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Diversity of Butterflies from District Muzaffarabad, Azad Kashmir

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Abstract: The adult butterflies were collected from nine localities of district Muzaffarabad through out the summer season of (April to October) 2001. A total of 28 species belonging to 7 families were collected. Diversity was calculated by using Shannon-Wiener diversity index, Shannon's equitability, Margalef's index, Simpson's index and RI index. The calculated values showed that the lowest diversity was obtained from Kohala and highest diversity was obtained from Shaeed Gali and Gari Dopatta.

Key words: Butterflies, diversity indices, richness, abundance, equitability

INTRODUCTION

Butterflies are the most popular and recognizable insects among the general public and science due to their beautiful colors and graceful flight. Their marvelous colors, harmonious shapes and graceful flights give pleasure to every one. The butterflies are found in every part of the world[1-3].

Butterflies have been studied systematically since 18th century and up till now 4500 species have been documented world wide but the fauna of the area under study was completely unexplored except a few attempts such as Khan *et al.*[4], Rafi *et al.*[5] and it is the first attempt to explore the butterfly fauna and to calculate the distributional diversity which will be continuously studied with the passage of the time.

Muzaffarabad district of Azad Kashmir is the biggest district which comprises on very diverse climatic conditions starting from very hot places like Muzaffarabad city to very cold places like Neelum valley and its surrounding mountains. The mountains of very high altitude make it difficult to take the samples from the whole district.

MATERIALS AND METHODS

The specimens were collected from nine localities of district Muzaffarabad namely Patika, Kohori, Shaeed Gali, Muzaffarabad city, Domail, Chattar, Brarkot, Kohala and Gari Dopatta (Fig. 1). The localities were visited fortnightly through out the summer season, from mid April to October. All the specimens were collected and total number was counted from each locality and a rank list was prepared from each locality (Table 1) and a collective rank list from all the localities was also prepared (Table 2).The specimens were identified up to species level with the help of available literature. To calculate the diversity of the butterflies four indices were used namely: Shannon-Wiener diversity index[6,7], with its equitability component, Margalef's index[8], Simpson's index[7] and RI index[9,10].

The form of the Shannon-Wiener index used is $H=-\sum(pi)\log_2 pi)$, where, "pi" is the proportion with in the sample of the number of the individuals of "ith" species and it is "ni/N", where, "ni" is the number of individuals in "ith" species and "N"is the total number of individuals. But the form of the index used in the present study is: $H=C\ \{\log_{10}N-1/N\sum(nr\log_{10}nr)\}$, where "N" is the total number of the individuals, "nr" is the rank abundance in "ith" species "C" is the conversion factor from $\log_2$ to $\log_{10}$.

The form of the Shannon's equitability used is: $J=H/H_{max}$, where, "H" is the Shannon-Wiener's diversity index and "H_{max}" is the $\log_2$ of "S", where, "S" is the total number of species in the sample.

The form of the Margalef's index used is: $D=S-1/\log_e N$,. Where, "S" is the number of species and "N" is the total number of individuals.

The Simpson's index used is $D=1-\sum(pi)^2$, where, "pi" proportion of "ith" species and is calculated as "ni/N", where, "ni" is the total number of individuals in the "ith" species and "N" is the total number of individuals in the sample but the form of the index used in the present study is: $D=\sum[ni(ni-1/N(N-1)]$, where, "ni" is the number of individuals in "ith" species and "N" is the total number of individuals in the sample.

