

**Research Article****Unveiling the unknown: a butterfly checklist of the Adampur forest in Bangladesh**

Mohammad Quamruzzaman Babu¹, Akash Mojumdar², Prosenjit Debbarma³,
Khurshed Alom⁴ and Md Ashraf Ul Hasan*

**Department of Biological Sciences, Texas Tech University, Lubbock, Texas, USA*

ARTICLE INFO**Article History**

Received: 19 September 2023

Revised: 11 December 2023

Accepted: 3 March 2024

Keywords: Butterfly, Checklist, Diversity, Adampur, Lepidoptera, Bangladesh.

ABSTRACT

Our study focuses on the butterfly checklist of the Adampur forest beat, located in the Rajkandi Reserve Forest of Moulvibazar, Bangladesh. The study was conducted between December 2014 and January 2018 and aimed to document butterfly species in the area. A total of 266 butterfly species belong to 149 genera and 6 families (Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Hesperidae, and Riodinidae) were recorded. The Lycaenidae family exhibited the highest species richness, comprising 33.08% (n = 88) of the recorded species, while the Riodinidae family was the least prevalent, representing 0.38% (n = 1) of the species. In this study, the butterfly species recorded revealed varying conservation status according to the International Union for Conservation of Nature Bangladesh assessment, with 26.69% listed as Endangered, 30.08% Least Concern, 23.68% Vulnerable, 1.50% Data Deficient, and 18.05% Not Evaluated. These findings offer crucial insights for future butterfly research and conservation in the Adampur forest beat.

Introduction

Butterflies, belonging to the Order Lepidoptera in the Class Insecta are exquisite creatures defined by their delicate wings. They experience a four-stage life cycle: eggs, larvae, pupae, and adults, with each stage contributing to their fascinating transformation. As per the available data, approximately 19,500 known species of butterflies are distributed across various ecosystems and regions worldwide (Kawahara et al., 2023). Bangladesh has a rich diversity of butterflies. With remarkable diversity, the country hosts 305 butterfly species are distributed among 6 families (Chowdhury et al., 2021), potentially reaching 400 (Larsen, 2004; Chowdhury and Hossain, 2013).

Bangladesh is divided into seven geographic regions, referenced within the scope of wildlife distribution: South, Southeast, Central, Northeast, North, Northwest, and Southwest. (Khan, 2008). These seven geographical regions represent three distinct forest types (mangrove forest, mixed evergreen forest, and moist deciduous forest). Overpopulation and subsequent transformations of natural landscapes into human settlements, agricultural lands, and monoculture plantations have reduced the country's natural land cover to merely about 6%, thereby compromising a significant portion of its biodiversity (Hasan and Kingston, 2022). However, within the remaining natural landscapes of the country, the northeastern part of Bangladesh showcases a rich

*Corresponding author: <md-ashraf.ul-hasan@ttu.edu>

¹House: 25, Road: 18, Sector: 11, Uttara, Dhaka 1230, Bangladesh; ²Department of Computer Science and Information Technology, Shanto-Mariam University of Creative Technology, Dhaka, Bangladesh; ³Satchari Village, Satchari National Park, Chunarughat, Habiganj, Sylhet, Bangladesh; ⁴Department of Zoology, Madanmohan College, Sylhet, Bangladesh

butterfly diversity, providing a suitable home for species that are either threatened or abundant (Chowdhury et al., 2021). The majority of protected areas in this part of Bangladesh feature mixed evergreen forests, particularly in the Moulvibazar District of the Sylhet Division (Hasan and Kingston, 2022). The Adampur Forest lies within the northeastern region of Bangladesh, located under the Sylhet division (Fig. 1). This mixed evergreen forest is within the Indo-Burma biodiversity hotspot (Myers et al., 2000). Abundant in biodiversity, this forest is a thriving habitat for a diverse range of wild floral and faunal species. A total of 549 species of angiosperms from 412 genera and 123 families have been recorded with their natural distribution (Haque et al., 2016). The region has a rich faunal diversity, housing threatened mammals such as the hoolock gibbon, bengal slow loris, rhesus macaque, black giant squirrel, and barking deer. Bird species occurring in the Adampur beat, including the oriental dwarf kingfisher, kalij pheasant, Indian spotted eagle, and grey-headed parakeet, stand as a threatened category within the country (IUCN Bangladesh, 2015). Reptiles such as the changeable lizard, Pope's green pit viper, spectacled cobra, and tokay gecko can also be observed. Extensive research efforts have been directed towards the flora of this region, yet the fauna, with a specific focus on butterflies, has remained relatively understudied. A notable gap in research pertains to butterflies, encompassing their habitat dynamics and the extent of species diversity within this ecosystem. Hence, this study's main objective was to create a comprehensive record of the butterfly population inhabiting the Adampur forest. Through synthesizing findings from prior research endeavors and our current study, we aimed to conduct an inventory study of butterflies in Adampur forest to contribute to the butterflies of Bangladesh. This study was designed to serve as a cornerstone for unveiling the intricate dynamics of butterfly populations, thereby making a significant contribution to the documentation of the exceptional biodiversity present within the Adampur forest.

Materials and Methods

Our study centered on constructing a butterfly checklist specifically for northeast Bangladesh. This study was conducted during this scheme between December 2014 and January 2018.

Study Area

The Adampur forest (24.26280 N and 91.91277 E) was selected as the study area based on its well-suited ecological conditions, which create an optimal habitat for a diverse range of butterfly species.

It is located within the Kamalganj upazila in the Moulvibazar district of Bangladesh (Fig. 1), which falls within the jurisdiction of the Rajkandi Reserve Forest range. The Adampur forest spans an extensive expanse of 5295.55 hectares and includes a mixture of deciduous and evergreen forests and hillocks, while the Dhalai River meanders through its neighboring vicinity (Islam et al., 2006).

