e-planet **23** (2): 194-200 (December 2025)

Assessment of community led conservation efforts and butterfly diversity in the periphery of Satkosia Tiger Reserve, Angul, Odisha, India

M. PAWAR* AND A. SARSAVAN

Foundation for Ecological Security, Post Box No. 29, Jahangirpura, Hadgud, District -Anand, Gujarat, India- 388 370

**manohar.pawar@fes.org.in*

Date of receipt: 10.12.2025 Date of acceptance: 20.12.2025

ABSTRACT

In total, 93 species were documented across 21 unique transects in community restored area highlighting the comprehensive nature of the survey and its potential to contribute to our understanding of butterfly ecology in the periphery of Satkosia Tiger Reserve. The Shannon diversity index, a measure of species diversity that considers both abundance and evenness, ranges from 2.3 to 3.5 across the surveyed sites. The abundance of butterfly species was almost same across all types of habitat. The mean Shannon Diversity Index for the entire study area was calculated to be 3.05, reflecting the richness and variety of butterfly species observed during the survey. The surveyed sites include areas such as forests, fallow lands, and agricultural land, representing diverse ecological habitats. Among all the land uses, maximum butterfly richness and abundance were recorded in forests followed by agricultural and fallow lands.

Key words: Angul, butterflies, community restoration, ecology, habitat, land-use

INTRODUCTION

Restoration, not only provides livelihood sbut also support diversity, and ecological services which are required for the smooth functioning of ecosystem (Hobbs and Harris, 2001; Benayas et al., 2009). To measure the ecosystem, health and community efforts to restore the common butterflies is one of the major indicators for assessment and understanding the change in habitat quality of the landscape (Bonebrake et al., 2010; Kremen, 1992).

The butterflies play a vital role in different ecosystems and are important indicators of healthy environment and ecosystems (Ghazanfar et al., 2016). There is a co-evolutionary relationship between butterflies and plants, indicating that their lives have close ecological inter-linkages (Paul et al.,1964). Butterflies are an important components of food chain as they act as prey for small mammals, reptiles, amphibians, birds, and other insects. Additionally, butterflies play a crucial role in pollination for wild plants and agricultural crops by carrying pollen from one plant to another plant far apart and induce genetic variation in the plant species (Kumar et al., 2021). Ecologists also use butterflies as model organisms to study the impact of climate change and habitat loss, since they are pollination sensitive and cannot survive under unfavorable environmental conditions (Hill et al., 2021).

MATERIALS AND METHODS

The present study has been conducted in the periphery of Satkosia Tiger Reserve covering 7200 hectare area in Angul district, located in central Odisha during September to October, 2023 (Fig. 1). This area is characterized by undulating topography, interspersed by streams and rivulets flowing into the two major river systems- Brahmani and Mahanadi. It has a rich forest with an elevation ranging between 152-823 meters. The Satkosia Gorge Wildlife Sanctuary is a characteristic feature of the area.

