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Further knowledge of the genus *Nyctobrya* Boursin, 1957 from the Canary Islands (Spain), with description of a new species from El Hierro (Lepidoptera: Noctuidae)

P. Falck

Abstract

It describes *Nyctobrya ingridae* Falck, sp. nov. and record *N. canaria* (Alphéraky, 1890) for the first time from the Canary Island, El Hierro, Spain. Photographs of adults and genitalia of the new species are provided. Both species are DNA barcoded. Both morphology and analyses of DNA barcodes support the identification and distinctiveness of the new species as it appears well-supported and genetically isolated.
Keywords: Lepidoptera, Noctuidae, new species, new record, DNA barcodes, Canary Islands, Spain.

Profundización en el conocimiento del género *Nyctobrya* Boursin, 1957 de las Islas Canarias (España), con descripción de una nueva especie de El Hierro (Lepidoptera: Noctuidae)

Resumen

Se describe *Nyctobrya ingridae* Falck, sp. nov. y se registra *N. canaria* (Alphéraky, 1890) por primera vez de la isla canaria de El Hierro, España. Se presentan fotografías de adultos y genitalia de la nueva especie. Ambas especies tienen ADN códigos de barras genéticos. Tanto la morfología como los análisis de los ADN códigos de barras, apoyan la identificación y el carácter distintivo de la nueva especie, ya que parece bien sustentada y aislada genéticamente.
Palabras clave: Lepidoptera, Noctuidae, nueva especie, nuevo registro, ADN código de barra, Islas Canarias, España.

Introduction

The genus *Nyctobrya* Boursin, 1957 (Noctuidae) is treated in three relatively recent papers: Behounek & Speidel (2013), Fischer & de Freina (2014) and Falck & Karsholt (2022) with description of three new species. Hitherto six species are known: *N. simonyi* (Rogenhofer, 1889), *N. canaria* (Alphéraky, 1889), *N. maderensis* (Bethune-Baker, 1891), *N. pinkeri* Behounek & Speidel, 2013, *N. hierroana* Fischer & de Freina, 2014 and *N. vilfredi* Falck & Karsholt, 2022.

Fieldwork undertaken in the Canary Island, El Hierro from the end of July until the beginning of August 2022 by the author revealed several new records of Lepidoptera. The most surprisingly record is that of an unknown *Nyctobrya*-species dealt with in the present paper.

Material and methods

Al the specimens were attracted to an 8-watt super actinic light. Genitalia were dissected and prepared following Robinson (1976). Adults were photographed with a Canon EOS 700D camera equipped with a Canon EF 100 mm objective. The genitalia slides were photographed using a Soptop CX40T Trinocular microscope in conjunction with a Toup Tek P10500A-E3 / E3ISPM05000KPA-E3 / 5.0MP USB3 camera.

DNA samples were prepared from dried legs according to the prescribed standards and processed at the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) to obtain the 658 base-pair long barcode fragment of the mitochondrial COI gene (cytochrome c oxidase I). Intra- and interspecific distances of DNA barcode fragments were calculated using analytic tools of BOLD with the Kimura 2-parameter model of nucleotide substitution. Genetic clusters are presented with their barcode index number (BIN; cf. Ratnasingham & Hebert, 2013). A neighbour-joining tree was constructed using analytic tools of BOLD with the Kimura 2-parameter model and COI-5P Cytochrome Oxidase Subunit 1-5' Region (15) as marker. Details of successfully sequenced voucher specimens are publicly available through the dataset DS-NYCTOB at www.boldsystems.org and at dx.doi.org/10.5883/DS-NYCTOB.

Abbreviations used

GP	Genitalia preparation
PF	Collection of Per Falck, Neksø, Denmark
MNCN	Collection of Antonio Vives, Museo Nacional de Ciencias Naturales, Madrid, Spain

Results

Nyctobrya ingridae Falck, sp. nov. (Figures 1-3, 3a, 5)

Holotype ♂: Spain, El Hierro, Sabinosa, 100 m, 22-VII-3-VIII-2022, leg. P. Falck (MNCN).

Paratypes: Spain, El Hierro, Sabinosa, 100 m, 2 ♀, 22-VII-3-VIII-2022, leg. P. Falck, genitalia slide 3754PF; Tacorón, 170 m, 3 ♂, 5 ♀, 22-VII-3-VIII-2022, leg. P. Falck; Frontera, 280 m, 2 ♂, 1 ♀, 22-VII-3-VIII-2022, leg. P. Falck, genitalia slide 3755PF, DNA samples Lepid Phyl 1134PF/CILEP1133-23, 1135PF/CILEP1134-23 (PF).

Description: Male. Wingspan 14-17.5 mm. Labial palp upturned, segment 2 with dark brown scale-tuft mottled with beige, segment 3 slightly shorter than segment 2, slender, dark brown mottled with beige medially and towards the tip. Antenna black, with relatively long ciliae approximately three times the length of the antenna diameter. Head and neck brownish; tegula and thorax dark brown. Forewing ground colour olive-brown; basal patch black; antemedian fascia black more or less confluent with claviform and orbicular stigmata, reniform stigmata blackish brown; antemedian fascia black; postmedian and subterminal fasciae jagged, blackish brown; at costa near apex and above tornus two irregular blackish spots; fringe brownish grey. Hindwing brownish grey, slightly paler at base; discal spot clearly recognizable; fringe brownish grey. Abdomen brown.

Female: Antenna with much shorter cilia than in the male. Ground colour dark brown. Wing pattern as in male, but less distinct.

Male genitalia (Figures 3, 3a): Uncus long and spatulate. Tegumen sub-triangular. Valva basally relatively broad, slightly narrowing distally; ventral edge apically pointed. Ampulla long and evenly curved. Juxta trapezoid, anteriorly acute. Phallus relatively short and broad, vesica with a large group of relatively small cornuti.

Female genitalia (Figure 5): Ostium membranous, narrow and rounded. Ductus bursae relatively long and broad, slightly sclerotized, transition to ostium short, constricted and membranous. Corpus bursae membranous, very long almost parallel-sided, posterior apex rounded, slightly sclerotised.

DNA barcodes (Figure 7): Two specimens were sequenced resulting in full length DNA barcodes (658 bp) for both specimens. The barcodes fall within Barcode Index Number (BIN) BOLD: AEU9813. The intraspecific distance is 0%. The minimum p-distance to nearest neighbour *N. canaria* is 3.04%, with the Barcode Index Number (BIN) BOLD: AEE9801. The result supports the status of *N. ingridae* sp. nov. as a separate species.

Diagnosis: *N. ingridae* resembles the other members of the genus. It differs by the much smaller wingspan (21-28 mm in the other species with the exception of *N. simonyi debilis* (Rebel, 1894) with a wingspan of 18.5-21mm) and the less contrasting forewing without white and orange mottling. Males differs from *N. canaria* and *N. vilfredi* by the longer ciliae of the antenna; in *N. canaria* and *N. vilfredi* the length of the ciliae are approximately as long as the diameter of the antenna. In the male genitalia *N. ingridae* differs from *N. canaria* by the lack of triangular projection distally at costa and the larger cornuti. From *N. vilfredi* it differs by the slenderer valva, the larger projection apically of the ventral edge of valva and the larger cornuti. From *N. simonyi*, *N. pinkeri*, *N. hierroana* and *N. maderensis* it differs by the lack of the large and robust cornutus. In the female genitalia it differs from all other members of the genus by the very long and narrow corpus bursae.

Biology: Early stages unknown. The specimens were attracted to light from late July to early August relatively close to the coast.

Distribution: Known only from the southern and northern part of the island of El Hierro, Spain. The species is probably endemic to El Hierro.

Etymology: The species name is dedicated to my newborn granddaughter Ingrid.

Nyctobrya canaria (Alphéraky, 1890) (Figures 4, 4a, 6)

Bryophila algae var. *canaria* Alphéraky, 1890, in Romanoff. *Mém. Lép., 5,* 224, pl. 11, fig. 5

Material examined: SPAIN, El Hierro, Frontera, 280 m, 2 ♀, 22-VII-3-VIII-2022, leg. P. Falck, genitalia slide 3772PF, 3820PF, DNA samples Lepid Phyl 1131PF/CILEP1130-22, 1235PF/CILEP1234-23; Jinama, 1250 m, 1 ♂, 22-VII-3-VIII-2022, leg. P. Falck, genitalia slide 3773PF; Cruz de Las Reyes, 1360 m, 1 ♀, 22-VII-3-VIII-2022, leg. P. Falck, genitalia slide 3775PF, DNA sample Lepid Phyl 1236PF/CILEP1235-23 (PF). First records from El Hierro.

DNA barcodes (Figure 7): Three specimens were sequenced resulting in 658 bp, full length DNA barcode fragments for two specimens and fragments of 640 bp for one specimen. The barcodes fall within Barcode Index Number (BIN) BOLD: AEU9814. The intraspecific distance is 0%. The minimum p-distance to nearest neighbour *N. canaria* (the La Gomera and Tenerife populations) is 2.88%, with the Barcode Index Number (BIN) BOLD: AEE9801.

Distribution: Hitherto known from La Palma (Behounek & Speidel, 2013), La Gomera and Tenerife.

Remarks: The adults and genitalia of both sexes are figured by Behounek & Speidel (2013, p. 161-163) and Falck & Karsholt (2022, pp. 159, 162, 164).

Although the minimum uncorrected p-distance between the populations from La Gomera, Tenerife and El Hierro is above the 2% threshold suggested as a putative guideline for species delimitation by Hebert et al. (2003), it was not possible to separate the two populations by differences neither in adult appearance nor in the morphology of the genitalia (see figures 4, 4a, 6).

For comparison a Neighbor-joining tree of DNA barcodes from all species known in the Canary Islands is provided (Figure 7).

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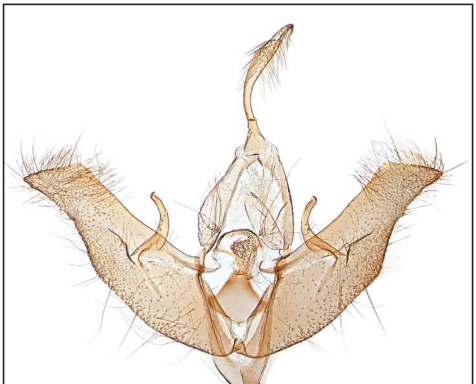
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4a

Figures 1-4a. 1. *Nyctobrya ingridae* Falck, sp. nov., ♂, El Hierro, 17.5 mm. **2.** *Nyctobrya ingridae* Falck, sp. nov., ♀, El Hierro, 15.5 mm. **3.** *Nyctobrya ingridae* Falck, sp. nov., male genitalia, GP3755PF. **3a.** Phallus, GP3755PF. **4.** *Nyctobrya canaria* (Alphéraky, 1890), male genitalia, GP3773PF. **4a.** Phallus, GP3773PF.

Figures 5-6. 5. *Nyctobrya ingridae* Falck, sp. nov., female genitalia, GP3754PF. **6.** *Nyctobrya canaria* (Alphéraky, 1890), female genitalia, GP3754PF.

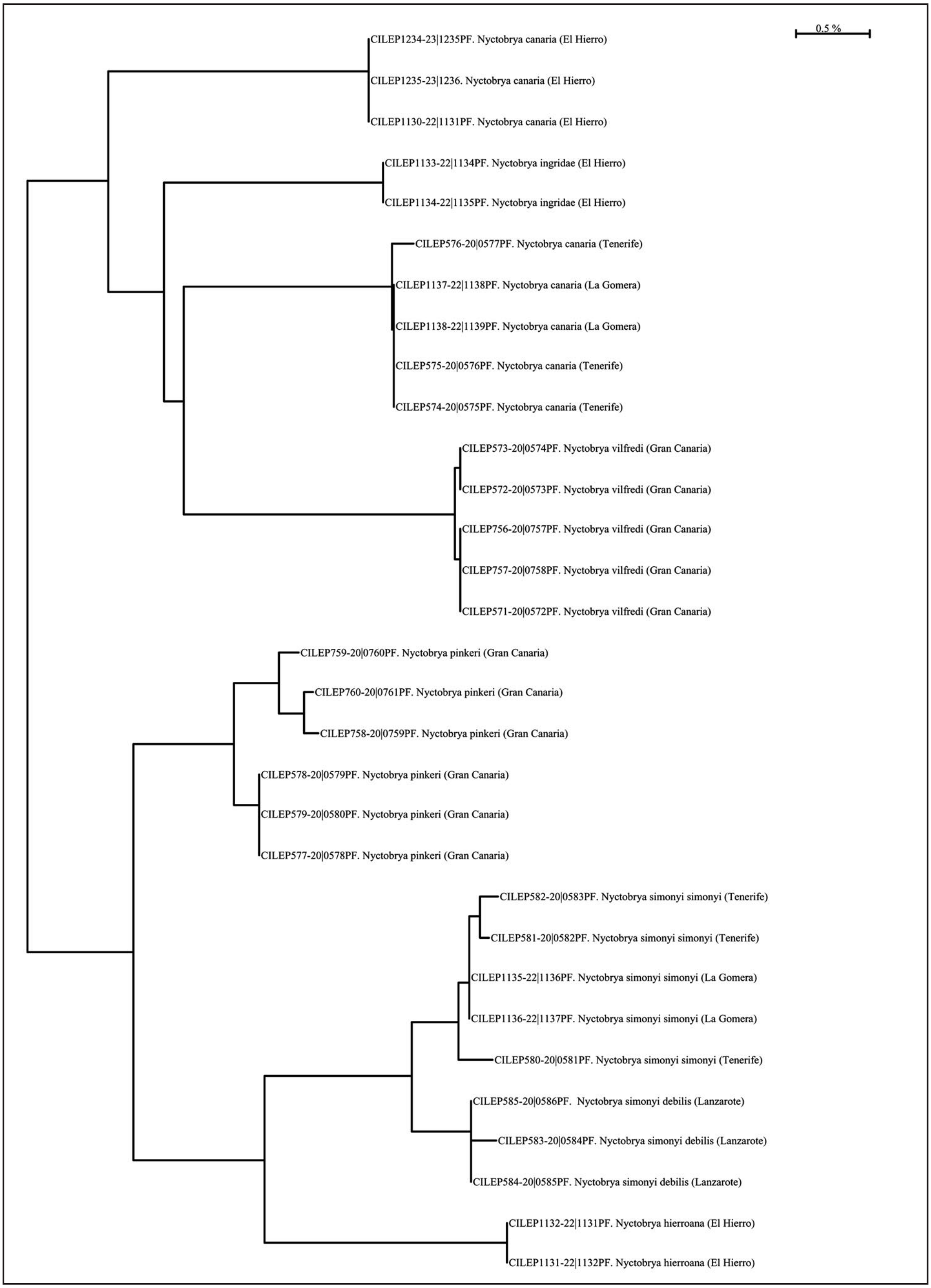

Figure 7. Neighbor-joining tree of DNA barcodes of six *Nyctobrya*-species from the Canary Islands.

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Merulempista turturella (Zeller, 1848) **new to the Maltese Islands (Lepidoptera: Pyralidae, Phycitinae)**

Jonathan Agius

Abstract

The genus *Merulempista* Roesler, 1967 and the species *Merulempista turturella* (Zeller, 1848) are reported for the first time from the Maltese Islands. Distribution and habits of the larvae and adult are included. A Maltese name is proposed for this new record.

Keywords: Lepidoptera, Pyralidae, Phycitinae, *Merulempista turturella*, new record, Malta Islands.

Merulempista turturella **(Zeller, 1848) nueva en Malta (Lepidoptera: Pyralidae, Phycitinae)**

Resumen

El género *Merulempista* Roesler, 1967 y la especie *Merulempista turturella* (Zeller, 1848) se menciona por primera vez para Malta. Se incluye la distribución y hábitat del adulto. Se propone un nombre maltés para este nuevo registro.

Palabras clave: Lepidoptera, Pyralidae, Phycitinae, *Merulempista turturella*, nuevo registro, Malta.

Introduction

Merulempista Roesler, 1967 is a small genus of fifteen described species distributed in the Palaearctic, Indomalayan and the Australasian ecozones with 10 species found within Europe (Slamka, 2019). *Merulempista turturella* (Zeller, 1848) is known from the Canary Islands, Spain, Mallorca, France, mainland Italy, Sicily, Morocco, Algeria, Tunisia, Egypt and Israel. The genus is characterized by the male gnathos distally hooked, the sclerotized costa often produced to a distal process, and the female antrum deeply concave at middle and greatly extending backward posterolaterally (Yingdang, 2011).

Material

The species has been recorded from several coastal locations across the Maltese islands. MALTA, Għadira Nature Reserve 9-IX-2021, 4-X-2021, 28-II-2022, 16-V-2022, 1-VI-2022, 10-X-2023; Simar Nature Reserve 14-IX-2021, 11-X-2021, 28-II-2022, 22-III-2022, 06-III-2023; Salina Nature Reserve 31-VIII-2022, 05-X-2022; Gozo, San Blas 26-VIII-2022.

Discussion

In the Canary Islands, the larvae of *M. turturella* (Zeller, 1848) have been observed feeding on the flower buds and the delicate flower parts of *Tamarix canariensis* Willd (Slamka, 2019). They typically inhabit saline open environments and similar biotopes where their host plants grow. Interestingly, all the specimens found in both Malta and Gozo were in such habitats. While, so far, there is no documented evidence of these larvae in Malta, it's important to highlight that *Tamarix africana* Poir, is one of the most prevalent tree species in the areas where these specimens were discovered. However, it is worth mentioning that even though they are less common, *Tamarix gallica* L. and *Tamarix parviflora* DC., can be found on the Maltese Islands. *T. gallica* L. is present in all the three nature reserves maintained by BirdLife Malta, albeit in much smaller numbers that *T. africana* Poir. Consequently, it is highly probable that *Tamarix africana* Poir, serves as the primary food source for the larvae of *M. turturella* (Zeller, 1848).

Figure 1. *Merulempista turturella* (Zeller, 1848) and its habitat - MALTA, Għadira Nature Reserve, 1 ♂, 10-X-2023, J. Agius leg.

Conclusion

The species is new to the Maltese lepidopterofauna. I propose the Maltese name "Merulempista tal-faxxi skuri", after the ante-medial vertical lines crossing the forewings.

Acknowledgments

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    Vives Moreno, A. (2014). *Catálogo sistemático y sinonímico de los Lepidoptera de la Península Ibérica, de Ceuta, de Melilla y de las Islas Azores, Baleares, Canarias, Madeira y Salvajes (Insecta: Lepidoptera)*. Improitalia.

