

## An updated checklist of the butterfly fauna of Ajodhya Hills, Purulia, West Bengal, India along with new distribution records

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### Abstract

To understand and update the account of the butterfly diversity in Ajodhya Hills, Purulia, West Bengal, India a study was carried out in two consecutive years from January 2020 to December 2021 with photographic documentation. A total of 143 butterflies from 6 families, 19 subfamilies and 95 genera were recorded. The highest richness was found in the families Nymphalidae with 45 species and Lycaenidae with 44 species, whereas Riodinidae had the lowest richness with only 1 species recorded. This study also reports the addition of one species, Black Angle *Tapena thwaitesi* (Moore), to the state butterfly fauna of West Bengal, as well as the addition of one species, Common Orange Awlet *Burara jaina* (Moore), to the butterfly fauna of southern West Bengal. In addition, three species, Plain Banded Awl *Hasora viitta* (Butler), Malabar Spotted Flat *Celaenorrhinus ambareesa* (Moore) and Common Acacia Blue *Surendra quercetorum* (Moore), were recorded with the first photographic documentation from southern West Bengal representing the rediscovery of Malabar Spotted Flat after 124 years from the Chotanagpur Plateau of West Bengal. The present study updates knowledge of the butterfly diversity of Ajodhya Hills and discusses the threats and conservation of the area, which may help in threat prevention, developing effective conservation strategies and to build awareness among the local people and government authorities to save the wildlife of Ajodhya Hills and its habitats.

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### Introduction

Butterflies play an important role in understanding local environmental health because they are very sensitive to climatic changes and that is why they are considered good ecological indicators (Kunte, 2000; Posa and Sodhi, 2006; Bonebrake et al., 2010). A good number of butterflies in a place indicates good floral diversity in the area as different butterfly species use different plants as their host plant (Öckinger et al., 2006; Mukherjee and Ghosh, 2018).

More than 18,000 butterflies are reported around the globe and India is home to more than 1,500 of these butterfly species (Singh, 2011).

In the present research, the authors studied and documented the butterfly diversity of Ajodhya Hills, Purulia district, West Bengal, India. The biodiversity of Purulia has been poorly studied to date (Das, 2016). The only detailed work on butterflies of Ajodhya Hills was done by Samanta et al., 2017 which contributed a total of 54 species to the known butterfly fauna of Baghmundi village and some areas

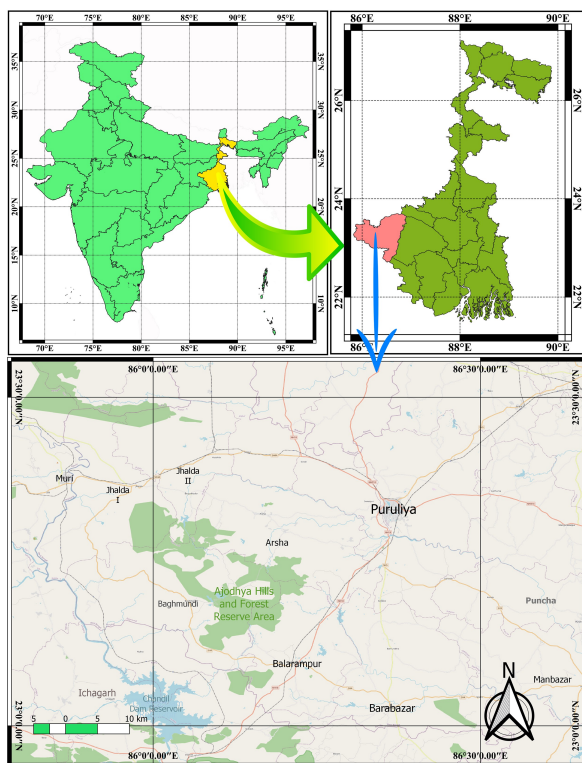
from the Ajodhya Hills (Samanta et al., 2017). After that, some species were added to the butterfly fauna of Ajodhya Hills (Mukherjee et al., 2021; Kuiry et al., 2022; Mahato et al., 2022; Samanta et al., 2022). The authors' motive is to update the number of taxa comprising the butterfly fauna of Ajodhya Hills and they hope the results of this study will help increase understanding of the richness and abundance of the butterfly fauna and also help in the conservation of this under-explored area.

## Material and Methods

### Study area

Purulia district lies between 22°43' N, 85°49' E and 23°42' N, 86°54' E (Malick, 1966), in the western part of West Bengal, Eastern India. Ajodhya Hills (22°09' N, 86°07' E) in Purulia is an extended part of Dalma Hills in Jharkhand within the Chotanagpur Plateau ecoregion and it occupies a total area of 401.4 km<sup>2</sup> (Dasgupta, 2015; Das, 2016; Ghosh and Mukhopadhyay, 2022). It is situated on the oldest landmass in the world (Chowdhury et al., 2021). Sal (*Shorea robusta*) forest is predominant in Ajodhya Hills mixed with various species such as Palash (*Butea monosperma*), Kusum (*Schleichera oleosa*), Mahua (*Madhuca longifolia*), Neem (*Azadirachta indica*) and Kendu (*Diospyros melanoxylon*) (Das, 2016). A total of 26 orchid species including 15 terrestrial and 11 epiphytic species have been reported from the region (Chakraborti et al., 2021).

The study area (Fig. 1) maintains a tropical to subtropical climate.



**Figure 1:** Map of the study area Ajodhya Hills, Purulia district, West Bengal, India.

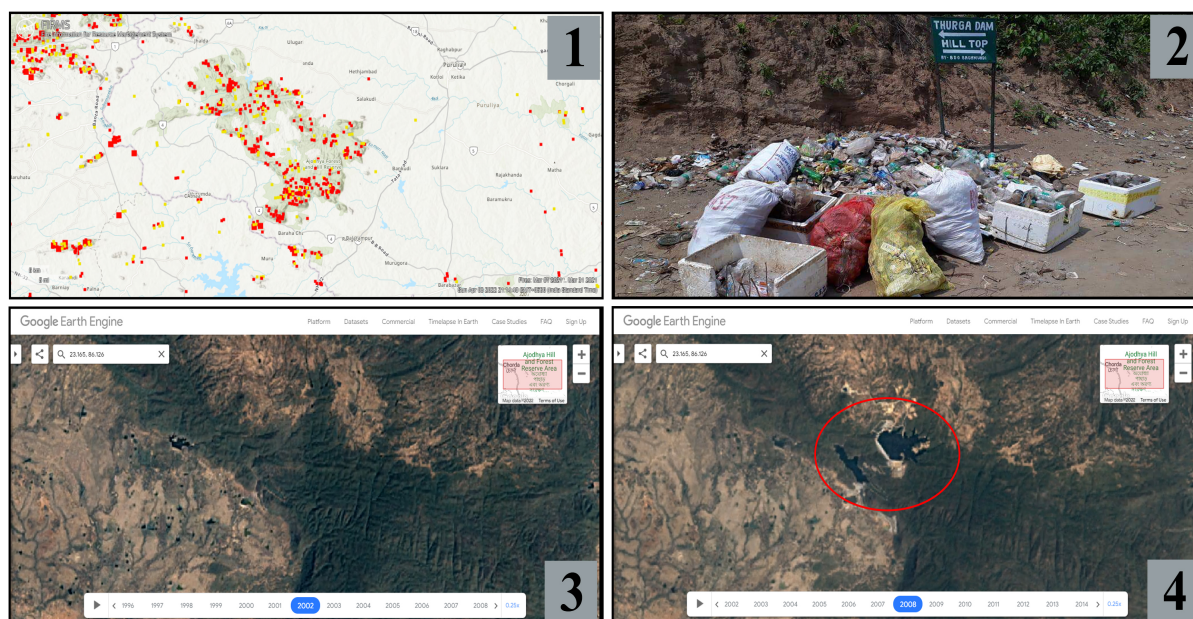
Forests of the area are of a dry deciduous type with some moist patches and the temperature varies between 2.8 °C and 52 °C (Samanta et al., 2017). Southwest monsoon is the main source of rainfall in the district. The average annual rainfall of the area ranges from 1,100 mm to 1,500 mm (Das, 2016). The study area contains various aquatic and terrestrial habitats including Sal (*Shorea robusta*) forests, rocky hills, shrub swamps, agricultural lands, dams, streams and human habitation. Tourism plays a vital role in the economy of the study area but due to unplanned tourism and garbage produced through it, habitats are facing major issues. As the forests of the study area are not protected, many other major forest issues (Fig. 2) including deforestation, hydroelectricity projects, uncontrolled forest fire (man-made), hunting of wild animals, etc., are encountered (Paul, 2003; Manna and Mondal, 2019).