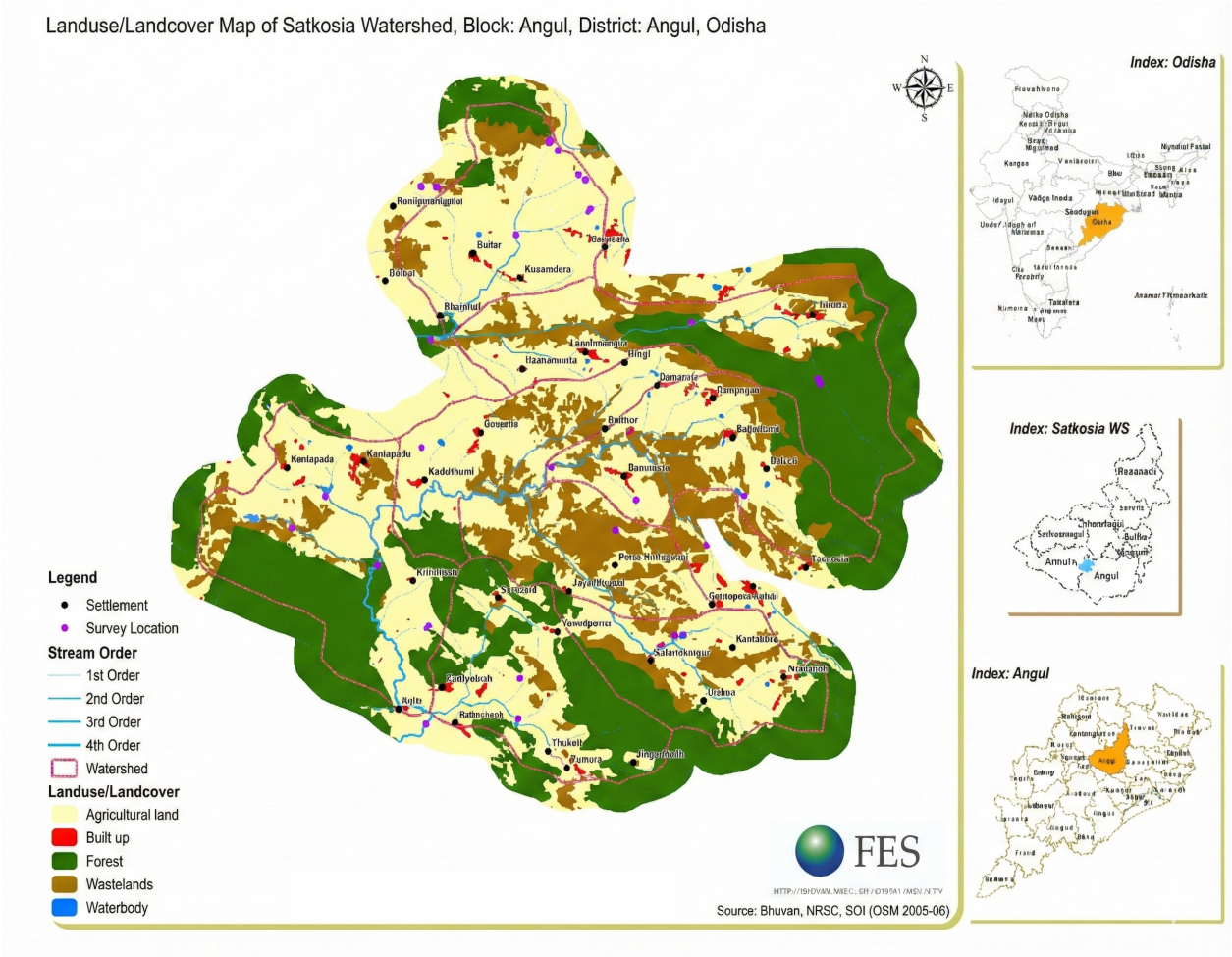

Fig. 1. Map of study area (not in scale)

The monitoring protocol was based on modified Pollard walks (Koh and Sodhi, 2004; Pollard and Yates, 1993). Transects were visited between 10:00 and 16:00 hours. Transects (approximately 500m length and 20m breadth) were walked in one direction at a slow and even pace (~1-2 km/h) for a duration of 25-30 minutes on clear days. Quantitative sampling was done systematically across 18 locations covering five different habitats, namely, agricultural land, agricultural fallow land, fallow land, forest and grassland. Species level identification was done using keys (Kehimkar, 2008; Kunte, 2000 and Mohapatra et al., 2012) and mostly photographic documentation was carried out. The analysis of the species observed was done with the help of Shannon-Wiener Index (H), Evenness (J), Simpson's Index/Dominance, Simpson's Index of diversity (1-D) were Simpson's Reciprocal Index (1/D) (Magurran, 1988; Pielou, 1969).

RESULTS AND DISCUSSION

A total of 1674 butterflies representing 93 species belonging to 6 families were recorded (Table 2) during the study period. The highest representation was from Nymphalidae (33 species), followed by Lycaenidae (20 species), Hesperiidae (21 species), Pieridae (11 species), Papilionidae (7 species) and Riodinidae (1 species). The distribution pattern of these families across forest, agricultural fields, and fallow lands reflects the influence of vegetation structure, plant species composition, and microhabitat heterogeneity on butterfly assemblages (Fig. 2).

