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RESEARCH

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Diversity and species richness of butterfly in soraipung range of Dehing Patkai National Park, Assam, India

Renu Gogoi[1*], Abhijit Chetry[2] and Anubhav Bhuyan[3]

Abstract

Background The present study deals with the butterfly diversity in Soraipung Range of Dehing Patkai National Park. The site was chosen on the basis that it lies in between Eastern Himalaya and Indo-Burma which is acclaimed as global biodiversity hotspot.

Results A total of 92 butterfly species belonging to 5 families were recorded during the study of which 13 species were listed as protected under various schedules of the Indian Wildlife (Protection) Act, 1972 and 11 species were restricted to the Eastern Himalaya, India. Members of the Nymphalidae family were found to be dominant with (41) number of species followed by Papilionidae (17), Lycaenidae (16), Hesperiidae (10) and the least Pieridae (8). The maximum diversity is obtained in Nymphalidae family: where Shannon–Wiener Diversity Index (H′) is 3.604584 and Evenness (E) is 0.970651 while the minimum diversity is in Pieridae family where Shannon–Wiener Diversity Index (H′) is 1.936217 and Evenness (E) is 0.970651.

Conclusions The study reveals that Soraipung range is rich in butterfly diversity but on the contrary their study is poorly documented. During the survey 13 threatened species and 11 species restricted to the Eastern Himalaya have been also documented in the National Park, thus making it an important butterfly habitat in the state. Therefore, its necessary to conduct more study as well as research on the butterflies in Dehing Patkai National Park for effective conservation and management programs.

Keywords Dehing-Patkai, Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, Soraipung

Background

Dehing Patkai National Park is located in the districts of Dibrugarh and Tinsukia that interspersed with semi-evergreen deciduous vegetation and lush green flora, the only patch of rainforest in Assam. The region represents an important part of Indo Myanmar bio-diversity hotspots and considered as the most species-rich regions in the Indian Sub-continent. The species richness and endemism make this an important region for butterfly diversity and conservation in India (Gogoi, 2013). Area rich in butterfly are often rich in other fauna too. Butterfly is the nature jewel, distributed worldwide with different ecological functions. They are indicator of healthy environment (Ghazanfar et al. 2016). Their vulnerability makes them quick to react to change in environment. This specificity to vegetation type, worldwide distribution, rapid response to climate change makes them a useful organism to monitor environmental changes (Gowda et al., 2011). Their caterpillars are important source of food for higher life forms like birds, lizards and other

*Correspondence:
Renu Gogoi
renugogoi39@gmail.com
[1] Department of Zoology, Cotton University, Guwahati, Assam 781001, India
[2] Department of Biotechnology, Gauhati University, Guwahati, Assam 781014, India
[3] Department of Animal Ecology and Wildlife Biology, Gauhati University, Guwahati, Assam 781014, India

insectivorous animal. They are pollinators of a large number of flowering plants, thus serve a wide range of environmental benefits (Losey & Vaughan, 2006). Some butterfly larvae feed on pest like aphids as a result their caterpillars also serve as important biological pest control (Ehrlich, 1984). Butterfly is classified into two superfamilies; Hesperioidea, consisting of a single family Hesperiidae and Papilionoidea, having four families: Papilionidae (Swallowtails), Pieridae, Nymphalidae (Brush-footed butterflies) and Lycaenidae (Kehmikar, 2008). Among the 5 families, the most diverse species of butterfly were belonging to Nymphalidae family followed by Hesperidae, Pieridae and Lycaenidae respectively (Leon-Cortes et al., 2019).

There is a need for the regular monitoring and documentation of butterfly species from the Dehing Patkai National Park as monitoring of species diversity enables estimation of the prospective functional roles of the species. This can also be used as a tool to reduce human mismanagement and pollution in urbanized, protected, industrial and managed areas (Wilson 1997). In previous study, 237–292 species of butterflies were observed from Dehing Patkai National Park earlier known as Jeypore-Reserve Forest along with a large number of very rare species like Indian Yellow-Vein Lancer *Pyroneura margherita* (Butler, 1879), Bi-coloured Hedge blue *Udara selma cerima* (Corbet, 1937), Snowy Angle *Darpa pteria* (Hewitson, 1868) (Gogoi, 2013; Karthikeyan & Venkatesh, 2011; Singh, 2015). Despite of rich biodiversity Dehing Patkai is less explored as well as recent studies were not recorded; hence the present study was undertaken to document the number of butterflies with special reference to their conservation status.

Methods

Study Area

Soraipung is a small part or the main access point of the Dehing Patkai National Park. It was earlier known as Dehing Patkai Wildlife Sanctuary, recently on 09 June 2021 it is upgraded as National Park by the Forest Department of Assam. The park is located in the Dibrugarh and Tinsukia districts of Assam with an area of 231.65 km^2 rainforest and lies between latitudes- 27°17′53″N and longitudes 95°30′59″E. The climate of the study area is characterized by annual rainfall of more than 4,000 mm. The region supports a rich faunal, avifaunal and floral diversity because of its annual rainfall and diverse vegetation. The vegetation is characterized by trees like *Dipterocarpus retusus* that dominates the emergent layer of this rainforest and different flowering plants like *Mesua ferrea, Amoora wallichi, Dysoxylum binectiferum, Dipterocarpus macrocarpus* etc.