### Data collection

The present study is based on the butterfly diversity from different habitats of Ajodhya Hills. The authors observed the butterfly fauna for a period of two consecutive years from January 2020 to December 2021 using a combination of the Direct Search Method (Sutherland, 1996) and the Opportunistic Sighting Method. A year was divided into four different seasons: summer (March to May), monsoon (June to August), post-monsoon (September to November) and winter (December to February). Observations were made in good weather (when no rain or heavy winds were involved) between 07:00 hr. and 16:00 hr. The authors also used previous documentation by Samanta et al. (2017) and Mahato et al. (2022) to complete the account of the known butterfly diversity of the study area.

Photographs were taken using DSLR cameras (Nikon D5600, Canon 750D and Canon 77D). All the species encountered during the survey were photographed and identified using suitable keys mentioned in various field guides (Evans, 1932; Wynter-Blyth, 1957; Kehimkar, 2016; Bhakare and Ogale, 2018). Keeping conservation policies in mind, none of the specimens were collected during the survey; however, in some critical cases where the species could not be determined with the naked eye or photographs, they were captured by net following Tiple (2012) with proper precautions to ensure that the scales present on the wings were minimally affected. After that, they were identified, photographed and released with the least possible disturbance in the same habitat from where they were captured. The encounter rate of each butterfly species was divided into four groups: widespread ( $W \geq 75.00\%$ ), common ( $C = 50.00\% - 74.99\%$ ), occasional ( $O = 25.00\% - 49.99\%$ ) and rare ( $R \leq 24.99\%$ ). The following notations were used for the biodiversity data reported herein: ‘\*’ to show newly recorded species from the area, ‘+’ to indicate the first photographic documentation from the southern part of West Bengal, ‘\$’ to show the first record from the southern part of West Bengal and ‘#’ to show a new record for the state West Bengal. For location data such as the map of the study area (Fig. 1) Q-GIS software version 3.18 and data analysis in Microsoft Office Excel, 2007 were used.





**Figure 2:** Threats to the study area in Ajodhya Hills, Purulia: 1) Fire reports in the study area from 01 March 2021 to 31 March 2021 where yellow dots represent fire reports during day hours and red dots represents fire reports during night hours. 2) The garbage produced from unplanned tourism near Thurga Dam within the study area Ajodhya Hills. 3) Study area before the Hydroelectric Power Project (year 2002). 4) Land loss (circle) resulting from the Hydroelectric Power Project (year 2008).

## Results

From the documentation by Samanta et al. (2017), Mahato et al. (2022) and two years of field study, a total of 143 butterfly species belonging to 95 genera, 19 subfamilies and 6 families were recorded (Figs. 3–12). A family-wise checklist containing common and scientific names along with abundance rate is given in Table 1. Nymphalidae (Fig. 5) with 45 species (31.46% of the total species) and Lycaenidae (Fig. 4) with 44 species (30.77%) were the most dominant families followed by Hesperidae (Fig. 3) with 29 species (20.28%), Pieridae (Fig. 7) with 14 species (9.79%) and Papilionidae (Fig. 6) with 10 species (7%). Riodinidae (Fig. 8) was found to have the lowest richness during this study. Only one species from Riodinidae (0.7% of the total species) was recorded. A good species to genera ratio of 1.50 was observed in this study. Among 19 subfamilies (Fig. 12), Polyommatainae was the most diverse subfamily with 23 species followed by Theclinae with 19 species, Hesperinae with 16 species, Limenitidinae with 14 species, Papilioninae with 9 species, Pyrginae and Nymphalinae with 9 species each, Coliadinae with 8 species, Satyrinae with 7 species, Pierinae with 6 species, Charaxinae and Danaeinae with 5 species each and Coeliadinae with 4 species. Of the remaining subfamilies, Curetinae and Biblidinae were represented by two species each and Acraeinae, Cyrestinae, Heliconiinae and Nemeobiinae were represented by only one species each.

During this study, Black Angle *Tapena thwaitesi* and Common Orange Awlet *Burara jaina* butterflies were recorded for the first time from the state of West Bengal and the southern part of West Bengal, respectively. In addition, the three species Plain Banded Awl *Hasora vitta*, Malabar Spotted Flat *Celaenorrhinus ambareesa* and Common Acacia Blue *Surendra quercetorum* were recorded with the first photographic documentation from southern West Bengal. Common and scientific names of these species, along with their distribution and references are given in Table 2. Other important species were Wax Dart *Cupitha purreea* (Moore), Smaller Dartlet *Oriens goloides* (Moore), Potanthus Dart *Potanthus sp.* (Scudder), Golden Angle *Caprona ransonnettii* (Felder), Common Yellow-breasted Flat *Gerosis bhagava* (Moore), Angled Pierrot *Caleta decidia* (Hewitson), Malayan *Megisba malaya* (Horsfield), Large-spotted Oakblue *Arhopala nicevillei* (Bethune-Baker), Copper Flash *Rapala pheretima* (Hewitson), Fluffy Tit *Zeltus amasa* (Hewitson), Plain Tawny Rajah *Charaxes psaphon* (Westwood), Anomalous Nawab *Polyura agraria* (Swinhoe), Common Map *Cyrestis thyodamas* (Boisduval), Blackvein Sergeant *Athyma ranga* (Moore), Staff Sergeant *Athyma selenophora* (Kollar), Common Lascar *Pantoporia hordonia* (Stoll), Extra Lascar *Pantoporia sandaca* (Butler), Grey Count *Tanaecia lepidea* (Butler), Spotless Grass Yellow *Eurema laeta* (Boisduval), Tree Yellow *Gandaca harina* (Horsfield) and Painted Jezebel *Delias hyparete* (Linnaeus). Brief notes on some species are given below.

**Table 1:** Family-wise checklist containing common and scientific names along with abundance rate. Abundance Index: W = widespread; C = common; O = occasional; R = rare. \* = newly recorded species from the study area Ajodhya Hills; # = new record for the state of West Bengal; \$ = first record from the southern part of West Bengal; + = first photographic documentation from the southern part of West Bengal.

