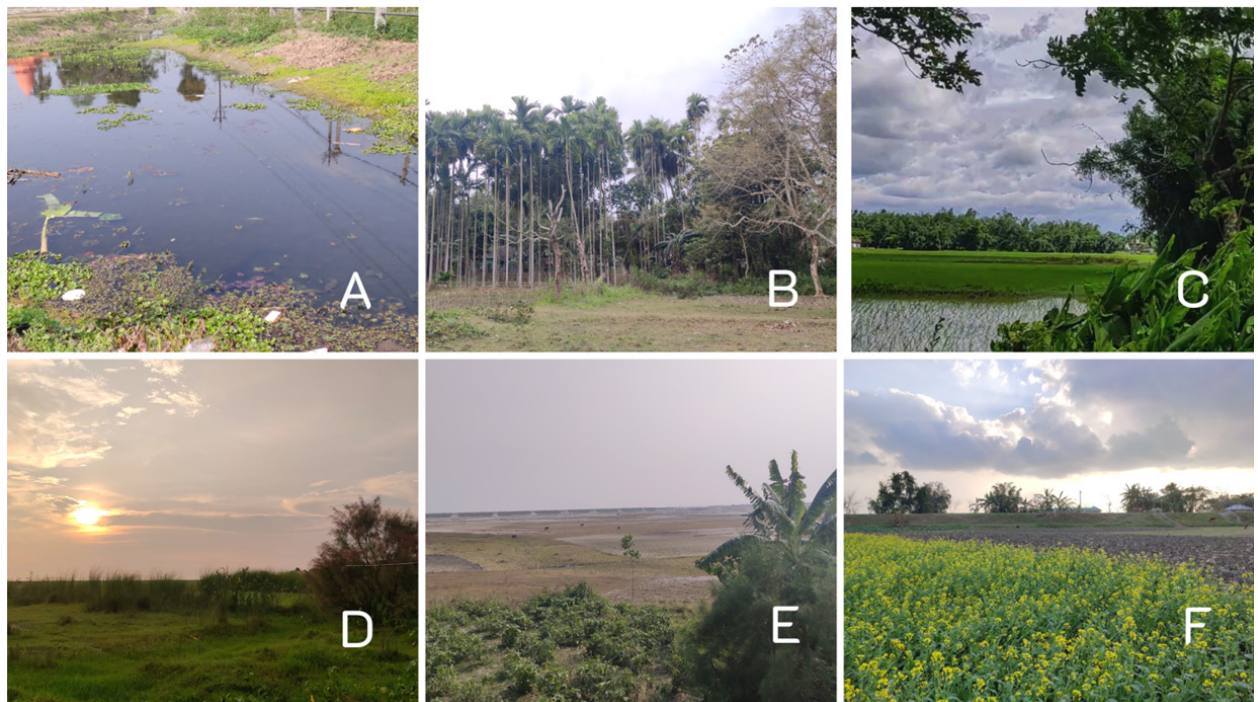


Image 2. Study areas from Mekhliganj. Photograph A, B & C represent Town Area and photograph D, E & F represent River Bank.

Table 1. A brief representation of the selected sampling sites with their habitat types and locations.

Sampling site	Location	Description
TA	26.358°N, 88.906°E	Ephemeral water bodies, ponds, wetlands, shrubs, small and large trees, agricultural lands in close proximity to human settlements.
RB	26.359°N 88.896°E	Riverbed (120–130 meter far from water), bushes, agricultural lands, aquatic plants and grasses, few human settlements.

Table 2. Checklist of the butterflies reported from Mekhliganj.

