

## Butterfly species diversity and distribution in protected forest areas of North-West Himalaya of India

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**ABSTRACT:** The Himalaya North-West region heavily depends on water resources for irrigation, food, hydropower, sanitation, and industry, as well as for the functioning of many important ecosystem services. It is also identified as a mega hot spot for biological diversity. The Himalayan forest ecosystem is even not untouched from overexploitation, habitat loss and illegal trade of butterfly and other insect species. This region is also on the verge of modernization, urbanization and tourism activity that lead to degradation of natural habitat. Due to this, more challenges to study on the faunal diversity of North-West Himalaya region. Among the faunal diversity, Butterflies are one of the most important and significant insect species for the pollination in the forest as well as agro-ecosystem.

The field survey conducted to investigate the butterfly diversity and their distribution in different protected forest areas of North-West Himalayan states, Himachal Pradesh and Uttarakhand during the years of 2018-2019. The study revealed presence of 102 butterfly species distributed in 5 families, 18 subfamilies and 66 genera. During the present field investigations documented the dominant family was found to be 55 species of Nymphalidae (53.92%) with 10 subfamilies followed by 17 species of Pieridae (16.66%) with 2 subfamilies, 18 species of Lycaenidae (17.64%) with 2 subfamilies, whereas 7 species of Hesperidae (6.86%) with 2 subfamilies and 5 species of Papilionidae were represented (4.95%) with 1 subfamily. Out of 102 species of butterflies recorded, 11 species are legally protected under Indian Wildlife (Protection) Act, 1972. The three families, Pieridae (1), Nymphalidae (6) and Lycaenidae (4) of 11 species recorded from study area belong to different Schedules of this act of which 2 species are in schedule I, 7 species in schedule II and 2 species in schedule-IV.

However, protected forest areas too are under severe anthropogenic activities like, farming pressure, construction of highways, dams, indiscriminate harvesting woods, leaves, fruits, seeds and human pressure due to tremendous flow of tourists was found a major threat to faunal diversity of the Indian Himalaya including North-West Himalaya. Therefore, more investigations are also still required in different ecological regimes to conserve the terrestrial ecosystem of the Himalayan region.

**Keywords:** Butterflies, Protected forest areas, North-West Himalaya, diversity, distribution.

### INTRODUCTION

North-West Himalaya refers to the western part of the Himalayan Mountain region, stretching from Badakhshan in north eastern Afghanistan, southern Tajikistan to India (Jammu and Kashmir, Himachal Pradesh and Uttarakhand). The North-Western Himalayas have alpine forests to semi-evergreen, deciduous, sub-tropical broad-leaved hill forests, sub-tropical pine forests and sub-tropical montane temperate forests. As per the state of forests report 2015 of the Forest Survey of India (FSI) the actual forest cover (21.34%) and tree cover (2.82%) of India is 24.16% (forest & tree cover) of the geographic area,

corresponding to 79.2 million ha. There have several National Parks, Wildlife Sanctuaries and large areas of protected and unprotected forest (Rodgers and Panwar 1988; Rawal and Dhar 2001).

The North-Western Himalaya is very famous for its unique and versatile floral and faunal biodiversity. The Western Himalayan broadleaf forests may be divided into forests of two types: evergreen and deciduous broadleaved forests. The evergreen broadleaf forest is dominated by oaks, consisting of *Quercus semecarpifolia*, *Quercus leucotrichophora*, *Quercus floribunda*, *Quercus glauca* and *Quercus baloot* and conifers species, *Cedrus deodara* *Pinus*

*wallichiana*, *Abies pindrow*, *Prunus cornuta*, *Abercaesium*, *Betula utilis*, and other species of plants were also found in the regions *Anogeissus latifolia*, *Shorea robusta*, *Tectona grandis*, *Terminalia tomentosa*, *Bombax malabaricum*, *Bomboos* sp., *Syzigium cumini*, *Eucalyptus* spp., *Ficus glomerata*, *Pterospermum acerifolium* and *Dalbergia sissoo*, *Cassia* sp., *Diospyros embriopterys*, *Zizyphus* spp., and several other shrubs and herbs.

