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Verification and photographic documentation of two species of the genus *Graphium* Scopoli, 1777 from Uttar Pradesh, India, supplementing the updated Checklist of *Graphium* species in the Indian Subcontinent (Lepidoptera: Papilionidae)

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Abstract

Two species of the genus *Graphium* Scopoli, 1777, are rediscovered and documented from Uttar Pardesh in this paper. This research presents the first record of *G. agamemnon* (Linnaeus, 1758) and *G. nomius* (Esper, 1799) within Uttar Pradesh based on photographic evidence and field observations. The paper also supplements with updated checklist on *Graphium* species in Indian subcontinent. The discovery highlights the importance of continuous monitoring and documentation of Papilionoidea species, especially within protected areas, to enhance our understanding of their distribution and contribute to their conservation.
Keywords: Lepidoptera, Papilionidae, field observations, photography, documentation, habitat, conservation, India.

Verificación y documentación fotográfica de dos especies del género *Graphium* Scopoli, 1777 de Uttar Pradesh, India, que complementan la lista actualizada de especies de *Graphium* del subcontinente indio (Lepidoptera: Papilionidae)

Resumen

En este trabajo se redescubren y documentan dos especies del género *Graphium* Scopoli, 1777, de Uttar Pardesh. Esta investigación presenta el primer registro de *G. agamemnon* (Linnaeus, 1758) y *G. nomius* (Esper, 1799) en Uttar Pradesh basado en pruebas fotográficas y observaciones de campo. El artículo también complementa la lista actualizada de especies de *Graphium* en el subcontinente indio. El descubrimiento pone de relieve la importancia de la vigilancia y documentación continuas de las especies de Papilionoidea, especialmente dentro de las zonas protegidas, para mejorar nuestra comprensión de su distribución y contribuir a su conservación.
Palabras clave: Lepidoptera, Papilionidae, observaciones de campo, fotografía, documentación, hábitat, conservación, India.

Introducción

Papilionoidea are essential components of ecosystems, contributing to pollination and serving as indicators of environmental health. Documenting their distribution is crucial for biodiversity

conservation efforts. In India, five subspecies of the *Graphium agamemnon* species are found. The first, *G. agamemnon menides,* is widespread in Sri Lanka and also present in Peninsular India, particularly in the Western Ghats, where it inhabits both lowland areas and elevations up to 1200 meters. The second subspecies, *G. agamamnon agamemnon,* is commonly sighted in the northeastern Ghats of northern Orissa, Jharkhand, and southern West Bengal, as well as in the Himalayas, adapting to altitudes reaching 1800 meters. Its habitat spans from southeastern Himachal Pradesh (Sirmaur) across Uttarakhand, Nepal, northern Bihar (Champaran), Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh and the rest of northeastern India, including all of Bangladesh. This subspecies, previously known as *rufescens* (Oberthür, 1879) and *rufoplenus* (Fruhstorfer, 1898), exhibits a broad distribution across various landscapes within the Indian subcontinent. Previously classified as *Zetides agamemnon,* the Tailed Jay, in Evans (1932). Third is *G. agamamnon andamana* (Lathy, 1907)*:* Fairly common in the Andaman Islands. Fourth is *G. agamamnon decorates* (Rothschild, 1895). This subspecies is common in the Car and Central Nicobar Islands. Fifth is *G. agamamnon pulo* (Evans, 1932)*:* Rare in the Southern Nicobar Islands, meanwhile *Graphium nomius* (Esper, 1799) also exhibits two subspecies. *G. nomius nomius* is commonly found in Sri Lanka and widely distributed across India, particularly in the Western Ghats, reaching elevations of up to 900m. Its range extends from Himachal Pradesh to Bhutan, encompassing various states except for certain areas in Gujarat, Rajasthan, Haryana, Punjab, and Kashmir. On the other hand, *G. nomius swinhoei* (Moore*,* 1878) previously known as *pernomius* (Moore, [1903]), is rare in northeastern India, primarily in western Assam, Meghalaya, Manipur, and southeastern Arunachal Pradesh, with occasional sightings in Bangladesh. Initially classified as *Pathysa nomius,* it was later reclassified in Evans (1932). This research aims to document the first sighting of *G. agamemnon* and *G. nomius* within Uttar Pradesh, specifically within the confines of the Pilibhit Tiger Reserve. Genus *Graphium* has 21 known species from India and the Indian subcontinent Gasse (2018), Kunte et al (2024) (Appendix I).