Methods of study

Random surveys and Line transect method of Pollard was used for sampling butterflies and to collect necessary study data (Pollard, 1977). Pollard walk was done by walking for one hour on each transact line using a nylon rope within a fixed distance—2.5 m either side of the transect line and 5 m ahead also recorded all butterfly seen inside the area of trails. For Sampling designing altogether five belt transects (TI. T2. T3, T4, T5) were laid down along with fourteen-point count centers (S1. S2. S3. S4, S5. S6. S7, S8, S9, S10, S11, S12, S13, S14). Sampling site were surveyed for a total of five times, thrice in the morning and twice in the evening hours.

Common butterflies were identified on the spot during sampling or by taking photos with the help of camera. Colour patterns, sizes and shapes as well as their designs were considered in identification of the species of butterfly with the help available literature as well as photographs described by (Evans, 1932; Kehmikar, 2008; Kumar et al., 2016; Kunte, 1997; Sunil et al., 2016).

Data analysis

The numbers of species present in each of the four families is considered as the species richness. Species diversity was calculated using Shannon Diversity index $H' = -\sum Pi \ln(Pi)$.

where, Pi = Proportion of the ith species.

ln = Natural logarithm of Pi.

Species evenness were calculated using the formula; $J = H'/\ln(s)$.

where, H' = Value of Shannon–Wiener index.

ln s = The natural log of the species richness (total number of species).

Results

Lepidopteran butterflies as a nature jewel occupies a vital place in the ecosystem. The result reveals a total of 92 species belonging to 5 families in the Soraipung range of Dehing Patkai National Park. Among the five families, Nymphalidae were found to be dominant with 41 (45%) number of species, followed by Papilionidae 17(18%), Lycaenidae 16 (17%), Hesperidae 10 (11%) and least Pieridae 8(9%) (Table 1), (Fig. 1). Diversity in term of number of species represent the Shannon-Weiner Diversity Index (H') of the butterfly families Nymphalidae, Lycaenidae, Papilionidae, Pieridae, Hesperiidae 3.604584, 2.590941, 2.68954, 1.936217, 2.208639 respectively. The evenness of the species belonging to the five families was calculated through Pielou's Evenness Index and the value was found in between 0.93–0.97 which is a good indication for the ecosystem (Table 2).

Table 1 List of butterfly species reported in Dehing Patkai National Park, Assam

Serial No	Common Name	Scientific Name	Restricted species of Eastern Himalaya
Family: Nymphalidae			
1	Autumn Leaf	*Doleschallia bisaltide indica* (Moore, 1899)	
2	Indian Oakleaf	*Kallima inachus inachus* (Doyere, 1840)	
3	Myanmarese Wizard	*Rhinopalpa Polynice birmana* (Fruhstorfer, 1898)	Endemic
4	Common Leopard	*Phalantha phalantha phalantha* (Drury, 1773)	
5	Black Vein Sergeant	*Athyma ranga ranga* (Moore, 1858)	
6	Common Sergeant	*Athyma perius perius* (Linnaeus, 1758)	
7	Colour Sergeant	*Athyma inara inara* (Westwood, 1850)	
8	Staff Sergeant	*Athyma selenophora bahula* (Moore, 1858)	
9	Orange Staff Sergeant	*Athyma cama cama* (Moore, 1858)	
10	Common Duffer	*Discophora sondaica zal* (Westwoot, 1851)	Endemic
11	Oriental Commander	*Moduza procris procris* (Cramer, 1777)	
12	Green Commodore	*Sumalia daraxa daraxa* (Doubleday, 1848)	Endemic
13	Common Nawab	*Charaxes bharata* (Felder, 1867)	
14	Peacock Pansy	*Junonia almana almana* (Linnaeus, 1758)	
15	Grey Pansy	*Precis atlites atlites* (Linnaeus, 1763)	
16	Lemon Pansy	*Junonia lemonias lemonias* (Linnaeus, 1758)	
17	Common Palmfly	*Elymnias hypermnestra undularis* (Linnaeus, 1763)	
18	Jezebel Palmfly	*Elymnias Vasudeva* (Moore, 1858)	
19	Spotted Palmfly	*Elymnias malelas malelas* (Hewitson, 1863)	
20	Peal's Palmfly	*Elymnias pealii* (Wood-Mason, 1883)	Endemic
21	Common Indian Crow	*Euploea core core* (Cramer, 1780)	
22	Magpie Crow	*Euploea radamanthus radamanthus* (Febricius, 1793)	
23	Common Sailer	*Neptis hylas varmona* (Moore, 1872)	
24	Plain Sailer	*Neptis cartica cartica* (Moore, 1872)	Endemic
25	Short Banded Sailer	*Phaedyma columella ophiana* (Moore, 1872)	
26	Dingiest Sailer	*Neptis harita harita* (Moore, 1875)	Endemic
27	Small Yellow Sailer	*Neptis miah miah* (Moore, 1858)	
28	Oriental Great Eggfly	*Hypolimnus bolina jacintha* (Drury, 1773)	
29	Large Yeoman	*Cirrochroa aoris aoris* (Doubleday, 1847)	
30	Variable Tawny Rajah	*Charaxes bernardus hierax* (C. & R. Felder, 1793)	
31	Common Bushbrown	*Mycalesis perseus blasius* (Febricius, 1793)	
32	Plain Bushbrown	*Telinga malsarida* (Butler, 1868)	Endemic
33	Wavy Maplet	*Chersonesia intermedia rahrioides* (Moore, 1899)	Endemic
34	Plain Tiger	*Danaus chrysippus chrysippus* (Linnaeus, 1758)	
35	Striped Tiger	*Danaus genutia genutia* (Cramer, 1779)	
36	Glassy Tiger	*Parantica aglea melanoides* (Moore, 1883)	
37	Common Evening Brown	*Melanitis leda leda* (Linnaeus, 1758)	
38	Great Evening Brown	*Melanitis zitenius zitenius* (Herbst, 1796)	
39	Common Five Ring	*Ypthima baldus baldus* (Febricius, 1775)	
40	Common Mapwing	*Cyrestis thyodamas indica* (Evan, 1924)	
41	Common Baron	*Euthalia aconthea garuda* (Moore, 1858)	
Family: Lycaenidae			
42	Dark Grass Blue	*Zizeeria karsandra* (Moore, 1865)	
43	Indian Lesser Grass Blue	*Zizina Otis indica* (Murray, 1874)	
44	Pea Blue	*Lampides boeticus* (Linnaeus, 1767)	
45	Pale Grass Blue	*Pseudozizeeria maha maha* (Kollar, 1844)	
46	Long-tailed Blue	*Lampides boeticus* (Linnaeus, 1767)	
47	Lime Blue	*Chilades lajus lajus* (Stoll, 1780)	
48	Common Pierrot	*Castalius rosimon rosimon* (Febricius, 1775)	