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Bioecological and Molecular Studies of *Heliothis nubigera* Herrich-Schäffer, 1851 and *Trichoplusia ni* (Hübner, [1803]) associated with *Ferula communis* L. as a new host in AlUla, Saudi Arabia (Lepidoptera: Noctuidae)

Rayan M. Alansari & Amin A. Seleem

Abstract

Heliothis nubigera Herrich-Schäffer, 1851 and *Trichoplusia ni* (Hübner, [1803]) (Lepidoptera: Noctuidae) are serious polyphagous for economic crops searching for a host to complete their life cycle. The present study was conducted to estimate the relationship between *Heliothis nubigera* and *Trichoplusia ni* with *Ferula communis* L. in two locations, Hassat Al-dab and Almotadal, AlUla Government, Almadina Almunawarah, Saudi Arabia. Genomic DNA was isolated from *Heliothis nubigera* and *Trichoplusia ni* for molecular identification. The results indicate that *Heliothis nubigera* and *Trichoplusia ni* completes their larval stages during the growth of *Ferula communis*. Molecular identification by gene sequencing of the target fragment of COI showed 100% identical to *Heliothis nubigera* with Accession number HM875008.1 and 98.44% identical to *Trichoplusia ni* with Accession number KX862907.1 using BLAST/N. The study concludes that the target fragment of the COI mitochondrial gene is a useful method for the identification of *Heliothis nubigera* and *Trichoplusia ni*. The study recorded that *Heliothis nubigera* and *Trichoplusia ni* use *Ferula communis* as a new host plant located in Hassat Al-dab and Almotadal, AlUla Government, Saudi Arabia.

Keywords: Lepidoptera, Noctuidae, *Heliothis nubigera, Trichoplusia ni, Ferula communis,* COI mitochondrial gene, interaction insects with plants, Saudi Arabia.

Estudios bioecológicos y moleculares de *Heliothis nubigera* Herrich-Schäffer, 1851 y *Trichoplusia ni* (Hübner, [1803]) asociados a *Ferula communis* L. como nuevo hospedante en AlUla, Arabia Saudita (Lepidoptera: Noctuidae)

Resumen

Heliothis nubigera Herrich-Schäffer, 1851 y *Trichoplusia ni* (Hübner, [1803]) (Lepidoptera: Noctuidae) son graves polífagos de cultivos económicos que buscan un hospedador para completar su ciclo biológico. El presente estudio se llevó a cabo para estimar la relación entre *Heliothis nubigera* y *Trichoplusia ni* con *Ferula communis* L. en dos localidades, Hassat Al-dab y Almotadal, Gobierno de AlUla, Almadina Almunawarah, Arabia Saudí. Se aisló el ADN genómico de *Heliothis nubigera* y *Trichoplusia ni* para su identificación molecular. Los resultados indican que *Heliothis nubigera* y *Trichoplusia ni* completan sus estadios larvarios durante el crecimiento de *Ferula communis*. La identificación molecular mediante secuenciación génica del fragmento diana de la COI mostró una identidad del 100% con *Heliothis nubigera*, con el número de acceso HM875008.1, y del 98,44% con *Trichoplusia ni*, con el número de acceso KX862907.1. KX862907.1 mediante BLAST/N. El estudio concluye que el fragmento diana del gen mitocondrial COI es un método útil para la identificación de *Heliothis nubigera* y *Trichoplusia ni*. El estudio registró que *Heliothis nubigera* y *Trichoplusia ni* utilizan *Ferula communis* como nueva planta huésped localizada en Hassat Al-dab y Almotadal, Gobierno de AlUla, Arabia Saudí.

Palabras clave: Lepidoptera, Noctuidae, *Heliothis nubigera*, *Trichoplusia ni*, *Ferula communis*, gen mitocondrial COI, interacción insectos con plantas, Arabia Saudí.

Introduction

Interactions between insects and plants have been regulated with many chemical signals leading to multiple behavioral responses (Peyrovi et al. 2011). Many insects use visual cues and olfactory perception stimuli to find their target such as food resources, choice of oviposition site, and recognition of conspecifics for mating depending on the chemical senses, which may be volatile oils or aromatic compounds (Thacker, 2002). Insects search for the plant host by attractant chemicals to complete their life cycle by preferences of female oviposition and acceptance of food for larvae. Acceptance and aversive behavior of insects for the potential hosts depends on the gustatory chemoreceptors in insects that work when an insect contacts a plant with its legs that respond to various chemicals (Ozaki et al. 2011; Zhang et al. 2013).

Ferula communis L. is considered the plant host for some Lepidoptera by female oviposition preferences, larval food acceptance, and taste sensitivity (Sollai et al. 2018). *Ferula communis* has an unpleasant-smelling, aromatic smell (volatile oils) that attracts insects; it belongs to the family Apiaceae (Umbelliferae), where *Ferula* L. from Latin means “rod” (Fernch, 1971). It is commonly used as spices, in folklore medicine, in preparation of local drugs, good source of gum-resin, rich source of biologically active compounds, and local drugs (Sahebkar & Iranshahi, 2010; Mohammadhosseini et al. 2019). *Ferula communis* L. is known for its toxicity, where it causes intoxication of goats, hemorrhagic diathesis in grazing sheep, and neurological toxicity (Shlosberg & Egyed, 1983; Lahmar et al. 2018; Kharchoufa et al. 2021). Saudi Arabia contains four species of *Ferula* i.e: *Ferula sinaica* Boiss., *Ferula rutbaensis* C. C. Towns., *Ferula ovina* (Boiss) Boiss., and *Ferula communis*. *Ferula* species is native to arid regions and detected in desert areas, mountainous regions, central and south-west Asia Mediterranean area (Yaqoob & Nawchoo, 2016).

Heliothinae species are serious polyphagous vegetable pests and have high reproduction rates and contain about 400 species worldwide (Kravchenko, 1984; Mitter et al. 1993; Matov et al. 2008). A variety of common names for Heliothinae are bollworm, flower caterpillar, budworm, pod borer, and earworm (Zalucki et al. 1986; Cunningham & Zalucki, 2014). Since the 1950’s *Heliothis* Ochsenheimer, 1816 species have been considered the major pests of cotton. *Heliothis* species is considered the world’s most damaging pest Lepidoptera, where they infest and damage several important economic crops such as zygophyllum, cotton, tomatoes, chickpeas, sunflowers, tobacco *Echinops*, watermelons, and lonicera (Matthews, 1991; 1999). The common species of Heliothinae are *Helicoverpa armigera* (Hübner, [1805]), *Heliothis nubigera* Herrich-Schäffer, 1851, *Heliothis peltigera* and the rare species are *Heliothis albida* (Hampson, 1905) and *Schinia scutosa* ([Denis & Schiffermüller], 1775) (Amer & El Torkey, 2019). *Heliothis nubigera* is a polyphagous pest of significant economic importance in agriculture, it attacks many fields and vegetable crops throughout the world (Amer & El Torkey, 2019). Kravchenko et al. (2005) reported that *Heliothis nubigera* has multivoltine and probably bivoltine with summer aestivation. *Heliothis nubigera* is known as a common migratory species flying from February to November in North Africa, and Middle East. Larvae of *Heliothis nubigera* are polyphagous and prefer Solanaceae and Fabaceae families in feeding (Matov et al. 2008). The probability of the successful spread of *Heliothis nubigera* is because there are many host choices that change through space and time and depend on availability and attractiveness. *Heliothis nubigera* occupies semi-desert, desert, arid areas, tropical, and subtropical areas. Geographical records of *Heliothis nubigera* are Algeria, Afghanistan, Cape Verde, Armenia, Cyprus, Israel, Italy, Czechoslovakia, Iran, Saudi Arabia, Jordan, Kazakhstan, Lebanon, Tunisia, Morocco, Turkey, Libya, Malta, Central Asia, India, Yemen, Mauritania, Niger, Sicily, Somalia, Sudan, Oman, Syria, Tadzhikistan, Turkmenistan, and United Arab Emirates (Amer & El Torkey, 2019).

Trichoplusia ni (Hübner, [1803]), is a highly migratory pest, fly long distances, spreads in the spring and early summer, late summer, and fall (Mitchell & Chalfant, 1984; Cervantes et al. 2011; Franklin et al. 2011). This species comes from the crawling behavior of larvae and the preference for cruciferous vegetables (broccoli, cabbages, bok choy) as host plants (Capinera, 2001). It is a polyphagous pest on cruciferous plants and attacks a diverse range of crops, over 160 plants can serve as hosts of cabbage looper larvae such as cotton, weedy species, peas, ornamental plants, beets, celery, tomatoes, and lettuce (Shikano & Isman, 2009; Mpumi et al. 2020). *Trichoplusia ni* adult is a migratory moth and successfully spread in a wide range of host plants, which change through space and time and depend on availability and attractiveness (Chomchalow, 2003). *Trichoplusia ni* causes significant economic crop losses either in vegetable production greenhouses or in traditional agriculture, where it has strong resistance to bioinsecticides based on *Bacillus thuringiensis* toxins (Caron & Myers, 2008). The cabbage looper larvae are marked with irregular holes with variable shapes during feeding on the host leaves (Mpumi et al. 2020). *Trichoplusia ni* becomes difficult to manage and control due to resistance to many insecticides and broad distribution (Capinera, 2001; Fening et al. 2013). *Trichoplusia ni* could overwinter in the pupal stage or not (Cervantes et al. 2011).

There are no bioecological studies on the relation of *Heliothis nubigera* and *Trichoplusia ni* with *Ferula communis* as a new host. Thus, the present work aimed to investigate the geographical location of *Ferula communis*, *Heliothis nubigera*, and *Trichoplusia ni*. insert *Ferula communis* as a new host of *Heliothis nubigera* and *Trichoplusia ni*. In addition, use the molecular tool to identify the *Heliothis nubigera* and *Trichoplusia ni*. The current work is the first paper discuss the relation of these insects with Ferula.

Materials and Methods

Sampling procedures

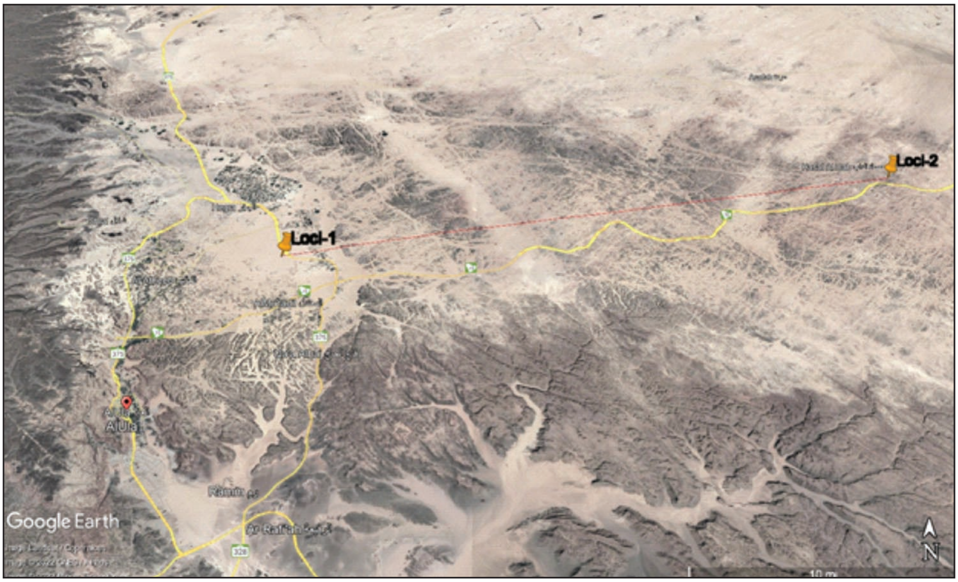

Figure 1. Photograph shows the map of the collection sites; Loci 1 (Almotadal region) faraway 17km from AlUla and Loci 2 (Hassat Al-dab) faraway 70km from AlUla. The distance between Loci 1 and 2 is 55km.

The present work was conducted to evaluate the occurrence of *Heliothis nubigera* and *Trichoplusia ni* on *Ferula communis* from two locations, Almotadal region (26º44’18.7”N

37º59’55.6”E) (17 km away from AlUla Government) and Hasat Al-dab (26º50’29.7”N 38º31’58.9”E) (70 km away from AlUla Government) (Figure 1), Almadina Al-Munawarah, Saudi Arabia. The larvae of *Heliothis nubigera* and *Trichoplusia ni* were collected from *Ferula communis* from January to May during 2019, 2020, and 2021. Some larvae were left in the field for next trip observations. The morphological identification of *Heliothis nubigera* and *Trichoplusia ni* was performed (Matov et al. 2008; Mpumi et al. 2020). The *Ferula communis* was identified by Prof. Dr. Kadry Abdelkhalik (Biology Department, Faculty of Science, Umm Al-Qura University, Saudi Arabia) and by utilizing available literature (Anzalone et al. 1991). The collected larvae were reared in the laboratory until the emergence of the adult stage to confirm the kind of studied insect. The larvae feed upon fresh leaves of *Ferula communis* and complete development until the pupa stage. The rearing beaker was provided with sand and sawdust to be suitable for the pupa stage. The laboratory specimens were developed into adult moths then, killed, pinned, and dried. Some samples were frozen at -20 for DNA extraction. The insect traps have been used in the field to catch the adult stage.

DNA extraction, PCR amplification, and gene sequencing

Genomic DNA was isolated from the legs of *Heliothis nubigera* and *Trichoplusia ni* according to the manufacturer’s protocol of the Geneaid kit (gSYNCTM DNA extraction kit quick protocol; catalog number GS100). Genomic DNA was loaded in 1% agarose gel electrophoresis in Tris-borate-EDTA to check the quality of extraction. The polymerase chain reaction (PCR) machine used in this study is a Veriti 96 well thermal cycler, s. n. 2990238536, and Applied biosystems company. Polymerase chain reaction (PCR) was performed with primers LCO(F) (5 - GGT CAA CAA ATC ATA AAG ATA TTG G - 3) and HCO(R) (5 - TAA ACT TCA GGG TGA CCA AAA AAT CA - 3) for target of a fragment of the COI mitochondrial gene of *Heliothis nubigera* (Folmer et al. 1994; Leite et al. 2014). The primers for the target of a fragment of the COI mitochondrial gene *Trichoplusia ni* are forward primer (5- TTGTGACAGCCCATGCATTT 3-) and reverse primer (5^{-} GGGGCCCCTAATATAAGAGGTACTA 3-) based on Primer-BLAST as a tool for design target-specific primers (Ye et al., 2012). Amplification reactions were done in the final volume of 25 µL according to procedures (Leite et al. 2014). All reagents used in PCR are GOTag®Green Master Mix, 2x (Ref number: M712)(Promega). The aliquots after amplification were loaded in agarose gel electrophoresis (1% w/v). Purification of amplicons was done by ethanol precipitation. DNA sequencing was done by using the same primer used in amplification by DNA sequencing equipment (3500 Genetic Analyzer, model: 622-0010, serial number: 291-23-030, company: Applied biosystems) at the Center of Excellence in Genomic Medicine Research in King Abdulaziz University, Kingdom of Saudi Arabia. The reagents kit used in the cycle sequence step is the Big Dye Terminator v3.1 cycle sequencing kit (ref number: 4336917) and 5X Sequencing buffer v1.1/3.1 (ref number: 4336697). BlastN tool was used to determine phylogenetic tree construction, sequence alignment, and available homology online at NCBI (Madden, 2002).

Results

Heliothis nubigera larvae move freely on the parts of *Ferula communis* searching for food during the period of development. Small and large larvae (1st, 2nd, 3rd instar) were observed on the leaves, flowers, follicles, and stems (Figures 2A-F). The breeding season of *Heliothis nubigera* was accompanied with the growth of *Ferula communis*, which grows in Hassat Al-dab and Almotadal in January and finishes in May depending on the rain season in this region. Small larvae were fed preferentially on leaves, while large larvae were detected in the leaves and flowers of *Ferula communis*. Larvae used plant follicles during rest, bad weather, and escaping from enemies (Figure 2D). Larvae used follicles or leaves of *Ferula communis* as housing for the dormant stage (pupae) in cocoons (field observation). Larvae feed and damage some parts of *Ferula communis* such as the stem (Figures 3A-E). The larvae of *Heliothis nubigera* are characterized by small gray caterpillars that undergo a change in mosaic colors during instars to brown, green, and orange with distinct white or yellow longitudinal lines (Figures 2-3). Excretory products of larvae were left in the follicles of *Ferula* *communis* (Figures 3B, D, E). The study records the time penetration of *Heliothis nubigera* larvae to the sand between the roots of *Ferula communis* or far away from plants (nearly 50 cm) to form pupa at 15 cm depth, where they drop to the ground leaving the feeding site and burrow into the soil and pupate (Figures 4 A-C). Also, the pupa was found enclosed in a network of white threads on the leaves or follicles of *Ferula communis* in the field (field observations). The adult stage was collected from the bottom of the *Ferula communis* during daytime hidden between *Ferula communis* leaves.

