



Diversity of butterflies (Lepidoptera: Rhopalocera) from cold desert of district Kargil in the union territory of Ladakh, India

Ahsan Ali^{1*}, Neelima R. Kumar¹ and Umesh Bharti²

¹Department of Zoology, Panjab University, Chandigarh - 160014, India; Email: ahsanalirahimi@gmail.com

²Department of Zoology, Government Post Graduate Government College for Girls, Sector-11, Chandigarh - 160011, India

Abstract

An extensive butterfly fauna survey of district Kargil in the union territory of Ladakh was conducted. The field study was carried out from April 2019 to September 2019, May 2020 to September 2020, April 2021 to September 2021 and April 2022 to September 2022. 23 species belonging to 17 genera of 3 families of butterflies were recorded from the area under reference. The analysis and characterisation of the butterfly fauna will provide essential information on the ecology of the area and act as a good bioindicator. It can predict the status of conservation and protection of any given area.

Keywords: Butterflies, Cold Desert, Diversity Indices, Kargil, Lepidoptera, Trans Himalaya

Introduction

Kargil, situated in the Ladakh union territory, is a district renowned as the cold desert of India. It is positioned within the Trans Himalayan Mountain belt. The specific analysis area in Kargil is situated at an altitude of 2,888 meters above sea level, spanning between 34°36' North Latitude and 76°06' East Longitude. Geographically, it is in the north of the Indian territory, bordering Pakistan in the north, Leh district in the east, and the Kashmir valley in the west. The district is characterized by mountainous landscapes, encompassing a range of altitudes from 2,888 meters up to 7,135 meters. It features stunning valleys like Drass, Suru, Sankoo, Zankar, Chicktan, Batalik, and Sodh. Approximately 60-80% of the valley consists of arid hilly high slopes. The region is home to remarkable mountain ranges, including two prominent peaks, Nun (7,135m) and Kun (7,932m), which remain snow-covered throughout the year. Other notable peaks, such as Pinnacle Peak (6,930m), Tiger Hill (5,307m), and Tololing Peak (4,876m), attract tourists and mountaineers from around the world.

The climate in Kargil is humid, with more vegetation compared to the neighbouring district of Leh. The area is characterized by cold, barren, hilly, rocky, snow-capped

mountains, low moisture, and a dry temperate zone. During the summer season, temperatures range from 25°C to 35°C, while in winter, they drop to extremely low levels, ranging from -20°C to -35°C. Notably, two sub-regions of Kargil, namely Drass and Zankar, are among the coldest regions on Earth, with temperatures plummeting from -45°C to -55°C. The valleys in Kargil are officially closed for several months each year due to heavy snowfall, isolating them from the rest of the country. The biodiversity in the Kargil district is unique and of great conservation interest. Precipitation serves as the sole source of water for irrigation in the region.

The order Lepidoptera (Endopterygota), which comprises scaly winged insects, includes both moths (Heterocera) and butterflies (Rhopalocera). Butterflies are mobile fliers during day time (diurnal) and conspicuously attractive. They are easily noticed flying around in sunshine. On the websites of the Butterflies of India at the time of the last listing, there were 1,029 species while 1,200 moth species were recorded on the Moths of India website (Sondhi and Kunte, 2020). Particular species of butterfly diversify and get distributed according to their ability to move around, the biogeography of the area and also their ecological demands. Various species of

* Author for correspondence

butterflies visit from one flower to another as they are nectar feeders. Those species play an important role in helping plant pollination (Khan *et al.*, 2011). Butterflies play an imperative role in maintaining the food chain in the forest ecosystem. They are thought to be an essential component of insect biodiversity. Several butterflies are pollinators of various angiosperms. Their eggs, larvae (caterpillars), and adults (butterflies) are food for other animals, while the larvae cause damage to several crops. The target of the current investigation was to examine the variety of butterfly species and study the feeding habitat of butterflies in dry arid cold deserts, and short summer prairies with tropical dissymmetric environments. A recently published record from this region is of Tara and Hussain (2016), who recorded 8 species of butterflies from the Suru valley of Kargil.

Materials and Methods

Study Area

Kargil has an area of 4036 sq. km. It is located between 30-35° North latitude and 75-77° East West. The neighbouring borders of the region are Pakistan (mainly

Gilgit-Baltistan) from the North-West side, Himachal Pradesh from the South side, the Leh district from the East and Baramullah, Srinagar, Kishtiwari and Doda from the South-West side. The region is divided into four distinct categories of herbal valleys, mainly Suru Valley, Drass Valley, Indus Valley (Batalik) and the Upper Sindh Valley or Kanji Nallah Valley (Figure 1).

