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Research Article

Checklist of the genus *Euthalia* (Lepidoptera: Nymphalidae) from Namdapha National Park and Tiger Reserve with the Discovery of a Rare butterfly *Euthalia malaccana*: Second photographic record from Indian Sub-continent

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ABSTRACT

The study provides details of an addendum for the genus *Euthalia* in the checklist of Namdapha National Park and Tiger Reserve (Arunachal Pradesh, India), with salient details of the first-ever photographic evidence of the elusive species *Euthalia malaccana* Fruhstorfer, 1889. Incidentally, it is also the only second-ever photographic record from the Indian sub-continent. The sighting occurred during a butterfly survey on 16.X.2024 at Lunkai nalla. By analyzing the photographic evidence with relevant identification keys, its gender and identification at species level was confirmed. The study also distinguishes between elevation and habitat-type of the locations of 1st and 2nd sighting, which are physically separated by another state's forest. Alpha-diversity studies were also undertaken to statistically analyse the checklist for understanding the existing distribution, richness, abundance, and evenness. The manuscript also presents details of its global presence and rarity, thereby highlighting the significance of this discovery. It further implies upon the possibility of species thriving on range edges showcasing early signs of bio-geographic shifts. Herewith, the recording and critical identification of Fruhstorfer's Baron is a feed-forward for all stakeholders towards the need for renewed efforts and inclination in safeguarding the vulnerable pristine habitat of Namdapha National Park and Tiger Reserve to sustain its butterfly hotspot status.

Key words: Fruhstorfer*, malaccana,* Lepidoptera, Arunachal, Nymphalidae, Namdapha.

INTRODUCTION

Urbanisation as an anthropogenic form of rampant development is widely transforming all forms of natural land-use pattern with severe negative impacts (Akarsh *et al.,* 2022; Sachin *et al.,* 2020; Monica *et al.,* 2021; Vrinda & Rajesh, 2018; Banerjee *et al.,* 2017; Gopinath *et al.,* 2014). Among all land-uses, the most severe impact is upon the green spaces which have several environmental and ecological benefits (Abeer *et al.,* 2024; Faraaz, *et al.,* 2023). Thereby the impact not only devastates the ecosystem functions but also brings in wide implications upon the food chain and food web (Balasubramanya & Rajesh, 2018). Also a critical concern remains the rampant influence of urbanisation demands making inroads into the once forbidden dense green spaces such as the forested areas (Arunachalam *et al.,* 2004). Consequently, the phased fragmentation and eventual destruction of natural landscapes and habitat, would pose negative outcomes and challenges such as depreciation or extinction of endemic flora and faunal species with irreversible influence on the localised climate set-up (Aftab *et al.,* 2021; Murali, *et al.,* 2013; Mahesh, *et al.,* 2025).

In this context, butterflies are most impacted, on account of their skewed preferences for nectarine species and larval host plants, with the negative bearing of micro-climatic changes and air pollution arising from vehicular movements inside the forest ecosystems (Thapa *et al.,* 2023). Therefore, their presence or absence can serve as vital bio-indicators of both ecological and environmental health for any form of green space (Fleishman, and Murphy, 2009). In the afore-mentioned perspective, Namdapha National Park and Tiger Reserve which is located in Arunachal Pradesh (India) as a famed hotspot for butterflies; is potentially vulnerable (Das *et al.,* 2020). The butterflies of this pristine forest are facing stress owing to rise in infrastructure especially resulting from demands for improved road connectivity, such as from Miao to Vijaynagar (Arunachalam *et al.,* 2004; Murali *et al.,* 2013). The immediate impacts include destruction of puddling zones on the natural pathways, and loss of existing host plants and nectar species while widening the carriageways. Other impacts also include gaseous emissions into ambient air, and oil-fuel leaks onto the mud puddling surfaces. These invariably interfere with other aspects of the butterfly

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life cycle. In this regard, and in lieu of Sustainable Development Goal #15 (Life on Land); any systematic or exploratory study focusing upon on the butterfly composition, diversity, richness, abundance, and distribution can serve to facilitate the "Principle of Precautionary Approach", so as to understand the ecosystem health and its resilience. In this direction, the present study unveils the details of sighting of a rare butterfly *Euthalia malaccana* Fruhstorfer, 1889 and its addition to the Checklist for genus *Euthalia* at Namdapha National Park and Tiger Reserve. As the sighting also happens to be the only second photographic record from the Indian Sub-continent, the study attempts to raise awareness towards measures for *in-situ* conservation, with habitat protection /restoration.

Scope of Study

Euthalia is a genus of butterflies from the Nymphalidae family widely referred to as Barons and Dukes (Upadhyaya & Sheikh, 2025a). *Euthalia malaccana* Fruhstorfer, 1899 was formerly considered to be a subspecies of *Euthalia adonia* Cramer, 1780. Originally classified as *Euthalia adonia malaccana* Fruhstorfer, 1899; its status was later elevated to as a full species (Eliot, 2020), and in 1999 a major revision of the lubentina group was undertaken (Yokochi, 1999). Until 2024, its occurrence in India has remained uncertain and continued to be disputed owing to the lack of substantial evidence. This is despite mentions in the scientific papers and literatures which only suggests (but does not prove) of its possible presence in Assam and Meghalaya (Fleming, 1975). This is also owing to the fact that *Euthalia malaccana* Fruhstorfer, 1889, very closely resembles the relatively more abundant and commonly seen *Euthalia lubentina* Cramer, 1777. Hence, thereby without a valid photograph or specimen, it is easy to get confused and mis-judge the species on-site. Apart from the frequent misidentification with *Euthalia lubentina* Cramer, 1777; the revision of *Euthalia adonia* Cramer, 1780 has further complicated its reported range.