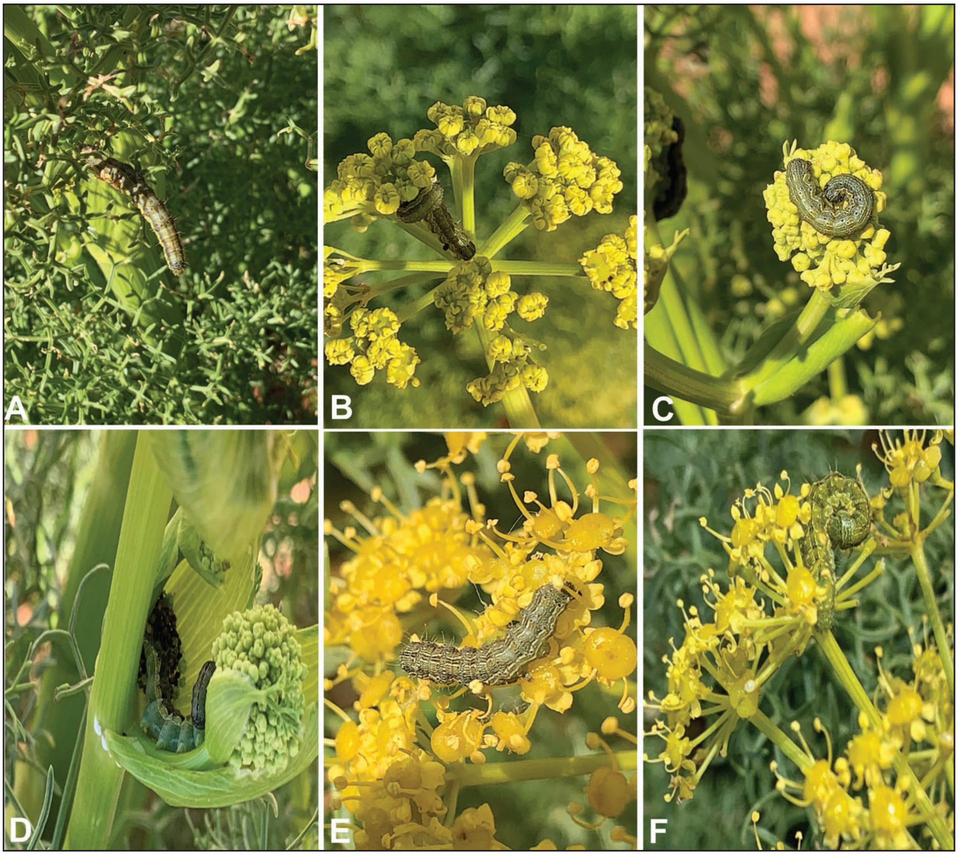

Figure 2. Photographs show *Heliothis nubigera* larvae on the *Ferula communis,* on leaves (**A**), flowers before opening (**B-C**), the follicle (**D**) and during the flowering season (**E-F**).

In the laboratory, the larvae of *Heliothis nubigera* were reared in the lab and fed with fresh leaves of *Ferula communis*. The pupa appears in green color and then develops into a reddish-brown color, where the length is approximately 20 mm. The mature larvae use available sand mixed with sawdust to form a cocoon to complete the pupa stage or sometimes use a covered net for the pupation stage (lab observation). The duration time of pupation is about 18 days to develop into an adult in the lab. The pupa contains a cremaster spine shape. The distance between genital and anal opening slots in the pupa uses as a marker to distinguish between male and female. It is small in male pupa and large in female pupa (Figures 4 C-D). The adult stage of *Heliothis nubigera* has forewings mosaic greyish ochreous flushed with pale brown, pale reniform stigma dark grey, and a narrow margin containing separated dark spots. The hind wings are creamy white in the anterior part and blackish in the posterior part. The female contains two white rings on the hind wing that were not detected in the adult male (Figures 5A, B).

Figure 3. Photographs show the damage effect of *Heliothis nubigera* larvae on the *Ferula communis*, stems (**A-B**), flowers (**C**), and follicles (**D, E**). The white arrow indicates the damage by *Heliothis nubigera* larvae.

PCR AMPLIFICATION AND GENE SEQUENCING OF *HELIOTHIS NUBIGERA*

The obtained sequenced regions (one direction for forward primer and one direction for reverse primer) of the target fragment of the COI mitochondrial gene were deposited in BLAST/N programs. The results of query 10727 using BLAST/N program for cytochrome oxidase (COI) gene revealed 100% of percent identical with *Heliothis nubigera* (Accession no.HM875008.1), 94.71% of percent identical with *Heliothis peltigera* (Accession no. KX862103.1), 94.52% of percent identical with *Heliothis punctifera* (Accession no. HQ951195.1), 94.32 % of percent identical with *Heliothis terracottoides* Rothschild, 1921 (Accession no. EU768926.1), 94.13% of percent identical with *Heliothis ononis* ([Denis & Schiffermüller], 1775) (Accession no. JF851824.1), 93.93% of percent identical with *Heliothis belladonna* (Edwards, 1881) (Accession no. GU702691.1), 93.74% of percent identical with *Heliothis maritima* Graslin, 1855 (Accession no. MF054419.1), and 93.74% of percent identical with *Heliothis adaucta* Butler, 1878 (Accession no. KT988655.1). The current results confirm the molecular identification of *Heliothis nubigera* for the current studied samples (Figure 6).

Figure 4. Photographs show mature larvae of *Heliothis nubigera* (white circle) drop to the ground, where they burrow into the soil and pupate between the roots of *Ferula communis* (**A-B**) or faraway from roots (**C**). The pupa stage of *Heliothis nubigera* in the lab contains cremaster spines (**D-E**). The distance between genital and anal opening is small in male pupa (**D**). The black arrow indicates the genital opening, and the white arrow indicates the anal opening (**E**).

Figure 5. Photographs show the adult stage of *Heliothis nubigera* rearing in the lab (**A-B**). The female contains two white rings on the hind wing (white arrows, **B**), which was not detected in the adult male (**A**).

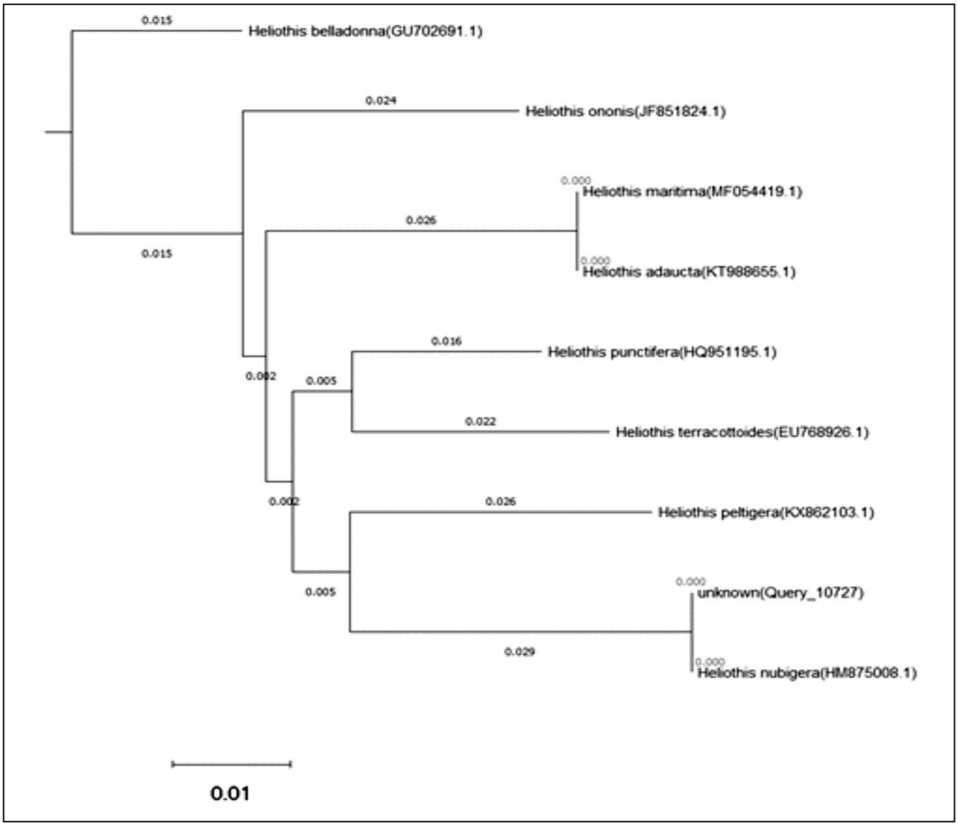

Figure 6. Phylogenetic tree using the BLAST/N of query 10727, which showed similarity with *Heliothis nubigera* and its related species with outgroups from the GenBank/NCBI based on (COI) sequences.

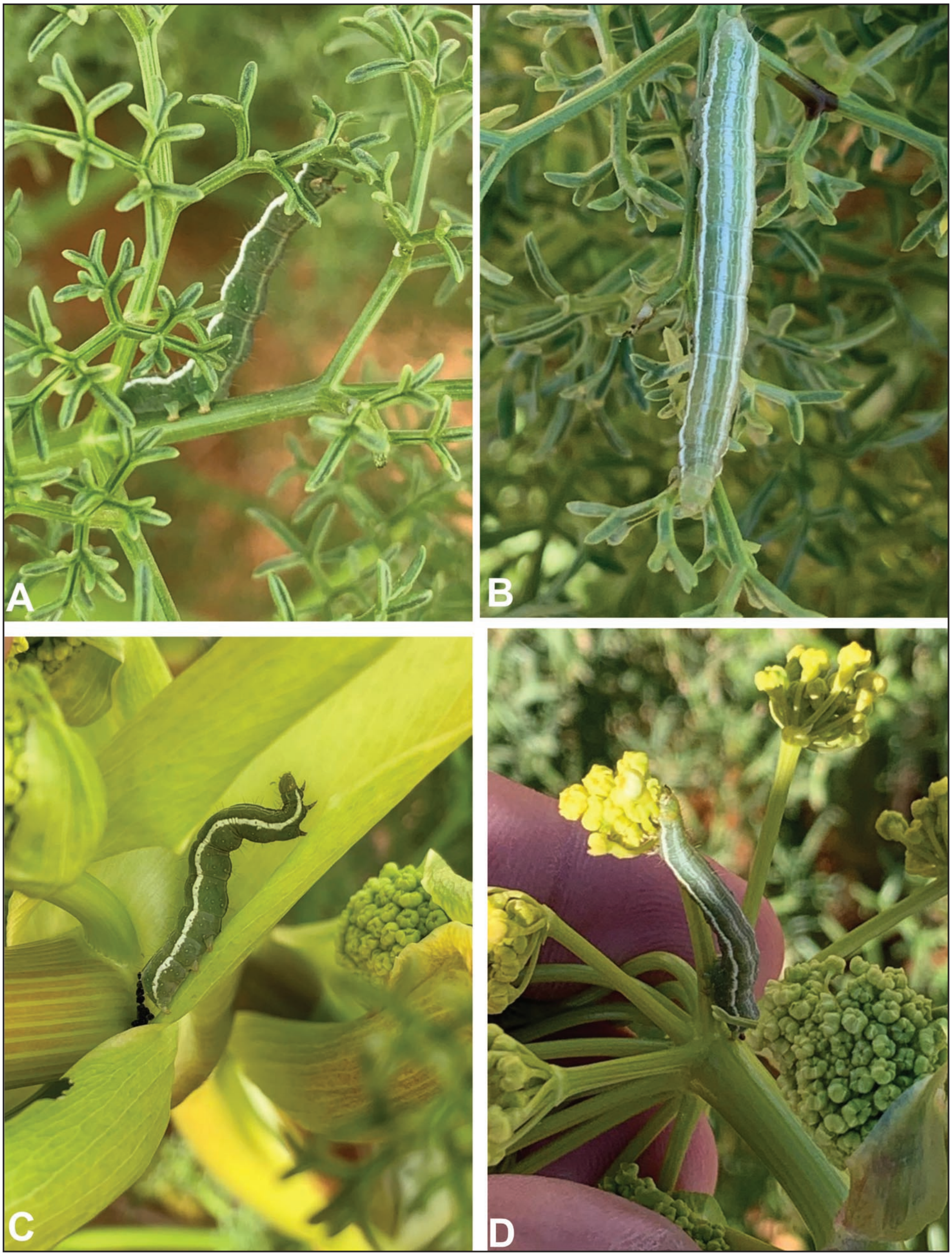

Figure 7. Photographs show *Trichoplusia ni* larvae on the *Ferula communis*, on the leaves (A-B), in the follicles (**C**), and on the flowers (**D**).

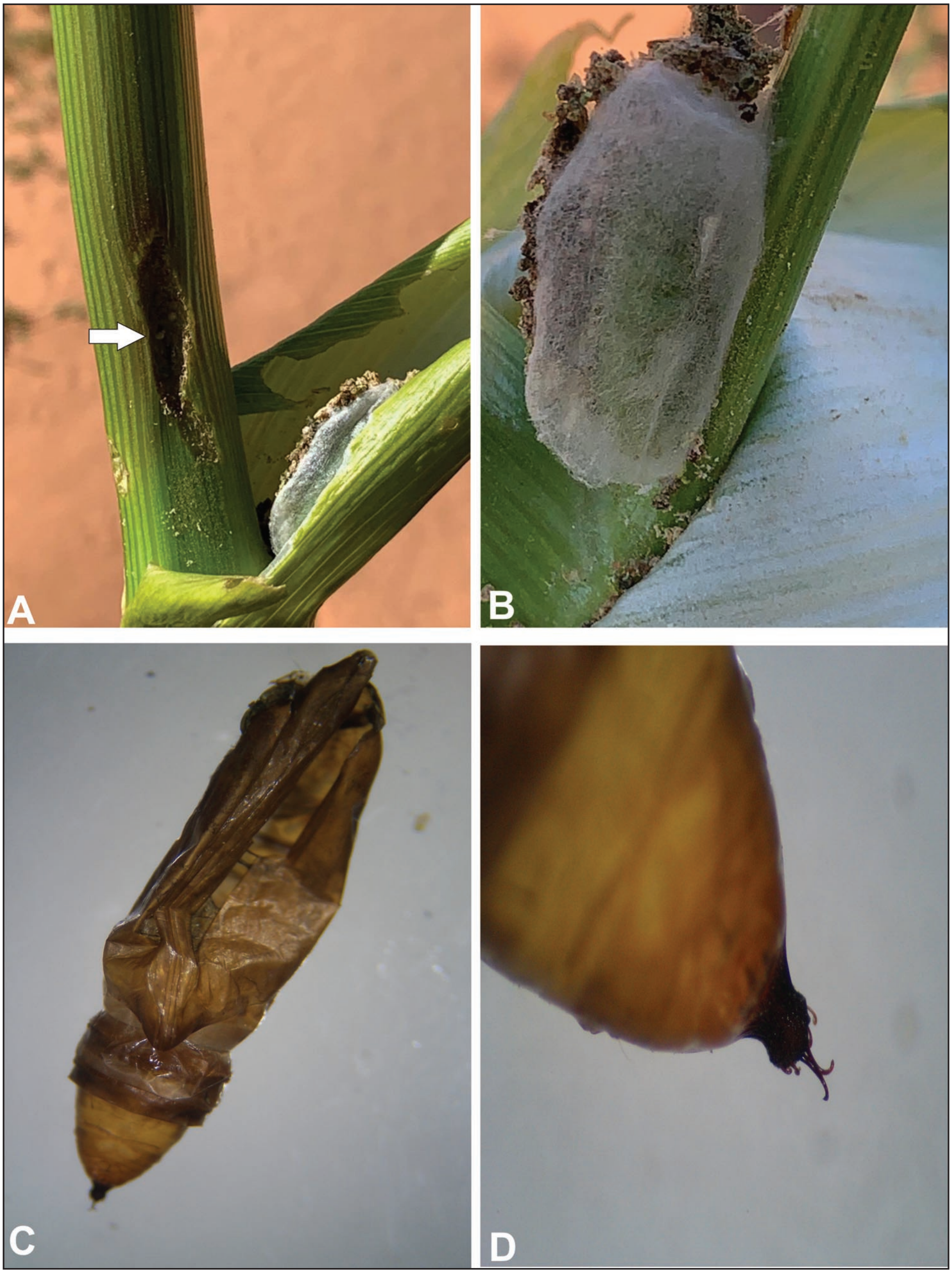

Figure 8. Photographs show the pupa stage in the follicle of *Ferula communis* (**A-B**). The pupa stage has two large curved spines and small spines at the end (**C-D**). The white arrow indicates the damage by *Trichoplusia ni* larvae before pupation.

Figure 9. Photographs show the adult stages of *Trichoplusia ni* in the lab (**A-B**). The male is characterized by long dense hairs on the abdomen (**C**, black arrow), while the female contains little hairs (**D**, white arrow).

Trichoplusia ni larvae, pupa, and adult on *Ferula communis*: The breeding season of *Trichoplusia ni* was associated with the growth of *Ferula communis*, which depends on the rainy season in the studied locations (Hassat Al-dab and Almotadal) from January to May 2019, 2020, and 2021. *Trichoplusia ni* larvae occur on the different parts of *Ferula communis*; on leaves; in follicles, and on flowers (Figures 7A-D). *Trichoplusia ni* larva has 3º prolegs, therefore it is a looper and it arches its back into a loop when it crawls. *Trichoplusia ni* larva has four distinct white longitudinal lines on the body. The young larvae were fed on the leaves of small *Ferula communis*, whereas growing and elder larvae chew larger holes in the stems. The pupa stage was found enclosed in a network of white threads on the leaves or in the follicle of *Ferula communis* (Figures 8A, B). *Trichoplusia ni* larvae used *Ferula communis* follicles during rest, bad weather, escaping from enemies, and as a housing for the dormant stage (pupae) in cocoons (Figures 8A, B). The damage-feeding effect of *Trichoplusia ni* larvae on the *Ferula communis* before pupation was noted (Figures 8A, B). Excretory products of *Trichoplusia ni* larvae were left in the follicles and used for pupation in follicles (Figures 8A, B). The larvae sometimes form a network of white threads (a cocoon) on a covered net or drop into a mixture of sand and sawdust and burrow for the pupation stage (lab observation). *Trichoplusia ni* larvae (3rd instar) take around three weeks in the laboratory to develop into a pupa (20 mm), which appears initially green in color and then turns dark brown or reddish brown. The pupa end has two large, curved spines and small spines at the end (Figures 8C, D). *Trichoplusia ni* adult moths are mottled in the lab after pupation time (around 23 days) either in the sand or in the covered net. The forewing of the adult moth is unique and distinguishes *Trichoplusia ni* from most other Noctuidae. The forewing has silvery white spots, which take U or Y and are often connected with a circle or dot (Figures 9 A, B). The hind wings are blackish in the posterior part and light brown in the anterior portions. The forewing of males is shaded with gray and brown, and the forewings of females are uniformly grayish brown (Figures 9A, B). Long dense hairs occur on the abdomen of the male, while small little hairs on the female abdomen (Figures 9 C, D).

PCR AMPLIFICATION AND GENE SEQUENCING OF *TRICHOPLUSIA NI*

The obtained sequenced regions of the target fragment of the COI mitochondrial gene after DNA sequencing by one direction for reverse primer were deposited in BLAST/N programs. The results of the cytochrome oxidase subunit I (COI) gene in BLAST/N of query 35127 showed similarly 98.44% with *Trichoplusia ni* (Accession no. KX862907.1). *Caenides lota* (Evans, 1937) (Accession no. KY019786.1) showed similarly 96.88% with query 35127. *Hyperaeschrella nigribasis* (Hampson, [1893]) (Accession no. MN131551.1) showed similarly 96.88% with query 35127. The current results confirm the molecular identification of *Trichoplusia ni* for the current studied samples (Figure 10).