S. No.	Species	Common name	Abundance index
<b>Family Hesperidae</b>			
<b>Subfamily Coeliadinae</b>			
01	<i>Badamia exclamationis</i> (Fabricius, 1775)	Brown Awl	O
02	<i>Burara jaina</i> (Moore, [1866])	Common Orange Awlet*\$	R
03	<i>Hasora chromus</i> (Cramer, [1780])	Common Banded Awl*	C
04	<i>Hasora vitta</i> (Butler, 1870)	Plain Banded Awl**	R
<b>Subfamily Hesperinae</b>			
05	<i>Ampittia dioscorides</i> (Fabricius, 1793)	Bush Hopper*	C
06	<i>Baoris farri</i> (Moore, 1878)	Complete Paint-brush Swift*	R
07	<i>Borbo cinnara</i> (Wallace, 1866)	Rice Swift*	O
08	<i>Caltoris sp.</i> Swinhoe, 1893	Caltoris Swift*	R
09	<i>Cupitha purreea</i> (Moore, 1877)	Wax Dart*	O
10	<i>Hyarotis adrastus</i> (Stoll, [1780])	Tree Flitter*	R
11	<i>Iambrix salsala</i> (Moore, 1866)	Chestnut Bob*	O
12	<i>Matapa aria</i> (Moore, [1866])	Common Branded Redeye*	R
13	<i>Suastus gremius</i> (Fabricius, 1798)	Indian Palm Bob*	W
14	<i>Parnara bada</i> (Moore, 1878)	Ceylon Swift*	W
15	<i>Pelopidas agna</i> (Moore, [1866])	Obscure Branded Swift*	W
16	<i>Pelopidas mathias</i> (Fabricius, 1798)	Small Branded Swift*	W
17	<i>Oriens goloides</i> (Moore, [1881])	Smaller Dartlet*	R
18	<i>Potanthus sp.</i> Scudder, 1872	Potanthus Dart*	R
19	<i>Taractrocera maevius</i> (Fabricius, 1793)	Common Grass Dart*	R
20	<i>Udaspes folus</i> (Cramer, [1775])	Grass Demon	C
<b>Subfamily Pyrginae</b>			
21	<i>Caprona ransonnetii</i> (Felder, 1868)	Golden Angle*	C
22	<i>Celaenorrhinus ambareesa</i> (Moore, [1866])	Malabar Spotted Flat**	R
23	<i>Coladenia indrani</i> (Moore, [1866])	Tricolour Pied Flat*	R
24	<i>Gerosis bhagava</i> (Moore, [1866])	Common Yellow-breasted Flat*	R
25	<i>Sarangesa dasahara</i> (Moore, [1866])	Common Small Flat*	O
26	<i>Spialia galba</i> (Fabricius, 1793)	Indian Skipper*	O
27	<i>Tagiades japetus</i> (Stoll, [1781])	Common Snow Flat	R
28	<i>Tagiades litigiosa</i> Moeschler, 1878	Water Snow Flat*	C
29	<i>Tapena thwaitesi</i> Moore, [1881]	Black Angle*#	R
<b>Family Lycaenidae</b>			
<b>Subfamily: Curetinae</b>			
30	<i>Curetis acuta</i> Moore, 1877	Angled Sunbeam*	C
31	<i>Curetis thetis</i> (Drury, [1773])	Indian Sunbeam*	R
<b>Subfamily: Polyommatae</b>			
32	<i>Acytolepis puspa</i> (Horsfield, [1828])	Common Hedge Blue*	C
33	<i>Anthene emolus</i> (Godart, 1824)	Common Ciliate Blue*	W
34	<i>Anthene lycaenina</i> (Felder, 1868)	Pointed Ciliate Blue*	O
35	<i>Caleta decidia</i> (Hewitson, 1876)	Angled Pierrot*	O
36	<i>Castalius rosimon</i> (Fabricius, 1775)	Common Pierrot	W
37	<i>Catochrysops strabo</i> (Fabricius, 1793)	Forget-me-not*	C
38	<i>Chilades lajus</i> (Stoll, [1780])	Lime Blue*	C
39	<i>Chilades pandava</i> (Horsfield, [1829])	Plains Cupid*	W
40	<i>Euchrysops cnejus</i> (Fabricius, 1798)	Gram Blue*	C
41	<i>Everes lacturnus</i> (Godart, [1824])	Indian Cupid*	C
42	<i>Freyeria putli</i> (Kollar, [1844])	Small Grass Jewel*	O
43	<i>Jamides bochus</i> (Stoll, [1782])	Dark Cerulean*	O
44	<i>Jamides celeno</i> (Cramer, [1775])	Common Cerulean*	C
45	<i>Lampides boeticus</i> (Linnaeus, 1767)	Pea Blue*	C
46	<i>Leptotes plinius</i> (Fabricius, 1793)	Zebra Blue*	C
47	<i>Megisba malaya</i> (Horsfield, [1828])	Malayan	R
48	<i>Prosotas dubiosa</i> (Semper, [1879])	Tailless Lineblue*	W
49	<i>Prosotas nora</i> (C. Felder, 1860)	Common Lineblue*	W
50	<i>Pseudozizeeria maha</i> (Kollar, [1844])	Pale Grass Blue	W
51	<i>Tarucus nara</i> (Kollar, 1848)	Striped Pierrot*	C
52	<i>Zizeeria karsandra</i> (Moore, 1865)	Dark Grass Blue*	R
53	<i>Zizina otis</i> (Fabricius, 1787)	Lesser Grass Blue	C
54	<i>Zizula hylax</i> (Fabricius, 1775)	Tiny Grass Blue*	C



Table 1: (Continued).