It is also to be noted that this species is not mentioned in any of the existing schedules of the Indian Wildlife Protection Act amended in 2022 (Anonymous, 2023). The first confirmed photographic record for India has been mentioned from Basar Sago Road in Arunachal Pradesh (Upadhyaya & Sheikh, 2025a). Hence it can be affirmed in conjunction with reliable historical notes that *Euthalia malaccana* Fruhstorfer, 1889 has not been reported from Namdapha National Park and Tiger Reserve to-date, therewith paving way for the need of well-conceptualised targeted surveys and diligent monitoring.

Systematic Position

Class: Insecta Linnaeus, 1758
Order: Lepidoptera Linnaeus, 1758
Family: Nymphalidae Rafinesque, 1815
Subfamily: Limenitidinae Behr, 1864
Genus: *Euthalia* Hubner, 1819
Species: *Euthalia malaccana* Fruhstorfer, 1899

MATERIALS AND METHODS

Study Area

Namdapha National Park and Tiger Reserve (Figure 1), located in the Changlang district of Arunachal Pradesh, encompasses an area of around 1,985 square kilometres, ranking it among the most extensive preservation zones in the Eastern Himalayan region. Positioned at the junction of the Patkai Hills and the Dapha Bum range of the Mishmi Hills, it extends between latitudes 27°23'N and 27°39'N and longitudes 96°15'E to 96°58'E. It is blessed with a sub-tropical climate (www.arunachalonline.in). As an outcome, the species composition of Namdapha National Park and Tiger Reserve is rich with wide diversity. Renowned for its rich biodiversity, it has hence been a study area for periodic and regular lepidopteran surveys since 2018 (Upadhaya & Sheikh, 2025b).

Exploratory Methodology

The present study with its highlighted discovery is an outcome of a 10-day field survey conducted during

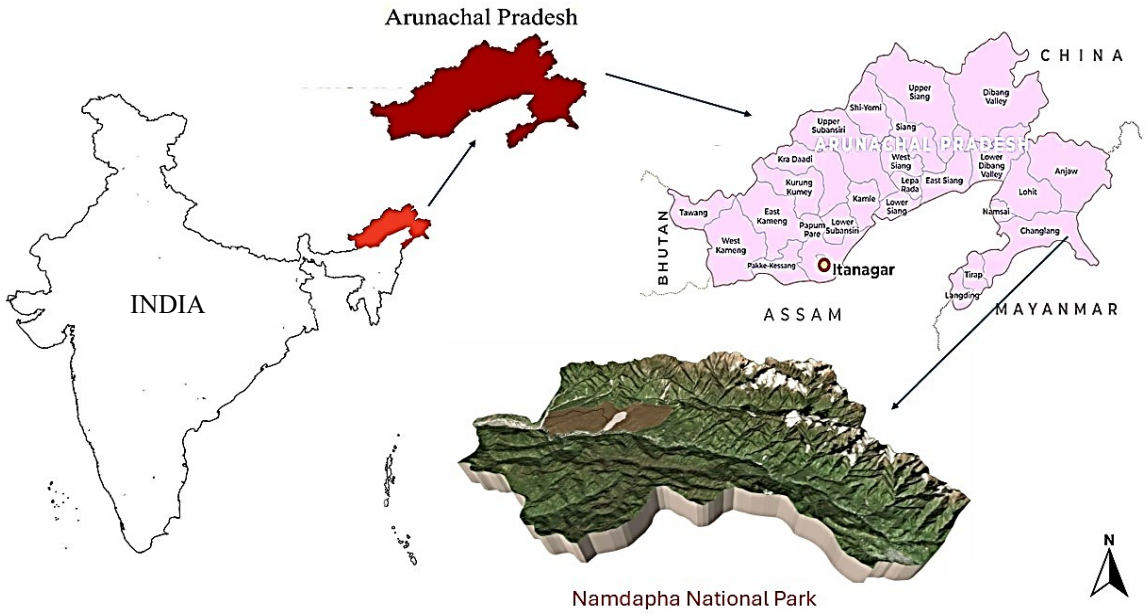


Figure 1. Location of Namdapha National Park and Tiger Reserve within Arunachal Pradesh, India.

October 2024 at Namdapha National Park and Tiger Reserve. All pertinent habitats such as riverbanks, forest paths, small streams, and areas surrounding waterfalls were explored during the exercise viz. random line transects. The surveys were carried out amidst sunny days, gloomy mornings, rainy days etc. Most of the species spotted during the survey were identified and distinguished by authors on the site itself. Certain others which warranted a detailed analysis of the morphological features were studied off-site by studying photographs and comparing them with pertinent ID keys. No specimens were collected in compliance with India's Wildlife Protection Act amended in 2022 (Anonymous, 2023).

