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Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

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Cover: The nine vultures of India, digital art made on Krita by Dupati Poojitha.

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COMMUNICATION

Butterfly diversity in Jitpur Simara Sub-metropolitan City, Bara District, Nepal: a preliminary checklist

Alisha Mulmi [1], Prakriti Chataut [2] & Mahamad Sayab Miya [3]

[1,2] Institute of Forestry, Hetauda Campus, Tribhuvan University, Hetauda 44107, Nepal.
[3] Department of Biological Sciences, Western Kentucky University, Bowling Green, Kentucky 42101, USA.
[1] alishamulmi03@gmail.com, [2] prakritichataut232@gmail.com, [3] mahamad.miya440@topper.wku.edu (corresponding author)

Abstract: Butterflies are among the most charismatic creatures, a well-studied group of insects, and significant bioindicators of the terrestrial ecosystem. Despite several studies conducted in different regions of Nepal, research in the tropical areas remains sparse. Hence, this study aimed to prepare a checklist of butterflies in the tropical region of the Bara District, Nepal. We conducted opportunistic butterfly surveys using the checklist method over a complete annual cycle (May 2023-April 2024) across three habitat types: forests, agricultural lands, and human settlements. A total of 85 butterfly species from 66 genera belonging to six families were recorded. Among them, the Nymphalidae family was the richest in terms of species (*S* = 41), followed by Lycaenidae (*S* = 19), Pieridae (*S* = 12), Hesperiidae and Papilionidae (*S* = 6), and Riodinidae (*S* = 1). Among the recorded species, 12 are classified as Least Concern, and 73 are Not Evaluated, according to the IUCN Red List. The record of such a vast number of species from a small area underscores the importance of tropical regions for butterfly habitats. This study highlights the biodiversity value of the central Terai and provides a baseline for future research and conservation planning.

Keywords: Bio-indicator, butterfly survey, habitats, insect, Lepidoptera, Nymphalidae, tropical region.

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Author details: AM – bachelor's student at the Institute of Forestry, Hetauda Campus, Tribhuvan University, Nepal. She has been involved in insect diversity, bird, and other biodiversity monitoring projects. PC – bachelor's student at the Institute of Forestry, Hetauda Campus, Tribhuvan University, Nepal. She is engaged in butterfly and bird research projects. MSM – MS in Biology (Graduate Assistant), Western Kentucky University, KY, USA. He is currently a Research Assistant at the Department of Entomology and Plant Pathology, University of Arkansas, Fayetteville, AR, USA. His research focus includes insect biodiversity, phylogenetics, and systematics.

Author contributions: Alisha Mulmi: conceptualization, investigation, methodology, data curation, resources, validation, writing– original draft, review, and editing. Prakriti Chataut: investigation, writing– original draft, review, and editing. Mahamad Sayab Miya: supervision, methodology, formal analysis, validation, visualization, writing– original draft, review, and editing.

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INTRODUCTION

Butterflies are charismatic insects belonging to Lepidoptera, the second-largest insect order, which also comprises moths (Khan et al. 2023). Approximately 19,000 species of butterflies have been described worldwide (van Nieukerken et al. 2011). They play a crucial role in ecosystem functioning, especially in plant pollination and the food chain, serving as a food source for birds, amphibians, and reptiles (Tiple & Bhagwat 2023). Similarly, they function as important bio-indicators for terrestrial ecosystems because of their sensitivity to environmental changes such as habitat loss, fragmentation, disturbance, and climate change (Wilson & Maclean 2011; Syaripuddin et al. 2015; Ellis et al. 2019; Forsberg et al. 2020; Hill et al. 2021).