S. No.	Species	Common name	Abundance index
<b>Subfamily Theclinae</b>			
55	<i>Amblypodia anita</i> Hewitson, 1862	Purple Leaf Blue	W
56	<i>Arhopala amantes</i> (Hewitson, 1862)	Large Oakblue	C
57	<i>Arhopala atrax</i> (Hewitson, 1862)	Indian Oakblue*	R
58	<i>Arhopala nicevillei</i> Bethune-Baker, 1903	Large-spotted Oakblue	R
59	<i>Iraota timoleon</i> (Stoll, [1790])	Silverstreak Blue*	R
60	<i>Loxura atymnus</i> (Stoll, 1780)	Yamfly*	W
61	<i>Mahathala ameria</i> (Hewitson, 1862)	Falcate Oakblue	R
62	<i>Rapala iarbus</i> (Fabricius, 1787)	Common Red Flash	R
63	<i>Rapala manea</i> (Hewitson, 1863)	Slate Flash*	C
64	<i>Rapala pheretima</i> (Hewitson, 1863)	Copper Flash*	O
65	<i>Rapala varuna</i> (Horsfield, [1829])	Indigo Flash	O
66	<i>Rathinda amor</i> (Fabricius, 1775)	Monkey Puzzle*	R
67	<i>Spindasis elima</i> (Moore, 1877)	Scarce Shot Silverline*	O
68	<i>Spindasis ictis</i> (Hewitson, 1865)	Common Shot Silverline*	O
69	<i>Spindasis vulcanus</i> (Fabricius, 1775)	Common Silverline	W
70	<i>Surendra quercetorum</i> (Moore, [1858])	Common Acacia Blue* <sup>+</sup>	O
71	<i>Tajuria cippus</i> (Fabricius, 1798)	Peacock Royal*	O
72	<i>Virachola isocrates</i> (Fabricius, 1793)	Common Guava Blue*	R
73	<i>Zeltus amasa</i> (Hewitson, 1865)	Fluffy Tit*	O
<b>Family Nymphalidae</b>			
<b>Subfamily Acraeinae</b>			
74	<i>Acraea violae</i> (Fabricius, 1793)	Tawny Coster	W
<b>Subfamily Biblidinae</b>			
75	<i>Ariadne ariadne</i> (Linnaeus, 1763)	Angled Castor*	W
76	<i>Ariadne merione</i> (Cramer, [1777])	Common Castor	C
<b>Subfamily Charaxinae</b>			
77	<i>Charaxes bernardus</i> (Fabricius, 1793)	Tawny Rajah*	O
78	<i>Charaxes psaphon</i> Westwood, 1847	Plain Tawny Rajah*	C
79	<i>Charaxes solon</i> (Fabricius, 1793)	Black Rajah	O
80	<i>Polyura agraria</i> (Swinhoe, 1887)	Anomalous Nawab*	R
81	<i>Polyura bhārata</i> (C. and R. Felder, [1867])	Indian Nawab	C
<b>Subfamily Cyrestinae</b>			
82	<i>Cyrestis thyodamas</i> Boisduval, 1846	Common Map*	R
<b>Subfamily Danainae</b>			
83	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain Tiger	W
84	<i>Danaus genutia</i> (Cramer, [1779])	Common Tiger	C
85	<i>Euploea core</i> (Cramer, [1780])	Common Crow	W
86	<i>Euploea klugii</i> Moore, [1858]	King Crow*	O
87	<i>Tirumala limniace</i> (Cramer, [1775])	Blue Tiger	C
<b>Subfamily Heliconiinae</b>			
88	<i>Phalanta phalantha</i> (Drury, [1773])	Common Leopard	W
<b>Subfamily Limenitidinae</b>			
89	<i>Athyma nefte</i> (Cramer, [1780])	Colour Sergeant	R
90	<i>Athyma perius</i> (Linnaeus, 1758)	Common Sergeant*	R
91	<i>Athyma ranga</i> Moore, [1858]	Blackvein Sergeant	R
92	<i>Athyma selenophora</i> (Kollar, [1844])	Staff Sergeant*	O
93	<i>Euthalia aconthea</i> (Cramer, [1777])	Common Baron	C
94	<i>Euthalia lubentina</i> (Cramer, [1777])	Gaudy Baron*	O
95	<i>Moduza procris</i> (Cramer, [1777])	Commander	W
96	<i>Neptis hylas</i> (Linnaeus, 1758)	Common Sailer	W
97	<i>Neptis jumbah</i> Moore, [1858]	Chestnut-streaked Sailer*	W
98	<i>Pantoporia hordonia</i> (Stoll, [1790])	Common Lascar*	C
99	<i>Pantoporia sandaca</i> (Butler, 1892)	Extra Lascar*	R
100	<i>Phaedyma columella</i> (Cramer, [1780])	Short-banded Sailer*	O
101	<i>Symphaedra nais</i> (Forster, 1771)	Baronet	W
102	<i>Tanaecia lepidea</i> (Butler, 1868)	Grey Count*	O
<b>Subfamily Nymphalinae</b>			
103	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great Eggfly	W
104	<i>Hypolimnas misippus</i> (Linnaeus, 1764)	Danaid Eggfly*	O
105	<i>Junonia almana</i> (Linnaeus, 1758)	Peacock Pansy	W
106	<i>Junonia atlites</i> (Linnaeus, 1763)	Grey Pansy	W
107	<i>Junonia hierta</i> (Fabricius, 1798)	Yellow Pansy	C
108	<i>Junonia iphita</i> (Cramer, [1779])	Chocolate Pansy	W
109	<i>Junonia lemonias</i> (Linnaeus, 1758)	Lemon Pansy	W
110	<i>Junonia orithya</i> (Linnaeus, 1758)	Blue Pansy	C
111	<i>Vanessa cardui</i> (Linnaeus, 1758)	Painted Lady*	R

**Table 1: (Continued).**

S. No.	Species	Common name	Abundance index
<b>Subfamily Satyrinae</b>			
112	<i>Elymnias hypermnestra</i> (Linnaeus, 1763)	Common Palmfly	C
113	<i>Lethe europa</i> (Fabricius, 1775)	Bamboo Treebrown*	R
114	<i>Melanitis leda</i> (Linnaeus, 1758)	Common Evening Brown	W
115	<i>Mycalesis mineus</i> (Linnaeus, 1758)	Dark-branded Bushbrown*	C
116	<i>Mycalesis perseus</i> (Fabricius, 1775)	Common Bushbrown	W
117	<i>Ypthima baldus</i> (Fabricius, 1775)	Common Five-ring	R
118	<i>Ypthima huebneri</i> Kirby, 1871	Common Four-ring	W
<b>Family Papilionidae</b>			
<b>Subfamily Papilioninae</b>			
119	<i>Graphium agamemnon</i> (Linnaeus, 1758)	Tailed Jay*	C
120	<i>Graphium antiphates</i> (Cramer, [1775])	Five-bar Swordtail	O
121	<i>Graphium doson</i> (C. and R. Felder, 1864)	Common Jay	C
122	<i>Graphium nomius</i> (Esper, 1799)	Spot Swordtail	O
123	<i>Pachliopta aristolochiae</i> (Fabricius, 1775)	Common Rose	O
124	<i>Papilio clytia</i> Linnaeus, 1758	Common Mime	C
125	<i>Papilio crino</i> Fabricius, 1793	Common Banded Peacock*	C
126	<i>Papilio demoleus</i> Linnaeus, 1758	Lime Butterfly	W
127	<i>Papilio polymnestor</i> Cramer, [1775]	Blue Mormon	O
128	<i>Papilio polytes</i> Linnaeus, 1758	Common Mormon	W
<b>Family Pieridae</b>			
<b>Subfamily Coliadinae</b>			
129	<i>Catopsilia pomona</i> (Fabricius, 1775)	Common Emigrant	W
130	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	Mottled Emigrant	C
131	<i>Eurema andersoni</i> Moore, 1886	One-spot Grass Yellow*	C
132	<i>Eurema blanda</i> (Boisduval, 1836)	Three-spot Grass Yellow*	O
133	<i>Eurema brigitta</i> (Stoll, [1780])	Small Grass Yellow*	W
134	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common Grass Yellow	W
135	<i>Eurema laeta</i> (Boisduval, 1836)	Spotless Grass Yellow*	R
136	<i>Gandaca harina</i> (Horsfield, [1829])	Tree Yellow*	O
<b>Subfamily Pierinae</b>			
137	<i>Belenois aurota</i> (Fabricius, 1793)	Pioneer*	R
138	<i>Cepora nerissa</i> (Fabricius, 1775)	Common Gull*	C
139	<i>Delias eucharis</i> (Drury, 1773)	Common Jezebel/Indian Jezebel	C
140	<i>Delias hyparete</i> (Linnaeus, 1758)	Painted Jezebel*	W
141	<i>Leptosia nina</i> (Fabricius, 1793)	Psyche	C
142	<i>Pareronia hippia</i> (Fabricius, 1787)	Common Wanderer/Indian Wanderer	O
<b>Family Riodinidae</b>			
<b>Subfamily Nemeobiinae</b>			
143	<i>Abisara bifasciata</i> Moore, 1877	Double-banded Judy	C

**Table 2:** List of new unique records along with their previous distribution and references. # = new record for West Bengal; \$ = first record from southern part of West Bengal; + = first photographic documentation from southern West Bengal. The state West Bengal is represented by WB. National level distribution is categorized into five regional groups (NI: North India; NEI: North East India; CI: Central India; SI: Southern India; AnIs: Andaman) and state level distribution is categorized into two groups (SB: Southern West Bengal, NB: Northern West Bengal.)