	Family	Common name	Scientific name	Occurrence		Status
				TA	RB	
1	Papilionidae	Common Mormon	<i>Papilio polytes</i>	✓	✓	VC
		Lime Butterfly	<i>Papilio demoleus</i>	✓	✓	M
		Tailed Jay	<i>Graphium agamemnon</i>	✓	-	R
2	Hesperiidae	Grass Demon	<i>Udaspes folus</i>	✓	✓	VC
		Straight Swift	<i>Parnara guttatus</i>	✓	✓	VC
		Chestnut Bob	<i>Iambrix salsala</i>	✓	-	R
		Dark Palm Dart	<i>Telicota bambusae</i>	✓	✓	M
		Pale Palm Dart	<i>Telicota colon</i>	✓	✓	M
		Common Redeye	<i>Matapa aria</i>	✓	✓	M
		Fulvous Pied Flat	<i>Pseudocoladenia dan</i>	✓	-	R
		Common Dartlet	<i>Oriens gola</i>	✓	✓	VC
3	Pieridae	Mottled Emigrant	<i>Catopsilia pyranthe</i>	✓	✓	VC
		Common Emigrant	<i>Catopsilia pomona</i>	✓	✓	VC
		Striped Albatross	<i>Appias libythea</i>	✓	✓	VC
		Eastern Striped Albatross	<i>Appias olferna</i>	✓	✓	VC
		Common Grass Yellow	<i>Eurema hecabe</i>	✓	✓	VC
		Tree Yellow	<i>Gandaca harina</i>	✓	✓	M
		The Common Jezebel	<i>Delias eucharis</i>	✓	-	M
		Red-Spot Jezebel	<i>Delias descombesi</i>	✓	-	R
		Psyche	<i>Leptosia nina</i>	✓	✓	VC
		Asian Cabbage White	<i>Pieris canidia</i>	✓	✓	M
4	Lycaenidae	Slate Flash	<i>Rapala manea</i>	✓	-	R
		Common Pierrot	<i>Castalius rosimon</i>	✓	✓	VC
		Orchid Tit	<i>Chliaria othona</i>	✓	-	R
		Apefly	<i>Spalgis epius</i>	✓	-	M
		Common Hedge Blue	<i>Acytolepis puspa</i>	✓	-	R
		Pale Grass-Blue	<i>Pseudozizeeria maha</i>	✓	✓	VC
		Lesser Grass-Blue	<i>Zizina otis</i>	✓	✓	VC

from RB (14%), and Papilionidae: three species from TA (6%) & two species from RB (5%) (Table 3; Figures 1, 2). During the study period, some butterfly species were observed more frequently than others. Family-wise occurrence of all the butterflies is summarized in Table 2.

Results showed that alpha diversity of TA was little higher than the RB (comparing Shannon Weiner index).

	Family	Common name	Scientific name	Occurrence		Status
				TA	RB	
4	Lycaenidae	Common Imperial	<i>Cheritra freja</i>	✓	✓	M
		Pea Blue	<i>Lampides boeticus</i>	-	✓	M
		Lime Blue	<i>Chilades lajus</i>	✓	✓	M
		Common Cerulean	<i>Jamides celeno</i>	✓	✓	M
		Dark Cerulean	<i>Jamides bochus</i>	✓	-	M
5	Nymphalidae	Common Bushbrown	<i>Mycalesis perseus</i>	✓	✓	VC
		Long-brand Bushbrown	<i>Mycalesis visala</i>	✓	✓	VC
		Common Four-ring	<i>Ypthima huebneri</i>	✓	✓	VC
		Common Five-ring	<i>Ypthima baldus</i>	✓	✓	VC
		Common Baron	<i>Euthalia aconthea</i>	✓	✓	M
		Plain Tiger	<i>Danaus chrysippus</i>	✓	✓	M
		Striped Tiger	<i>Danaus genutia</i>	✓	✓	M
		Blue Tiger	<i>Tirumala limniace</i>	✓	✓	M
		Common Palmfly	<i>Elymnias hypermnestra</i>	✓	✓	VC
		Common Castor	<i>Ariadne merione</i>	-	✓	R
		Common Indian Crow	<i>Euploea core</i>	✓	✓	M
		Common Evening Brown	<i>Melanitis leda</i>	✓	✓	VC
		Common Leopard	<i>Phalanta phalantha</i>	✓	-	R
		Grey Pansy	<i>Junonia atlites</i>	✓	✓	M
		Peacock Pansy	<i>Junonia almana</i>	✓	✓	VC
		Lemon Pansy	<i>Junonia lemonias</i>	✓	✓	M
		Common Sailor	<i>Neptis hylas</i>	✓	✓	M
		Yellow Coster	<i>Acraea issoria</i>	✓	-	R
		Danaid Eggfly	<i>Hypolimnas misippus</i>	✓	✓	M
		Great Eggfly	<i>Hypolimnas bolina</i>	✓	-	R
		Extra Lascar	<i>Pantoporia sandaka</i>	✓	✓	M
		Commander	<i>Moduza procris</i>	✓	✓	R