The last index used is RI index[9,10]. The form of the index used is $RI=\sum Ri/S(M-1)$, where "S" is the number of

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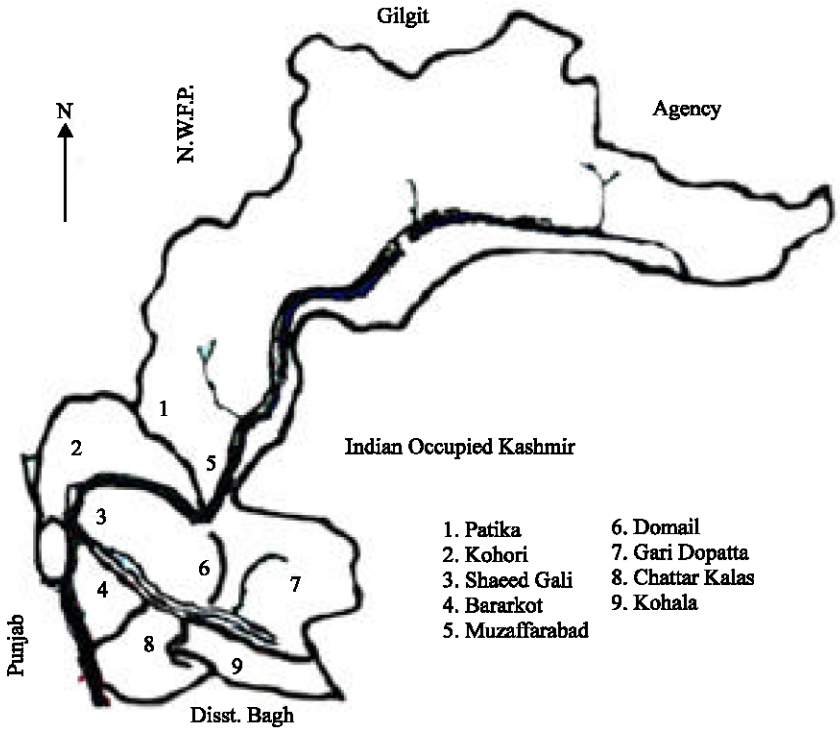

Fig. 1: Map of District Muzaffarabad, Azad Kashmir

investigated species of insects, "M" is the number of rank of abundance (0,1,2,3,...M-1) and "Ri" is the rank value of "ith" species in the sample.

RESULTS AND DISCUSSION

Diversity is the major feature of the animal communities. It is the number of species present and their numerical composition. Diversity is the niche time stability dependent, which means if a large number of niche is present it will support high diversity[11-13]. Generally, homogeneous conditions yield low diversity where as heterogeneous conditions yield higher diversity[14-16].

Diversity indices are a measure of a way in which individuals in an ecological community are distributed among species. A co-efficient of diversity is a convenient way of demonstrating the variety of species present in a habitat or a sample and the abundance of individuals with in the species. The measure of diversity of the fauna will represent the number and the available niches present in the environment. If niche heterogeneity is great, it will support a more diverse fauna and thus will result in a higher co-efficient or index of diversity[15].

The first index used in the present study is Shannon-Wiener diversity index[6]. This index is distribution dependent and suffers least from criticism of validity in application of biological data[15]. The calculated values ranged from 1.72 (at Kohala) to 3.45 and 3.51 (at Shaheed Gali and Gari Dopatta respectively). At remaining all the sites it raged from 2.77 to 3.32 (Muzaffarabad city and Kohori, respectively) (Table 1). The calculated values of the index showed that butterflies are well distributed where vegetation is was abundant, like Shaheed Gali and Gari Dopatta, where as the sites, like Kohala due to less flowering plants and less vegetation the fauna was poorly distributed.

Shannon's equitability component showed that the fauna was well distributed except at Kohala and Muzaffarabad city. Kohala and Muzaffarabad city resemble with each other in having less vegetation and poor flora.

The calculated value of Margalef's index ranged from 2.55 (Muzaffarabad) to 4.15 (Gari Dopatta). These calculated values coincide with those of Shannon-Wiener's diversity index and its equitability component.

The calculated values of Simpson's index ranged from 0.07 (Gari Dopatta) to 0.20 (Kohala) and calculated values of RI index vary from 0.08 (Kohala) to 0.37 and 0.37 at Muzaffarabad and Braakot, respectively (Table 1).

