



## A Preliminary Study on the Status and Distribution of Butterfly Fauna in and around the valley of Reetha Sahib, Champawat, Kumaun Himalaya, India

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**ABSTRACT:** The present study was the first attempt to determine the status and distribution of butterflies in the valley of Meetha Reetha Sahib (Ladhiya valley) located in district Champawat, Uttarakhand. No previous information is available regarding the butterflies inhabiting this region, so the area was surveyed from August, 2016 to July, 2017 based on observations and sightings for records of the butterfly fauna. The study revealed a total of 2523 individuals of butterflies belonging to 62 species and five families. Nymphalidae was the most dominant family with 33 species and averaging 53.22% of the total recorded species of butterflies from the present study area, followed by Pieridae (10 species and 16.13%), Lycaenidae (10 species and 16.13%), Papilionidae (Six species and 9.68%) and Hesperidae (Three species and 4.84%), respectively. *Pieris brassicae* (Linnaeus) was recorded as the most dominant species during the study period followed by *Pieris canidia* (Linnaeus), *Eurema hecabe* (Linnaeus) and *Euploea core* (Cramer). On the other hand, *Pseudoergolis wedah* (Kollar), *Symbrenthia lilaea* (Hewitson) and *Arhopala atrax* (Hewitson) were recorded as less abundant species during the study period. Across the seasons, higher species richness and abundance of butterflies were recorded during rainy season followed by summer and winter, respectively. Out of 62 species of butterflies recorded, 5 species are legally protected under Indian Wildlife (Protection) Act, 1972.

**Keywords:** Butterflies, Conservation, Diversity, Family, Himalayas, Seasons, Status.

### INTRODUCTION

In the present scenario, an accelerated rate of biodiversity loss is one of the global challenges faced by mankind (European Commission, 2001). Worldwide, over 11,000 species of plants and animals are threatened to face a high risk of extinction in the near future as a result of human activity augmented by global climate change (Saraf and Murali, 2017). Around the world, butterflies are regarded as one of the most well taxonomically and ecologically studied group of insects belonging to the order Lepidoptera (Robbins and Opler, 1997 and Mihoci *et al.*, 2011). Butterflies prefer a particular set of habitats and host plants for their survival. Being sensitive to the temperature, humidity and light levels and also to disturbances and changes in the quality of habitat they are regarded as potential indicator species of environmental quality and healthy ecosystems (Gunathilagaraj *et al.*, 1998, Balmer and Erhardt,

2000; Hogsden and Hutchinson, 2004 and Thomas, 2005). There are about 1,504 species of butterfly fauna in the Indian subcontinent (Tiple, 2011) and 323 species of butterfly fauna have been recorded from the state of Uttarakhand (Kumar, 2008). Uttarakhand hosts a range of diverse floral and faunal richness. Geographically, it shares the part of both Central and Western Himalayan region and is located in the central sector of Himalaya, thus owing to its vivid and rich biodiversity. Several studies on butterfly diversity have been conducted in this state which is either confined to only protected areas (Arora, 1995; Arora, 1997; Uniyal, 2004; Joshi, 2007; Joshi and Arya, 2007; Singh, 2009; Bhardwaj and Uniyal, 2011; Bhardwaj *et al.*, 2012; Tewari and Rawat, 2013; Arya and Dayakrishna, 2017 and Kumar *et al.*, 2017) or in few specific habitats (Singh and Bhandari, 2003; Tyagi *et al.*, 2011; Smetacek, 2012 and Arya *et al.*, 2016).

However, such distribution records for species of butterfly is substantially lacking from the present study site lying in the north-eastern part of the state which holds a poor record of insect fauna. So, the present work aims to assess the species composition, status and seasonal diversity of butterflies in the valley of Reetha Sahib of district Champawat.