Table 1 (continued)

Serial No	Common Name	Scientific Name	Restricted species of Eastern Himalaya
49	Elbowed Pierrot	*Caleta elna noliteia* (Fruhstorfer, 1918)	
50	Himalayan Purple Sapphire	*Heliophorus epicles latilimbata* (Fruhstorfer, 1908)	
51	Dark Sapphire	*Heliophorus indicus* (Fruhstorfer, 1908)	
52	Plain Hedge Blue	*Celastrina lavendularis limbatus* (Moore, 1879)	
53	Hill Hedge Blue	*Celastrina argiolus iynteana* (de Niceville, 1884)	Endemic
54	Hedge Blue	*Acytolepis puspa gisca* (Fruhstorfer, 1910)	
55	Banded Silverline	*Spindasis lohita himalayanus* (Moore, 1884)	
56	Bright Sunbeam	*Curetis bulis bulis* (Westwood, 1851)	
57	Common Yamfly	*Loxura atymnus atymnus* (Stoll, 1780)	
Family: Pieridae			
58	Indian Cabbage White	*Pieris canidia indica* (Evans, 1926)	
59	Common Grass Yellow	*Eurema hecabe hecabe* (Linnaeus, 1758)	
60	One Spot Grass Yellow	*Eurema andersonii jordani* (Moore, 1886)	
61	Common Emigrant	*Catopsilia pomona pomona* (Febricius, 1775)	
62	Mottled Emigrant	*Catopsilia pyranthe pyranthe* (Linnaeus, 1758)	
63	Red Base Jezebel	*Delias pasithoe pasithoe* (Linnaeus, 1767)	
64	Great Orange Tip	*Hebomoia glaucippe glaucippe* (Linnaeus, 1758)	
65	Indian Orange Albatross	*Appias galba* (Wallance, 1867)	
Family: Papilionidae			
66	Five Bar Swordtail	*Graphium antiphates nebulosus* (Butler, 1881)	
67	Great Jay	*Graphium eurypylus acheron* (Moore, 1885)	
68	Common Jay	*Graphium doson axionides* (Page & Treadaway, 2014)	
69	Common Blue Bottle	*Graphium sarpedon sarpedon* (Linnaeus, 1758)	
70	Common Rose	*Pachliopta aristolochiae aristolochiae* (Febricius, 1775)	
71	Common Batwing	*Atrophaneura varuna astroion* (Westwood, 1842)	
72	Lesser Batwing	*Atrophaneura aidoneus* (Doubleday, 1845)	
73	Common Mormon	*Papilio polytes romulus* (Cramer, 1775)	
74	Common Windmill	*Byasa polyeuctes polyeuctes* (Doubleday, 1842)	
75	Lime Swallowtail	*Papilio demoleous demoleous* (Linnaeus, 1758)	
76	Paris Peacock	*Papilio paris paris* (Linnaeus, 1758)	
77	Common Peacock	*Papilio polyctor ganesa* (Doubleday, 1842)	
78	Red Helen	*Papilio helenus helenus* (Linnaeus, 1758)	
79	Yellow Helen	*Papilio nephelus* (Boisduval, 1836)	Endemic
80	White Dragontail	*Lamproptera curius curius* (Febricius, 1787)	Endemic
81	Spangle	*Papilio protenor eurotenor* (Fruhstorfer, 1908)	
82	Lesser Zebra	*Graphium marareus indicus* (Rothschild, 1895)	
Family:Hesperiidae			
83	Grey Branded Redeye	*Matapa druna* (Moore, 1866)	
84	Common Branded Redeye	*Matapa aria* (Moore, 1866)	
85	Indian Dart	*Potanthus pseudomaesa* (Moore, 1881)	
86	Wax Dart	*Cupitha purreea* (Moore, 1877)	
87	Common Palm Dart	*Telicota colon colon* (Febricius, 1775)	
88	Common Snow Flat	*Tagiades japetus ravi* (Moore, 1866)	
89	Small Green Awlet	*Burara amara* (Moore, 1866)	
90	Common Orange Awlet	*Burara jaina jaina* (Moore, 1866)	
91	Small Banded Swift	*Pelopidas mathias mathias* (Febricius, 1798)	
92	Large Banded Swift	*Pelopidas assamensis* (de Niceville, 1882)	