Insects are significant parts of forest ecosystem and play one of the key indicators of healthy ecosystems, immense role in food in the ecological food chain and prey, predators, hosts for parasitoids and parasites (Springett, 1978; Gunathilagaraj *et al.*, 1998; Kunte, 2000; Hill *et al.*, 2002; Bonebrake *et al.*, 2010; Pandey *et al.*, 2013). Butterflies belong to the order Lepidoptera (suborder Rhopalocera-Club antennae) and are active fliers during the day time (diurnal). The diversity and distribution of a particular species of butterfly is dependent not only on the geography of the area and the ability of the species to move around within it, but also on the ecological demands of the species. Many species of butterflies are nectar feeders and thus, frequently visit flowers and move from one flower to another (Tiple *et al.*, 2006) and larvae are feeds on their host plants (Tiple *et al.*, 2011; Nitin *et al.*, 2018). Butterflies are one of the best-known pollinators and bio indicators (Balmer and Erhardt 2000; Sharma and Joshi, 2009; Durairaj and Sinha 2015; Saikh *et al.*, 2021), undoubtedly perform beneficial role in assisting with plant pollination in the ecosystem. Thus, butterflies are both beneficial and on the other hand damage caused by the larvae as they feed on valuable forestry and agricultural crops is considerable (Beeson 1941; Browne 1968; Joshi *et al.*, 2004; Nair 2007).

In North-West Himalayan Region, numerous scientific records regarding distribution and diversity of butterflies has been published by various workers (Arora *et al.*, 1995; Uniyal, Mathur 1998; Singh 1999; Singh and Bhandari 2003; Thakur *et al.*, 2006; Joshi, 2007; Singh, 2009; Maulik 2010; Bhardwaj *et al.*, 2012; Sharma and Kumar, 2015; Sondh and Kunte 2018; Singh and Sondhi, 2016; Singh, 2018; Arya *et al.*, 2020; Shakih *et al.*, 2021), but also published so many

new species and records for the North-West Himalaya (Singh, 2007; Smetacek, 2010, 2012; Sondhi, 2017; Sharma and Sharma 2017ab, 2018ab, 2020; Singh and Singh, 2019, 2020),

Recently, Das *et al.* (2018) compiled the 1,249 members of this group, falling in 343 genera under six families butterflies from Indian Himalaya and 1,151 species/subspecies from North-West Himalaya and Chandra *et al.* (2019) also woke out the butterflies diversity in the selected protected areas of North-West Himalaya.

Though, several studies on butterflies diversity workout from the North-West Himalaya region but there is large forest areas of protected and unprotected still remains to investigate different groups of fauna including butterflies. Therefore, the purpose of the study was to assess the diversity and distribution of butterflies in different protected forest areas of North-West Himalaya.

## MATERIALS AND METHODS

The survey conducted to study of butterflies in different protected forest areas of North-Western Himalayan states, Himachal Pradesh and Uttarakhand during 2018-2019. The different species of butterflies were collected by author and co-authors using aerial sweep insect net. The butterflies were observed and photographed by using NIKON SLR Camera in the field. The details of survey and sampling localities, districts, states, forest types vegetation, GPS coordinates and altitude presented (Table 1, Fig. 1).

The collected individuals in the field were transferred into insect collection paper packs and were brought to the laboratory of Northern Regional Centre, Zoological Survey of India, Dehradun, where these were properly stretched, pinned, oven dried for 72 hours at 60°C, labelled, identified, registered and preserved in insect collection boxes and kept in Modern Insect Storage Compactors. Identification of adult individuals was carried out using identification keys provided by (Evans 1932; Wynter-Blyth 1957; Kunte 2000; Kehimkar 2008), field guides (Singh 2017; Sondhi and Kunte 2018) and published literatures (Smetacek 2016; 2018).

**Table 1: Details of survey and sampling localities of protected and unprotected forest areas of North-West Himalayan states.**

Sr. No.	Forest areas	District/ States	Forest types	GPS coordinates	Altitude m
1	Khajjar, Kalatop, Khajjar WLS	Chamba, Himachal Pradesh	Deodar and Chir pine forest	N 32°32.772' E 076°03.550'	1457
2	Kugati Wildlife Sanctuary, Bharmour	Chamba/ Himachal Pradesh	Mixed forest, Bushes, Flowering plants	N 32°27.875' E 076°39.377'	2392
3	Govind Wildlife Sanctuary	Uttarakashi Uttarakashi, Uttarakhand	Chir-Pine, Mixed forest, Bushes, Flowering plants	N 31°04'13.05' E 078°06'16.01'	1438
4	Corbett National Park	Nainital, Uttarakhand	Sal and Teak forest, Bushes, Flowering plants	N 29°25'16.66' E 079°00'04.62'	322

## RESULTS AND DISCUSSION

The study revealed presence of 102 butterfly species distributed in 5 families, 18 subfamilies and 66 genera. During the present field investigations documented the dominant family was found to be 55 species of Nymphalidae (53.92%) with 10 subfamilies followed by 17 species of Pieridae (16.66%) with 2 subfamilies, 18 species of Lycaenidae (17.64%) with 2 subfamilies, whereas 7 species of Hesperidae (6.86%) with 2 subfamilies and 5 species of Papilionidae were represented (4.90%) with 1 subfamily (Table 2, Fig. 2, 3).