## MATERIAL AND METHODS

### A. Study Area

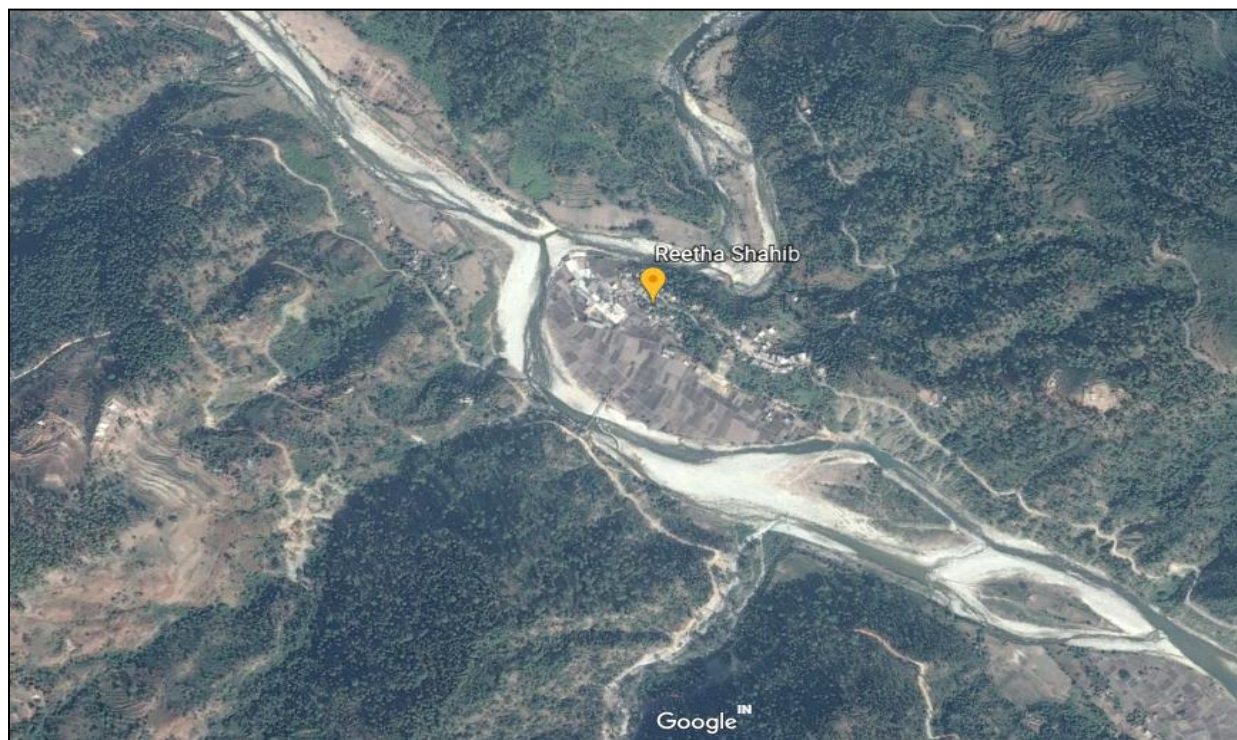
The present study site Meetha Reetha Sahib (29°17' N Latitude and 79°52' E Longitude) lying between Shivalik and middle Himalayan mountain range at an elevation of 940m above msl in the Kumaun Himalaya is renowned for its scenic beauty and religious history. The reverent sacred Sikh Shrine in the study area is located on the confluence of Ladhiya and Ratiya rivers, near village Deyuri of district Champawat, Uttarakhand (Image 1). The mystically sweet tasted edible fruits of *Sapindus* (Reetha/ soapnut plant) grown here only is often given as 'Prasad' to the pious devotees (Image 2). The region is set in a valley surrounded by mountains containing vegetation of sub-tropical sal mixed forest type. The dominant plant species include *Shorea robusta*, *Mallotus philippinensis*, *Syzygium cumini*, *Pinus roxburghii*,

*Ficus* sp., *Adina cordifolia*, *Boehmeria rugulosa*, *Mangifera indica*, *Citrus* sp., *Callicarpa macrophylla*, *Justicia adhatoda*, *Woodfordia fruticosa*, *Ricinus communis*, *Persea odoratissima*, *Eupatorium odoratum*, *Lantana camara* etc. Some part of the land nearby the riverine habitat is cultivated for agricultural practices by local villagers (Image 3).

