Butterfly diversity and abundance with reference to habitat heterogeneity in and around Neora Valley National Park, West Bengal, India

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Abstract

Butterfly diversity in and around Neora Valley National Park (NVNP), West Bengal, India was studied from three different habitat types that included thick vegetation assemblage with closed canopy cover, edges of forest and areas of human intervention during April – May 2010. A total of 30 butterfly species belonging to the families of Hespeririidae (3.33%), Papilionidae (16.65%), Pieriidae (13.32%), Nymphalidae (53.28%) and Lycaenidae (13.32%) were identified in the present investigation. Highest butterfly diversity and abundance was recorded from areas of forest edges (54.83% of individuals represented by 16 different species), while dense forest (30.64 % of individuals represented by 11 different species) and areas with human habitats (14.52 % of individuals represented by 8 different species) showed lower butterfly diversity and abundance. Accordingly highest Shannon Weiner diversity score of 2.32 was recorded from areas of forest edges. The butterflies that showed high occurrences were Indian Tortoise Shell (*Aglais cashmiriensis*), Yellow Coster (*Acraea issoria*) and Himalayan Five Ring (*Ypthima sakra*). Only 1 butterfly species, Yellow Coster (*A. issoria*) was found to co-occur in all the three sites. Accelerating human civilizations has lead to destruction of much of the global natural habitats while it has often been found to exert adverse effects on biodiversity. Findings made during this study also indicate negative influence of anthropogenic intervention on overall butterfly diversity from the present location.

Key words: Biodiversity hotspot, butterfly, canopy closure, diversity indices, habitat heterogeneity, Neora Valley National Park.

Introduction

Biologists around the globe are facing particularly great conservation challenges under the mounting threats of anthropogenic disturbances to biodiversity. Moreover, holistic inventory of diversity requires nearly impossible levels of time and effort (Lawton *et al.*, 1998). Insects, representing majority of animal species (ranging anywhere from 5-30 million) are a perfect example of these challenges (Godfray *et al.*, 1999). Consequently insects remain mostly undiscovered and are frequently omitted from conservation assessments (Leather *et al.*, 2008). Butterflies represent an oppor-

tunity in this respect, in that many species can typically be sampled and identified in a short time and provide an indication of habitat or conservation value as well (Brown, 1997). Among the 19,238 described global butterfly species (Heppner, 1998) India hosts 1,501 species of butterflies (Gaonkar, 1996).

Neora Valley National Park (NVNP), located in the Eastern Himalayas is a global 'biodiversity hotspot'. The compact virgin forest of NVNP belongs to an Important Bird Area (Islam and Rahmani, 2004). Relationships between habitat and butterfly diversity are well on record from different parts of the Indian subcontinent (Ramesh *et al.*, 2010; Tiple and Khurad, 2009). The present rapid assessment attempts to prepare a checklist of butterflies as well as aims to compare butterfly diversity from closed canopy cover areas of NVNP, its edges and in areas where forests are subjected to various degrees of pressure from human disturbances.

Materials and methods
Neora Valley was registered as a National Park way back in the year 1992 based on the provisions of the Wildlife (Protection) Act 1972 and covers two biomes, the Sino-Himalayan Temperate Forest (Biome - 7) from 1800 m to 3600 m of elevation and the Sino-Himalayan Subtropical Forest (Biome - 8) from 1000 m to 2000 m of elevation (Islam and Rahmani, 2004). According to Champion and Seth (1968) the phytogeography of NVNP consists of the Subtropical Broadleaf Hill Forest, Montane Wet Temperate Forest and Subtropical Pine Forest and lies in the biogeographic zone 2

(Rodgers *et al.*, 2002). Floral and faunal composition of NVNP typically represents that of Oriental region with high endemism. Human settlements of late around this protected area have altered the biodiversity by means of habitat degradation. This region is a major tourist attraction presently and this in addition with the pressure for livelihood of local people is forcing the conversion of this biodiversity paradise.

Three contrasting forest patches were chosen in the present study depending upon the complexity of habitat structure. Thick vegetation assemblage with closed canopy cover, edges of forest and areas of human intervention in and around NVNP were studied for butterfly diversity and has been referred to as Study Area – 1 (27°05′49″ N; 88°41′29″ E; 1927 m msl), Study Area – 2 (27°06′01″ N; 88°40′33″ E; 1612 m msl) and Study Area – 3 (27°05′11″ N; 88°39′41″ E; 2061 m msl) in the present investigation (Fig. 1). NVNP was found to be primarily dominated by species of *Quercus*, *Taxus, Tsuga, Acer, Betula, Castanopsis*, *Magnolia* and *Michellia* while Bamboo (*Arundinaria spp.*) was found to be dominant in the understory.