VC—Very Common | M—Moderate | R—Rare.

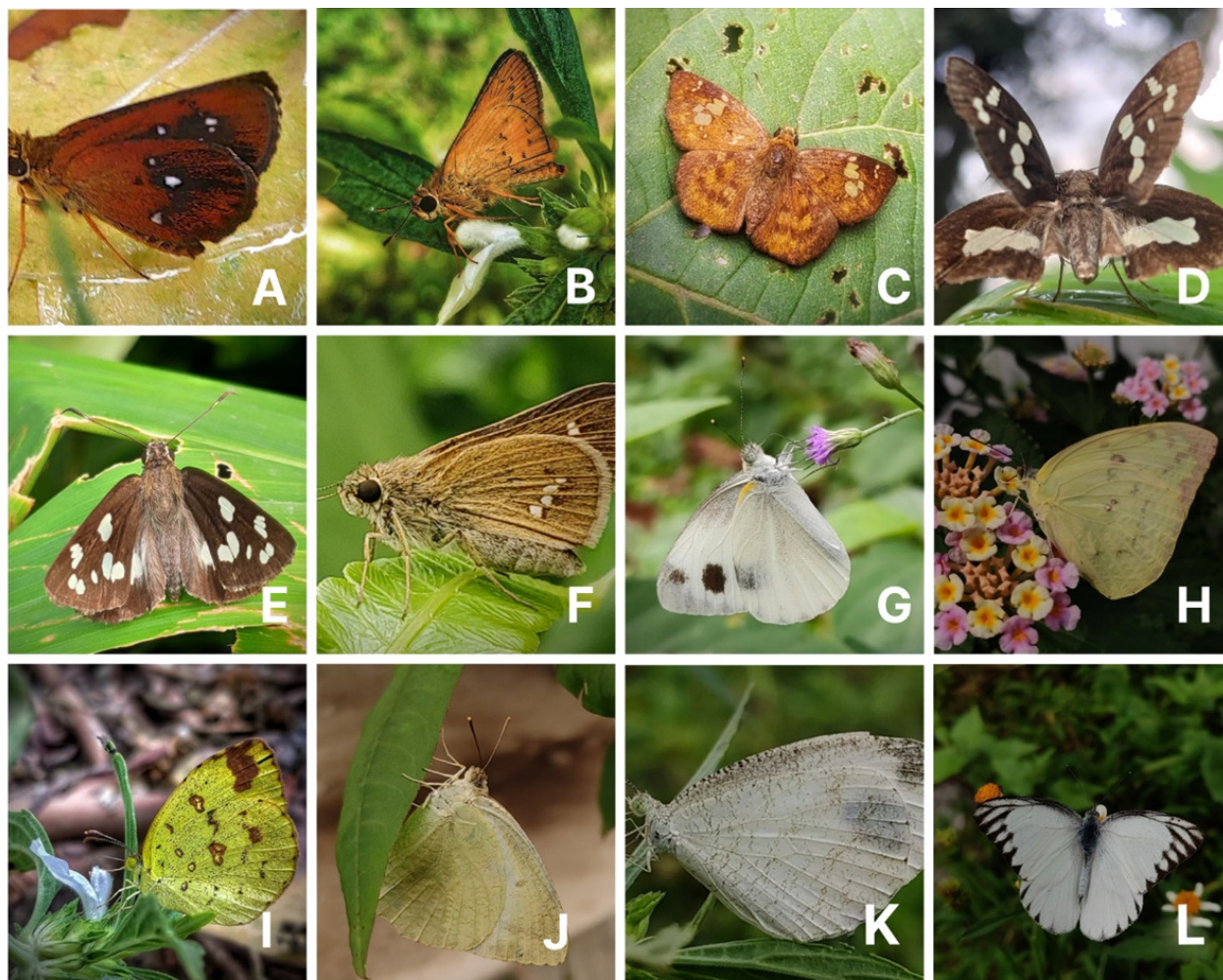


Image 3. Butterflies of the family Hesperidae and Pieridae recorded during the study.

A—Chestnut Bob *Iambrix salsala* | B—Dark Palm Dart *Telicota bambusae* | C—Fulvous Pied Flat *Pseudocoladenia dan* | D—E. Grass Demon *Udaspes folus*: D—view from lower side, E—view from upper side | F—Straight Swift *Parnara guttatus* | G—Asian Cabbage White *Pieris canidia* | H—Common Emigrant *Catopsilia pomona* | I—Common Grass Yellow *Eurema hecabe* | J—Mottled Emigrant *Catopsilia pyranthe* | K—Psyche *Leptosia nina* | L—Striped Albatross *Appias libythea*. © Abhirup Saha.

Margalef index showed higher diversity in TA (6.967) compared to RB (5.865). On the other hand, dominance was more in RB (0.05728) than TA (0.04523). Evenness index for both the study sites were close to each other. The Berger-Parker index, which indicates single taxa dominance was higher in RB (0.1454) compared to TA (0.1182). Table 5 summarises the different diversity indices of the butterflies from the two study sites.

DISCUSSIONS

As per our knowledge, this study is the first of its kind from this town and will shed some light on the region's ecosystem health and macro fauna conservation needs. Previously, three studies regarding butterfly diversity

in Cooch Behar District were carried out. Thirty-three species out of a total 55 species of butterflies recorded during this study were also reported in those studies (Das et al. 2020; Roy et al. 2022). Whereas, 22 species were observed for the first time from Cooch Behar District, which were not recorded by previous authors (Das et al. 2020; Roy et al. 2022). These are – *Parnara guttatus*, *Iambrix salsala*, *Telicota bambusae*, *Telicota colon*, *Matapa aria*, *Pseudocoladenia dan* & *Oriens gola* from family Hesperidae; *Rapala manea*, *Chliaria othona*, *Spalgis epius*, *Zizina otis*, *Cheritra freja*, *Lampides boeticus* & *Jamides celeno* from family Lycaenidae; *Mycalasis perseus*, *M. visala*, *Ariadne merione*, *Junonia lemonias*, *Acraea issoria*, *Pantoporia sandaka* & *Moduza procris* from family Nymphalidae, and *Gandaca harina* from family Pieridae.

