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Diversity and Richness of Butterflies in the Sub-Alpine Forests of Western Himalaya (Himachal Pradesh)

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Abstract: ***Butterflies are conspicuous insects of the order Lepidoptera. The present study was conducted in various Sub-Alpine forests of Himachal Pradesh. The study was carried out in Sub- Alpine forests, during different seasons of the year 2013-2015. A total of 298 specimens of butterflies belonging to 69 species were collected and sampled. Shannon-Weiner index, Margalef's index and Pielou's index was used for calculating butterflies species diversity, species richness and species evenness. The present study revealed that maximum species diversity was in Kalatop in the year, 2014 (2.736) and minimum was in Marhi in the year, 2015 (1.553). Similarly, species richness was maximum in Chotabanghal in the year 2014, (4.702) and minimum was in Jalori Jot in the year 2013, (1.515). Evenness was maximum in Jalori Jot in the year 2014, (1.077) and minimum was in Kalatop in the year 2013, (0.838). Regarding different family of butterflies it was found that species diversity was found highest in case of family Nymphalidae (2.85) and lowest in family Hesperiidae (1.72). Species richness was found highest in Nymphalidae (7.45) and it was lowest in family Hesperiidae (0.74). Species evenness was found highest in family Nymphalidae (0.97) and lowest in family Pieridae and Papilionidae (0.90). Present study was modest attempt to explore the species diversity, species richness and species evenness of butterflies from Sub-Alpine forests of Himachal Pradesh.***

Keywords: Lepidoptera, Sub-Alpine, Himachal Pradesh, Species diversity, Species Evenness

1. Introduction

There were about 1,504 species of butterflies in Indian subcontinent (Gaonkar, 1996; Smetacek, 1992). Insects comprise more than 53% of 1.4 million species on earth (Hassan, 1998). Lepidoptera are regarded as one of the important component of biodiversity (New & Collins, 1991) and are the second largest order among insects. These include moth (Heterocera) and butterflies (Rhopalocera) of which 70,820 are butterflies according to most recent estimates (Shields, 1989). Many of butterfly species are strictly seasonal and prefer only a particular set of habitats (Kunte, 1997) and they are good indicators in terms of anthropogenic disturbance and habitat quality (Kocher and Williams, 2000). Being good indicators of climatic conditions as well as seasonal and ecological changes, they can serve in formulating strategies for conservation. It is hence encouraging that butterflies are now being included in biodiversity studies and biodiversity Conservation prioritization programmes (Gadgil 1996). Many workers who made the collection of butterflies from Himalayas. Evans (1932, 1949), Talbot (1939, 1947). Mani (1986) described 377 species of butterflies except Hesperiidae from Himalayas. Himachal Pradesh is a hilly and mountainous state situated between 30°22' and 33°12' North latitude and 75°47' to 79° 04' East longitude in the lap of North West Himalayas. The diversity of altitude and climate has given Himachal Pradesh a rich variety of flora. The present study was conducted to estimate species diversity, species richness and species evenness from Sub-Alpine forests of Himachal Pradesh.

2. Materials and Methods

Collection of butterflies

The survey cum collection of butterflies was undertaken during 2013-2015. Various sites of Sub-Alpine forests of Chanshal (Shimla), Marhi (Manali), Kalatop (Chamba), Chotabanghal (Kangra), Hattu (Narkanda), Chitkul (Kinnaur), Pangi (Chamba) and Jalori jot was selected for study on butterfly diversity. An insect net was used in order to collect butterflies**.** Butterflies were removed gently after they became enclosed in the bag by a rapid twist of the handle (Arora, 1990). The collected specimens were killed with the help of Ethyl acetate vapours in insect killing bottles. Butterflies were pinned by entomological pins of 38 mm length, nos. 3 and 5 for large and 20 for small specimens. Species was identified after their comparison with reference collection housed at F.R.I Dehradun and with available literature.

Statistical analysis

Shannon-Wiener diversity Index

The species diversity was calculated following Shannon-Wiener diversity Index (H), 1949

$H = \Sigma\ Pi \ln Pi$
Where $Pi = S/N$
S = number of individuals of one species
N = total number of all individuals in the sample
In = logarithm to base

Margalef's Index

Margalef's index was used as a simple measure of species richness (Margalef's, 1958).

Margalef's index = $(S-1) / \ln N$
S= Total number of species
N= Total number of individuals in the sample

ln= natural logarithm

Evenness index

Evenness Index was calculated as per (Pielou, 1966).

e = H/ ln S

Where S= Total number of species, N= Total number of individuals of all the species, H = Index of diversity.

