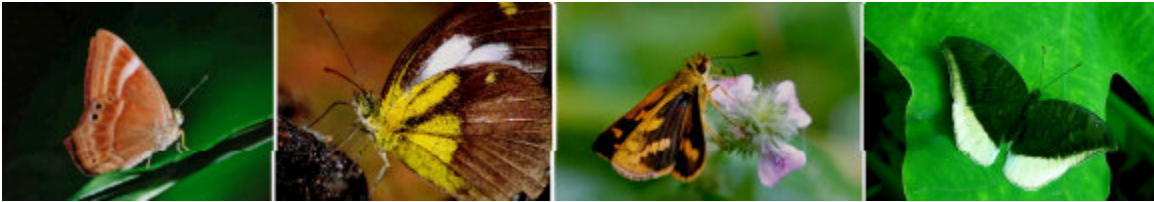




BUTTERFLIES AS BIOINDICATORS



K S Anoop Das
Lalitha Vijayan
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Salim Ali Centre for Ornithology and Natural History

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EXECUTIVE SUMMARY

In a pristine forest of the post Miocene and Pleistocene uplifted Western Ghats of India, this study addressed the community characteristics of butterfly assemblages as a function of habitat quality. Three variants of the evergreen forest - evergreen with grassland, disturbed evergreen and evergreen proper, two variants of the shola forests - montane shola forests and montane shola with grassland, and the broad-leaved hill forests were the specific habitat types selected within the Silent Valley National Park (SVNP) for the study. Apart from the characterization of butterfly guilds in each of the above forest types, the study aimed at identifying indicator species of butterflies for the specific habitat types. The natural treefall gaps which suddenly open up a strikingly different microhabitat within the forest types were used to monitor the response of butterflies to habitat change. Attempt was also made to establish a communication channel with the local residents living at the fringes of the National Park, so as to infuse the importance of conservation of nature in the area.

We employed two methods to assess the identity and density of butterfly species in each of the habitat types. The first was the Modified Pollard Walk using fixed width transects. There were a total of six transects walked at a frequency of once per month. The second method was *Van Someren* traps baited with smashed bananas mixed with pine-apple and rum. A total of 26 traps were employed for a period of 11 months, totaling 2173 trap days. The community parameters deciphered were *species richness*, *species abundance* and *species diversity*. The community composition was assessed based on species accumulation curve, cluster analysis, *k*-dominance curve and rarefaction. *IndVal* measures of each of the species were calculated to identify the indicator species.

A total of 133 species of butterflies belonging to five families were recorded during the study period. This included nine species endemic to the Western Ghats. Of these 35 were trapped in the fruit bait traps. All the variants of the evergreen forest types showed high species richness. Among them, the evergreen forest with grassland was found to be the richest followed by disturbed evergreen and evergreen proper, indicating ecotone effect. Species abundance was highest in the evergreen forest with grasslands, with 862 individuals, followed by disturbed evergreen forest (653) then by evergreen (573). Least abundance were observed in broadleaved hill forest (35), whereas shola and shola with grasslands harbored 62 and 105 respectively. The computed species diversity also showed the same pattern, highest at the evergreen with grassland and least at the broad-leaved hill forest. We reported significantly low indices for all the three parameters at the montane shola forests, montane shola with grassland and the broad-leaved hill forests. This gradation of indices between forest types held true when the influence of elevation was removed from the data sets. Species accumulation curves reached an asymptote in neither of the forest types, but leveled off smoothly indicating that the guilds were not completely sampled, but yet the samples were representative. The diversity index, fisher's alpha ranged from 11.18 to 28.45 and was significantly different across habitats at $p < 0.001$.

