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## Effect of anthropogenic factors on the species distribution of nymphalid and pierid butterflies in five different locations of Garhwal and Kumaun region of Uttarakhand, India

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### Abstract

Taking the increasing anthropogenic pressure and its drastic outcomes on the distribution of vegetation and fearful environmental changes into the consideration following study was done to observe the difference in butterfly biodiversity of two families, Nymphalidae and Pieridae in five different places of Uttarakhand and to observe their relationship with local environmental conditions. A total number of 2887 individuals comprising 39 species of butterflies belonging to 2 families, Pieridae and Nymphalidae were recorded during the surveys carried out in 5 different sites situated at different elevation gradients i.e. Chamoli, Kedarnath, Bageshwar and Almora and Dehradun. Butterfly population was found to be correlated with the human population as well as, with the distribution of vegetation. Maximum numbers of butterflies were recorded from Chamoli followed by Almora and Dehradun. The least number of butterflies were recorded from Kedarnath, due to the comparatively higher elevation and lesser temperature as compared to the other location. Due to high anthropogenic impact in Bageshwar a low population of butterflies were recorded, when compared to a much bigger city Dehradun with a better butterfly count.

**Keywords:** Nymphalidae, Pieridae, anthropogenic pressure, biodiversity, Uttarakhand

### 1. Introduction

Insects comprise a total of more than 53% of the recorded almost 1.4 million species of living organisms on the planet earth, out of which Coleoptera, Lepidoptera and Diptera are the insect Orders which has the highest number of species. According to the recent records, the Order Lepidoptera may have the higher number of species than earlier records <sup>[1]</sup>. As per importance it is one of the most important insect order in agriculture and also a widespread and widely recognized insect order in the world. Linnaeus <sup>[2]</sup> recognized three divisions of the Lepidoptera, i.e., *Papilio*, *Sphinx* and *Phalaena*, with seven subgroups in *Phalaena*. These three divisions consist today as 46 super families of order Lepidoptera. Under these 46 superfamilies estimated 174,250 species have been recorded <sup>[3]</sup>, which are further divided in 126 families. Among 174,250 described species of Lepidopteran in 2007, butterflies and skippers are estimated to comprise approximately 17,950 <sup>[4]</sup>.

Butterflies have been admired for centuries for their physical beauty. Butterflies and moths offer good opportunities for studies on population and community ecology <sup>[5]</sup>. Butterflies have a vital position in the ecosystem and their occurrence and diversity are considered as good indicators of the health of any given terrestrial biotope. Butterflies are also good indicators of environmental changes as they are sensitive to habitat degradation and climate change. Many species are strictly seasonal, preferring only a particular set of habitats. In spite of this, butterflies have been generally neglected by community ecologists and there are very few studies available on their community structures, population dynamics and the eco climatic factors which affect them. Being good indicators of climatic conditions as well as seasonal and ecological changes, they can serve in formulating strategies for conservation. However, they have largely been ignored by conservation biologists and policy-makers as well. It is hence encouraging that butterflies are now being included in biodiversity studies and biodiversity conservation prioritization programmes <sup>[6]</sup>. The Indian subcontinent has a diverse terrain, climate and vegetation, hosts about 1,504 species of butterflies <sup>[7]</sup>. The present study was carried out in order to assess the effect of human population on species richness and diversity

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of butterflies, mainly of two orders viz. Nymphalidae and pieridae in five observation sites of Garhwal and Kumaun region of Uttarakhand, India.