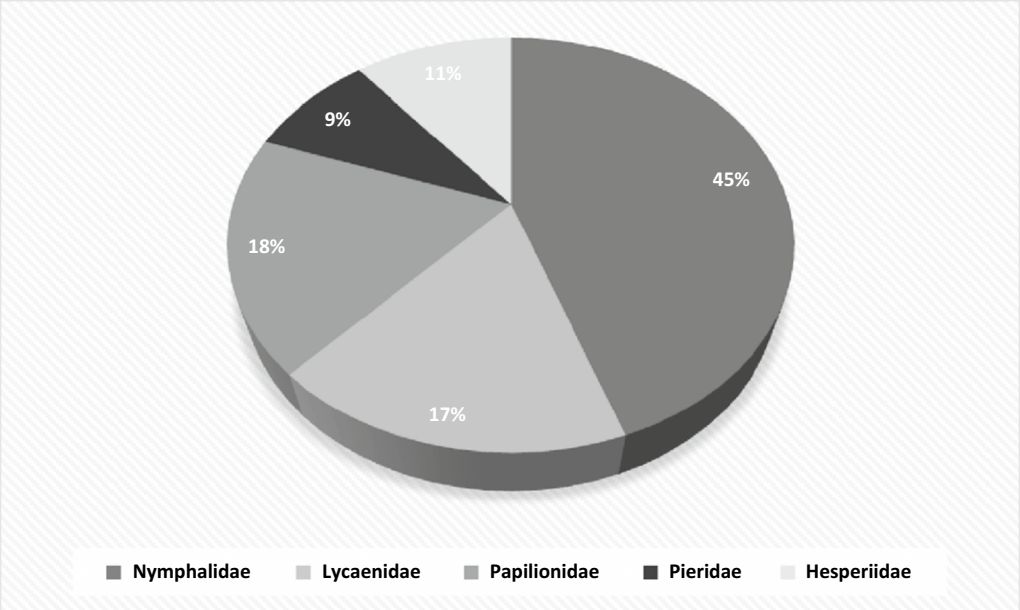

Fig. 1 Percentage occurrence of butterfly species under different families

Table 2 Species richness in term of number of species, Shannon-Weiner Diversity Index (H′) and Evenness (E) of the Butterfly families observed at Dehing Patkai National Park

Family	Number of species	Number of individual	Shannon-Weiner diversity index (H′)	Pielou's Evenness index (E)
Nymphalidae	41	143	3.604584	0.970651
Lycaenidae	16	42	2.590941	0.934484
Papilionidae	17	38	2.68954	0.94929
Pieridae	8	26	1.936217	0.931123
Hesperiidae	10	23	2.208639	0.9592

From the survey it was also reported that 11 species of butterflies were restricted to the Eastern Himalaya, India viz. *Rhinopalpa Polynice birmana* (Fruhstorfer, 1898), *Discophora sondaica zal* (Westwoot, 1851), *Sumalia daraxa daraxa* (Doubleday, 1848), *Elymnias pealii* (Wood-Mason, 1883), *Neptis cartica cartica* (Moore, 1872), *Neptis harita harita* (Moore, 1875), *Telinga malsarida* (Butler, 1868), *Chersonesia intermedia rahrioides* (Moore, 1899), *Celastrina argiolus iynteana* (de Niceville, 1884), *Papilio nephelus* (Boisduval, 1836) and *Lamproptera curius curius* (Febricius, 1787). On the basis of level of protection provided by Indian Wildlife Protection Act, 1972. 13 species were recorded from the study area belong to different Schedules of the act viz. *Elymnias pealii* Schedule-I, *Acytolepis puspa gisca* Schedule-I, *Discophora sondaica zal* Schedule-I, *Spindasis lohita himalayanus* (Moore, 1884) Schedule-II, *Melanitis zitenius zitenius* Schedule-II, *Elymnias vasudeva* Schedule-II, *Athyma ranga ranga* Schedule-II, *Charaxes bernardus hierax* Schedule-II, *Chersonesia intermedia rahrioides* Schedule-II, *Rhinopalpa Polynice birmana* Schedule-II, *Euploea radamanthus radamanthus* Schedule-IV, *Pelopidas assamensis* Schedule-IV and *Appias galba* Schedule-IV (Table 3).