Butterflies are one of the most studied groups of insects worldwide (Pinkert et al. 2022). Tropical regions harbor the highest biodiversity, so the insect (Lepidoptera) diversity around the globe (Slade & Ong 2023), which is due to factors such as long evolutionary history, higher productivity, spatial heterogeneity, and increased ecological or niche specialization (Dyer et al. 2007; Ricklefs & Marquis 2012; Brown 2014). Although a large proportion of butterflies reside in the tropics, there is a notable deficiency in the study of tropical butterfly ecology and diversity compared to temperate butterflies, which hinders effective conservation efforts (Bonebrake et al. 2010; Pinkert et al. 2022). Local or regional studies can bridge the information gap and offer support for their conservation.

Nepal is home to 695 species of butterflies (Sajan et al. 2025) likely thriving due to its varied geography and climate, which ranges from tropical in the southern plains to tundra, and nival in the snow-covered north (Paudel et al. 2021). Studies on this group in Nepal are primarily focused on subtropical to temperate regions, such as (Miya et al. 2021; Subedi et al. 2021), with very little research in the tropical region (Khanal 2006, 2009; Suwal 2015; Tamang et al. 2019; Miya et al. 2025). Bara District, located in the tropical Terai region of Nepal, encompasses diverse habitats that potentially harbour a rich diversity of insects, including butterflies. To our knowledge, there is no published information on butterflies in the Bara District, which necessitates studies regarding this group in the region.

To document butterfly diversity, researchers employ various sampling techniques depending on study objectives and habitat characteristics. Those include the Pollard walk survey (Pollard 1977), point count (Henry et al. 2015), tapping & netting, mark-recapture (Kral et al. 2018), and, less frequently, the checklist method (Royer et al. 1998). Pollard walk and mark-recapture are popularly used for long-term monitoring of butterflies, while point count is suitable when other traditional methods are difficult to employ (Henry et al. 2015). In comparison, tapping & netting, as well as the checklist method, are more practical for the initial determination of the species (Royer et al. 1998). In the checklist method, a preliminary list of butterflies is prepared to mark the presence or absence, created based on the hypothetically complete list of regularly breeding resident species in the region (Royer et al. 1998).

Given the ecological importance of butterflies and the knowledge gap in Nepal's tropical lowlands, this study aimed to document butterfly diversity in Jitpur Simara Sub-metropolitan City of Bara District using a year-round checklist method. The resulting checklist serves as a foundational reference for future ecological studies and biodiversity monitoring in the region.

MATERIALS AND METHODS

Study area

The study was conducted in Jitpur Simara Sub-metropolitan City (JSSMC), Ward No. 1 Bara District, Nepal (Figure 1). The JSSMC covers an area of 311.67 km², and Ward No. 1, covers an area of 42.75 km². The sub-metropolitan city is situated between 26.850°–27.850° N, 84.850°–85.267° E, with an altitude ranging from 152–915 m. The study area encompasses three major land use types: forests, agricultural lands, and human settlements (JSSMC 2020). The forest of the Bara District is dominated by Sal *Shorea robusta*, along with the linear patches of riverine forests (Baral et al. 2022). The study area's fertile soil supports seasonal crops, primarily paddy in summer, and wheat & mustard in winter. The human settlement area includes home gardens with some seasonal flowers. The study area exhibits four distinct seasons: pre-monsoon (March–May), monsoon (June–September), post-monsoon (October–November), and winter (December–February), the four seasonal categories of Nepal. The region's average annual temperature is 24.5°C, with July being the hottest month at 36°C, and January the coldest at 8.6°C. Likewise, the average annual precipitation is 1,653 mm, with most of the rainfall occurring between mid-June and mid-July (>83%) (Baral et al. 2022).