The landscape of Kargil is a rocky wasteland enclosed by steep mountains from the four corners, with a minimum elevation of 8,000 ft (2,888 meters). Kargil falls in the climate zone of the Himalayan rainforest, where the dry wind reaches Kargil after being deprived of its moisture in the plains and mountains of the Himalayas. The climate of the Kargil district is a combination of both desert and arctic climates. Therefore, Ladakh is generally referred to as “COLD DESERT”. Rainfall in the region is very low. Hefty snowfall in winter and mostly strong wind in the evenings of summer and autumn. Generally, the optimum snowfall in winter is around 2 to 5 feet annually. The fauna of the district includes Asiatic ibex (*Capra ibex*), Marmots (*Marmota himalayana*) snow leopard (*Panthera uncia*), Ladakh urial (*Ovisvignei vignei*), Tibetan wolf (*Canis lupus langier*), Musk deer (*Moschus*

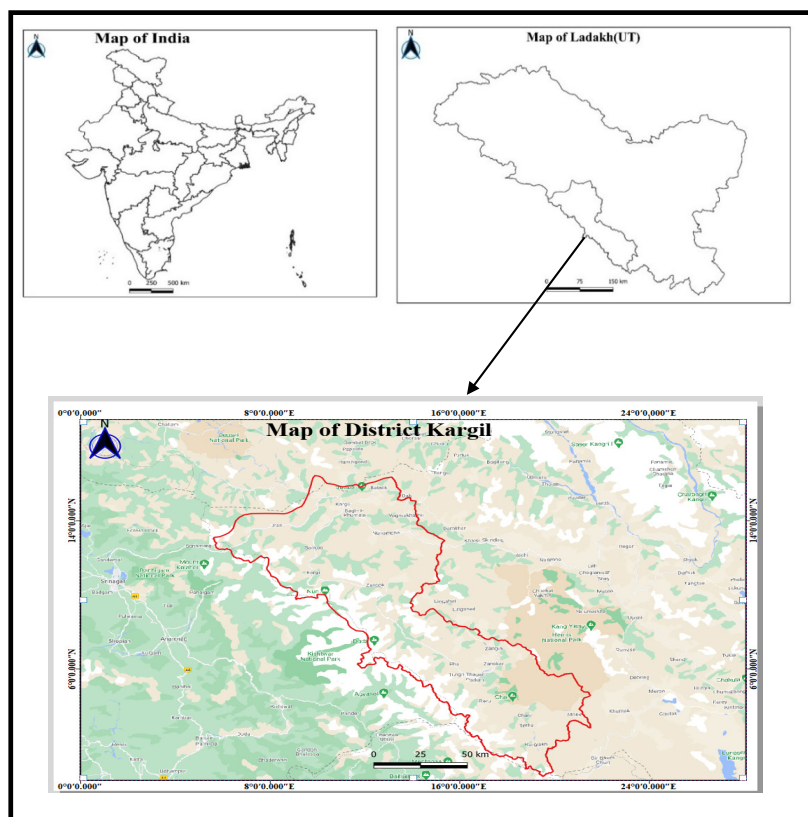


Figure 1. GIS image showing the collection sites of kargil Ladakh (U.T).

spp.), Pikas (*Ochotona ladacensis*), Himalayan Brown bear (*Ursus arctos isabellinus*), and Hares (*Lepus oirotolus*). The vegetation mainly includes Juniper (*Juniperus communis*), Poplar (*Populus species*), Willow (*Salix species*), Apple (*Malus domestica*), Apricot (*Prunus armeniaca*), Mulberry (*Morus alba*) and Sea buckthorn (*Hippo phaerhamnoides*) (Figure 2).

Collection and Preservation of Specimens

Butterflies were collected with the help of a butterfly collection net. They were transferred to glass bottles

and fumigated with ethyl acetate for killing the captured specimens. The killed specimens were placed on the stretching board and stretched following necessary procedures and precautions. The stretched specimens were dried for 72 hrs at open room temperature. Naphthalene balls were kept in the insect boxes to prevent attack of other insects or fungi on the preserved specimens. Collection was made between 9:30 am and 5:00 pm from April to September, which was the maximum butterfly activity time. Latitude, Longitude and Altitude were recorded with the aid of GPS (Table 1).



Figure 2. Photograph of Collection sites in Kargil Ladakh (U.T).