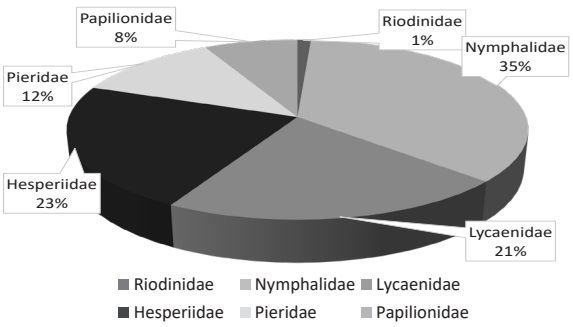

Fig. 2. Family wise diversity of butterflies

Ypthima huebneri, Euploea core, Ampittia dioscorides, Eurema hecabe, and *Mycalesis perseus* were the most abundant species in the study area. Majority of plant species belonging to the above mentioned genus are abundant in the study area. *Ampitta dioscorides* was another species present in high abundance, this could be attributed to the fact that *Cynodon dactylon* and *Oryza sativa* which are the main host-plants for this butterfly species are abundant in agricultural fields in the study area.

Table 1. Diversity indices for different habitats

Land use	No. of species	Shannon-Wiener Index (H)	Evenness (J)	Simpson's Index/ Dominance	Simpson's Index of diversity (1-D)	Simpson's Reciprocal Index (1/D)
Agriculture	54	3.12	0.78	0.058	0.942	17.245
Fallow land	49	3.37	0.87	0.042	0.958	23.618
Forest	68	3.49	0.83	0.041	0.959	24.231
Total	93	3.79	0.84	0.028	0.972	36.132

The highest representation was from Nymphalidae (33 species), followed by Lycaenidae (20 species), Hesperiidae (21 species), Pieridae (11 species), Papilionidae (7 species), and Riodinidae (1 species). The distribution pattern of these families across forest, agricultural fields, and fallow lands reflects the influence of vegetation structure, plant species composition, and microhabitat heterogeneity on butterfly assemblages.

The Shannon-Wiener Index (H') followed a similar gradient, with the highest diversity observed in forest (H' = 3.49), followed by fallow land (H' = 3.37) and agriculture (H' = 3.12). These values indicate generally high diversity across the landscape, with forest habitats providing the greatest structural complexity and microhabitat variation (Table. 1).

Evenness (J) values were consistently high across habitats (Table. 1), showing that species were fairly evenly distributed. Fallow land showed the highest evenness (0.87), suggesting a relatively uniform distribution of species typically associated with early-successional vegetation. Dominance, measured using Simpson's Index (D), was highest in agriculture (0.058), reflecting the influence of regular disturbance and the prevalence of a few tolerant species. Forest (D = 0.041) and fallow land (D = 0.042) showed lower dominance, indicating higher ecological balance and reduced skewness in species abundance. The overall values indicate a highly diverse and ecologically balanced butterfly community across the periphery of Satkosia Tiger Reserve. The checklist of butterflies recorded from Satkosia Tiger Reserve, Angul, Odisha has been presented in Table. 2.

The forested (68) patches around Satkosia Tiger Reserve showed the highest diversity, particularly dominated by Nymphalidae and Lycaenidae. This is because forest habitats provide multi-layered canopy structure (trees, shrubs, herbs, climbers), forest edges and ecotones, shade-tolerant nectar plants, fruiting resources, higher humidity and microclimatic stability and more importantly the presence of host plants for forest specialists. The high richness of these families indicates that forest patches maintain good ecological quality, structural heterogeneity, and continuous vegetation cover required for forest-dependent species. Agricultural fields dominated by crops, bund vegetation, weeds, and scattered trees supported

