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Checklist

Exploring Humla's awe-inspiring butterfly diversity, confirming the presence of *Agriades dis* Grum-Grshimailo, 1891 in Nepal

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Abstract

This study provides a checklist of butterfly species from Humla District, Karnali Province, Nepal, based on field observations conducted in July 2017 and secondary data. A total of 39 butterfly species were documented, of them 31 were recorded during this study. The majority of species belong to the Nymphalidae family (19 species), followed by Lycaenidae (10 species), Pieridae (6 species), Papilionidae (2 species), Riodinidae (1 species), and Hesperiidae (1 species). This checklist includes revised information on altitudinal, seasonal, and geographical distributions, alongside detailed descriptions of notable and rarely observed species such as *Agriades dis*, *Callerebia nirmala*, and *Colias ladakensis*. The findings reveal the rich biodiversity of butterflies in this remote Himalayan region, with several species extending their known ranges and appearing at new altitudinal zones. Highlighting the conservation significance, these results underscore the importance of ongoing biodiversity assessments in the face of environmental and climate changes. This research contributes valuable baseline data for Nepal's butterfly fauna, informing future conservation strategies and ecological studies in the Himalayan ecosystem.

Keywords: Butterfly diversity; Conservation; Himalayan ecosystem; Nymphalidae; Range extension

1 | Introduction

Butterflies, the scaly-winged flying beauties that belong to the insect order Lepidoptera, are among the most studied and aesthetically pleasing groups of insects, often considered key indicators of environmental health and biodiversity (Perveen and Fazal 2013; Sawchik et al. 2005; Kocher and Williams 2000; Larsen 1988). Approximately, 17000–20000 species of butterfly have been listed so far in the world (IUCN 2025; Smithsonian Institute 2023; Perveen and Ahmad 2012; Smith 2011b, 2010; Shields 1989) where China contributed the most followed by India with 1403 butterfly species (Varshney and Smetacek 2025; Gasse 2021; Nair et al. 2014). Nepal, is well known for its distinct topography and range of climates within a small array of areas, is home to 695 different species of butterflies (Van der Poel 2024). The distribution and diversity of butterflies in Nepal are moderately understood, despite their ecological importance. The availability of adequate data and primarily comparative information has become fragmented as a result. This fragmentation has hindered the development of effective programs for biodiversity management and conservation, particularly for butterflies.

With the help of our opportunistic field surveys and literature reviews, the current effort attempts to bridge the data availability gap by offering a preliminary checklist of butterfly species from Humla District, a highly unexplored region of Nepal. By adding this data, we hope to support the global biodiversity database and the Nepal database, as well as provide a basis for future studies. The study area's record of a few rare and seldom observed butterflies also emphasizes how crucial butterfly conservation is to Nepal's larger efforts to preserve biodiversity.

2 | Materials and methods

2.1 | Study area

The Humla District of Karnali Province in west Nepal (Fig. 1) is situated between latitudes 29°35' N and 30°57' N and longitudes 81°18' E and 82°07' E, encompassing elevations ranging from 1,524 meters to 7,337 meters above sea level, with maximum temperatures of 10° to 25°C, minimum temperatures from –10° to –28°C, as well as annual rainfall of 25.4 to 146.9 mm and relative humidity of 65.9 – 79.5 % (CBS 2018, 2019).

The survey was conducted during three-week expedition based in Simikot and Namkha Rural Municipalities of Humla District covering altitudinal ranges from 2,200 to 5,700 meters above sea level,

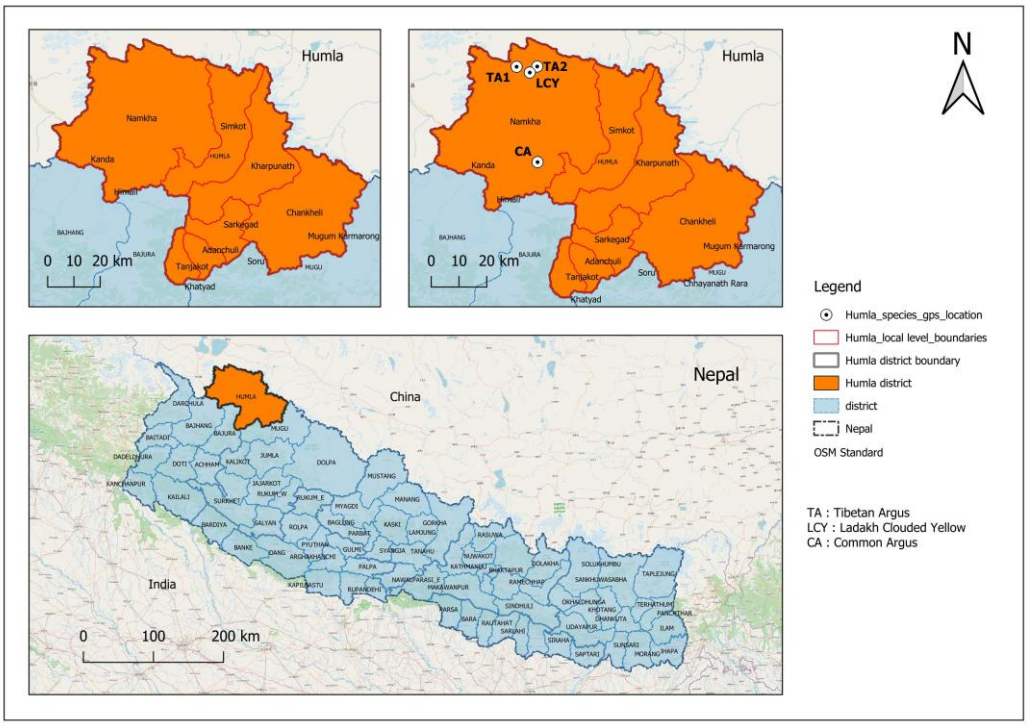

Figure 1. Map of the study area showing sampling location.

