



Preliminary checklist of butterfly diversity from the Himachal Pradesh Agricultural University, Palampur, India

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ARTICLE INFO	ABSTRACT
<p>Received : 06 December 2022 Revised : 13 February 2023 Accepted : 06 March 2023</p> <p>Available online: 26 June 2023</p> <p>Key Words: Agricultural landscape Conservation management Himalayan diversity Lepidoptera</p>	<p>Butterflies are the bio-indicator species for monitoring the health of the ecosystem. A preliminary checklist of the butterfly diversity was prepared by a long-term survey from 2019 to 2022 in varied habitats in the agriculture landscape of the Himachal Pradesh Agriculture University (HPAU), India. The study recorded 74 butterfly species belonging to six families Nymphalidae, Pieridae, Lycaenidae, Hesperidae, Papilionidae and Riodinidae. In addition, there are some rare records of butterfly species such as Common Wall (<i>Lasiommata schakra</i>), Dark Blue Tiger (<i>Tirumala septentrionis</i>), Ringed Argus (<i>Callerebia annada</i>) and Pioneer (<i>Belenois aurota</i>). Some butterflies are habitat specific and few also show local migration from high-elevation areas of the surrounding Dhauladhar ranges. The preliminary checklist prepared from the present study was also compared with Central University of Himachal Pradesh (CUHP) located in the similar landscape of the study area. This will help to understand the long-term effect of habitat degradation from human-modified environment and agricultural activities to facilitate effective conservation strategies to protect Himalayan ecosystem.</p>

Introduction

Among insects, butterflies (Insecta: Lepidoptera) are most commonly used as bio-indicator for understanding the ecosystem's health and the impact of climate change (Harsh 2014; Bhardwaj *et al.*, 2012; Kumar 2021a). The ecological studies of butterflies are always a subject of interest in the scientific community considering their distribution, short life span, rapid reproductive rates and host plant specificity. Butterfly diversity can be used as a global climate change indicator and human interventions such as urban development and habitat fragmentation. Weibull *et al.* (2000) pointed out that landscape heterogeneity has a more pronounced effect on butterfly diversity; still, the widespread use of the chemicals in modern agriculture poses an imminent threat to non-target Lepidoptera (Mule *et al.*, 2017). The agricultural landscapes of the Himalaya are also victim of the

impact of anthropogenic activities such as the clearing of natural vegetation, applying chemical herbicides and insecticides and stubble burning in the agricultural fields.

Many researchers have carried out study on butterfly diversity with many checklists and new records for the hilly state of Himachal Pradesh, India (Arora *et al.*, 2009; Chandel *et al.*, 2013; Singh *et al.*, 2014; Kumar *et al.*, 2020a; Kumar *et al.*, 2020b; Kumar 2021a; Thakur *et al.*, 2021). However, the agricultural landscape is yet to be thoroughly studied for Himachal Himalaya, among these the university premises are less studied, and no records have been published by any university and related institutions. Therefore, the present study was carried out to prepare the checklist of butterfly diversity of Himachal Pradesh Agriculture University (HPAU), India. Further, the data was

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compared with the butterfly checklist recorded for the Central University of Himachal Pradesh (CUHP), India (Kumar *et al.*, 2022). The study would generate first baseline records to know the present status of butterfly diversity and address various issues to conserve diversity in Himalayan ecosystem.

Material and Methods

The study area is located in the agro-climatic zone II of Himachal Pradesh, India (76.5489°N and 32.1029°E). The extensive survey was carried out in HPAU, Palampur, Himachal Pradesh, India, from 2019 to 2022 (Figure 1). As per Köppen and Geiger's classification, the study area comes under a monsoonal-influenced humid subtropical climate (Cwa). The area comprises various habitats such as agriculture (A), forest (F), grassland (G), tea orchards (T), wasteland (W) and wetland (Wt). The agricultural fields were covered with the experimental trials, while a large area covered scattered patches of tea orchards, grassland, wasteland and forest. Many flowering plants and wild edible fruit species, such as *Berberis aristata*, *B. lyceum*, *Terminalia chebula*, *Zizyphus auritiana*, *Urtica dioica* and *Zanthoxylum armatum*

(Kumar 2021b), provide shelter and food to the butterfly community.