On the basis of level of protection provided by Indian Wildlife Protection Act, 1972, 3 families, Pieridae (1), Nymphalidae (6) and Lycaenidae (4) of 11 species recorded from study area belong to different Schedules of this act of which 2 species are in schedule I, 7 species in schedule II and 2 species in schedule-IV. Several species of butterflies were observed highest in mixed forest areas as compared to species specific forest due to varieties of plants available in mixed forest. It was found that more species of butterflies in forest edges, rivers, streams, lakes as compared to dense forest areas in the study areas.

Several factors are responsible to distribution of butterflies such as climatic conditions; host plants and nectars plants availability (Tiple *et al.*, 2009; Vinithashri and Kennedy 2021). It was observed that the most of the butterflies congregated to the nectar plant *Lantana*, which was most available in the study areas. It was also observed that the highest butterflies species found in the plains as compared to hill slopes during the study areas. Such variations at both generic and species levels, especially among butterfly communities, reflect the habitat complexity and range of larval host plants available in the region (Chowdhury, 2014; Das *et al.*, 2018).

The nymphalids butterfly, *Cyrestis thyodmas* feeds on the most species of *Ficus*. The common crow, *Euploea core* is a common species feeding on various species of *Ficus*, *Holarrhena*, *Nerium* and *Streblus asper*. Painted lady, *Vanessa cardui* feeds on a several species of herbs and shrubs, *Artemisia vulgaris*, *Blumea* sp., *Coricus arvensis* and *Xornia diphylla* (Beeson 1941; Browne 1968).

In terms of the total number of individuals reported, Nymphalidae (53.92%) followed by 17 species of Pieridae (16.66%), 18 species of Lycaenidae (17.64%) whereas 7 species of Hesperidae (8.86%) and 5 species of Papilionidae were represented by (4.90%) respectively. Such domination of Nymphalid butterflies might be due to the polyphagous nature of their larval forms and similar pattern with the predominance of family Nymphalidae have also been extensively registered from different forest and protected areas of

North-West Himalaya (Singh, 2009; Bhardwaj and Uniyal, 2013; Ayra *et al.*, 2020; Singh, 2022).

Based on the observations, *Eurema hecabe*, *Pieris brassicae*, *Papilio demoleus*, *Junonia* spp., *Acraea terpsicore*, *Catopsilia* spp., *Ythima* spp., *Danaus chrysippus*, *Euploea core*, *Phalanta phalantha*, *Papilio polytes*, *Leptosia nina* and *Aglais caschmirensis* were the most abundant and frequently sighted species in all of the total individuals of butterflies recorded in the present study. The other frequently observed butterflies in the different forest areas include species such as *Papilio polyctor*, *Parantica aglea*, *Ariadne* spp., *Celastrina huegelii*, etc. On the other hand some species were observed very less number such as *Lasiommata sakhara*, *Acraea aissoria*, *Pseudoergolis wedah*, *Symbrenthia lilaea*, *Euploea mulciber*, *Colias fieldi*, *Gonepteryx rhamni*, *Heliophorus* spp., and *Spialia galba*, etc.

Various studies conducted for the assessment of butterfly diversity and distribution in the different areas of North-Western Himalayan regions by renowned lepidopterists since nineteenth century. Hannington (1910–1911); Ollenbach (1930–1931), Mani (1986); Arora *et al.* (1995); Mackinnon and Niceville (1997, 1998); Arora (1997) studied the butterfly diversity and distribution in different areas of North-West Himalaya. Later, Uniyal (2007) reported 75 species of butterflies from the Great Himalayan Conservation Landscape (GHCL) Kullu and Kinnaur areas. Sidhu and Sharma (2010) studied the butterfly fauna of Uttarakhand. Bhardwaj and Uniyal (2011) recorded 34 species from Gangotri National Park, Uttarakhand. Kumar and Mattu (2014) recorded 40 species from Mandi district (Balh valley), Himachal Pradesh. Chandel *et al.* (2013) reported 50 species from Kangra District in the Bir-Billing area. Tewari and Rawat (2013) listed 134 species belonging to 81 genera and 8 families from Jhilmil Jheel Conservation Reserve, Haridwar, Uttarakhand. Singh and Banyal (2014) also observed 49 species of butterflies in Chamba District. Mehra *et al.* (2017) recorded 493 butterfly species referable to 219 genera were reported from Western Himalaya, out of which, 89 species (60 species are narrowly endemic) *i.e.* 18% were found to be endemic. Arya *et al.* (2018) reported 42 species and 30 genera under six families from Lesser Himalayan Oak Forest for Promoting Ecotourism at City Nainital, Uttarakhand. Recently, Kumar (2021) recorded 88 butterfly species from the Foothill Region of Dhauladhar Ranges Kangra Valley, North-West Himalaya. Recently, Singh (2022) reported 370 butterfly taxa (Papilionidae (31), Pieridae (32), Nymphalidae (138), Lycaenidae (97), Hesperidae (62) and Riodinidae (7) from Uttarakhand areas of North-West Himalaya. Verma and Arya (2022) studied the butterfly diversity and abundance in a sub-tropical wetland environment of Shyamlat, Western Himalaya