comprising temperate, alpine and subalpine geographical regions. The Limi Valley, a prominent feature of Upper Humla, which lies in the northwestern region of Humla district (Namkha Rural Municipality) shares border to Tibet in north and west, Muchu, Khangalgaun, and Hepka in the south and Simikot Rural Municipality in the east) remains isolated from the rest of Nepal (CBS 2018, Kusi & Werhan 2016). The lower Limi Valley is characterized by steep, rocky slopes, while the terrain beyond Pigung Lagna transitions into the vast, gentle slopes of the Tibetan Plateau (CBS 2018, Kusi & Werhan 2016). The Limi Khola is the primary river in this area, fed by several tributaries such as the Gyau Khola, Sakya Khola, Ngin Khola, and Talung Khola (CBS 2018, Kusi & Werhan 2016).

Ecologically, Upper Humla is significant for its diverse flora and fauna, providing habitats for various species adapted to high-altitude conditions. The district's unique topography and climate create distinct ecological zones, fostering a rich biodiversity that includes several important floras including *Pinus wallichiana*, *Taxus wallichiana*, *Rododendron* and fauna *Neofelis nebulosa*, *Bos motus*, *Panthera uncia* (CBS 2018). The weather is characterized by severe winters with heavy snowfall (November through April), while summers are relatively mild (CBS 2018, Kusi & Werhan 2016).

2.2 | Methods

From 20 July to 11 August 2017, an opportunistic study was conducted at elevations ranging from 2,200 to 5700 meters (selected areas of Simikot and Namkha Rural Municipalities). It was conducted around our camping grounds and along the trekking routes that led from Simikot to the Raling Gumba region (Simikot Rural Municipality), Simikot to Upper Humla (Limi Valley), and Hilsa (Namkha Rural Municipality), before returning to Simikot. An opportunistic observation survey strategy was employed to collect primary data and literature reviews for secondary data. This approach allowed for the direct observation of numerous butterflies in the field along routes through a range of habitats, including forests, riverbanks, and meadows. Surveys were carried out between 9:00 AM and 4:00 PM Nepalese time, which is when butterfly activity is at its highest.

To ensure proper species documentation, butterflies were observed and documented along specified walking routes using a combination of photography and visual identification. The observations were made at a distance that was visible to a naked eye, usually within 5–200 meters (rough estimates) to the observer's left, right, and head. As alternate photographic sites, butterflies were also photographed near glacier lakes, along river tributaries, and around the camping places in addition to the walking paths.

A handheld GPS device was used to record the coordinates of each sighting. Documentation was limited to photographs using a Nikon D500 and D5100 DSLR cameras equipped with a Nikon AF-S DX NIKKOR 55–200 mm f/4–5.6G ED VR II lens for further identification. Later data were entered and managed in Microsoft Excel Professional Plus 2019.

While during our research period, Smetacek (2017) and Smith (2011a, b, 2010, 1994) guidebooks were used to identify butterflies, and consultated national and international experts. We followed Van

Table 1. GPS location of seldom seen butterfly species with previous recorded elevations and present recorded elevations.

Name	Latitude (d)	Longitude (d)	Altitude (m) previous	Altitude (m) present	Date	Remarks
Agriades dis	30° 21' 15.55"	81° 34' 50.68"	4876	4872	30 July, 2017	Tso lamyok lake to Gyau Khola
Agriades dis	30° 21' 17.42"	81° 39' 28.52	4876	4751	31 July, 2017	Gyau Khola to Chyakpalung
Callerebia nirmala	30° 2' 41.03"	81° 39' 26.01"	2410-3050	**3125**	26 July, 2017	Salli Danda, Humla
Colias ladakensis	30° 20' 7.29"	81° 37' 48.22"	3660-4700	**4738**	30 July, 2017	Gyau Khola valley
Chaetoprocta kurumi	29° 58' 29.73"	81° 49' 7.76"	1370-2870	**3046**	22 July, 2017	Simikot village
Albulina galathea	30° 15' 23.41"	81° 42' 15.45"	2830-4020	**4537**	1 August, 2017	Selima Tso Taal area

der Poel and Smetacek's (eds.) 2022 annotated catalogue book to draw the species' scientific and common names.