In the present study observations were made during 28.04.10 – 04.05.10 following a fixed daily three transects for each study location of 500 m length with 5 m on either side covered in an hour walking at a constant pace between 06:00 hrs and 04:00 hrs. The samplings were continued for seven consecutive days and resulted in a final count of 21 transects form each study location (hence a total of 63 transects were studied). All the butterflies on the line as well as 5 m on each side were recorded with
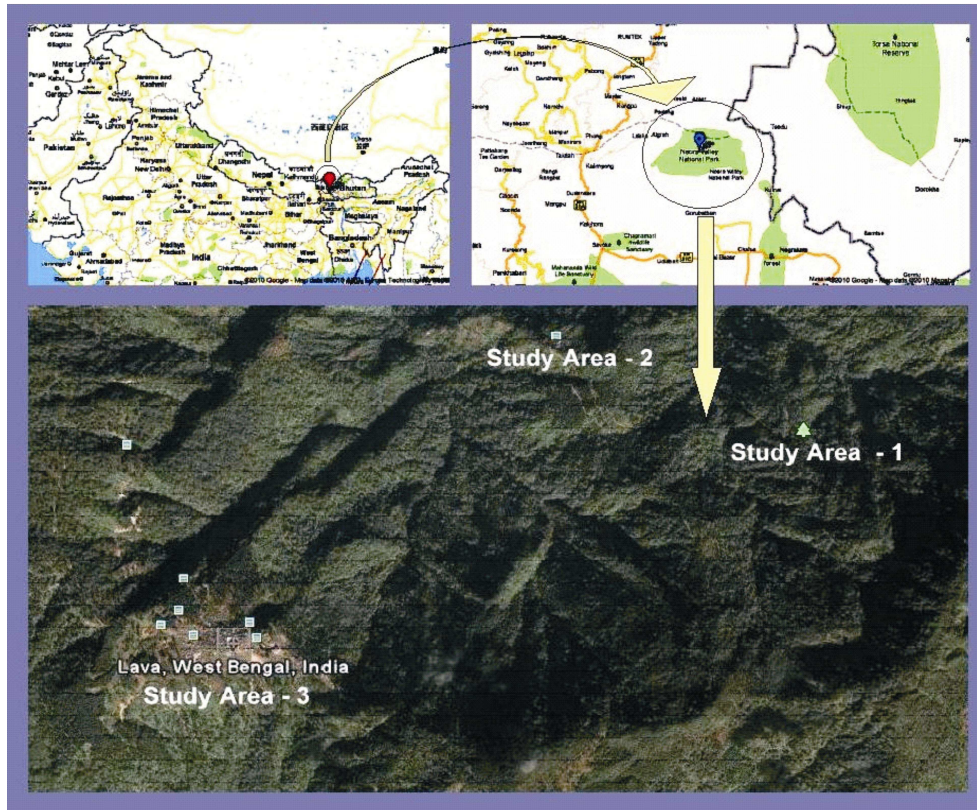
Figure 1. Map of the three study areas (Study Area - 1, Study Area - 2 and Study Area - 3) in and around Neora Valley National Park.

respective time and number of individuals seen. Butterfly species were identified directly in the field or in difficult cases following photography and identification following Haribal (1992) and Kehimkar (2008). No capture or collections were made during the present study.

All the diversity indices were calculated by applying PAST statistical software. Hierarchical cluster analysis was done to construct a dendrogram for commenting on the relation between the studies areas, using SPSS 13.0.

Results
A total of 30 butterfly species belonging to families of Papilionidae, Pieriidae, Nymphalidae, Lycaenidae and Hespeririidae were recorded during the short period of present study (Tab. 1).

Family wise distribution of all the butterfly species varied widely among all the three study sites with Nymphalidae having the highest representative species followed by Papilionidae (Fig. 2).