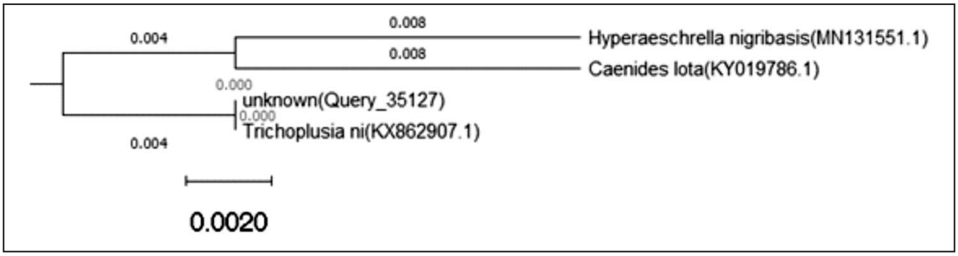

Figure 10. Phylogenetic tree using the BLAST/N of query 35127, which showed similarity with *Trichoplusia ni* and its related species with outgroups from the GenBank/ NCBI based on (COI) sequences.

Discussion

There is no information on the relation between *Heliothis nubigera* and *Trichoplusia ni* associated with *Ferula communis*, which are important for understanding and aiding in predicting the ability of these species to successfully live in different locations, different host plants, and understanding the biology of the pest complex in the target crop. The present study reported the occurrence of small larvae on the small plant leaves that means the chemicals compounds in leaves attract the female for oviposition. Many signals such as chemical, visual cues, and olfactory perception stimuli are involved in the interactions between insects and plants, which lead to various behavioral responses to find their target such as food resources, attractant, antifeedent, recognition for mating, repellent, and deterrent (Nordlund, 1981; Peyrovi et al. 2011). Insects select a specific oviposition site on plant might be due to the type of surface texture, plant morphology, prior experience from larval feeding memory, chemoreceptors on the ovipositor, nectar production, nutrients of plant quality, plant chemical attractiveness, and suitability for offspring development (Cullen, 1969; Adjei-Maafo & Wilson, 1983; Hassan, 1985; Mabbett & Nachapong 1983; Zalucki et al. 1986; Shikano & Isman, 2009). Behavioral adaptations are the first barrier in the insect-plant relationship, where the insect discriminates and senses before nutritional and toxic factors become operative (Dethier, 1973). Some authors support the relationship between oviposition preferences and larval performance (Gripenberg et al. 2010; Sollai et al. 2018).

Insects have a gustatory neuron system that is sensory organs and has an important role in host plant acceptance, host selection, food recognition, and final oviposition choice, where it is located in the lateral and medial styloconic sensilla of larvae and in foretarsi and mouthparts of adults (Sollai et al. 2017a, b, c; Sollai et al. 2018). Abundant evidence suggests that insects searching on the plant host depend on the detection of unique combinations in the host chemicals and the presence of shared attractant chemicals; the oviposition and larval preadaptation occur on plants that are chemically similar to hosts (Berenbaum, 1990). Attractant chemicals in plants (volatile oils or aromatic compounds) and gustatory chemoreceptors in insects are the most considered signals for the insects to female oviposition preferences, food acceptance for larvae, and complete their life cycle (Dethier, 1973; Ozaki et al. 2011; Zhang et al. 2013). Electrophysiological studies established that larvae recognize and respond to complex mixtures of chemicals rather than to a specific host-recognition signal (Dethier, 1970; Berenbaum, 1990). Field bioassay and electroantennogram tests showed the role of green leaf volatile compounds through long-distance olfaction in contact chemoreception (Guerin & Visser, 1980; Guerin & Stadler, 1984). Host recognition received an amount of attention because the oviposition stimulant mechanism for adult females was identified (Stadler & Buser, 1984; Feeny et al. 1988).

The interactions between umbelliferous plants and insects have received considerable attention in insect-plant associations depending on the umbellifer chemistry. Previous reports documented that some orders of insects are represented in association exclusively or almost exclusively with the Umbelliferae species; i.e., lepidopterous larvae are the most conspicuous of umbel-lifer specialists (Berenbaum, 1990). All members of the Umbelliferae family contain essential oils that are primarily terpenoids and phenylpropanoids, flavonoids, and resins in schizogenous canals in all parts of the plant that attract the adult stage for oviposition (Hegnauer, 1971; Berenbaum, 1990). The presence of shared attractant chemicals in *Ferula* species and a progression of chemosensory responses are responsible for the attraction of insects to specific plants (Berenbaum, 1990). In contrast, the umbellifer chemicals are toxic to nonspecialist insect species. Generalist insects that feed regularly on umbellifers plants might depend on avoidance mechanisms that probability serve as preadaptations to deal with toxins and metabolic adaptation, which means metabolizing toxic material in the plant to non-toxic substances (Camm et al. 1976; Berenbaum, 1990). The principal toxicants in the umbellifer family are the furanocoumarins, and p coumaric acid derivatives, which are activated by ultraviolet light (Berenbaum, 1983). Umbellifer compounds include phenylpropanoids, terpenes, furanocoumarins, coumarins, and flavonoids that have been shown toxic to generalist herbivores (Berenbaum, 1990). Some umbellifer insects have metabolic adaptation, which means the ability to tolerate or metabolize some toxic material in the plant without suffering ill effects such as furanocoumarins (Camm et al. 1976). The furan ring double bond is oxidized through an epoxide intermediate to produce two dicarboxylic acid derivatives that are nonphototoxic metabolites (Ivie et al. 1983; Bull et al. 1986). Other insects metabolize the furanocoumarin xanthotoxin by cytochrome P450 mechanism (Ivie et al. 1983; Bull et al. 1986). *Trichoplusia ni* shows tolerance of aflatoxin B1, which increases throughout the development (Zeng et al. 2013; Berenbaum et al. 2021). Recent work records the death of some insects on the flowers of *Ferula communis* L. (Alansari, et al., 2024).

Heliothis nubigera and *Trichoplusia ni* search for a suitable plant host far away from attack or pesticide spray, where Hasat Al-dab and Almotadal regions are considered open fields or wild-type fields. Small larvae feed preferentially on leaves, while large larvae feed preferentially on leaves and flowers of *Ferula communis,* which may suggest developmental differences in feeding site preferences. *Heliothis* species oviposition on its host plants was noted before peak flowering and nectar production**,** on pre-flowering soybeans, cotton, tobacco, the leaf-whorls of seedling sorghum, leaves of sunflowers at any stage, tomatoes and lucerne at any stage, and pre-tassled maize (Zalucki et al. 1986; Cunningham & Zalucki, 2014). Oviposition by *Heliothis* sp. includes many cues such as nectar production, plant morphology, chemical attractiveness, nutrients of plant quality, and individual females which vary in their responses to these cues (Adjei-Maafo, 1980; Adjei-Maafo & Wilson, 1983; Mabbett & Nachapong, 1983). *Heliothis* spp. choose only the plants that will support the development of their larvae to pupation or adulthood (Manjunath et al. 1989). Heliothines may use similar cues to identify their hosts, where they prefer Asteraceae, Fabaceae, Malvaceae, Solanaceae, Poaceae, and Rosaceae families as host plants (Cunningham & Zalucki, 2014). The study concludes that gene sequencing of the target fragment of the COI mitochondrial gene is a useful method for *Heliothis nubigera* and *Trichoplusia ni* identification. Also, the study recorded the occurrence of *Ferula communis* in two locations, Hassat al-dab and Almotadal, AlUla Government, KSA. In addition, insert *Ferula communis* as a new host for *Heliothis nubigera* and *Trichoplusia ni*.

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COMITÉ PARA LA PROTECCIÓN DE LA NATURALEZA, PROYECTO DE INVESTIGACIÓN CIENTÍFICA DE SHILAP / *COMMITTEE FOR THE PROTECTION OF NATURE, SHILAP SCIENTIFIC RESEARCH PROJECT*

Solicitud de autorización para recoger Lepidoptera con fines científicos en España

Las solicitudes cumplirán las siguientes condiciones:

1.– Estar al día en el pago de la cuota anual de la Sociedad, antes de solicitar los permisos.

2.– Enviar un correo electrónico al Secretario General de SHILAP con todos los datos personales, incluyendo nombre, apellidos, dirección, DNI o número de pasaporte, número de teléfono (con código del país y prefijo) y correo electrónico. Estos datos serán enviados al Secretario General con un mínimo de 45 días de antelación al período de captura previsto.

3.– Se detallará el área donde se desea capturar el material (provincia y/o región), el período de tiempo (días, meses o todo el año); método de captura que se desea emplear (manga entomológica, grupo electrógeno, etc.), material que se desea recoger (especies, géneros, familias, y/o superfamilias) y cualquier otro dato que se desee añadir.

4.– Todos los socios de SHILAP que soliciten estos permisos para recoger Lepidoptera en España con fines científicos, serán incluidos en el Proyecto de Investigación Científica creado por la Sociedad y denominado: *“Faúnula Lepidopterológica Ibérica, Baleárica y región Macaronésica”*.

5.– Con el fin de contribuir con este Proyecto Científico, se ruega remitan a SHILAP, **o una copia por correo electrónico (e-mail), con el listado del material recogido en EXCEL,** sólo en este formato, indicando la Familia, Subfamilia, Tribu, nombre de la especie (género, especie, autor y año), localidad, coordenadas UTM (1 X 1) o GPS, provincia, fecha de captura, colector y número de machos y hembras capturados (**sólo 5 ejemplares por taxón y localidad, máximo**). Por favor, utilice sólo el *“Catálogo sistemático y sinonímico de los Lepidoptera de la Península Ibérica, de Ceuta, de Melilla y de las islas Azores, Baleares, Canarias, Madeira y Salvajes (Insecta: Lepidoptera)*” (A. VIVES MORENO, 2014)”. Esta lista es necesaria para este Proyecto Científico de SHILAP y para nuevas autorizaciones.

6.– Es obligatorio publicar en *SHILAP Revista de lepidopterología,* las nuevas especies o subespecies que se descubran y remitir a SHILAP **una parte del material TIPO**, para su posterior incorporación a la colección de Lepidoptera del Museo Nacional de Ciencias Naturales en Madrid, España.

7.– Se recuerda a todos los socios de la obligación de estar autorizados para recoger Lepidoptera, con fines científicos, en España y que está prohibida todo tipo de actividad comercial, con el material capturado.

8.– Conocer los fines científicos de SHILAP y comprometerse a pagar los gastos de participación en este Proyecto Científico, que la Junta Directiva considere en cada momento.

Application for permits to collect Lepidoptera in Spain for scientific purposes

Applications must abide by the following conditions:

1.– The Society’s annual fee must be paid before applying for the permits.

2.– To send an electronic mail the General Secretary of SHILAP, with all the personal data, including name, surname, address, ID card number or Passport number, telephone number (with country code and prefix) and electronic mail address. These data must reach the General Secretary at least 45 days in advance of the foreseen collecting activity.

3.– The collecting area to be visited by the applicant should also be detailed (province and/or region), expected dates (days, months, or the whole year), collecting method (entomological net, generator, etc.), taxonomical groups of interest to be collected (species, genera, families and/or superfamilies); any other data the applicant wishes to add.

4.– All members of SHILAP who apply for these permits to collect Lepidoptera in Spain with scientific purposes, will be included in the Scientific Research Project created by the Society and called: *“Lepidopterological Fauna of the Iberian Peninsula, Balearic Islands and Macaronesian region”*.

5.– In order to contribute to this Scientific Project, it is requested to send to SHILAP, **either a copy by electronic mail (e-mail), with the listing of materials collected in EXCEL** (- only in this format, please), indicating the Family, Subfamily, Tribe, name of the species (genera, species, author’s name and year), town, UTM (1 X 1) or GPS coordinates, province, dates of capture, collector and numbers of males and females captured (**only 5 specimens per taxon and locality, maximum**). Please, use only the *“Catálogo sistemático y sinonímico de los Lepidoptera de la Península Ibérica, de Ceuta, de Melilla y de las islas Azores, Baleares, Canarias, Madeira y Salvajes (Insecta: Lepidoptera)* (A. VIVES MORENO, 2014)”. This list is necessary for this Scientific Project of SHILAP and for new authorizations.

6.– It’s obligatory to publish in *SHILAP Revista de lepidopterología*, the new species or subspecies that are discovered and to remit to SHILAP **a part of the TYPE material**, for later incorporation into the Lepidoptera Collection of the National Museum Natural Sciences, Madrid, Spain.

7.– All members are kindly reminded of the obligation to be duly authorized for collecting Lepidoptera, with scientific purposes, in Spain and that it is forbidden all type of commercial activity, with the captured material.

8.– To know about the scientific aims of SHILAP and to commit to pay the expenses of participation in this Scientific Project, that the Board of Directors considers at any given moment.

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Contribution to the knowledge of *Stygioides italica* Mazzei & Yakovlev, 2016 (Lepidoptera: Cossidae)

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Abstract

With this new report of *Stygioides italica* Mazzei & Yakovlev, 2016 for southern Italy (Calabria: Monte Pollino), we take the opportunity to survey some populations from central and southern Italy from a molecular-genetic point of view and to highlight some morphoanatomical characters that may facilitate the distinction between the recent *S. italica* Mazzei & Yakovlev and *Stygioides colchica* (Herrich-Schäffer, 1851).
Keywords: Lepidoptera, Cossidae, *Stygioides italica*, *Stygioides colchica*, Italy.

Contribución al conocimiento de *Stygioides italica* Mazzei & Yakovlev, 2016 (Lepidoptera: Cossidae)

Resumen

Con este nuevo informe de *Stygioides italica* Mazzei & Yakovlev, 2016 para el sur de Italia (Calabria: Monte Pollino), aprovechamos la oportunidad para sondear algunas poblaciones del centro y sur de Italia desde un punto de vista genético-molecular y destacar algunos caracteres morfoanatómicos que pueden facilitar la distinción entre los recientes *S. italica* Mazzei & Yakovlev y *Stygioides colchica* (Herrich-Schäffer, 1851).
Palabras clave: Lepidoptera, Cossidae, *Stygioides italica*, *Stygioides colchica*, Italia.

Contributo alla conoscenza di *Stygioides italica* Mazzei & Yakovlev, 2016 (Lepidoptera: Cossidae)

Riassunto

Con questa nuova segnalazione di *Stygioides italica* Mazzei & Yakovlev, 2016 per il sud Italia (Calabria: Monte Pollino), si coglie l'occasione per sondare sotto l'aspetto genetico-molecolare alcune popolazioni dell'Italia centrale e meridionale ed evidenziare alcuni caratteri morfo anatomici che possono agevolare la distinzione fra la recente *S. italica* Mazzei & Yakovlev e *Stygioides colchica* (Herrich-Schäffer, 1851).
Parole chiave: Lepidoptera, Cossidae, *Stygioides italica*, *Stygioides colchica*, Italia.

Introduction

The recent description of *Stygioides italica* Mazzei & Yakovlev, 2016 (Lepidoptera: Cossidae) asked for a revision of the scarce records available for Italy concerning *Stygioides colchica* (Herrich-Schäffer, 1851) (= *tricolor* auct. nec Lederer, 1858) (Pinzari & Pinzari, 2020).

First Italian records are very old (Curò, 1890; Ragusa, 1893), followed by other data some of which very recent (Turati, 1919; Dannehl, 1927a,b,c,d; Daniel, 1954-55; de Freina & Witt, 1990; Bertaccini et al. 1997; Parenzan & Porcelli, 2006; Grassi et al. 2007; Cabella & Fiori, 2010; Pinzari & Pinzari, 2023).

The careful examination of a male collected on the 1st of July 2002 in the Abruzzo region, around Campo Felice, L'Aquila, at 1300 m a.s.l., and initially identified as *Stygioides colchica* (Grassi et al. 2007), led to the description of a new species, *Stygioides italica* Mazzei & Yakovlev, 2016. As consequence, all previous Italian records of *Stygioides colchica* need to be revised to ascertain whether both species are present in Italy or not. Our research, supported by molecular analyses, indicate the presence of one species only (*Stygioides italica*). However, further investigation is needed to investigate the presence in Sicily on the Madonie Mountains (Ragusa, 1893) due to data uncertainty and isolation of island populations.

Italian distribution of *Stygioides italica* Mazzei & Yakovlev, 2016 (nec *Stygioides colchica* Herrich-Schäffer, 1851 = *tricolor* auct. nec Lederer, 1858) was largely documented in Mazzei & Yakovlev (2016), Pinzari & Pinzari (2020), here updated by one record in Apulia (Rolli, 2023), several specimens from Latium (Pinzari & Pinzari, 2023), and one more original record.

Materials and methods

The field collecting was carried out on the South slope of the Mount Pollino, on a dry rocky prairie (Figures 1-2). Snow melting was incomplete and spring flowering just started. During collecting day there were sunny sky, no wind, and warm temperatures (16-18ºC).

The legs of four *Stygioides italica* specimens, 1 ♀, Monte Pollino, Calabria, Italy, 2050 m, 08-VI-2022, sample ID: BC_ZSM_Lep_116421, leg. Bertaccini, coll. Bertaccini; 1 ♀, Vallemare, Lazio, Italy, 1455 m, 2-VI-2022, sample ID: BC_ZSM_Lep_116423, leg. M. Pinzari, coll. Pinzari; 1 ♀, Aranova, Fiumicino, Lazio, Italy, 50 m, 3-VI-2020, sample ID: BC_ZSM_Lep_116422, leg. Mn. & M. Pinzari, coll. Pinzari; 1 ♂, Vallemare, Lazio, Italy, 1455 m, 2-VI-2022, sample ID: BC_ZSM_Lep_117095, leg. M. Pinzari, coll. Bertaccini) were submitted to molecular barcoding analysis to explore intra-specific genetic diversity. The standard protocol of the Canadian Centre for DNA Barcoding (CCDB) was used for sequencing the barcode fragment (658bp) of the mitochondrial cytochrome oxidase gene, subunit 1 (COI 5'), which is accepted as a standard marker for the identification of most animals. LepF1 and LepR1 were the primers used for PCR and sequencing (Hajibabaei et al. 2006). Sequences are deposited in the Barcode of Life DataSystems (BOLD), accessible at www.boldsystems.org in the public dataset DS-STYGIOID (doi: https://dx.doi.org/10.5883/DS-STYGIOID).

Comparisons of male genitalia of *S. italica* with its nearest taxa were carried out by using images available in de Freina & Witt (1990) for *S. colchica* and in Saldaitis et al. (2007) for *Stygioides colchica dercetis* (Grum-Grshimailo, 1899).

