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Community structure and habitat selection of butterflies in Rajaji National Park, a moist deciduous forest in Uttaranchal, India

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Most estimates of species loss have focused on species rich tropical forests, and fragmentation in these forests leads to loss of habitat and erosion of biodiversity. Biological diversity plays a significant role of enriching soil, maintaining water and nutrient cycles. It is now increasingly recognized as a vital parameter to assess global and local environmental changes and sustainability of developmental activities (Lovejoy 1995). Compared with other insect groups, the high visibility of butterflies, together with their relatively known taxonomy, has resulted in this group receiving a reasonable amount of attention. Further, butterflies are suited as indirect measures of environmental changes because they are very sensitive to local weather, climate and light levels. The richness of butterfly community also indicates diverse plant communities in any habitat, as these insects are directly dependent on the plants. The purpose of present investigation was to assess species diversity, evenness and richness of butterflies in four selected habitats having different plant communities in a moist deciduous forest region, representing a range of anthropogenic activities.

This study was carried out in a protected forest in the Motichur Sanctuary of Rajaji National Park located at 29°15' to 30°15' N and 77°55' to 78°30' E, Uttaranchal, India. Four sites (each ca. 3 ha) representing habitats under different vegetation communities and levels of disturbances were selected (Table 1). Level of disturbances was determined by observing the various anthropogenic activities in different study sites during the study period. Elevation of the study sites ranged between 360 to 440 m. These sites were subdivided based on canopy opening (percent visibility of sky) as very closed (0-10%), closed (10-50%), open (50-90%) and very open (90-100%). The sites differed markedly with respect to plant communities. Site 1 and 3 had the highest number of tree, shrub and herb species (47 to 76). Site 2 with 31 to 45 species was intermediate, whereas Site 4 had only 17 to 27 species (Joshi *et al*.1999). In all sites, grasses were in leaf throughout the year and senescence started in pre- and post-monsoon period from May to June and November to March. The climate of the study area is subtropical with distinct summer, winter and rainy seasons. The annual precipitation was 1060 mm and 950 mm in the first and second year of study, respectively.

Sampling of insects was done using systematic net sweeps at 15 days interval. Method of Gadagkar *et al.* (1990) was adopted for carrying out net sweeps. The insects collected were later separated into different taxonomic groups and a record of species representing different families of Lepidoptera was maintained. These were oven dried at 60°C for 72 h. Entomological Section of Forest Research Institute, Dehradun and Indian Agricultural Research Institute, Delhi, identified the insects.

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Table 1. Characteristic features of different study sites selected in the moist deciduous forest for the present study.

Vegetation characteristics	Anthropogenic activities	Microhabitats present
Site 1: Mixed forest of *Shorea robusta, Mallotus philippinensis, Terminalia alata* and *T. bellerica.* Ground vegetation comprised of grasses	Free from human disturbances	Close 8%, Open 48%, Very open 34%
Site 2: Natural forest of *Shorea robusta.* Ground vegetation mainly *Cynodon dactylon, Veronia conizoides* and *Leucas mollissima*	Previously logged but now free from human disturbances	Very close 6%, Close 32%, Open 62%
Site 3: Mixed forest like Site 1	Moderately disturbed	Very close 2%, Close 12%, Open 40%, Very open 46%
Site 4: Plantation of *Tectona grandis* and some other species, about 15 years old. Very sparse ground vegetation dominated by weeds and forbs	Highly disturbed by Gujjars and their cattle	Open 33%, Very open 67%

The diversity of Lepidoptera was expressed using Shannon-Wiener Index (H) (Southwood 1978), which is expressed as: $H = - \Sigma P_i \log_e P_i$, where, P_i is the relative abundance of each species in the sample and $\log_e$ is the natural log of P_i. For determining the evenness, Shannon-Wiener index of evenness (Kotila 1986) was used. This measure is the ratio of the maximum value of H to the realized value of H; thus Evenness = H/H_{max}, where, H is the realized value of diversity and H_{max} the maximum possible value of diversity.

A total of 1857 individuals, belonging to 40 species and 7 families of Order Lepidoptera were recorded (Table 2). Thirty eight species of butterflies were recorded in the first year and 33 species in the second year. *E. hecabe*, constituting 16.5% of the total, was abundant both in disturbed and undisturbed habitats. The second most abundant species, *M. leda ismene* (16.2%) showed greater abundance at Sites 2 and 3. Rare species recorded from the study area included *U. folus, H. bolina, Leptosia* sp., *H. androcles*, *A. violae*, *H. missipus*, *C. rosemon*, *G. nomius* and *A. phalantha*.