S. No.	Scientific name	Common name	Previous distribution	References
<b>Family Hesperidae</b>				
<b>Subfamily Coeliadinae</b>				
1	<i>Burara jaina</i> (Moore, [1866])	Common Orange Awlet <sup>\$</sup>	WB (NB), NI, NEI, CI, SI, AnIs	Kehimkar, 2016; Sheela et al., 2015
2	<i>Hasora vitta</i> (Butler, 1870)	Plain Banded Awl <sup>+</sup>	WB (SB and NB), NEI, CI, SI, AnIs	Ghatak and Roy, 2013; Sheela et al., 2015; Kehimkar, 2016; Das et al., 2019
<b>Family Hesperidae</b>				
<b>Subfamily Pyrginae</b>				
3	<i>Celaenorrhinus ambareesa</i> (Moore, [1866])	Malabar Spotted Flat <sup>+</sup>	WB (SB), CI, SI	Watson, 1897; Kehimkar, 2016
4	<i>Tapena thwaitesi</i> Moore, [1881]	Black Angle <sup>#</sup>	Odisha, NEI, SI	Varshney and Smetacek, 2015; Kehimkar, 2016
<b>Family Lycaenidae</b>				
<b>Subfamily Theclinae</b>				
5	<i>Surendra quercetorum</i> (Moore, [1858])	Common Acacia Blue <sup>+</sup>	WB (SB and NB), Jharkhand, NI, NEI, CI, SI, AnIs.	Ghosh and Siddique, 2005; Ghatak and Roy, 2013; Rao et al., 2013; Kehimkar, 2016

**Family HesperIIDae**

**Subfamily Coeliadinae**

**Common Orange Awlet *Burara jaina***

This species was sighted three to four times in the study area and a female specimen was photographed on 11 November 2020 at 15:12 hr while it was laying eggs near a forest waterbody. The species has been reported from Maharashtra, Uttaranchal, Arunachal Pradesh, Chhattisgarh, Andaman Island and the northern part of West Bengal (Sheela et al., 2015; Kehimkar, 2016) but this species is not reported from the southern part of West Bengal (Samanta et al., 2017; Dwari and Mondal, 2020; Mukherjee and Mondal, 2020). Hence, this is the first record of this species for the southern part of West Bengal.

**Plain Banded Awl *Hasora vitta***

This species is very similar in appearance to the Common Banded Awl *Hasora chromus* (Cramer) but can be distinguished from it by the broad white or bluish band on under hindwing (UNH) (Kehimkar, 2016). The species was sighted only once in the study area on 14 August 2020 at 08:25 hr. It has been reported from Maharashtra, Sikkim to Arunachal Pradesh, Chhattisgarh, West Bengal and Andaman Island (Ghatak and Roy, 2013; Sheela et al., 2015; Kehimkar, 2016). There is no photographic documentation of this species from the southern part of West Bengal (Das et al., 2019). Hence, this is the first

photographic documentation from the southern part of West Bengal.

**Family HesperIIDae**

**Subfamily Hesperiiinae**

**Potanthus Dart (*Potanthus* sp.)**

On a few occasions during this study, some specimens of this genus were photographed in the study area. Only darts of the genus *Telicota* are known from the Purulia district (Das, 2018). Even reports of this genus from southern West Bengal are rare. Therefore, this is an important report not only for the district but also for southern West Bengal.

**Family HesperIIDae**

**Subfamily Pyrginae**

**Malabar Spotted Flat *Celaenorrhinus ambareesa***

Malabar Spotted Flat is also known as Dakhan Spotted Flat. It was sighted only twice in the study area and one fresh specimen was photographed on 13 July 2021 from a forest stream. The species has previous records from Southern India to Madhya Pradesh and West Bengal (Kehimkar, 2016). The species has been reported from the Manbhoom district of Bengal by Watson (1897); thereafter, Das et al. (2019) reported this species from Sundarbans of West Bengal but no photographic documentation was found. Hence, this is the rediscovery of Malabar Spotted Flat *Celaenorrhinus ambareesa* after 124 years in the Chotanagpur Plateau region of West Bengal.



**Figure 3:** Butterflies of family HesperIIDae. 1) *Badamia exclamatoris* 2) *Burara jaina* 3) *Hasora chromus* 4) *Hasora vitta* 5) *Ampittia dioscorides* 6) *Baoris farri* 7) *Borbo cinnara* 8) *Caltoris* sp. 9) *Cupitha purreea* 10) *Hyarotis adrastus* 11) *Iambrix salsala* 12) *Matapa aria* 13) *Suastus gremius* 14) *Parnara bada* 15) *Pelopidas agna* 16) *Pelopidas mathias* 17. A) *Oriens goloides* closewing 17. B) *Oriens goloides* openwing 18) *Potanthus* sp. 19) *Taractrocera maevis* 20) *Udaspes folus* 21) *Caprona ransonnettii* 22) *Celaenorrhinus ambareesa* 23) *Coladenia indrani* 24) *Gerosis bhagava* 25) *Sarangesa dasahara* 26) *Spialia galba* 27) *Tagiades litigiosa* 28) *Tapena thwaitesi*.





**Figure 4:** Butterflies of family Lycaenidae. 1) *Curetis acuta* 2) *Curetis thetis* 3) *Acytolepis puspa* 4) *Anthene emolus* 5) *Anthene lycaenina* 6) *Caleta decidia* 7) *Castalius rosimon* 8) *Catochrysops strabo* 9) *Chilades lajus* 10) *Chilades pandava* 11) *Euchrysops cnejus* 12) *Everes lacturnus* 13) *Freyeria putli* 14) *Jamides bochus* 15) *Jamides celeno* 16) *Lampides boeticus* 17) *Leptotes plinius* 18) *Megisba malaya* 19) *Prosotas dubiosa* 20) *Prosotas nora* 21) *Pseudozizeeria maha* 22) *Tarucus nara* 23) *Zizeeria karsandra* 24) *Zizina otis* 25) *Zizula hylax* 26) *Amblypodia anita* 27) *Arhopala amantes* 28) *Arhopala atrax* 29) *Arhopala nicevillei* 30) *Iraota timoleon* 31) *Loxura atymmus* 32) *Rapala iarbus* 33) *Rapala manea* 34) *Rapala pheretima* 35) *Rapala varuna* 36) *Rathinda amor* 37) *Spindasis elima* 38) *Spindasis ictis* 39) *Spindasis vulcanus* 40) *Surendra quercetorum* 41) *Tajuria cippus* 42) *Virachola isocrates* 43) *Zeltus amasa*.

### Black Angle *Tapena thwaitesi*

This species is also known as Angled Flat and can be identified by its broad angled wings (Kehimkar 2016). During this study, this species was sighted near a forest stream on 13 July 2021 at around 11:38 hr. The species has a distribution in Maharashtra, Odisha and Assam to Arunachal Pradesh (Kehimkar, 2016). However, this species was not reported from West Bengal before (Ghatak and Roy, 2013; Samanta et al., 2017; Das, 2018; Mitra et al., 2018; Dwari and Mondal, 2020; Mukherjee and Mondal, 2020). Hence, it can be concluded that it is the first record of this species from the state.

### Family Lycaenidae

#### Subfamily Theclinae

#### Common Acacia Blue *Surendra quercetorum*

This species was spotted multiple times in the study area and occurrence was at its peak in the months of November and December near forest water bodies and deep dry areas in the forest. Records of this species are known from Maharashtra, Andhra

Pradesh to Jharkhand, Himachal Pradesh to Arunachal Pradesh, West Bengal and Andaman Island (Rao et al., 2013; Ghatak and Roy, 2013; Kehimkar, 2016). The species is common in the northern part of West Bengal but there are only a few reports from the southern part of West Bengal. Also, there is no photographic documentation of this species from the southern part of West Bengal (Ghosh and Siddique, 2005). Hence, we can say that it is the first photographic documentation of Common Acacia Blue *Surendra quercetorum* from the southern part of West Bengal.