Table 1. Name of location recorded during the survey along with Latitude, Longitude and altitudinal range

S. No.	Location Name	Latitude	Longitude	Altitude
1	Shashi Mountain	34°34'01"N	76°20'05"E	4243m
2	Karkitchoo, Hardass	34°36'01"N	76°02'45"E	2681m
3	Poyen (Honakit)	34°33'42"N	76°08'28"E	2712m
4	Tambis, Kanoor, Trespone and Marpodoks-Saliskote	34°25'14"N	76°03'21"E	2820m
5	Tumail Colony, Pashkum Thang	34°32'29"N	76°09'24"E	2903m
6	Chutumail, Akchamal	34°33'22"N	76°10'58"E	3009m
7	Apati	34°34'12"N	76°12'40"E	3348m
8	Skamboo	34°27'37"N	76°14'23"E	3329m
9	Shilikchay	34°24'17"N	76°07'30"E	2659m
10	Lankerchay	34°19'06"N	76°57'26"E	2949m
11	Zanskar, Padum	33°28'03"N	76°52'54"E	3578m
12	Batalik, Gurgurdoo	34°39'24"N	76°20'21"E	2825m
13	Garkone	34°38'05"N	76°25'43"E	2757m
14	Drass, Mushkoo	34°26'11"N	75°40'05"E	3198m
15	Hagnis, Chiktan	34°29'03"N	76°28'56"E	3503m

Identification of Butterflies

Identification and classification of butterfly species were done using field guides and accessible literature. Taxonomic information on butterflies of India has been published by Evans (1932), Talbot (1939, 1947), Wynter-Blyth, (1957), Das and Verma (1965), Hilaludin (1997), Tshikolovets (2005), Kehimkar (2008), Khan *et al.*, (2011), Sindhu *et al.*, (2012), Qureshi and Bhagat (2015), Tara and Hussain (2016), Sondhi *et al.* (2017) Lamiyan and Sharma (2018) and Das *et al.* (2023). Several species of butterflies were identified from the parent department and Forest Research Institute (F.R.I) Dehradun.

Analysis of Diversity

Shannon Diversity Index (1949) (Shannon & Wiener, 1949)

The diversity of species was calculated according to Shannon-Wiener Index (H).

$$H = \sum [(P_i) * \ln (P_i)]$$

where, H = Shannon-Weiner Index

$$P_i = n_i/N$$

$$\sum = \text{Sum}$$

where, n_i = Number of individuals of each species

N = Total number of individuals of all species

ln = Natural logarithm

Species Richness

There are several richness indices for measuring richness. During the present study Margalef's Index (1970) was applied.

$$\text{Margalef's Index} = (S-1) / \ln N$$

S = Total species number

N = Total number of individuals in sample

ln = Natural logarithm

Evenness Index

Actual diversity value can be compared with the maximum possible diversity by using a measure called evenness. The formula for measuring evenness of diversity was that of Hill (1973), i.e., $E = H / \ln S$

where, S = Total number of species

N = Total number of individuals of all the species

H = Index of diversity sampling of butterflies

Simpson Index of Diversity (1-D)

Simpson (1949) is one of the commonly used and simplest diversity calculations that gives the probability that two entities taken at random from the dataset of interest represent the same type. Simpson index depends on the

number of species and their relative dominance. Index D value falls between 0 to 1. If the value comes nearer to zero, the diversity is too low; if the value comes near to one or above, diversity is too high.

$$D = \sum n_i(n_i-1)/N(N-1)$$

D = Simpson's diversity

n_i = total number of individuals of a particular species

N = total number of individuals of all species

Based on the relative abundance evaluated, butterflies were classified into three categories: very common (above 30); common (between 15–30); Un common (from 1–15).

Results and Discussion

23 species belonging to 17 genera of 3 families have been observed and collected during the present field investigation (Table 2, Figure 3). Of these, 10 species were of the family Pieridae, 8 species were from the family Nymphalidae, and 5 species were from the family Lycaenidae. The family Pieridae (5 genera) showed the highest number of species (10), followed by Nymphalidae (8 genera) 8 species and Lycaenidae (4 genera) of 5 species. The most dominant family was Pieridae, as 43% of the total species observed belonged to this family, followed by the family Nymphalidae (35%) and Lycaenidae (22%) (Figure 4).

The relative abundance study revealed that out of the total observed species, 57% species were uncommon, 26% were common species, and 17% were very common species (Figure 5). Analysis of the species diversity of butterflies showed that the highest species diversity was in the family Pieridae (2.04), followed by the family Nymphalidae (1.97), and the lowest species diversity was in the family Lycaenidae (1.53). The family Pieridae (1.69) showed the maximum species richness, followed by the family Nymphalidae (1.41) and the least species richness was recorded in the family Lycaenidae (0.88). Species evenness was reported maximum in the family Lycaenidae (0.95), followed by the family Nymphalidae (0.94) and the minimum evenness was recorded in the family Pieridae (0.90). Results of the Simpson diversity index (1-D) revealed the highest infinite diversity in the family Pieridae (0.86), followed by the family Nymphalidae (0.84) and the least diversity was reported in the family Lycaenidae (0.78) (Table 3). The family Pieridae (10 species, 44%) witnessed the highest relative abundance, followed by Nymphalidae (8 species, 34%), and the family Lycaenidae (5 species, 22%) showed the minimum relative abundance (Figure 6).