3 | Results

During the 23-day survey, we observed 31 species of butterflies belonging to 31 genera and representing 5 families. Incorporating secondary data from Smith 1980 (3 species), BPP 1995 (1 species), and photographs from Rinzin Phunjok Lama pers. comm. 2024 & 2025 (4 species), we have updated the checklist to include 39 species belonging to 6 families (Annex 1). Out of 39 species, 19 (49%) belonged to the Nymphalidae, 10 (26%) were Lycaenidae, 6 (15%) were Pieridae, 2 (5%) were Papilionidae and 1 (3%) belonged to Hesperiidae and Riodinidae (Fig. 2).

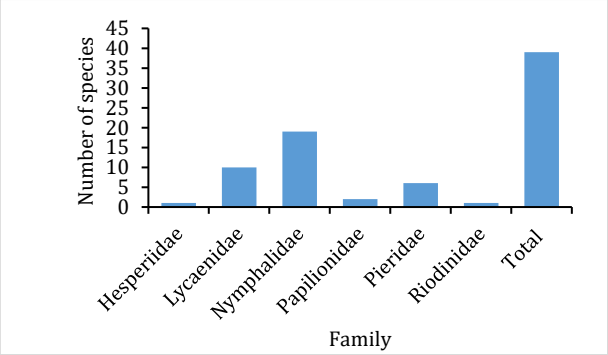

Figure 2. Th number of butterfly species with respect to different families in the study area.

The checklist contains 3 species listed as vulnerable and 2 species listed as Susceptible in the Nepal Red Data Book (BPP 1995): *Paralasa nepalica* (endemic to Nepal, Van der Poel & Smetachek 2022; Smith 1994), *Colias ladakensis,* and *Parnassius epaphus,* and two susceptible species *Agriades orbitulus* and *Aglais ladakensis*. Earlier results of this survey include new distributional and altitudinal records of *Paralasa nepalica* (Suwal et al. 2019) and of *Pontia callidice* (Suwal et al. 2021). Here, we present updates on three seldom reported species: *Agriades dis*, *Callerebia nirmala*, and *Colias ladakensis*, and new altitudinal updates for Large Green Underwing *Albulina galathea*, and Nepal Walnut Blue *Chaetoprocta Kurumi* (Table 1).

Tibetan argus Agriades dis (Grum-Grshimailo, 1891)

We present here the first photographic record of *A. dis* from Humla in its natural environment (Fig. 3 & 4). Also, our records are the second record for Nepal after Chapagain and Chhetri 2006 from Lomangthang, Upper Mustang at 4876 m asl (Surendra Pariyar pers. comm. 2025). We recorded a mating pair of *A. dis* at 4872 m asl on

Figure 3. Mating pair of Tibetan argus *Agriades dis*

Figure 4. Tibetan argus *Agriades dis* (upperside view)

July 30, 2017, on a walking trail at 4751 m asl at Gyau Khola on July 31, 2017 basking near water resource (Table 1).

We observed nectar plants such as *Corydalis elegans robusta, Rhododendron Lepidotum, Leontopodium jacotianum, Arenaria* spp., *Androsace* spp., *Oxytropis* spp., and *Astragulus* spp., and evergreen bushes as its habitat.

Common argus *Callerebia nirmala* (Moore, 1865)

On July 26, 2017, a single individual of *Callerebia nirmala* (Fig. 5) was spotted at Salli Daanda, Humla, at a height of 3125 m asl (Table 1) flying and basking. Bailey first described *C. nirmala* in Nepal in 1936 (Piet Van der Poel pers. comm. 2025), and then by Colin Smith in

Figure 5. Common argus *Callerebia nirmala*

1980 from Jagard Khola, Jumla at 2407 m asl (Surendra Pariyar pers. comm. 2025). Thus, this report demonstrated the species' new distribution area and altitude range inside Nepal. The habitat consists of a mixed forest of *Pinus roxburghii*, and *Juniperus* sp, with invasive species *Lantana camara, Ageratum houstonianum, Ageratina adenophora*, and *Chromolaena odorata*.

Ladakh clouded yellow *Colias ladakensis* (Felder & Felder, 1865)

On July 30, 2017, we found a single individual of *Colias ladakensis* (Fig. 6) on the southern side of steep *Juniperus* slopes at 4738 m asl on the north side of the riverbed of the Gyau Khola valley. These slopes are covered in creeping, evergreen shrubs, most likely of the genus *Juniperus*, flowering plants like *Corydalis elegans robusta*, *Rhododendron Lepidotum*, *Leontopodium jacotianum*, *Arenaria* sp, and *Androsace* sp, and they create dense, rough vegetation that acts as a heaven for the insect fauna, according to findings by Vis and Coene 1987.

Figure 6. Ladakh clouded yellow *Colias ladakensis*

In addition to the three rarely observed species, we recorded new altitudinal height for the Large Green Underwing (*Albulina galathea*) at 4,537 m and the Nepal Walnut Blue (*Chaetoprocta kurumi*) at 3,046 m (Table 1) as well. One individual of *A. galathea* was seen mineral sipping from horse dung, while among the two *C. kurumi* individuals, one was found dead and the other was resting on a maize plant leaf.