a different community of butterflies, especially Pieridae and Hesperiidae. Open sunny conditions, abundance of herbaceous weeds, Seasonal crops, agriculture edges supporting grasses and legumes. Agricultural landscapes, despite being modified, act as semi-natural habitats that sustain generalist and open-habitat butterflies. Species richness (54) here reflects availability of herbaceous vegetation rather than woody plant structure. *Ampittia dioscorides* and *Junonia almanac* (99) emerged as the most abundant species. The Bush Hopper is known to prefer grassy patches, weedy edges commonly found along agricultural bunds and small water channels, which explains its dominance and frequently seen in crop fields, fallow edges, and open patches. Its preference for disturbed habitats makes agriculture fields ideal. *Ypthima huebneri* (46), *Mycalesis perseus* (45) *Eurema hecabe* (43) are other notable species found in the agriculture dominated patches. The abundance pattern reflects the structural openness and herbaceous vegetation diversity. The dominance of grassland-associated and disturbance-tolerant species highlights how agriculture acts as a productive yet dynamic habitat supporting high butterfly activity. Fallow lands act as transition habitats, and serve as important buffer zones between forest and agriculture, enhancing landscape-level connectivity. Fallow or abandoned agricultural lands had a mixture of early successional weeds, grasses, and shrubs, attracting nectar-feeding generalists, Sunlight-exposed open patches, dominated by fast-growing weeds (*Tridax* spp., *Chromolaena* sp.) and high abundance of herbaceous flora are well supported to habitat generalist and specialist species.

The highest abundance recorded in this habitat was for *Catopsilia pomona* (38) and *Eurema hecabe* (38) and known to prefer sunlit open areas where host plants such as Cassia, Senna, and various legumes thrive naturally in abandoned or seasonally fallow farmlands. Their dominance indicates that the fallow landscape is rich in herbaceous vegetation and early-successional plant species that support larval development and adult foraging. Another notable species was *Ypthima huebneri, Papilio polytes* and *Acraea terpsicore,* reflecting the presence of weedy herbaceous flora. The presence of species is further reinforcing the role of fallow land as a stable habitat for early-successional and disturbance-tolerant butterfly species. Results show that butterfly diversity increases with heterogeneous vegetation structure, Forest habitats support specialists, while open and fallow habitats support generalists together forming a complementary landscape mosaic that enhances overall richness.

Table 2. Checklist of butterflies recorded from Satkosia Tiger Reserve, Angul, Odisha

Sl. No	Family	Common name	Scientific name
1	Hesperiidae	Bush hopper	*Ampittia dioscorides* (Fabricius, 1793)
2	Hesperiidae	Brown awl	*Badamia exclamationis* (Fabricius, 1775)
3	Hesperiidae	Rice swift	*Borbo cinnara* (Wallace, 1866)
4	Hesperiidae	Golden angle	*Caprona ransonnettii* (R. Felder, 1868)
5	Hesperiidae	Plain palm-dart	*Cephrenes acalle* (Höpffer, 1874)
6	Hesperiidae	Tricolour pied flat	*Coladenia indrani* (Moore, 1866)
7	Hesperiidae	Bispot banded ace	*Halpe porus* (Mabille, 1877)
8	Hesperiidae	Common banded awl	*Hasora chromus* (Cramer, 1780)
9	Hesperiidae	Chestnut bob	*Iambrix salsala* (Moore, 1866)
10	Hesperiidae	Common branded redeye	*Matapa aria* (Moore, 1866)
11	Hesperiidae	Restricted demon	*Notocrypta curvifascia* (C. & R. Felder, 1862)
12	Hesperiidae	Straight swift	*Parnara guttatus* (Bremer & Grey, 1852)
13	Hesperiidae	Small branded swift	*Pelopidas mathias* (Fabricius, 1798)