Table 2. List of butterflies (Rhopalocera) species recorded from Kargil (Ladakh)

S. No.	Scientific Name	Common name	Family	Host plant	Status
1	<i>Pontia callidice</i> (Hubner, 1800)	Lofty Bath White	Pieridae	<i>Androsace lanuginosa</i> , <i>Brassica juncea</i>	UC
2	<i>Pontia daplidice</i> (Linnaeus, 1758)	Bath White	Pieridae	<i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Fagopyrum esculentum</i> , <i>Brassica juncea</i> , <i>Taraxacum officinale</i>	VC
3	<i>Colias erate</i> (Esper, 1805)	Eastern Pale Clouded Yellow	Pieridae	<i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Taraxacum officinale</i>	VC
4	<i>Colias feldii</i> (Menetries, 1855)	Dark Clouded Yellow	Pieridae	<i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Fagopyrum esculentum</i> , <i>Brassic ajuncea</i>	UC
5	<i>Colias phiolodice</i> (Godart, 1819)	Clouded Sulphur	Pieridae	<i>Medicago sativa</i> , <i>Medicago falcate</i> , <i>Taraxacum officinale</i>	C
6	<i>Pieris brassicae</i> (Linnaeus, 1758)	Large Cabbage White	Pieridae	<i>Malus domestica</i> , <i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcate</i>	VC
7	<i>Pieris canidia</i> (Sparman, 1768)	Indian Cabbage White	Pieridae	<i>Taraxacum officinale</i> , <i>Malus domestica</i> , <i>Prunus armeniaca</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Brassica juncea</i>	C
8	<i>Pieris rapae</i> (Linnaeus, 1758)	Small Cabbage White	Pieridae	<i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Brassica juncea</i> , <i>Prunus armeniaca</i>	UC
9	<i>Gonepteryx rhamni</i> (Linnaeus, 1758)	Common Brimstone	Pieridae	<i>Taraxacum officinale</i>	UC
10	<i>Euchloe daphalis</i> (Moore, 1865)	Himalayan Pearl White	Pieridae		UC
11	<i>Celastrina argiolus</i> (Linnaeus)	Hill Hedge Blue	Lycaenidae	<i>Taraxacum officinale</i> , <i>Medica gosativa</i> , <i>Medicago falcata</i> , <i>Brassica juncea</i>	VC
12	<i>Lycaena phlaeas</i> (Linnaeus, 1761)	Common Copper	Lycaenidae	<i>Prunus armeniaca</i> , <i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcate</i>	C
13	<i>Aricia agestis</i> (Denis & Schiffermüller, 1775)	Brown Argus	Lycaenidae	<i>Taraxacum officinale</i> , <i>Medicago sativa</i> , <i>Medicago falcata</i> , <i>Brassica juncea</i> , <i>Fagopyrum esculentum</i> ,	UC

14	<i>Plebejus christophi</i> (Staudinger, 1874)	Small Jewel Blue	Lycaenidae	<i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcate</i>	UC
15	<i>Pseudophilotes vicrama</i> (Moore, 1865)	Chequered Blue	Lycaenidae	<i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcate</i>	C
16	<i>Vanessa cardui</i> (Linnaeus, 1758)	Painted Lady	Nymphalidae	<i>Prunus armeniaca</i> , <i>Malus domestica</i> , <i>Taraxacum officinale</i> , <i>Fagopyrum esculentum</i> , <i>Medicago sativa</i> , <i>Medicago falcate</i> , <i>Brassica juncea</i>	VC
17	<i>Aulocera swaha</i> (Fruhstorfer, 1911)	Common Satyr	Nymphalidae		UC
18	<i>Aglais caschmirensis</i> (Kollar, 1844)	Indian tortoiseshell	Nymphalidae	<i>Taraxacum officinale</i>	C
19	<i>Argynnis jainadeva persephone</i> (Hemming, 1934)	Ladakh Highbrown Silverspot	Nymphalidae	<i>Medicago sativa</i> , <i>Medicago falcata</i>	UC
20	<i>Hyponphele brevistigma</i> (Moore, 1893)	Short-Branded Meadow Brown	Nymphalidae	<i>Taraxacum officinale</i> , <i>Medicago sativa</i> , <i>Medicago falcata</i>	C
21	<i>Lasiommata menava</i> (Moore, 1965)	Dark Wall	Nymphalidae	<i>Taraxacum officinale</i> , <i>Medicago sativa</i> , <i>Medicago falcata</i>	VC
22	<i>Hipparchia parisatis</i> (Kollar, 1849)	White-Edged Rock Brown	Nymphalidae	<i>Medicago sativa</i> , <i>Medicago falcate</i> , <i>Morus rubra</i>	C
23	<i>Polygonia c-album</i> (Linnaeus, 1758)	Comma	Nymphalidae	<i>Taraxacum officinale</i> , <i>Brassica juncea</i>	C