4 | Discussion

Agriades dis is a rare highland butterfly belonging to the Lycaenidae family. It is found in temperate regions of North America, Europe, and Asia (Savela 2022). It has been referred to as *A. luana* by some authors, though Balint considers it a junior synonym (Van der Poel and Smetacek 2022). *A. dis* have blackish wings above and olive-grey underneath, with distinct white borders and transverse markings (Grum-Grshimaïlo 1891). It is endemic to the Alpine region of the Amdo Diet. In Nepal, three species of *Agriades* are present: *A. dis*, *A. orbitulus*, and *A. kurtjohnsoni* (Van der Poel & Smetacek 2022).

Callerebia nirmala is a species in the Nymphalidae family, found exclusively in the Sino-Himalayan region (Varshney & Smetacek 2025; Butler 1867; Bruna et al. 2000; Huang 2003; Savela 2022). Earlier studies (Evans 1927, 1932; Talbot 1947; Wynter-Blyth 1957; Moore 1865) classified *Callerebia* under Erebiai. *Callerebia nirmala* differs from *Erebia scanda* (Hugel 1848) in absence of numerous white stripes on the underside of the hind wing and having a single ocellus near the anal angle (Moore 1865). Several subspecies have been described from India; however, their phenotypic variations are not fully understood and their geographic boundaries are not sufficiently defined (Kunte et al. 2022).

Colias ladakensis is a rare butterfly from the Pieridae family, found at high altitudes of 3600-5300 m in the Himalayas and Trans-Himalayas. It ranges across Central Asia, from Kashmir and Ladakh to the central Himalayas (Gasse 2018; Thapa 1998; BPP 1995; Talbot 1947), and extends over the Paleartic region (Talbot 1947). This species, with a wingspan of 45 – 55 mm, displays distinctive dark-bordered upper forewings with prominent spots that do not reach the margin. The spot in space 3 is notably smaller. On the underside of the forewing, black spots are confined to spaces 1 to 3. The upper hindwing is darker, featuring a complete post-discal band and large yellow marginal spots separated by veins. The disco-cellular area may have an orange spot or be absent (Sondhi 2017; Tshikolovets, 2005; Mani 1986; Talbot 1947; Evans 1927, 1932).

Initially discovered in Nepal in 1979 in the Kali Kandales Valley at 3900 m, *C. ladakensis* is seen as a characteristic high-altitude species, typically flying between 3800 m and 5000 m (Thapa 1998; BPP 1995; Vis & Coene 1987; Mani 1986; Kostrowicki 1969). It is a seldom-seen butterfly in Nepal, categorized as vulnerable in the Nepal Red List due to its restricted range (west and central *lekh* of the Dolpa and Mustang, 3660 – 4240 m) (BPP 1995) and specific habitat needs, often found on sandy hillocks with flowering *Caragana versicolor*. This species is characterized by its erratic, low flight during the summer months (Sondhi et al. 2017; Vis & Coene 1987).

The family Nymphalidae had the highest number of species (19 species) reported. One possible reason for this is the availability of larval host plants and adult nectar plants during the study period (Murugesan et al. 2013). Several other studies also observed a similar pattern of high records for this family (KC and Sapkota 2024; Shrestha et al. 2024; Neupane & Miya 2021; Sharma & Poudel 2021; Subedi et al. 2021; Shrestha et al. 2020; Shrestha et al. 2018). In our study, the Lycaenidae family was the second largest family, with a total of 10 species. The presence of grass species that persisted during our study time July 20 to August 11, 2017, in the study area could serve as a good host for Lycaenidae members (Nimbalkar et al. 2011).

The presence of invasive plant species, such as *Chromolaena odorata*, which produces abundant nectar (Laxmi & Raju 2011), and *Lantana camara*, a year-round bloomer that serves as an excellent nectar source for butterflies (Day et al. 2003), may have contributed to the higher diversity of butterflies observed in the lower part of Humla (below 3000 m). The upper Humla region is significant for its butterfly diversity, as evidenced by the discovery of rarely-reported species, including *Paralasa nepalica, Colias ladakensis, Agriades dis, Agriades orbitulus,* and *Parnassius epaphus*. Additionally, the data on butterfly distribution and altitudinal ranges collected during a brief visit indicate the potential for further discoveries with more thorough and long-term research. There is very limited information available about the butterfly fauna in this area, making it challenging to determine the exact species composition. As a result, our understanding of the threats facing butterflies in this region is also limited, which makes it unrealistic to provide effective conservation and protection recommendations. To address the issue, it is essential to gather more information about the butterflies in the area and their distribution throughout Humla district.

Compared to earlier records from Nepal, certain species *Callerebia nirmala, Colias ladakensis, Chaetoprocta Kurumi,* and *Albulina galathea* have been found at much higher elevations. However, it's important to note that this isn't always because the species' range is expanding. It can also be due to increased surveys and better identification methods (Sun et al. 2021). As a result, caution must be exercised. Predicting recent records of butterfly species at new elevations or range extensions is challenging because we lack detailed knowledge of butterfly migration patterns, highland butterfly ecology, and seasonal distribution. For many rarely seen species, our knowledge of distribution areas, elevation ranges, and seasonal occurrence in Nepal is insufficient. Therefore, more comprehensive taxonomic and spatial distribution research is needed, incorporating proper survey designs that account for variability (Moore et al. 2014). Our understanding of most species from this region remains limited.