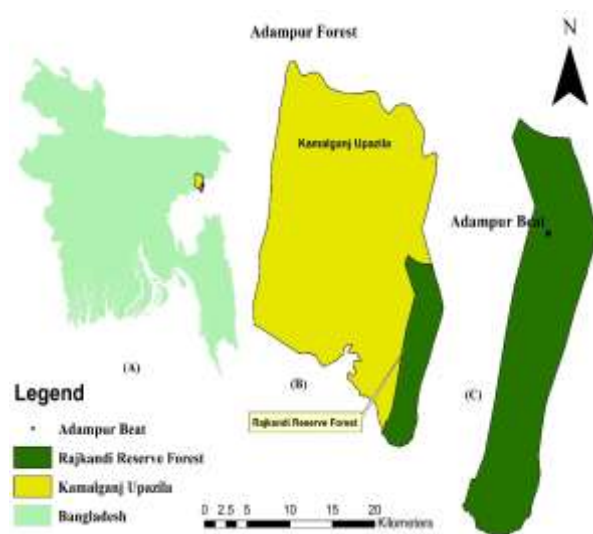


Fig. 1. Map of the study area. A) Bangladesh's political boundary; B) Kamalganj upazila under the Moulvibazar district; C) Adampur forest located within the Rajkandi Reserve Forest range.

The streams (in Bengali: Chara) run through the dense forest and hillocks. The thick foliage and large dipterocarp trees give rise to a verdant canopy above,

which permits only intermittent solar irradiance to permeate the ecosystem below. The yearly precipitation averages around 275 centimeters, while the typical humidity is 82% (Tabassum, 2018).

Data collection and identification of butterfly species

The butterflies were observed and recorded, adhering to the established methodology described by Pollard and Yates (1993), as it provides an extensive approach for conducting long-term butterfly surveys (Patterson et al., 2023). Butterflies were observed walking along streams, roads, forest trails, timber plantation areas, villages, and around the forest. We carried out a survey along established transects to collect presence-absence data for butterflies. Each transect was approximately 1-2 kilometers long and 12 meters wide. These transects were randomly selected to encompass diverse habitat types, and consistent observations were carried out under suitable weather conditions to document butterfly species (Hasan et al., 2018), as butterfly diversity is strongly affected by severe weather conditions (Robinson et al., 2012).

The identification process of butterflies involved the utilization of field guides such as Kunte (2000), Chowdhury and Hossain (2013), and Kehimkar (2016). These guides provided valuable information regarding taxonomic and common names per the standards of Larsen (2004) and Kehimkar (2016). Digital and mobile phone cameras were employed to photograph the specimens to aid identification. The photographs of the individuals were then compared to the field guides (mentioned above) and extensive databases available on websites, such as <https://www.ifoundbutterflies.org/>, <https://www.inaturalist.org/>, and <https://yutaka.it-n.jp/>. These online resources proved to be valuable references during the identification process. To further clarify, we contacted the butterfly taxonomy experts from home and abroad. Finally, the classification system utilized to categorize the butterflies followed the guidelines that Larsen (2004) outlined. Information was gathered from IUCN

Bangladesh (2015) to evaluate the local status of butterflies. The collected data was managed using Microsoft Excel (2016).

Result and Discussion

A total of 266 species of butterflies, comprising a range of 149 genera and 6 families, namely Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Hesperidae, and Riodinidae, were recorded throughout the study. In the realm of identified species, Lycaenidae exhibited the most species, which was 33.08% (n = 88), followed by Nymphalidae (29.32%, n = 78), Hesperidae (23.31%, n = 62), Papilionidae (7.14%, n = 19), Pieridae (6.77%, n = 18), and Riodinidae (0.38%, n = 1) (Fig. 2).

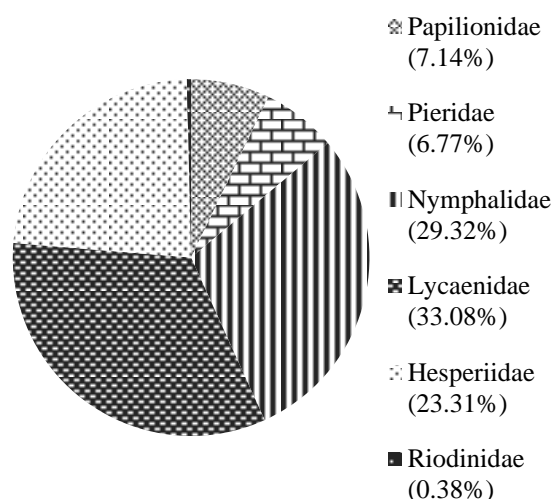


Fig. 2. Family-wise percentage of the recorded butterfly species.

Based on the information provided by IUCN Bangladesh (2015), it was found that 71 (26.69%) out of the total 266 species fell under the category of Endangered (EN), 63 species (23.68%) were identified as Vulnerable (VU), 80 species (30.08%) were listed as Least Concern (LC), and 4 species (1.50%) were included as Data Deficient (DD). Additionally, 48 species (18.05%) remained unassessed and were categorized as Not Evaluated (NE), thus not yet included in the country's red list (Fig. 3).

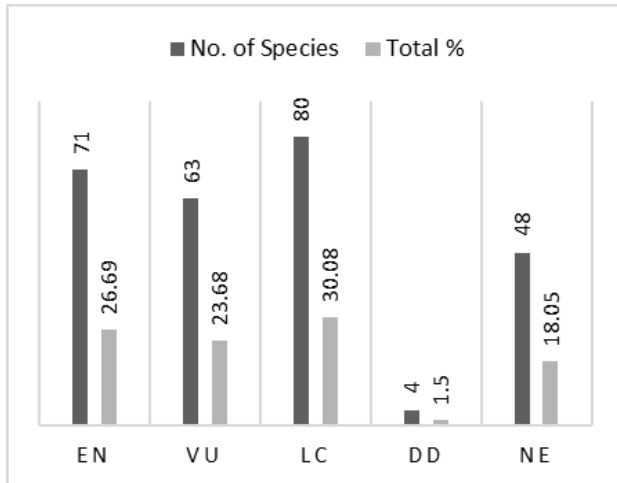


Fig. 3. Status of butterflies found in the Adampur forest (following IUCN Red List status, IUCN Bangladesh 2015).

Table 1. A checklist of butterfly species recorded in Adampur Beat within the Rajkandi Reserve Forest from December 2014 to January 2018 with their local status.