### Family Nymphalidae

#### Subfamily Cyrestinae

#### Common Map *Cyrestis thyodamas*

This species was observed only once during the two years of the study period 12 December 2021. The Common Map can be easily identified by its semi-transparent white wings with irregular vertical dark lines (Kehimkar, 2016). This species is very common in northern West Bengal but reports from southern West Bengal are rare (Ghatak and Roy, 2013).



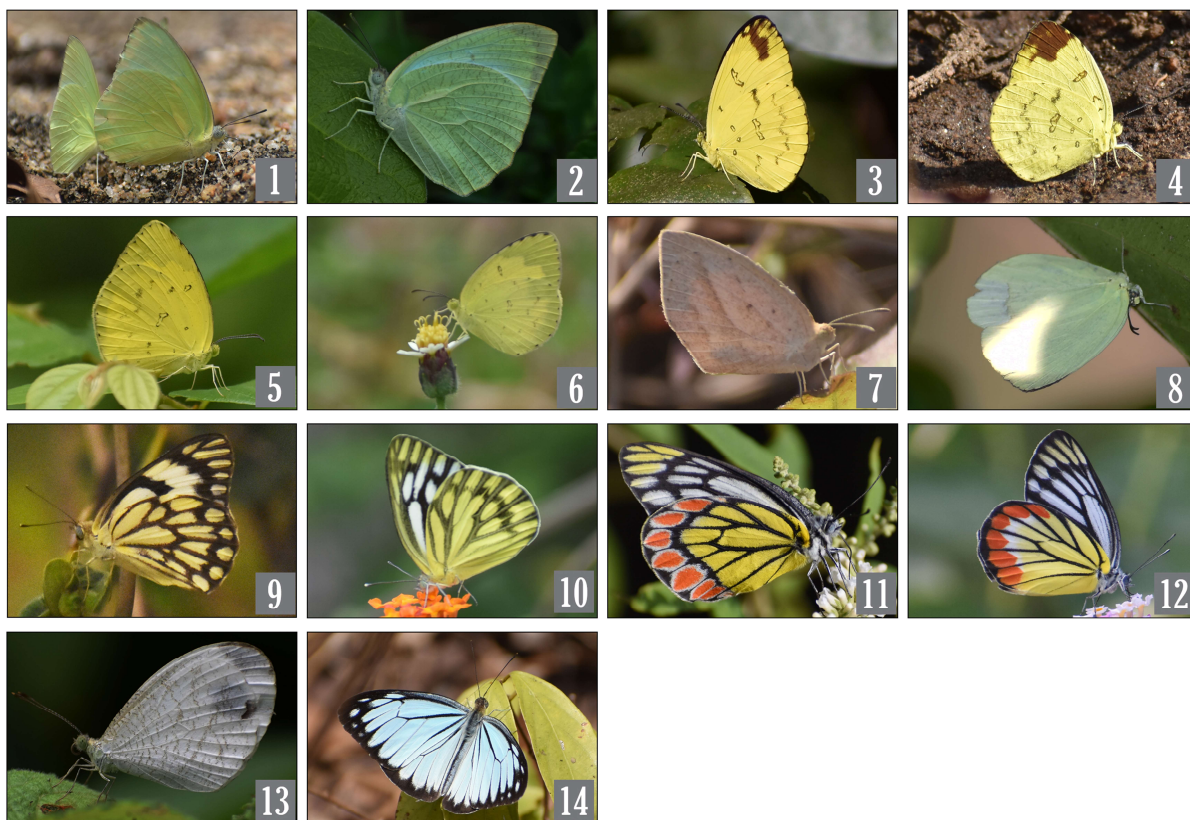


**Figure 5:** Butterflies of family Nymphalidae. 1) *Ariadne ariadne* 2) *Ariadne merione* 3) *Charaxes bernardus* 4) *Charaxes psaphon* 5) *Charaxes solon* 6) *Polyura agraria* 7) *Polyura bharata* 8) *Cyrestis thyodamas* 9) *Danaus chrysippus* 10) *Danaus genutia* 11) *Euploea core* 12) *Euploea klugii* 13) *Tirumala limniace* 14) *Acraea violae* 15) *Phalanta phalantha* 16) *Athyma perius* 17) *Athyma ranga* 18) *Athyma selenophora* 19) *Euthalia aconthea* 20) *Euthalia lubentina* 21) *Moduza procris* 22) *Neptis hylas* 23) *Neptis jumbah* 24) *Pantoporia hordonia* 25. A) *Pantoporia sandaca* 25. B) *Pantoporia sandaca* showing Identifying character Large white Speculum in the UPH Costal region 26) *Phaedyma columella* 27) *Symphaedra nais* 28) *Tanaecia lepidea* 29) *Hypolimnias bolina* 30) *Hypolimnias misippus* 31) *Junonia almana* 32) *Junonia atlites* 33) *Junonia hierta* 34) *Junonia iphita* 35) *Junonia lemonias* 36) *Junonia orithya* 37) *Vanessa cardui* 38) *Elymnias hypermnestra* 39) *Lethe europa* 40) *Melanitis leda* 41) *Mycalesis mineus* 42) *Mycalesis perseus* 43) *Ypthima huebneri*.



**Figure 6:** Butterflies of family Papilionidae. 1) *Graphium agamemnon* 2) *Graphium antiphates* 3) *Graphium doson* 4) *Graphium nomius* 5) *Pachliopta aristolochiae* 6) *Papilio clytia* 7) *Papilio crino* 8) *Papilio demoleus* 9) *Papilio polymnestor* 10) *Papilio polytes*.





**Figure 7:** Butterflies of family Pieridae. 1) *Catopsilia pomona* 2) *Catopsilia pyranthe* 3) *Eurema andersoni* 4) *Eurema blanda* 5) *Eurema brigitta* 6) *Eurema hecabe* 7) *Eurema laeta* 8) *Gandaca harina* 9) *Belenois aurota* 10) *Cepora nerissa* 11) *Delias eucharis* 12) *Delias hyparete* 13) *Leptosia nina* 14) *Pareronia hippia*.