A checklist of butterfly diversity was prepared with well-planned survey from 7:00 am to 9:00 am and 4:30 to 6:00 pm one day a week in various habitats (Figure 1). Many rare butterfly species were also recorded from opportunistic sightings while working in the experimental fields. These photographic records of the butterfly species were collected with the Nikon 3300 camera using DX NIKKOR 70-300 mm lens. Most of the butterfly species were geotagged with Nikon p900 camera that provides the option to collect geographic coordinates with GPS logging feature. The taxonomic identification of the butterflies was carried out with available literature and field guides (Mani 1986; Kehimkar 2016; Smetacek 2017; Kasambe 2018; Sondhi and Kunte 2018). Based on the relative abundance of butterflies' species, they have been categorized into three groups such as very common (VC) species (the sighting of the butterfly was >50 times in a year), common (C) (sighting of the butterfly was from 5-20 times per year) and rare (R) species, the butterfly species were recorded in unique habitat as per availability of the host plant (sighted 1-5 times in a year).

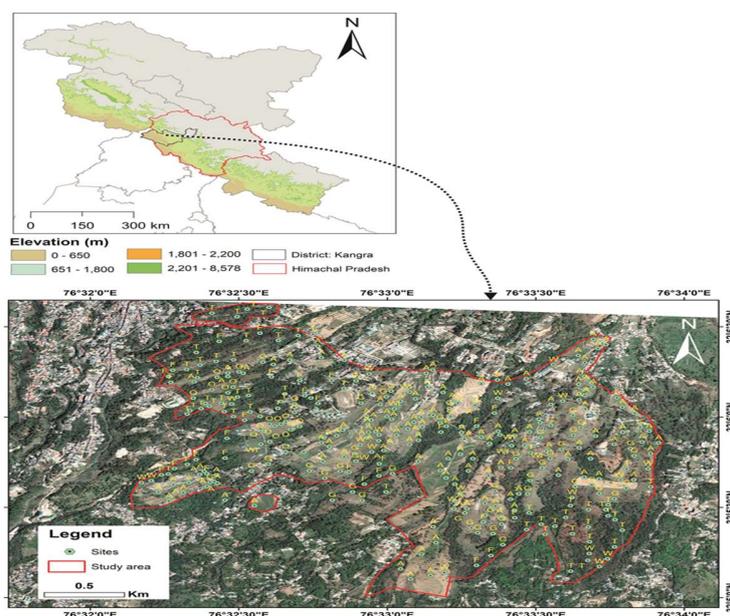


Figure 1: Sites covered to document butterfly diversity in agricultural landscape of HPAU, Palampur, north-western Himalaya, India. Abbreviation: A= agriculture; F= forest; G= grassland; O= orchard, T= tea orchard; W= wasteland vegetation; Wt= wetland habitats

Results and Discussion

The study recorded 74 butterfly species belonging to 6 families and 57 genera in HPAU (Table 1). The 53 butterfly species are common, and 23 are new in HPAU premises. The table also shows the comparison of the checklist of butterfly diversity prepared for the Temporary Academic Block (TAB), Central University of Himachal Pradesh (CUHP), India (Kumar *et al.*, 2022). The CUHP is located in the agglomeration of three academic institutions with more area under human land use and habitat diversity. The photographic records of the new butterfly species compared to the CUHP

are given in Figures 2&3, while the photographic records of common species are also given for the butterfly diversity in Kangra valley, northwest Himalaya, India (Kumar 2021a). Some of the butterfly species, such as Common Copper (*Lycaena phlaeas*), Anomalous Nawab (*Charaxes agrarius*), Common Map (*Cyrestis thyodamas*), Common Wall (*Lasiommata schakra*), Dark Blue Tiger (*Tirumala septentrionis*), Ringed Argus (*Callerebia annada*), Bath White (*Pontia daplidice*) and Pioneer (*Belenois aurota*) were encountered a single time indicating their vulnerable status in the study area.