SL No.	Common Name	Scientific Name	Local Status
Family Papilionidae			
1	Common Batwing	<i>Atrophaneura varuna</i> (White, 1842)	EN
2	Common Mime	<i>Chilasa clytia</i> (Linnaeus, 1758)	LC
3	Tailed Jay	<i>Graphium agamemnon</i> (Linnaeus, 1758)	LC
4	Common Jay	<i>Graphium doson</i> (C. & R. Felder, 1864)	LC
5	Common Bluebottle	<i>Graphium sarpedon</i> (Linnaeus, 1758)	VU
6	White Dragontail	<i>Lamproptera curius</i> (Fabricius, 1787)	EN
7	Common Rose	<i>Pachliopta aristolochiae</i> (Fabricius, 1775)	LC

8	Common Raven	<i>Papilio castor</i> (Westwood, 1842)	EN
9	Yellow Helen	<i>Papilio chaon</i> (Westwood, 1845)	VU
10	Red Helen	<i>Papilio helenus</i> (Linnaeus, 1758)	VU
11	Lime Swallowtail	<i>Papilio demoleus</i> (Linnaeus, 1758)	LC
12	Great Mormon	<i>Papilio memnon</i> (Linnaeus, 1758)	LC
13	Blue Mormon	<i>Papilio polymnestor</i> (Cramer, 1775)	LC
14	Common Mormon	<i>Papilio polytes</i> (Linnaeus, 1758)	LC
15	Great Zebra	<i>Graphium xenocles</i> (Doubleday, 1842)	EN
16	Five-Bar Swordtail	<i>Graphium antiphates</i> (Cramer, 1775)	VU
17	Spot Swordtail	<i>Graphium nomius</i> (Esper, 1799)	EN
18	Common Birdwing	<i>Troides helena</i> (Linnaeus, 1758)	VU
19	Golden Birdwing	<i>Troides aeacus</i> (C. & R. Felder, 1860)	EN
Family Pieridae			
20	Common Albatross	<i>Appias albina</i> (Boisduval, 1836)	EN
21	Chocolate Albatross	<i>Appias lycinda</i> (Cramer, 1777)	LC
22	Striped Albatross	<i>Appias libythea</i> (Fabricius, 1775)	LC
23	Plain Puffin	<i>Appias indra</i> (Moore, 1858)	VU
24	Indian Cabbage White	<i>Pieris canidia</i> (Linnaeus, 1768)	LC
25	Common Emigrant	<i>Catopsilia pomona</i> (Fabricius, 1775)	LC
26	Mottled Emigrant	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	LC

27	Common Gull	<i>Cepora nerissa</i> (Fabricius, 1775)	LC
28	Red-Spot Jezebel	<i>Delias descombesi</i> (Boisduval, 1836)	LC
29	Common Jezebel	<i>Delias eucharis</i> (Drury, 1773)	LC
30	Painted Jezebel	<i>Delias hyparete</i> (Linnaeus, 1758)	LC
31	Red-Base Jezebel	<i>Delias pasithoe</i> (Linnaeus, 1767)	LC
32	One-Spot Grass Yellow	<i>Eurema andersonii</i> (Moore, 1886)	LC
33	Three-Spot Grass Yellow	<i>Eurema blanda</i> (Boisduval, 1836)	LC
34	Common Grass Yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)	LC
35	Tree Yellow	<i>Gandaca harina</i> (Horsfield, 1829)	EN
36	Great Orange Tip	<i>Hebomoia glaucippe</i> (Linnaeus, 1758)	VU
37	Psyche	<i>Leptosia nina</i> (Fabricius, 1793)	LC
Family Nymphalidae			
38	Tawny Coster	<i>Acraea terpsicore</i> (Linnaeus, 1758)	LC
39	Constable	<i>Dichorragia nesimachus</i> (Doyère, 1840)	LC
40	Angled Castor	<i>Ariadne ariadne</i> (Linnaeus, 1763)	LC
41	Common Castor	<i>Ariadne merione</i> (Cramer, 1777)	LC
42	Common Sergeant	<i>Athyma perius</i> (Linnaeus, 1758)	LC
43	Color Sergeant	<i>Athyma inara</i> (Westwood, 1850)	VU
44	Blackvein Sergeant	<i>Athyma ranga</i> (Moore, 1858)	VU
45	Orange Staff Sergeant	<i>Athyma cama</i> (Moore, 1858)	EN
46	Leopard Lacewing	<i>Cethosia cyane</i> (Drury, 1773)	LC

47	Tawny Rajah	<i>Charaxes bernardus</i> (Fabricius, 1793)	EN
48	Black Rajah	<i>Charaxes solon</i> (Fabricius, 1793)	VU
49	Common Maplet	<i>Chersonesia risa</i> (Doubleday, 1848)	EN
50	Common Yeoman	<i>Cirrochroa tyche</i> (C. & R. Felder, 1861)	EN
51	Rustic	<i>Cupha erymanthis</i> (Drury, 1773)	LC
52	Common Map	<i>Cyrestis thyodamas</i> (Doyère, 1840)	EN
53	Plain Tiger	<i>Danaus chrysippus</i> (Linnaeus, 1758)	LC
54	Striped Tiger	<i>Danaus genutia</i> (Cramer, 1779)	LC
55	Blue Tiger	<i>Tirumala limniace</i> (Cramer, 1775)	LC
56	Dark Blue Tiger	<i>Tirumala septentrionis</i> (Butler, 1874)	VU
57	Glassy Tiger	<i>Parantica aglea</i> (Stoll, 1782)	VU
58	Common Duffer	<i>Discophora sondaica</i> (Boisduval, 1836)	LC
59	Red-Spot Duke	<i>Dophla evelina</i> (Stoll, 1790)	EN
60	Common Palmfly	<i>Elymnias hypermnestra</i> (Linnaeus, 1763)	LC
61	Spotted Palmfly	<i>Elymnias malelas</i> (Hewitson, 1863)	EN
62	Tiger Palmfly	<i>Elymnias nesaea</i> (Linnaeus, 1764)	EN
63	Long - Branded Blue Crow	<i>Euploea algea</i> (Godart, 1819)	EN
64	Common Crow	<i>Euploea core</i> (Cramer, 1780)	LC
65	Blue King Crow	<i>Euploea klugii</i> (Moore, 1858)	VU