Nineteen species of butterflies were common in all the study sites. Sites 1 and 3 had 25 common species, Sites 3 and 4 had 24 species in common, while Sites 1 and 2 with no ongoing disturbances had 24 common species. Maximum number of species (35) was recorded during summer, followed by rainy (31) and winter (27) season. Sixteen species were recorded during all the three seasons, 6 species were recorded only during summer and 2 during winter season.

The ecological indices show a clear difference among the habitats (Table 3). Site 3 with all four types of microhabitat showed highest values for diversity, evenness and abundance during the study period. Species richness was highest for Site 4 in the first year, which had only open and very open types of microhabitats, while it was highest for Site 2 in the second year.

In the present study a marked difference in the community structure of butterflies were recorded among the different sites. Site 4, which is a disturbed forest with open or very open canopy, thus offering higher solar radiation and more warm and congenial ambient temperature to the butterflies supported highest number of species. However, the minimum plant diversity and high disturbances have affected the overall diversity, evenness, and abundance of butterflies at this site. Disturbances alter the grass and herb species composition and cattle uproot grasses while feeding on them thus influencing species diversity and composition of flora and fauna (Rodgers 1986).

Site 3, with moderate level of disturbance, appears to be an ideal habitat for these butterflies as it had an overall higher values of species diversity, evenness and abundance. This site had 80 to 85% of its microhabitat as open, thus receiving greater solar radiations, and with the highest plant diversity. These factors have made it the most suitable site for the greater activities of the butterflies. Southwood (1975) suggested that the most woodland natural habitat herbivores, specially the sap suckers are more influenced by the food quality. Srygley & Chai (1990) have reported that 75% of neotropical butterflies they

Table 2. Taxonomic composition and number of individuals of butterflies recorded from different study sites during 1997-1999 in a moist deciduous forest in India.

Taxonomic composition	1997 - 98					1998 - 99				
Papilionidae	Site 1	Site 2	Site 3	Site 4	Total	Site 1	Site 2	Site 3	Site 4	Total
Papilio demoleus Linn.	1		1	5	7	1	2		12	15
P. polytes romulus Cramer	1	1	3	7	12	3	1	3	5	12
Parides philoxinus Gray.		2		1	3	1		1	1	3
Graphium nomius Esper									2	2
Danaidae										
Euploea core core But.	18	6	31	2	57	15	8	21	5	49
Danaus chrysippus Linn.	15	17	18	5	55	17	1	4	5	27
D. aglea Stol.	1	1	3		5			1		1
Danais plexippus Linn	1		1		2	6	1		1	8
Tirumal limniace limniace Cramer		2	1	1	4	12		1	1	14
Nymphalidae										
Precis atlites Linn.	5	1	20	2	28	2		23	3	28
P. almana almana Linn.	3	1	2		6	2		1		3
P. lemonias lemonias Linn.	10	3	4	3	20	3	5	4	3	15
P. hierta hierta Fabr.		1			1		2		1	3
P. iphita iphita Cramer	2		3	7	12	2		1	2	5
P. orithya ocyale Hubner			3	1	4		1			1
Hypolimnas missipus Linn.			1		1			1		1
H. bolina Linn.									1	1
Neptis yerburyi But.	11	3	19	15	48	9	1	24	5	39
Kallima inachus Boisd		1			1		2		1	3
Acraea violae Fabr.		1	1		2					
Atella phalantha Drury		1			1	2				2
Rathinda hordonia Stoll	1		8	2	11	2	1	3	2	8
Pyrameis C. cardui Linn.		9	1		10					
Pieridae										
Eurema hecabe Linn.	67	76	47	50	240	19	19	21	7	66
Delias eucharis Drury		3		1	4					
Catopsilia pomona Fabr.	8	9	9	11	37	54	55	36	40	185
C. florella Fabr.		8		2	10	1	1	4	3	9
Pareronia valeria hippia Fabr.		4			4		2			2
Pieris canidia Sparr.	27	49	15	12	93	11	10	2	7	30
Cepora nerissa Fabr.		4			4		1		2	3
Leptosia sp.		2			2					
Anaphaeis aurota aurota Fabr.		2		3	5	2			16	18
Lycaenidae										
Castalius rosimon Fabr.	1		1		2					
Castalius sp.	2	1	2		5				2	2
Amblypodia sp.	1		1	2	4	86		19	1	106
Satyridae										
Melanitis leda ismene Cramer	4	7	97	114	222	2	4	47	26	79
Mycalesis perseus blasius Fabr.	5	2	22	13	42	7		20	9	36
Ypthima balda balda Fabr.	6	25	31	9	71	5	3	28	7	43
Hesperiidae										
Haliophorus androcles D&H		1		1	2					
Udaspes folus Cramer				1	1					
Total	190	242	346	260	1038	264	118	268	169	819

