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First state record of *Arhopala atrax* (Hewitson, 1862) (*Lepidoptera*: *Lycaenidae*) from Bihar, India

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Abstract
This study documents the first confirmed record of *Arhopala atrax* (Hewitson, 1862), commonly known as the Indian Oakblue, from Bihar, India. The species was recorded from Rajgir Wildlife Sanctuary (WLS), Nalanda District, during butterfly monitoring surveys conducted on first on 17 June 2022, and subsequently in 2023, and 2024. The first sighting occurred along the Nature Safari Road in mixed deciduous forest, followed by repeat observations in the same locality in subsequent years, suggesting the species' continued presence and possible establishment in the area. *Arhopala atrax* belongs to the family *Lycaenidae* and is generally distributed across northeastern and southern India, with few records from central regions. Its occurrence in Rajgir WLS extends its known distribution to the southeastern Gangetic plains and adds a new state record for Bihar. The finding highlights the sanctuary's ecological significance as an important refuge for butterfly diversity and emphasizes the need for sustained monitoring to understand habitat use, seasonal occurrence, and population trends of *Arhopala atrax* and other lesser-known lycaenids in this biologically rich yet understudied landscape.

Keywords: *Arhopala atrax*, *Indian Oakblue*, *Lycaenidae*, Rajgir Wildlife Sanctuary, range extension, new distribution record

Introduction

The *Lycaenidae* family, commonly known as gossamer-winged butterflies, is the second-largest butterfly family after Nymphalidae (brush-footed butterflies). This family consists of over 6,000 species worldwide, accounting for approximately 30% of all known butterfly species. In India, 318 species have been documented (Varshney & Smetacek, 2015) [10, 11]. Renowned for their small size, vibrant coloration, and intricate wing patterns, these butterflies are not only visually striking but also ecologically fascinating. However, studying them poses challenges due to their brief flight periods and a preference for remaining hidden in dense vegetation. This family includes some of the most elusive and delicate butterflies, such as the Oakblues which are often overlooked in field studies due to their cryptic nature. Their beauty and ecological importance make them an integral part of butterfly diversity, demanding focused attention for research and conservation.

Arhopala atrax (Hewitson, 1862) [5], commonly known as the Indian Oakblue, was first described by Hewitson (1962) [5] from regions of Peninsular India. Subsequent records have expanded its known range considerably. Varshney and Smetacek (2015) [10, 11] documented its broader distribution extending from Jammu & Kashmir to the northeastern states, while Kehimkar (2016) [6] reported its occurrence across West Bengal, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, Himachal Pradesh, and Arunachal Pradesh, as well as neighbouring countries including Nepal, Bhutan, and Myanmar. Bhakare and Ogale (2018) [2] further extended its known range to include Maharashtra, Gujarat, Karnataka, and Delhi. Despite these widespread records, *Arhopala atrax* had not been reported from the Gangetic plains, leaving a significant biogeographical gap between its Peninsular and Himalayan populations (Antram, 1989; Talbot, 1939) [9].

The Indian Oakblue belongs to the family *Lycaenidae* and is characterized by marked sexual "dimorphism" males exhibit vivid iridescent blue upperwings, while females are duller with earthy-brown tones that provide excellent camouflage. The species typically inhabits dense forest canopies and shaded understories, making it visually captivating yet infrequently observed. Its brief flight period, preference for low-light environments, and close resemblance to related *Arhopala* species contribute to its underreporting in butterfly surveys. Although *Arhopala atrax* exhibits a wide but fragmented distribution across Asia, its occurrence in northern India has remained poorly understood, largely due to limited fieldwork in forested landscapes of the Gangetic plains. Recent observations from Uttar Pradesh (Prakash *et al.*, 2022) [7] and now from Rajgir WLS, Bihar, bridge this distributional gap and underscore the ecological importance of underexplored habitats in revealing hidden elements of India's butterfly diversity. These findings reaffirm the significance of Rajgir's dry deciduous forests as a critical refuge for forest-dependent Lycaenids and highlight the value of continued biodiversity surveys in documenting the true extent of the India lepidopteran fauna.

The discovery of *Arhopala atrax* in Rajgir WLS highlights the sanctuary's significance as a refuge for forest-dependent and range-restricted species. The low-elevation *Sal* (*Shorea robusta*) forests offer suitable microhabitats with dense canopy cover, moderate humidity, and filtered light conditions ideal for *Arhopala atrax*. The sanctuary's humid, shaded Sal forests provide an ideal habitat for *Arhopala atrax*, underscoring the importance of such environments in butterfly conservation, especially in the face of habitat loss and climate change. Such habitats are increasingly rare in the southern Gangetic plains, making this record ecologically noteworthy. Butterflies like *Arhopala atrax* contribute to pollination and overall forest regeneration, serving as key indicators of ecosystem health. However, their persistence is threatened by habitat degradation, deforestation, and climate variability. The present finding underscores the need for systematic surveys and long-term monitoring in underexplored areas such as Rajgir. Identifying and conserving priority habitats will not only aid

in protecting *Arhopala atrax* but also benefit a broad spectrum of forest-dependent butterfly species. Strengthening habitat connectivity across the sanctuary's fragmented forest patches remains essential for maintaining population stability and ensuring genetic diversity.

Material and Methods

Study Area

Rajgir WLS, located in the Nalanda district of Bihar, spans an area of 35.84 km² and forms part of the Rajgir Hills range (Figure 1). The sanctuary's landscape is characterized by rugged terrain, gentle valleys, and seasonal streams that create a mosaic of habitats suitable for butterflies, including *Arhopala atrax* (Indian Oakblue).