Data collection

The study was conducted from May 2023–April 2024, covering all seasons of the year, with sampling occurring

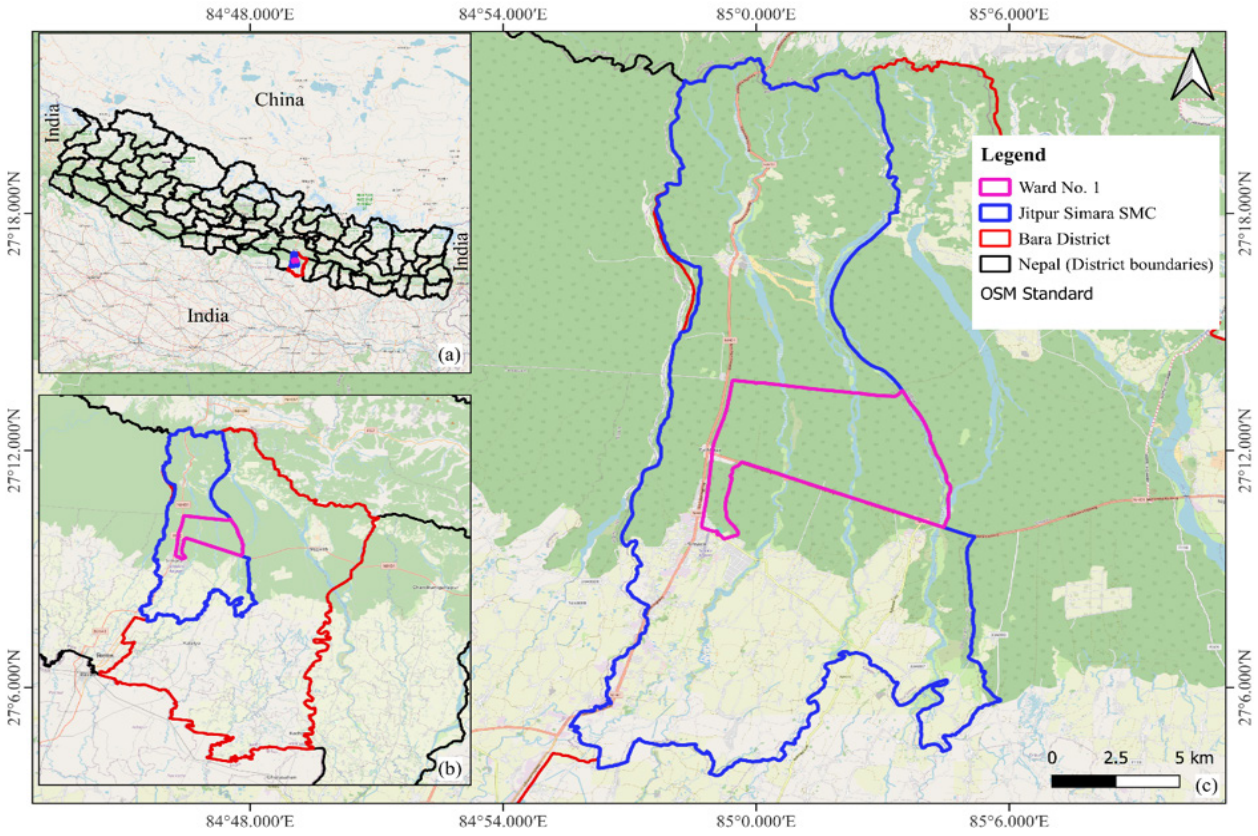

Figure 1. Study area map showing: a—District boundaries of Nepal | b—Bara District | c—Jitpur Simara Sub-metropolitan City with ward number one boundary.

twice a month. Using a checklist method, we documented butterflies to determine their presence in the region, serving as a baseline for future studies. Butterflies were opportunistically surveyed across three habitat types: forests, agricultural lands, and human settlements. Two observers explored the study area from 1000–1500 h on sunny days to maximize butterfly detection (Sajan & Sapkota 2024; Miya et al. 2025). This period is deemed appropriate for sampling butterflies because their activity is linked to the day's temperature (Wittman et al. 2017). We recorded the presence or absence of species, based on species expected to occur in central Terai, compiled from Smith (2011) and other regional records. The first author photographed all butterflies in natural settings using a Nikon Coolpix L340 camera to aid in identification. Initial field identifications of species were later verified through comparison with reference guides (Smith 2011; Smith et al. 2016), published literature (Tamang et al. 2019; Neupane & Miya 2021; Van der Poel & Smetacek 2022), internet sources, and consultation with expert lepidopterists when identification was uncertain.