3. Results and Discussion

A total of 298 specimens of butterflies belonging to 69 species were collected and sampled. During the present study it was found that the maximum diversity index was in, Kalatop 2014, (2.736) for the consecutive three years 2013-2015 (Table 1, Fig 1). The minimum diversity index was shown in Marhi in the year 2015, (1.553). Similarly, species richness was maximum in Chotabanghal in the year 2014, (4.702) and minimum in Jalori Jot in the year 2013, (1.515). Evenness was maximum in Jalori Jot in the year 2014, (1.077) and minimum was in Kalatop in the year 2013, (0.838). Species diversity was found highest in case of family Nymphalidae (2.85) followed by Lycaenidae (2.66), Pieridae (2.59), Papilionidae (2.17) and lowest in family Hesperiidae (1.72) (Table 2, Fig 2). Species richness was found highest in Nymphalidae (7.45) followed by Lycaenidae (3.75), Pieridae (3.68), Papilionidae (1.26) and it was lowest in family Hesperiidae (0.74). Species evenness was found highest in family Nymphalidae (0.97) followed by Hesperiidae (0.96), Lycaenidae (0.92) and lowest in family Pieridae and Papilionidae (0.90). The diversity and abundance of butterfly species is greatly associated with the availability of food plants in the surrounding habitat (Kunte *et al*., 1999) consequently the lack of butterfly diversity is not entirely due to the climate but is more directly a result of low floral diversity leading to support greater butterfly diversity (Harisha *et al*., 2013). Butterflies species richness has the tendency to become richer in forest habitats than in highly disturbed areas (Mohagan *et al*., 2011). This implies that vegetation type also affects species richness and anthropogenic disturbances are detrimental to conservation of butterflies (Stefanescu *et al.,* 2004). Climatic and anthropogenic factors play an important role in determining butterfly species richness which supports the present study (Stefanescu *et al*., 2010). Biological diversity, richness and evenness of the Sub-Alpine forests of Himachal Pradesh have not been documented till date. The present study is the first study of this type in the Sub-Alpine forests of Himachal Pradesh so it is very difficult to conclude that butterflies species diversity, species richness and species evenness were increasing or decreasing it is suggested that area should be continuously monitoried to observe any change in diversity, richness and evenness.

Table 1: Shanon –weiner index, Margalef's index and Evenness index of Butterfly fauna

Localities	2013			2014			2015		
	Species diversity (H)	Species evenness (J)	Species Richness (MA)	Species diversity (H)	Species Evenness (J)	Species Richnness (MA)	Species diversity (H)	Species Evenness (J)	Species Richness (MA)
Chanshal	2.415	0.854	4.228	2.445	0.846	4.103	2.572	0.844	4.479
Hattu	2.412	0.87	4.55	2.352	0.839	4.039	2.598	0.91	4.66
Marhi	2.455	0.906	4.158	2.263	0.911	3.418	1.553	0.965	1.737
Kalatop	2.323	0.838	4.219	2.736	0.987	4.329	2.326	0.93	3.204
Chotabanghal	2.335	0.884	3.290	2.633	0.894	4.702	2.296	0.895	3.432
Kinnaur	2.026	0.845	2.836	2.548	0.993	2.517	2.341	0.913	3.403
Pangi	2.029	0.923	2.517	1.976	0.899	2.376	2.139	0.861	3.204
Jalori Jot	1.569	1.025	1.515	1.662	1.077	2.404	1.636	0.841	2.117

Table 2: Diversity, richness and evenness of different families of Butterflies

Family	*Species diversity (H)*	*Species evenness (J)*	*Species Richness (MA)*
Nymphalidae	2.85	0.97	7.45
Pieridae	2.59	0.90	3.68
Lycaenidae	2.66	0.92	3.75
Papilionidae	2.17	0.90	1.26
Hesperiidae	1.72	0.96	0.74