Discussion

During the study a total of 92 species belonging to 5 butterfly families were reported of which family Nymphalidae is found to be dominant with 41 numbers of species. Species belonging to family Nymphalidae were abundant not only in Dehing Patkai National Park but also in other parts. Such as in Dibru-Saikhowa biosphere reserve 45 number of Nymphalidae species were reported followed by Lycaenidae (21), Pieridae (17), Papilionidae (15) and Hesperiidae (7) (Joshi & Dhyani, 2014). 22 Nymphalidae species of over 89 individuals found to be the most abundant family reported in Rowa Wildlife Sanctuary, Tripura (Lodh & Agarwala, 2016). A total of 158 butterfly species were observed in Titabar, Jorhat, Assam, out of which 61 butterflies belongs to Nymphalidae family, 38 Lycaenidae, 29 Hesperiidae, 17 Pieridae, 11 Papilionidae and two from family Riodinidae (Konwar & Bortamuly, 2021). 252 species were recorded from Manas World Heritage Site of which Nymphalidae was found to be dominant with 101 species followed by Lycaenidae 63, Hesperiidae 35, Pieridae 27, Papilionidae 24 and

Riodinidae 2 (Bhattacharjee & Ahmed, 2020). Species richness and butterfly diversity in the Trishna Wildlife Sanctuary in Tripura showed the presence of 59 species of butterflies that included 21 distinctive species and 9 species included in the threatened category (Majumder et al., 2012). Islam et al., (2022) reported a total of 150 species of butterflies belonging to six families viz., Nymphalidae (44.89%), Lycaenidae (23.12%), Pieridae (12.24%), Hesperidae (10.20%), Papilionidae (8.16%) and Riodinidae (1.36%) in the Raimona National Park, Assam. Chahar et al. (2021) reported a total of 39 species of butterflies belonging to five families of which family Nymphalidae is the dominating family with 14 species. The area has cultivated and wild plants which serve as host plant for laying the eggs and nectar plants for nectar in NES Ratnam College campus and Kukreja residential complex, Mumbai. Maximum number of species with dominant diversity were reported in family Nymphalidae (n = 14, H = 2.33, D = 8.81) while least in family Hesperidae (n = 3, H = 1.04, D = 2.67) in the campus of Cotton University, Assam, India (Bishaya et al., 2021). In North-East India, many of the biodiversity rich area are yet to be explored for records of fauna and flora including insect diversity, which represent a major proportion of the faunal diversity of tropical forests (Clark & May, 2002; Lewis & Basset, 2005; Losey & Vaughan, 2006). Earlier a total of 292 species of butterflies were recorded from Joypure Reserve Forest (Gogoi, 2013). This may be because the area is lies in the foothills of Patkai-Bum hill ranges of Arunachal Pradesh which is likely to influence the bio-geographic pattern of many Malayan butterflies in Northeastern India (Evans, 1932; Watt & Boggs, 2003). Butterflies are important model group in ecology and conservation they perform different ecological services such as pollination, nutrient decomposition, good indicators of the ecosystem health etc. (Koh, 2007; Kunte, 1997; Majumder et al., 2012). 6 numbers of rare species were also found in Dehing Patkai during the study period viz. *Rhinopalpa Polynice birmana* (Fruhstorfer, 1898), *Athyma ranga ranga* (Moore, 1858), *Telinga malsarida* (Butler, 1868), *Chersonesia intermedia rahrioides* (Moore, 1899), *Eurema andersonii jordani* (Moore, 1886) and *Atrophaneura aidoneus* that are similarly reported by (Gogoi, 2013; Watt & Boggs, 2003). As the study area harbors different species of rare and endemic butterflies, the Dehing Patkai National Park can be an important site for the Conservation of butterflies. Some of the common or restricted butterflies which were observed in the study area are given in (Fig. 2). During study different forms of *Kallima inachus inachus* (Doyere, 1840) and *Catopsilia pyranthe pyranthe* (Linnaeus, 1758) as well as different species of genus *Elymnias, Athyma, Junonia, Heliophorus* and *Papilio* were also recorded. Many of the species

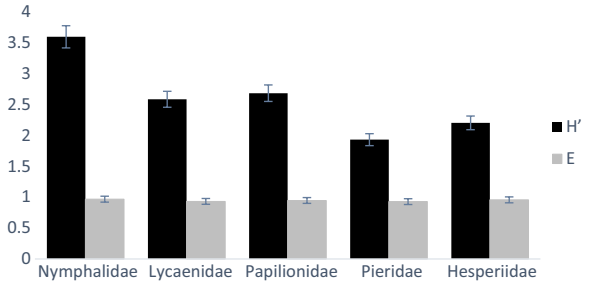

Fig. 2 Shannon-Weiner Diversity Index (H′) and Evenness (E) of the Butterfly families observed at Dehing Patkai National Park