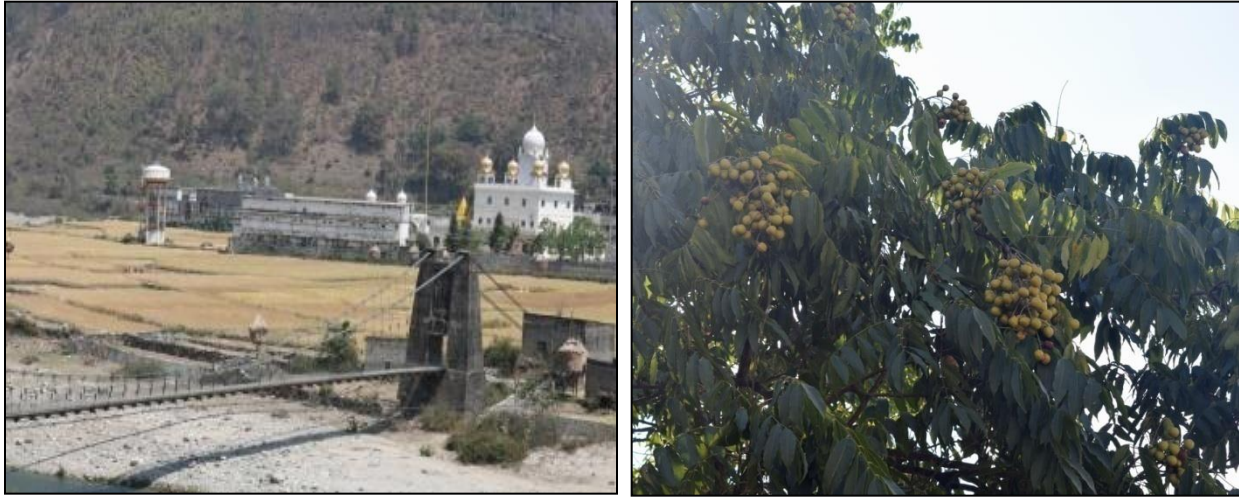
The climate of the study area is of sub-tropical type, characterized by hot summer season (March-June), moist and wet rainy season (July-October) and cold winter season (November- February). During peak festival seasons heavy influx of pilgrims and other anthropological activities such as lopping, collection of minor and major forest products, felling of trees are among the recorded levels of disturbances.

### B. Survey and Identification of Butterflies

The present study was conducted during three different seasons (summer, rainy and winter) from August, 2016 to July, 2017. The butterfly survey in and around the valley of Meetha Reetha Sahib and along the sides of river was made by direct observations along the distance of 50m on either side of transect and by random walks mostly during the morning (08:00–11:00 hr) and in the evening (3:00–17:00 hr).



**Image 1:** Map showing the location of present study site (Ladhiya valley) in Kumaun Himalaya.



**Image 2:** Photographs showing sacred Sikh Shrine located at Ladhiya River in the valley of Meetha Reetha Sahib alongwith its renowned plant of sweet tasted fruits named *Sapindus* (Reetha/soapnut plant).



**Image 3:** Photographs depicting certain selected areas of sampling where transects were laid down in order to determine species composition and abundance of butterflies during the study period.

The butterflies were identified with suitable literature and butterfly identification guides (Haribal, 1992; Kumar, 2008; Kehimkar, 2014 and Singh, 2017).

#### *C. Species Composition and Status of Butterflies*

An inventory of different identified species of butterflies placed in accordance to their families was prepared to determine the species composition of the present study area. Status of butterflies was evaluated as per the number of sightings in the study area and were categorized as Very Common (more than 100 sightings), Common (41-100

sightings), Uncommon (11-40 sightings) and Rare (1-10 sightings).

#### *D. Seasonal Variation in Diversity*

Using the program PAST (2005), various measures of diversity indices (dominance, richness, Shannon diversity and evenness) were calculated in order to quantify the seasonal variation of butterflies.

### **RESULTS AND DISCUSSION**

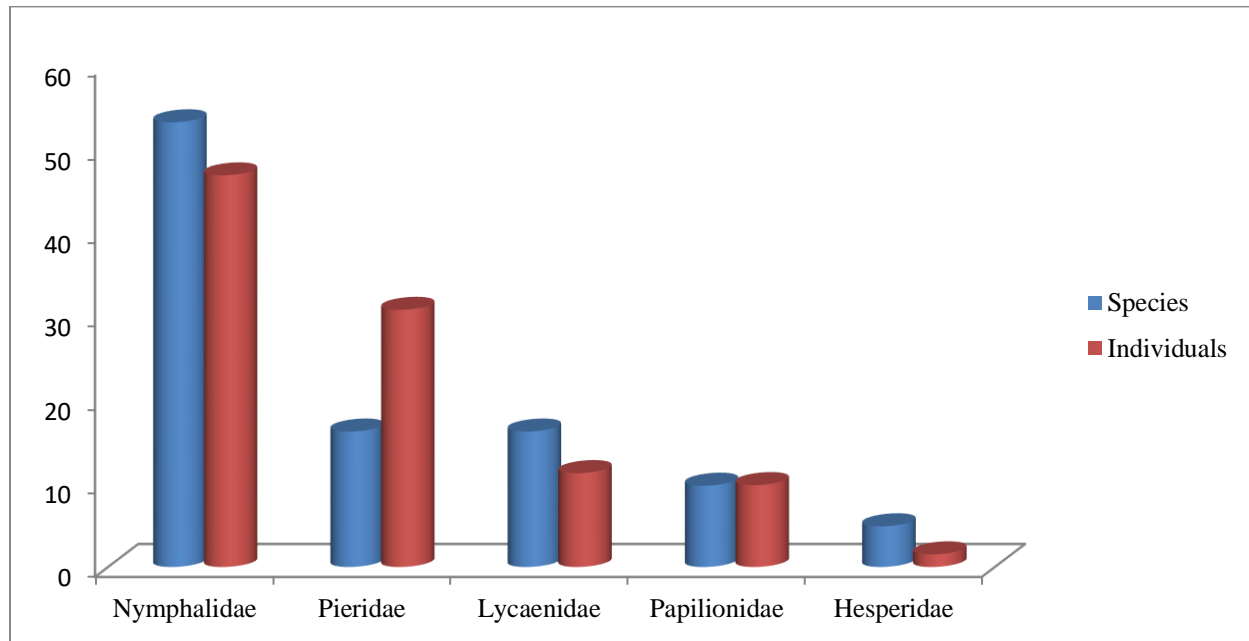
A total of 2523 individuals of butterflies belonging to 62 species and five families recorded from the entire valley of Meetha Reetha Sahib have been given in Tables 1 and 2.