and reported 64 species and 45 genera under six butterfly families.

Forest areas are critical for nature conservation and maintaining ecosystem services and thus inventorying biodiversity in such zones is of prime importance (Vina and Liu 2017). The diversified vegetation pattern along altitudes, the forest ecosystem provides sufficient natural resources required for survival of a good range of butterflies throughout the year (Pandey *et al.*, 2013). The unplanned and improper tourism management and tremendous pressure from factors such as cutting of forest tree, slash and burn system, the prevalence of frequent forest fires especially in the pine forests during summers, overgrazing mainly close to the lower altitudinal zone of the protected forest areas, pose potential threats of regional loss and extinction of biodiversity (Mehra *et al.*, 2017; Choudhary, 2014; Arya *et al.*, 2020).

The protected areas are a key part of conservation strategies to mitigate and monitor losses of biological diversity due to changes in climate and land use (Zografou *et al.*, 2014). In those areas, the reduced direct anthropic pressure allows for more easily focusing on and detecting the effect of climate modifications, and the natural evolution of vegetation, on biodiversity.

Still, there is a significant gap in the subject with little record of lesser known or threatened species and their ecology, which should be explored in many parts of protected areas, more necessarily so in the current situation of the climatic backdrop.

Thus, the study suggests that the protect forest areas must be monitored for other biological resources which would assist in managing and preserving not only endangered species of butterflies but also important other faunal groups as well as in strengthening the status of the forest areas of North-West Himalaya.

**Table 2: List of butterflies recorded in different protected forest areas of North-West Himalaya.**

Sr. No.	Subfamilies	Species	Common Name (WPAC-Status)	Distribution in different protected and unprotected forest areas of North-West Himalaya
<b>I</b>		<b>Family: Papilionidae Latreille, 1802</b>		
1	Papilioninae Latreille, 1802	<i>Papilio polytes romulus</i> (Cramer, 1758)	Common mormon	Corbett National Park, Uttarakhand
2		<i>Papilio polyctor</i> (Boiswadal, 1758)	Common Peacock	Sakad Forest areas, Lilh Forest areas, Chamba, Himachal Pradesh
3		<i>Papilio demoleus</i> (Linnaeus, 1758)	Lime butterfly	Rajpura forest areas, Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
4		<i>Garphium doson</i> (Feld & Feld, 1864)	Common jay	Corbett National Park, Nainital, Uttarakhand
5		<i>Pachliopta aristolochiae</i> (Fabricius, 1775)	Common rose	Corbett National Park, Nainital, Uttarakhand
<b>II</b>		<b>Family: Pieridae Swainson, 1820</b>		
6.	Coliadinae Swainson, 1827	<i>Catopsilia pomona</i> (Fabricius, 1775)	Lemon emigrant	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Phogut Forest areas, Nainital, Uttarakhand
7		<i>Catopsilia pyranthe pyranthe</i> (Linnaeus, 1758)	Mottled emigrant	Lilh Forest areas, Chamba, Himachal Pradesh, Taluka way to Har- Ki-Doon Forest areas, Uttarakashi, Corbett National Park, Nainital, Uttarakhand
8		<i>Eurema hecabe</i> (Linnaeus, 1758)	Large grass yellow	Govind Pashu Vihar (WLS), Uttarakashi, Corbett National Park, Uttarakhand Mardei Forest areas, Mardei Forest areas, Kugati Wildlife Sanctuary, Bharmour Chamba, Himachal Pradesh
9		<i>Eurema brigitta</i> (Stoll, 1780)	Small grass yellow	Govind Pashu Vihar (WLS), Uttarakashi, Corbett National Park, Nainital, Uttarakhand
10		<i>Eurema blanda</i> (Boisduval, 1836)	Three Spot Grass yellow	Rudraprayag Forest area, Rudraprayag, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
11		<i>Eurema laeta laeta</i> (Boisduval, 1836)	Spotless grass yellow	Taluka Forest area, Uttarakashi, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand Uttarakhand
12		<i>Colias electo fieldi</i> (Menetries, 1855)	Dark clouded yellow	Bhalei forest area, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
13	<i>Gonepteryx rhamni</i> (Linnaeus, 1758)	Common brime stone	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Govind Pashu Vihar Forest areas, Uttarakashi, (WLS), Uttarakhand	
14	Pierinae Swainson,	<i>Belenois aurota aurota</i> (Fabricius,	Pioneer	Govind Wildlife Sancutary, Purola Forest