Table 1: Checklist of butterfly diversity from Himachal Pradesh Agricultural University and their comparison with Central University Himachal Pradesh, India

SN	Common Name	Scientific Name	Abundance	Wildlife (Protection) Act, 1972	CUHP (2014-2019)	HPAU (2019-2022)
Family: HesperIIDae (8)						
1	Common Spotted Flat	<i>Celaenorhinus leucocera</i> (Kollar, 1844)	R		+	+
2	Conjoined Swift	<i>Pelopidas conjuncta</i> (Herrich-Schäffer, 1869)	R		+	+
3	Fulvous Pied Flat	<i>Pseudocoladenia dan</i> (Fabricius, 1787)	R		+	+
4	Grass Demon	<i>Udaspes lolus</i> (Cramer, 1775)	C		-	+
5	Indian Palm Bob	<i>Suastus gremius</i> (Fabricius, 1798)	R		+	+
6	Indian Skipper	<i>Spialia galba</i> (Fabricius, 1793)	VC		+	+
7	Spotted Small Flat	<i>Sarangesa dasahara</i> (Moore, 1866)	C		-	+
8	Straight Swift	<i>Parnara gunatus</i> (Bremer & Grey, 1852)	VC		+	+
Family: LycaenIDae (9)						
9	Common Copper	<i>Lycaena phlaeas</i> (Linnaeus, 1761) -	R		-	+
10	Common Flash	<i>Rapala nissa</i> (Kollar, 1844)	R		-	+
11	Common Hedge Blue	<i>Acytolepis puspa</i> (Horsfield, 1828)	VC		-	+
12	Dark Grass Blue	<i>Zizeeria karsandra</i> (Moore, 1865)	C		-	+
13	Hill Hedge Blue	<i>Celastrina argiolus</i> (Linnaeus, 1758)	VC		-	+
14	Pale Grass Blue	<i>Pseudozizeeria maha</i> (Kollar, 1844)	VC		+	+
15	Red Pierrot	<i>Talicauda nyseus</i> (Guérin-Méneville, 1843)	R		-	+
16	Slate Flash	<i>Rapala manea</i> (Hewitson, 1863)	R		+	+
17	Sorrel Sapphire	<i>Heliphorus sena</i> (Kollar, 1844)	R		-	+
Family: NymphalIDae (38)						
18	Anomalous Nawab	<i>Charaxes agrarius</i> (Swinhoe, 1887)	R		-	+
19	Bamboo Treebrown	<i>Lethe europa</i> (Fabricius, 1775)	R		+	+
20	Banded Treebrown	<i>Lethe confusa</i> (Aurivillius, 1898)	VC		+	+
21	Blue Pansy	<i>Junonia orithya</i> (Linnaeus, 1758)	C		+	+
22	Broad-banded Sailer	<i>Neptis sankara</i> (Kollar, 1844)	R		+	+
23	Chocolate Pansy	<i>Junonia iphita</i> (Cramer, 1779)	VC		+	+
24	Club Beak	<i>Libythea myrrha</i> (Godart, 1819)	VC		+	+
25	Common Baron	<i>Euthalia aconthea</i> (Cramer, 1777)	C		+	+
26	Common Castor	<i>Ariadne merione</i> (Cramer, 1777)	C		+	+
27	Common Crow	<i>Euploea core</i> (Cramer, 1780)	C		+	+
28	West Himalayan Five-ring	<i>Ypthima nikaia</i> (Moore, 1875)	R		+	+
29	Common Jester	<i>Symbrenthia lilaea</i> (Hewitson, 1864)	R		+	+
30	Common Leopard	<i>Phalanta phalantha</i> (Drury, 1773)	C		+	+
31	Common Map	<i>Cyrestis thyodamas</i> (Boisduval, 1840)	R		-	+
32	Common Nawab	<i>Charaxes bhārata</i> (Felder & Felder, 1867)	R		-	+
33	Common Sailer	<i>Neptis hylas</i> (Linnaeus, 1758)	C		+	+
34	Common Sergeant	<i>Athyma perius</i> (Linnaeus, 1758)	C		+	+
35	Common Threering	<i>Ypthima asterope</i> (Klug, 1832)			+	-