The reported observations and records suggest multiple possibilities: either species were always present in these geographic, elevational, or seasonal ranges but remained unnoticed due to a difference in research timing and their occurrence, lack of surveys or species has expanded their range. Range extension could be a result of normal or increased migration, possibly influenced by habitat or environmental changes. Climate change is one factor that may have led to butterflies being observed in new locations (Cormont et al 2011; Kallioniemi 2013). These highlights the importance of studying butterfly species' migratory and dispersal behavior for their current conservation conditions and understand various ecological perspectives.

5 | Conclusions

Our survey in the Humla district has significantly broadened our knowledge of the region's butterfly species. We identified 39 species, including the first photographic proof of *Agriades dis*, one of Nepal's most uncommon butterflies, establishing its presence in the country. We also documented rarely seen species like *Callerebia nirmala* and *Colias ladakensis*. These findings have definitely highlighted the Upper Humla region's ecological importance and the critical need for long-term scientific research to better understand seasonal diversity and species distribution, both of which are critical for their survival. Our observation also suggests that a number of factors, including the presence of invasive plant species, sources of nectar, and the availability of larval host plants, has affected in presence of varieties of butterflies in Humla. Also, the fact that fewer butterfly species have been observed at higher elevations complies with earlier research, suggesting that particular environmental factors significantly influence butterfly communities.

From our research, the range extensions and new altitude records reported in this study may be due to lack of previous research attempt or unnoticed or actually changes in butterfly distributions driven by environmental factors, including climate change. This highlights the need for implementation of immediate scientific research and monitoring to draw the actual butterfly population dynamics.

The unique habitats of Humla particularly in Upper Humla, are certainly under threat due to increasing road construction, changing land use patterns, and trends in migration. These activities have certainly had adverse impacts on specialized species. Considering this, conservation measures have to be implemented as soon as feasible. Finally, our findings provide an important foundation for future research and conservation efforts in Humla. We can help to protect the great diversity of butterflies in this region for future generations by promoting awareness among local communities and encouraging further scientific research.

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Authors' contributions

S.P.S. conceptualization, investigation, data analysis, original draft, review, and editing. K.D.H. Investigation, review, and editing. N.K. funding acquisition, review, and editing, principal investigator of the Wild Yak project.

Conflicts of interest

The authors declare no conflict of interest.

References

Biodiversity Profiles Project (BPP) (1995). Red Data Book of the Fauna of Nepal. Biodiversity Profiles Project Technical Publication NO. 4. Department of National Parks and Wildlife Conservation. Ministry of Forests and Soil Conservation. His Majesty's Government of Nepal. Kathmandu. ISBN: 90-73287-05-7.

Bruna C.D., Gallo E. and Sbordoni V. (2000). Guide to the Butterflies of the Palearctic Region, Satyridae. Part 2, Subfamily Satyrinae, tribe Ypthimini: Argestina, Boeberia, Callerebia, Grumia, Hemadara, Loxerebia, Paralasa, Proterebia, Milan: Omnes Artes, 2000, 58pp

Butler A.G. (1867). Descriptions of some remarkable new Species and a new Genus of Diurnal Lepidoptera. Ann. Mag. nat. Hist. (3) 20 (117): 2016–217.

Central Bureau of Statistics (CBS) (2019). Environment Statistics of Nepal 2019. Government of Nepal, Nepal Planning Commission, Central Bureau of Statistics. ISBN:978-9937-0-5748-6.

Central Bureau of Statistics (CBS), Bajura (2018). Objective description of Humla district-2075 B.S. Government of Nepal. Nepal Planning Authority and Central Bureau of Statistics.

Chapagain N.R. and Chetri M. (2006). Biodiversity Profile of Upper Mustang. National Trust for Nature Conservation, Annapurna Conservation Area Project, Upper Mustang Biodiversity Conservation Project. Kathmandu, Nepal. IV + 32 pp.

Cormont A., Malinowska A.H., Kostenko O., Radchuk V., Hemerik L., DeVries M.F.W. and Verboom J. (2011). Effect of local weather on butterfly flight behaviour, movement, and colonization: significance for dispersal under climate change. Biodiversity and Conservation, 20:483–503. https://doi.org/10.1007/s10531-010-9960-4.

Day M.D., Wiley C.J., Playford J. and Zalucki M.P. (2003). Lantana: Current Management, Status and Future Prospects. Australian Centre for International Agricultural Research, 5:1–20.

Evans W.H. (1932). The Identification of Indian Butterflies. The Bombay Natural History Society, 29(2): 519 -537.

Evans W.H. (1927). The Identification of Indian Butterflies. The Bombay Natural History Society. The Diocesan Press, Madras. x+302pp+32pl.

Gasse P.V. (2018). Butterflies of Indian Sub-continent – Annotated checklist. Pdf version from internet. https://www.biodiversityofindia.org/ index.php?title=Butterflies_of_the_Indian_sub-continent. Accessed on July 2024.

Gasse P.V. (2021). Butterflies of Indian Subcontinent, Distributional Checklist. Tshikolovets Publications. ISBN: 9788090708945. 272pp.