The vegetation is dominated by dry deciduous forests with prominent species such as Sal (*Shorea robusta*), Saja (*Terminalia tomentosa*), *Butea monosperma*, and *Anogeissus latifolia*. Natural water sources like the Pachanan and Saraswati rivers help maintain local humidity and support rich floral and faunal diversity.

The surrounding hill slopes and limited anthropogenic disturbance enhance its value as a refuge for forest-dependent species. Major butterfly families recorded from Rajgir WLS include Nymphalidae, Pieridae, and *Lycaenidae*. To document butterfly diversity, a stratified random sampling approach was adopted to ensure adequate coverage of distinct microhabitats, including forest interiors, edges, riverbanks, and open clearings, enabling systematic monitoring of species occurrence and abundance.

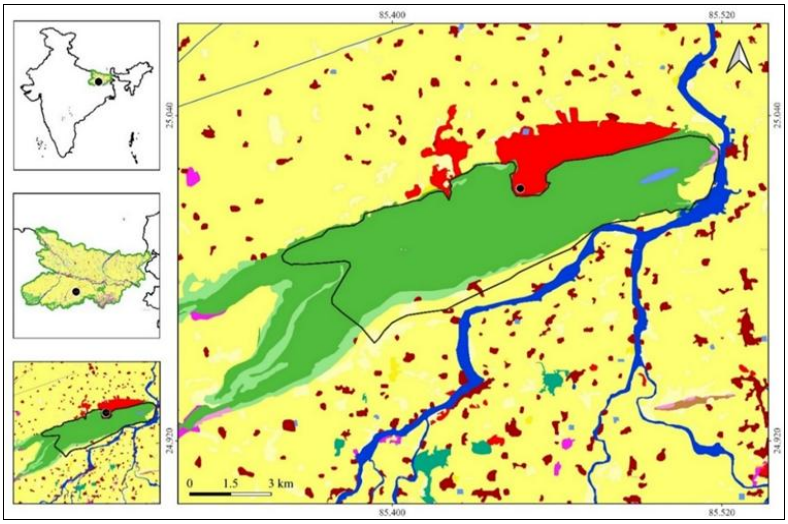

Fig 1: Map of the sampling area Rajgir WLS

Sampling and Identification of Species

Field surveys were conducted from 2022 to 2024 in Rajgir WLS using line transect and opportunistic sighting methods to document butterfly diversity. Transects were established across major habitat types, including *Sal* forests, riverbanks, and open clearings, ensuring representative coverage of the area. Observations were made between 08:00 and 11:00 hours on clear, sunny days when butterfly activity was highest. Individuals were identified in the field through close-range photography using digital cameras, later verified using standard field guides (Kehimkar, 2016; Wynter-Blyth, 1957) [6, 12]. Data were recorded systematically to confirm species occurrence and temporal patterns.

Result and Discussion

In this study, *Arhopala atrax* (Hewitson, 1862) [5], commonly known as the Indian Oakblue, is reported for the first time from the state of Bihar, India (Figure 2). The initial confirmed sighting occurred on 17 June 2022 along the Nature Safari Road in Rajgir WLS, Nalanda district. The butterfly was photographed while basking on the lower canopy of a *Sal* (*Shorea robusta*) tree in the early morning hours. Subsequent observations made in June 2023 and June 2024 at the same locality confirmed the continued presence of the species, indicating its seasonal recurrence and possible local establishment. This finding fills a crucial gap in the known distribution of *Arhopala atrax*, previously documented from Peninsular India, the northeastern states, and the Himalayan foothills, but not from the Gangetic plains.

Arhopala atrax typically inhabits dense, low-elevation forests, preferring areas with high canopy cover and abundant shade. It is closely associated with oak forest (*Quercus* spp.) and related host plants in other regions, though its larval host in Bihar remains unknown. The rugged topography and forested microhabitats along the Nature Safari Road, coupled with the sanctuary's humid environment and minimal disturbance, provide suitable conditions for this elusive lycaenid. The record emphasizes the ecological importance of Rajgir WLS as a refuge for specialized forest-dependent butterflies and other taxa.

The presence of *Arhopala atrax* highlights the need for detailed studies on butterfly ecology, phenology, and habitat preferences in Bihar. Long-term monitoring is essential to understand population trends and to evaluate the effects of habitat alteration and climate variability. Conservation efforts should focus on maintaining forest connectivity, protecting native vegetation, and identifying larval host plants through targeted field studies and genetic analyses.

This first state record of *Arhopala atrax* contributes substantially to the growing knowledge of butterfly diversity in northern India. It reinforces the importance of underexplored

regions like Rajgir WLS, where systematic surveys continue to reveal previously undocumented species, underscoring the sanctuary's role in regional biodiversity conservation and ecosystem resilience.

Fig 2: Photograph of *Arhopala atrax* (Indian Oakblue) in Rajgir WLS

Conclusion

The first confirmed record of *Arhopala atrax* (Indian Oakblue) from Rajgir WLS marks a significant addition to the butterfly fauna of Bihar and bridges a key gap in the species known distribution across India. The repeated sightings between 2022 and 2024 indicate the species continued presence and suggest that Rajgir dry deciduous *Sal* forests provide suitable microhabitats for its persistence. This discovery underscores the ecological importance of the sanctuary as a refuge for forest-dependent butterflies and other taxa. It also highlights the urgent need for systematic biodiversity documentation in underexplored landscapes of the Gangetic plains. Strengthening habitat protection, maintaining forest connectivity, and conducting detailed studies on host plant associations and genetic variability will enhance our understanding of *Arhopala atrax* ecology and support effective conservation planning. Continued monitoring in Rajgir WLS will be crucial to safeguard its unique and evolving butterfly diversity.

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