



Butterfly diversity in Nabarangpur District, Odisha, India: A two-year field survey and conservation assessment

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Abstract

This study documents butterfly diversity in Nabarangpur District, Odisha, within the Eastern Ghats landscape, using field observations conducted over 24 months from January 2022 to December 2023. Surveys were undertaken along 50 predefined transects distributed among forest, grassland, agricultural, riparian and associated human-modified habitats. Butterflies were recorded primarily by visual encounter and photographic documentation, with selective sweep-netting for difficult identifications; field locations were georeferenced using GPS. The project report documented 147 butterfly species representing nine families. Nymphalidae was the largest reported family with 42 species (28.57%), followed by Lycaenidae with 35 species (23.81%) and Pieridae with 28 species (19.05%); the remaining six families together accounted for 42 species (28.57%). The field report qualitatively associated higher butterfly diversity with structurally complex and vegetation-rich habitats, while agricultural and riparian habitats contributed additional species with more specific resource requirements. A post-monsoon increase in diversity was also reported. These patterns are broadly consistent with published butterfly studies from other parts of Odisha, although seasonal peaks vary among landscapes. The documented richness is comparable with the well-studied Koraput landscape, where 148 species were recorded, and exceeds several smaller-site inventories in Odisha. The present work therefore provides a useful district-level baseline. However, the original report did not preserve a complete species-by-transect abundance matrix, voucher accession numbers, or the numerical output of the reported canonical correspondence analysis. The manuscript emphasizes habitat protection, host-plant conservation, reduction of pesticide pressure, landscape connectivity, community participation and standardized long-term monitoring.

Keywords: Butterflies, *Lepidoptera*, Nabarangpur, Odisha, Eastern Ghats, species richness, habitat heterogeneity; conservation

Introduction

Butterflies are conspicuous components of terrestrial insect communities and are frequently used in ecological assessments because their distributions respond to vegetation structure, resource availability, microclimate and landscape modification. Their dependence on larval host plants and adult nectar resources makes butterfly assemblages sensitive to changes in habitat composition and management. They also occupy important trophic positions as herbivores and prey and contribute to pollination through adult flower visitation (Pollard & Yates, 1993)^[9].

Nabarangpur District occupies an important position in south-western Odisha and forms part of the broader Eastern Ghats landscape. The district covers approximately 5,294 km² and extends from about 19°09'–20°05' N and 81°52'–82°53' E according to the Odisha District Gazetteer. The district includes forest patches, hill systems, agricultural land, grassland and riparian environments, providing a heterogeneous landscape capable of supporting diverse butterfly communities (Government of Odisha, 2018)^[5].

Published studies demonstrate that butterfly richness in Odisha can vary markedly with spatial scale, habitat structure and sampling effort. Acharya and Pal recorded 53 species around Chandandhara waterfall in the Nabarangpur region. Mahata and Palita recorded 148 species from eight sites in Koraput using standardized transect counts, while Bacha and colleagues recorded 75 species in Sambalpur

University Campus. A Rayagada study documented 75 species across agricultural and agro-forest habitats. These studies provide a useful regional framework for interpreting the Nabarangpur inventory without treating values from other landscapes as direct measurements of the present study (Acharya & Pal, 2019; Bacha & Lenka, 2023; Bacha *et al.*, 2023; Das *et al.*, 2025^[1, 2, 3, 4]; Mahata & Palita, 2022).

Objectives

1. To document butterfly species richness and family-level composition in Nabarangpur District.
2. To examine the occurrence of butterflies across major habitat categories represented by the field survey.
3. To interpret the observed diversity in relation to habitat heterogeneity and seasonality using comparable studies from Odisha.
4. To identify conservation priorities and methodological requirements for future standardized monitoring.

Materials and Methods

1. Study area

Nabarangpur District is situated in south-western Odisha. The official Odisha District Gazetteer gives an area of approximately 5,294 km² and geographic coordinates of 19°09'–20°05' N and 81°52'–82°53' E. The district is characterized by a mixture of forested landscapes, by

agricultural areas, low hills, grassland/open habitats and riverine environments. The Indravati forms the boundary between Nabarangpur and Koraput in part of the district. The field project sampled sites representing this environmental heterogeneity rather than attempting to estimate the butterfly fauna of every habitat patch uniformly (Government of Odisha, 2018)^[5].