Table 3 Species protected under Indian Wildlife (Protection) act, 1972

Scientific name	Source	Status
Elymnias pealii	IWPA	Schedule I (Part IV)
Acytolepis puspa gisca	IWPA	Schedule I
Discophora sondaica zal	IWPA	Schedule I (Part IV)
Spindasis lohita himalayanus (Moore, 1884)	IWPA	Schedule II
Melanitis zitenius zitenius	IWPA	Schedule II (Part II)
Elymnias vasudeva	IWPA	Schedule II (Part II)
Athyma ranga ranga	IWPA	Schedule II
Charaxes bernardus hierax	IWPA	Schedule-II
Chersonesia intermedia rahrioides	IWPA	Schedule-II
Rhinopalpa polynice birmana	IWPA	Schedule-II
Euploea radamanthus radamanthus	IWPA	Schedule-IV
Pelopidas assamensis	IWPA	Schedule-IV
Appias galba	IWPA	Schedule-IV

IWPA Indian wildlife (protection) act, 1972

shows a sexual dimorphism such as in *Hypolimnus bolina jacintha* (Drury, 1773). This phenomenon is probably influence by underlying genetic architecture responsible for sex limited expression (Oliver & Monteiro, 2010).

Among the families, the maximum species richness is obtained in Nymphalidae family: where Shannon–Wiener Diversity Index (H) is 3.604584 and Evenness is 0.970651 while the minimum is in Pieridae where Shannon–Wiener Diversity Index (H) is 1.936217 and Evenness is 0.970651. The result indicating that the study area is more diverse of species of butterfly. Variety of microhabitats and vegetation for the butterflies might be the reasons for the occurrence of good number of species richness and diversity (Sreekumar & Balakrishna, 2001). Moreover, the Shannon Evenness (E) revealed that the distribution of butterfly species of five families was almost of the same or even ranges from (0.93 to 0.97) (Table 2). Similar, result reported