14	Hesperiidae	Large branded swift	*Pelopidas subochracea* (Moore, 1878)
15	Hesperiidae	Common small flat	*Sarangesa dasahara* (Moore, 1866)
16	Hesperiidae	Asian grizzled skipper	*Spialia galba* (Fabricius, 1793)
17	Hesperiidae	Oriental palm bob	*Suastus gremius* (Fabricius, 1798)
18	Hesperiidae	Grey-veined grass dart	*Taractrocera maevius* (Fabricius, 1793)
19	Hesperiidae	Dark palm-dart	*Telicota bambusae* (Moore, 1878)
20	Hesperiidae	Pale palm dart	*Telicota colon* (Fabricius, 1775)
21	Hesperiidae	Grass demon	*Udaspes folus* (Cramer, 1775)
22	Lycaenidae	Common hedge blue	*Acytolepis puspa* (Horsfield, 1828)
23	Lycaenidae	Common ciliate blue	*Anthene emolus* (Godart, 1824)
24	Lycaenidae	Indian oakblue	*Arhopala atrax* (Hewitson, 1862)
25	Lycaenidae	Angled castor	*Ariadne ariadne* (Linnaeus, 1763)
26	Lycaenidae	Angled pierrot	*Caleta decidia* (Hewitson, 1876)
27	Lycaenidae	Common pierrot	*Castalius rosimon* (Fabricius, 1775)
28	Lycaenidae	Forget-me-not	*Catochrysops strabo* (Fabricius, 1793)
29	Lycaenidae	Lime blue	*Chilades lajus* (Stoll, 1780)
30	Lycaenidae	Plains cupid	*Chilades pandava* (Horsfield, 1829)
31	Lycaenidae	Common silverline	*Cigaritis vulcanus* (Fabricius, 1775)
32	Lycaenidae	Gram blue	*Euchrysops cnejus* (Fabricius, 1798)
33	Lycaenidae	Black-spotted grass jewel	*Freyeria putli* (Kollar, 1844)
34	Lycaenidae	Orchid tit	*Hypolycaena othona* (Hewitson, 1865)
35	Lycaenidae	Common cerulean	*Jamides celeno* (Cramer, 1775)
36	Lycaenidae	Yamfly	*Loxura atymnus* (Stoll, 1780)
37	Lycaenidae	Dingy blue	*Petrelaea dana* (de Nicéville, 1884)
38	Lycaenidae	Pale grass blue	*Pseudozizeeria maha* (Kollar, 1844)
39	Lycaenidae	Monkey puzzle	*Rathinda amor* (Fabricius, 1775)
40	Nymphalidae	Common acacia blue	*Surendra quercetorum* (Moore, 1858)
41	Nymphalidae	Striped pierrot	*Tarucus nara* (Kollar, 1848)
42	Nymphalidae	Lesser grass blue	*Zizina otis* (Fabricius, 1787)
43	Nymphalidae	Tawny coster	*Acraea terpsicore* (Linnaeus, 1758)
44	Nymphalidae	Common castor	*Ariadne merione* (Cramer, 1777)
45	Nymphalidae	Anomalous nawab	*Charaxes agrarius* (Swinhoe, (1887)
46	Nymphalidae	Black rajah	*Charaxes solon* (Fabricius, 1793)
47	Nymphalidae	Plain tiger	*Danaus chrysippu*s (Linnaeus, 1758)
48	Nymphalidae	Striped tiger	*Danaus genutia* (Cramer, 1779)
49	Nymphalidae	Common palmfly	*Elymnias hypermnestra* (Linnaeus, 1763)
50	Nymphalidae	Common crow	*Euploea core* (Cramer, 1780)
51	Nymphalidae	Common baron	*Euthalia aconthea* (Cramer, 1777)
52	Nymphalidae	Great eggfly	*Hypolimnas bolina* (Linnaeus, 1758)
53	Nymphalidae	Glassy tiger	*Ideopsis similis* (Linnaeus, 1758)

