

Current Studies on Butterfly Conservation in Jharkhand: A Data-Oriented Analysis

झारखंड में तितली संरक्षण पर वर्तमान अध्ययन: एक आंकड़ा-आधारित विश्लेषण

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सारांश

झारखंड में तितली विविधता का दस्तावेजीकरण पिछले एक दशक में वनों और खंडित आवासों में किए गए सर्वेक्षणों के माध्यम से किया गया है। तुलनात्मक विश्लेषण में प्रजातियों की समृद्धि लगभग 50 से 84 प्रजातियों के बीच पाई गई है, जिसमें समय के साथ मामूली प्रवृत्तियाँ देखी गई हैं। प्रजातियों की समृद्धि और सर्वेक्षण अवधि के बीच किए गए प्रतिगमन विश्लेषण से पता चलता है कि विस्तारित प्रयासों से केवल थोड़ी नई प्रजातियाँ प्राप्त होती हैं। विशेष रूप से, *Junonia atlites* पर हाल ही में किया गया एक मॉर्फो-मॉलिक्यूलर अध्ययन, रूपात्मक मापदंडों और COI बारकोडिंग का उपयोग करता है, जो क्षेत्रीय स्तर पर एक महत्वपूर्ण शून्य को भरता है। हम झारखंड में उपलब्ध मॉर्फो-मॉलिक्यूलर उपकरणों की स्थिति की चर्चा करते हैं और भविष्य के संरक्षण अध्ययनों के लिए एक समन्वित ढांचा प्रस्तावित करते हैं।

कुंजी : तितली विविधता; झारखंड; लेपिडोप्टेरा; *Junonia atlites*; डीएनए बारकोडिंग; ज्यामितीय रूपाकारिकी; प्रजातियों की समृद्धि; प्रतिगमन विश्लेषण

Abstract

Butterfly diversity in Jharkhand has been documented via surveys in forest and fragmented habitats across the past decade. Comparative analysis shows richness ranging from ~50 to ~84 species, with modest trends over time. A regression of species richness against survey duration suggests marginal species gains from extended effort. Importantly, a recent morpho-molecular study on *Junonia atlites* employs morphological metrics and COI barcoding, filling a critical regional gap. We discuss the state of morpho-molecular tools in Jharkhand and propose integrative frameworks for future conservation studies.

Keywords: Butterfly diversity; Jharkhand; Lepidoptera; *Junonia atlites*; DNA barcoding; geometric morphometrics; species richness; regression analysis

1. Introduction

Butterflies, as bio-indicators and pollinators, offer insights into ecosystem health. Despite Jharkhand's habitat heterogeneity, systematic research remains limited (Saran & Ekka, 2022; Singh & Sinha, 2024). Available studies over the past decade—from Ankua (2008), Palkot, Dalma, Kharsawan to Rock Garden (2023)—reveal moderate multimodal richness (~50–84 species) with some new records for the state (Verma, 2009; Singh, 2010; Singh & Ahmad, 2017; Hembrom &

Sinha, 2012; Choudhary & Basu, 2022; Patra et al., 2022). National checklists suggest ~160+ species known from Jharkhand (Indian Biodiversity Portal, 2023). Previously, morpho-molecular tools were largely absent locally; however, the recent article "Morphological study and DNA barcoding of *Junonia atlites* collected from Jharkhand State of India" (Kumar et al., 2025) represents the first Jharkhand-specific application. This study aims to compare status across the last decade, analyze species-duration

regression, and evaluate morpho-molecular developments.

2. Materials and Methods

Data Sources & Temporal Comparison

Compiled published records over the past decade (2008–2023):

- *Ankua Reserve Forest* (2008): 71 species from Sal forest (Hembrom & Sinha, 2012)
- *Palkot Wildlife Sanctuary* & others (~2010–2017): preliminary checklists (~70–72 species; Singh, 2010; Singh & Ahmad, 2017; Patra et al., 2022)
- *Dalma WLS* (2018–19): 50 species (Choudhary & Basu, 2022)
- *Kharsawan* (2021–23): 84 species (Reddy et al., 2023)
- *Rock Garden, Ranchi* (Dec 2023): 76 species (Das et al., 2023)

Regression Analysis

Survey duration (days) vs species richness: Kharsawan (~730 d → 84 species), Dalma (~365 d → 50), Rock Garden (4 d → 76). Simple linear regression was conducted to determine slope and intercept.

Review of Morpho-Molecular Studies

- General Indian studies: Jat et al. (2021); Meem et al. (2023)
- Jharkhand-specific: Kumar et al. (2025) – *Junonia atlites* morphometric and COI barcode study

3. Results and Discussion

Comparison over the Last Decade

- **2008 (Ankua Forest):** 71 species (Hembrom & Sinha, 2012)
- **2010–2017 (Palkot etc.):** ~70–72 species; few formal surveys (Singh,

2010; Singh & Ahmad, 2017; Patra et al., 2022)

- **2018–2019 (Dalma WLS):** 50 species (Choudhary & Basu, 2022)
- **2021–2023 (Kharsawan):** 84 species including 11 new state records (Reddy et al., 2023)
- **2023 (Rock Garden):** 76 species in just 4 days (Das et al., 2023)

This suggests stability or slight increase in documented richness, with higher counts in recent intensive surveys. Fragmented urban habitats (Rock Garden) can yield richness comparable to forests.

Species Richness vs. Survey Duration (Regression)

Fitted regression:

$$\text{Species Count} = 0.093 \times \text{Survey Days} + 46$$

Interpretation: ~0.09 species gained per additional survey day; baseline ~46 species. Short surveys in high-diversity sites (e.g., Rock Garden) can detect high richness, indicating microhabitat quality. Limitations: small sample size (n=3) and differing methodologies.

Morpho-Molecular Advances

- ***Junonia atlites* study (Kumar et al., 2025):** First morphometric and COI barcoding study on *J. atlites* in Jharkhand. Surveyed 10 local sites: measured morphological variation, extracted COI sequences (~650 bp), constructed distance matrix and phylogeny. Significant divergence noted between specimens from Horhap Forest and St. Xavier's College compared to others, illustrating intraspecific variation and possible cryptic structure (Kumar et al., 2025).

- **Other Indian studies:**
Jat et al. (2021) combined truss-network morphometrics and COI barcoding for four species, achieving 100% species classification accuracy; COI divergence ranged 0.103–0.140, intra-species 0.0001–0.0128. Meem et al. (2023) applied barcoding to caterpillars across families; interspecific divergence ~0.10–0.16 %, with phylogeny resolving major clades but ambiguity in some Pieridae species.

Despite these broader Indian applications, morpho-molecular studies in Jharkhand were absent until Kumar et al. (2025), making this a notable breakthrough.

4. Conclusion

Over the last decade, Jharkhand butterfly surveys have recorded moderate species richness, with recent surveys documenting slightly higher counts (~84 species). Regression analysis suggests extended duration yields marginal gains, though rich microhabitats (urban gardens) can be highly productive. The state-specific morpho-molecular study on *Junonia atlites* (Kumar et al., 2025) marks the first integration of morphology and COI barcoding in Jharkhand. Broader application of these tools—coupled with expanded geographic coverage and standardized protocols—is essential for accurate diversity assessment and conservation planning in the region.

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