Statistical analysis was carried out to extricate the diversification in the existing bio-inventory with logical tools such as Margalef's Species Richness Index, Shannon Index, Simpson's Index of Diversity and Pielou's Evenness. Margalef's Species Richness Index was employed to quantify the variability of species (Margalef, 1958). Shannon-Wiener Index was made use of to estimate evenness and the richness (Shannon & Wiener, 1949). Simpson's Index of Diversity was computed to assess the probability that two randomly selected individuals would belong to distinct species (Simpson, 1949). Pielou's Evenness was utilised to explore equitability for relative species viz. abundance and distribution (Pielou, 1966).

RESULTS AND DISCUSSION

Totally 93 butterfly species belonging to 85 genera and 6 families were spotted during the exploratory exercise. As can be observed from Table 1, Pieridae family despite the low diversity had higher abundance with the maximum population count of 400. This was contributed vastly by species having higher population such as *Ixias pyrene* Linnaeus, 1764. Nymphalidae family on the other hand was observed to have the maximum count of species and genera (51 and 46 respectively), thereby presenting ecological balance in terms of both high diversity and high representation. Hesperiidae had moderate diversity and lower counts, owing to seasonal variation. On the other hand, Lycaenidae had fairly diverse species richness, but with lower individual counts, owing to seasonal variation. Papilionidae also had moderate diversity, but relatively higher number of individuals on account of locally high abundance. Riodinidae was found to have low diversity with modest individual count. Similar inferences can be drawn from the heatmap (Figure 2), which depicts the family-wise composition of butterflies in terms of number of species, genera, and individuals. Herein the colour gradient corresponds to the count, with the darker shades representing the higher values.

Computation results of Alpha Diversity (within habitat) and the inferential details is highlighted in Table 2 and discussed further on. When Margalef's Species Richness Index was computed per family, it was found that Nymphalidae with index value of 9.98 had the largest species richness and moderate number of individuals, thereby indicative of diverse species composition within the family. Hesperiidae with index value of 4.26 was fairly rich in species with fewer individuals, thereby showing a good balance. Lycaenidae with index value of 2.67 depicted moderate species richness with fewer individuals, clearly hinting at localized species.

Though Papilionidae and Pieridae were dominated by a few species with several individuals, they presented lower richness per individual, and had index values of 1.61 and 1.00, respectively. Riodinidae with index value of zero indicated no richness due to observation of only one species. The overall Margalef's Species Richness Index was calculated and found to be 13.8.

The aforementioned statistics thereby indicates the in-situ presence of a large number of varied butterfly species. This is conclusive from the fact that the reserve forest includes a wide range of ecological niches, thereby re-stressing upon the need for habitat conservation at Namdapha National Park and Tiger Reserve. The Shannon-Wiener Index was computed and found to be 1.34. This highlights moderate family level diversity. While there is a considerable dominance by Pieridae (Figure 3), it is still not sufficient to spread among the other families to avoid a low diversity status. Equitability i.e., Pielou's Evenness upon computation was found to be 0.296 on a 0 to 1 scale. This indicates that the evenness is quite low, thereby indicating uneven distribution and individual among species. Though Pieridae as a family is common, yet no single family has monopolised the community. Simpson's Index of Diversity was computed and found to be 0.664. This represents moderate dominance, as higher values near 1 implies dominance by certain groups, and greater richness and balance.

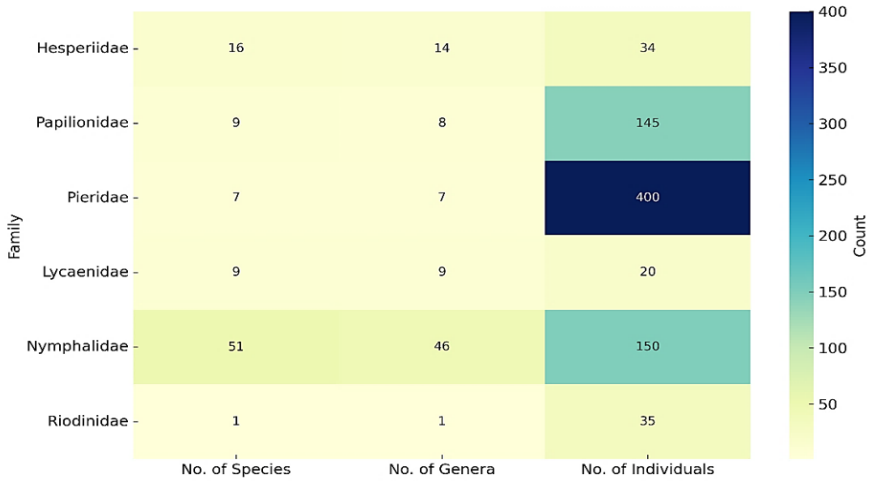


Figure 2. Family-wise distribution of butterfly species, genera and individuals

Table 1. Family-wise summary of butterfly diversity and abundance recorded during the study.