54	Nymphalidae	Peacock pansy	*Junonia almana* (Linnaeus, 1758)
55	Nymphalidae	Grey pansy	*Junonia atlites* (Linnaeus, 1763)
56	Nymphalidae	Yellow pansy	*Junonia hierta* (Fabricius, 1798)
57	Nymphalidae	Chocolate pansy	*Junonia iphita* (Cramer, 1779)
58	Nymphalidae	Lemon pansy	*Junonia lemonias* (Linnaeus, 1758)
59	Nymphalidae	Blue pansy	*Junonia orithya* (Linnaeus, 1758)
60	Nymphalidae	Orange oakleaf	*Kallima inachus* (Doyère, 1840)
61	Nymphalidae	Bamboo treebrown	*Lethe europa* (Fabricius, 1775)
62	Nymphalidae	Common evening brown	*Melanitis leda* (Linnaeus, 1758)
63	Nymphalidae	Dark evening brown	*Melanitis phedima* (Cramer, 1780)
64	Nymphalidae	Commander	*Moduza procris* (Cramer, 1777)
65	Nymphalidae	Small long brand bushbrown	*Mycalesis igilia* (Fruhstorfer, 1911)
66	Nymphalidae	Dark-brand bushbrown	*Mycalesis mineus* (Linnaeus, 1758)
67	Nymphalidae	Common bushbrown	*Mycalesis perseus* (Fabricius, 1775)
68	Nymphalidae	Common sailer	*Neptis hylas* (Linnaeus, 1758)
69	Nymphalidae	Common leopard	*Phalanta phalantha* (Drury, 1773)
70	Nymphalidae	Baronet	*Symphaedra nais* (Forster, 1771)
71	Nymphalidae	Grey count	*Tanaecia lepidea* (Butler, 1868)
72	Nymphalidae	Blue tiger	*Tirumala limniace* (Cramer, 1775)
73	Nymphalidae	Common five-ring	*Ypthima baldus* (Fabricius, 1775)
74	Nymphalidae	Common four-ring	*Ypthima huebneri* (Kirby, 1871)
75	Papilionidae	Common jay	*Graphium doson* (C. & R. Felder, 1864)
76	Papilionidae	Common rose	*Pachliopta aristolochiae* (Fabricius, 1775)
77	Papilionidae	Crimson rose	*Pachliopta hector* (Linnaeus, 1758)
78	Papilionidae	Lime swallowtail	*Papilio demoleus* (Linnaeus, 1758)
79	Papilionidae	Green-banded peacock	*Papilio palinurus* (Fabricius, 1787)
80	Papilionidae	Blue mormon	*Papilio polymnestor* (Cramer, 1775)
81	Papilionidae	Common mormon	*Papilio polytes* (Linnaeus, 1758)
82	Pieridae	Lemon emigrant	*Catopsilia pomona* (Fabricius, 1775)
83	Pieridae	Mottled emigrant	*Catopsilia pyranthe* (Linnaeus, 1758)
84	Pieridae	Indian jezebel	*Delias eucharis* (Drury, 1773)
85	Pieridae	Painted jezebel	*Delias hyparete* (Linnaeus, 1758)
86	Pieridae	One-spot grass yellow	*Eurema andersonii* (Moore, 1886)
87	Pieridae	Small grass yellow	*Eurema brigitta* (Stoll, 1780)
88	Pieridae	Common grass yellow	*Eurema hecabe* (Linnaeus, 1758)
89	Pieridae	Yellow orange-tip	*Ixias pyrene* (Linnaeus, 1764)
90	Pieridae	Psyche	*Leptosia nina* (Fabricius, 1793)
91	Pieridae	Dark wanderer	*Pareronia ceylanica* (C. & R. Felder, 1865)
92	Pieridae	Common wanderer	*Pareronia valeria* (Cramer, 1776)
93	Riodinidae	Double-banded judy	*Abisara bifasciata* (Moore, 1877)

CONCLUSION

The study area is a mosaic type of landscape with a variety of natural and man-made ecosystems. This ecosystem is rich in flora and fauna. Village level institutions, Van Suraksha Samiti (VSS) and Eco Development Committees (EDC) are committed to the sustainable use and conservation of these ecosystems. For the past few years, programs for the improvement of natural habitats have been continuously being carried out in this area. It directly impacted the floral and faunal diversity of the area and as a result, the number of species documented by the current study may be higher, requiring further study for understanding the symbiotic relations of flora and butterfly diversity which will not only be helpful for conservation of species but also will serve the overall ecosystem health.