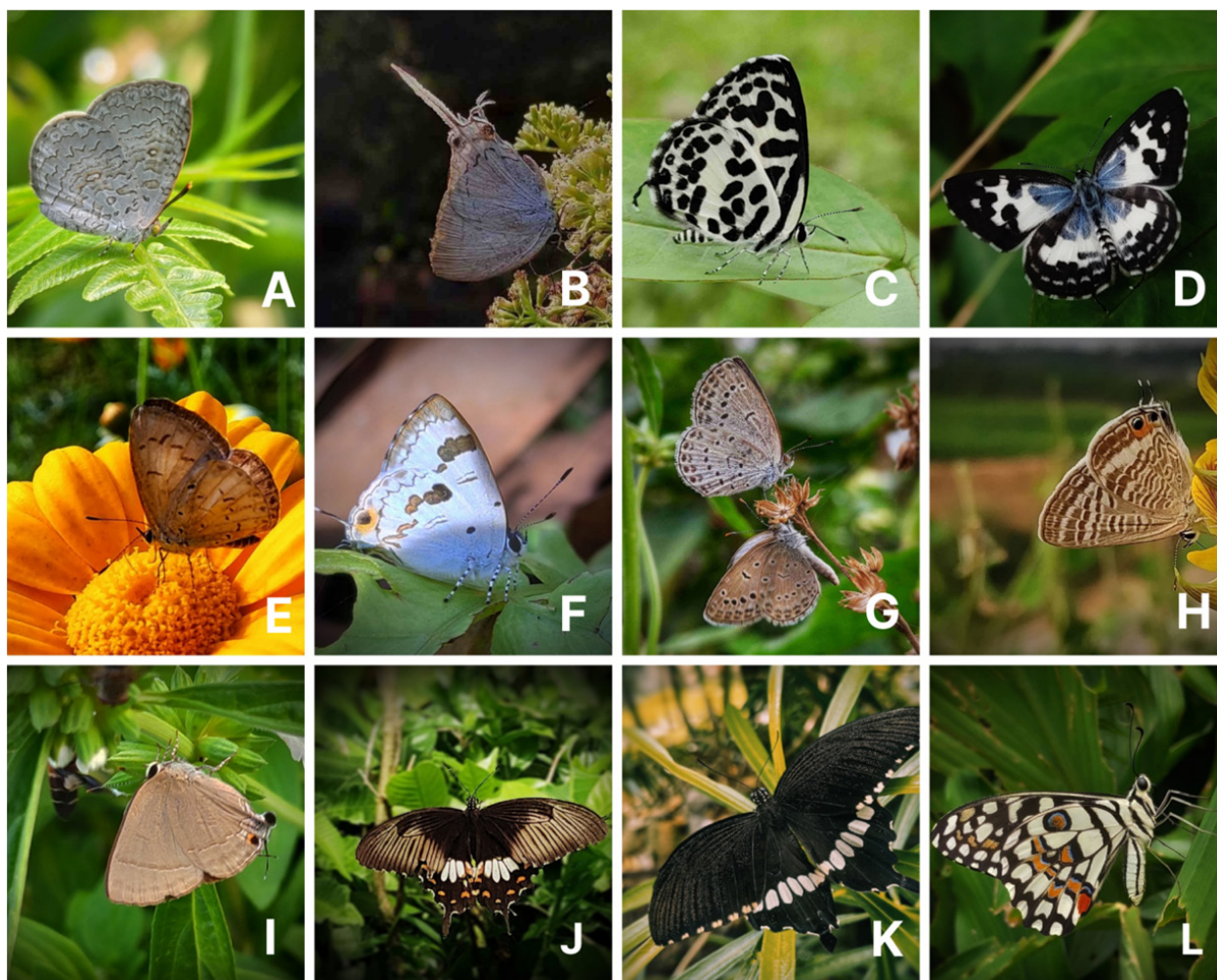


Image 4. Butterflies of the family Lycaenidae and Papilionidae recorded during the study.

A—Apefly *Spalgis epius* | B—Common Imperial *Cheritra freja* | C–D—Common Pierrot *Castalius rosimon*: C. underside. D. upper side | E—Common Hedge Blue *Acytolepis puspa* | F—Orchid Tit *Chliaria othona* | G—Pale Grass Blue *Pseudozizeeria maha* | H—Pea Blue *Lampides boeticus* | I—Slate Flash *Rapala manea* | J–K—Common Mormon *Papilio polytes*: J—Female. K—Male | L—Lime Butterfly *Papilio demoleus*. © Abhirup Saha.