Family	Hespe-riidae	Papilionidae	Pieridae	Lycaenidae	Nymphalidae	Riodinidae
Number of Species	16	9	7	9	51	1
Number of Genera	14	8	7	9	46	1
Number of Individuals	34	145	400	20	150	35

Table 2. Summary of Alpha Diversity Indices for Butterfly families, recorded during the survey.

Diversity Index	Taxonomic Level / Family	Computed Value
Margalef's Species Richness Index	Nymphalidae	9.98
	Hesperiidae	4.26
	Lycaenidae	2.67
	Papilionidae	1.61
	Pieridae	1.00
	Riodinidae	0.00
	Overall (All Families)	13.80
Shannon–Wiener Index (H′)	Family level	1.34
Pielou's Evenness Index (J′)	Family level	0.296
Simpson's Index of Diversity (1 − D)	Family level	0.664

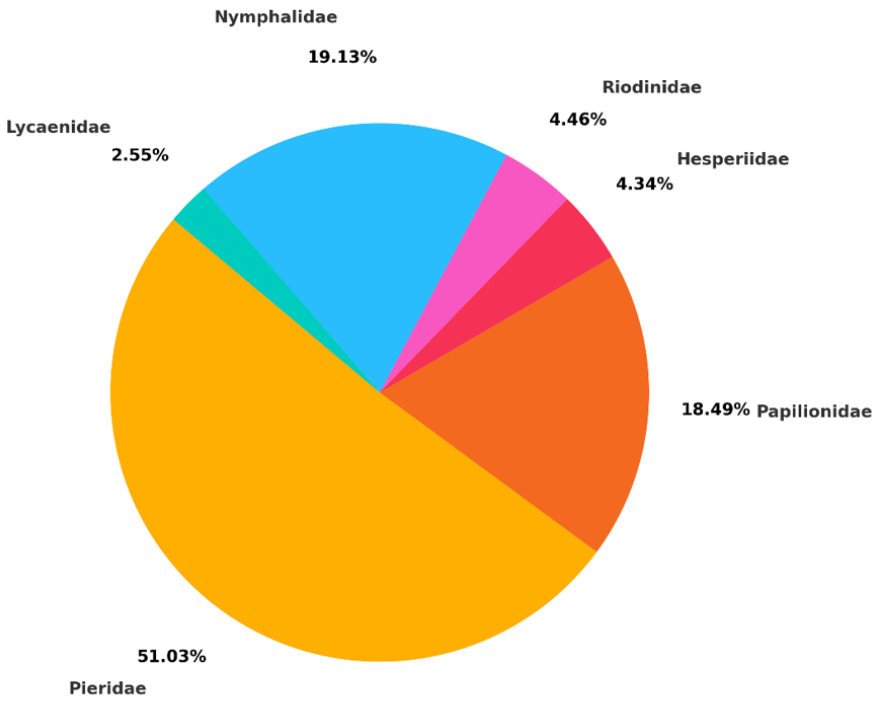


Figure 3. Relative Abundance of Individuals family-wise.

Table 3. Updated checklist and relative abundance of genus *Euthalia*, recorded during the survey.

#	Species recorded in Namdapha	Abundance (%)	Count
1	Euthalia aconthea Cramer, 1777 Common Baron	30.77	12
2	Euthalia alpheda Godart, 1824 Streaked Baron	10.26	4
3	Euthalia anosia Moore, 1858 Grey Baron	5.13	2
4	Euthalia eriphylae de Nicéville, 1891 Grey-tipped Baron	2.56	1
5	Euthalia franciae Gray, 1846 French Duke	—	0
6	Euthalia lubentina Cramer, 1777 Gaudy Baron	10.26	4
7	Euthalia monina Fabricius, 1787 Powdered Baron	12.82	5
8	Euthalia patala Kollar, 1844 Grand Duchess	—	0
9	Euthalia phemius Doubleday, 1848 White-edged Blue Baron	17.96	7
10	Euthalia telchinia Ménétriés, 1857 Blue Baron	7.69	3
11	Euthalia nara Moore, 1859 Bronze Duke	—	0
12	Euthalia malaccana Fruhstorfer, 1889 Fruhstorfer's Baron	2.56	1

Table 4. Global Distribution and Wildlife Protection Act (WPA) Status for the genus *Euthalia* (Anonymous, 2023).