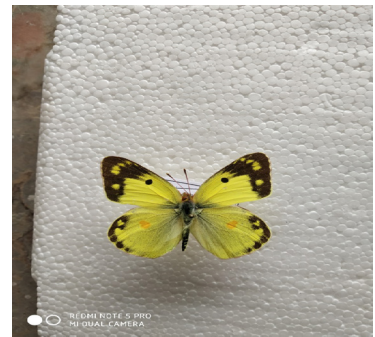
VC: Very Common, C: Common and UC: Un Common



Pontia callidice (Hubner)



Pontia daplidice (Linnaeus)



Colias erate (Esper)



Colias fieldii (Menetries)



Colias phiolodice (Godart)



Pieris brassicae (Linnaeus)



Pieris canidia (Sparman)



Pieris rapae (Linnaeus)



Gonepteryx rhamni (Linnaeus)



Euchloe daphalis (Moore)



Celastrina argiolus (Linnaeus)



Lycaena phlaeas (Linnaeus)



Figure 3. Pictorial representation of butterflies reported from Kargil Ladakh.

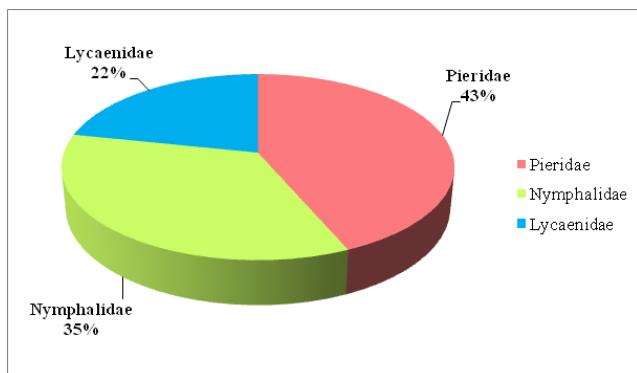


Figure 4. Percentage composition of families of butterflies.

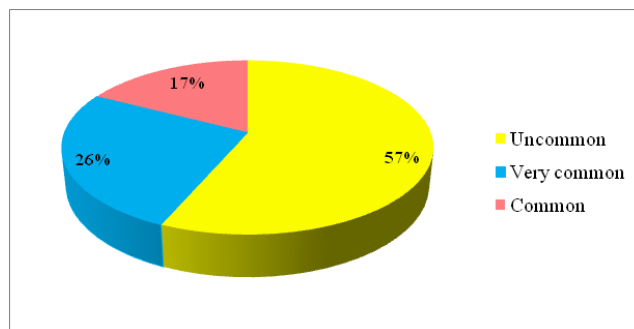


Figure 5. Status-wise composition of butterfly species.

Table 3. Shannon-Weiner diversity indices

Family	No. of species	Species diversity	Species richness	Species evenness	Simpson Index
Pieridae	10	2.08	1.69	0.90	0.86
Nymphalidae	8	1.97	1.41	0.94	0.84
Lycaenidae	5	1.53	0.88	0.95	0.78

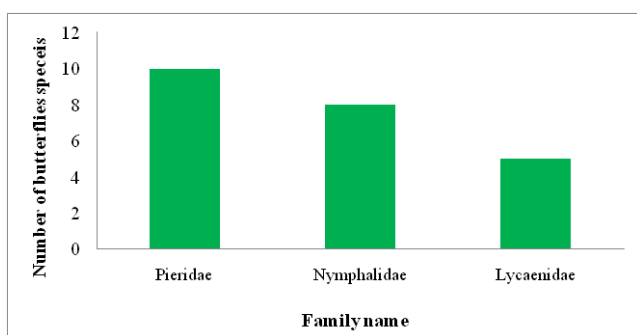


Figure 6. Percentage composition of families of butterflies.

Acknowledgements

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