2. Survey period and sampling design

Field observations were reported for 24 months, from

January 2022 through December 2023. The project established 50 predefined transects distributed among representative habitat categories. Named survey locations included Hirli Dongri Hill, Mangalam Timber Road, Mangalam Timber Hill, the Central Silk Board Office area at Majhiguda, and Papdahandi Arjun Forest. The source report describes the sampling design as stratified across habitat types including forest, grassland and agricultural areas, with riparian/wetland environments considered in the habitat interpretation (Mallik, 2024^[8]–2025).

Table 1: Summary of the documented field-survey design (Mallik, 2024^[8]–2025).

Parameter	Documented project information
Survey period	January 2022–December 2023 (24 months)
Number of predefined transects	50
Main habitats represented	Forest, grassland, agricultural and riparian-associated habitats
Named locations	Hirli Dongri Hill; Mangalam Timber Road; Mangalam Timber Hill; Central Silk Board Office–Majhiguda; Papdahandi Arjun Forest
Primary observation period	Approximately 09:00–16:00
Primary methods	Visual encounter, photographic documentation, GPS tagging
Supplementary method	Selective sweep-netting for difficult identifications

3. Field observation and identification

Butterflies were observed along transects and identified in the field whenever possible. Photographs were obtained for documentation, while sweep-netting was used selectively for individuals that were difficult to identify visually. The project report states that identification involved taxonomic keys, field guides, reference collections, morphological characters and expert consultation. The source report also indicates that records were organized by species, location, date and habitat type (Mallik, 2024–2025; Kunte *et al.*, 2026)^[6, 8].

4. Data treatment and analytical caution

Species richness and family-level composition were summarized directly from the project report. The report gives a total of 147 species and nine families and provides counts for three families: Nymphalidae (42), Lycaenidae (35) and Pieridae (28). The remaining six families therefore account for 42 species in combination. Percentages were recalculated from the reported total of 147 species. These are species-richness proportions, not relative abundance (Mallik, 2024^[8]–2025).

The project report refers to statistical analyses and a canonical correspondence analysis (CCA), but the underlying species-by-transect matrix, environmental matrix, ordination coordinates, eigenvalues, variance explained and significance tests were not included in the available report. Accordingly, no new numerical diversity index, multivariate statistic or abundance estimate is presented as an observed result. This precaution prevents literature-derived or modelled values from being misrepresented as field measurements (Mallik, 2024–2025; ter Braak, 1986)^[8, 10].

Results

1. Species richness and family composition

The field project documented 147 butterfly species belonging to nine families. Nymphalidae was the largest reported family with 42 species, followed by Lycaenidae with 35 and Pieridae with 28. Together, these three families accounted for 105 species, or 71.43% of the total reported richness. The remaining six families together contributed 42 species (28.57%) (Mallik, 2024^[8]–2025).

Table 2: Family-level species richness available from the project report. The six less-resolved families are retained as a combined category because individual family counts were not recoverable from the report (Mallik, 2024^[8]–2025).

Family/group	Species richness	Percentage of total
Nymphalidae	42	28.57%
Lycaenidae	35	23.81%
Pieridae	28	19.05%
Other six families (combined)	42	28.57%
Total	147	100.00%

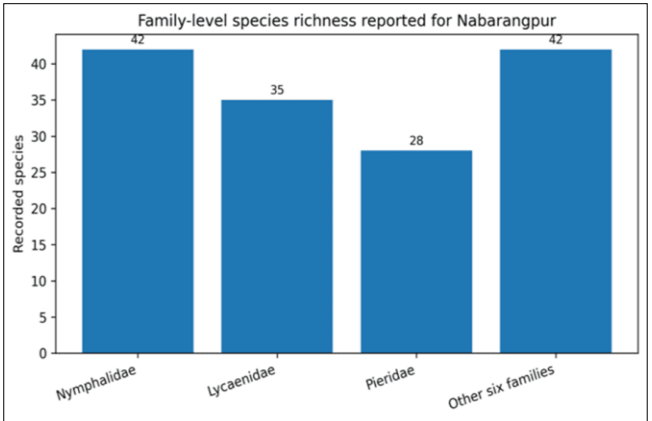


Fig 1: Family-level species richness reconstructed from the three family counts explicitly reported in the project and the combined remainder.