#	Species	Global Distribution	WPA Status
1	Euthalia aconthea Cramer, 1777 Common Baron	India, Sri Lanka and Southeast Asia	Not Listed
2	Euthalia alpheda Godart, 1824 Streaked Baron	Northeast India, Southeast Asia and Philippines	Not Listed
3	Euthalia anosia Moore, 1858 Grey Baron	Southeast Asia and rare in Northeast India	Schedule II
4	Euthalia eriphylae de Nicéville, 1891 Grey-tipped Baron	India, Myanmar and Thailand	Schedule II
5	Euthalia franciae Gray, 1846 French Duke	Northeast India and Indochina	Schedule II
6	Euthalia lubentina Cramer, 1777 Gaudy Baron	India, Nepal, Bhutan and Southeast Asia	Schedule IV
7	Euthalia monina Fabricius, 1787 Powdered Baron	Southeast Asia and Northeast India	Not Listed
8	Euthalia patala Kollar, 1844 Grand Duchess	Pakistan, India, Nepal, Thailand and China	Schedule II
9	Euthalia phemius Doubleday, 1848 White-edged Blue Baron	India, Myanmar and China	Not Listed
10	Euthalia telchinia Ménétriés, 1857 Blue Baron	Northeast India, Myanmar and Southeast Asia	Schedule I
11	Euthalia nara Moore, 1859 Bronze Duke	India, Nepal, Bhutan, Thailand, Laos and China	Schedule II
12	Euthalia malaccana Fruhstorfer, 1889 Fruhstorfer's Baron	Vietnam, Northeast India, Indonesia, Thailand, Laos, Cambodia, Malaysia, Singapore and Myanmar	Not Listed

Before the discovery of *Euthalia malaccana*, Namdapha National Park and Tiger Reserve's checklist had 11 species under the genus of *Euthalia*. These are mentioned from 1 to 11 in Table 3, with #12 highlighting details of *Euthalia malaccana*. Table 4 also showcases the Schedules and Protection Levels for these species as per WPA (Anonymous, 2023); with their global distribution (Leksono *et al.,* 2025; Millah *et al.,* 2023; Kehimkar, 2016; Miyazaki *et al.,* 2006; Tytler, 1940; de Nicéville, 1891). From the afore-mentioned checklist, the species which was observed during the current survey have been showcased in Figures 4 to 16. These include *Euthalia aconthea* (Figure 4 & 5), *Euthalia anosia* (Figure 6), *Euthalia eriphylae* (Figure 7), *Euthalia phemius* (Figure 8 & 9), *Euthalia monina* (Figure 10 & 11), *Euthalia telchinia* (Figure 12 & 13), *Euthalia alpheda* (Figure 14 & 15) and *Euthalia lubentina* (Figure 16). *Euthalia franciae*, *Euthalia patala* and *Euthalia nara* were not spotted during the survey owing to seasonal factors. However, they have been observed during other periods by the current authors in Namdapha National Park and Tiger Reserve and have been presented in Figures 17, 18 and 19 respectively.

All the plates presented in the manuscript have been photographed by authors in Namdapha National Park and Tiger Reserve, Arunachal Pradesh itself. The scientific description of aforementioned species under the genus *Euthalia* as per validated literature and physical & photographic observation by authors is presented further with host plant details (Leksono *et al.,* 2025; Millah *et al.,* 2023; Kehimkar, 2016; Miyazaki *et al.,* 2006; Tytler, 1940; de Nicéville, 1891; https://powo.science.kew.org/).

***Euthalia aconthea* Cramer, 1777 - Common Baron**

Both sexes of this species exhibit outer discal band with small black-coloured dots on the upper side of their hindwing (UPH). The upper side (UP) has a deep olive-green sheen over a brown ground colour. The underside (UN) is white with sparse black markings. Males are darker and possess a row of small white spots beyond the cell, located at the base of spaces 2 to 6. In females, these spots are larger. Females are also larger in size, pale brown in colour, and display a prominent white band on the upper side of the forewing (UPF). On the underside of the hindwing (UNH), the spot in space 1 of the outer discal band is shifted inward. Host plant: *Anacardium occidentale* L, *Mangifera indica* L. (Anacardiaceae), *Bryonia* sp. (Cucurbitaceae), *Streblus asper* Lour. (Urticaceae).

***Euthalia alpheda* Godart, 1824 - Streaked Baron**

Very similar to the male, White-edged Blue Baron, but lacks the pale blue margin or the narrow white termen on the upper side of the hindwing (UPH). In both sexes, the upper side of the forewing (UPF) bears narrow white discal streaks beyond the cell, forming irregular Y-shaped markings with the arms extending to the costa. While the males have a pronounced dark brown upper side (UP), the females are much paler. The female's UPF features narrow terminal white streaks just below the apex. The UPH displays a continuous marginal band. Host plant: Data deficient.

***Euthalia anosia* Moore, 1858 - Grey Baron**

Both sexes have a prominently falcate forewing (FW) apex. In males, predominantly the hindwing (HW) tornus is produced, with the termen concave before the tornus. The upper side (UP) is brown, suffused with greenish tones and dusted with ashy grey. The underside (UN) is greyish green. Females exhibit a curved row of small white discal spots beyond the cell, extending from space 2 or 3 to the costa. The hindwing in females is evenly rounded. Host plant: *Mangifera indica* L. (Annacardiacea).

***Euthalia eriphylae* de Nicéville, 1891 - Grey-tipped Baron**

Females can be readily identified by the shape of the submarginal dark band on the upper side of the forewing; this band curves inward at the middle rather than running parallel to the termen, as observed in males. Males of the dry-season form (DSF) show more pointed forewing apices and hindwing tormi. Their upper side colouration is lighter overall, and the pale markings appear even fainter, particularly along the termen of both wings. On the hindwing, the pale terminal area contains a series of isolated dark spots. In females of the DSF, the upper side is considerably paler; the white subapical markings on the forewing are nearly pure white, lacking the sullied or pale brown tone. The submarginal band on the hindwing is slightly lighter along its inner edge, with the inward-pointing crescents appearing more sharply defined. The underside is very pale, with the bluish suffusion that nearly covers the hindwing extending into the forewing base and cell. Host plant: Data deficient.