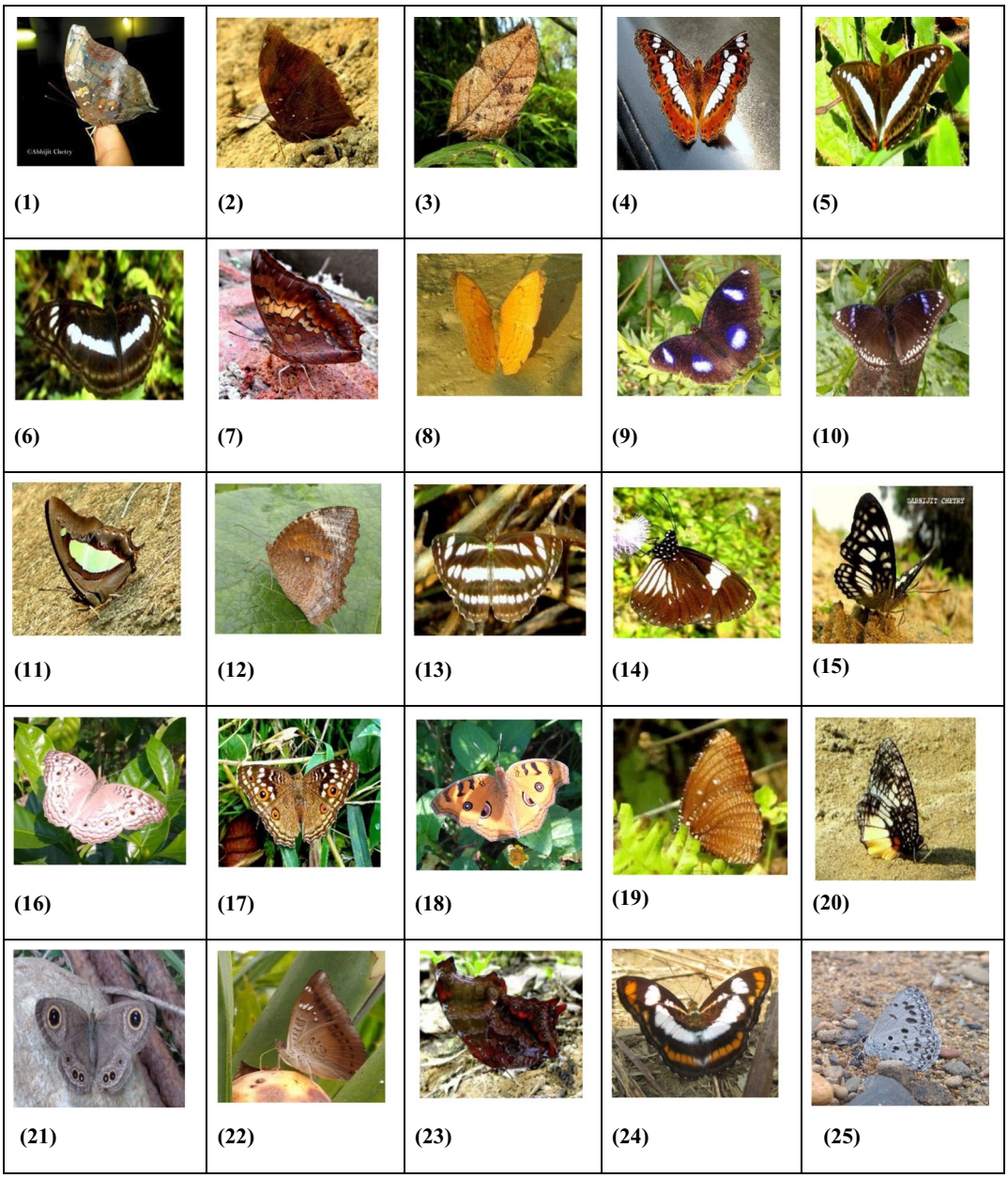

Fig. 3 Family-Nymphalidae (1) *Doleschallia bisaltide indica* (Moore, 1899), (2)(3) *Kallima inachus inachus* (Doyere, 1840), (4) *Moduza procris procris* (Cramer, 1777), (5) *Sumalia daraxa daraxa* (Doubleday, 1848), (6) *Athyma selenophora bahula* (Moore, 1858), (7) *Charaxes bernardus hierax* (C. & R. Felder, 1793), (8) *Cirrochroa aoris aoris* (Doubleday, 1847), (9) Male *Hypolimnus bolina jacintha* (Drury, 1773), (10) Female *Hypolimnus bolina jacintha* (Drury, 1773), (11) *Charaxes bharata* (Felder, 1867), (12) Female *Elymnias hypermnestra undularis* (Linnaeus, 1763), (13) *Neptis hylas varmona* (Moore, 1872), (14) *Euploea radamanthus radamanthus* (Febricius, 1793), (15) *Athyma ranga ranga* (Moore, 1858), (16) *Junonia atlites atlites* (Linnaeus, 1763), (17) *Junonia lemonias lemonias* (Linnaeus, 1758), (18) *Junonia almana almana* (Linnaeus, 1758), (19) *Elymnias malelas malelas* (Hewitson, 1863) and (20) *Elymnias Vasudeva* (Moore, 1858) (21) *Ypthima baldus baldus* (Febricius, 1775), (22) *Euthalia aconthea garuda* (Moore, 1858), (23) *Rhinopalpa polynice birmana* (Fruhstorfer, 1898) and (24) *Athyma inara inara* (Westwood, 1850). Family- Lycaenidae (25) *Acytolepis puspa gisca* (Fruhstorfer, 1910), (26) *Heliophorus epicles latilimbata* (Fruhstorfer, 1908) (27) *Lampides boeticus* (Linnaeus, 1767), (28) *Spindasis lohita himalayanus* (Moore, 1884) and (29) *Zizeeria karsandra* (Moore, 1865), (30) *Castalius rosimon rosimon* (Febricius, 1775), (31) *Caleta elna noliteia* (Fruhstorfer, 1918), (32) *Pseudozizeeria maha maha* (Kollar, 1844) and (33) *Heliophorus indicus* (Fruhstorfer, 1908). Family- Pieridae (34) *Appias galba* (Wallance, 1867), (35) *Pieris canidia indica* (Evans, 1926), (36) *Delias pasithoe pasithoe* (Linnaeus, 1767), (37) *Eurema hecabe hecabe* (Linnaeus, 1758), (38, 39) *Catopsilia pyranthe pyranthe* (Linnaeus, 1758). Family- Papilionidea (40) *Byasa polyeuctes polyeuctes* (Doubleday, 1842), (41) *Graphium antiphates nebulosus* (Butler, 1881), (42) *Papilio nephelus* (Boisduval, 1836), (43) *Papilio demoleous demoleous* (Linnaeus, 1758), (44) *Papilio protenor eurotenor* (Fruhstorfer, 1908), (45) *Atrophaneura aidoneus* (Doubleday, 1845) and (46) *Papilio paris paris* (Linnaeus, 1758). Family- Hesperiidia (47) *Burara amara* (Moore, 1866), (48) *Cupitha purreea* (Moore, 1877), (49) *Telicota* sp. and (50) *Pseudocoladenia* sp.