Highest butterfly diversity was recorded in Study Area – 2 (total species

Table 1. Checklist of butterflies along with their status and abundance (average butterfly number m^{-2}) for the three Study Areas (SA 1, 2 and 3) in and around Neora Valley National Park. (C = Common, NR = Not Rare and LC = Locally Common).

| Common name	Scientific name	Status	SA – 1	SA – 2	SA – 3
Small Branded Swift	*Pelopidus mathias*	C	00	01	00
Common Blue Apollo	*Parnassius hardwickii*	C	00	01	00
Great Jay	*Graphium Eurypylus*	NR	00	00	01
Blue Mormon	*Papilio polymnestor*	NR	00	00	01
Redbreast	*Papilio alcmenor*	NR	00	00	01
Common Rose	*Atrophaneura aristolochiae*	C	01	00	00
Common Grass Yellow	*Eurema hecabe*	C	02	00	04
Yellow Orange Tip	*Ixias pyrene*	C	00	10	00
Striped Albatross	*Appias libythea*	LC	01	00	00
Indian Cabbage White	*Pieris canidia*	C	02	00	00
Powdery Green Sapphire	*Heliophorus tamu*	NR	00	01	00
Pale Grass Blue	*Pseudozizeeria maha*	C	01	00	00
Dark Judy	*Abisara fylla*	C	01	00	00
Punchinello	*Zemeros flegyas*	C	02	00	00
Blue Tiger	*Tirumala limniace*	C	00	00	01
Double Branded Crow	*Euploea sylvester*	LC	00	00	8
Long- Branded Blue Crow	*Euploea algea*	NC	00	03	00
Straight-Banded Tree Brown	*Lethe verma*	C	01	00	00
Himalayan Fivering	*Ypthima sakra*	C	14	02	00
Yellow Coster	*Acraea issoria*	LC	05	02	01
Red Lacewing	*Cethosia biblis*	C	00	10	00
Green Commodore	*Sumalia daraxa*	NR	00	10	00
Common Lascar	*Pantoporia hordonia*	C	00	01	00
Clear Sailer	*Neptis clinia*	C	00	03	00
Black Prince	*Rohana parisatis*	NR	00	01	00
Circe	*Hestina nama*	NR	00	02	00
Indian Red Admiral	*Vanessa indica*	C	00	03	00
Painted Lady	*Vanessa cardui*	C	00	02	00
Indian Tortoiseshell	*Aglais cashmiriensis*	C	08	16	00
Autumn Leaf	*Doleschallia bisaltide*	NR	00	00	01
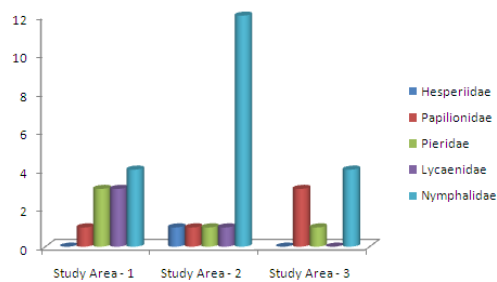
Figure 2. Family-wise distribution of butterfly species from the three study areas (Study Area - 1, Study Area - 2 and Study Area - 3) in and around Neora Valley National Park.

count of 16) followed by Study Area – 1 (total species count of 11) and Study Area – 3 (total species count of 8). Fig. 3 represents the commonality of occurrence among the three study sites. The transition zones between Study Area – 1 and Study Area – 2, Study Area – 2 and Study Area – 3 and Study Area – 1 and Study Area – 3 are represented by 3, 2 and 1 butterfly species respectively. Only 1 butterfly species Yellow Coster (*A. issoria*), was found to co-occur in all the three sites.

All the diversity indices studied in the present investigation were always found to be invariably higher at Study Area–2 (Tab. 2).

Dendrogram analysis (Fig. 4) showed that Study Area –1 and Study Area–3 were nearer to each other while most diverse forest edges of Study Area–2 were the farthest.

Discussion

Since British Raj, thousands of hectares of rich virgin forestlands of Eastern Himalayan region have been cleared off for timber harvesting, or to accommodate tea gardens in the pristine rain-forested and undulating grassland areas. Later, the pressure of growing population and the demand of civilization have further decimated the jungle of these regions. Breathtaking scenic beauty attracts crores of national and international tourists throughout the year that too put a lot of pressure on the ecosystem. Moreover, the consequence of degradation of large forest areas on insect livelihood is poorly understood (Sayer and Whitmore, 1991). Keeping all these in view measurement of species diversity and abundance has become critically important to understanding forest communities and their conservation.

