

Influence of seasonal fluctuations on eyespot variation in *Ypthima asterope* Klug and *Y. inica* Hewiston (Nymphalidae, Satyrinae)

Babita Sharma*, Sushmita Prakash and Ashok Kumar

Department of Zoology, B.S.N.V. PG College, University of Lucknow, Lucknow 226001, Uttar Pradesh, India.

Email: babitash1825@gmail.com*; sushmitawildlife@gmail.com; ashokbsnv11@gmail.com

ABSTRACT: The eyespots of certain brown butterflies vary in response to seasonal changes. The present study mainly focuses on the variation in eyespot patterns of two *Ypthima* species (*Y. asterope* and *Y. inica*) under the influence of seasonal fluctuations. Morphologically similar, both species differ in number, size, and the ocelli (eye spot) arrangements present on both forewings and hindwings, indicating how the species vary from each other, with seasonal forms mostly noticeable in the wet season and reduced or absent in the dry season. Seasonal monitoring showed *Y. asterope* had limited activity in winter, while *Y. inica* showed more abundance, had a wider range of seasonal presence, and was more resilient overall. A correlation study for both species revealed that their abundance decreased as temperatures increased, but their numbers rose with higher air pressure, while relative humidity had no significant effect. © 2026 Association for Advancement of Entomology

KEY WORDS: Satyrini, abundance, eyespot (ocelli), polyphenism, temperature, air pressure

INTRODUCTION

Butterflies are admired for their graceful flight, vibrant wing coloration, and prominent wing markings, among which eyespots are considered one of the most crucial features. These eyespots are highly diverse in size, shape, number, and colour combinations, contributing significantly to butterfly diversity. Members of the family Nymphalidae possess well-defined circular eyespots on their wings, which play an important role in predator deterrence, mimicry, and survival (Stevens, 2005; Monteiro, 2008). The subfamily Satyrinae comprises medium-sized butterflies generally characterized by dull brown to dark brown coloration, transverse white or tawny bands, and

conspicuous ocelli on both dorsal and ventral wing surfaces (Sharma and Goswami, 2020). Commonly referred to as “Browns,” these butterflies exhibit weak and erratic flight close to the ground and are frequently associated with bushes, grasses, bamboo patches, and shaded habitats. Adults primarily feed on tree sap, fermented liquids such as toddy, and juices from rotten fruits, while larvae mostly develop on grasses and bamboos, except in *Elymnias* spp., which utilize palms as larval host plants (Mathew and Soumya, 2013). Many satyrid butterflies display pronounced seasonal polymorphism, particularly on the ventral wing surface, representing an adaptive response to varying environmental conditions. Wet-season forms generally possess brighter brown coloration with distinct eyespots, whereas dry-

* Author for correspondence

season forms are comparatively dull brown with reduced or obscure eyespots, often showing cryptic coloration that enhances camouflage.

Among Satyrinae, the present study focuses on two species of the tribe Satyrini, namely *Ypthima asterope* Klug, 1832 (Common Three-ring) and *Ypthima inica* Hewitson, 1865 (Lesser Three-ring), both belonging to the family Nymphalidae. *Ypthima asterope* is distributed throughout most parts of India except Ladakh, whereas *Y. inica* occurs from Punjab southwards to Maharashtra and eastwards through Uttarakhand, West Bengal, and Tripura (Varshney and Smetacek, 2015). In Uttar Pradesh, *Y. asterope* has been recorded throughout the state, while *Y. inica* has been reported from several regions (Van Gasse, 2021; Pandey *et al.*, 2024). Although both species resemble each other morphologically, they can be distinguished by the arrangement of eyespots on the ventral wing surfaces. In *Y. asterope*, the underside of the forewing bears one large eyespot, while the hindwing contains a small eyespot in vein space 6 along with two tornal ocelli in vein spaces 1b and 2. In contrast, *Y. inica* possesses a large eyespot in vein space 6 of the hindwing and two small tornal eyespots in vein spaces 1 and 2, whereas the forewing bears a large sub-apical eyespot that does not form a complete loop. Additionally, the apical and tornal eyespots are misaligned, and the eyespot in vein space 2 is shifted outward. These diagnostic markings are more distinct in wet-season forms but become reduced or occasionally absent during the dry season (Evans, 1932; Bhakare and Ogale, 2018). The diversity in butterfly wing variation and seasonal variation reflects important ecological adaptations and species resilience under different environmental conditions. Therefore, the present study investigates the eyespot variation with respect to seasonality effect in both *Ypthima* species with special emphasis on understanding the influence of environmental factors such as temperature, humidity, and air pressure.

MATERIALS AND METHODS

The study was conducted within the heterogeneous habitats like Grasslands, Shrublands and forest patches of Lucknow district which includes the

Reserve forests of Rasoolpur Iduria (26°44'40.9"N; 80°56'01.6"E), Musabagh (26°52'26.1"N; 80°52'12.8"E), Kukrail Reserve Forest (26°54'45.5"N; 80°59'32"E) during three distinct seasons, summer, monsoon (pre- and post-monsoon), and winter during September 2024 to August 2025. Two species of the *Ypthima* genus were chosen and spotted their morphological characteristics. The survey of the butterflies was based on opportunistic sightings, and the collection of butterfly specimens is avoided strictly, although we performed Catch and Release method by using an aerial sweep net. These butterfly numbers were counted during the morning hours 8:00 AM to 11:00 AM and again in the afternoon from 2:00 to 4:00 PM.