Of these, Nymphalidae was the most dominant family with 33 species and averaging 53.22% species richness of total species, followed by Pieridae (10 species and 16.13%), Lycaenidae (10 species and 16.13%), Papilionidae (Six species and 9.68%) and Hesperidae (Three species and 4.84%), respectively. In terms of number of individuals, family Nymphalidae was dominant again with 46.85%, followed by Pieridae (30.72%), Lycaenidae (11.18%), Papilionidae (9.75%) and Hesperidae (1.50%), respectively (Table 1 and Fig. 1). On the basis of number of sightings, four species of butterflies were recorded as very common constituting 6.45% of total recorded butterflies

followed by common- 23 species (37.10%), uncommon- 30 species (48.39%) and rare- 5 species (8.06%) (Table 2 and Fig. 2). In spite of being a preliminary one, our study results has indicated a rich assemblage of butterfly fauna in the region. In many habitats, plants community determines the physical structure of the environment, thus influencing the distribution of the animal species (Lawton, 1983). The topography and varied floral diversity of the study area which comprises agricultural crops, many cultivated and wild trees, shrubs, herbs and grasses might be attributed for overall diversity of the butterfly fauna as plants constitute their larval and adult food sources.

**Table 1: Percentage contribution of relative number of species and individuals of different families of butterflies recorded from the study site.**

S. No.	Family	Number of species	Percent of species (%)	Number of individuals	Percent of individuals (%)
1.	Nymphalidae	33	53.22	1182	46.85
2.	Pieridae	10	16.13	775	30.72
3.	Lycaenidae	10	16.13	282	11.18
4.	Papilionidae	6	9.68	246	9.75
5.	Hesperidae	3	4.84	38	1.50
<b>TOTAL</b>		<b>62</b>	<b>100</b>	<b>2523</b>	<b>100</b>



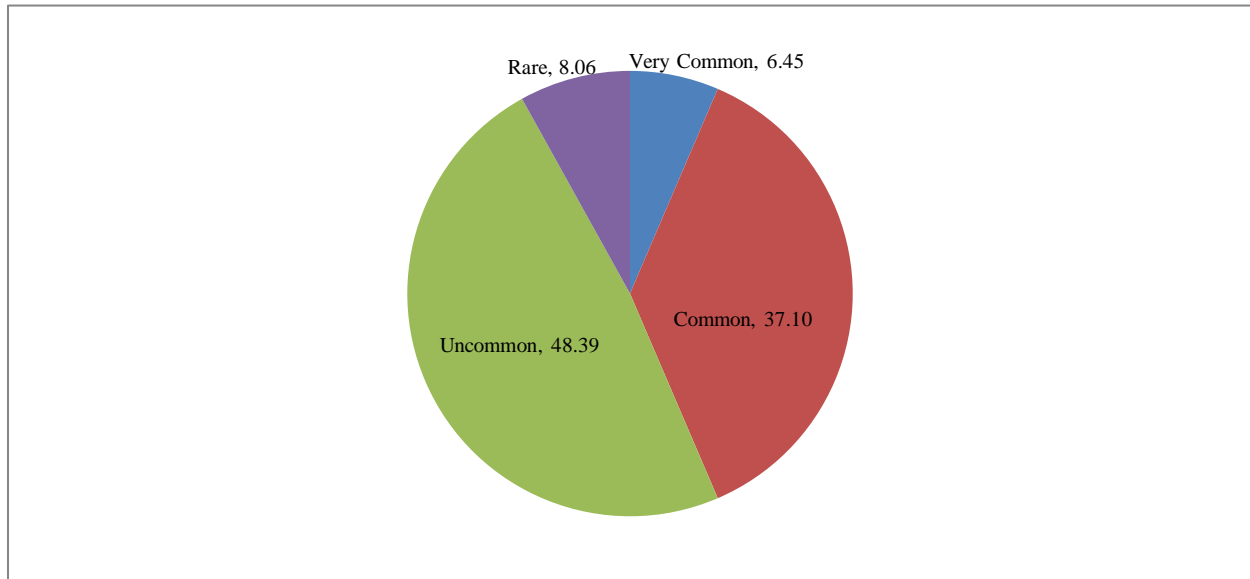
**Fig. 1.** Percentage contribution of relative number of species and individuals of different families of butterflies recorded from the study site from August, 2016 to July, 2017.