With respect to similarity of butterfly assemblages among forest types studied, broad-leaved hill forests stood out in the group with Sorenson's quantitative indices >10 between other forest types. Between the variants of evergreen, the similarity indices were >56 and between the shola variants it was 57.5. However, the butterfly assemblage of the broad-leaved hill forests was more similar to the shola assemblages than the evergreen assemblages as shown by the Bray Curtis Cluster diagram. The pattern of distribution of the individuals between species referred to as equitability or evenness was also found to be different between habitats. Another indicator of pattern resemblance was that the log series model fits with all habitats except the broad-leaved hill forests and shola. The k -dominance curves crossed for the

evergreen variants indicating that they cannot be discriminated among themselves. Rarefaction analysis indicated that the evergreen forest with grassland was the richest habitat followed by disturbed evergreen, evergreen, the shola variants and then the broad-leaved hill forests.

While only four species (3.3%) of butterflies were common in all the six forest types studied, 37 species (30.3%) were recorded from only a single habitat. Patchiness in species populations or in whole communities as computed based on Chi-squared tests divided the 133 species into two groups- 58 species in aggregated form and the rest 75 species distributed randomly.

Specific attention to treefall gaps was a unique feature of this study. It helped to characterize the immediate response of species to habitat disturbance. Four different microhabitats, with respect to butterflies, namely- forest edge, natural forest, treefall gap and canopy were compared using fruit-bait trap data. Species abundance was more in forest edge area followed by gap, natural forest and canopy. At the gaps, higher diversity, greater evenness and lower scaled dominance of butterfly assemblages were observed. The study unequivocally showed that treefall gaps are not neutral with respect to the community structure of butterflies in the forests around them. The species composition at gaps resembles the open areas than the shaded forests which indicates the response of butterflies to a sudden habitat change as caused by a treefall.

We used the indicator value (*IndVal*) method, which combines measures of habitat fidelity and specificity, to the indicator responses of butterflies in SVNP. The indicator responses were verified by sampling in different areas of the Park. The study identified indicator species based on *IndVal* measure for all the evergreen variant forest types. For the evergreen forests they are *Jamides bochus*, *Graphium sarpedon*, *Danaus chrysippus* and *Jamides celeno*. These findings highlight the importance of a bioindicator-based approach to ecological monitoring, rather than the use of a diversity index approach in which species identity plays no part.

Programme such as nature awareness lectures and guiding field trips for the school children yielded very good response as they showed great enthusiasm and excitement in identifying the butterflies. The students from various schools and colleges (MRC tribal school-Mukkali, Peevees Public School- Nilambur and Farook College-Calicut) had participated in various programmes conducted as a part of the outreach programmes. The students have taken up projects such as the common butterfly life history stages in the home gardens and they had contacted us with great eagerness, while explaining the progress of their own observations.

Members of the Eco-development committee in SVNP continued to involve community members from various nearby tribal villages in all aspects of the conservation work. This participatory approach has successfully encompassed formal training of tourist guides, attending various development programmes, forest surveillance and assisting forest staff with periodic bird surveys and elephant census. This target group and the associated forest officials were given a training programme on butterfly identification and conservation which was found to be very constructive in creating a mindset to appreciate the importance of the beautiful invertebrates. They are now knowledgeable enough to identify and communicate the salient features of the species to the visitors at the National Park.

Whilst the current study did not explicitly evaluate threats to butterflies, general observations indicate that many threats still exist. Netting and illegal trade, mainly exporting is still prevalent and has been widely reported in the Nadukani region of Ghats, which is hardly 35 km from the study area. The initiative of the outreach programs were attended by students from near this sensitive area also, spreading the message of conservation in an otherwise situation of ignorant inertia.

This study used a combination of sighting and trapping methods for the first time to study butterflies in the tropical evergreen forests of the Western Ghats. It characterized the butterfly assemblages in six forest types and found that one third of the recorded species were highly habitat sensitive. Indicator

and detector species of butterflies were identified for the evergreen variant forest types which would help assess habitat health in the future. The study emphasizes the role of ecotones and fringes in the conservation of the area at a time when part of the buffer zone of the National Park is being designated for a hydroelectric project. The outreach programs have initiated a new sensibility to view the Park as home of the frail invertebrates along with the bigger mammals already in the glare of publicity.