The species identification relied on photographic evidence captured by a Nikon D5600 with a 70-300 lens, and it was further identified by available field guidebooks (Kehimkar, 2016; Smetacek, 2017; and Bhakare and Ogale, 2018) and additional literature data. The environmental factors, such as temperature, humidity, and air pressure were recorded by using AccuWeather app. Pearson's correlation coefficient (*r*) has been used on the relationship between weather parameters and abundance of the selected species. The correlation was applied because the variables were continuous and assumed to have linear relationships. All statistical calculations were performed using Microsoft Excel for the analysis of recorded monthly data for both species.

RESULTS AND DISCUSSION

The findings demonstrate a season-wise analysis of both species, exhibiting clear variation. *Ypthima asterope* was moderately active, with the most sightings in September, December, and February, with fewer sightings in October, November, January, April, and August and were clearly absent in March, May, June, and July. This is an indicative of clear limited seasonal presence confined to the post-monsoon and winter. There were a higher total abundance and a wider range of times in *Y. inica* and was often seen in greater numbers from September through October and November, peaked in December and February, and remained high in

January and again in May and August. There were no sightings in March, April, June, or July, suggesting sensitivity to the extreme hot summer. Both species were most active during the post-monsoon (September–November) and winter (December–February) seasons, but they experienced a sharp decrease in numbers or complete absence during early summer (March–July) due to adverse climatic conditions, such as high temperatures and scarcity of their vegetation, which affected their activity, survival, and detectability. As a whole, *Y. inica* (with Lesser three-ring) showed greater resilience and adaptability to seasonal environmental variation compared to *Y. asterope* (with Common three-ring). Its broader seasonal incidence and higher abundance suggest a stronger tolerance to fluctuating ecological conditions, whereas *Y. asterope* appeared more seasonally constrained (Fig. 2).

The correlation analysis indicated that weather parameters such as temperature, humidity, and air pressure influenced the abundance of both species. The results found a strong negative correlation between average temperature and the abundance of *Y. asterope* ($r = -0.70$, $p < 0.05$) and *Y. inica* ($r = -0.77$, $p < 0.01$). However, the air pressure shows a significant positive correlation with *Y. asterope* ($r = 0.74$, $p < 0.01$) and *Y. inica* ($r = 0.77$, $p < 0.01$). The relative humidity of the species revealed a mild and non-significant correlation with *Y. asterope* ($r = 0.18$, $p > 0.05$) and *Y. inica* ($r = 0.27$, $p > 0.05$) (Fig. 3).

The findings indicated that both species are highly affected because of the seasonal and environmental fluctuations. The abundance of both species is high in the winter season when the temperature is cool, humid, and steady. Their abundance decreases during hot and dry weather conditions. The atmospheric variables play a crucial role in affecting their behavior, survival, eyespot variation, distribution, and seasonal occurrence. Earlier studies on other satyrine butterflies done by Brakefield (1987) and Prasannakumar *et al.* (2026) revealed that the seasonal forms and ecological adaptation are mostly affected by the climatic factors. The eyespot size varied due to environmental factors

that highly affect both wing morphology and pattern formation during larval and pupal development. Favorable seasons are beneficial in growth and development, resulting in the visibility of big and clear eyespots (Fig. 1). Apart from these factors,



Fig. 1 (a) 2024 and (b) 2025 Wet season form of Common three ring (*Y. asterope*); (c) 2024 and (d) 2025 Wet season form of Lesser three ring (*Y. inica*)

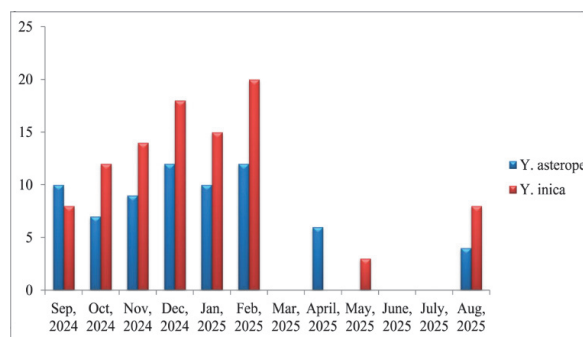


Fig. 2 Seasonal (monthly) observation of *Y. asterope* and *Y. inica* across heterogeneous habitats of Lucknow

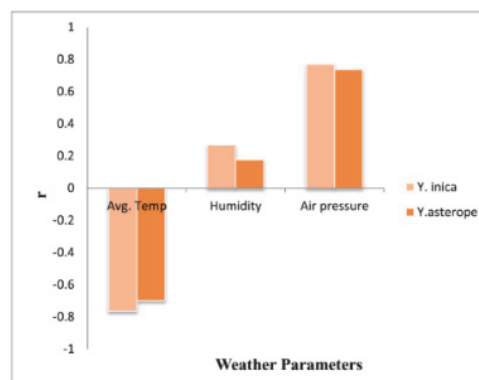


Fig. 3 Correlation between weather parameters and seasonal abundance of both *Y. asterope* and *Y. inica*

hot and dry weather negatively impacts eyespot development, whereas both eyespot size on the forewing and hindwing will be reduced. The previous findings in satyrine butterflies, where temperature-mediated developmental plasticity significantly impacts the size of eyespots and seasonal morph expression (Ramos *et al.*, 2013; Prasannakumar *et al.*, 2025). Humidity is another environmental factor that also affects the eyespots and seasonal forms of butterflies. On satyrine butterflies studied by Prasannakumar *et al.* (2026), it was suggested that humidity alone and with temperature helps to regulate seasonal polyphenism and wing pattern plasticity in tropical butterflies. The maintenance of natural vegetation and the protection of moist microhabitats support the sustainability of the diversity and butterfly population. Of these, long term monitoring programs should be initiated to understand how seasonal changes influenced the diversity and adaptation of butterflies.

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