**Table 2: Species composition and status of butterflies recorded from the study site (C= Common; UC= Uncommon; VC= Very common and R= Rare).**

S.No.	Scientific Name	Common Name	Status	Relative Abundance
<b>PAPILIONIDAE</b>				
1.	<i>Graphium sarpedon</i> (Linnaeus)	Common BlueBottle	C	1.74
2.	<i>Pachliopta aristolochiae</i> (Fabricius)	Common Rose	UC	0.55
3.	<i>Papilio demoleus</i> Linnaeus	Lime Butterfly	UC	1.34
4.	<i>Papilio paris paris</i> Linnaeus	Paris Peacock	UC	1.34
5.	<i>Papilio polyctor</i> (Boisduval)	Common Peacock	C	1.66
6.	<i>Papilio polytes</i> Linnaeus	Common Mormon	C	3.10
<b>HESPERIDAE</b>				
7.	<i>Parnara guttata</i> (Bremer & Grey)	Straight Swift	UC	0.52
8.	<i>Pseudoborbo bevani</i> (Moore)	Bevan's Swift	UC	0.64
9.	<i>Tagiades cohaerens cynthia</i> Evans	Evan's Snow flat	R	0.36
<b>PIERIDAE</b>				
10.	<i>Catopsilia pomonina</i> (Fabricius)	Common Emigrant	C	2.18
11.	<i>Catopsilia pyranthe</i> (Linnaeus)	Mottled Emigrant	C	1.95
12.	<i>Colias fieldii</i> Menetries	Dark Clouded Yellow	UC	1.18
13.	<i>Eurema brigitta</i> (Stoll)	Small Grass Yellow	C	2.95
14.	<i>Eurema hecabe</i> (Linnaeus)	Common Grass Yellow	VC	4.60
15.	<i>Eurema laeta</i> (Boisduval)	Spotless Grass Yellow	C	3.54
16.	<i>Gonepteryx nepalensis</i> Doubleday	Himalayan Brimstone	C	1.74
17.	<i>Pieris brassicae</i> (Linnaeus)	Large Cabbage White	VC	7.33
18.	<i>Pieris canidia</i> (Linnaeus)	Indian Cabbage White	VC	4.76
19.	<i>Pontia daplidice</i> (Linnaeus)	Bath White	UC	0.52
<b>LYCAENIDAE</b>				
20.	<i>Acytolepis puspa</i> (Horsfield)	Common Hedge Blue	C	2.18
21.	<i>Arhopala atrax</i> (Hewitson)	Indian Oak Blue	R	0.31
22.	<i>Dodona durga</i> (Kollar)	Common Punch	C	2.14
23.	<i>Eures lacturnus</i> (Godart)	Indian Cupid	UC	0.80
24.	<i>Heliophorus sena</i> (Kollar)	Sorrel Sapphire	C	2.37
25.	<i>Lampides boeticus</i> (Linnaeus)	Pea Blue	UC	1.27
26.	<i>Lycaena pavana</i> (Westwood)	White Bordered Copper	UC	0.43
27.	<i>Talicauda nyseus</i> (Guerin-Meneville)	Red Pierrot	UC	0.52
28.	<i>Deudorix epijarbas</i> (Moore)	Cornelian	UC	0.52
29.	<i>Zemeros flegyas</i> (Cramer)	Punchinello	UC	0.63
<b>NYMPHALIDAE</b>				
30.	<i>Aglais cashmiriensis</i> (Kollar)	Indian Tortoiseshell	C	3.25
31.	<i>Argyreus hyperbius</i> (Linnaeus)	Indian Fritillary	UC	0.91
32.	<i>Ariadne merione</i> (Cramer)	Common Castor	UC	1.30
33.	<i>Athyma opalina</i> (Kollar)	Himalayan Sergeant	R	0.36
34.	<i>Athyma perius</i> (Linnaeus)	Common Sergeant	UC	1.23
35.	<i>Callerebia ananda</i> (Moore)	Ringed Argus	C	1.98
36.	<i>Cupha erymanthis</i> (Drury)	Rustic	C	1.94
37.	<i>Cynitia lepidea</i> (Butler)	Grey Count	UC	0.68
38.	<i>Cyrestis thyodamas</i> Boisduval	Common Map	UC	0.43
39.	<i>Danaus chrysippus</i> (Linnaeus)	Plain Tiger	C	2.54
40.	<i>Danaus genutia</i> (Cramer)	Striped Tiger	C	2.26
41.	<i>Euploea core</i> (Cramer)	Common Crow	VC	4.32
42.	<i>Euploea mulciber</i> (Cramer)	Striped Blue Crow	UC	1.19
43.	<i>Junonia almana</i> (Linnaeus)	Peacock Pansy	UC	1.15
44.	<i>Junonia atlites</i> (Linnaeus)	Grey Pansy	UC	1.35
45.	<i>Junonia hierta</i> (Fabricius)	Yellow Pansy	C	2.06
46.	<i>Junonia iphita</i> (Cramer)	Chocolate Pansy	C	3.33
47.	<i>Junonia lemonias</i> (Linnaeus)	Lemon Pansy	C	1.74
48.	<i>Junonia orithiya</i> (Linnaeus)	Blue Pansy	C	2.98