66	Blue Spotted Crow	<i>Euploea midamus</i> (Linnaeus, 1758)	EN
67	Striped Blue Crow	<i>Euploea mulciber</i> (Cramer, 1777)	VU
68	Double Branded Blue Crow	<i>Euploea sylvester</i> (Fabricius, 1793)	EN
69	Common Baron	<i>Euthalia aconthea</i> (Cramer, 1777)	LC
70	Gaudy Baron	<i>Euthalia lubentina</i> (Cramer, 1777)	EN
71	Powdered Baron	<i>Euthalia monina</i> (Fabricius, 1787)	EN
72	White-Edged Blue Baron	<i>Euthalia phemius</i> (Doubleday, 1848)	EN
73	Great Eggfly	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	LC
74	Danaid Eggfly	<i>Hypolimnas misippus</i> (Linnaeus, 1764)	VU
75	Peacock Pansy	<i>Junonia almana</i> (Linnaeus, 1758)	LC
76	Grey Pansy	<i>Junonia atlites</i> (Linnaeus, 1763)	LC
77	Yellow Pansy	<i>Junonia hierta</i> (Fabricius, 1798)	LC
78	Chocolate Pansy	<i>Junonia iphita</i> (Cramer, 1779)	LC
79	Lemon Pansy	<i>Junonia lemonias</i> (Linnaeus, 1758)	LC
80	Blue Pansy	<i>Junonia orithya</i> (Linnaeus, 1758)	VU
81	Orange Oakleaf	<i>Kallima inachus</i> (Doyère, 1840)	EN
82	Knight	<i>Lebadea martha</i> (Fabricius, 1787)	VU
83	Bamboo Treebrown	<i>Lethe europa</i> (Fabricius, 1775)	VU
84	Common Red Forester	<i>Lethe mekara</i> (Moore, 1858)	EN
85	Dark Archduke	<i>Lexias dirtea</i> (Fabricius, 1793)	EN
86	Common Evening Brown	<i>Melanitis leda</i> (Linnaeus, 1758)	LC

87	Commander	<i>Moduza procris</i> (Cramer, 1777)	LC
88	White-Bar Bushbrown	<i>Mycalesis anaxias</i> (Hewitson, 1862)	EN
89	Dark-brand Bushbrown	<i>Mycalesis mineus</i> (Linnaeus, 1758)	LC
90	Common Bushbrown	<i>Mycalesis perseus</i> (Fabricius, 1775)	VU
91	Long-Brand Bushbrown	<i>Mycalesis visala</i> (Moore, 1858)	VU
92	Chinese Bushbrown	<i>Mycalesis gotama</i> (Moore, 1858)	VU
93	Common Sailer	<i>Neptis hylas</i> (Linnaeus, 1758)	LC
94	Chestnut-Streaked Sailer	<i>Neptis jumbah</i> (Moore, 1858)	LC
95	Clear Sailer	<i>Neptis nata</i> (Moore, 1858)	VU
96	Nigger	<i>Orsotriaena medus</i> (Fabricius, 1775)	VU
97	Common Lascar	<i>Pantoporia hordonia</i> (Stoll, 1790)	VU
98	Perak Lascar	<i>Pantoporia paraka</i> (Butler, 1879)	EN
99	Clipper	<i>Parthenos sylvia</i> (Cramer, 1775)	VU
100	Common Leopard	<i>Phalanta phalantha</i> (Drury, 1773)	LC
101	Common Nawab	<i>Polyura athamas</i> (Drury, 1773)	LC
102	Jewelled Nawab	<i>Charaxes delphis</i> (Doubleday, 1843)	EN
103	Blue Nawab	<i>Charaxes schreiber</i> (Godart, 1824)	EN
104	Pallid Nawab	<i>Charaxes arja</i> (C. & R. Felder, 1867)	EN
105	Black Prince	<i>Rohana parisatis</i> (Westwood, 1851)	EN

106	Popinjay	<i>Stibochiona nicea</i> (Gray, 1846)	VU
107	Common Jester	<i>Symbrenthia lilaea</i> (Hewitson, 1864)	EN
108	Courtesan	<i>Euripus nyctelius</i> (Doubleday, 1845)	EN
109	Common Earl	<i>Tanaecia julii</i> (Lesson, 1837)	VU
110	Plain Earl	<i>Tanaecia jahnu</i> (Moore, 1858)	EN
111	Vagrant	<i>Vagrans egista</i> (Cramer, 1780)	VU
112	Cruiser	<i>Vindula erota</i> (Fabricius, 1793)	EN
113	Common Five-Ring	<i>Ypthima baldus</i> (Fabricius, 1775)	VU
114	Common Four-Ring	<i>Ypthima huebneri</i> (Kirby, 1871)	LC
115	Grey Count	<i>Tanaecia lepidea</i> (Butler, 1868)	VU
Family Lycaenidae			
116	Red Imperial	<i>Suasa lisides</i> (Hewitson, 1863)	NE
117	Plane	<i>Bindahara phocides</i> (Fabricius, 1793)	NE
118	Harlequin	<i>Taxila haquinus</i> (Fabricius, 1793)	EN
119	Blue Imperial	<i>Ticherra acte</i> (Moore, 1858)	NE
120	Common Imperial	<i>Cheritra freja</i> (Fabricius, 1793)	VU
121	Silver-streaked Acacia Blue	<i>Zinaspas todara</i> (Moore, 1884)	NE
122	Common Acacia Blue	<i>Surendra quercetorum</i> (Moore, 1858)	EN
123	Dark Oakblue	<i>Arhopala rama</i> (Kollar, 1844)	NE
124	Aberrant Oakblue	<i>Arhopala abseus</i> (Hewitson, 1862)	NE
125	Centaur Oakblue	<i>Arhopala centaurus</i> (Fabricius, 1775)	LC