36	Common Treebrown	<i>Lethe rohria</i> (Fabricius, 1787)	R		+	+
37	Common Wall	<i>Lasiommata schakra</i> (Kollar, 1844)	R		-	+
38	Dark-branded Bushbrown	<i>Mycalasis mineus mineus</i> (Linnaeus, 1758)	VC		+	+
39	Dark Blue Tiger	<i>Tirumala septentrionis</i> (Butler, 1874)	R		-	+
40	Double Branded Crow	<i>Euploea sylvester</i> (Fabricius, 1793)	R		+	+
41	Glassy Tiger	<i>Parantica aglea</i> (Stoll, 1782)	R		+	+
42	Grey Pansy	<i>Junonia atlites</i> (Linnaeus, 1763)	R		+	+
43	Himalayan Chestnut Tiger	<i>Parantica sita sita</i> (Kollar, 1844)	R		+	+
44	Himalayan Tortoiseshell	<i>Aglaia cashmirensis</i> (Kollar, 1844)	VC		+	+
45	Indian Fritillary	<i>Argyreus hyperbius</i> (Linnaeus, 1763)	VC		+	+
46	Indian Red Admiral	<i>Vanessa indica</i> (Herbst, 1794)	R		+	+
47	Lemon Pansy	<i>Junonia lemonias</i> (Fruhstorfer, 1758)	C		+	+
48	Orange Oakleaf	<i>Kallima inachus</i> (Doyere, 1840)	R		+	+
49	Painted Lady	<i>Vanessa cardui</i> (Linnaeus, 1758)	R		+	+
50	Peacock Pansy	<i>Junonia almana</i> (Linnaeus, 1758)	R		+	+
51	Ringed Argus	<i>Callerebia annada</i> (Moore, 1858)	R		-	+
52	Striped Blue Crow	<i>Euploea mulciber</i> (Cramer, 1777)	R	Schedule IV	+	+
53	Striped Tiger	<i>Danaus genutia</i> (Cramer, 1779)	R		+	+
54	Vagrant	<i>Vagrans egista</i> (Cramer, 1780)	R		+	+
55	Yellow Coster	<i>Acraea issoria anomala</i> (Kollar, 1819)	R		-	+
56	Yellow Pansy	<i>Junonia hierta</i> (Fabricius, 1798)	R		-	+
Family: Papilionidae (6)						
57	Common Bluebottle	<i>Graphium sarpedon</i> (Linnaeus, 1758)	R		+	+
58	Common Lime	<i>Papilio demoleus</i> (Linnaeus, 1758)	R		+	+
59	Common Mormon	<i>Papilio polytes</i> (Linnaeus, 1758)	C		+	+
60	Common Peacock	<i>Papilio bianor</i> (Cramer, 1777)	R		+	+
61	Glassy Bluebottle	<i>Graphium cloanthus</i> (Westwood, 1841)	R		+	+
62	Lesser Punch	<i>Dodona dipoea</i> (Hewitson, 1866)		Schedule II	+	-
63	Yellow Swallowtail	<i>Papilio machaon</i> (Linnaeus, 1758)	R		+	+
Family: Pieridae (11)						
64	Bath White	<i>Pontia daplidice</i> (Linnaeus, 1758)	R		-	+
65	Common Brimstone	<i>Gonepteryx rhamni</i> (Linnaeus, 1758)	R		+	+
66	Common Emigrant	<i>Catopsilia pomona</i> (Fabricius, 1775)	R		+	+
67	Common Grass Yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)	C		+	+
68	Common Jezebel	<i>Delias eucharis</i> (Drury, 1773)	R		-	+
69	Dark Clouded Yellow	<i>Colias fieldii</i> (Menetries, 1855)	C		-	+
70	Hill Jezebel	<i>Delias belladonna</i> (Fabricius, 1793)	R		-	+
71	Indian Cabbage White	<i>Pieris canidia</i> (Linnaeus, 1758)	C		+	+
72	Mottled Emigrant	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	R		+	+
73	Pioneer	<i>Belenois aurota</i> (Fabricius, 1793)	R		-	+
74	Small Grass Yellow	<i>Eurema brigitta</i> (Stoll, 1780)	C		+	+
Family: Riodinidae (2)						
75	Pulm Judy	<i>Abisara echerius</i> (Stoll, 1790)	R		+	+
76	Common Punch	<i>Dodona durga</i> (Kollar, 1844)	R		-	+

Abbreviation: C= Common, VC= Very common, R= Rare

The present study revealed that Nymphalidae (38) was the dominant family, followed by Pieridae (11), Lycaenidae (9), Hesperidae (8), Papilionidae (6) and Riodinidae (2).

The low sighting of butterfly species near the built-up area and agriculture field indicates anthropogenic disturbances and agricultural activities. Many researchers discussed the role of landscape heterogeneity as more in comparison to the farming system while comparing organic and conventional farming system (Weibull *et al.*, 2000). Furthermore, researchers also pointed out that use of agrochemicals also impact the butterfly species

in the agricultural ecosystem (Pekin 2013; Pendl *et al.*, 2013; Mule *et al.*, 2017).