2. Habitat-associated patterns

The project report indicates that forest habitats supported the greatest breadth of butterfly diversity, which is ecologically plausible because forests provide layered vegetation, shaded microhabitats, larval host plants, nectar resources and shelter. Grassland and open habitats were also important, particularly for sun-loving and nectar-feeding species. Agricultural landscapes contributed butterfly records where host plants, weeds, flowering resources or field margins were available, whereas riparian and wet habitats were described as important for species associated with higher moisture and particular host plants (Mallik, 2024^[8]–2025; Mahata & Palita, 2022; Bacha & Lenka, 2023)^[3].

Table 3: Habitat interpretation based on the documented project observations and ecological context. These are qualitative patterns; habitat-wise species counts were not available for recalculation (Mallik, 2024^[8]–2025).

Habitat category	Pattern documented/interpreted from the project	Conservation relevance
Forest / wooded habitat	Highest qualitative diversity; complex vegetation and shelter support multiple guilds.	Retain canopy, understorey and host plants; reduce fragmentation.
Grassland / open habitat	Supports open-habitat and nectar-feeding butterflies.	Avoid complete conversion; maintain flowering patches and seasonal heterogeneity.
Agricultural habitat	Supports adaptable species where weeds, host plants and field margins persist.	Reduce pesticide pressure; retain vegetated field margins and mixed land use.
Riparian / wet habitat	Provides moist microhabitats and specialized plant resources.	Protect streamside vegetation and avoid pollution and excessive clearing.
Human-modified sites	May retain generalist species and provide stepping stones when vegetation persists.	Maintain gardens, roadside flowering plants and habitat connectivity.

3. Seasonality

The original project identifies a post-monsoon increase in butterfly diversity, associated with moderate rainfall and increased vegetation resources. This pattern is consistent with the 12-month Sambalpur University study, which reported maximum diversity during the post-monsoon period, but it is not universal across Odisha. Mahata and Palita reported higher species assemblages during dry

seasons in Koraput, while Bacha and Lenka recorded the highest overall species occurrence during summer in agricultural and agro-forest sites of Rayagada. These differences indicate that butterfly seasonality is strongly site- and habitat-dependent and should not be generalized across the entire Eastern Ghats (Mallik, 2024–2025; Bacha *et al.*, 2023; Bacha & Lenka, 2023^[2, 3, 8]; Mahata & Palita, 2022).

4. Comparison with other Odisha inventories

Table 4: Comparison with selected published butterfly inventories from Odisha. Differences in sampling duration, effort and habitat coverage mean that species totals are not directly equivalent measures of diversity (Acharya & Pal, 2019; Bacha & Lenka, 2023; Bacha *et al.*, 2023; Das *et al.*, 2025^[1, 2, 3, 4]; Mahata & Palita, 2022).

Study	Species	Families	Survey design	Main setting
Nabarangpur, present study (Mallik, 2024 ^[8] –2025)	147	9	24 months; 50 predefined transects	Forest, grassland, agricultural and riparian-associated habitats
Koraput (Mahata & Palita, 2022)	148	6	Nov 2016–Oct 2017; 8 sites; 300-m Pollard walks	Natural forest, agroforestry, urban green
Rayagada (Bacha & Lenka, 2023) ^[3]	75	5	Jan–Dec 2020; two land types	Agricultural and agro-forest
Sambalpur University (Bacha <i>et al.</i> , 2023) ^[2]	75	6	12 months; Pollard walk	Campus, scrubland, reserve forest, roadside pasture
Chandandhara waterfall, Nabarangpur (Acharya & Pal, 2019) ^[1]	53	6	~9 months	Waterfall-associated landscape
Barbara Forest, Odisha (Das <i>et al.</i> , 2025) ^[4]	69	6	December 2024 survey	Tropical deciduous forest