## 2. Material and Methods

### 2.1 Study sites

The five study areas, Kedarnath, Chamoli, Bageshwar, Almora and Dehradun are located in Garhwal and Kumaun region of western Himalayan range with different elevation gradients from 2140ft to 11614ft in five different districts, Rudraprayag, Chamoli, Bageshwar, Almora and Dehradun respectively. Progressing from east to west, the Himalayan range west of Nepal is divided into the Kumaun Himalaya with Nainital as the principal town; the Garhwal Himalaya, with Mussoorie and Dehradun as the principal towns; Himachal Pradesh with Shimla and Kulu as the principal town; Kashmir, with Jammu the principal town in the outer ranges, and the Pakistan Himalaya, with the hill station of Mussoorie. This area is known as the Western Himalaya. Butterflies belonging to two families, Nymphalidae and Pieridae were caught from 5 different elevations viz. Dehradun, Chamoli, Bageshwar, Almora and Kedarnath of Uttarakhand, with a different human population.

#### 2.1.1 Dehradun

Dehradun is a densely populated city, lying in the base of Doon Valley, which also has the famous hill stations like Mussoorie and Chakrata in it along with the Shiwalik hills and Lesser Himalayan Range. Dehradun is situated at an altitude of 652m / 2140ft above mean sea level and lies between 30.31649N latitude and 78.03219E longitude. Collection from this site was done from the 4 different localities, Rajpur, Clement town, Forest Research Institute and Dharampur, situated at different locations in the city.

#### 2.1.2 Chamoli

Second collection site was Chamoli, which is situated at an altitude of 1550m / 5090ft above mean sea level and lies between 30.2937439N latitude and 79.560344E longitude. Collection was done in nearby areas like Alkapuri, Kothiyalsain, and Math villages with a moderately dense forest of pine and oak trees with a moderate level of anthropogenic pressure.

#### 2.1.3 Bageshwar

Bageshwar town is situated at the basin of river Saryu and Gomati at an altitude of 1004m / 3294ft above mean sea level and lies between 29.85N latitude and 79.766667E longitude. This collection site contains a Pine dominated forests around a highly dense human population. The temperature ranges between 11°C in the month of January to 27.3°C in the month of June. The vegetation includes Pine dominated forest with other types of shrubs and herbs. Study site receives a high level of disturbance due to the population and very less vegetation in the town area.

#### 2.1.4 Almora

Almora is located on a ridge at the southern edge of the Kumaun hills of the Himalaya range, at an altitude of 1649m / 5410ft and lies in between 29.58924N latitude and 79.64667E longitude with a high anthropogenic pressure along with a moderately dense forest of oak and pine, in and around of the city.

#### 2.1.5 Kedarnath

Kedarnath is a holy place for Hindus located in district Rudraprayag. The Kedarnath and surrounding area is rich in biological diversity and is one of the most important regions of Garhwal Himalaya. The area of Kedarnath selected for this study is a particularly remote area, and the human population residing in the area is very less and is fully dependent on forest resources. It is situated at an altitude of 3553m / 11614ft above mean sea level and lies between 30.734627N latitude and 79.066895E longitude, within a dense forest with great diversity. The highest and lowest temperature recorded at an altitude of 3050m has been 25°C and -10°C respectively [8]. The site is snow bound for three months in the year after a heavy snowfall in December.

### 2.2 Study on butterfly biodiversity collected from three different study sites

The butterflies were collected by "Sweep Net Sampling Method", as per Gadagkar *et al.*, [9]. Specimens were identified with help of literature available [10, 11] and identification keys [12, 13].

## 3. Result and Discussion

To study the effects of anthropogenic factors on butterfly biodiversity in five different areas having different human population were surveyed during the year of 2015 and the study after collection of 2887 individuals belonging to 2 different families viz. Pieridae and Nymphalidae. The result of the present investigation presented and discussed as follows.

A total of 2887 individuals of 39 species of butterflies, belonging to 2 families namely Pieridae, and Nymphalidae were recorded during the surveys in 5 different areas with different human population, which has been shown in table 1. The perusal of table 1 depicted that Bageshwar, having dense population and low vegetation in and around the city has the lowest number of butterfly species with less diversity, whereas in Dehradun, city with higher human population than Bageshwar but comparatively sufficient vegetation in and around the city was having far greater butterfly population with a better butterfly biodiversity. A total of 205 butterflies of 24 species, out of which 106 butterflies of 10 species belonging to family Pieridae and 99 butterflies of 14 species, belonging to family Nymphalidae were recorded from Bageshwar, which was far lesser than the number of species recorded in a more populated but more densely vegetated city area of Dehradun, where a total of 594 butterflies from 33 species, out of which 227 butterflies from 12 species belonging to family Pieridae and 367 butterflies of 21 species belonging to family Nymphalidae were recorded.