126	Doherty's Dull Oakblue	<i>Arhopala khamti</i> (Doherty, 1891)	NE
127	Dusted Oakblue	<i>Arhopala bazaloides</i> (Hewitson, 1878)	DD
128	Falcate Oakblue	<i>Mahathala ameria</i> (Hewitson, 1862)	VU
129	Green Oakblue	<i>Arhopala eumolphus</i> (Cramer, 1780)	VU
130	Hewitson's Dull Oakblue	<i>Arhopala oenea</i> (Hewitson, 1869)	NE
131	Large Oakblue	<i>Arhopala amantes</i> (Hewitson, 1862)	VU
132	Spot Less Oakblue	<i>Arhopala fulla</i> (Hewitson, 1862)	NE
133	Tamil Oakblue	<i>Arhopala bazaloides</i> (Hewitson, 1878)	DD
134	Vinous Oakblue	<i>Arhopala athada</i> (Staudinger, 1889)	NE
135	Yellowdisc Tailless Oakblue	<i>Arhopala perimuta</i> (Moore, 1858)	EN
136	Indian Oakblue	<i>Arhopala atrax</i> (Hewitson, 1862)	NE
137	Assam Flash	<i>Rapala tara</i> (de Nicéville, 1889)	NE
138	Common Red Flash	<i>Rapala iarbus</i> (Fabricius, 1787)	VU
139	Copper Flash	<i>Rapala pheretima</i> (Hewitson, 1863)	VU
140	Indigo Flash	<i>Rapala varuna</i> (Horsfield, 1829)	VU
141	Scarlet Flash	<i>Rapala dienece</i> (Hewitson, 1878)	EN
142	Slate Flash	<i>Rapala manea</i> (Hewitson, 1863)	LC
143	Suffused Flash	<i>Rapala suffusa</i> (Moore, 1878)	NE
144	Common Onyx	<i>Horaga onyx</i> (Moore, 1858)	NE
145	Witch	<i>Araotes lapithis</i> (Moore, 1858)	NE

146	Dingy Lineblue	<i>Petrelaea dana</i> (de Nicéville, 1884)	EN
147	Brown Lineblue	<i>Prosotas lutea</i> (Martin, 1895)	EN
148	Common Lineblue	<i>Prosotas nora</i> (C. Felder, 1860)	LC
149	Pointed Lineblue	<i>Ionolyce helicon</i> (Felder, 1860)	DD
150	Tailless Lineblue	<i>Prosotas dubiosa</i> (Semper, 1879)	VU
151	Transparent Six Lineblue	<i>Nacaduba kurava</i> (Moore, 1858)	NE
152	Teesta Brown Lineblue	<i>Prosotas lutea sivoka</i> (Evans, 1910)	EN
153	Pale Four-Lineblue	<i>Nacaduba hermus</i> (C. Felder, 1860)	NE
154	Common Hedgeblue	<i>Acytolepis puspa</i> (Horsfield, 1828)	VU
155	Pale Hedge Blue	<i>Udara dilecta</i> (Moore, 1879)	NE
156	White-Disc Hedge Blue	<i>Celatoxia albidisca</i> (Moore, 1884)	NE
157	Common Brownie	<i>Miletus chinensis</i> (C. Felder, 1862)	EN
158	Purple Leaf Blue	<i>Amblypodia anita</i> (Hewitson, 1862)	EN
159	Common Ciliate Blue	<i>Anthene emolus</i> (Godart, 1824)	VU
160	Pointed Ciliate Blue	<i>Anthene lycaenina</i> (R. Felder, 1868)	EN
161	Angled Pierrot	<i>Caleta decidia</i> (Hewitson, 1876)	LC
162	Banded Blue Pierrot	<i>Discolampa ethion</i> (Westwood, 1851)	VU
163	Black-spotted Pierrot	<i>Tarucus balkanica nigra</i> (Bethune-Baker, 1918)	NE
164	Common Pierrot	<i>Castalius rosimon</i> (Fabricius, 1775)	LC
165	Dark Pierrot	<i>Tarucus ananda</i>	NE

		(de Nicéville, 1884)	
166	Himalayan Pierrot	<i>Tarucus venosus</i> (Moore, 1882)	NE
167	Striped Pierrot	<i>Tarucus nara</i> (Kollar, 1848)	EN
168	Common Tinsel	<i>Catapaecilma major</i> (Druce, 1895)	EN
169	Forget-me-not	<i>Catochrysops strabo</i> (Fabricius, 1793)	VU
170	Silver Forget-me-not	<i>Catochrysops panormus</i> (C. Felder, 1860)	NE
171	Lime Blue	<i>Chilades lajus</i> (Stoll, 1780)	LC
172	Orchid Tit	<i>Hypolycaena othona</i> (Hewitson, 1865)	VU
173	Toothed Sunbeam	<i>Curetis acuta</i> (Moore, 1877)	DD
174	Indian sunbeam	<i>Curetis thetis</i> (Drury, 1773)	LC
175	Double-Tufted Royal	<i>Dacalana penicilligera</i> (de Nicéville, 1890)	EN
176	Cornelian	<i>Deudorix epijarbas</i> (Moore, 1858)	NE
177	Gram Blue	<i>Euchrysops cnejus</i> (Fabricius, 1798)	LC
178	Indian Cupid	<i>Everes lacturnus</i> (Godart, 1824)	EN
179	Purple Sapphire	<i>Heliophorus epicles</i> (Godart, 1824)	VU
180	Common Tit	<i>Hypolycaena erylus</i> (Godart, 1824)	VU
181	Silverstreak Blue	<i>Iraota timoleon</i> (Stoll, 1790)	EN
182	Common Cerulean	<i>Jamides celeno</i> (Cramer, 1775)	LC
183	Dark Cerulean	<i>Jamides bochus</i> (Stoll, 1782)	VU
184	Metallic Cerulean	<i>Jamides alecto</i> (C. Felder, 1860)	LC