Data analysis

We followed Van der Poel & Smetacek (2022) for the scientific name of the butterfly species. The IUCN status of butterflies is based on the IUCN Red List of Threatened Species (IUCN 2025).

RESULTS

A total of 85 butterfly species from 66 genera belonging to six families (Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, and Riodinidae) were recorded. Nymphalidae was the richest family with 41 species, followed by Lycaenidae (*S* = 19), Pieridae (*S* = 12), Papilionidae (*S* = 6), Hesperiidae (*S* = 6), and Riodinidae (*S* = 1) (Figure 2). The complete list of butterflies, including their families, scientific names, common names, and IUCN Red List status, is provided in Table 1. The butterfly images are shown in photo plates (Images 1–85). Among the total species, 12 are classified under the 'Least Concern' (LC) category of the Red List, while 73 were 'Not Evaluated' (NE) (Table 1).

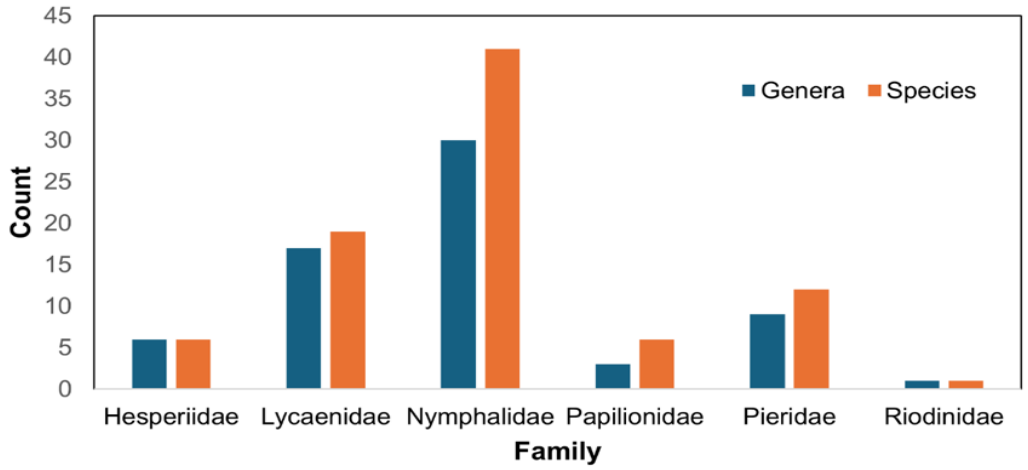

Figure 2. Family-wise distribution of butterfly genera and species in the study area.

DISCUSSION

In this study, we documented the butterfly fauna from a small region of the tropical climate of Nepal. The recorded species account for 12.23% of all butterfly species found in Nepal, reflecting their rich diversity in the study area. The species number in our study area is quite comparable to studies from similar climatic regions of Nepal. While our species richness was lower than the 133 species reported from the eastern lowland (Tamang et al. 2019) and central lowland Nepal (Hetuada; *S* = 115) (Miya et al. 2025), it exceeded findings from other tropical sites such as Parsa National Park (*S* = 31) (PNP 2018) and Surkhet District (*S* = 33) (Oli et al. 2023).

Among the six families recorded, Nymphalidae was the richest family in terms of species, followed by Lycaenidae. Nymphalidae is one of the most diverse families of butterflies, with more than 6,152 species distributed worldwide (van Nieukerken et al. 2011). Approximately, 34% of the butterflies found in Nepal belong to this group (Van der Poel & Smetacek 2022). Moreover, they are generalists with a large range of host plants and geographic ranges (Slove & Janz 2011; Nylin et al. 2014), which is also presumably favored by their large wingspan, active flight, and higher dispersal ability (Marini-Filho & Martins 2010; Freire et al. 2021). In our study, Nymphalidae represented 48.23% of the total species recorded, which aligns with global patterns, and reflects the ecological adaptability of this family to tropical environmental conditions.