Grum-Grshimailo G.E. (1891). Lepedoptera nova in Asia centrali novissime lecta et descripta. Horae Societatis Entomologicae Rossicae. 25:445–465.

Huang H. (2003). A list of butterflies collected from Nujiang (Lou Tse Kiang) and Dulongiang, China with descriptions of new species, and revisional notes Neue Entomologische Nachrichten 55:3–114.

IUCN. (2025). IUCN SSC Butterfly and Moth specialist group. https://iucn.org/our-union/commissions/group/iucn-ssc-butterfly-and-moth-specialist-group. Accessed on June 2025.

Kallioniemi E.P. (2013). Effects of morphology, habitat and weather on the movement behabiour of range-expanding butterfly species. A thesis submitted for the degree of Doctor of Philosophy, School of Environmental Sciences, University of East Anglia, UK.

KC S. and Sapkota A. (2024). Butterfly Diversity and Community Dynamics in the Central Himalayas: Species Composition, Richness, Abundance, and Seasonal Variation of Butterflies (Lepidoptera: Papilionoidea) in Bhorletar, Nepal. Ecol Evol, 14:e70612. https://doi.org/10.1002/ece3.70612.

Kocher S.D., and Williams E.H. (2000). The diversity and abundance of North American butterflies vary with habitat disturbance and geography. Journal of Biogeography, 27(4):785–794.

Hugel, C.F. (1848). Kaschmir und des Reich der Siek. Stutt. Hall. Vrlg., 4 (2): 452.