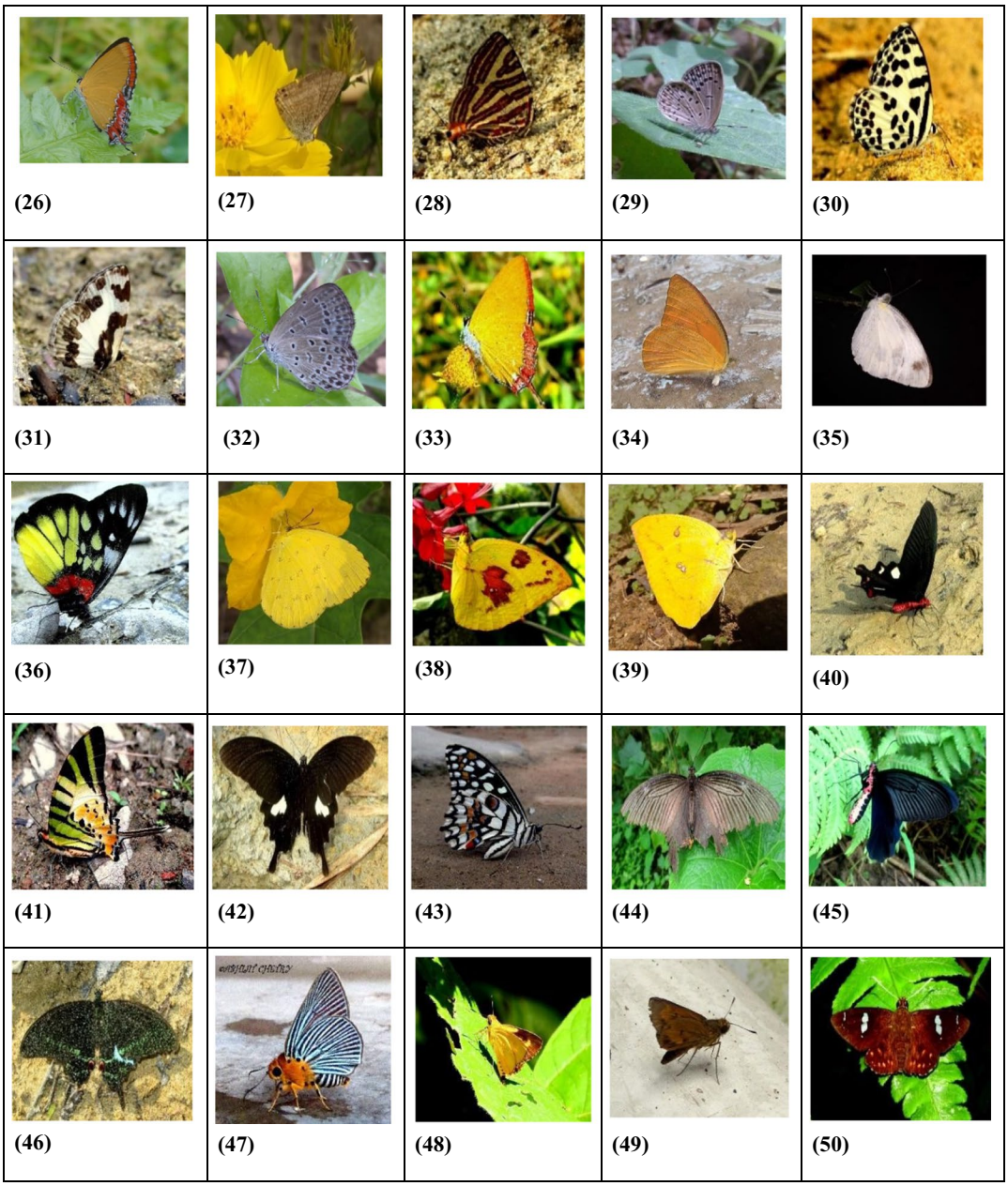

Fig. 3 continued

by Basavarajappa et al., (2018) the Shannon diversity index ranged between 4.49 and 4.59 and the Shannon 'E' (Evenness) indices were 0.98 and 0.94, suggesting evenness between the six forests ranges. Wale and Abdella, (2021) recorded a total of 27,568 butterflies belonged to three families, five subfamilies, and eight genera. According them Equitability (Pielou's index) showed equal distribution of the species, i.e., 0.8 to 0.9 in forest, except at the open grassland at Tara Gedam (0.3) in northwestern Ethiopia. Thus, the present study provided insight into the butterflies of Dehing Patkai National Park and has incited further research for maintenance of forest habitats for butterfly conservation (Fig. 3).

Conclusions

The occurrence of butterflies in a particular area is very significant as a pollinator and biological indicators. Their presence or absence can tell us about the health and stability of the ecosystem. In the presence study a total of 92 species of butterflies were reported from the Soraipung

Range of Dehing Patkai National Park. Among all the butterfly families Nymphalidae family was found to be dominant in number followed by Papilionidae, Lycaenidae, Hesperiidae and the least Pieridae. 11 species of butterfly were found to be restricted to the Eastern Himalaya and 13 species of butterflies were listed as protected under various schedules of the Indian Wildlife (Protection) Act, 1972. Due to their beneficial ecological role and good number of occurrence appropriate strategies should be made for their conservation in different areas of Dehing Patkai National Park.

Abbreviations

T	Transect line
S	Sampling site
H′	Shannon-Weiner diversity index
E	Shannon Evenness
IWPA	Indian Wildlife (Protection) Act

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Author contributions
Authors AC and AB were involved in the sampling, statistical analysis, identification of studied species, manuscript preparation and site management. Author RG managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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Declarations

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