Results and Discussions

Original record: Mount Pollino, Cosenza, Italy, 2050 m a.s.l., 1 ♀, 8-VI-2022.

The female was found on the South slope of the Mount Pollino, on a dry rocky prairie (Figures 1-2). We observed very scarce butterflies and small geometrids such as several *Cleta filacearia* (Herrich-Schäffer, [1847]) and rare *Lythria cruentaria* (Hufnagel, 1767). At 13:30 a specimen supposedly belonging to the Psychidae family was observed flying frenetically on the ground, jumping from one flower to the next. Its correct identification as a specimen of *Stygioides*, very rare in Italy, was early recognized and here specifically identified as *Stygioides italica* Mazzei & Yakovlev, 2016.

To the best of our knowledge, this is the record at the highest altitude for this species. Previously a female was found on the Montalto, Aspromonte Mountains, at 1700 metres above the sea level (Bertaccini et al. 1997).

Stygioides italica was found in very different habitats despite the paucity of records, being collected from lowland to more than 2000 metres of altitude. Larval foodplants are unknown, but we can suppose it feeds on some Boraginaceae such as *Echium* and *Cynoglossum* like the congeneric *Stygioides colchica* (Korb, 1910).

Stygioides italica seems to be an Italian endemic, whilst *Stygioides colchica* is known from Greece (Peloponnese peninsula), SW Russia, Ukraine (Crimea, Zaporozhskaya Reg.) Turkey, Lebanon, Syria, Israel, Armenia, and Iran (Alipanah et al. 2021).

DNA barcoding analyses recovered a full sequence of 658bp for the Pollino and one of the Vallemare specimens and a shorter sequence of 627bp for the second specimen from Vallemare and of 345bp for the Aranova specimen as follows:

Sample ID: BC_ZSM_Lep_116421; sequence ID: GWOUK940-22; Pollino (658bp)
AACATTATATTTTATTTTTGGTATTTGATCTGGATTAGTAGGAACTTCTCTTAGTCTTTT
AATTCGAGCTGAATTAGGTAATCCTGGATCTTTAATTGGTAATGATCAAATTTATAATA
CTATTGTTACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCTATTATAATTGG
AGGTTTTGGTAATTGATTAGTACCATTAATGTTAGGAGCCCCTGATATAGCTTTCCCAC
GAATAAATAATATAAGTTTTTGATTACTCCCCCCCTCTTTAACCCTTTTAATTTCTAGAA
GAATCGTTGAAAATGGTGCTGGAACAGGATGAACAGTTTATCCACCTTTATCTTCTAAT
ATCGCCCATAGAGGAAGTTCAGTTGATTTAGCTATTTTTTCCCTTCATTTAGCTGGTATT
TCCTCAATTTTAGGAGCTATTAATTTTATTACCACTATTATTAATATACGACCCTATAAT
ATATCATTTGACCAAATACCTCTTTTTGTCTGAGCAGTTGGCATCACCGCTTTATTATTA
CTTCTTTCTCTTCCTGTATTAGCAGGAGCTATTACTATATTATTAACTGATCGAAATTTA
AATACTTCATTTTTTGACCCAGCAGGAGGTGGAGATCCAATTTTATATCAACATTTATTT

Sample ID: BC_ZSM_Lep_116423; sequence ID: GWOUK942-22; Vallemare (658bp)
AACATTATATTTTATTTTTGGAATTTGATCTGGATTAGTAGGAACTTCTCTTAGTCTTTT
AATTCGAGCTGAATTAGGTAATCCTGGATCTTTAATTGGTAATGATCAAATTTATAATA
CTATTGTTACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCTATTATAATTGG
AGGCTTTGGTAATTGATTAGTACCATTAATATTAGGAGCCCCTGATATAGCTTTCCCAC
GAATAAATAATATAAGTTTTTGATTACTCCCCCCCTCTTTAACCCTTTTAATTTCTAGAA
GAATCGTTGAAAATGGTGCTGGAACAGGATGAACAGTTTATCCACCCTTATCTTCTAAT
ATCGCCCATAGAGGAAGTTCAGTTGACTTAGCTATTTTTTCCCTTCATTTAGCTGGTATT
TCCTCAATTTTAGGAGCTATTAATTTTATTACCACTATTATTAATATACGACCCTATAAT
ATATCATTTGACCAAATACCTCTTTTTGTCTGAGCAGTTGGCATTACCGCTTTATTATTA
CTTCTTTCTCTTCCTGTATTAGCAGGAGCTATTACTATATTATTAACTGATCGAAATTTA
AATACTTCATTTTTTGACCCAGCAGGAGGTGGAGATCCAATTTTATACCAACATTTATT T

Sample ID: BC_ZSM_Lep_117095; sequence ID: GWOUL189-23; Vallemare (627bp)
AACATTATATTTTATTTTTGGAATTTGATCTGGATTAGTAGGAACTTCTCTTAGTCTTTT
AATTCGAGCTGAATTAGGTAATCCTGGATCTTTAATTGGTAATGATCAAATTTATAATA
CTATTGTTACAGCTCATGCTTTTATTATAATTTTTTTTATAGTTATACCTATTATAATTGG
AGGCTTTGGTAATTGATTAGTACCATTAATATTAGGAGCCCCTGATATAGCTTTCCCAC
GAATAAATAATATAAGTTTTTGATTACTCCCCCCCTCTTTAACCCTTTTAATTTCTAGAA
GAATCGTTGAAAATGGTGCTGGAACAGGATGAACAGTTTATCCACCCTTATCTTCTAAT
ATCGCCCATAGAGGAAGTTCAGTTGACTTAGCTATTTTTTCCCTTCATTTAGCTGGTATT
TCCTCAATTTTAGGAGCTATTAATTTTATTACCACTATTATTAATATACGACCCTATAAT
ATATCATTTGACCAAATACCTCTTTTTGTCTGAGCAGTTGGCATTACCGCTTTATTATTA
CTTCTTTCTCTTCCTGTATTAGCAGGAGCTATTACTATATTATTAACTGATCGAAATTTA
AATACTTCATTTTTTGACCCAGCAGGAGG

Sample ID: BC_ZSM_Lep_116422; sequence ID: GWOUK941-22; Aranova (345bp)
CCTCCCCCCTCTTTAACCCTTTTAATTTCTAGAAGAATCGTTGAAAATGGTGCCGGAAC
AGGATGAACAGTCTATCCACCTTTATCTTCTAATATCGCCCATAGAGGAAGTTCAGTTG
ACTTAGCTATTTTTTCCCTTCATTTAGCTGGTATTTCCTCAATTTTAGGAGCTATTAATTT
TATTACCACTATTATTAATATACGACCCTATAATATATCATTTGACCAAATACCTCTTTT
TGTCTGAGCAGTTGGCATCACCGCTTTATTATTACTTCTTTCTCTTCCTGTATTAGCAGG
AGCTATTACTATATTATTAACTGATCGAAATTTAAATACTTCATTT

Specimens submitted to DNA barcoding analysis were found in very different habitats ranging from 50 to 2050 m of altitude. The completely uniform morphology of adults corresponds to a genetic difference (BOLD Barcode Gap Analysis) comprised between the 0.97% of the Pollino-Vallemare pair and the 1.76% of the Vallemare-Aranova pair. The two sequences from Vallemare specimens were identical. The short length of the sequence recovered for the Aranova specimen (345bp) suggest caution in the interpretation of data.

Comparisons of male genitalia with available iconography of nearest taxa showed a clear affinity of *S. italica* with *S. colchica dercetis* that should be better evaluated when molecular data will be available also for *S. colchica colchica* and *S. colchica dercetis*.

Lastly, in addition to the adult habitus of *Stygioides italica* (Figures 4-6), some important distinctive characters, such as the antennas (Figures 3a-c), the scales that cover the upper surface of the female forewings (Figures 7-9) and the male genitalia of nearest species (Figures 10-12), were shown.

Conclusions

Stygioides italica Mazzei & Yakovlev, was recorded after its description for few localities of Central and South Italy, but comparisons with the congeneric *S. colchica* are lacking. In this paper we provided original distribution data, the first molecular data for *S. italica*, and contributed to the knowledge of some distinctive characters such as antennae, scales covering forewings of females, and male genitalia of nearest species. The availability of full DNA barcode sequence for all taxa can strongly contribute in the future to investigate the interspecific relationships within the genus *Stygioides*.

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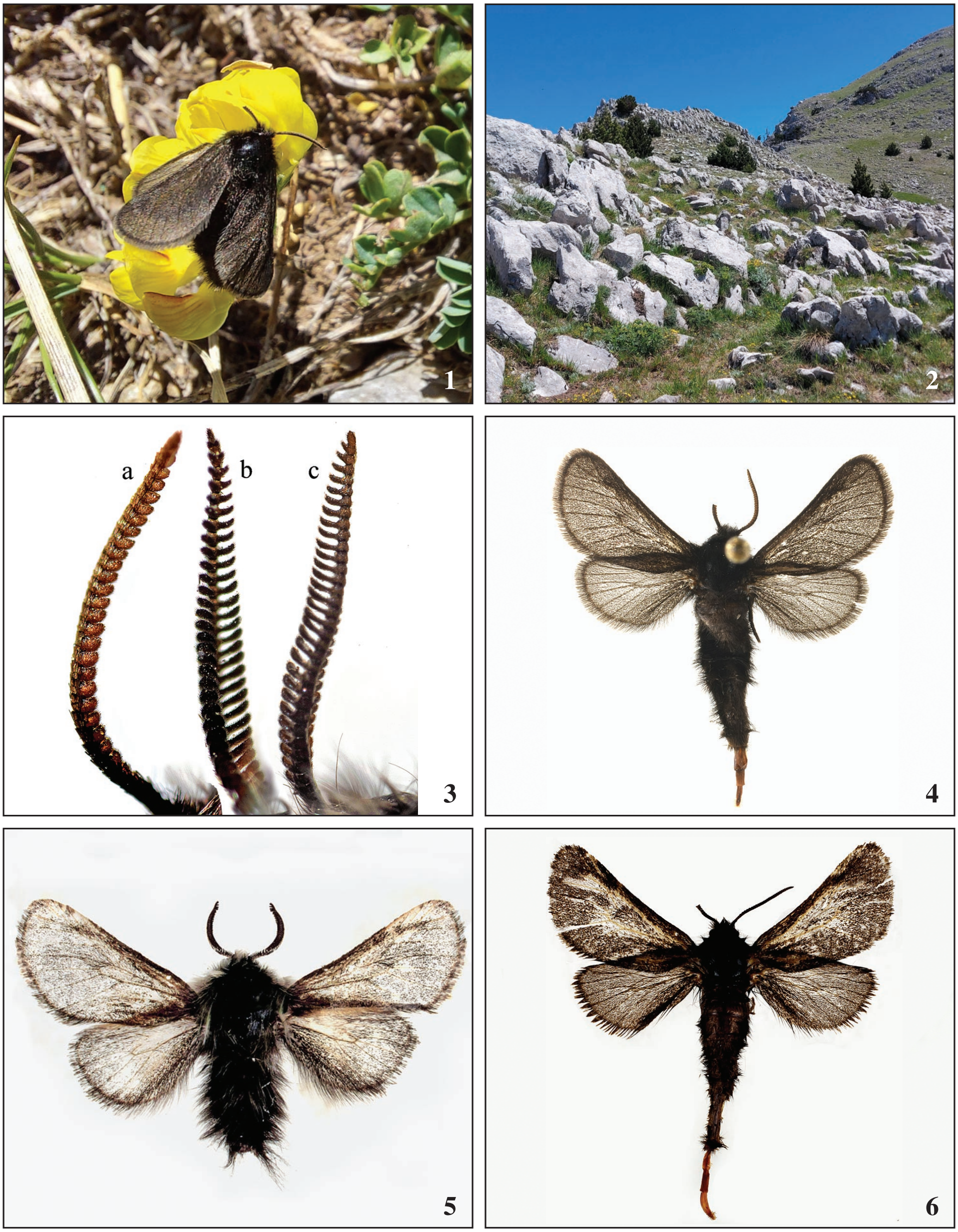
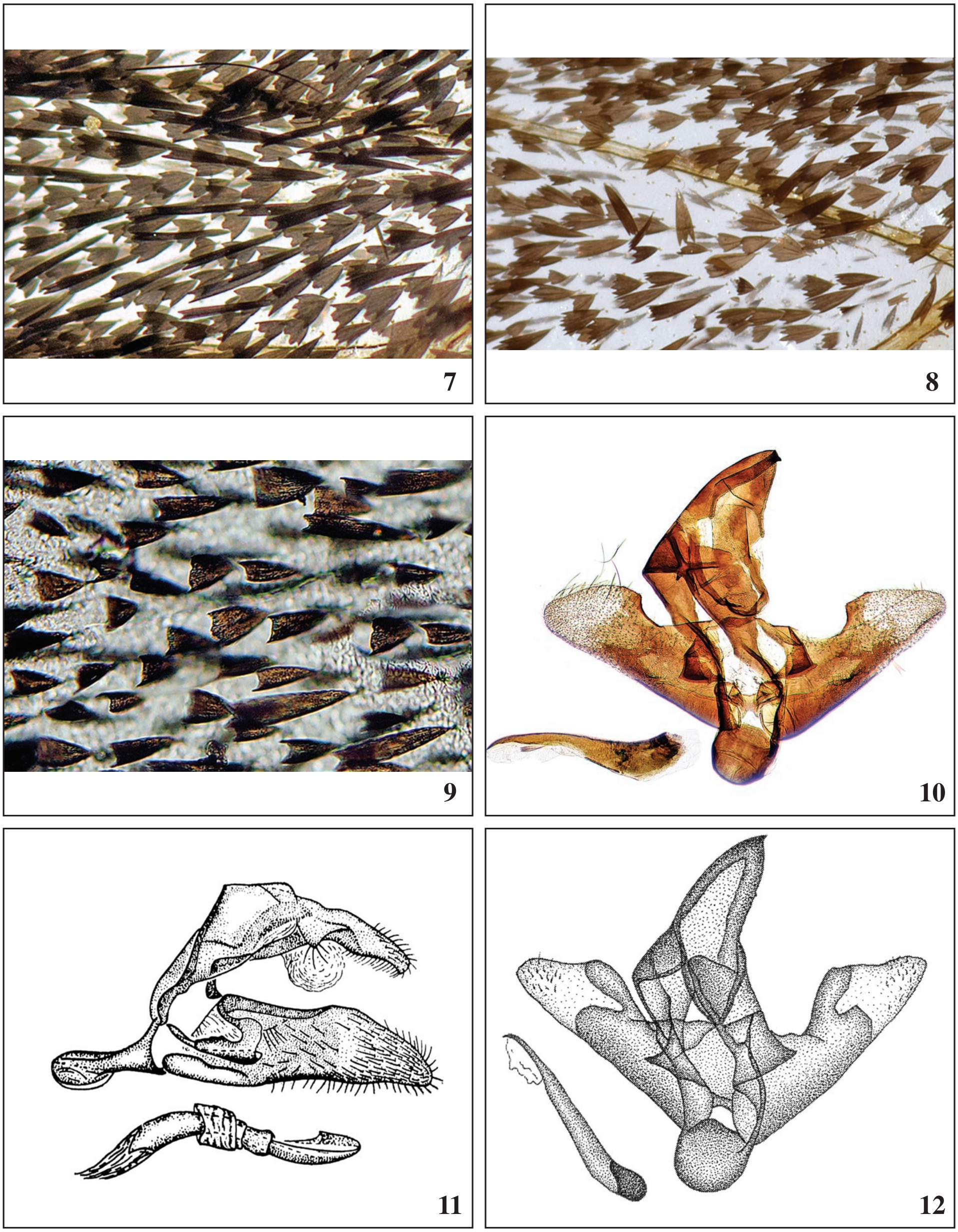


Figures 1-6. 1. *Stygioides italica* ♀ (live) Mount Pollino, 8-VI-2022. **2.** Collecting site of *Stygioides italica* on the Pollino Massif. **3a-c.** *Stygioides italica*: **3a.** female antenna, Pollino Massif, 8-VI-2022 **3b-c.** male antenna, Lazio: Vallemare (RI), 1455 m, 2-VI-2022. **4.** *Stygioides italica* ♀ Pollino Massif, wingspan 15,2 mm. **5.** *Stygioides italica* ♂ Lazio: Vallemare (RI), 1455 m, 2-VI-2022, wingspan 15,3 mm. **6.** *Stygioides italica* ♀ Aspromonte: Montalto (RC), 1700 m, 31-V-1994, wingspan 17,2 mm.



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A Rapid Assessment of Pronophilina Reuter, 1896 community structure and diversity in the uppermost cloud forests near timberline in Manu National Park, Peru (Lepidoptera: Nymphalidae, Satyrinae)

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Abstract

The subtribe Pronophilina Reuter, 1896 is a group of Papilionoidea that is particularly useful for assessing biodiversity and human-made disturbance, especially in cloud forests. This is because of their high diversity, abundance, distribution patterns, ecological fidelity, and usefulness in formulating conservation policies. A rapid assessment (RAP) was conducted on the Pronophilina in two locations in the upper montane area of Manu National Park, southeastern Peru. The assessment included an evaluation of species richness, faunal composition, similarity, and community structure of Lepidoptera in the area. The two locations were only 30 km apart but in different elevations, ranging from 2800 to 3200 m above sea level. The study recorded a total of 1941 specimens of 45 species, with 18 species (40%) belonging to the genus *Pedaliodes* Butler, 1867, and as many as 1356 individuals (70%) were found in this genus. Some local species were found to be restricted to very narrow elevation ranges at the forest-puna grassland ecotone. The community structure showed good adjustment with the RAD log-normal model in Trocha Unión and with the Zipf-Mandelbrot model in Qurqurpampa, indicating that the sample obtained is representative of well-preserved uppermost cloud forests. The Sørensen similarity index was relatively low, despite the short distance between the two sites and no apparent geographic isolation. Sampling by "Van Someren-Rydon" traps was confirmed as a very effective method for studying cloud forest species, Satyrinae in particular, to evaluate community structure, diversity, and altitudinal distribution.

Keywords: Lepidoptera, Nymphalidae, Satyrinae, conservation policies, forest disturbance, RBA, RAD, Peru.

