

Does beta diversity influence species structure and composition? A study on limenitinae butterflies (Family: Nymphalidae) along an elevational gradient in the Eastern Himalayan Landscape of West Bengal, India.

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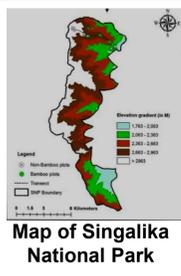
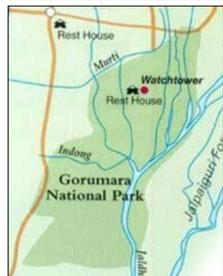
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INTRODUCTION

- Beta diversity facilitates the comparison of difference in species composition among communities across different ecosystems.
- It varies along environmental gradients, and this understanding helps in exploring the well-being of different butterfly communities within a landscape.

STUDY AREA



The study was conducted in the surrounding regions outside the jurisdiction of the protected areas of Eastern Himalayas:
 ✓ Singalika National Park
 ✓ Neora Valley National Park
 ✓ Gorumara National Park

Map of Gorumara National Park

Map of Singalika National Park

Map of Neora valley National Park

METHODOLOGY

The present study investigates the community composition (beta diversity patterns) of limenitinae butterflies along an elevational gradient.

Six elevational belts (<=1500 masl, 1501-2000 masl, 2001-2500 masl, 2501-3000 masl, 3001-3500 masl, >=3501 masl) were established in the surrounding regions outside the jurisdiction of the protected areas of Eastern Himalayas.

Euthalia nais



Athyma selonophora



DATA ANALYSIS

- Bray-Curtis dissimilarity was used for estimating species abundance due to its high sensitivity to relative abundance and species composition.
- Euclidean distance metrics represented dissimilarities between data points across various communities.
- UPGMA was employed for grouping similar communities hierarchically based on shared characters such as environmental variables of habitat.
- The turnover component of beta-diversity demonstrated species replacement from one site to another, while nestedness highlighted the occurrence of species-poor assemblages as subsets of more species-rich communities.
- Additionally, Sorenson similarity measured the degree of overlap in species composition between two communities across the elevational gradient.

Athyma opalina



Parsarpa zyla



RESULTS

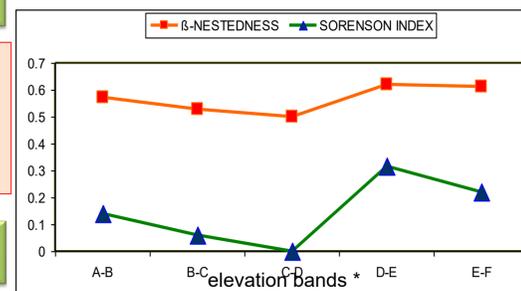


Figure 1: Representation of species nestedness and similarity index

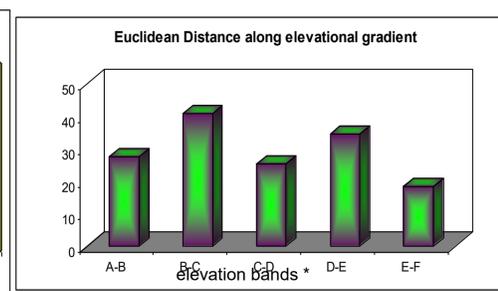


Figure 2: Representation of euclidean distance value along elevation gradient

*where elevation bands (in masl) are represented alphabetically. i.e. A ≤ 1500 B=1501-2000, C=2001-2500, D=2501-3000, E=3001-3500, F ≥3501

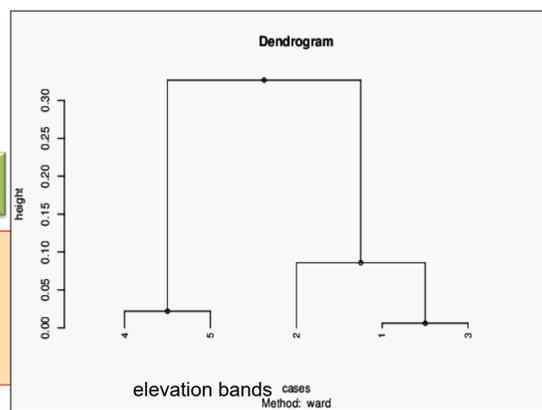


Figure 3: Hierarchical clustering illustrating stepwise β-diversity values indicating species dissimilarity where 1=A-B, 2=B-C, 3=C-D, 4=D-E, 5=E-F and A ≤ 1500 B=1501-2000, C=2001-2500, D=2501-3000, E=3001-3500, F ≥3501

	A	B	C	D	E	F
A	0.000	0.173	0.365	0.463	0.652	0.843
B	0.173	0.000	0.236	0.311	0.580	0.783
C	0.365	0.236	0.000	0.167	0.482	0.699
D	0.463	0.311	0.167	0.000	0.360	0.622
E	0.652	0.580	0.482	0.360	0.000	0.338
F	0.843	0.783	0.699	0.622	0.338	0.000

Table 1: Pair-wise dissimilarity in species distribution between elevation belts where A ≤ 1500 B=1501-2000, C=2001-2500, D=2501-3000, E=3001-3500, F ≥3501

- Stepwise beta diversity formed a peak between 3001-3500 masl (0.360), indicating the highest species dissimilarity. However, pairwise beta diversity showed a consistent increase in dissimilarity with an increase in distance between two elevation bands, favoring the distance-decay hypothesis. (Figure 3, Table 1).
- These higher values are probably indicative of the substitution of species components, suggesting species occurrence exclusively in each elevation belt.
- Euclidean distance metrics reached the highest value between B and C communities (40.575). (Figure 2).
- The highest nestedness in species occurrence (0.621) and Sorenson's similarity (0.318) were recorded across D and E communities (Figure 1).

CONCLUSION

- Results suggest a change in species composition significantly along elevational gradients, with distinct butterfly communities in different belts.
- Peak in beta diversity and species turnover at 3000-3500 masl indicates a zone of high species replacement and community differentiation.
- Distance-decay pattern in pair-wise beta diversity emphasizes spatial separation in community composition.

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