***Euthalia franciae* Gray, 1846 - French Duke**

Often mistaken for Sergeants but differs by having a greenish upper side (UP) with a broad discal band on both wings, which becomes slightly diffused at vein 2 on the upper side of the hindwing (UPH). The upper side of the forewing (UPF) bears a submarginal row of whitish spots. The UPH features a submarginal row of black spots and a marginal row of small white spots. The underside (UN) is shining and pale greenish blue. The female is larger.
Host plant: Data deficient.

***Euthalia lubentina* Cramer, 1777 - Gaudy Baron**

Both sexes are dark green with an iridescent sheen, featuring red and black spots on the upper side of the hindwing (UPH) and within the cell of the upper side forewing (UPF). The males have a Y-shaped discal band comprising of small white spots on their UPF. The female shows large white spots before the end-cell and a discal band of large, irregular spots. The UPH also contains a row of dark submarginal spots.
Host plant: *Scurrula parasitica* L. (Loranthaceae).

***Euthalia monina* Fabricius, 1787 - Powdered Baron**

Both Sexes are dimorphic. The male has a black or dark brown upper side (UP), with the discal band of the upper side forewing (UPF) and the marginal half of the upper side hindwing (UPH) covered in powdery blue. The forewing (FW) apex is pointed. The hindwing (HW) has a produced tornus, and the termen is convex above the tornus. The underside (UN) is yellow-brown. The female has a pale brown UP with two dark discal lines, and the area between them is much paler compared to similarly appearing females of other Barons. The UPH contains two streaks in the cell. The FW apex is not produced, resembling that of the Plain Earl. The UPF has a pale discal band that is pushed inward at space 3.



Figure 4. *Euthalia aconthea* (Male)



Figure 5. *Euthalia aconthea* (Female)



Figure 6. *Euthalia anosia*



Figure 7. *Euthalia eriphylae*



Figure 8. *Euthalia phemius* (Female



Figure 9. *Euthalia phemius* (Male)



Figure 10. *Euthalia monina* (Male)



Figure 11. *Euthalia monina* (Female)



Figure 12. *Euthalia telchinia* (Male)



Figure 13. *Euthalia telchinia* (Female)



Figure 14. *Euthalia alpheda* (Male)



Figure 15. *Euthalia alpheda* (Female)



Figure 16. *Euthalia lubentina* (Male)



Figure 17. *Euthalia patala*



Figure 18. *Euthalia franciae*



Figure 19. *Euthalia nara*

The UN is yellow-brown, with the dorsal area of the underside hindwing (UNH) being greenish. Host plant: *Shorea robusta* Roth (Dipterocarpaceae), Mallotus subulatus Müll. Arg (Euphorbiaceae), *Diospyros melanoxylon* Roxb (Ebenaceae), *Macaranga hullettii*, King ex Hook.f. and *Clidemia hirta* (Melastomataceae).

***Euthalia nara* Moore, 1859 - Bronze Duke**

Both sexes have a bronzy olive-green upper side (UP) and lack apical white spots. The male displays prominent dusky pale spots in spaces 2 and 3 on the upper side forewing (UPF), and the upper side hindwing (UPH) shows a distinct yellow area in spaces 6 and 7. The male lacks a white discal band, whereas the female possesses a continuous white discal band on the UPF, which narrows towards the area above the tornus. In the female, the spot in space 4 on the UPF is narrow, elongate, pointed, and distinctly separated from the other spots. Host plant: Data deficient.

***Euthalia patala* Kollar, 1844 - Grand Duchess**

Both sexes closely resemble the Green Duke. The upper side forewing (UPF) has apical spots that are equal in size and aligned one above the other, with discal spots in spaces 3 and 4 having their inner edges in line. There are no white spots in space 1 of the UPF. On the upper side hindwing (UPH), discal spots are present only in spaces 6 and 7. The UPF discal band is pale yellow in the male, while in the female it is white, with all spots being elongated. Host plant: *Quercus incana* W. Bartram (Fagaceae).

***Euthalia phemius* Doubleday, 1848 - White-edged Blue Baron**

Sexes are dimorphic. The upper side (UP) of the male is dark brown with white discal streaks near the costa, forming an irregular pattern. The margin of the upper side hindwing (UPH) is pale blue, with the outer edge (termen) as pure white and narrow. On the upper side forewing (UPF), the male has an outer discal band that runs parallel to the termen. The female is pale brown with a broad white discal band on the UPF, extending from the costa to the termen at vein 1. The UPF also features two prominent apical spots. Host plant: *Nephelium litchi* Steud (Sapindaceae).