A total of 922 butterflies of 36 species out of which, 359 butterflies of 13 species, belonging to family Pieridae and 564 butterflies from 23 species, belonging to family Nymphalidae were collected from Almora, a hill station which is densely populated but has an adequate amount of vegetation in between the city area with a dense forest around the city. Whereas, a total of 968 butterflies were recorded with 363 butterflies from 13 species, belonging to family Pieridae and 605 butterflies from 22 species, belonging to family Nymphalidae from Chamoli, which is moderately populated station and has a fair amount of vegetation around the area. At lastly, in Kedarnath, total 198 butterflies belonging to 14 different species of two families, were found during the survey, out of which, 39 butterflies were from 3 different

species, belonging to family Pieridae and 159 butterflies were from 11 species, belonging to family Nymphalidae.

This result shows a drastic effect of dense human population and unplanned development on distribution and abundance of butterfly population in these different locations. Least number of butterflies was found in Kedarnath, location which is situated at 3553m height from mean sea level. On the other hand Bageshwar, from where only 205 butterflies were recorded, has shown the correlation between, dense human population and unplanned development in and around the city area. Whereas, while comparing it with the butterfly population recorded from Almora, which is situated at a more or less similar altitude, has more butterfly biodiversity due to a planned development and moderately dense vegetation in and around the city.

Singh <sup>[14]</sup> have also done a study on altitudinal variation in six different species of family Pieridae and Nymphalidae in Kumaun region of Uttarakhand and have found 19 species

belonging to family Pieridae and 10 species belonging to family Nymphalidae. Smetacek <sup>[15]</sup> have studied the effects of lower atmospheric humidity and forest fire on the distribution of butterflies in Maheshkhan Reserve Forest, Nainital, and Uttarakhand. The study site was situated at an elevation of 2600m above the mean sea level. Whereas, one of the sites in this study, Kedarnath situated at 3553m above the mean sea level and a total of 14 species, 3 species belonging to family Pieridae and 11 species belonging to family Nymphalidae were present abundantly in this study site as well. Out of 39 species, 3 species viz. *Polyura dolon*, *Athyma asura* and *Polygonia egea agnicula* belonging to family Nymphalidae were found in Kedarnath region only and has supported the earlier study of Arun P Singh <sup>[16]</sup> who studied the butterfly population of Kedarnath Musc Deer Reserve in 2009. This shows the higher adaptation of these butterfly species for a low temperature conditions.