Our findings are similar to studies from different locations of tropical regions of Nepal, such as Jhapa and Illam Districts (Tamang et al. 2019), Makwanpur District (Miya et al. 2025), Morang District (Subba & Tumbahangfe 2015), eastern Siwalik (Bhusal & Khanal 2009), and western lowlands (Khanal 2009). Similar findings were also noted in the subtropical region of Nepal in the Tanahun, Syangja, Kaski, and Kathmandu Districts (Miya et al. 2021; Neupane & Miya 2021; Subedi et al. 2021). Our findings also align with the butterfly studies conducted in Bhutan (Singh & Chib 2015) and India (Raut & Pendharkar 2010).

Species such as *Danaus chrysippus, Graphium nomius*, and *Papilio polytes* were the most common, while species like *Abisara bifasciata*, and *Junonia orithya* were rarely observed. Likewise, the checklist includes several butterfly species that are considered relatively uncommon in Nepal, such as *Arhopala eumolphus, Caleta decidia, Euripus consimilis,* and *Odontoptilum angulata*. This underlines the need for more detailed ecological studies and better protection of these habitats, especially in the central Terai, a region often underrepresented in butterfly research. Moreover, the conservation status assessment revealed that 14.12% are categorized as 'Least Concern' by Red List, while the majority (85.88%) remain 'Not Evaluated' (NE), highlighting significant knowledge gaps in butterfly conservation assessments for the region.

CONCLUSIONS

This study provided a preliminary checklist of butterflies from a small region of Jitpur Simara Sub-metropolitan City, central Terai, Nepal, comprising a total of 85 species belonging to six families. This finding highlights the significance of tropical regions of Nepal for butterfly diversity, emphasizing the need to conserve butterfly habitats in these areas. Nymphalidae was the richest family regarding the species, consistent with findings from similar or dissimilar climatic regions, denoting their adaptation to

Table 1. List of butterflies recorded in the study area with their family, scientific name, common name, and IUCN Red List status.