***Euthalia telchinia* Ménétriés, 1857 - Blue Baron**

Both sexes have the hindwing (HW) evenly rounded, without any projection at the tornus. The forewing (FW) apex is produced, but not pointed. It also features a white fringe. The male resembles the Common Earl and Grey Count. The male upper side (UP) is dark brown with a blue margin on the upper side hindwing (UPH), extending to vein 3. The underside (UN) is dull brown. The female UP is pale brown, with a broad, inclined dark brown band extending from the UPF apex to about two-thirds along the dorsum, continuing onto the UPH just beyond the cell. The UPF also shows five dusky white spots arranged in a curved row beyond the cell. The UN is yellowish brown. Sexes are dimorphic. Host plant: Data deficient.

Alpha Diversity for species observed under genus Euthalia

There is a moderately diverse assemblage with *Euthalia aconthea* being the most dominant species in the community. The species also presented a high level of evenness among other species and contributed significantly to the community structure. Equitability i.e., Pielou's Evenness upon computation was found to be 0.898 on a 0 to 1 scale thereby suggesting even distribution among the species documented. Herein the evenness was also boosted by the stable population of *Euthalia phemius* and viz. the sighting and presence of *Euthalia lubentina* by matching abundance of similar species. On the lop side, *Euthalia anosia* and *Euthalia eriphylae* had lower representation due to rarer species. However, even a small population can aid in elevating species richness, whilst having little effect on evenness. Herein, while the presence of *Euthalia monina* with its moderate abundance has resulted in balancing *Euthalia aconthea's* dominance, *Euthalia alpheda* had significantly contributed towards the mid-level diversity and richness. Margalef's Species Richness Index was computed and found to be 1.924, thereby presenting a moderate level of species richness. This attribute was reinforced by the sighting and presence of *Euthalia eriphylae* (a rare species) and *Euthalia telchinia* (an uncommon species). The Shannon-Wiener Index was computed and found to be 1.868. This highlights moderate to high family-level diversity with both richness and evenness. The sighting and presence of *Euthalia eriphylae* (a rare species) also cannot be ruled out in boosting the Shannon index. Upon computation the Simpson's Index of Diversity was found to be 0.817, thereby representing high diversity. As evident from the afore-mentioned biodiversity indices, the dataset on an overall indicates a fairly balanced and healthy species distribution. Among the species that were not recorded during the survey, the absence of *Euthalia franciae*, *Euthalia patala* and *Euthalia nara* is mainly owing to seasonal distribution. The lower count of *Euthalia anosia*, *Euthalia eriphylae* and *Euthalia telchinia* can also be attributed to seasonal fluctuations and the fact that they are uncommon species.

Specifics of Discovery

The sighting of *Euthalia malaccana* Fruhstorfer, 1889 is the first photographic record from Namdapha National Park and Tiger Reserve, and the second record from India. Its relevance in terms of discovery is discussed further. The published research with the first Indian 'photographic' record for *Euthalia malaccana* Fruhstorfer, 1899; mentions a single individual to be reported from within a community forest habitat alongside a road in Basar, Arunachal Pradesh; at a higher altitude of 685 meters on 14.IX.2024 (Upadhyaya & Sheikh, 2025a). Contrastingly, the present site of discovery was a streamside and at a lower elevation of 150m above msl on 16.X.2024. Separated by around 400 km, both the 1st and 2nd site of sightings are geographically, politically, and physically divided by another neighbouring state's (Assam) forest Dibru Saikhowa National Park. The same is highlighted in Figure 20.



Figure 20. Birds-view highlighting the presence of a neighbouring state forest (Dibru Saikhowa National Park, Assam) separating the location of 1st and 2nd discovery (Lai Ho, Basar and Lunkai Nalla, Namdapha National Park and Tiger Reserve) (Source: Google Earth).



Figure 21. The typical landscape of Lunkai Nalla within Namdapha National Park and Tiger Reserve.



Figure 22. Location of Lunkai Nalla within Namdapha National Park and Tiger Reserve, Arunachal Pradesh, India (Source: Google Earth).

A single female individual of *Euthalia malaccana* was sighted on 16.X.2024 around 12 pm mid-noon, at an altitude of 150m above msl, in Lunkai nalla (Figure 21 & 22) bearing a Latitude and Longitude of 96° 23'10.2912"N and 27°29'35.0376"E, respectively. The individual was initially observed as basking on the rocks (Figure 23). Further, it was noticed to be sucking water trapped in between the rocks through its proboscis (Figure 24). The individual was immediately photographed with DSLR cameras by authors on account of its variable distinguished appearance from that of *Euthalia lubentina* (Cramer, 1777). The ID was affirmed by studying the multiple photographs, with the ID keys (Eliot, 2020). The external morphological characteristics were also found to be consistent with the original description by Fruhstorfer, 1899. The butterfly upon disturbance from other butterflies was found to have moderately fast flight before disappearing into the forest. This finding also hints at the possibility of differential elevation-based range-extensions due to climate change-mediated alterations in the environment (Aadarsa et al. 2021).

As observed in Figure 23 and 24, *Euthalia malaccana* Fruhstorfer, 1899 is distinguished by a blue apical spot on forewings, which is more prominent in the males, whereas in comparison the females exhibit larger apical spots. The hindwings feature smaller red spots. (Eliot, 2020). These are seldom reddened in Neomalayan races of *Euthalia lubentina* (Figure 25). Blue, lacking a black streak above the cubitus in specimens (Eliot, 2020).