Una evaluación rápida de la estructura y diversidad de la comunidad de Pronophilina Reuter, 1896 en los bosques nublados más altos cerca del límite maderero en el Parque Nacional del Manu, Perú (Lepidoptera: Nymphalidae, Satyrinae)

Resumen

La subtribu Pronophilina Reuter, 1896 es un grupo de Papilionoidea particularmente útil para evaluar la biodiversidad y las perturbaciones causadas por el hombre, especialmente en los bosques nubosos. Esto se debe a su gran diversidad, abundancia, patrones de distribución, fidelidad ecológica y utilidad para formular políticas de conservación. Se llevó a cabo una evaluación rápida (RAP) de la Pronophilina en dos localidades de la zona montañosa superior del Parque Nacional del Manu, al sureste de Perú. La evaluación incluyó una valoración de la riqueza de especies, la composición faunística, la similitud y la estructura comunitaria de los Lepidoptera de la zona.

Las dos localidades estaban separadas por sólo 30 km pero en elevaciones diferentes, entre 2.800 y 3.200 m sobre el nivel del mar. El estudio registró un total de 1941 ejemplares de 45 especies, de las que 18 especies (40%) pertenecían al género *Pedaliodes* Butler, 1867, y se encontraron hasta 1356 individuos (70%) de este género. Algunas especies locales se encontraron restringidas a rangos de elevación muy estrechos en el ecotono bosque-pradera de puna. La estructura de la comunidad mostró un buen ajuste con el modelo log-normal RAD en Trocha Unión y con el modelo Zipf-Mandelbrot en Qurqurpampa, lo que indica que la muestra obtenida es representativa de bosques nubosos superiores bien conservados. El índice de similitud de van Sørensen fue relativamente bajo, a pesar de la corta distancia entre los dos lugares y de no existir un aislamiento geográfico aparente. El muestreo mediante trampas “Van Someren-Rydon” se confirmó como un método muy eficaz para estudiar las especies de los bosques nubosos, Satyrinae en particular, para evaluar la estructura de la comunidad, la diversidad y la distribución altitudinal.

Palabras clave: Lepidoptera, Nymphalidae, Satyrinae, políticas de conservación, perturbación forestal, RBA, RAD, Perú.

Introduction

Tropical regions around the world are known for their high biodiversity and endemism of flora and fauna (Hamer & Hill 2004; Lodh & Agarwala, 2016; Meseguer et al. 2022). However, they are under threat of species extinction due to deforestation and habitat loss caused by increasing human demands (Lodh & Agarwala, 2016; Moreira et al. 2023). Among these regions, the Andean tropical montane forest (ATMF) is considered the principal hotspot of global biodiversity, and it has extremely high species richness in most taxonomic groups of plants and animals and contains sites with high speciation rates (Pennington & Lavin, 2010; Toledo-Aceves et al. 2011; Ledo et al. 2012; Horwath et al. 2019; Bax et al. 2021; Meseguer et al. 2022), and it is also home to many endemic species with restricted geographic ranges (Luebert & Weigend, 2014; Hutter et al. 2017; Pérez-Escobar et al. 2017; Meseguer et al. 2022). However, the ATMF is among the most threatened ecosystems on the planet, with a speedy rate of loss of its natural vegetation cover due to human land-use change, such as agricultural expansion, urbanization, and deforestation (Armenteras et al. 2011; Toledo-Aceves et al. 2011; Quitián et al. 2018; Aide et al. 2019; Horwath et al. 2019; Moreira et al. 2023). This has put many endemic species at risk of extinction due to the bottleneck process in their populations (Toledo-Aceves et al. 2011; Mahecha-Jiménez et al. 2011; Soh et al. 2019; Bax et al. 2021). Moreover, due to their restricted elevation range, many ATMF plant and animal species have naturally limited distribution in the cloud belt of tropical mountains, ATMF distribution is often considered analogous to an archipelago or islands, with deforestation enhancing the isolation of remaining ATMF fragments (Toledo-Aceves et al. 2011; Mahecha et al. 2019).

Over the last two decades, there has been a gradual loss of tropical forests in Latin America, specifically the ATMF, that have been cleared and replaced with pastures and crops, leading to a permanent loss of forest cover, and due to their high population density, the ATMF has been subjected to intense agricultural activity, which has led to their reduction (Castellanos-Mora & Agudelo-Hz, 2020; Moreira et al. 2023). Extensive areas of cloud forests are being cut down for timber, cleared for agriculture at mid-elevations, and burnt for grazing at high elevations and the act of burning is likely the primary reason behind the widespread and dramatic disappearance of vast portions of lowland and montane tropical forests in South America for centuries (Arroyo-Kalin, 2012; Aide et al. 2019). It is increasingly clear that the impact of human activity in the tropical Andes has been intense and long-lasting, with evidence dating back to the pre-Columbian era, and this activity has greatly contributed to the deforestation of the region, particularly at high elevations near timberline, and on a larger scale than what we see today (Loughlin et al. 2018). For the above reasons, ATMF is widely regarded as a conservation priority worldwide because provide important ecosystem services to millions of people (Ivory & Misrachi, 2014; Moreira et al. 2023) due to its critical role in the maintenance of hydrological and nutrient cycles, carbon sequestration and storage, and prevention of erosion and its high biodiversity (Toledo-Aceves et al. 2011; Soh et al. 2019; Bax et al. 2021). For that reason, there is an immediate need for conservation in highly diverse tropical ecosystems, especially in remote areas like mountain habitats. However, the lack of data has been a barrier to effective planning and implementation of conservation efforts (Lodh & Agarwala, 2016).

Conservation International introduced the Rapid Assessment Program (RAP) in 1990 for species-rich areas, to create baseline data which includes species checklists, records of habitat structure, and of disturbance and anthropogenic pressures in a short time, and vegetation type, etc. (Alonso et al. 2011; Lodh & Agarwala, 2016). To address this, Rapid Biodiversity Assessment (RBA) is a cost- and time-effective method for exploring the biodiversity of tropical habitats and it is considered a good method for predicting species richness using indicator taxa (Pearson, 1994; Lodh & Agarwala, 2016; Oliveira et al., 2020; Tettey et al. 2020). In addition, the RBAs only use a taxonomic group to indicate the site's status (Tettey et al. 2020). Butterflies are commonly used to assess the health of both pristine and anthropogenic ecosystems. They have also been utilized to study various aspects of tropical forest ecology in natural, managed, and degraded ecosystems (Tettey et al. 2020). Moreover, butterflies are a promising group of insects for rapid assessment because they are widespread, conspicuous, and easily recognizable, taxonomically well-known, and effective indicators of forest health (Lodh & Agarwala, 2016; Henao-Bañol & Gantiva-Q., 2020; Tettey et al. 2020; Sharma & Sharma, 2021). Also, Lepidoptera diversity is an indicator of biodiversity because they depend on plant diversity and different habitats according to ecosystem ecology (Ferrer-Paris et al. 2013; Lodh & Agarwala, 2016; Tettey et al. 2020; Sharma & Sharma, 2021).

The subtribe Pronophilina Reuter, 1896 is one of the groups of Lepidoptera almost entirely restricted to ATMF region (Casner & Pyrcz, 2010; Mahecha et al. 2019; Pyrcz et al. 2019). Thanks to numerous contributions, over the last two decades, in all aspects of their taxonomy, phylogeny and natural history it turned from one of the least known into one of the better known, if not the best-known group of Andean Lepidoptera, and they present a number of characteristics which make them a group particularly suitable for researching biodiversity (Pyrcz et al. 2009; Casner & Pyrcz, 2010; Pyrcz et al. 2019; Díaz-Suárez et al. 2022). In particular, Pronophilina are one of the most abundant and arguably the most species-rich group among AMTF with well over 600 known species (Lamas et al. 2004; Pyrcz, 2010). They are highly habitat-specific, restricted to well-defined ranges of altitude, an issue which has been studied with considerable focus, and are extremely sensitive to habitat degradation which affects their elevational ranges (Mahecha-Jiménez et al. 2011; Pyrcz & Garlacz, 2012; Díaz-Suárez et al. 2022). Species are often geographically limited, confined to single ranges or valleys, with only a few having wider distributions (Pyrcz et al. 2020). Even though their highly complicated alpha-taxonomy still require some research, it can be considered as fair, and fast species identification only occasionally presents any serious obstacles (Marín et al. 2017; Padrón et al. 2021). In addition, the spatial distribution patterns of Pronophilina are well-known and fine-tuned both geographically and altitudinally, and this is fundamental from the perspectives of biogeography and population ecology. (Padrón et al. 2021). The presence of Pronophilina is generally high in bamboo thickets, where the adults remain close to their host plants, which are mainly Chusquea Kunth bamboos (Poaceae) (Pyrcz et al. 2009; Mahecha et al. 2019; Pyrcz et al. 2020; Padrón et al. 2021). Finally, and importantly, the use of van Someren-Rydon traps baited with decomposing animal matter guarantees the obtaining of a numerically large, statistically viable sample, frequently representative of local Pronophilina communities within a limited time frame (Pyrcz et al. 2009; Díaz-Suárez et al. 2022).

On a global scale, the number of species in most animal groups, including Lepidoptera, either decreases steadily with increasing elevation or has a peak at mid-elevation (Brehm et al. 2007; Grytnes & Maccain, 2007; Despland et al. 2018). However, recent studies conducted throughout the Andes yield a somewhat different pattern, with several groups of Lepidoptera whose diversity increases with altitude, sometimes reaching the highest values close to timberline at some 2600-3000 m, for example some taxa of the Larentiinae subfamily of Geometridae (Brehm et al. 2003), or to that matter the Pronophilina (Pyrcz, 2010). In this study, we did an RBA of Pronophilina butterfly community structure and diversity along two transects in the uppermost cloud forests near timberline in Manu National Park, Cusco department in SE Peru with the aim to confirm that Pronophilina are good habitat preservation indicators in the Andes.

Material and methods

Study Area

Study area is situated in the upper Madre de Dios watershed, in the upper montane area of the Manu National Park, located in the department of Cusco in southern Peru (Figure 1). The Manu NP covers 17163 km^2 of Amazonian rainforest, montane forests and Andean grasslands between 150 m and 4200 m. The Park was created in 1973 in order to preserve natural habitats of the upper River Manu in the basin of the Madre de Dios. It was recognized as Biosphere Reserve by the UNESCO in 1977, and it is the second largest national park of Peru and corresponds to the one of the top diversity terrestrial areas of the World (Myers et al. 2000).

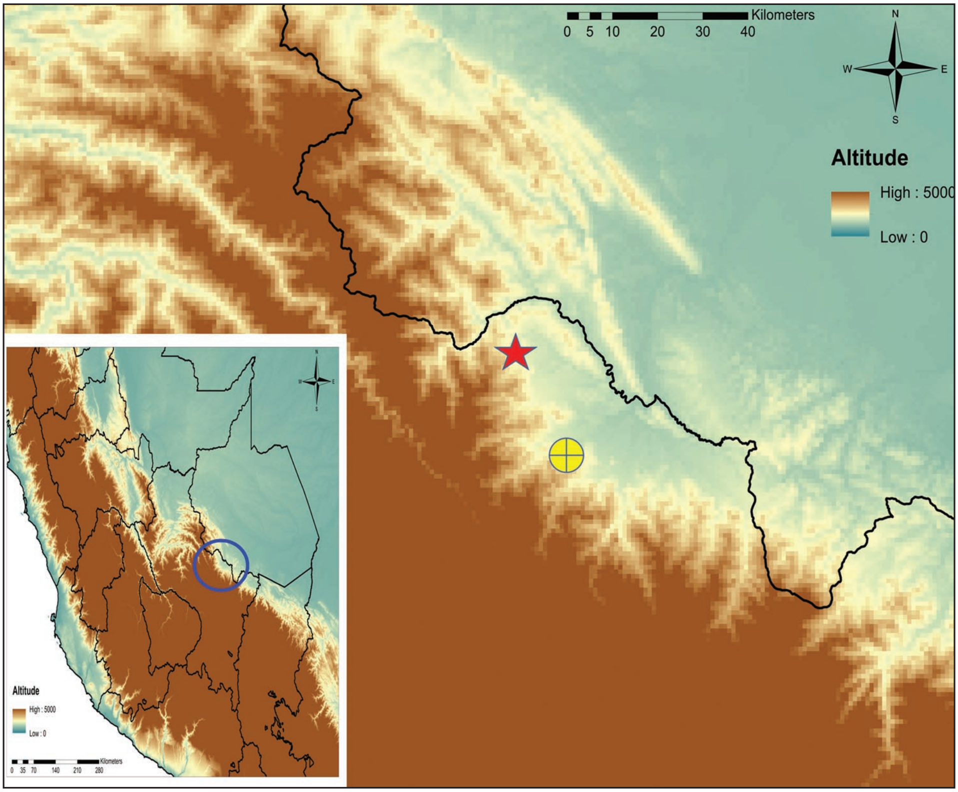


Figura 1. Location map of study sites in the Manu National Park, Peru. The red star is the Qurqurpampa station and the yellow circle the Trocha Union station.

RBA methodology

Two altitudinal transects were set at 2800-3500 m.a.s.l. One of them situated 4 km north of the park rangers' station Qurqurpampa (12º54' S 71º47'W), along the trails with links it with the village of Callanga. The second transect was set along the so-called trail Trocha Union (13º06' S 71º36' W), which links the sector of Tres Cruces with the road going down the Valley of Kosñipata. Both transects covered three kinds of habitats: puna grassland, transitional shrubby forest (tree-line ecotone), and montane forest. Papilionoidea were sampled using entomological nets and 20 Van Someren-Rydon traps, baited with decomposing fish. Traps were separated by 50 m each, starting at grassland forest ecotone at 3200 m and going down to 2800 m. Transect walks and traps were surveyed for five consecutive days each sampling period. Traps were revised daily. Only entomological nets were used in the habitat of puna grassland for four consecutive days, traps were not installed due to poor sampling efficiency demonstrated in previous studies (Pyrcz et al. 2013). Field work was carried out by two people. Field work/sampling took place three times in October (2012), April (2013) and August (2013).

TAXONOMY

All the material was set and examined in the laboratory of entomology at the Museo de Historia Natural de la Universidad Nacional de San Agustín (MUSA), Arequipa, Perú, and crossed-checked, also against the type specimens kept at the Nature Education Centre of the Jagiellonian University, Kraków, Poland (CEPUJ) and the Museo de Historia Natural de la Universidad Nacional Mayor San Marcos (MUSM), Lima, Perú. Additionally, the types illustrated at Butterflies of America website were examined. Most of the material is deposited at MUSA and voucher specimens in the collections of CEPUJ and MUSM. In the case of specimens requiring more sophisticated methods of taxonomic analysis, male and female genitalia were dissected and compared to type specimens, using standard procedures (Pyrcz et al. 2019).

DATA ANALYSIS

As a quantitative measure both the abundance, the number of species, doubletons and singletons recorded at each station were given. For the evaluation of alpha diversity three diversity measures: Fisher alpha, Shannon-Entropy and Simpson-Inv. estimative were calculated. As a measure of dominance, the Berger-Parker, and of evenness the Pielou estimative were used (Mahecha-Jiménez et al. 2011; Pyrcz & Garlacz, 2012; Urbano et al. 2018). Moreover, the Hill numbers (q= 0, 1, 2) were estimated for each site as a complementary measure of alpha diversity (Hill, 1973; Moreno et al. 2011; Chao et al. 2014; Marín et al. 2014; Hsieh et al. 2016). The sample coverage and species diversity-based rarefaction/extrapolation (RE) sampling curves were performed by site sampling, in which computes the Hills numbers for rarefied and extrapolated samples with sample completeness up to the coverage value of double the reference sample size (Hsieh et al. 2016). Moreover, the sample-size and coverage-based RE of Hill numbers as a unified framework for estimating species diversity. Likewise, a sample coverage RE curve can compare sites that have different sizes in their samples (Hsieh et al. 2016). Sørensen similarity index was computed to assess the similarity among both sites. Sørensen's coefficient of similarity was calculated based on presence/absence data for each species. It varies from 0 to 1, and a value close to 1 indicates greater similarity between sites, hence a low diversity ß (Magurran, 2013; Ganamé et al. 2020).

The Relative Abundance Distribution (RAD) was calculated to describe the sampled community (Chao et al. 2015; Cusack et al. 2015). The Akaike's Information Criteria (AIC) was carried out to select the best RAD model for each site, with subsequent inferences based on the model with the lowest AIC value (Burnham & Anderson, 2002; Cusack et al. 2015). However, the fitting of models to RADs is an intuitive way of representing and comparing community structures, it does not in itself provide information on the relative rank each species occupies within the observed communities (Cusack et al. 2015). All analyses were carried out in R version 3.6.3 (R DEVELOPMENT CORE TEAM, 2020). Species accumulation curves were plotted using the package iNEXT (HSIEH et al. 2013), and analyses of community composition and structure were carried out in package diverse (Guevara et al. 2016) and BiodiversityR (Kindt & Coe, 2005).