	Scientific name	Common name	IUCN Red List
	Family Hesperiidae		
1	*Badamia exclamationis* (Fabricius, 1775)	Brown Awl	NE
2	*Matapa aria* (Moore, 1866)	Common Red Eye	NE
3	*Odontoptilum angulata* (C. Felder, 1862)	Chestnut Angle	NE
4	*Parnara guttatus* (Bremer & Grey, 1852)	Straight Swift	NE
5	*Sarangesa dasahara* (Moore, 1866)	Common Small Flat	NE
6	*Spialia galba* (Fabricius, 1793)	Indian Skipper	NE
	Family Lycaenidae		
7	*Acytolepis puspa* (Horsfield, 1828)	Common Hedge Blue	NE
8	*Arhopala eumolphus* (Cramer, 1780)	Green Oakblue	NE
9	*Caleta decidia* (Hewitson, 1876)	Angled Pierrot	LC
10	*Castalius rosimon* (Fabricius, 1775)	Common Pierrot	NE
11	*Catochrysops strabo* (Fabricius, 1793)	Forget-me-not	NE
12	*Chilades lajus* (Stoll, 1780)	Lime Blue	NE
13	*Chliaria othona* (Hewitson, 1865)	Orchid Tit	NE
14	*Curetis acuta* (Moore, 1877)	Angled Sunbeam	NE
15	*Jamides alecto* (C. Felder, 1860)	Metallic Cerulean	NE
16	*Jamides celeno* (Cramer, 1775)	Common Cerulean	NE
17	*Lampides boeticus* (Linnaeus, 1767)	Pea Blue	LC
18	*Leptotes plinius* (Fabricius, 1793)	Zebra Blue	NE
19	*Luthrodes pandava* (Horsfield, 1829)	Plains Cupid	NE
20	*Poritia hewitsoni* (Moore, 1866)	Common Gem	NE
21	*Prosotas nora* (C. Felder, 1860)	Common Line Blue	NE
22	*Pseudozizeeria maha* (Kollar, 1844)	Pale Grass Blue	NE
23	*Rapala manea* (Hewitson, 1863)	Slate Flash	NE
24	*Rapala varuna* (Horsfield, 1829)	Indigo Flash	NE
25	*Surendra quercetorum* (Moore, 1858)	Common Acacia Blue	NE
	Family Nymphalidae		
26	*Acraea violae* (Fabricius, 1793)	Tawny Coster	NE
27	*Aglais caschmirensis* (Kollar, 1844)	Indian Tortoiseshell	NE
28	*Ariadne merione* (Cramer, 1777)	Common Castor	NE
29	*Athyma nefte* (Cramer, 1780)	Color Sergeant	NE
30	*Athyma perius* (Linnaeus, 1758)	Common Sergeant	NE
31	*Charaxes bernardus* (Fabricius, 1793)	Tawny Rajah	NE
32	*Cupha erymanthis* (Drury, 1773)	Rustic	NE
33	*Cynitia lepidea* (Butler, 1868)	Grey Count	NE
34	*Cyrestis thyodamas* (Boisduval, 1846)	Common Map	NE
35	*Danaus chrysippus* (Linnaeus, 1758)	Plain Tiger	LC
36	*Danaus genutia* (Cramer, 1779)	Common Tiger	NE
37	*Discophora sondaica* (Boisduval, 1836)	Common Duffer	NE
38	*Elymnias hypermnestra* (Linnaeus, 1763)	Common Palmfly	NE
39	*Euploea core* (Cramer, 1780)	Common Indian Crow	LC
40	*Euripus consimilis* (Westwood, 1850)	Painted Courtesan	NE
41	*Euthalia aconthea* (Cramer, 1777)	Common Baron	NE
42	*Hypolimnas bolina* (Linnaeus, 1758)	Great Eggfly	NE
43	*Junonia almana* (Linnaeus, 1758)	Peacock Pansy	LC
44	*Junonia atlites* (Linnaeus, 1763)	Grey Pansy	NE
45	*Junonia iphita* (Cramer, 1779)	Chocolate Pansy	NE
46	*Junonia lemonias* (Linnaeus, 1758)	Lemon Pansy	NE
47	*Junonia orithya* (Linnaeus, 1758)	Blue Pansy	LC
48	*Kallima inachus* (Boisduval, 1846)	Orange Oakleaf	NE
49	*Kaniska canace* (Linnaeus, 1763)	Blue Admiral	NE
50	*Lethe europa* (Fabricius, 1775)	Bamboo Treebrown	NE
51	*Melanitis leda* (Linnaeus, 1758)	Common Evening Brown	LC
52	*Melanitis phedima* (Cramer, 1780)	Dark Evening Brown	NE
53	*Moduza procris* (Cramer, 1777)	Commander	NE
54	*Mycalesis mineus* (Linnaeus, 1758)	Dark-brand Bushbrown	NE
55	*Mycalesis perseus* (Fabricius, 1775)	Common Bushbrown	NE
56	*Mycalesis visala* (Moore, 1858)	Long-brand Bushbrown	NE
57	*Neptis hylas* (Linnaeus, 1758)	Common Sailer	NE
58	*Neptis soma* (Moore, 1858)	Creamy Sailer	NE
59	*Orsotriaena medus* (Fabricius, 1775)	Jungle Brown	NE
60	*Pantoporia hordonia* (Stoll, 1790)	Common Lascar	NE
61	*Parantica aglea* (Stoll, 1782)	Glassy Tiger	NE
62	*Phalanta phalantha* (Drury, 1773)	Common Leopard	LC
63	*Vagrans egista* (Cramer, 1780)	Vagrant	NE
64	*Vanessa indica* (Herbst, 1794)	Indian Red Admiral	NE
65	*Ypthima baldus* (Fabricius, 1775)	Common Five-ring	NE
66	*Ypthima huebneri* (Kirby, 1871)	Common Four-ring	NE
	Family Papilionidae		
67	*Graphium doson* (C. & R. Felder, 1864)	Common Jay	NE
68	*Graphium nomius* (Esper, 1799)	Spot Swordtail	NE
69	*Pachliopta aristolochiae* (Fabricius, 1775)	Common Rose	LC
70	*Papilio clytia* (Linnaeus, 1758)	Common Mime	NE
71	*Papilio demoleus* (Linnaeus, 1758)	Lime Swallowtail	NE
72	*Papilio polytes* (Linnaeus, 1758)	Common Mormon	NE