	1820	1793)		areas, Uttarakashi, Uttarakhand
15		<i>Cepora nerissa</i> (Fabricius, 1775)	Common Gull (Sch.II)	Govind Pashu Vihar (WLS), Uttarakashi, Corbett National Park, Nainital, Uttarakhand-
16		<i>Delias eucharis</i> (Drury, 1773)	Indian Jezebel	Corbett National Park, Nainital, Uttarakhand
17		<i>Ixias marianne</i> (Cramer, 1779)	White Orange Tip	Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
18		<i>Ixias pyrene</i> (Linnaeus, 1764)	Yellow Orange Tip	Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
19		<i>Leptosia nina nina</i> (Fabricius, 1793)	Psyche	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
20		<i>Pieris canidia indica</i> (Sparrman, 1768)	Indian cabbage White	Bhalei Forest area, Himachal Pradesh, Jhumar Forest area, Himachal Pradesh, Taluka Forest area, Uttarakashi, Uttarakhand, Purola Forest areas, Uttarakashi, Uttarakhand
21		<i>Pieris brassicae nepalensis</i> (Doubleday, 1846)	Large Cabbage White	Khajjar WLS, Dalhousie, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand,
22		<i>Pareronia valeria</i> (Fabricius, 1878)	Common Wanderer	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
<b>III</b>		<b>Nymphalidae Rafinesque, 1815</b>		
23.	Heliconiinae Swainson, 1822	<i>Acraea terpsicore</i> (Fabricius, 1758)	Tawny Coster	Govind Pashu Vihar (WLS), Uttarakashi, Bheemtal Forest areas, Uttarakhand, Mardei Forest area, Chamba, Himachal Pradesh
24.		<i>Acraea isooria isooria</i> (Hubner, 1819)	Yellow Coster	Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand, Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Lahru Forest area, Kangra, Himachal Pradesh,
25		<i>Argynnis hyperbius</i> (Linnaeus, 1763)	Indian Fritillary	Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
26		<i>Phalanta phalantha</i> (Drury, 1773)	Common leopard	Rajpura Forest area, Chamba, Himachal Pradesh, Purola Forest areas, Uttarakashi, Uttarakhand
27	Bibliidinae Boisduval, 1833	<i>Ariadne merione tapestrina</i> (Moore, 1777)	Common Castor	Kangra and Chamba Forest areas, Himachal Pradesh
28		<i>Ariadne Ariadne</i> (Linnaeus, 1763)	Angled Castor	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand, Corbett National Park, Uttarakhand
29	Charaxinae Guenée, 1865	<i>Charaxes bhārata</i> (Felder & Felder, 1867)	Indian Nawab	Taleru Chamera dam Forest areas, Chamba, Himachal Pradesh
30		<i>Charaxes solon</i> (Fabricius, 1793)	Black Rajah (Sch.II)	Taluka Forest areas, Uttarakashi, Uttarakhand
31	Danainae Boisduval, 1833	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain tiger	Bhalei Forest area, Himachal Pradesh, Taluka Forest area, Uttarakashi, Bheemtal Forest area, Nainital, Annua Forest areas, Rudraprayag, Uttarakhand
32		<i>Danaus genutia</i> (Cramer, 1779)	Striped or Common Tiger	Annua Forest areas, Rudraprayag, Corbett National Park, Uttarakhand
33		<i>Euploea core core</i> (Cramer, 1781)	Common Indian crow (Sch.IV)	Bheemtal Forest areas, Corbett National Park, Nainital, Uttarakhand, Taleru Chamera dam forest area, Chamba, Himachal Pradesh
34		<i>Euploea mulciber mulciber</i> (Cramer, 1777)	Striped Blue crow (Sch.IV)	Lilh Forest areas, Chamba, Himachal Pradesh
35		<i>Tirumala limniace</i> (Cramer, 1775)	Blue Tige	Rajpura, Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Ramnagar, Nainital, Uttarakhand
36		<i>Parantica aglea melanoides</i> (Stoll, 1782)	Glassy Tiger	Lilh Forest areas, Rajpura, Forest areas, Chamba, Taleru Chamera dam Forest areas, Mardei Forest area, Chamba, Himachal Pradesh, Taluka to Har-ki-Don, Forest areas Uttarakashi, Uttarakhand