Materials ad methods

Study Area

The Pilibhit Tiger Reserve encompasses the Pilibhit, Lakhimpur Kheri, and Bahraich Districts within Uttar Pradesh, India (Figure 1). Positioned adjacent to the India-Nepal border, it spans the foothills of the Himalayas and the plains of Uttar Pradesh, known as the 'terai'. As one of India's 50 Project Tiger reserves, it stands as a testament to biodiversity and conservation efforts. Notably, the Pilibhit district is celebrated for its dense forest cover, with over 800 km^2 (310 sq mi) of forests, accounting for nearly 23% of the district's total area as of 2004.

Methods

On 27-VIII-2023, a field survey was conducted within the Pilibhit Tiger Reserve in Uttar Pradesh, India, focusing on Rhopalocera diversity and these two species mentioned above were seen and photographed. Again, after a week four more individuals of *Graphium nomius* and two individuals of *G. agamemnon* were seen and photographed in the same locality. Visual observations and photographic documentation were employed to record Rhopalocera species encountered during the surveys. GPS coordinates were collected for sighting to accurately document the location of observations. It's important to note that no Rhopalocera were collected or harmed during this process. A distribution map was prepared using ArcGIS 10.5 software, utilizing the original base map of India as a reference (Figure 1).

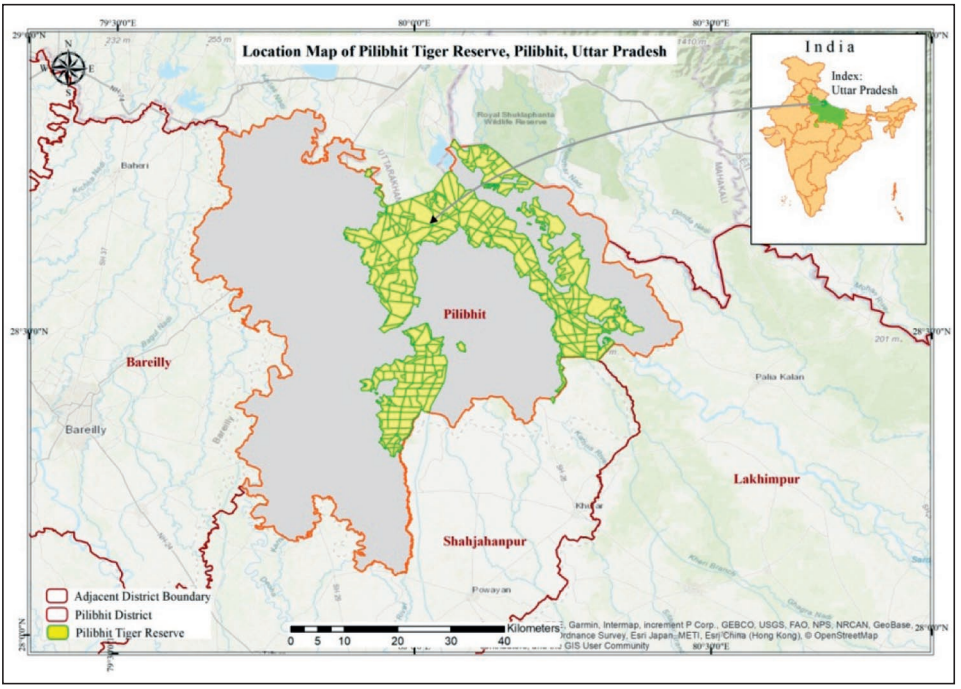

Figure 1. Map showing the location of *Graphium* species.

Identification

Identification was conducted using available literature, including references such as Kehimkar (2016) and Evans (1932), which provided valuable guidance and information on this species (Figures 2-3).

Results: In this study, two *Graphium* species were seen and photographed viz., *G. agamemnon* (Linnaeus, 1758) and *G. nomius* (Esper, 1799), belonging to the family Papilionidae.

Graphium agamemnon (Linnaeus, 1758) (Figure 2)

Diagnosis: A species with black wings adorned with green spots and streaks. On the underside, the wings are pale brown with black markings, suffused with lilac or green spots. Additionally, it features a tail.

Material examined: INDIA.Uttar Pradesh: Pilibhit Tiger Reserve, 28.693ºN 79.854ºE, 170 m, 27-VIII-2023, observed more than four individuals by Rupak De, Ratindra Pandey & Abu Arshad Khan.