Table 2 continued...

S.No.	Scientific Name	Common Name	Status	Relative Abundance
<b>NYMPHALIDAE</b>				
49.	<i>Lethe confusa</i> Aurivillius	Banded Treebrown	UC	0.99
50.	<i>Lethe rohria</i> (Fabricius)	Common Treebrown	UC	0.52
51.	<i>Mycalesis perseus</i> (Fabricius)	Common Bushbrown	UC	0.43
52.	<i>Neptis hylas</i> (Linnaeus)	Common Sailer	C	1.58
53.	<i>Parantica aglea</i> (Stoll)	Glassy Tiger	C	2.06
54.	<i>Phalanta phalantha</i> (Drury)	Common Leopard	UC	0.43
55.	<i>Pseudoergolis wedah</i> (Kollar)	Tabby	R	0.24
56.	<i>Symbrenthia lila</i> (Hewitson)	Common Jester	R	0.28
57.	<i>Vagrans sinha</i> (Kollar)	Vagrant	UC	0.60
58.	<i>Vanessa cardui</i> (Linnaeus)	Painted Lady	UC	0.43
59.	<i>Vanessa indica</i> (Herbst)	Indian Red Admiral	C	1.74
60.	<i>Ypthima baldus</i> (Fabricius)	Common Five-ring	UC	0.83
61.	<i>Ypthima huebneri</i> Kirby	Common Four-ring	UC	1.22
62.	<i>Ypthima narenda</i> (Kollar)	Large Three-ring	UC	0.48

**Fig. 2.** Status of butterflies (in percentage) observed from the study site from August, 2016 to July, 2017.

In addition, the plant species which acts as rich source of nectar influence the occurrence of butterfly species (Tiple *et al.*, 2007). Butterflies belonging to families Pieridae and Nymphalidae are very common in our study area and *Lantana camara* and *Tagetes* sp. acts as major source of nectar for the butterflies. On the basis of relative abundance of butterflies *Pieris brassicae* (Linnaeus) which constituted 7.33% of total individuals of butterflies recorded was the most dominant species during the study period followed by *Pieris canidia* (Linnaeus) (4.76%), *Eurema hecabe* (Linnaeus) (4.60%), *Euploea core* (Cramer) (4.32%), *Eurema laeta* (Boisduval) (3.54%), *Junonia iphita* (Cramer)