Moreover, the number of species recorded in this study is consistent with other studies regarding butterfly diversity in various locations of West Bengal with similar landscape patterns (Ghosh & Siddique 2005; Mukherjee et al. 2015; Ghosh & Saha 2016; Mandal 2016; Mukherjee et al. 2016; Dey et al. 2017; Samanta et al. 2017; Das 2018; Pahari et al. 2018; Mahata et al. 2020; Mukherjee & Mondal 2020). The number of species recorded from the two study sites differed slightly maybe because TA was topographically more diverse than RB and also maybe TA was more suitable to support the host plants of the recorded butterfly species.

A total of five species were found to be included under the Wildlife (Protection) Act (WPA), 1972 (Table 4), viz., *Chliaria othona* included under schedule I and *Lampides boeticus* included under schedule II from

family Lycaenidae; *Euploea core* included under schedule IV and *Hypolimnas misippus* included under schedule II from family Nymphalidae and *Appias libythea* included under schedule IV from family Pieridae.

The high diversity of butterfly fauna of Mekhliganj indicates the presence of preferable vegetation for different butterfly species. However, gradual urbanization of the town can lead to the disposal of host plants of butterflies resulting in decreased butterfly diversity.

CONCLUSION

The present study is a preliminary record of butterfly diversity from Mekhliganj town of Cooch