Kostrowicki A.S. (1969). Geography of the Palearctic Papilionoidea (Lep). Zakl. Zool. Syst. Polsk. Akad. Nauk., Krakow. 380.
Kunte K., Sondhi S. and Roy P. (Eds.). (2022). Butterflies of India, v. 3.03. Indian Foundation for Butterflies. URL: https://www.ifoundbutterflies.org. Accessed on August 2024.
Kusi N. and Werhahn G. (2016). Humla, Journey into the Hiden Shangri-La. Himalayan Map House, Kathmandu, Nepal. ISBN:978-9937-649-51-3.
Larsen T.B. (1988). The butterflies of the Nilgiri mountains of the Southern India (Lepidoptera: Rhopalocera). Journal of the Bombay Natural History Society, 85:26–43.
Laxmi P.V. and Raju A.J.S. (2011). *Chromolaena odorata* (L.) King and H.E. Robins (Asteraceae), an important nectar source for adult butterflies. Journal of Threatened Taxa, 3(2):1542–1547; http://doi.org/10.11609/JoTT.02504.1542-7
Mani M. S. (1986). Butterflies of the Himalaya. Volume 36 of Series entomologica. Oxford and IBH Publishing Company, New Delhi, Bombay, Calcutta. ISBN: 8120401263, 9788120401266, p 62.
Moore A.L., McCarthy M.A., Parris K.M., Moore J.L. (2014). The Optimal Number of Surveys when Detectability Varies. PLoS ONE, 9(12):e115345. http://doi.org/10.1371/journal.pone.0115345
Moore F. (1865). List of Diurnal Lepidoptera collected by Capt. A.M. Land in the N.W. Himalayas Proc. Zool. Soc. Lond., 1865(12):501.
Murugesan M., Arun P.R. and Prusty B.A.K. (2013). The butterfly community of an urban wetland system - a case study of Oussudu Bird Sanctuary, Puducherry, India. Journal of Threatened Taxa, 5(12):4672–4678. http://doi.org/10.11609/ JoTT.o3056.4672-8.
Nair A.V., Mitra P. and Aditya S. (2014). Studies on the diversity and abundance of butterfly (Lepidoptera: Rhopalocera) fauna in and around Sarojini Naidu College campus, Kolkata, West Bengal, India. Journal of Entomology and Zoology Studies, 2:129–134.
Neupane K. and Miya M.S. (2021). Butterfly diversity of Putalibazar Municipality, Syangja District, Gandaki Province, Nepal. Journal of Threatened Taxa 13(7): 18827-18845. https://doi.org/10.11609/jott.6635.13.7.18827-18845
Nimbalkar R.K., Chandekar S.K. and Khunte S.P. (2011). Butterfly diversity in relation to nectar food plants from Bhor Tahsil, Pune District, and Maharashtra, India. Journal of Threatened Taxa 3(3):1601–1609.
Perveen F. and Ahmad A. (2012). Checklist of butterfly fauna of Kohat, Khyber Pakhtunkhwa, Pakistan. Arthropods, 1(3):112–117.
Perveen F. and Fazal F. (2013). Checklist of butterfly fauna from Hazara University, garden campus, Mansehra, Pakistan. SOAJ of Entomological Studies, 2:26–33.
Savela M. (2022). http://ftp.funet.fi/index/Tree_of_life/insecta/ lepidoptera/. Accessed on June 2025.
Sawchik J., Dufrene M. and Lebrun P. (2005). Distribution patterns and indicator species of butterfly assemblages of wet meadows in southern Belgium. Belgian Journal of Zoology, 135(1):43–52.
Sharma J. and Poudel L. (2021). Butterfly diversity in Kumakh Rural Municipality, northern part of Salyan District, Karnali Province, Nepal. Arthropods, 10(2):53–59. ISSN 22244255.
Shields O. (1989). World numbers of butterflies. Journal of the Lepidopterists' Society, 43(3):178–183.
Shrestha B.R., Baral S., Budha-Magar S., Thapa Magar K., Gaudel P., Suwal S.P., Tamang S.R., Dewan A., Gurung M.B., and Shrestha P. (2024). Vegetation Productivity Determines the Response of Butterflies along Elevation Gradients in the Trans-Himalayas, Nepal. Ecosphere, 15(10):e70019. https://doi.org/10.1002/ecs2.70019
Shrestha, B. R., Timsina B., Münzbergová Z., Dostálek T., Gaudel P., Basnet T.B., and Rokaya M.B. (2020). Butterfly-Plant Interactions and Body Size Patterns along an Elevational Gradient in the Manang Region of Central Nepal. Journal of Mountain Science, 17(5):1115–27. https://doi.org/10.1007/S11629-019-5381-3
Shrestha B.R., Sharma M., Thapa Magar K., Gaudel P., Gurung M.B. and Oli B. (2018). Diversity and status of butterflies at different sacred forests of Kathmandu valley, Nepal. Journal of Entomology and Zoology Studies, 6(3):1348–1356.
Smetacek P. (2017). A Naturalist's Guide to the Butterflies of India, Pakistan, Nepal, Bhutan, Bangladesh, and Sri Lanka. John Beaufoy Publishing Let., United Kingdom.
Smith C. (2011a). Illustrated checklists of Nepal's butterflies, Majpuria Publication, Craftsman Press. Bangkok, Thailand, 129 pp.
Smith C. (2011b). A Photographic Pocket Guide to Butterflies of Nepal. Himalayan Map House, Basantapur, Kathmandu, Nepal. ISBN: 99933-47-73-6.
Smith C. (2010). Lepidoptera of Nepal, Himalayan Nature.
Smith C. (1994). Butterflies of Nepal, Craftsman Press, Bangkok.
Smith C. (1980). Some Butterflies of Western Nepal Part II Pre-and Post-Monsoon Butterflies. Journal of Natural History Museum, Vol. 4, No.2,
Smithsonian Institute (2025). Butterflies. https://www.si.edu/spotlight/buginfo/butterfly . Accessed on June 2025
Sondhi S., Valappil B., Sondhi Y. and Sondhi A. (2017). A report on some butterflies (Lepidoptera) from Ladakh in Jammu and Kashmir and Lahaul in Himachal Pradesh, India. Journal of Threatened Taxa, 9(3):9971–9987; http://doi.org/10.11609 /jott.3024.9.3.9971-9987.
Subedi B., Stewart A. B., Neupane B., Ghimire S., and Adhikari H. (2021). Butterfly species diversity and their floral preferences in the Rupa Wetland of Nepal. Ecology and Evolution, 11(5):2086–2099. https://doi.org/10.1002/ ece3.7177.
Sun J., Futahashi R. and Yamanaka T. (2021). Improving the Accuracy of Species Identification by Combining Deep Learning with Field Occurrence Records. Front. Ecol. Evol., 9:762173. https://doi.org/10.3389/fevo.2021.762173
Suwal S.P., Hengaju K.D. and Kusi N. (2019). Additional record of the poorly known Argus Paralasa nepalica Paulus, 1983) (Insecta: Lepidoptera: Nymphalidae) in Nepal. Journal of Threatened Taxa, 11(1):13173–3174.
Suwal S.P., Hengaju K.D. and Kusi N. (2021). New locality record of the Lofty bath white butterfly *Pontia callidice* (Hübner, 1800) in Nepal. Nepalese Journal of Zoology 5(2):90–93. https://doi/org/10.3126/njz.v5i2.42037
Talbot G. (1947). Fauna of British India. Butterflies Volume 2. Community online edition. http://archive.org/details/ FaunaOfBritishIndia.Butterflies2. pp. 298–315. Online version dated 02 August 2012.
Thapa V.K. (1998). An Inventory of Nepal's Insects, Vol II. IUCN Nepal, Kathmandu, xii+245, p 201.s
Tshikolovets V.V. (2005). The Butterflies of Ladak (N. W. India). Published by Vadim V. Tshikolovets, Pardubice, Czech Republic, 176pp+30pl.
Van der Poel P. (2024). First record of *Coladenia pinsbukana* (Lepidoptera: Hesperiidae) Large-spot Pied Flat from Nepal, extending its distribution area westward. Bionotes, 26(2):68–70. ISSN 0972-1800.
Van der Poel P. and Smetacek P. (eds.). (2022). An annotated Catalogue of the Butterflies of Nepal. Bionotes: Occasional Paper 1. Vii +241 pp.
Varshney R.K., and Smetacek P. (2015). A Synoptic Catalogue of the Butterflies of India. New Delhi: Butterfly Research Centre, Bhimtal and Indinov Publishing, New Delhi. 179. https://doi/org/10.13140/RG.2.1.3966.2164
Vis R., and Coene H.A. (1987). Lepidopterological investigations in Kashmir and Ladakh (India). Nota Lepidopterologica, 10(1):5–24.
Wynter-Blyth M.A. (1957). Butterflies of the Indian Region. Bombay Natural History Society, Bombay, xx+523pp+72pl.