	Scientific name	Common name	IUCN Red List
	Family Pieridae		
73	*Appias lalage* (Doubleday, 1842)	Spot Puffin	NE
74	*Appias libythea* (Fabricius, 1775)	Striped Albatross	NE
75	*Belenois aurota* (Fabricius, 1793)	Pioneer	LC
76	*Catopsilia pomona pomona* (Fabricius, 1775)	Lemon Emigrant	NE
77	*Delias hyparete* (Linnaeus, 1758)	Painted Jezebel	NE
78	*Delias pasithoe* (Linnaeus, 1767)	Red-base Jezebel	NE
79	*Eurema blanda* (Boisduval, 1836)	Three-spot Grass Yellow	NE
80	*Eurema hecabe* (Linnaeus, 1758)	Common Grass Yellow	LC
81	*Leptosia nina* (Fabricius, 1793)	Psyche	NE
82	*Pareronia hippia* (Fabricius, 1787)	Indian Wanderer	NE
83	*Pieris canidia* (Linnaeus, 1768)	Indian Cabbage White	NE
84	*Pontia daplidice* (Linnaeus, 1758)	Bath White	LC
	Family Riodinidae		
85	*Abisara bifasciata* (Moore, 1877)	Double-banded Judy	NE

a wide range of habitats, and climate. This checklist will serve as an essential reference for future research in the region. We recommend: (1) expanding sampling efforts to nearby areas to capture landscape-level patterns in butterfly diversity, (2) incorporating standardized measures of abundance in future research, and (3) examining host plant relationships to better understand butterfly habitat requirements and inform conservation planning.

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Image 1–20. 1—Brown Awl | 2—Common Red-eye | 3—Chestnut Angle | 4—Straight Swift | 5—Common Small Flat | 6—Indian Skipper | 7—Common Hedge Blue | 8—Green Oakblue | 9—Angled Pierrot | 10—Common Pierrot | 11—Forget-me-not | 12—Lime Blue | 13—Orchid Tit | 14—Angled Sunbeam | 15—Metallic Cerulean | 16—Common Cerulean | 17—Peablue | 18—Zebra Blue | 19—Plains Cupid | 20—Common Gem. © Alisha Mulmi.

Image 21–40. 21—Common Lineblue | 22—Pale Grass Blue | 23—Slate Flash | 24—Indigo Flash | 25—Common Acacia Blue | 26—Tawny Coster | 27—Indian Tortoiseshell | 28—Common Castor | 29—Color Sergeant | 30—Common Sergeant | 31—Tawny Rajah | 32—Rustic | 33—Grey Count | 34—Common Map | 35—Plain Tiger | 36—Common Tiger | 37—Common Duffer | 38—Common Palmfly | 39—Common Indian Crow | 40—Painted Courtesan. © Alisha Mulmi.