185	White Cerulean	<i>Jamides pura</i> (Moore, 1886)	EN
186	Pea Blue	<i>Lampides boeticus</i> (Linnaeus, 1767)	LC
187	Zebra Blue	<i>Leptotes plinius</i> (Fabricius, 1793)	LC
188	Yamfly	<i>Loxura atymnus</i> (Stoll, 1780)	VU
189	Malayan	<i>Megisba malaya</i> (Horsfield, 1828)	EN
190	Opaque Six-Lineblue	<i>Nacaduba beroe</i> (C. Felder & R. Felder, 1865)	LC
191	Small Four-Lineblue	<i>Nacaduba pavana</i> (Horsfield, 1828)	NE
192	Common Quaker	<i>Neopithecops zalmora</i> (Butler, 1870)	LC
193	Common Gem	<i>Poritia hewitsoni</i> (Moore, 1866)	EN
194	Bhutia Lineblue	<i>Prosotas bhutea</i> (de Nicéville, 1884)	NE
195	Pale Grass Blue	<i>Pseudozizeeria maha</i> (Kollar, 1844)	LC
196	Banded Royal	<i>Rachana jalindra</i> (Horsfield, 1829)	EN
197	Scarce Slate Flash	<i>Rapala scintilla</i> (de Nicéville, 1890)	NE
198	Chocolate Royal	<i>Remelana jangala</i> (Horsfield, 1829)	VU
199	Apefly	<i>Spalgis epius</i> (Westwood, 1851)	EN
200	Club Silverline	<i>Spindasis syama</i> (Horsfield, 1829)	VU
201	Long Branded Silverline	<i>Spindasis lohita</i> (Horsfield, 1829)	VU
202	Lesser Grass Blue	<i>Zizina otis</i> (Fabricius, 1787)	LC
203	Dark Grass Blue	<i>Zizeeria karsandra</i> (Moore, 1865)	LC

Family Hesperiiidae			
204	Pygmy Scrub Hopper	<i>Aeromachus pygmaeus</i> (Fabricius, 1775)	VU
205	Bush Hopper	<i>Ampittia dioscorides</i> (Fabricius, 1793)	NE
206	Forest Hopper	<i>Astictopterus jama</i> (C. & R. Felder, 1860)	LC
207	Common Banded Demon	<i>Notocrypta paralysos</i> (Wood-Mason & de Nicéville, 1881)	LC
208	Grass Demon	<i>Udaspes folus</i> (Cramer, 1775)	LC
209	Restricted Demon	<i>Notocrypta curvifascia</i> (C. & R. Felder, 1862)	EN
210	Spotted Demon	<i>Notocrypta feisthamelii</i> (Boisduval, 1832)	NE
211	Chocolate Demon	<i>Ancistroides nigrita</i> (Latreille, 1824)	NE
212	Tree Flitter	<i>Hyarotis adrastus</i> (Stoll, 1780)	VU
213	Bengal Swift	<i>Pelopidas agna</i> (Moore, 1866)	LC
214	Black Paintbrush Swift	<i>Baoris unicolor</i> (Moore, 1884)	EN
215	Ceylon Swift	<i>Parnara bada</i> (Moore, 1878)	EN
216	Paintbrush Swift	<i>Baoris farri</i> (Moore, 1878)	NE
217	Conjoined Swift	<i>Pelopidas conjuncta</i> (Herrich-Schäffer, 1869)	LC
218	Contiguous swift	<i>Polytremis lubricans</i> (Herrich-Schäffer, 1869)	EN
219	Continental Swift	<i>Parnara ganga</i> (Evans, 1937)	NE
220	Dark Straight Swift	<i>Parnara apostate</i> (Chiba & Eliot, 1991)	NE
221	Great swift	<i>Pelopidas</i>	EN

		<i>assamensis</i> (de Nicéville, 1882)	
222	Rice Swift	<i>Borbo cinnara</i> (Wallace, 1866)	LC
223	Small Branded Swift	<i>Pelopidas mathias</i> (Fabricius, 1798)	VU
224	Straight Swift	<i>Parnara guttatus</i> (Bremer & Grey, 1852)	LC
225	Large Bengal Swift	<i>Pelopidas subochracea</i> (Moore, 1878)	NE
226	Dark Yellow-Banded Flat	<i>Celaenorrhinus aurivittata</i> (Moore, 1879)	EN
227	Common Small Flat	<i>Sarangesa dasahara</i> (Moore, 1866)	VU
228	Common Snow Flat	<i>Tagiades japetus</i> (Stoll, 1781)	VU
229	Common Spotted Flat	<i>Celaenorrhinus leucocera</i> (Kollar, 1848)	NE
230	Fulvous Pied flat	<i>Pseudocolade-nia dan</i> (Fabricius, 1787)	EN
231	Suffused Snow Flat	<i>Tagiades gana</i> (Moore, 1866)	VU
232	Tricolor Pied Flat	<i>Coladenia indrani</i> (Moore, 1866)	NE
233	Water Snow Flat	<i>Tagiades litigiosa</i> (Möschler, 1878)	EN
234	Indian Ace	<i>Halpe homolea</i> (Hewitson, 1868)	NE
235	Light Straw Ace	<i>Pithauria stramineipennis</i> (Wood-Mason & de Nicéville, 1887)	NE
236	Moore's Ace	<i>Halpe porus</i> (Mabille, 1877)	VU
237	Shorthorn Ace	<i>Halpe veluvana</i> (Evans, 1932)	NE
238	Banded Ace	<i>Halpe zema</i> (Hewitson, 1877)	NE
239	Common Awl	<i>Hasora badra</i> (Moore, 1858)	VU