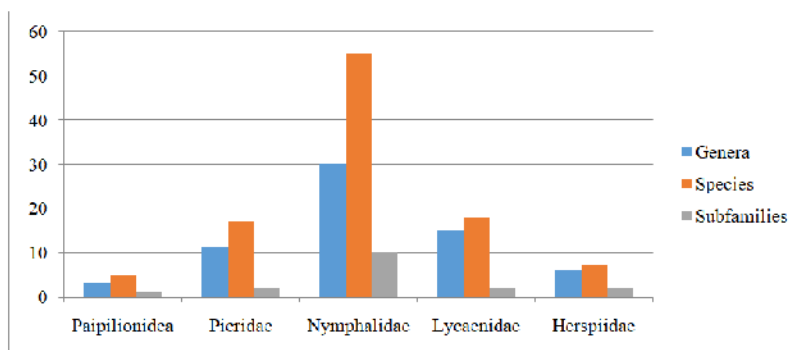
37	Nymphalinae Rafinesque, 1815	<i>Aglais caschmirensis</i> (Kollar, 1844)	Indian Tortoiseshell	Naddi Forest areas, Panchapura, Forest area Dhamashala, Kangra, Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Purola Forest areas, Taluka Forest areas, Uttarakashi, Charkhet Forest areas, Nainital, Uttarakhand
38		<i>Junonia iphita</i> (Cramer, 1779)	Chocolate Pansy	Bhalei Forest area Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Corbett National Park, Uttarakhand
39		<i>Junonia hierta hierta</i> (Fabricius, 1798)	Yellow Pansy	Bhalei Forest area Himachal Pradesh, Corbett National Park, Uttarakhand
40		<i>Junonia orithya swinhoei</i> (Butler, 1885)	Blue Pansy	Chamba Forest area, Himachal Pradesh Corbett National Park, Uttarakhand
41		<i>Junonia lemonias</i> (Linnaeus, 1758)	Lemon Pansy	Panchapura Forest area, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Corbett National Park, Uttarakhand,
42		<i>Junonia almana almana</i> (Linnaeus, 1758)	Peacock Pansy	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Purola Forest area, Uttarakashi, Corbett National Park, Nainital, Annua Forest areas, Rudraprayag, Uttarakhand
43		<i>Junonia atlites</i> (Linnaeus (1763)	Grey Pansy	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
44		<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great Eggfly	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Bheemtal Forest areas, Nainital, Uttarakhand
45		<i>Hypolimnas misippus</i> (Linnaeus, 1764)	Danaid Egg fly (Sch.II)	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Purola Forest areas, Uttarakashi, Uttarakhand
46		<i>Symbrenthia lilaea</i> Hewitson, 1864	Common Jester	Corbett National Park, Ramanagar, Nainital, Uttarakhand
47		<i>Kallima inachus</i> (Doyere, 1840)	Orange Oakleaf	Corbett National Park, Nainital, Uttarakhand
48		<i>Vanessacardui</i> (Linnaeus, 1758)	Painted Lady	Charkhet Forest area, Bhimtal Forest area, Nainital. Uttarakhand
49		<i>Vanessa indica</i> (Herbst, 1794)	Indian red admiral	Mardei Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
50		Pseudergolinae Jordon, 1898	<i>Pseudergolis wedah</i> (Kollar, 1844)	The Tabby
51	Satyrinae Boisduval, 1833	<i>Aulocera swaha</i> (Kollar, 1844)	Common Satyr	Rakh Forest area, Chamba, Himachal Pradesh
52		<i>Aulocera saraswati saraswati</i> (Kollar, 1844)		Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Annua Forest area, Rudraprayag, Uttarakhand
53		<i>Callerebia annada</i> (Moore, (1858)	Ringed Argus	Taleru Chamera dam forest area, Chamba, Himachal Pradesh
54		<i>Callerebia hyrbida</i> (Butler, 1880)	Hybrid Argus	Rakh Forest area, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
55		<i>Callerebia nirmala</i> (Moore, 1865)	Common Argus	Rakh Forest area, Chamba, Himachal Pradesh
56		<i>Callerebia scanda</i> (Kollar, 1844)	Pallid Argus	Taleru Chamera dam forest area, Chamba, Himachal Pradesh
57		<i>Elymnias hypermentra</i> (Drury, 1773)	Common Palmfly	Dalhousie Forest area, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
58		<i>Lasiommata schakra schakra</i> (Kollar, 1844)	Common Wall	Naddi Forest areas, Dharamshala, Kangra, Rajpura Forest area, Chamba, Himachal Pradesh,
59		<i>Lethe europa</i> (Fabricius, 1775)	Bamboo Treebrown	Taleru Chamera dam forest area, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
60		<i>Lethe isana</i> (Kollar, 1844)	Common Forester	Naddi Forest areas, Dharamshala, Kangra,
61		<i>Lethe rohria</i> (Fabricius, 1787)	Common Treebrown	Govind Pashu Vihar (WLS), Uttarakashi,