As it is almost impossible to record diversity in a holistic manner recent directives to estimate forest diversity for conservation have concentrated on performing rapid inventories (Anon, 1993; Roberts, 1991), that too utilizing individual taxa (Noss, 1990; Pearson, 1994; Ryti, 1992), or by developing extrapolation techniques to estimate diversity in a variety of habitat types (Colwell and Coddington, 1994; Hammond, 1994; Kiester *et al.*, 1996). Again habitat association of butterflies can be directly related to the availability of larval host plants, vegetation cover of herbs, shrubs and trees for nectaring of butterflies (Thomas, 1995).

Butterfly diversity in the tropics is highly endemic and mostly depends on forest vegetation (Collins and Morris, 1985; Sutton and Collins, 1991). Kitahara and Fujii (1994) have predicted lesser butterfly diversity in regions with high human disturbances. Accordingly Blair and Launer (1997) have recorded fewer butterfly species and reduced overall abundance with increasing urbanization in California. Extinction of species with more restricted distribution and therefore of high conservation values has often been found to be resulted from disturbances (Hamer *et al.*, 1997; Hill *et al.*, 1995).

The present results demonstrate that the relative abundance and diversity of butterfly species was highest in forest edges (Study Area–2) comprising of both habitat generalist and habit specialist predicting that it was the best place for butterfly

Table 2. Diversity indices for butterfly species from Study Areas (SA 1, 2 and 3) in and around Neora Valley National Park.

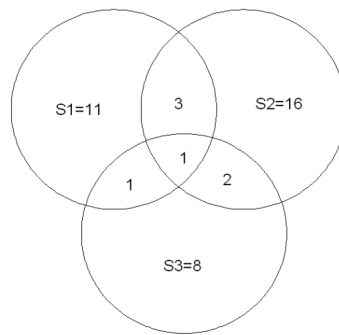| Diversity Indices	SA – 1	SA – 2	SA – 3
Butterfly species	11	16	8
Shannon Weiner Diversity	1.91	2.32	1.66
Simpson's Dominance Index	0.79	0.87	0.73
Pielou's Evenness Index	0.61	0.64	0.66
Margalef's Richness Index	2.75	3.56	2.42

Figure 3. Commonality in co-occurrence of butterfly species from the three study areas (Study Area - 1, Study Area - 2 and Study Area - 3) in and around Neora Valley National Park.
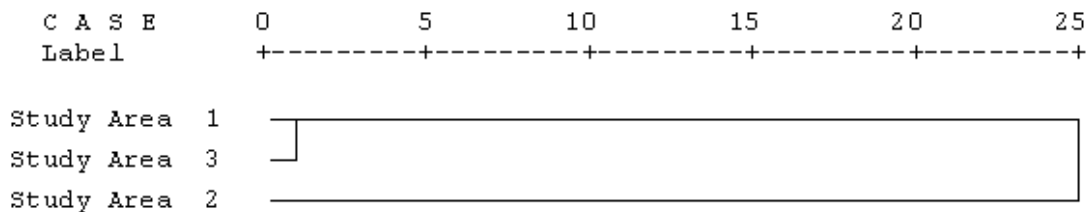

Figure 4. Dendrogram showing the relationship between the three study areas.

aggregation with suitable micro-environmental conditions and easy availability of host plants. Closed canopy cover with dense forest is suitable for only specialized butterfly species and that might have resulted in the present study to record less butterfly diversity from Study Area – 1.

Present findings also indicated negative influence of anthropogenic intervention on overall butterfly diversity from Study Area – 3.

So far as distribution pattern of butterfly species from the present location is concerned, only one species was found to be

co-occurring in all the three study sites. This habitat specific distribution of butterflies was reflected in the study of diversity indices where all the indices were always found to be invariably higher in areas of forest edges. Butterfly diversity and abundance in canopy closure were higher than in areas with human interventions but diversity indices score of both the study areas were comparable. This was also reflected in the dendrogram where the most diverse forest edges (Study Area – 2) was found to be separately located from the cluster of Study Area – 1 and Study Area – 3. This findings might be attributed to the fact that although both Shannon measures ($H^/$) and Simpson's index (D_{SIMP}) consider the proportional abundance of species, $H^/$ is more sensitive to rare species, whereas D_{SIMP} puts emphasis on the common species.

It may be noted that only a few selected patches of forests were studied and that too for shorter time span, a more intensive study would surely result in identifying many more species. Detailed studies could be made to improve the list of butterfly species and to ascertain their characteristic distribution in different forest patches from the present location. The impact of anthropogenic alteration of the habitats in and around Neora Valley National Park also needs intensive studies.

Acknowledgements

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