**Figure 8:** Butterfly of family Riodinidae: *Abisara bifasciata*.

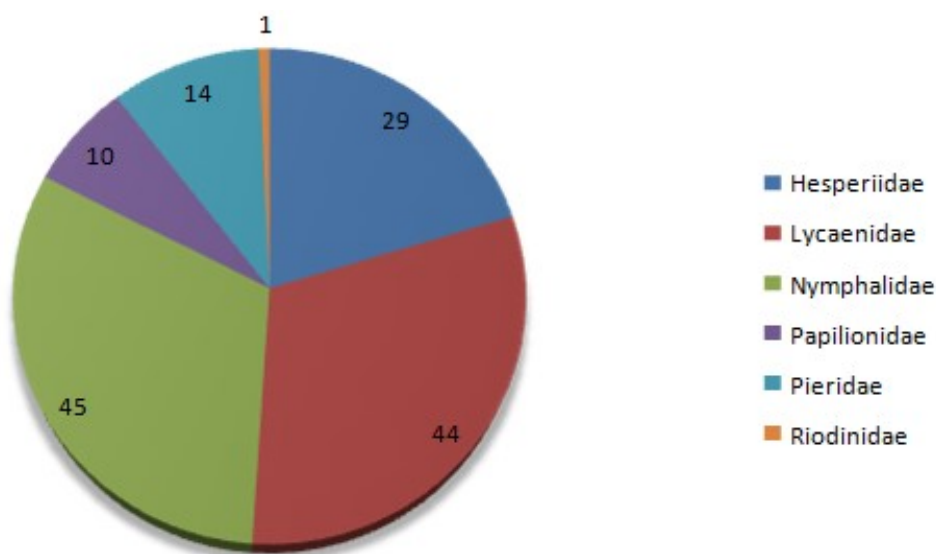


## Discussion

The present study on the butterfly diversity of Ajodhya Hills, West Bengal reported 143 butterflies including 86 newly reported butterfly species from the study area which is the highest number of recorded butterfly species from an area in the plateau region of West Bengal (Samanta et al., 2017; Das, 2018; Dwari and Mondal, 2020; Mukherjee and Mondal, 2020). A good species to genera ratio of 1.50 was observed which indicates the good health and distribution of several host plants and nectaring plants in the study area (Kunte, 2000; Öckinger et al., 2006; Mukherjee and Ghosh, 2018). High richness was recorded in the families Nymphalidae and Lycaenidae, which is similar to previous studies on butterfly diversity from the state (Samanta et al., 2017; Das, 2018; Mahata et al., 2020; Mukherjee and Mondal, 2020). Four species, Common Snow Flat *Tagiades japetus* (Stoll), Falcate Oakblue *Mahathala ameria* (Hewitson), Colour Sergeant *Athyma nefte* and Common Five-ring *Ypthima baldus* (Fabricius) were not recorded during the two years of the study period (from January 2020 to December 2021). Colour Sergeant *Athyma nefte* was reported by Mahato et al. (2022) and the rest of the three species were reported by Samanta et al. (2017). The previous study by Samanta et al. (2017) suggested that climate and vegetation may be reasons for the low richness in Hesperidae but the results of the present study oppose this conclusion; Hesperidae was among the most dominant families after Nymphalidae and Lycaenidae. One butterfly from Hesperidae, Black Angle *Tapena thwaitesi*, is newly recorded for the state of West Bengal and another species, Common Orange Awlet *Burara jaina*, from the same family, is newly recorded from the southern part of West Bengal. In addition, Plain Banded Awl *Hasora vitta*, Malabar Spotted Flat *Celaenorrhinus ambareesa* and Common Acacia Blue *Surendra quercetorum* were

recorded with the first photographic documentation from southern West Bengal. And the Malabar Spotted Flat *Celaenorrhinus ambareesa* was rediscovered from the Chotanagpur Plateau of West Bengal after 124 years during this study. Among 35 rare species, Plain Banded Awl *Hasora vitta*, Common Branded Redeye *Matapa aria* (Moore), Smaller Dartlet *Oriens goloides*, Malabar Spotted Flat *Celaenorrhinus ambareesa*, Common Yellow-breasted Flat *Gerosis bhagava*, Black Angle *Tapena thwaitesi*, Malayan *Megisba malaya*, Large-spotted Oakblue *Arhopala nicevillei*, Anomalous Nawab *Polyura agraria*, Blackvein Sergeant *Athyma ranga*, Spotless Grass Yellow *Eurema laeta* were observed just once or twice.

During the study period, the authors encountered multiple issues which could be major concerns for these butterflies in the future. Tourism is an ecologically important factor for the study area but pollution occurs due to unplanned tourism and garbage produced from tourism. The forests of the study area are not protected. Due to hydroelectric projects like the PPSP (Purulia Pump Storage Project) huge land loss and deforestation occurs in the study area. Deforestation impacts the vegetation of the area resulting in a decrease in the host plants of various butterflies. Moreover, multiple uncontrolled and man-made forest fire incidents regularly happen in the study area, which affects the growth of the vegetation as well as the butterfly population. As butterflies are very sensitive to climatic changes, these issues are major threats that can decrease the butterfly diversity of the area in the near future (Kunte, 2000; Posa and Sodhi, 2006). As already seen, some species reported by Samanta et al. (2017) such as Common Snow Flat *Tagiades japetus*, Falcate Oakblue *Mahathala ameria* and Common Five-ring *Ypthima baldus* were not found during the two years of the study period.



**Figure 9:** Pie chart representation of total number of butterfly species recorded from each family.

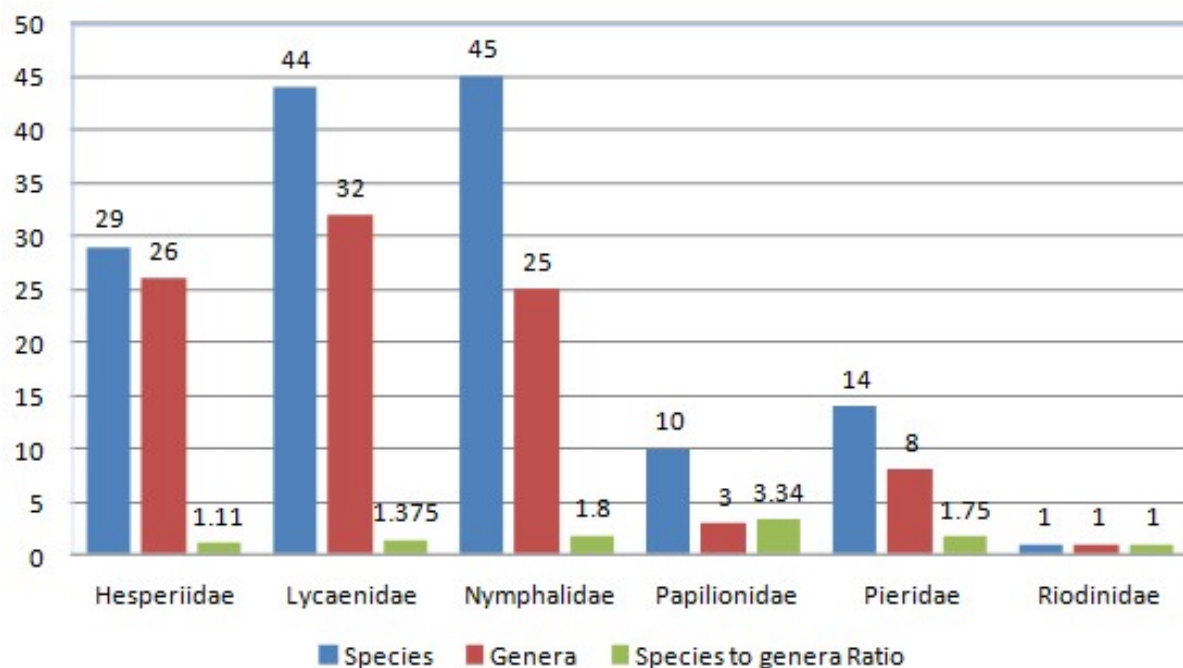


Figure 10: Total numbers of species, genera and their ratio in each family.