Image 41–60. 41—Common Baron | 42—Great Eggfly | 43—Peacock Pansy | 44—Grey Pansy | 45—Chocolate Pansy | 46—Lemon Pansy | 47—Blue Pansy | 48—Orange Oakleaf | 49—Blue Admiral | 50—Bamboo Treebrown | 51—Common Evening Brown | 52—Dark Evening Brown | 53—Commander | 54—Dark-brand Bushbrown | 55—Common Bushbrown | 56—Long-brand Bushbrown | 57—Common Sailer | 58—Creamy Sailer | 59—Jungle Brown | 60—Common Lascar. © Alisha Mulmi.

Image 61–80. 61—Glassy Tiger | 62—Common Leopard | 63—Vagrant | 64—Indian Red Admiral | 65—Common Five-ring | 66—Common Four-ring | 67—Common Jay | 68—Spot Swordtail | 69—Common Rose | 70—Common Mime | 71—Lime Swallowtail | 72—Common Mormon | 73—Spot Puffin | 74—Striped Albatross | 75—Pioneer | 76—Lemon Emigrant | 77—Painted Jezebel | 78—Red-base Jezebel | 79—Three-spot Grass Yellow | 80—Common Grass Yellow. © Alisha Mulmi.

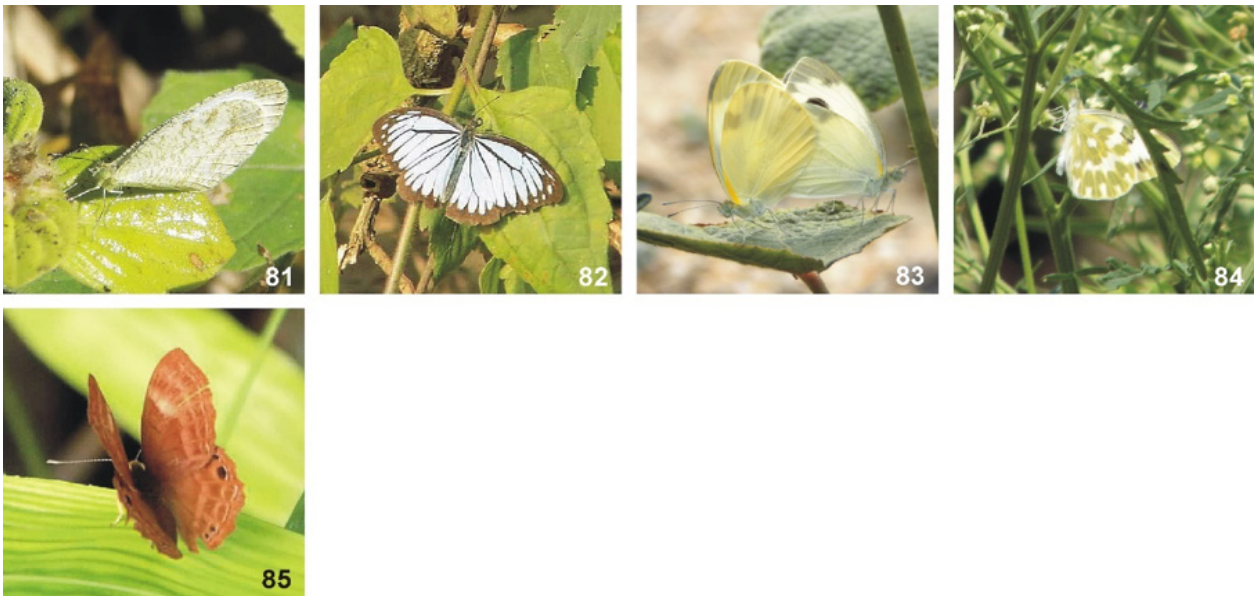

Image 81–85. 81—Psyche | 82—Indian Wanderer | 83—Indian Cabbage White | 84—Bath White | 85—Double-banded Judy. © Alisha Mulmi.

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