240	Common Banded awl	<i>Hasora chromus</i> (Cramer, 1780)	EN
241	Brown Awl	<i>Badamia exclamationis</i> (Fabricius, 1775)	VU
242	Banded Orange Awlet	<i>Burara oedipodea</i> (Swainson, 1820)	NE
243	Indian Awl King	<i>Choaspes benjaminii</i> (Guérin-Méneville, 1843)	EN
244	Small Green Awlet	<i>Burara amara</i> (Moore, 1866)	EN
245	Chestnut Bob	<i>Iambrix salsala</i> (Moore, 1866)	LC
246	Grass Bob	<i>Suada swerga</i> (de Nicéville, 1895)	NE
247	Indian Palm Bob	<i>Suastus gremius</i> (Fabricius, 1798)	EN
248	Narrow-banded Velvet Bob	<i>Koruthaialos rubecula cachara</i> (Evans, 1949)	EN
249	Small Palm Bob	<i>Suastus minuta</i> (Moore, 1877)	NE
250	Dark Velvet Bob	<i>Koruthaialos butleri</i> (de Nicéville, 1884)	NE
251	Common Wight	<i>Iton semamora</i> (Moore, 1866)	NE
252	Common Redeye	<i>Matapa aria</i> (Moore, 1866)	LC
253	Black Veined Branded Redeye	<i>Matapa sasivarna</i> (Moore, 1866)	VU
254	Giant Redeye	<i>Gangara thyrsis</i> (Fabricius, 1775)	VU
255	Fringed Redeye	<i>Matapa cresta</i> (Evans, 1949)	NE
256	Chestnut Angle	<i>Odontoptilum angulata</i> (C. Felder, 1862)	LC
257	Common Dartlet	<i>Oriens gola</i> (Moore, 1877)	LC
258	Smaller Dartlet	<i>Oriens goloides</i> (Moore, 1881)	VU

259	Common Grass Dart	<i>Taractrocera maevius</i> (Fabricius, 1793)	NE
260	Dark Palm Dart	<i>Telicota bambusae</i> (Moore, 1878)	VU
261	Wax Dart	<i>Cupitha purreea</i> (Moore, 1877)	EN
262	Pale Palm Dart	<i>Telicota colon</i> (Fabricius, 1775)	NE
263	Tufted Ace	<i>Sebastonyma dolopia</i> (Hewitson, 1868)	EN
264	Indian Grizzled Skipper	<i>Spialia galba</i> (Fabricius, 1793)	LC
265	Banana Skipper	<i>Erionota torus</i> (Evans, 1941)	EN
Family Riodinidae			
266	Punchinello	<i>Zemeros flegyas</i> (Cramer, 1780)	LC

A total of 266 butterfly species have been identified in the study area, showcasing a notably extensive array of butterfly fauna. This stark disparity in richness becomes evident when comparing the butterfly fauna of the study area with that of diverse protected areas situated in northeast Bangladesh: 195 butterfly species were recorded in Satchari National Park (Hasan et al., 2018), 159 species in Lawachara National Park (Khandokar et al., 2013), and 74 species in Rema-Kalenga Wildlife Sanctuary (Shihan and Prodhan, 2014). In addition, numerous previously undocumented species have been newly recorded in Bangladesh, with their discoveries originating from the Adampur forest. Notable instances include *Graphium megarus* (Westwood, 1844) observed in March 2013 (Khan et al., 2014), *Logania distanti massalia* (Doherty, 1891) encountered in December 2014 (Sadat et al., 2016), *Zinaspia todara distorta* (de Nicéville, 1887) sighted in March 2016 (Khan et al., 2017), *Arhopala rama ramosa* (Evans, 1925) documented in April 2016 (Khan et al., 2017), and *Kaniska canace* (Linnaeus, 1763) identified in March 2017 (Neogi et al., 2018).

Furthermore, *Chersonesia intermedia* (Martin, 1895) was added to the roster in September 2022 (Rashid et al., 2022). However, the species listed, namely *Graphium megarus*, *Logania distanti massalia*, *Kaniska canace*, and *Chersonesia intermedia*, have not been encountered in our research endeavors or other investigations. These findings underscore the dynamic biodiversity of the Adampur forest and its contribution to expanding the known butterfly species repertoire within Bangladesh. Hence, a compelling need emerges to escalate our efforts, encompassing a comprehensive array of fauna, to undertake supplementary research initiatives dedicated to the conservation of the mentioned species and all other coexisting fauna.

The extensive range of butterfly species reflects a healthy environment, as butterflies act as sensitive indicators of environmental and habitat changes (Thomas, 2005; Gross et al., 2007). A higher presence of herbaceous plants creates favorable conditions and sustenance for butterfly species.

In the study area, there were 266 identified butterfly species, and out of these, 134 species (50.37%, EN = 26.69%, and VU = 23.68%) accounted for and fell into the threatened category (IUCN Bangladesh, 2015). The prevailing ecological factor responsible for this situation predominantly involves habitat deterioration, primarily initiated by the alteration of natural land covers into agricultural lands, which includes timber plantations, human settlements, and the expansion of infrastructure (buildings, roads, and bridges) in the area (Hasan and Kingston, 2022). A group of 48 species constituted 18.05% of the total 266 species that are Not Evaluated species (IUCN Bangladesh, 2015). To gain a comprehensive understanding of the ecology and potential threats to these unassessed species, it is imperative to undertake ecological research, evaluate their distribution, monitor population dynamics, and identify specific endangerment factors.

The current butterfly checklist will serve as a baseline, reinforcing the need for further ecological research. Undertaking this inventory will play a pivotal role in refining the checklist, cataloging the

butterflies' host plants, and enabling a more precise and effective conservation strategy for the Adampur Forest's butterfly population.

Conclusions

The study of Adampur Forest's butterfly diversity highlighted its role as a vital habitat for 266 species across six families. The distribution percentages among families emphasize the ecosystem's complexity. Conservation urgency is evident. Half of the recorded species are threatened. The discovery of previously undocumented species underscores the significance of the biodiversity of this forest. Butterflies' sensitivity to environmental changes and their ecological roles emphasizes the need for continued conservation. The existing butterfly checklist was a fundamental reference, yet its limitations underscore the vital need for continuous ecological studies. Updating the checklist, documenting host plants, and refining conservation strategies will be pivotal in preserving the butterfly population within the Adampur Forest, particularly amidst changing environmental conditions. This study is a cornerstone for understanding the forest's biodiversity and significant contribution to the broader ecosystem.

Acknowledgment

The authors would like to thank the field assistants and the local community for helping in conducting the study. The taxonomic identification of butterfly species was made possible with the assistance of experts from Bangladesh and abroad. We thank Md. Naim Ur Rashid for creating the study area map.

Author contributions

Conceptualization: MQB, PD, MAUH; methodology: MAUH, MQB; data collection and curation: MQB, MAUH, PD, KA, AM; original draft preparation: AM, MAUH; draft review and editing: MAUH, AM; supervision: MAUH. Following revisions, all authors approved the manuscript.