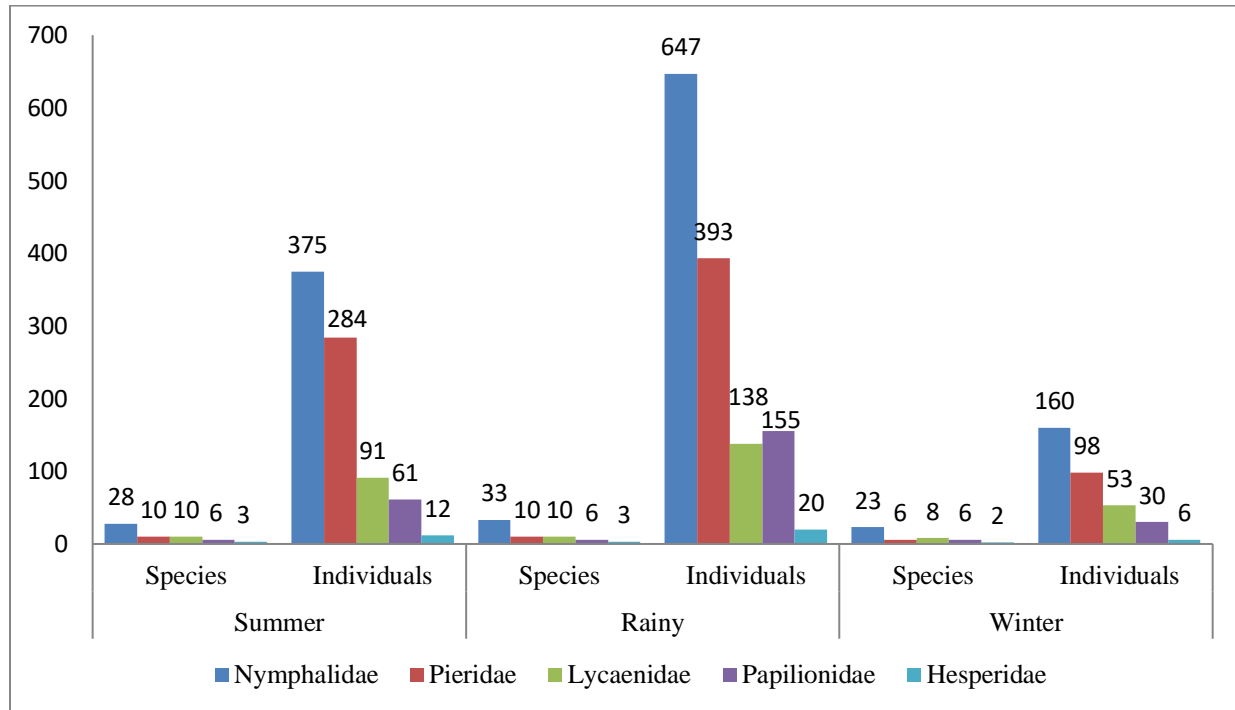
(3.33%), *Aglais cashmirensis* (Kollar) (3.25%) and *Papilio polytes* Linnaeus (3.10%). On the other hand, *Pseudoergolis wedah* (Kollar) (0.24%) was recorded as least abundant species during the entire study period followed by *Symbrenthia lila* (Hewitson) (0.28%), *Arhopala atrax* (Hewitson) (0.31%), *Athyma opalina* (Kollar) (0.36%) and *Tagiades cohaerens cynthia* Evans (0.36%) (Table 2). Out of 62 species of butterflies recorded, five species namely *Acytrolepis puspa* (Horsfield), *Deudorix epijarbas* (Moore), *Lampides boeticus* (Linnaeus), *Euploea core* (Cramer) and *Euploea mulciber* (Cramer) are legally protected under Indian Wildlife (Protection) Act, 1972.

Fig. 3 shows the family wise seasonal variation of butterflies observed during the entire study period. Abundance of butterflies was found to be varied across different seasons. Among the recorded species, family Nymphalidae revealed significant seasonal variation in species richness however; family Papilionidae showed similar pattern of species richness. Maximum number of species and individuals of butterflies were recorded during the rainy season (62 species and 1353 individuals),

related to the availability of better larval host plants stimulated by high rainfall in monsoon (Kunte, 1997) followed by summer (57 species and 823 individuals) and winter (45 species and 347 individuals), respectively (Fig. 4). The diversity indices that were calculated have been presented in Table 3 providing information about distribution of butterflies across different seasons during the study period.