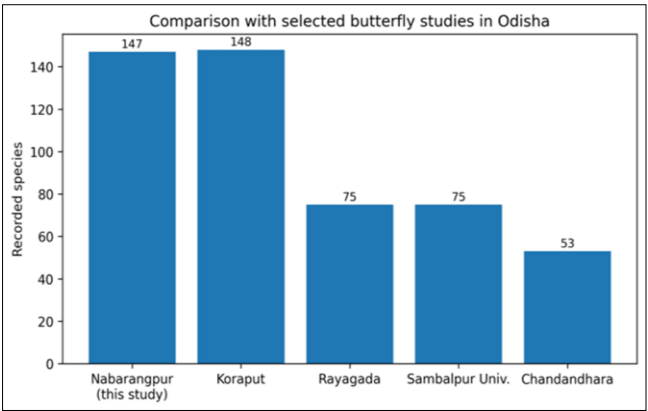


Fig 2: Species totals reported by selected butterfly studies in Odisha.

Discussion

The documented richness of 147 species places the Nabarangpur inventory among the more species-rich

district- or multi-site butterfly surveys currently available from Odisha. The total is almost identical to the 148 species reported from Koraput by Mahata and Palita, despite differences in survey design and sampling intensity. It is substantially higher than the 53 species reported from the Chandandhara waterfall study within the broader Nabarangpur region, which is expected because the present project covered a wider range of habitats and a longer period. The comparison therefore supports the value of landscape-scale sampling rather than suggesting that one site is intrinsically more diverse than another (Mallik, 2024–2025; Acharya & Pal, 2019^[1, 8]; Mahata & Palita, 2022; Bacha & Lenka, 2023; Bacha *et al.*, 2023; Das *et al.*, 2025)^[2, 3, 4].

The dominance of Nymphalidae, followed by Lycaenidae and Pieridae, is consistent with several Odisha butterfly studies. Nymphalidae was also the richest family in Koraput, Rayagada and Barbara Forest. Such repeated family-level patterns likely reflect the broad ecological

amplitude and diversity of host and nectar associations within these groups. Nevertheless, family-level richness alone does not measure community evenness or abundance, and the present dataset should not be interpreted as demonstrating numerical dominance of individuals (Mahata & Palita, 2022; Bacha & Lenka, 2023; Das *et al.*, 2025)^[3, 4]. Habitat heterogeneity is likely to be a major driver of the recorded richness. Forests provide a greater range of microclimates and plant resources than simplified habitats, while forest edges, grasslands, agricultural margins and riparian vegetation can increase resource continuity across the landscape. Published Koraput data similarly show strong differences among habitat types, with natural forest sites supporting distinct and often richer assemblages than highly modified landscapes. The Nabarangpur observations therefore fit a broader Eastern Ghats pattern in which landscape heterogeneity contributes to butterfly persistence (Mallik, 2024^[8]–2025; Mahata & Palita, 2022).

Seasonality requires particular caution. The Nabarangpur project reported a post-monsoon peak, and the Sambalpur University study also recorded maximum diversity during post-monsoon. In contrast, Koraput showed higher assemblages in dry seasons and Rayagada showed the highest species occurrence in summer. Differences in rainfall, elevation, vegetation phenology, sampling protocol and habitat composition can all shift the timing of local peaks. Future Nabarangpur monitoring should therefore record monthly abundance rather than relying only on presence or absence (Mallik, 2024–2025; Bacha *et al.*, 2023^[2, 8]; Mahata & Palita, 2022; Bacha & Lenka, 2023)^[3].

Several conservation implications follow from the inventory. First, protection of forest patches should be accompanied by conservation of edges, streamside vegetation, grasslands and uncultivated field margins because these habitats can provide complementary resources. Second, larval host plants deserve explicit attention because adult butterfly counts alone may overlook breeding-habitat loss. Third, pesticide reduction and integrated pest management in agricultural interfaces could reduce non-target mortality. Fourth, habitat connectivity should be maintained through vegetated corridors and stepping-stone habitats. Finally, community-based monitoring and responsible butterfly-oriented ecotourism can increase local awareness while generating repeated observations (Pollard & Yates, 1993^[9]; Mahata & Palita, 2022; Bacha & Lenka, 2023)^[3].

The original project included claims concerning a specific percentage of forest-cover loss in Nabarangpur and described several records as rare or endemic. Those claims have not been retained as results in this manuscript because the project report did not provide a verifiable source or species-by-species evidence sufficient to support them. Similarly, the record labelled *Eurema lisa* in the project photo gallery has been excluded from the confirmed species interpretation pending taxonomic verification. These corrections improve the reliability of the manuscript and

illustrate why photographic records should be checked against current Indian butterfly taxonomic resources before publication (Mallik, 2024–2025; Kunte *et al.*, 2026)^[6, 8].