Results

COMMUNITY STRUCTURE

Table I. Abundance of the Pronophilina butterflies in each sampling site.

genus/species/subspecies	Qurqurpampa	Trocha Unión
Apexacuta astoreth (Thieme, 1907)	6	11
Corades cistene generosa Thieme, 1907	13	2
Corades iduna marginalis A. Butler, 1873	2	4
Corades melania melania Staudinger, 1894	0	2
Corades medeba Hewitson, 1850	0	1
Corades ulema Hewitson, 1850	1	0
Corades sp. nov. Pyrcz et al. Ms.	3	7
Daedalma dognini Pyrcz, 2011	4	24
Druphila venerata (A. Butler, 1873)	1	1
Eretris sp. nov. Pyrcz et al. Ms.	6	36
Junea doraete gideon (Thieme, 1907)	24	29
Junea dorinda whitleyi (H. Druce, 1876)	0	1
Lasiophila orbifera munda Thieme, 1907	0	1
Lasiophila piscina Thieme, 1903	29	142
Lymanopoda eubagioides A. Butler, 1873	2	4
Lymanopoda inaudita Pyrcz, 2010	8	0
Lymanopoda obsoleta (Westwood, 1851)	0	2
Lymanopoda translucida umbratilis Rosenberg & Talbot, 1914	29	36
Manerebia rubescens (A. Butler, 1873)	3	9
Panyapedaliodes drymaea (Hewitson, 1858)	1	1
Panyapedaliodes phila (Hewitson, 1862)	0	31
Panyapedaliodes silpa (Thieme, 1905)	0	2
Pedaliodes albutia Thieme, 1905	26	22
Pedaliodes auraria Thieme, 1905	193	276
Pedaliodes ackeryi Pyrcz & Viloria, 2008	2	44
Pedaliodes acjanaco Pyrcz, Viloria & Lamas, 2010	30	11
Pedaliodes antulla Thieme, 1905	0	9
Pedaliodes ferratilis A. Butler, 1873	1	29
Pedaliodes demathani ockendeni Lamas & Viloria, 2008	1	24
Pedaliodes melvillei Viloria & Lamas, 2008	83	209
Pedaliodes niveonota A. Butler, 1873	0	6
Pedaliodes patizathes (Hewitson, 1874)	14	53
Pedaliodes petri Pyrcz & Viloria, 1999	1	0
Pedaliodes pactyes ssp. nov. Pyrcz et al. Ms.	0	2
Pedaliodes phantasia Lamas, Viloria & Pyrcz, 2009	0	3
Pedaliodes phaeinomorpha Lamas, Viloria & Pyrcz, 2008	45	149
Pedaliodes proculeja Thieme, 1905	1	15
Pedaliodes uniformis Weymer, 1912	78	0
Pedaliodes simmias Thieme, 1905	16	43
Pedaliodes sp. nov. Pyrcz et al. Ms.	4	0
Punapedaliodes flavopunctata Krüger, 1924	4	21
Steremnia agraulis (Weymer, 1912)	5	17
Steremnia monachella (Weymer, 1912)	23	26
Steremnia umbracina (A. Butler, 1873)	2	5
Steroma bega andensis C. Felder & R. Felder, [1867]	3	0

A total of 1941 specimens of the subtribe Pronophilina were collected, 664 along the Qurqurpampa, and 1310 along the Trocha Unión transects respectively. They belong to 15 genera and

45 species. Overall, 18 species (40%) belong to the genus *Pedaliodes* Butler, 1867. All the species of *Pedaliodes* account for a total of 1358 individuals which constitutes as much as 70% of the sample. The most abundant species in both transects is *Pedaliodes auraria* with 469 individuals overall, representing 24% of the sample. The second and third most abundant species also belong to the genus *Pedaliodes* (*P. melvillei* - 293, *P. pheinomorpha* - 194 specimens). Four species singletons and six doubletons were reported (Table I).

The sample of Trocha Unión presents slightly higher values of all principal diversity estimates (in particular Shannon, Simpson, and Fisher alpha) (Table II), and significant difference between the two samples was evidenced (U- Mann-Whitney test: p-value = 0.039). These results are supported by Hill numbers of values for both sites (Table III). On the other hand, there is a major value of dominance in the Qurqurpampa sample as shown by Berger-Parker index.

Table II. Diversity estimates.

	Diversity Estimates				
Sites	Shannon- Entropy	Evenness	Simpson - Inv.	Fisher Alpha	Berger Parker
Qurqurpampa	2.4	0.63	0.72	6.8	0.39
Trocha Unión	3.1	0.75	0.9	8.7	0.22

Table III. Hill numbers or the effective number of species.

	Hill Numbers		
Sites	q0	q1	q2
Qurqurpampa	34	11.65	7.62
Trocha Unión	39	14.83	9.58

The analysis of sample coverage (Figure 2) and species diversity based on the RE curve (Figure 3) indicate to the sampling effort was appropriate for both sites. Additionally, the species diversity-sample coverage curves allowed to corroborate the good sampling effort (Figure 4). Although it is noteworthy that no curve reached an asymptote, this suggests that a more extensive sampling could potentially increase the number of species in the study area.

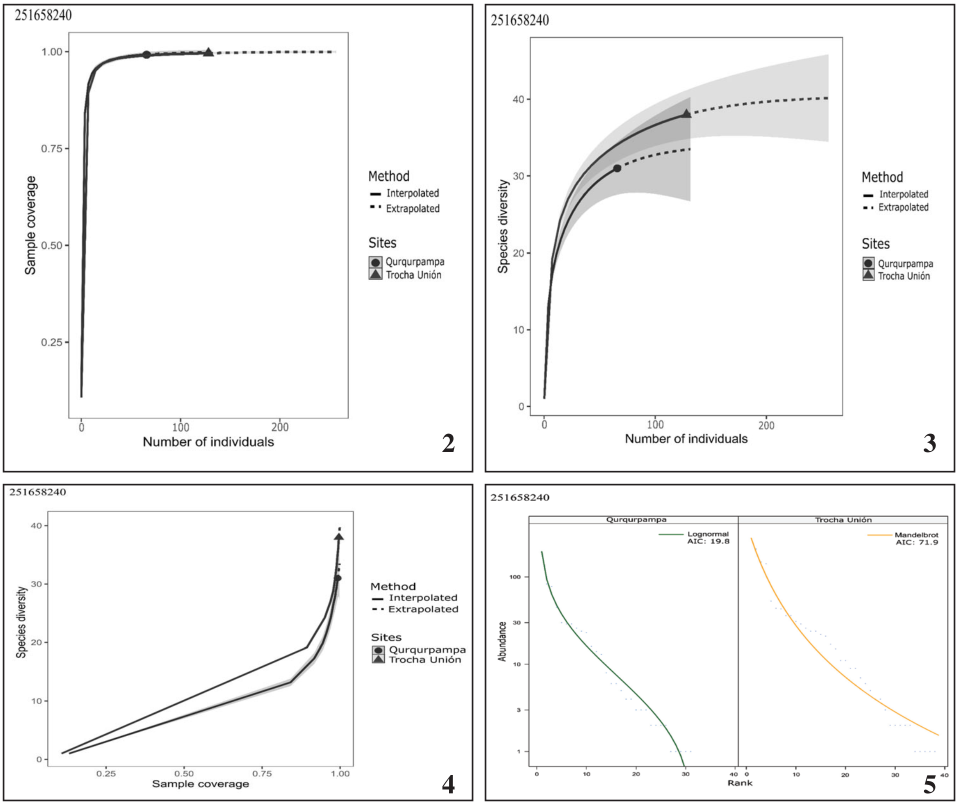
Five models of RAD were tested (null, preemption, lognormal, Zipf and Zipf-Mandelbrot models) (Table IV). According to the AIC criterion, the best adjustment for the sample of Trocha Unión turned out to be the Zipf-Mandelbrot model, whereas for Qurqurpampa the log-normal model (Table IV) (Figure 5). Our results are evidence of a similar pattern from the abundance distribution between dominant and rare species of butterflies in the study area.

Table IV. RAD models with AIC values.

Model	**Qurqurpampa**	**Trocha Unión**
Null	244.8	431
Preemption	83.5	161.4
Log-normal	**19.8**	81
Zipf	62	187
Zipf-Mandelbrot	30.8	**71.9**

Faunal similarities

Overall, 13 species were found in one of the localities only. Significantly, however, as many as nine of the species reported in only one of the localities were either singletons or doubletons. Among five species which were reported in more individuals, four apparently indicate some faunal dissimilarities between the two sites. In fact, two species were reported in Trocha Unión only, the most southerly site of the two are known to occur most southwards as well, in the well-sampled Acjanaco area, in particular *Pedaliodes antulla* Thieme, 1905 and *Pedaliodes niveonota* Butler, 1873. On the other hand, *Lymanopoda inaudita* Pyrcz, 2004 reported in Qurqupampa only has never been collected in Acjanaco but, on the other hands, it was known from the Abra Malaga-San Luis area situated just northwards of the study area. The most significant absentee in Trocha Unión is *Pedaliodes uniformis* Weymer, 1912 one of the co-dominant species in Qurqurpampa. The absence of *Panyapedaliodes phila* (Hewitson, 1862) in Qurqupampa is hardly understandable since it is a very widely distributed, nearly Panandean species found frequently above 2800 m.



Figures 2-5. 2. Sample coverage based RE curve. **3.** Species diversity based RE curve for each site. **4.** Species diversity vs. Sample coverage based RE curve. **5.** Relative Abundance Distribution (RAD) fitted to each site according to AIC criterion.

Sørensen similarity index is 0.66, which is a rather low value considered that the distance between the two collecting sites is only 30 km, and both are situated on the eastern slopes of the Cordillera de Vilcanota.

ALTITUDINAL PATTERNS

An overwhelming majority of the species recorded in both transects are those known to be associated with the highest strata of cloud forests, occurring elsewhere at 2800-3200 m, and found in well-preserved cloud forest. In particular, some species reported here are known to present extremely narrow elevational ranges and are basically restricted to the forest-paramo ecotone. Among such species we should list *Corades* sp. nov*.*, *Apexacuta astoreth* (Thieme, 1907)*, Daedalma dognini* Pyrcz, 2011*, Pedaliodes acjanaco* Lamas, Viloria & Pyrcz, 2010*, Pedaliodes proculeja* Thieme, 1905 and *Pedaliodes phantasia* Viloria, Lamas & Pyrcz, 2009. On the other hand, some species reported here are generally found at lower elevations than those covered by the transects, in particular *Lasiophila orbifera* Butler, 1868, *Corades medeba* Hewitson, 1850, *Lymanopoda obsolete* (Westwood, [1851])*, Pedaliodes petri* Pyrcz & Viloria, 1999 and *Steroma bega* Westwood, [1850] occurring elsewhere at lower elevations, generally at 1800-2600 m. They were recorded either as singletons, doubletons or in three individuals in the latter species, which shows the elevational band covered in this study was above their usual altitudinal range. All five are, however, widespread, and common species and occasionally can be found elsewhere above 2800 m. One species collected on both transects as singletons, *Panyapedaliodes drymaea* (Hewitson, 1858), is an indicator of secondary areas. *Punapedaliodes flavopunctata* (Staudinger, 1894) is the only species in the sample which is associated with puna grasslands and is found usually at considerably higher elevations than 3200 m. Its presence in both transects indicates the sampling occasionally took place slightly above the upper forest limit.

Discussion

This is the first RBA study for Pronophilina butterflies diversity in a sanctuary protected by law in Manu National Park, Cusco department in SE Peru, and our study proves once again that sampling with van Someren-Rydon baited traps is an extremely efficient method in carrying out quick surveys of Lepidoptera diversity and community structure in both lowland and montane rainforest habitats for local or regional studies (De Vries & Walla, 2001; Maicher et al. 2020), as well as in ecological assessments of habitat preservation versus anthropogenic activity within a limited time frame (Aduse-Poku et al. 2012; Whitworth et al. 2016). Such a method is efficient not only by attracting large numbers of individuals which enables to produce viable samples for statistical analysis, but it is also relatively specifically unbiased being equally attractive for all the species of a butterfly community, at least true for cloud forest Satyrinae (Pyrcz et al. 2009; Pyrcz & Garlacz, 2012). Biased sampling method is frequently a problem in similar studies, thus the use a wide array of baits is necessary (Maicher et al. 2020).

This study is, in our opinion, also valuable because it is one of the few to offer a comprehensive comparison of two ecologically similar and geographically marginally set apart localities, allowing a fine-tuned insight into intricate zoogeography of one of topographically most complex areas of the Andes. In fact, the two sampling transects are only 30 km away, both situated on the eastern slopes of the Vilcanota range and are not separated by any noticeable topographical event. And yet, their Sørensen similarity index is surprisingly low, and several interesting differences can be pointed out. For example, the absence of *Pedaliodes uniformis* the fifth most abundant species overall, and *Lymanopoda inaudita* along the Trocha Unión transect most likely reflects their south-eastern distribution limit, which is relevant from a zoogeographical perspective as it uncovers a discreet geographical pattern. On the other hand, the absence of *Panyapedaliodes phila*, a widespread Andean species common at 2600-3000 m along the Qurqurpampa transect is difficult to explain. For comparison, the faunas of Pronophilina of two sites separated by 50 km in the Venezuela Cordillera de Merida were also studied (Pyrcz & Wojtusiak, 2002; Pyrcz & Garlacz, 2012). In that case, the Sørensen similarity index was significantly higher, reaching 0.96. The two samples in Venezuela differed by one species only. Our results indicate much higher beta diversity, understood as species turn-over on a geographical scale, in the Peruvian Andes. Also, the species richness in Venezuela, whereas the altitudinal span covered was much wider, 700 m compared to 400 m in this study, was considerably lower with 22 and 23 species respectively. Higher diversity of two Peruvian localities was also reflected by Shannon and Fisher alpha indices.

Faunal structure of Pronophilina evidenced in this study is similar with other sampled Andean localities, such as Monte Zerpa and El Baho in the Venezuelan Cordillera de Merida (Pyrcz & Wojtusiak, 2002; Pyrcz & Garlacz, 2012), Alto del Zuque-Bogotá (Mahecha-Jiménez et al. 2011) and Frailejonal- La Calera (Díaz-Suárez et al. 2022) in the Colombian Eastern Cordillera; Belmira (Pyrcz et al. 2018) in the Colombian Central Cordillera; Tambito (Pyrcz & Wojtusiak, 1999), and Golondrinas (Pyrcz et al. 2009) on the Pacific slopes in Colombia and Ecuador, and Chachapoyas in northern Peru (Pyrcz, 2004). All the communities of Pronophilina are characterized by the dominance, in terms of species-richness and abundance, of *Pedaliodes*¸ with one to three strong dominant or co-dominant species, and a comparative under-representation of other genera in the sample. Such a faunal structure is not an artefact of the method of sampling nor seems to be related with the geographic setting of sampling locality or altitudinal span covered. The species dominance of *Pedaliodes* in the sample is not surprising given that it is also the most species-rich genus of Pronophilina accounting for nearly 50% of all known species in this subtribe (Pyrcz, 2004). However, the dominance of *Pedaliodes* in terms of abundance is less straightforward to interpret. Also, in the less diverse communities the dominance of a single species of *Pedaliodes* is more accentuated, which is particularly striking in the case of El Baho sample where *Pedaliodes minabilis* Pyrcz, 2008 constitutes as much as 53% of the sample (Pyrcz & Garlacz, 2012). Interestingly, dominant species of *Pedaliodes* in each locality belong to completely unrelated clades of the genus (Pyrcz et al. in prep.).

Our results suggest good preservation of the patches of uppermost forest where both samplings were carried out. This is shown, first, by the presence of species indicators of well-preserved habitats, in particular *Corades* sp. nov., *Apexacuta astoreth* (Thieme, 1907), *Lymanopoda inaudita* Pyrcz, 2010, or *Pedaliodes phaeinomorpha* Viloria, Lamas & Pyrcz, 2008, the latter one of the co-dominant species in the study area, elsewhere extremely localized and rare, for example along the nearby Acjanaco - Manu Road due to high disturbance of forest cover at 3000-3200 m. At the same time, very few species related with disturbed forest habitats were found in the study area, in particular only one individual of *Panyapedaliodes drymaea* (Hewitson, 1858) which is one of the most prominent indicators of high anthropogenic disturbance, very few specimens of *Steremnia umbracina* (Butler, 1873), another species related with secondary habitats, and none of *Pedaliodes palaepolis* (Hewitson, 1878), again a secondary forest indicator species (Pyrcz, 2004; Mahecha-Jiménez et al. 2011; Díaz-Suárez et al. 2022). Second, the RAD models fit in Trocha Unión (Zipf-Mandelbrot) and Qurqurpampa (log-normal) are also indicative of undisturbed, natural, varied and mature communities (may, 1975; Hill et al. 1995; Hill & Hamer, 1998; Marimon et al. 2015; Harterreiten-Souza et al. 2020; Nallis, 2021). In fact, the Zipf-Mandelbrot model assumes that, in the succession processes, late colonizing species have a specialized niche and thus are more difficult to find, while early colonizing species are more generalist and dominate in abundance regardless of the time of succession (Magurran, 2013; Harterreiten-Souza et al. 2020; Nallis, 2021). This model also assumes that colonization is initially stochastic depending on the regional abundance of generalist species, but that mature communities are determined according to the niche of late species (Nallis, 2021). The log-normal model assumes that ecological communities will have many species with intermediate abundance and few rare or common species (Schluter & Ricklefs, 1993; Harterreiten-Souza et al. 2020; Nallis, 2021). It has been argued that the use of RAD is a much more reliable method in comparing communities than non-parametric indices of diversity (Kim et al. 2013; Sæther et al. 2013). The latter, frequently used in the studies of biodiversity are shown to oversimplify the complex structural nature of communities and are not independent of sampling intensity, thus on sample size as well (Mouillot & Lepretre, 2000; Dornelas et al. 2011). Interestingly, this does not seem to be the case in our study. Most indices show closely similar values despite the fact that the Trocha Unión sample contains two times as many records as Qurqurpampa.

In sum, our study confirms that Pronophilina, thanks to their ecological and also behavioural qualities, such as habitat fidelity coupled with low adult vagility, and high sensibility to human made disturbance, which immediately express in their community structure, can be explored in the assessment of cloud forest state of preservation, and thus in formulating future conservation policies. In addition, to their other features, such as easy high species richness, standard sampling procedures, rapid data gathering protocols, and good knowledge of taxonomy among others, they surpass as potential habitat preservation indicators any other group of Andean Lepidoptera.

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A new species of *Rhuda* Walker, 1857 from Colombia (Lepidoptera: Notodontidae, Heterocampinae)

Efraín R. Henao, Rodrigo Bernal & Blanca Martínez

Abstract

The new species *Rhuda guayuyaco* Henao, Bernal & Martínez, sp. nov. from the Andean-Amazonian piedmont of Colombia, is described and illustrated. The new species differs in the FW being pale pinkish brown, the dark area pale brown, with smooth margins, its distal margin perpendicular to the costa. It superficially resembles the Brazilian *R. procas* (Druce, 1894), from which it differs in the irregular band beyond the two subterminal lines near the tornus being a pale, thin irregular line, instead of a dark band. The male genitalia differ from those of other species in the size of the valve, the shape of the uncus and the shape and size of the aedeagus.

Keywords: Lepidoptera, Notodontidae, Heterocampinae, Amazonia, new species, *Rhuda*, Colombia.

Una nueva especie de *Rhuda* Walker, 1857 de Colombia (Lepidoptera: Notodontidae, Heterocampinae)

Resumen

Se describe e ilustra la nueva especie *Rhuda guayuyaco* Henao, Bernal & Martínez, sp. nov. del piedemonte andino-amazónico de Colombia. La nueva especie difiere en que el FW es marrón rosado pálido, la zona oscura marrón pálido, con márgenes lisos, su margen distal perpendicular a la costa. Se parece superficialmente a la brasileña *R. procas* (Druce, 1894), de la que difiere en que la banda irregular más allá de las dos líneas subterminales cerca del tornus es una línea irregular pálida y fina, en lugar de una banda oscura. Los genitales masculinos difieren de los de otras especies en el tamaño de la valva, la forma del uncus y la forma y tamaño del aedeagus.