Graphium nomius (Esper, 1799) (Figure 3)

Diagnosis: A Papilionidae displaying a whitish hue with broad, brown margins accented by white spots on the undersides of both wings, accompanied by various bands. Notably, the hindwing boasts a row of distinct red spots at its centre, while also featuring elongated, sword-like tails.

Material examined: INDIA, Uttar Pradesh: Pilibhit Tiger Reserve, 28.693ºN 79.853ºE, 170 m, 27-VIII-2023, observed more than five individuals by Rupak De, Ratindra Pandey & Abu Arshad Khan.

Discussion

The verification and documentation of *Graphium agamemnon* and *Graphium nomius* within Uttar Pradesh, particularly within the Pilibhit Tiger Reserve, expands the accurate known distribution range of these species in this region of India. Indian Rhopalocera updated checklist by Gasse (2018) have not documented its occurrence in this region, Previous literature available on region regarding these two species Kumar et al. (2016), Kumar & Rana (2018), do not have shown any photographic evidence which can confirm the presence of these two species accurately in the area. It's worth noting that records published in predatory journals are not consulted in this article, ensuring the reliability and credibility of the findings. The present study is in line with previous research conducted within the same state, as demonstrated by articles authored by Behera (2016), Bura et al. (2016), De Rye Phillipe (1902), Director (2015), Sarkar & Mandal (2018), Sharma (2007), Champion & Seth (1968), Kumari & Sheikh (2021), Sheikh et al. (2023), and De et al. (2023). Furthermore, this study is correlated with research conducted in other states, and the current article follows a similar format to those articles. Examples of similar work from other states include Sheikh & Parey (2019a, 2019b), Sheikh & Malik (2020), Parey & Sheikh (2021), Riyaz et al. (2021), Sheikh (2022), Sheikh & Parey (2022), Gupta & Sheikh (2021), Khan & Sheikh (2022), Sheikh & Mishra (2022), Sheikh & Hassan (2023), Pandey et al. (2023), De et al. (2024), Khan et al. (2024) and Sheikh et al. (2024). The presence of *G. agamemnon* and *G. nomius* within a protected area underscores the importance of such areas for conserving biodiversity and highlights the need for continued monitoring and documentation efforts. The discovery emphasizes the importance of ongoing monitoring and documentation efforts to enhance our understanding of Papilionidae distribution and contribute to their conservation in India. Further research is warranted to investigate the habitat preferences, population dynamics, and conservation status of *G. agamemnon* & *G. nomius* within Uttar Pradesh.

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The checklist of genus *Gaphium* is based on Paul Van Gasse Checklist 2018, and updated version & Ifoundbutterflies website Kunte et al (2024)

Appendix I

1. *Graphium cloanthus* (Westwood, 1841)
   G. cloanthus: This species is commonly found in the Himalayas, typically inhabiting altitudes of up to 2700 meters. Its range extends from northeastern NWFP (Hazara) and northwestern Punjab (Murree) in Pakistan, across Kashmir, Himachal Pradesh, Uttarakhand, Nepal, Sikkim, northwestern West Bengal, and Bhutan, reaching Arunachal Pradesh and other northeastern regions of India (with no recorded sightings in Tripura). The species was previously identified as *Zetides cloanthus* and referred to as the Glassy Bluebottle in Evans' 1932 publication.

2. *Graphium sarpedon* (Linnaeus, 1758)
   G. sarpedon sirkari: This species is commonly found in the Himalayas, typically inhabiting areas up to 2800 m in altitude. Its distribution extends from northern NWFP (Hazara) and northwestern Punjab (Murree) in Pakistan, across Kashmir, Himachal Pradesh, northern Punjab (Siwaliks), Uttarakhand, Nepal, northern Bihar (Champaran), Sikkim, northern West Bengal, and Bhutan, reaching Arunachal Pradesh and other northeastern regions of India, as well as most of Bangladesh (excluding the southwest), including adjacent southern and central West Bengal. There have been sporadic sightings reported in southern Haryana (Delhi region). The subspecies sirkari, which was described by Page and Treadaway in 2013, was merged into the nominate subspecies of *Zetides sarpedon,* known as the Common Bluebottle, as per Evans' 1932 publication.