ACKNOWLEDGEMENT

Authors would like to express their thanks and gratitude to the community members, President, Gramya Jungle and staffs of Angul Forest Division for their spirit of conservation and restoration in the study area and their keen support during the study. Authors are also grateful to the Foundation for Ecological Security (FES), Angul for providing the facilities and extend sincere thanks to the FES Angul team for their assistance throughout the study. Special thanks to Mrs. Himani Sharma, Mr. Rahul Talegaonkar and Dr. Satish Kumar Sharma for their timely support and guidance.

REFERENCES

Benayas, J., Newton, A., Diaz, A. and Bullock, J. 2009. Enhancement of biodiversity and ecosystem services by ecological restoration: A meta-analysis. *Science* **325**: 1121-1124. https://doi.org/10.1126/science.1172460.

Bonebrake, T., Ponisio, L., Boggs, C. and Ehrlich, P. 2010. More than just indicators: A review of tropical butterfly ecology and conservation. *Biol. Conserv.* **143**: 1831-1841. https://doi.org/10.1016/j.biocon.2010.04.044.

Ghazanfar, M., Malik, M.F., Hussain, M., Iqbal, R. and Younas, M. 2016. Butterflies and their contribution in ecosystem: A review. *J. Entomol. Zool. Stud.* **4**(2): 115-118.

Hill, G.M., Kawahara, A.Y., Daniels, J.C., Bateman, C.C. and Schefers, B.R. 2021. Climate change effects on animal ecology: Butterflies and moths as a case study. *Biol. Rev.* **96**(5): 2113-2126. https://doi.org/10.1111/brv.12746.

Hobbs, R. and Harris, J. 2001. Restoration ecology: Repairing the earth's ecosystems in the new millennium. *Restor. Ecol.* **9**: 239-246. https://doi.org/10.1046/j.1526-100x.2001.009002239.

Kehimkar, I. 2008. *The book of Indian butterflies.* Bombay Natural History Society & Oxford University Press, Oxford & New York, pp. 497.

Koh, L.P. and Sodhi, N.S. 2004. Importance of reserves, fragments, and parks for butterfly conservation in a tropical urban landscape. *Ecol. Appl.* **14**(6): 1695-1708. https://doi.org/10.1890/03-5269.

Kremen, C. 1992. Assessing the indicator properties of species assemblages for natural areas monitoring. *Ecol. Appl.* **2**: 203-217. https://doi.org/10.2307/1941776.

Kumar, A., Sinha, A., Srivastava, D.P., Patel, P., Gautam, S., Ali, S., Singh, A., Kumar, A., Singh, P., Kavarshe, S., Singh, M. and Kumar, V. 2021. *Butterflies of Ratapani Wildlife Sanctuary.* MP Forest Department, MP; State Biodiversity Board &Tinsa Ecological Foundation, Bhopal, pp. 112.

Kunte, K. 2000. *Butterflies of Peninsular India*. Universities Press, Hyderabad and Indian Academy of Sciences, Bangalore, pp. 254.

Magurran, A.E. 1988. *Ecological diversity and its measurement*. Chapman and Hall, London, UK.

Mohapatra, P.P., Sarkar, V., Mishra, A.K. and Nair, M.V. 2012. *A field guide for beginners: Butterflies of Bonai, Odisha*. Odisha Forestry Sector Development Project, Bhubaneswar, India, pp. 210.

Paul, R.E. and Raven, P.H. 1964. Butterflies and plants: A study in coevolution. *Evolution,* **18**(4): 586-608. https://doi.org/10.2307/2406212.

Pielou, E.C. 1969. *An introduction to mathematical ecology*. John Wiley, New York, NY, USA, p. 286.

Pollard, E. and Yates, T.J. 1993. *Monitoring butterflies for ecology and conservation*. Chapman & Hall, London, pp. 274.