				Uttarakhand, Rakh Forest area Chamba, Himachal Pradesh
62		<i>Lethe sidonis</i> (Hewitson, 1863)	Common Woodbrown	Govind Pashu Vihar (WLS), Uttarakshi, Annua Forest area, Rudraprayag, Uttarakhand
63		<i>Melanitis phedima</i> (Cramer, 1780)	Dark Evening Brown	Taluka, way to Har-ki-Doon, Forest area Uttarakashi, Uttarakhand
64		<i>Melanitis leda</i> (Linnaeus, 1758)	Common Evening Brown	Kumaon hills, Corbett National Park, Nainital, Annua Forest area, Rudraprayag, Uttarakhand
65		<i>Mycalesis perseus</i> (Fabricius, 1775)	Common Bushbrown	Rajpura Forest areas, Himachal Pradesh,
66		<i>Mycalesis misenus</i> (Linnaeus, 1767)	Dark-Brand Bushbrown (Sch.II)	Corbett National Park, Ramanagar, Nainital, Uttarakhand
67		<i>Ypthima hubeneri</i> (Kirby, 1871)	Common Four Ring	Jhumar forest area, Chamba, Himachal Pradesh, Kumaon hills, Corbett National Park, Ramnagar, Uttarakhand
68		<i>Ypthima inica</i> (Hewitson, 1865)	Lesser Three Ring	Kugati Wildlife Sanctuary, Bharmour, Chamba, Himachal Pradesh, Khajjjar Wild Life Sanctuary, Chamba, Himachal Pradesh,
69		<i>Ypthima baldus</i> (Fabricius, 1775)	Common Five Ring	Mardei Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Ramangar, Nainital, Uttarakhand
70	Limenitidinae Behr, 1864	<i>Athyma opalina</i> (Kollar, 1844)	Himalayan Sergeant	Govind Pashu Vihar, Uttarakashi, Uttarakhand, Rajpura Forest areas, Chamba, Himachal Pradesh
71		<i>Athyma perius</i> (Linnaeus, 1758)	Common Sergeant	Rakh Forest areas, Chamba, Himachal Pradesh
72		<i>Moduza procris</i> (Cramer, 1777)	Commander	Kumaon hills, Corbett National Park, Ramanagar, Nainital, Uttarakhand
73		<i>Neptis hylas</i> (Moore, 1872)	Common Sailer	Jumar Forest area, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
74		<i>Euthalia aconthea</i> (Cramer, 1777)	Common Barron	Dalhousie Forest area, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
75	Cyrestinae Guenée, 1865	<i>Cyrestis thyodamas</i> (Doyere, 1840)	Common Map	Corbett National Park, Ramanagar, Nainital, Uttarakhand
76	Libytheinae Boisduval, 1833	<i>Libythea lepita</i> (Moore, 1858)	Common Beak (Sch.II)	Dalhousie Forest area, Chamba, Himachal Pradesh, Kumaon hills, Corbett National Park, Nainital, Uttarakhand
77		<i>Libythea myrrha</i> (Godart, 1819)	Club Beak	Taleru Chamera dam forest area, Mardei Forest area, Chamba, Himachal Pradesh
<b>IV</b>	<b>Lycaceniidae</b> Leach, 1815			
78	Polyommatae Swainson, 1827	<i>Acytolepis puspa</i> (Horsfield, 1828)	Common Hedge Blue (Sch.I)	Rajpura Forest areas, Chamba, Himachal Pradesh
79		<i>Celastrina huegelii</i> (Moore, 1882)	Large White Blue	Lile Forest area, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
80		<i>Celastrian gigas</i> (Hemming, 1928)	Silvery Hedge Blue	Rajpura Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
81		<i>Castalius rosimon</i> (Fabricius, 1775)	Common Pierrot (Sch-I)	Rajpura Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
82		<i>Talicauda nyseus</i> (Guerin-Meneville, 1843)	Red Pierrot	Rajpura Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
83		<i>Everes argides</i> (Pallas, 1771)	Tailed Cupid,	Rajpura forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
84		<i>Euchrysops cnejus cnejus</i> (Fabricius, 1798)	Gram Blue (Sch.II)	Corbett National Park, Nainital, Uttarakhand
85		<i>Chilada pandava</i> (Horsfield, 1829)		Rajpura Forest areas, Chamba, Himachal Pradesh, Kumaon hills, Corbett National Park, Nainital, Uttarakhand
86		<i>Lampides boeticus</i> (Linnaeus, 1767)	Pea Blue (Sch.II)	Taleru Chamera dam area, Chamba, Himachal Pradesh
87		<i>Pseudozizeeria maha</i> (Kollar, 1844)	Pale grass blue	Gehra Bharmour, Chamba, Forest areas, Chamba, Himachal Pradesh