3. *Graphium teredon* (C. & R. Felder, [1865])
   This species is widespread in Sri Lanka, inhabiting altitudes of up to 1800 m, particularly abundant in the southwest and absent from the northern regions. In Peninsular India, it is common, reaching the highest peaks of the Western Ghats. Its distribution spans from Kerala and Tamil Nadu in the south, extending northward through all states to southeastern Gujarat, southeastern Rajasthan (Aravalli Range), Madhya Pradesh, southern Chhattisgarh, and Orissa. Previously classified as the subspecies teredon of *Zetides sarpedon,* known as the Common Bluebottle, in Evans' 1932 publication.

4. *Graphium adonarensis* (Rothschild, 1896)
   G. adonarensis septentrionicolus: This species is rare and likely found at relatively low elevations in northeastern India, specifically south of the Brahmaputra in Assam (Nagaon) and Meghalaya (Khasi Hills). The Indian subspecies was described by Page and Treadaway in 2013.

5. *Graphium doson* (C. & R. Felder, 1864)
   G. doson doson: This species is commonly found in Sri Lanka, inhabiting areas from the lowlands up to 700 m, except in the extreme north. It was previously referred to as *jason* in certain sources.
   G. doson eleius: Common in Peninsular India, with a habitat range extending up to 1800m in the Western Ghats. It is observed from Kerala and Tamil Nadu in the south, northward through all states to eastern Gujarat, southeastern Rajasthan (Aravalli Range), Madhya Pradesh, Chhattisgarh, Jharkhand, and southern West Bengal, with a single record from Lucknow in Uttar Pradesh.
   G. doson axionides: This subspecies is widespread in the Himalayas and adjacent plains, reaching altitudes of up to 1500 m. Its distribution spans from Kashmir (Jammu) in the west, eastward through Himachal Pradesh (with an old record from Kangra), northern Punjab (south to Amritsar and Patiala), northern Haryana (Siwaliks, occasionally south to Delhi), Uttarakhand, northern Uttar Pradesh (Dudhwa National Park), Nepal, Sikkim, northern West Bengal, and Bhutan, reaching Arunachal Pradesh and other northeastern regions of India (with no recorded sightings in Mizoram), as well as throughout Bangladesh. It was previously identified as *axion* in Evans' 1932 publication, with the subspecies *axionides* being referred to as *axion*; however, the latter term is preoccupied, according to Page and Treadaway in 2014.

6. *Graphium evemon* (Boisduval, 1836)
   G. evemon albociliatis: This species is exceptionally rare, typically found at relatively low elevations in

northeastern India, specifically south of the Brahmaputra River, including central Assam, and extending into eastern Arunachal Pradesh, particularly the Mishmi Hills. It was previously classified as *Zetides evemon,* the Lesser Jay, in Evans' 1932 publication. However, Smetacek and Varshney consider *albociliatis* as a distinct species, *Graphium albociliatis,* the Scarce Jay, in accordance with Page and Treadaway's classification in 2014.

7. *Graphium eurypylus* (Linnaeus, 1758)
G. eurypylus acheron: This species is uncommon in the Himalayas, typically observed at elevations up to 1600 m. Its range spans from Sikkim and northern West Bengal, extending eastward through Bhutan to Arunachal Pradesh and the remaining northeastern regions of India (including Assam, Meghalaya, Manipur, and Mizoram), as well as central and northeastern Bangladesh. Previously identified as *cheronus* and *petina. G. eurypylus macronius:* This subspecies is rare and found in the Andaman Islands. It was previously classified as *Zetides eurypylus,* the Great Jay, in Evans' 1932 publication.

8. *Graphium chironides* (Honrath, 1884)
G. chironides: This species is fairly common in the Himalayas, typically found at elevations up to 1650 m. Its distribution ranges from central Nepal and adjacent northern Bihar (Darbhanga district) eastward through Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh and the remaining northeastern regions of India (excluding Tripura or Mizoram), as well as northeastern Bangladesh. It was previously referred to as *chiron* and *ligyra.* Given as *Zetides bathycles,* the Veined Jay, in Evans' 1932 publication, and classified as *Graphium bathycles* in Talbot's 1939 work.