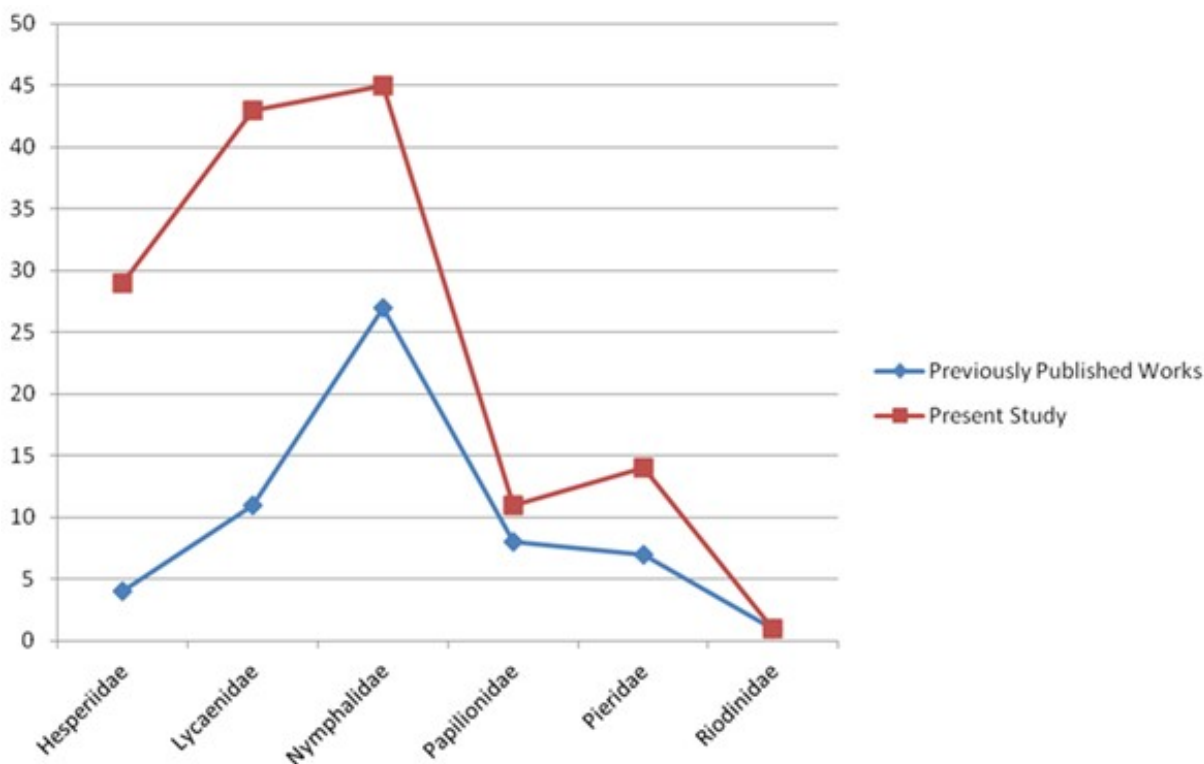


Figure 11: Family-wise comparison of published works on butterflies from the study area with the present study (Samanta et al., 2017; Mukherjee, 2021; Kuiry et al., 2022, Mahato et al., 2022; Samanta et al., 2022).

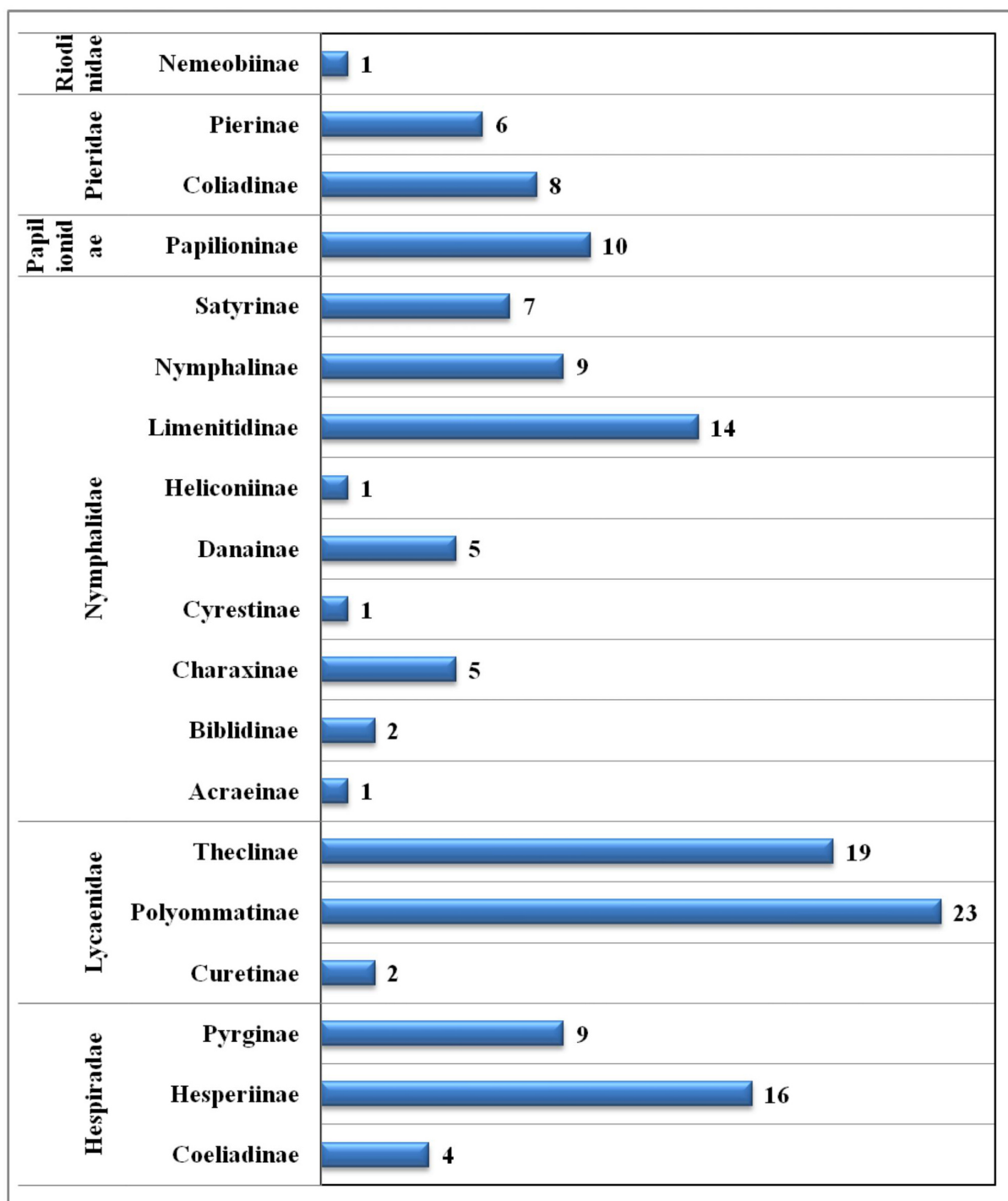


Figure 12: Total number of butterfly species from each subfamily.

### Conclusion

This study provides data on a total of 143 butterfly species including 86 newly reported species from Ajodhya Hills, Purulia which will help to understand the distribution, diversity, abundance rate and threats of the area. Such a number of recorded butterfly species indicates the presence of a variety of floral species in the study area. Newly recorded species from West Bengal and the southern part of West

Bengal indicate the good health of the study area at present. If it is possible to check major forest issues including deforestation, hydroelectricity projects, uncontrolled forest fire (man-made), unplanned tourism and the garbage produced through it, and to preserve the forests of the study area in their present condition, then the known diversity may be enhanced by many more species in the near future because of the forest type and the location of the study area.



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## Conflict of interest

All the authors declare that there are no conflicting issues related to this research article.

## Author contributions

A.M.: conceptualization, data collection, fieldwork, data curation, formal analysis, methodology, visualization, writing—original draft, writing—review and editing; A.K.: conceptualization, data collection, fieldwork; S.M.: conceptualization, data collection, fieldwork, writing—review and editing; S.S.: conceptualization, data collection, fieldwork, writing—review and editing.

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