88	Theclinae Swainson, 1831	<i>Deudorix epijarbus</i> (Moore, 1858)	Comelian	Taleru Chamera dam Forest areas, Chamba, Himachal Pradesh
89		<i>Rapala iarbus</i> (Fabricius, 1787)	Indian Red Flash	Lilh Forest areas, Chamba, Himachal Pradesh, Corbett National Park, Nainital, Uttarakhand
90		<i>Spindasis vulcanus</i> (Fabricius, 1775)	Common Silverline	Lumbgaon Forest area, Rudraprayag, Corbett National Park, Uttarakhand, Taleru Chamera dam Forest areas, Chamba, Himachal Pradesh,
91	Lycaeninae Leach, 1815	<i>Heliophorus tamu</i> (Kollar, 1844)	Powdery Green Sapphire	Dalhousie Forest area, Chamba, Himachal Pradesh
92		<i>Heliophorus sena</i> (Kollar, 1844)	Sorrel Sapphire	Rajpura Forest areas, Lilh Forest areas, Mardei Forest areas, Chamba, Himachal Pradesh
93		<i>Lycaena pavana</i> (Kollar, 1848)	White-Bordered Copper	Rakh Forest areas, Chamba, Himachal Pradesh
94		<i>Surendra quercetorum</i> (Moore, 1857)	Common Acacia Blue	Rakh Forest areas, Chamba, Himachal Pradesh, Kumaon hills, Corbett National Park, Nainital, Uttarakhand
95		<i>Leptotes plinius</i> (Fabricius, 1793)	Zebra Blue	Corbett National Park, Nainital, Uttarakhand
<b>Hesperiidae</b> Latreille, 1809				
96	Pyrginae Burmeister, 1878	<i>Spialia galba</i> (Fabricius, 1793)	Indian Skipper	Lumbgaon Forest area, Rudraprayag, Corbett National Park, Uttarakhand Uttarakhand
97		<i>Pseudocoladenia dan</i> (Kollar, 1844)	West Himalayan Pied Flat	Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
98	Hesperiinae Latreille, 1809	<i>Borbo cinnara</i> (Wallace, 1866)	Rice Swift	Govind Pashu Vihar (WLS), Uttarakashi, Lumbgaon Forest area, Rudraprayag, Uttarakhand
99		<i>Pelopidas conjuncta</i> (Herrich-Schaffer, 1869)	Conjoined Swift	Mardei Forest areas, Chamba, Himachal Pradesh, Govind Pashu Vihar (WLS), Uttarakashi, Uttarakhand
100		<i>Pelopidas mathias</i> (Fabricius, 1798)	Small Banded Swift	Mardei forest areas, Chamba, Himachal Pradesh
101		<i>Telicota bambuse</i> (Moore, 1878)	Dark Palm Dart	Kumaon hills, Corbett National Park, Uttarakhand
102		<i>Udaspes folus</i> (Cramer, 1775)	Grass demon	Taluka way to Har-ki-Doon, Forest area, Uttarakashi, Uttarakhand



**Fig. 1.** Images of different Protected Forest area in North-West Himalaya.



**Fig. 2.** Species diversity of Butterflies in the different families.





**Fig. 3.** Images of Butterfly diversity of North-West Himalaya.

## CONCLUSION

Our study emphasizes the significance of altitude and diverse habitat types structuring butterfly assemblage in different forest areas of North-West Himalaya. Thus, the butterfly diversity will help to establish the linkage of changing climate and biological phenomena as the area show a great variety of habitat and altitude when covering a small distance on the ground. Therefore, more investigations are also still required in different forest areas and ecological regimes to conserve the terrestrial ecosystem of the Himalayan region.

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