**Table 3: Seasonal variation in diversity indices of butterflies observed during the study period.**

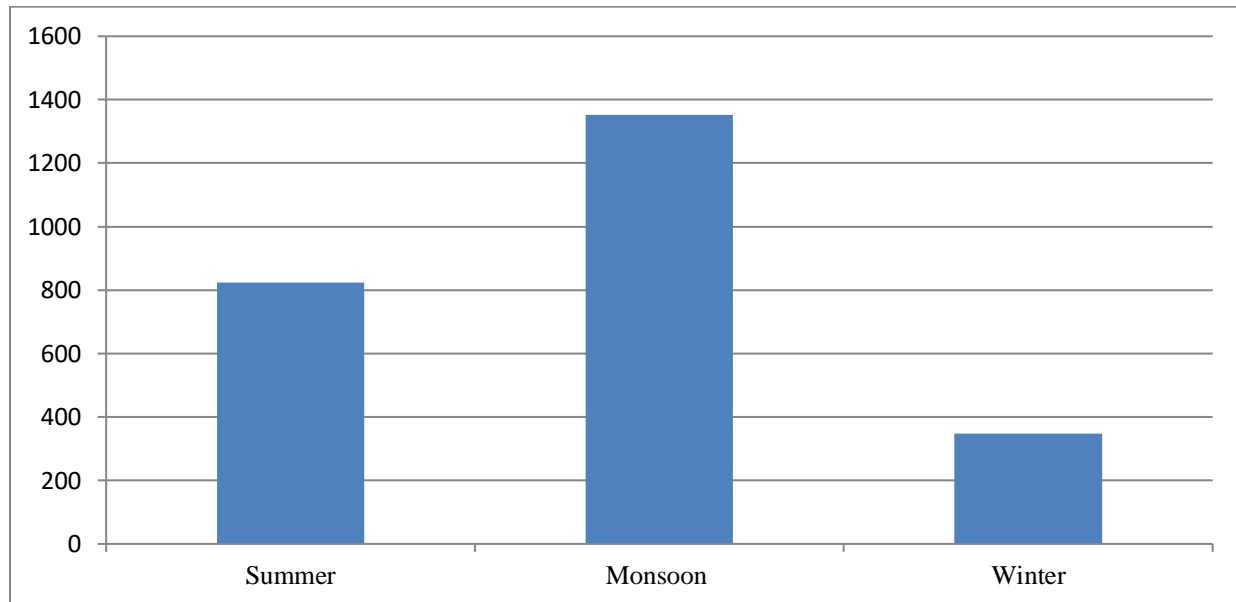
Indices	Season			Total
	Summer	Rainy	Winter	
Simpson	0.9597	0.9748	0.9594	0.973
Shannon	3.638	3.858	3.481	3.84
Margalef	8.342	8.46	7.522	7.787
Equitability/ Pielou (J')	0.8998	0.9347	0.9145	0.9303



**Fig. 3.** Family wise seasonal variation of butterflies in terms of number of species and individuals recorded from the study site from August, 2016 to July, 2017.

Shannon Wiener Diversity index ( $H'$ ) was calculated as 3.84 for overall samplings indicating rich diversity for the sampled area. During the study period maximum species diversity was recorded in rainy season (3.858) followed by summer (3.638) and winter (3.481). Margalef's Diversity Index ( $D$ ) was used to determine species richness. Rainy season had the highest Margalef index of 8.46; summer season had a value of 8.342 while the winter season had the least value of 7.522.

Simpson's Dominance Index ranged from 0.9594 to 0.9748 which is nearer to 1, indicating the dominance of certain species of butterflies as *Pieris brassicae* (Linnaeus), *Pieris canidia* (Linnaeus), *Eurema hecabe* (Linnaeus), *Euploea core* (Cramer) etc. Moreover, Pielou's Evenness Index ( $J'$ ) for the butterfly communities is 0.9303 which expresses that species were evenly distributed during the entire study period.



**Fig. 4.** Seasonal occurrence of individuals of butterflies recorded from the study site from August, 2016 to July, 2017.

Such pattern of butterflies throughout the year found to be similar in accordance with observations that have also been recorded earlier (Joshi and Arya, 2007; Tyagi *et al.*, 2011 ; Arya *et al.*, 2016 and Arya and Dayakrishna, 2017). Based on such studies it is observed that the area is rich in biological resources especially for butterfly community and in order to maintain faunal richness there should be planning for butterfly conservation and provisions for ecotourism.

## CONCLUSION

Our investigations on butterflies emphasises the importance of the study area in terms of preferred habitat providing them food and better breeding sites. The total numbers of recorded butterfly fauna from the present study site constituted 19.20% of butterflies from Uttarakhand, India. The provided information can be used for formulating any imperative measures on butterfly conservation that should be adopted for maintenance of sacrosanctity and sustainability of the habitat. It is also suggested that the present checklist should not be considered conclusive as there is a need for further elaborative studies and taxonomic additions from the present study site.

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