9. *Graphium agamemnon* (Linnaeus, 1758)
G. agamemnon menides: This species is common throughout Sri Lanka, inhabiting all lowlands and reaching elevations of up to 1200 m. In Peninsular India, it is also common, reaching altitudes of up to 2100 m in the Western Ghats. Its distribution spans from Kerala and Tamil Nadu in the south, extending northward through all states to Gujarat (excluding Kutch), central Rajasthan, Madhya Pradesh, Chhattisgarh, and southern Orissa.
G. agamemnon agamemnon: This subspecies is common in the northeastern Ghats in northern Orissa, Jharkhand, and southern West Bengal, as well as in the Himalayas, reaching elevations of up to 1800 m. Its habitat extends from southeastern Himachal Pradesh (Sirmaur) eastward through Uttarakhand, Nepal, northern Bihar (Champaran), Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh and the remaining northeastern regions of India, including all of Bangladesh. It was previously referred to as *rufescens* and *rufoplenus.*
G. agamemnon andamana: Fairly common in the Andaman Islands.
G. agamemnon decoratus: This subspecies is common in the Car and Central Nicobar Islands.
G. agamemnon pulo: Rare in the Southern Nicobar Islands. Previously classified as *Zetides agamemnon,* the Tailed Jay, in Evans' 1932 publication.

10. *Graphium arycles* (Boisduval, 1836)
G. arcyles occidentalis: This species is exceedingly rare, likely found at relatively low elevations in northeastern India, specifically south of the Brahmaputra in Manipur. Only one specimen has been recorded from Manipur. Initially identified as *Zetides arycles,* the Spotted Jay, in Evans' 1932 publication, and later classified as *Graphium arycles arycles.* The subspecies *occidentalis* was described by Page and Treadaway in 2014.

11. *Graphium macareus* (Godart, 1819)
G. macareus indicus: This subspecies is fairly common in the Himalayas, typically observed at elevations up to 1600 m. Its range extends from eastern Nepal eastward through Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh and northern Assam, specifically north of the Brahmaputra River. Previously referred to as polynices.
G. macareus lioneli: This subspecies is fairly common at relatively low elevations in northeastern India, specifically south of the Brahmaputra in Assam, Meghalaya, and Manipur, as well as in northeastern Bangladesh. It was previously classified as *Paranticopsis macareus,* the Lesser Zebra, in Evans' 1932 publication.

12. *Graphium xenocles* (Doubleday, 1842)
G. xenocles phrontis: This subspecies is uncommon in the Himalayas, typically found at elevations up to 1000 m. Its range extends from eastern Uttarakhand (Eastern Kumaon) eastward through Nepal (only recorded in the eastern region), Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh.
G. xenocles xenocles: This subspecies is also uncommon, reaching elevations of up to 1000 m, in northeastern India south of the Brahmaputra (excluding Tripura or Mizoram), including southeastern Arunachal Pradesh, as well as in northeastern and southeastern Bangladesh. Previously identified as theronus. Initially classified as Paranticopsis xenocles, the Great Zebra, in Evans' 1932 publication and in Varshney's 2010 work.
13. *Graphium megarus* (Westwood, 1844)
G. megarus: This species is uncommon, usually encountered at lower elevations in the eastern Himalayas, particularly in eastern Bhutan and western Arunachal Pradesh. It is also spotted in the western region of northeastern India, south of the Brahmaputra, especially in central Assam and Meghalaya, as well as in northeastern Bangladesh. Initially designated as *Paranticopsis megarus,* commonly known as the Spotted Zebra, in Evans' 1932 publication.

14. *Graphium eurous* (Leech, [1893])
G. eurous caschmirensis: This subspecies is uncommon in the western Himalayas, typically found at elevations ranging from 1200 to 2100m. Its distribution extends from Kashmir eastward through Himachal Pradesh to Uttarakhand.
G. eurous sikkimica: This subspecies is also uncommon in the Himalayas, inhabiting elevations ranging from 600 to 2900m. Its range spans from the extreme eastern part of Uttarakhand (Eastern Kumaon) eastward through Nepal, Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh, as well as the hills of northeastern India south of the Brahmaputra, including Meghalaya and Nagaland. Initially classified as *Pathysa eurous,* the Sixbar Swordtail, in Evans' 1932 publication.

15. *Graphium garhwalica* (Katayama, 1988)
This species is rare in the western Himalayas in Uttarakhand. It is known from both Garhwal (Auli, 2200 m) and Kumaon (Sikhar Hill in Bageshwar).