Figure 23. Basking behaviour by the female individual (*Euthalia malaccana* Fruhstorfer, 1899) at Lunkai Nalla in Namdapha National Park and Tiger Reserve, Arunachal Pradesh, India.



Figure 24. Puddling behaviour by the female individual (*Euthalia malaccana* Fruhstorfer, 1899) at Lunkai Nalla in Namdapha National Park and Tiger Reserve, Arunachal Pradesh, India

Inferential Outlook

While singular unique sightings of butterflies may appear circumstantial, they do often serve as the primary input of underlying ecological transformations beyond the location of discovery and within it. In the current era wherein, rampant urbanization continues to alter species distributions, single observations such as of *Euthalia malaccana* Fruhstorfer, 1889 can critically serve as a crucial indicator in the larger framework of ecological narratives. As per the IUCN Red List of Threatened Species status, *Euthalia malaccana* is listed as Least Concern based on last assessment conducted in 2009 (Müller & Tennent, 2011). However, based on photographic records from the web portal of inaturalist (www.inaturalist.org/), and published research data, the sightings are sparse (Leksono *et al.,* 2025; Millah *et al.,* 2023), and hence it actually belongs to 'rare' category within Rabinowitz's classification (Rabinowitz, 1981).

Also based on analysis, the abundance across reported locations was found to be non-uniform, thereby presenting itself as 'narrow-range' under Rapoport's classification (Rapoport, 1982). The global current distribution of *Euthalia malaccana* has been showcased in Figure 26.



Figure 25. Representative image for comparison of the external appearance and other morphological features of male Gaudy Baron (*Euthalia lubentina* Cramer, 1777) observed from Namdapha National Park and Tiger Reserve, Arunachal Pradesh, India.

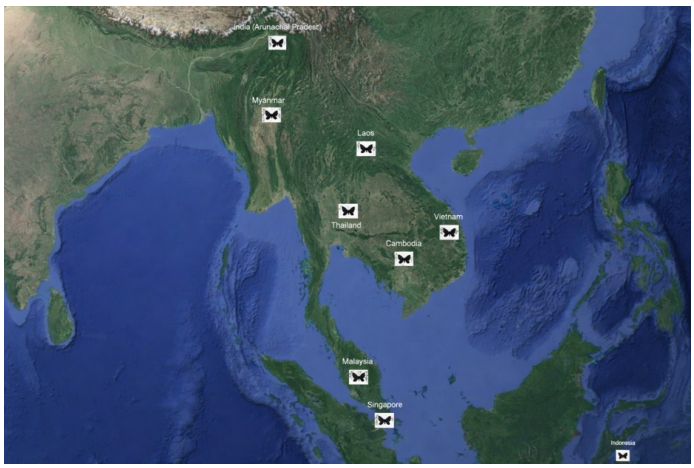


Figure 26. *Euthalia malaccana* distribution (world-wide).

The butterfly has its distribution across Myanmar, Thailand, Laos, Malaysia, Cambodia, Indonesia, Singapore, and Vietnam (Kosterin, 2019; Yokochi, 1999; Fleming, 1975), with more records reported from Malaysia and Indonesia. While Cambodia and Thailand have presented occasional observations, rests of locations have either only historical data (such as Singapore) or extremely real-time rare sightings such as in Laos. In this context it needs to be understood that lack of data invariably can lead to gaps in conservation efforts. Hence, any rare occurrence such as of *Euthalia malaccana* in India can be viewed in the context of being introduced into the protection status for India as per its Wildlife Protection Act of India amended in 2022 (Anonymous, 2023). Herewith, the rare records and sightings such as mentioned in this research article must be viewed in the context of habitat degradation, its fragmentation, climate-driven range shifts, revamped habitat connectivity, anthropogenic pressure etc. In this context butterflies such as *Euthalia malaccana* Fruhstorfer, 1889 act as ecological indicators and their movement into newer territories could trigger amendments in the taxa and become integral in analysing insights for long-term conservation strategies. Hence the study postulates intensified monitoring and habitat protection with integration of findings into the broader conservation discourse as part of larger ecological dynamics.

CONCLUSION

The observation showcases details of the second-ever photographic evidence of the rare *Euthalia malaccana* Fruhstorfer, 1889 from India and affirms its extension within the stenochorous Indo-Australian realm. This presents a significant implication in biogeographical conservation by mandating need for protecting such rare species and its habitat alike. The finding also highlights the distinct difference in the elevation and habitat-type of the only 1st and 2nd sighting for India, and hence also hints at the possibility of species addition to a pertinent schedule and protection level in the Wildlife Protection Act. This sighting whilst extending the known range of Fruhstorfer's Baron, also postulates the probable existence of habitat suitability which are less explored at Namdapha National Park and Tiger Reserve, and can hold potential for greater species richness and abundance aspects. Therefore, this addendum to existing inventory is hence critical for deciphering the ecosystem dynamics, and for re-gauging conservation strategies at Namdapha National Park and Tiger Reserve, Arunachal Pradesh, India.

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