**Table 1:** Individuals and species of butterflies recorded from five locations

S. No.	Species	DDN	CHM	BGS	ALM	KDN	Total
<b>Family: Pieridae</b>							
1.	<i>Pieris brassicae</i>	28	44	20	31	9	132
2.	<i>Pieris canidia</i>	22	29	11	35	3	100
3.	<i>Gonepteryx rhamni</i>	32	44	17	40	-	133
4.	<i>Colias fieldii</i>	19	35	9	29	27	119
5.	<i>Colias erate</i>	-	8	-	11	-	19
6.	<i>Delias eucharis</i>	22	36	10	33	-	101
7.	<i>Colias crocerus</i>	21	31	8	29	-	89
8.	<i>Aporia agathon</i>	29	48	12	46	-	135
9.	<i>Pieris daplidice moorei</i>	9	14	3	18	-	44
10.	<i>Pieris ontana ajaka</i>	25	39	12	41	-	117
11.	<i>Catopsilia pyranthe</i>	3	6	-	9	-	18
12.	<i>Catopsilia pomona</i>	2	3	-	1	-	6
13.	<i>Atrophaneura latreillei</i>	15	26	4	35	-	80
<b>Family: Nymphalidae</b>							
14.	<i>Symbrenthia lilae</i>	24	31	5	36	-	96
15.	<i>Aglais cashmireneis</i>	43	52	19	46	36	196
16.	<i>Callerebia annada caeca</i>	22	32	10	35	19	118
17.	<i>Mycalasis perseus</i>	23	34	3	30	-	90
18.	<i>Neptis harita</i>	15	28	-	26	-	69
19.	<i>Acraea terpsicore</i>	11	20	-	18	-	49
20.	<i>Vanessa cardui</i>	26	31	12	32	12	113
21.	<i>Vanessa cashmirensis</i>	9	15	-	18	5	47
22.	<i>Vanessa indica indica</i>	23	41	9	34	-	107
23.	<i>Junonia iphita</i>	14	27	1	21	6	69
24.	<i>Junonia almana</i>	9	19	-	15	-	43
25.	<i>Danaus chrysippus</i>	11	23	2	20	-	56
26.	<i>Danaus genutia</i>	-	6	-	3	-	9
27.	<i>Lethe verma</i>	14	32	-	21	-	67
28.	<i>Mycalasis francisca sanatana</i>	-	-	-	2	-	2
29.	<i>Lethe sidonis vaivarta</i>	17	28	6	21	-	72
30.	<i>Polyura dolon dolon</i>	-	-	-	-	2	2
31.	<i>Athyma asura asura</i>	-	-	-	-	1	1
32.	<i>Cynthia cardui</i>	21	35	6	33	29	124
33.	<i>Aglais cashmirensis aesis</i>	18	32	2	38	31	121
34.	<i>Issoria issaea</i>	10	22	-	20	14	66
35.	<i>Polygonia egea agnicula</i>	-	-	-	-	4	4
36.	<i>Neptis ananta ananta</i>	14	25	5	30	-	74
37.	<i>Neptis soma butleri</i>	26	35	11	36	-	108
38.	<i>Neptis mahendra</i>	15	32	8	26	-	81
39.	<i>Phalantha phalantha</i>	2	5	-	3	-	10
Total		594	968	205	922	198	2887

DDN- Dehradun, CHM- Chamoli, BGS- Bageshwar, ALM- Almora, KDN- Kedarnath

#### 4. Conclusion

In the present study, 39 species of two family viz. Pieridae and Nymphalidae were found to be distributed in five different locations of Garhwal and Kumaun Administrative Divisions of Uttarakhand. Higher butterfly population in Chamoli, Almora and Kedarnath explains the importance of rich flora to make a better environment for butterfly biodiversity to thrive in nature. In the present study, butterflies were found abundantly in Chamoli and Kedarnath where natural habitat are more favourable due to lesser disturbance to environment from anthropogenic pressure as compared to other three locations viz. Almora, Dehradun and Bageshwar. On the other hand, the two most populated sites in present study, Almora and Dehradun, butterfly population was better as compare to Bageshwar and this was due to the planned development of these cities. This planned development and sufficient greenery, in different portion of these two cities allows a comparatively favourable habitat for this beautiful and ecologically important creature in these cities.

Being situated in the foothills of Central Himalayan range, Bageshwar is a fast growing township of the Kumaun Division in Uttarakhand, the state which is considered as the home for a vast floral and faunal biodiversity of the country. Even after being heavily covered with dense forests, the state is facing a threat of losing around 15 different endangered animal species<sup>[17]</sup> and one of the key reasons behind this situation is the fast urbanization, due to the human migration from remotely located hilly, backward villages to the more accessible and developed small townships, like Bageshwar. Thus, anthropogenic pressure in such areas has increased drastically over the last two decades and such huge inflow of human population in these under developed areas, have resulted in a severe deforestation and lose of wild flora and fauna of the area. So, from this study it can be concluded that, a planned development of our localities can help us to prevent the destruction of the natural habitat for different species of plant and animals.

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