16. *Graphium paphus* (de Nicéville, 1886)
This species is also rare in the Himalayas, with an altitude range of 900 to 2700 m. It is found across Nepal, extending eastward through Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh, as well as the hills of northeastern India south of the Brahmaputra, including Meghalaya and Nagaland. Previously identified as glycerion. Initially classified as *Pathysa glycerion*, the Spectacled Swordtail, in Evans' 1932 publication, and as *Graphium glycerion* in Talbot's 1939 work.

17. *Graphium agetes* (Westwood, 1843)
G. agetes: This species is uncommon in the Himalayas, typically found at elevations up to 1200 m. Its distribution extends from Sikkim and northern West Bengal eastward through Bhutan to Arunachal Pradesh and the remaining northeastern regions of India (including Assam and Meghalaya), as well as northeastern Bangladesh. Initially classified as *Pathysa agetes,* the Fourbar Swallowtail, in Evans' 1932 publication.

18. *Graphium nomius* (Esper, 1799)
G. nomius nomius: This particular species is frequently found in Sri Lanka, especially in its eastern half, and can be spotted at elevations of up to 900 meters. In India, it has a broad distribution, commonly observed up to 900 meters in the Western Ghats. It is present in Kerala and Tamil Nadu, extending northward through all states except Kutch in Gujarat, western Rajasthan, western Haryana, southern Punjab, and Kashmir, all the way to the Himalayas, where it can be found at elevations of up to 1200 meters. Its range extends from Himachal Pradesh, reaching as far west as Kangra, and stretches eastwards through Uttarakhand, Nepal, Sikkim, northern West Bengal, and into Bhutan.
G. nomius swinhoei: This subspecies is seldom found at lower elevations in northeastern India, specifically north of the Brahmaputra in western Assam and south of it in Meghalaya and Manipur, as well as in southeastern Arunachal Pradesh (Namdapha National Park), and occasionally in northeastern and southeastern, and sometimes in central and southwestern Bangladesh. Previously referred to as *pernomius,* it was originally classified as *Pathysa nomius,* also known as the Spot Swordtail, in Evans' 1932 publication.

19. *Graphium aristeus* (Stoll, [1780])
G. aristeus anticrates: This subspecies is uncommon at relatively low elevations in the Himalayas, particularly in Sikkim, northern West Bengal, and Bhutan. It can also be found in northwest Assam near the Bhutan border, specifically in the Manas Biosphere Reserve. Additionally, it is observed in northeastern India south of the Brahmaputra (excluding Tripura or Mizoram) and northeastern Bangladesh. Initially classified as *Pathysa aristeus,* the Chain Swordtail, in Evans' 1932 publication.

20. *Graphium antiphates* (Cramer, [1775])
G. antiphates ceylonicus: This subspecies is rare and localized in Sri Lanka, inhabiting areas from the lowlands up to 900 m. It is also known as antiphanes.
G. antiphates naira: This subspecies is uncommon in the Western Ghats, reaching elevations of up to 900 m. Its distribution extends from Kerala and western Tamil Nadu northward through western Karnataka to Goa.
G. antiphates pompilius: This subspecies is common in the northern Eastern Ghats, ranging from southeastern Chhattisgarh northward through Orissa to Jharkhand and southern West Bengal. It is also found in the Himalayas, reaching elevations of up to 1400 m. Its habitat spans from eastern Nepal eastward through Sikkim, northern West Bengal, and Bhutan to Arunachal Pradesh and the remaining northeastern regions of India, as well as in northeastern and southeastern Bangladesh. It was previously known as *alcibiades, itamputi, nebulosus,* and *continentalis.*
Originally labelled as *Pathysa antiphates,* the Fivebar Swordtail, in Evans' 1932 publication. Smetacek and Varshney, in line with Larsen's perspective, consider *alcibiades* as the southwestern Indian subspecies rather than the *javan,* consequently establishing *naira* as a synonym.

21. *Graphium epaminondas* (Oberthür, 1879)
The species in question is commonly found in the Andaman Islands. Initially, it was considered a subspecies of *Pathysa antiphates,* known as the Fivebar Swordtail, according to Evans' publication in 1932. Talbot's work in 1939 classified it as a subspecies of *Graphium antiphates.* Varshney later reclassified *macareus, xenocles,* and *megarus* under *Paranticopsis; eurous* and *glycerion* under *Pazala;* and *agetes, nomius, aristeus, antiphates,* and epaminondas under *Pathysa.*

Figures 2-3. 2. *Graphium agamemnon* (Linnaeus) (Underwing). **3.** *Graphium nomius* (Esper) (Underwing).