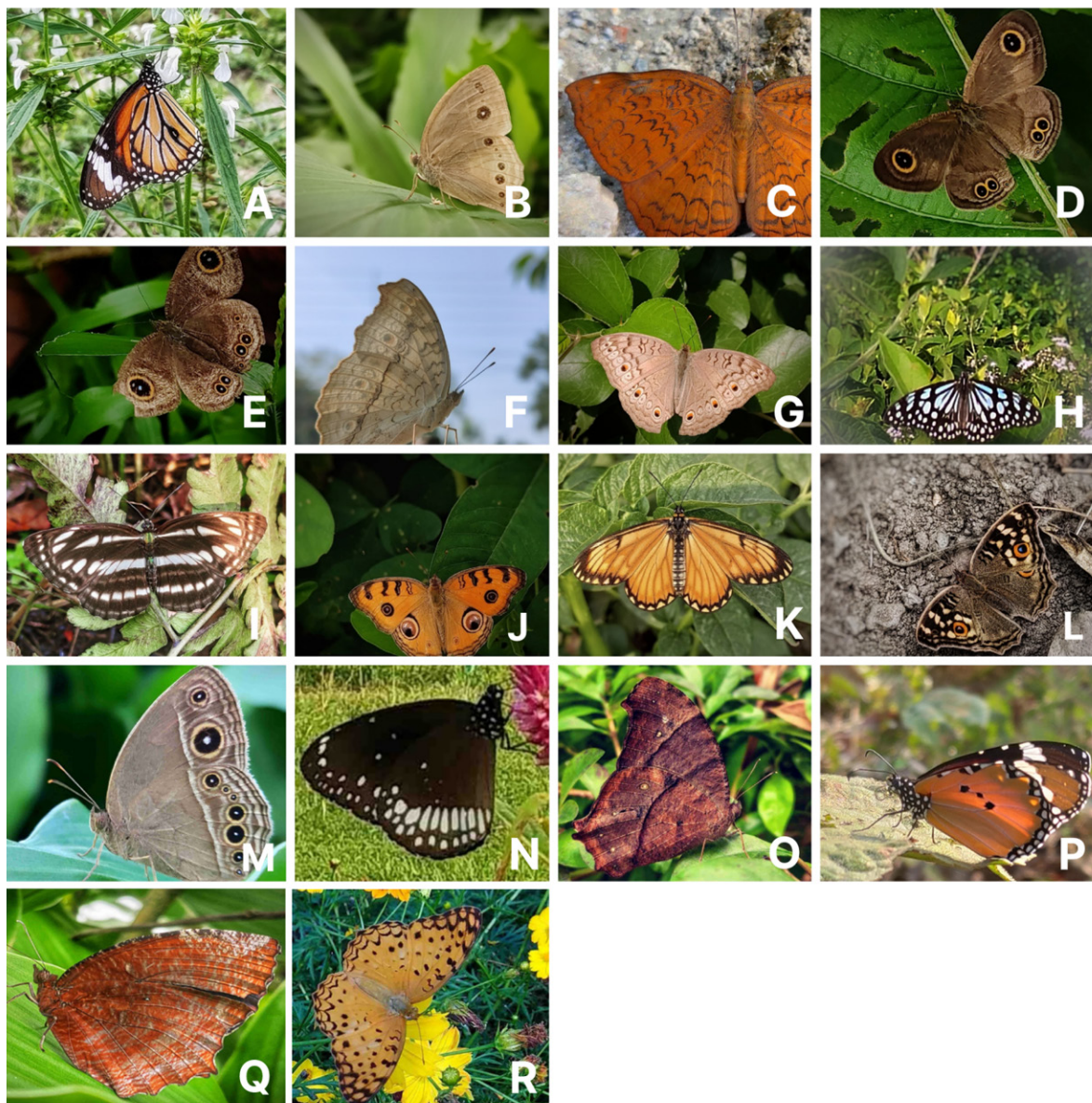


Image 5. Some butterflies of the family Nymphalidae recorded during the study.

A—Striped Tiger *Danaus genutia* | B—Long-brand Bushbrown *Mycalesis visala* | C—Common Castor *Ariadne merione* | D—Common Four-ring *Ypthima huebneri* | E—Common Five-ring *Ypthima baldus* | F-G. Grey Pansy *Junonia atlites*: F—underside | G. upper side | H. Blue Tiger *Tirumala limniace* | I—Common Sailor *Neptis hylas* | J—Peacock Pansy *Junonia almanac* | K—Yellow Coster *Acraea issoria* | L—Lemon Pansy *Junonia lemonias* | M—Common Bushbrown *Mycalesis perseus* | N—Common Crow *Euploea core* | O—Common Evening Brown *Melanitis leda* | P—Plain Tiger *Danaus chrysippus* | Q—Common Palmfly *Elymnias hypermnestra* | R—Common Leopard *Phalanta phalantha*. © Abhirup Saha.

Behar District. As the current study was restricted to two sites only, butterfly diversity may vary in other sites of the town. However, this study will help to get an idea of the diversity of butterflies from the study area. Moreover, first report of 22 butterfly species like *Parnara guttatus*, *Iambrix salsala*, *Telicota bambusae*, *Rapala manea*, *Chliaria othona*, *Spalgis epius*, *Zizina otis*, *Cheritra freja*, *Ariadne merione*, *Junonia lemonias*, *Acraea issoria*, *Pantoporia sandaka*, *Moduza procris*,

and *Gandaca harina*. from this region shows that there is need of more studies on diversity of Lepidoptera in other sites of Mekhliganj as well as entire Cooch Behar District. Investigating the butterfly fauna is crucial for recognizing and safeguarding diverse habitats facing potential anthropogenic changes, as these insects serve as potential pollinators for their nectar plants and indicate the condition of the overall ecosystem health.

Table 3. Relative abundance of different butterfly families from the study sites.

Family	Total number of genera recorded from both the sites	Total number of species	
		TA	RB
Hesperiidae	07	08	06
Nymphalidae	16	21	19
Pieridae	07	10	08
Lycaenidae	11	11	07
Papilionidae	02	03	02

Table 4. List of butterflies from Mekhliganj included under Indian Wildlife (Protection) Act, 1972 (WPA).