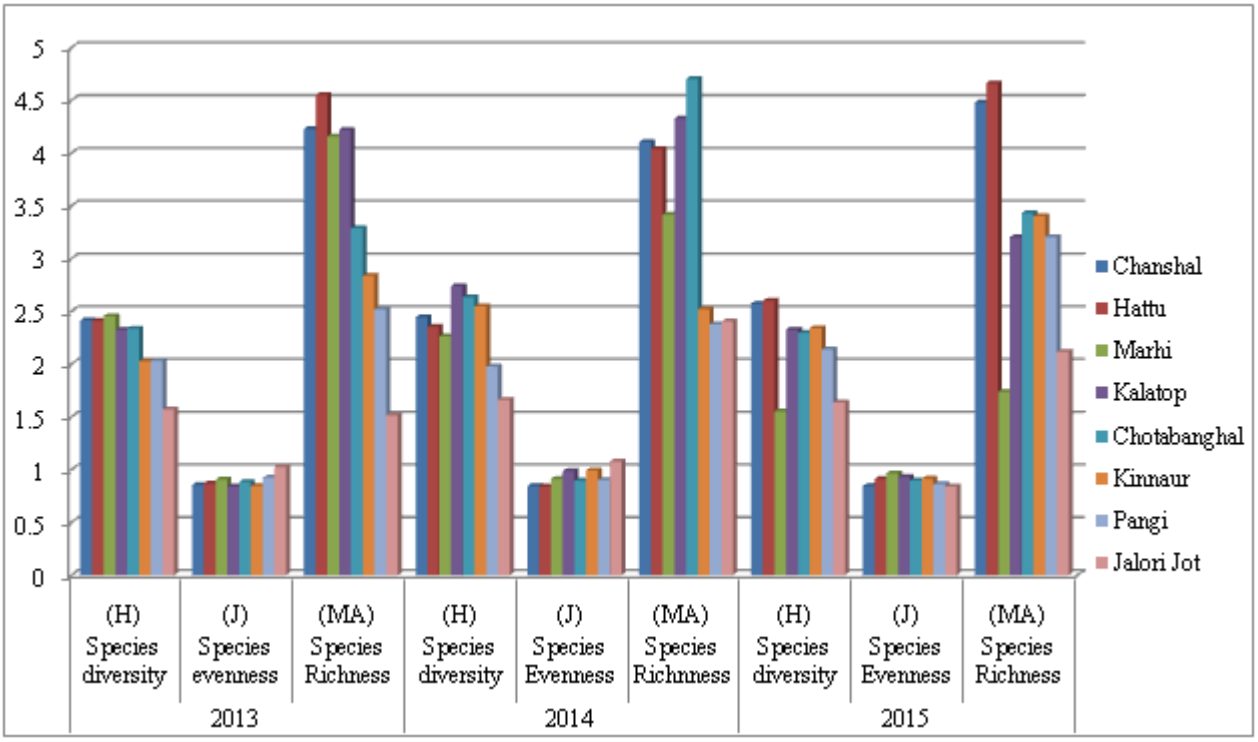

Figure 1: Showing species diversity, species richness and species evenness of different localities with year

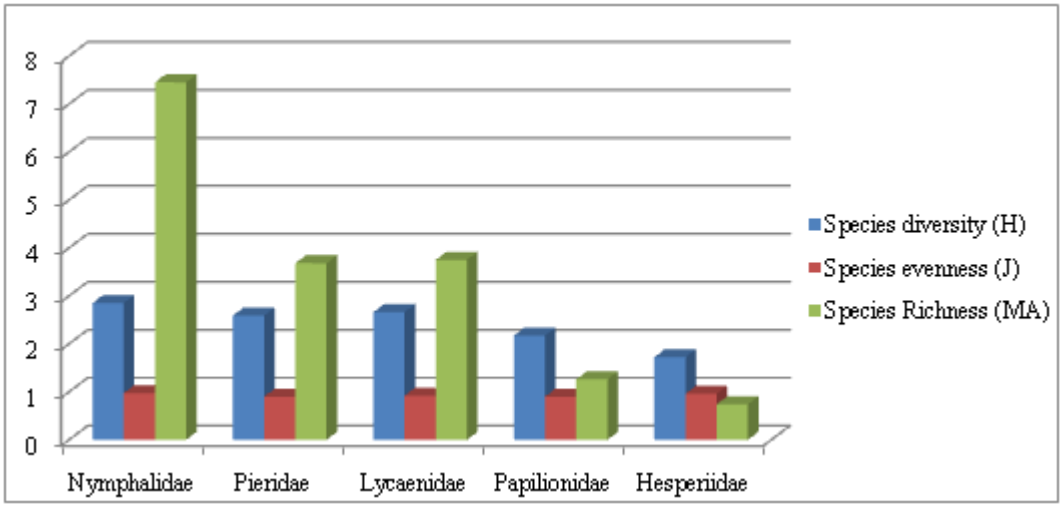

Figure 2: Shows the species diversity, species richness and species evenness

4. Conclusion

Biological diversity of the butterfly fauna in Sub-Alpine forests of Himachal Pradesh has not been documented till date. The present investigation revealed that Sub-Alpine forests shows diversified floral and faunal wealth. Extensive survey of butterfly diversity of the different Sub-Alpine forests will prove useful for further research studies in such habitats.

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