References

- Chowdhury S, Alam S, Chowdhury SU, Rokonzaman M, Shahriar SA, Shome AR and Fuller RA. Butterflies are weakly protected in Bangladesh, a mega-populated country. *Glob. Ecol. Conserv.* 2021; 26: e01484.
- Chowdhury SH and Hossain M. *Butterflies of Bangladesh: A Pictorial Handbook*. 2nd ed. Dhaka, Bangladesh: Skylark Printers; 2013. p.260.
- Gross K, Kalendra EJ, Hudgens BR and Haddad NM. Robustness and uncertainty in estimates of butterfly abundance from transect counts. *Popul. Ecol.* 2007; 49: 191-200.
- Haque AKMK, Khan SA, Uddin SN and Rahim MA. Taxonomic checklist of the pteridophytes of Rajkandi Reserve Forest, Moulvibazar, Bangladesh. *Jahangirnagar University J. Biol. Sci.* 2016; 5(2): 27-40.
- Hasan MAU and Kingston T. Bats of Bangladesh-A systematic review of the diversity and distribution with recommendations for future research. *Diversity*, 2022; 14(12): 1042.
- Hasan MAU, Neha SA, Baki MA and Babu MQ. An inventory of butterfly species in relation to food sources and climatic factors influencing their diversity and richness in a semievergreen forest of Bangladesh. *Arthropods*, 2018; 7(3): 53-68.
- Islam MA, Feeroz MM, Muzaffar SB, Kabir MM and Begum S. *Conservation of the Hoolock Gibbons (Hoolock hoolock) of Bangladesh: Population estimates, habitat suitability and management options*. Report to United States, Fish and Wildlife Service. Washington D.C. Mincograph, 2006. P. 48.
- IUCN Bangladesh. *Red List of Bangladesh, Volume 7: Butterflies*, IUCN (International Union for Conservation of Nature Bangladesh) Bangladesh Country Office Dhaka, Bangladesh; 2015, p. 400.
- Kawahara AY, Storer C, Carvalho APS, Plotkin DM, Condamine FL and Braga MP, et al. A global

- phylogeny of butterflies reveals their evolutionary history, ancestral hosts, and biogeographic origins. *Nat. Ecol. Evol.* 2023; 7: 903-913.
- Kehimkar ID. *Butterflies of India*. BNHS Field Guides. Mumbai Bombay Natural History Society; 2016, p. 505.
- Khan AKMMA, Khan T and Khan MK. Three new records of Butterflies from the northeastern region of Bangladesh. *The Festschrift on the 50th Anniversary of the IUCN Red List of Threatened Species, IUCN Bangladesh*, 2014; pp. 35-38.
- Khan MMH. *Protected Areas of Bangladesh – A Guide to Wildlife*. Dhaka, Bangladesh: Nishorgo Program, Wildlife Management and Nature Conservation Circle, Bangladesh Forest Department; 2008, p. 304.
- Khan T, Babu MQ, Hasan MAU, Shihan TR and Debbarma P. First records of *Zinaspia todara distorta* de Nicéville, 1887 and *Arhopala rama ramosa* Evans, 1925 (Lycaenidae: Theclinae) butterflies in Bangladesh. *J. Threat. Taxa.* 2017; 9(8): 10581-10584.
- Khandokar F, Rashid M, Das DK and Hossain M. Species diversity and abundance of Butterflies in the Lawachara National Park, Bangladesh. *Jahangirnagar Univ. J. Biol. Sci.* 2013; 2(2): 121-127.
- Kunte K. *Indian-A lifescape butterflies of peninsular India*. India: Universities Press (India) Private Limited; 2000, p. 254.
- Larsen TB. *An annotated checklist of the butterflies of Bangladesh (Lepidoptera, Rhopalocera)*. Dhaka, Bangladesh: IUCN (International Union for Conservation of Nature Bangladesh) Bangladesh Country Office; 2004, p. 158.
- Myers N, Mittermeier RA, Mittermeier CG, Fonseca GAB and Kent J. Biodiversity hotspots for conservation priorities. *Nature* 2000; 403: 853-858.
- Neogi AK, Islam MJ, Shalauddin M, Mondal AC and Hossain S. The first record of the Blue Admiral *Kaniska canace* Linnaeus, 1763 (Nymphalidae: Lepidoptera) from Bangladesh. *J. Threat. Taxa.* 2018; 10(10): 12429-12431.
- Patterson S, Harris J, Dinsmore S and Kinkead K. Evaluating differences in density estimation for central Iowa butterflies using two methodologies. *Peer J.* 2023; 11: e16165.
- Pollard E and Yates V. *Monitoring Butterflies for Ecology and Conservation*. Chapman and Hall, London, UK: Springer Dordrecht; 1993, p. 292.
- Rashid NU, Kayes MI, Oli MH and Kadija U. A new record of *Chersonesia intermedia* (Martin, 1895) for Bangladesh. *J. Entomol. Zool. Stud.* 2022; 10(6): 19-21.
- Robinson N, Armstead S and Bowers MD. Butterfly community ecology: the influences of habitat type, weather patterns, and dominant species in a temperate ecosystem. *Entomol. Exp. Appl.* 2012; 145(1): 50-60.
- Sadat MN, Neogi AK, Rahman MS, and Mondal AC. Notes on Two Lycaenid Butterflies Confirm to Bangladesh. *Biolife*, 2016; 4(1): 213-215.
- Shihan TR and Prodhan MAH. Butterflies of Rema-Kalenga wildlife sanctuary, Habiganj, Bangladesh. *Int. J. Fauna Biol.* 2014; 1(6): 96-100.
- Tabassum N. A taxonomic account of pteridophytic flora of Adampur forest, Moulvibazar district, Bangladesh. *Dhaka Univ. J. Biol. Sci.* 2018; 27(1): 101-111.
- Thomas JA. The ecology and conservation of *Maculinea arion* and other European species of large blue butterfly. Ecology and Conservation of Butterflies. *Chapman and Hall*. 1995, pp. 180-210.