Annex 1. Butterfly checklist with altitudinal and status information. The elevation is given only when it varies from the previously recorded elevation; otherwise, it is not.

S.N.	Family	Common name	Scientific name	Previous elevation range	Recorded elevation record	NRDB status	Remarks
1	Hesperiidae	Nepal skipper	*Pyrgus nepalensis*	3110– 4360			BPP 1995
2	Lycaenidae	Alpine mountain blue	*Agriades orbitulus*	2500– 4870		Susceptible	
3	Lycaenidae	Azure sapphire	*Heliophorus moorei*	1100– 3960			
4	Lycaenidae	Common copper	*Lycaena phlaeas*	1370– 4330			
5	Lycaenidae	Hill hedge blue	*Celastrina argiolus*	430– 3800			
6	Lycaenidae	Large green underwing	*Albulina galathea*	2830– 4020	**4537**		
7	Lycaenidae	Large hedge blue	*Celastrina huegelii*	800– 3110			
8	Lycaenidae	Nepal walnut blue	*Chaetoprocta kurumi*	1370– 2870	**3046**		
9	Lycaenidae	Pea blue	*Lampides boeticus*	120– 3950			
10	Lycaenidae	Meadow blue sp	*Polyommatus* sp	2380– 4490			Lama 2024
11	Lycaenidae	Tibetan argus	*Agriades dis*	4750– 4880			
12	Nymphalidae	Black-vein fritillary	*Melitaea arcesia*	2140– 5180			
13	Nymphalidae	Club beak	*Libythea myrrha*	120– 2100			
14	Nymphalidae	Common argus	*Callerebia nirmala*	2410– 3050	**3125**		
15	Nymphalidae	Common satyr	*Aulocera swaha*	2290– 4080			
16	Nymphalidae	Common wall	*Lasiommata schakra*	1070– 3780			Lama 2024
17	Nymphalidae	Grand mountain satyr	*Paroeneis grandis*	3700– 5000			
18	Nymphalidae	Himalayan sailer	*Neptis mahendra*	2130– 3230			Lama 2024
19	Nymphalidae	Hybrid argus	*Callerebia hybrida*	700– 3960			
20	Nymphalidae	Indian purple emperor	*Mimathyma ambica*	*610– 1220*			Smith 1980
21	Nymphalidae	Indian red admiral	*Vanessa indica*	140– 4510			
22	Nymphalidae	Indian tortoiseshell	*Aglais caschmirensis*	200– 5360			
23	Nymphalidae	Ladakh tortoiseshell	*Aglais ladakensis*	3860– 5330		Susceptible	Lama 2025
24	Nymphalidae	Large threering	*Ypthima nareda*	120– 3110			
25	Nymphalidae	Nepal argus	*Paralasa nepalica*	3500– 4400		Vulnerable	Suwal et al 2019
26	Nymphalidae	Painted lady	*Vanessa cardui*	120– 4940			
27	Nymphalidae	Queen of Spain fritillary	*Issoria lanthonia*	1370– 4910			
28	Nymphalidae	ringed argus	*Callerebia annada*	850– 2750			
29	Nymphalidae	Small silverfork	*Lethe Jalaurida*	2770– 3900			Smith 1980
30	Nymphalidae	Studded sergeant	*Athyma asura*	2620			Smith 1980
31	Papillionidae	Common red apollo	*Parnassius epaphus*	3780– 5280		Vulnerable	
32	Papillionidae	Common yellow swallowtail	*Papilio machaon*	980– 4720			
33	Pieridae	Dark clouded yellow	*Colias fieldii*	140– 5180			
34	Pieridae	Himalayan brimestone	*Genopteryx nepalensis*	610– 3780			
35	Pieridae	Indian cabbage white	*Pieris canidia*	120– 4000			
36	Pieridae	Ladakh clouded yellow	*Colias ladakensis*	3660– 4700	**4738**	Vulnerable	
37	Pieridae	Large cabbage white	*Pieris brassicae*	140– 4600			
38	Pieridae	Lofty bath white	*Pontia callidice*	4390– 5000			Suwal et al 2021
39	Riodinidae	Common punch	*Dodona durga*	1580– 2410			

Annex 2. Butterflies recorded from the study area

Agriades orbitulus

Heliophorus moorei

Lycaena phlaeas

Celastrina argiolus

Albulina galathea

Celastrina huegelii

Chaetoprocta kurumi

Lampides boeticus

Polyommatus sp

Agriades dis

Maletaea arcesia

Libythea myrrha

Callerebia nirmala

Aulocera swaha

Lasiommata schakra

Paroeneis grandis

Neptis mahendra

Callerebia hybrida

Vanessa indica

Aglais caschmirensis

Annex 2 (continued)

Aglais ladakensis

Ypthima nareda

Paralasa nepalica

Vanessa cardui

Issoria lanthonia

Callerebia annada

Parnassius epaphus

Papilio machaon

Colias fieldii

Gonepteryx nepalensis

Pieris canidia

Colias ladakensis

Pieris brassicae

Pontia callidice

Dodona durga