The project report also included a CCA-based interpretation of habitat associations. Because the numerical environmental matrix and ordination output were unavailable, the present manuscript does not reproduce a CCA figure or significance values. A future analysis should use a species-by-transect abundance or incidence matrix together with measured canopy cover, elevation, distance to water, vegetation structure, temperature, humidity and land-use variables. Such an analysis would provide a stronger quantitative test of the habitat associations suggested by the field observations (Mallik, 2024–2025; ter Braak, 1986)^[8, 10].

Conservation implications and recommendations

1. Protect and restore forest patches and maintain structural complexity, including understorey and native flowering vegetation.
2. Maintain riparian buffers, seasonal streams and wet microhabitats and reduce contamination from agricultural runoff.
3. Retain flowering field margins, hedgerows and uncultivated patches within agricultural landscapes to provide nectar and host-plant resources.
4. Reduce broad-spectrum pesticide use and encourage integrated pest management around important butterfly habitats.
5. Identify and protect larval host plants for locally important or habitat-specialist butterflies.
6. Maintain connectivity between forest, grassland, riparian and agricultural habitats through vegetated corridors and stepping-stone patches.
7. Establish a standardized monthly or bimonthly Pollard-walk monitoring programme with fixed transects and repeatable effort (Pollard & Yates, 1993)^[9].
8. Create a verified photographic/voucher reference collection and record GPS coordinates for each confirmed species (Kunte *et al.*, 2026)^[6].
9. Engage local communities, students and citizen scientists in ethically conducted monitoring and conservation education.
10. Use future quantitative analyses to test habitat and climate relationships rather than relying solely on qualitative impressions.

Representative field photographs

The following photographs are reproduced from the original project photo gallery. They are retained as documentary field records rather than used as independent evidence of species abundance. Species names should be checked against current taxonomic resources and, where possible, linked to a voucher-quality photograph or specimen record before a final species checklist is deposited (Mallik, 2024–2025; Kunte *et al.*, 2026)^[6, 8].



Fig 3: Representative butterfly photographs from the original Nabarangpur field project.

Conclusion

The two-year Nabarangpur field project documented a substantial butterfly assemblage of 147 species across nine families, with Nymphalidae, Lycaenidae and Pieridae together accounting for 71.43% of the reported species richness. The findings emphasize the importance of maintaining a heterogeneous landscape containing forest, grassland, agricultural margins and riparian habitats. Comparison with published studies from Koraput, Rayagada, Sambalpur and other Odisha landscapes shows that the Nabarangpur inventory is regionally significant, while also demonstrating that seasonal patterns differ among sites. The principal value of the present work is therefore as a district-level baseline and starting point for standardized monitoring. Future research should preserve complete transect-level abundance data, verify all species with current

taxonomic resources, quantify habitat variables and apply reproducible diversity and multivariate analyses. Conservation actions should prioritize habitat retention and connectivity, host-plant protection, reduced pesticide pressure, community participation and long-term monitoring (Mallik, 2024^[8]–2025; Mahata & Palita, 2022; Bacha & Lenka, 2023; Bacha *et al.*, 2023)^[2, 3].

Declarations

Funding: No specific external funding was reported in the source project.

Conflict of interest: There is no conflict of interest.

Data availability: The report-level data used here are summarized in Tables 1–5. The complete raw transect-by-species matrix, GPS dataset and voucher accession

information were not included in the available project report.

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Author contributions: P. P. Mallik conducted the fieldwork, including field observations, species documentation, photographic recording and field data collection. P. Maharana supervised the study, analysed the available field data, interpreted the results, prepared and critically revised the manuscript, and provided scientific and methodological guidance. Both authors reviewed and approved the final manuscript and accept responsibility for the accuracy and integrity of the work. Acknowledgements The authors acknowledge the guidance and institutional support provided by the Department of Zoology, Government Model Degree College, Nabarangpur. The original project also acknowledged cooperation from the Central Silk Board office, local site staff, forest personnel, local communities and student colleagues who assisted with field access and observations.

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