This also seems true for the study area where maximum rare sightings were recorded in grassland, tea orchards and forest habitat. The unavailability of the host plant in the agriculture field also seems responsible due to the clearing unwanted shrubs and other plants from the study. The impact of the surrounding landscape and habitats are responsible for the valuable supply of food and nectar for the butterfly community. More butterfly species were noticed in HPAU compared to the CUHP.

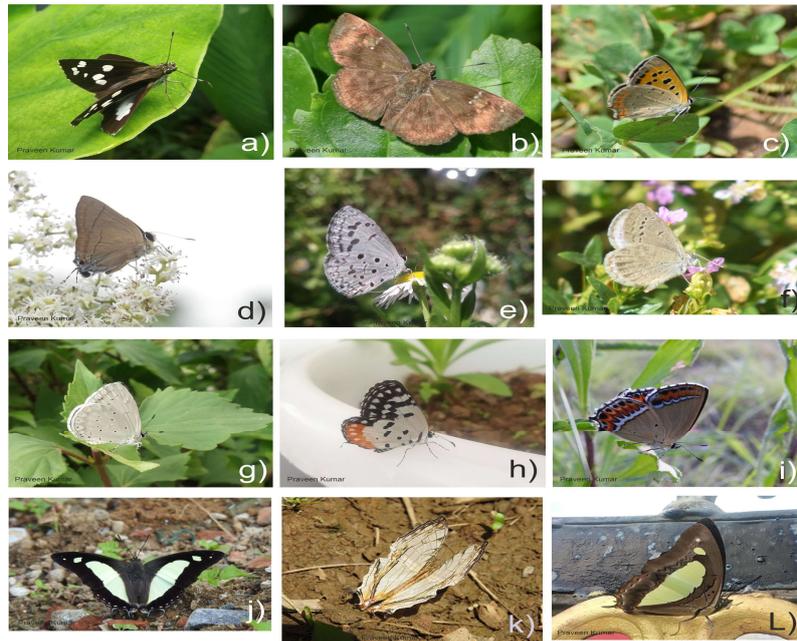


Figure 2: The representative butterfly species recorded new in HPAU in comparisons to the checklist of CUHP, India; a) *Udaspes lolus*, b) *Sarangesa dasahara*, c) *Lycaena phlaeas*, d) *Rapala nissa*, e) *Acytolepis puspa*, f) *Zizeeria karsandra*, g) *Celastrina argiolus*, h) *Talicada nyseus*, i) *Heliophorus sena*, j) *Charaxes agrarius*, k) *Cyrestis thyodamas*, l) *Charaxes bharata*



Figure 3: The representative butterfly species recorded new in HPAU in comparisons to the checklist of CUHP, India; a) *Lasiommata schakra*, b) *Tirumala septentrionis*, c) *Callerebia annada*, d) *Acraea issoria*, e) *Junonia hierta*, f) *Pontia daplidice*, g) *Delias eucharis*, h) *Colias fieldii*, i) *Delias belladonna*, j) *Belenois aurota*, k) *Dodona durga*

This was due to the large study area, habitat diversity, availability of the host plant and less human interference in the areas occupied by tea plantation, mixed forest and wetlands in HPAU.

Furthermore, CUHP is working on a temporary academic block surrounded by agglomeration of three academic institutions facing more anthropogenic onslaught resulting in less butterfly

diversity. However, the checklist of the butterfly diversity of premises show some very peculiar records highlighted as rare (Table 1) are the major concern. The distribution of butterfly species are also influenced by the availability of host plants to lay eggs (Kumar *et al.*, 2022). The clearing of shrubs and natural vegetation near the built up area also confine the butterfly species in specific habitats and host plant. So, such areas under natural vegetation, abandoned tree garden, forest, wasteland and parks can be used for butterfly conservation. The sites with less anthropogenic impact, such as grassland, wasteland and forest area on the university premises can be developed to conserve butterfly's diversity. Furthermore, the non-target effects of chemicals used need to be explored for lepidopterans (butterfly and moth) families to check the lethal dosage and devise alternatives for non-target species.

Conclusion

This study provides the first checklist of butterfly fauna for the agriculture university in the hilly state

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