District Muzaffarabad of Azad Kashmir has very diverse flora such as Gari Dopatta and Shaheed Gali has diverse and rich flora and Muzaffarabad city and Kohala has patchy and poor flora. The former areas support higher diversity and latter areas support less diversity and

Table 1: The calculated values of diversity indices from different places of District Muzaffarabad

Name of Place	Shannon-Wiener Index(Hs)	Shannon's Equitability (J)	Margalef's Index (d)	Simpson's Index (D)	RI Index
Patika	3.28	0.95	2.86	0.10	0.30
Khori	3.32	0.96	3.18	0.07	0.20
Bararkot	3.37	0.98	2.69	0.08	0.37
Muzaffarabad	2.77	0.84	2.55	0.18	0.37
Domail	3.02	0.91	2.87	0.09	0.25
Ghari Dopata	3.51	0.88	4.15	0.07	0.15
Shaeed Gali	3.45	0.88	3.97	0.09	0.16
Chattar	3.13	0.91	3.00	0.09	0.25
Kohala	1.72	0.46	4.45	0.20	0.08

Table 2: Collective rank list along with the lists of Taxa collected from different localities of District Muzaffarabad

Rank	Name of Taxa	Abundance	Patika	Kohori	Bararkot	Muzaffarabad	Domail	Gari Dopatta	Shaeed Gali	Chattar Kalas	Kohala
1	*Pieris brassicae*	51	3	5	6	14	4	4	9	3	4
2	*Catopsila pyranthe*	20	5	3	4	-	-	2	4	1	1
3	*Colias erate*	19	4	-	3	2	1	4	3	1	1
4	*Papilio philoxenus*	18	-	-	1	-	4	6	3	1	3
5	*Colias fieldi*	18	7	-	1	-	-	6	-	-	4
6	*Junonia orithya*	16	-	3	4	4	1	2	1	-	1
7	*Pontia daplidice*	14	-	-	-	2	4	1	3	3	1
8	*Pieris canidia*	13	-	1	6	1	2	2	1	-	-
9	*Papilio polyoctor*	12	-	2	7	-	-	2	-	1	-
10	*Phlantha phlantha*	12	4	-	-	2	1	3	1	1	1
11	*Danuis chrysippus*	11	-	-	-	3	4	2	-	-	2
12	*Deudorys epijarbus*	10	1	1	3	2	-	-	-	-	3
13	*Catopsila crocale*	10	4	1	-	-	1	-	1	3	-
14	*Celastrina ladonides*	9	1	-	-	-	-	-	1	6	1
15	*Genopteryx rhamni*	8	2	2	-	-	-	1	-	3	-
16	*Lampides boeticus*	8	-	-	-	-	1	-	2	5	-
17	*Papilio machaon*	5	-	-	2	-	-	-	-	-	3
18	*Terias hecabe*	5	1	1	2	-	-	1	-	-	-
19	*Danuis genutia*	4	-	1	1	2	-	-	-	-	-
20	*Catopsila pomana*	4	1	2	-	-	-	1	-	-	-
21	*Aglais cashmirensis*	3	-	1	-	-	-	-	2	-	-
22	*Venessa cardui*	2	-	-	-	-	-	1	1	-	-
23	*Trimula limniace*	1	-	-	1	-	-	-	-	-	-
24	*Junonia almanac*	1	-	1	-	-	-	-	-	-	-
25	*Rapala selira*	1	-	-	-	-	-	-	1	-	-
		∑N=275	N=33	N=24	N=41	N=32	N=23	N=36	N=33	N=28	N=25

all the used indices concluded that butterflies are normally distributed in the areas under the study.

The present study is the first study of this type in the area. Therefore, it is very difficult to say whether any species are supported by the enriched flora or any species are at the verge of extinction. Therefore, it is suggested that the area under study should be continuously monitored to observe any changes in the diversity of butterflies, because the changes in the diversity can only observed through continuous monitoring and comparing the data of every year.

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