	Family	Common name	Scientific name	WPA Schedule (1972)
1	Lycaenidae	Orchid Tit	<i>Chliaria othona</i>	I (Part IV)
		Pea Blue	<i>Lampides boeticus</i>	II (Part II)
2	Nymphalidae	Danaid Eggfly	<i>Hypolimnys misippus</i>	II (Part II)
		Common Indian Crow	<i>Euploea core</i>	IV
3	Pieridae	Striped Albatross	<i>Appias libythea</i>	IV

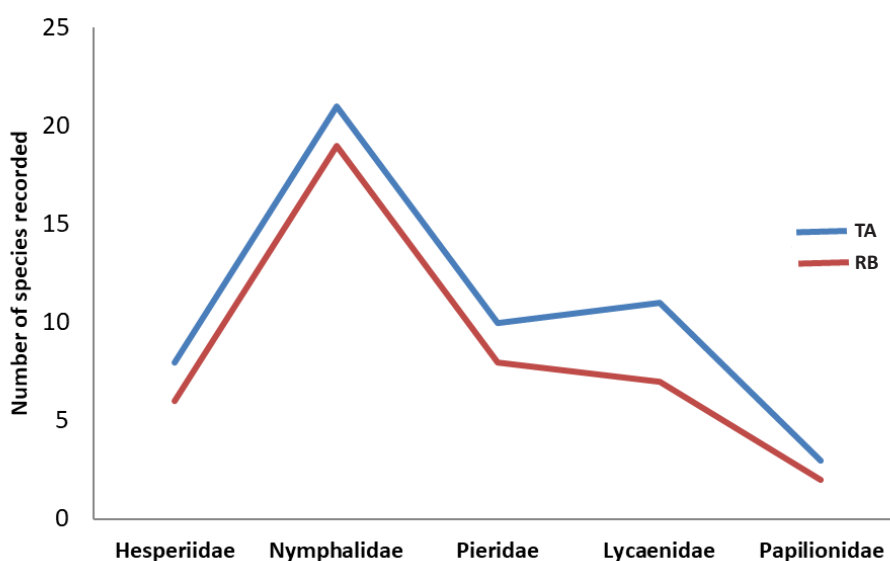
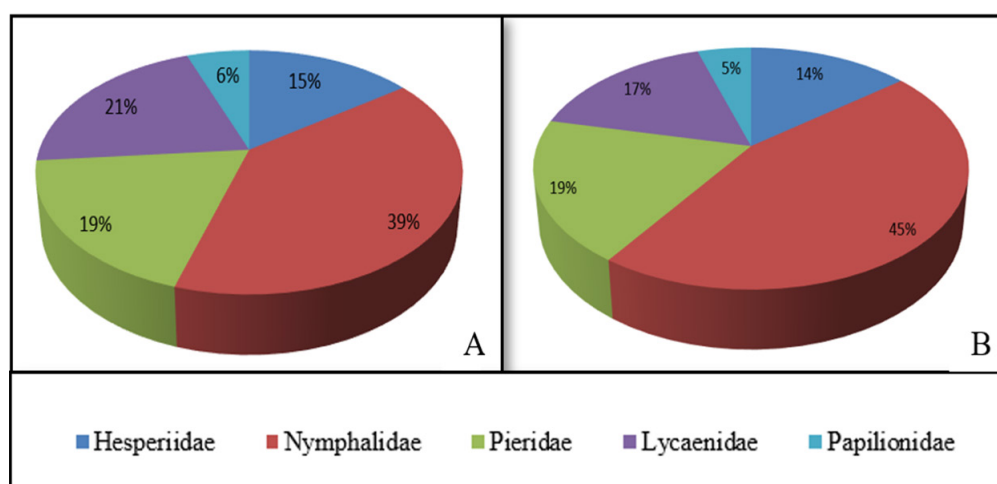
**Figure 1.** Comparative abundance of recorded species among different butterfly families between Town Area (TA) and River Bank (RB).**Figure 2.** Family-wise percent distribution of butterflies from Town Area (A) and River Bank (B).

Table 5. Site-wise diversity indices for butterfly species from Mekhliganj.

	Town Area	River Bank
Taxa_S	53	42
Simpson_1-D	0.9548	0.9427
Shannon_H	3.461	3.23
Dominance_D	0.04523	0.05728
Evenness_e^H/S	0.601	0.6017
Margalef	6.967	5.865
Berger-Parker	0.1182	0.1454

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