Table 3. Community structure of butterflies across sites and seasons in a moist deciduous forest in India.

Ecological Units	Diversity		Evenness		Richness	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Sites						
1	3.308	3.341	0.742	0.729	21	23
2	3.455	2.838	0.704	0.668	29	19
3	3.529	3.992	0.751	0.805	26	21
4	3.158	3.953	0.672	0.804	24	27
Seasons (Across all 4 sites)						
Rainy	3.049	3.191	0.674	0.705	23	23
Winter	2.851	2.682	0.607	0.686	23	15
Summer	3.910	3.737	0.782	0.762	32	29

captured were from open areas compared to 25% from the closed microhabitats. These sampling differences reflect a community wide pattern of increasing insect activity with increasing light and temperature. Higher values of diversity and species richness of butterfly community have been reported in rural communities near a village and in large clearings on the forest edge than in the closed forest (Leaps & Spitzer 1990) and in the undisturbed or moderately disturbed forests (Lien & Yuan 2003) because disturbance disrupts those species whose superior competitive abilities generally enable them to achieve dominance in a community, and some disturbance permits less competitive species to co-exist. The higher level of disturbance like the grazing decreases resource available to butterflies.

It is evident that species like *Leptosia* sp., may act as an indicator of high level of disturbance in any habitable area. *E. core core, M. leda ismene, P. atlites* and *Y. balda balda* might be positively affected by the moderate disturbances. Some species like *E. hecabe* and *P. canidia* appear to proliferate in all types of plant communities and disturbances and their occurrence all round the year is attributed to their polyphagous nature. Species like *U. folus* and *H. bolina* prefer closed micro-habitats. Two species recorded in the present study, *C. rosimon* and *H. missipus* are protected under Schedule I of Wildlife (Protection) Act, 1972, while *U. folus* is a rare species.

The results of the present study thus suggest that the habitat with open canopy and greater heterogeneity having moderate level of disturbances are preferred habitats of butterflies and their community structure may be a viable tool in assessing habitat suitability.

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References

Gadagkar, R., K. Chandrashekhar & P. Nair. 1990. Insect species diversity in the tropics: Sampling methods and a case study. *Journal of Bombay Natural Histroy Society* **87**: 337-357.

Joshi, P. C., J. A. Lockwood, N. Vashishth & A. Singh. 1999. Grasshopper (Orthoptera: Acridoidea) community dynamics in a moist deciduous forest in India. *Journal of Orthoptera Research* **8**: 17-23.

Kotila, P. M. 1986. *Ecological Measures.* Software Package, St. Lawrence University,USA.

Leaps, J. & K. Spitzer. 1990. Ecological determinants of butterfly communities (Lepidoptera: Papilionoidea) in the Tam Dao Mountains, Vietnam. *Acta Entomologica Bohemoslovaca* **87**: 182-194 .

Lien, Vu Van & Dechen Yuan. 2003. The differences of butterfly (Lepidoptera:Papilionoidea) communities in habitats with various degrees of disturbances and altitudes in tropical forests of Vietnam. *Biodiversity and Conservation* **12**: 1099-1111.

Lovejoy, T. E. 1995. *Biodiversity Measurement and Estimation.* Chapman and Hall, London.

Rodgers, W. A. 1986. The role of fire in the management of wildlife habitats: A review. *Indian Forester* **120**: 848.

Southwood, T. R. E. 1975. The dynamics of insect populations. pp. 151-199. *In*: D. Pimental (ed.) *Insects, Science and Society*. Academic Press, New York.

Southwood, T. R. E. 1978. *Ecological Methods*. Chapman and Hall, New York.

Srygley, R. B. & P. Chai. 1990. Predation and elevation of thoracic temperature in brightly colored neotropical butterflies. *The American Naturalist* **135:** 765-787.