Palabras clave: Lepidoptera, Notodontidae, Heterocampinae, Amazonia, nueva especie, *Rhuda*, Colombia.

Introduction

The family Notodontidae is known in Colombia from 515 species, 31% of them recorded for the first time in the country as late as past year (Bernal & Martínez, 2023; Prada-Lara et al. 2023). The high number of recent new records gives an idea of the poor knowledge of the family in that country.

The genus *Rhuda* Walker, 1857 is one of the most characteristic among the Notodontidae, the dark area below the costa being unique in the family. The genus comprises 14 species (Becker, 2021), three of which have been recorded in Colombia (Prada-Lara et al. 2023).

While documenting moths in the Estación Agroforestal Guayuyaco, in the Andean-Amazonian piedmont of the Cauca Department, in Colombia, two species appeared as relatively common on the light screen –*Rhuda focula* (Stoll, [1782]), and a species superficially resembling the Brazilian *Rhuda procas* (Druce, 1894) in overall appearance but differing from that species in several wing pattern details and in genitalia. The species is here described as new.

Rhuda guayuyaco **Henao, Bernal & Martínez, sp. nov.** (Figures 1, 2)

Holotype: Male with the following label: / Holotypus / 18-VIII-2023, Colombia, Centro de Capacitacion Agroforestal Guayuyaco, Colombia, Piamonte, Cauca, Miraflor, 1.020637º N, 76.444731º W, 295 m. EH-19745 deposited in the Museum Center, Natural History Museum, University of Caldas (MHN-UC). An adult male captured by Efraín Henao at a screen with white and UV light. Bernal, Martínez & Henao det. 2023

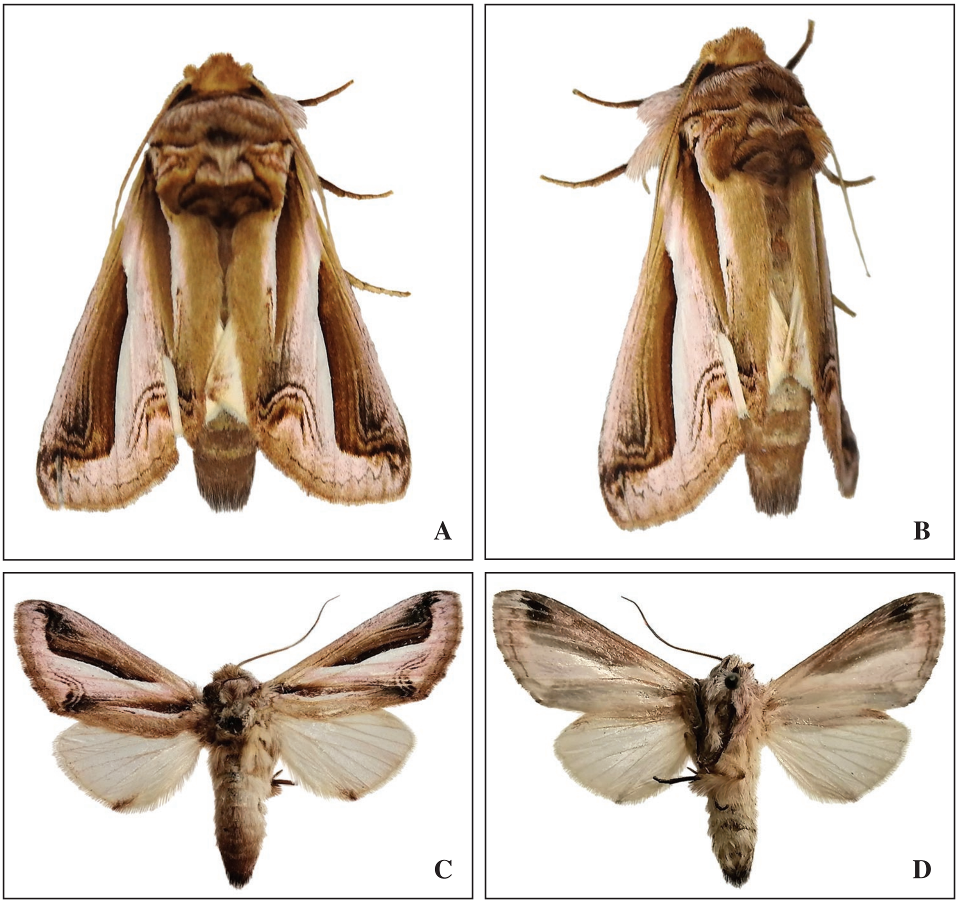

Figure 1. *Rhuda guayuyaco*. **A-B,** live individual; **C-D,** Holotype in dorsal (C) and ventral (D) view.

Description Male: FW 16.8 mm; wingspan 40 mm. Head and thorax pinkish brown, with blackish bands both in front and at the vertices; antenna with a long thin dark orange flagellum with 13 visible cilia; outer margin of tegula blackish; anterior tibia brown, middle and posterior tibia silver. Abdomen brown. Male genitalia (figure 2A) with uncus short and thick; valve large, broad, and flattened, sclerotized towards the upper edge, wide subtriangular, simple costa narrow and uniform, the rest weakly sclerotized. Aedeagus (figure 2B) thick, semi-erect, cylindrical; vesica globose and with two small cornuti. Distal margin of eighth sternite slightly concave (figure 2C).

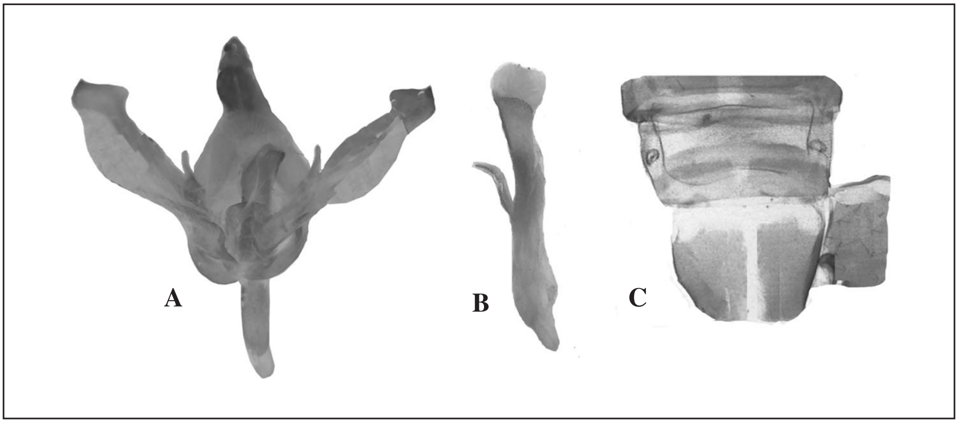

Figure 2. *Rhuda guayuyaco* **A,** genitalia, ventral view; **B,** aedeagus, lateral view; **C,** 8th sternite.

Diagnosis: FW with inner margin of dark area smooth, the distal margin almost perpendicular to costa; HW white, with a thin, submarginal brown line and an elongated, brown patch at tornus. Male genitalia with the tegumen simple and straight, uncus short and blunt; valve broad, large, and flattened; saccus short and round; vinculum a little sinuous; aedeagus long, thick, and well sclerotized, with multiple small cornuti and broad vesica.

Etymology: The specific epithet *guayuyaco* is the name of a river that runs from the eastern slopes of the Andes, passes close to the Guayuyaco Agroforestry Station, and flows into the upper Caquetá (Japurá) River. Guayuyaco is a name in Inga, a language of the Quechua family, with the element *-yaco* meaning river; the root *wayu* does not occur in Inga, but it means edible fruit in Quechua. The name is used here as a noun in apposition, and it is therefore indeclinable.

Ecological notes: During three successive nights, several individuals of *Rhuda guayuyaco* visited the white screens with white and UV lights at the Guayuyaco Agroforestry Station, together with *Rhuda focula*. During one night of sampling at the Kawarí Lookout, by the Fragua River, 22.6 km northeast of the Station, only *R. focula* was seen, among the ca. 400 species that visited our screen.

Discussion: *Rhuda guayuyaco* differs from other species in the genus in the FW being pale pinkish brown, the dark area pale brown, with smooth margins, its distal margin perpendicular to the costa. It superficially resembles the Brazilian *R. procas*, particularly in the distal margin of the dark coastal area being perpendicular to the costa. However, this species differs from *R. guayuyaco* in the irregular band beyond the two subterminal lines near the tornus being a thick, dark band, instead of a thin irregular line (see Draudt 1932, pl. 151i; Becker 2021, figs. 21-23). The genitalia of both species differ in the valve, which in *R. procas* is larger and broader than in *R. guayuyaco*; the distal portion of the valve has very different shapes, thin and fine in *R. procas* and broad and pointed in *R. guayuyaco*. The aedeagus is thinner and finer in *R. procas* while it is thick and robust in *R. guayuyaco*. The 8th abdominal sternite is concave in *R. guayuyaco*, like that of *R. diffusa*. *R. procas* is native to southeastern and central Brazil, its closest known locality being ca. 3600 km from the type locality of *R. guayuyaco*.

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Report of a New Larval Host Plant of *Galleria mellonella* (Linnaeus, 1758) from Kolkata, West Bengal, India (Lepidoptera: Pyralidae, Galleriinae)

Srinjoy Das & Kaustav Chakraborty

Abstract

In this study, we report for the first time a new larval host plant *Cassia fistula* L. for *Galleria mellonella* (Linnaeus, 1758) from Kolkata, West Bengal, India. *Galleria mellonella* is an established pest of beehives and till date, its larvae were known to feed only on the wax comb of *Apis* sp.,and destroy it. For this reason, beekeeping enterprises face high economic losses. Our finding opens a scope for extensive surveys in areas surrounding apiaries in order to quantify infestations in *C. fistula* which might provide a new insight in the pest management practices for *G. mellonella*.

Keywords: Lepidoptera, Pyralidae, Galleriinae, new host plant, *Galleria*, Kolkata, India.

Informe de una nueva planta alimenticia de las larvas de *Galleria mellonella* (Linnaeus, 1758) en Calcuta, Bengala Occidental, India
(Lepidoptera: Pyralidae, Galleriinae)

Resumen

En este estudio presentamos por primera vez una nueva planta alimenticia de las larvas de *Galleria mellonella* (Linnaeus, 1758), *Cassia fistula* L., de Calcuta, Bengala Occidental, India. *Galleria mellonella* es una plaga establecida de las colmenas y, hasta la fecha, se sabía que sus larvas sólo se alimentaban del panal de cera de *Apis* sp. y lo destruían. Por esta razón, las empresas apícolas se enfrentan a elevadas pérdidas económicas. Nuestro hallazgo abre la posibilidad de realizar estudios exhaustivos en las zonas circundantes a los colmenares para cuantificar las infestaciones de *C. fistula*, lo que podría aportar una nueva perspectiva sobre las prácticas de control de plagas de *G. mellonella*.

Palabras clave: Lepidoptera, Pyralidae, Galleriinae, nueva planta alimenticia, *Galleria*, Calcuta, India.

Introduction

The term wax moth is a common name which represents different species of moths that usually invade, attack and damage honeybee colonies and hive products. The list of wax moths are *G. mellonella* (Linnaeus, 1758), *Achroia grisella* (Fabricius, 1794), *Plodia interpunctella* (Hübner, [1813]) *Aphomia sociella* (Linnaeus, 1758) and *Ephestia kuehniella* Zeller, 1879. *G. mellonella*, the pest was classified *Tinea cerella* by Fabricus (1775), *Vindana obliquella* by Walker (1866) and later reclassified and named *G. melonella* (Linnaeus, 1758). Subfamily of *Galleria mellonella* is Galleriinae and its family is Pyralidae of order Lepidoptera. The species is well known for its parasitization of honeybees and their hives (Kwadha et al. 2017). *G.*

mellonella undergoes four developmental stages in its life cycle (egg, larva, pupa, and adult), so it is a typical holometabolous insect (Wojda et al. 2020). The eggs of this particular species vary in size (average length and width 0.478 mm and 0.394 mm), spheroidal shape with interspersed wavy lines which gives it a rough texture. Difference between male and female is not possible at larval stage, because Sex specific external morphological characters are absent. Polypod larvae with six legs on the thorax. The head of larva is composed of 3 well developed apical teeth but lacks sub-apical teeth with cream white body with sclerotized body parts. Male pupae are smaller in size than females. Pupa is white to yellow and gradually changes to dark brown. Sexual differentiation is possible in pupa. The adult moth shows sexual dimorphism. Males are generally smaller and less dark than females. The forewings for both sexes show varying intensities of pigmentation. The anterior two-third of the forewing is covered by scales that give it a uniformly darker pigmentation with comparison to the posterior one-third which is a mixture of stripes of darker and lighter pigment (Kwadha et al. 2017).

Female moths of *Galleria mellonella* (Linnaeus, 1758) lay eggs in honeybee comb cracks and crevices. The larvae feed honey, pollen, and brood, destroying the comb structure. Sometimes they show aggregation and cannibalism when there is a shortage of food (Kwadha et al. 2017). It was first reported in colonies of Asian honeybee, *Apis cerana* Fabricius, 1793. Williams (1997) and Shimanuki (1980), later designated this species as a pest as it is ubiquitously distributed everywhere beekeeping is practiced (Kwadha et al. 2017). After hatching, larvae move from cracks and crevices to the honeycomb where they begin to feed and build protective silken tubes, destroying the honeycomb structure in the process. This directional movement and feeding are stimulated chemically (Paddock, 1918; Nielson & Brister, 1979; Wojda et al. 2020). Worldwide record of larval host species of *Galleria melonella* is *Apis* sp. (Paddock, 1918; Nielsen & Briester, 1979; Shimanuki, 1980; Williams, 1997; Hosamani et al. 2017; Kwadha et al. 2017; Wojda et al. 2020).

Beekeeping has taken the shape of a promising enterprise. It is a very popular and highly economically beneficial integrated farming. India has a great scope for increasing bee farming. Bee-farming has two beneficial sides - firstly, the wax, honey, and different medical products, all have great market demands globally and secondly pollination services. But in India have some problems with beekeeping. One of the major problems is their natural enemies (Hosamani et al. 2017).

The *Galleria*'s larval stage destroys *Apis* sp. For this reason, beekeepers face heavy economic loss, approximately 60-70% worldwide (Ambaw et al. 2020). The larvae can also damage the box hive frames in highly infected hives, it can cause a huge amount of economic loss for beekeepers (Ambaw et al. 2020).

Result and Discussion

The larvae are feed mainly honeybee comb substances, but we observed a new type of food is consumed by these larvae. On 28-VIII-2022, we collected a fruit of *Cassia fistula* L. from a place nearby the Mahanayak Uttam Kumar metro station, Tollygunge, Southern part of the Kolkata, West Bengal, India. Kolkata, the eastern part of India is a warm, humid place. High temperature along with enough humidity is one the characteristics of this place during summer. In winter season, supposed to be in December and January, the average high temperature remains around 27ºC and low temperature remains around 13.8˚C along with 11-17 mm average rainfall. During monsoon in July and August (to some extent the September month), this place accounts high rainfall. In July average rainfall is 411 mm and in August 349 mm respectively. This specimen is collected by us in the month of August 2022 when the average temperature was 26ºC -32ºC (Mitra, 2019) (Figure 1). It is a metropolitan city with Latitude 22.4986ºN and Longitude 88.3454ºE.

The next day we suddenly observed a hole in the fruit, cut around the hole, and found in the area the pupa shell of a moth covered in a silk cotton-like material and surrounded by old excreta left by moth's larvae (Figure 2). Hoping to know what came out of the hole; we placed the fruit in a clean transparent container and covered its open mouth with a clean cloth. The next morning, we noticed that there were three more holes in the fruit as before, but this time the organisms that came out through the holes to stay covered could not escape. We took the opportunity to take photos of them and the photos were identified by one of the experts in the field as adult *Galleria melonella*.

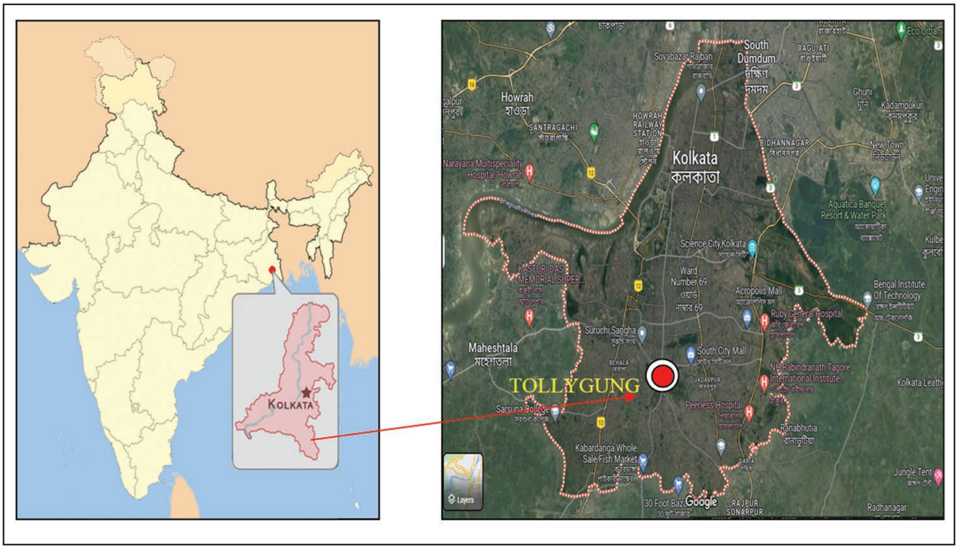

Figure 1. Collection location of the *C. fistula* fruit - Mahanayak Uttam Kumar metro station, Tollygunge, Kolkata, West Bengal, India

In *Galleria melonella* sexual dimorphism is observable. *Galleria melonella* moth's body length is 15-20 mm and wingspan are 31 mm, darker grey in color. In *Galleria melonella*, the labial palps of female projecting forward which looks like a beak in the head region (Kwadha et al. 2017). In males semi-lunar notch present in outer margin of front wing (Hosamani et al. 2017). All these morphological characters are able to separate this moth from the close congeners.

This study suggests a new larval host plant for the larvae of *Galleria mellonella*, which is not previously reported elsewhere. Based on our observation, we can suggest that planting this host plant *Cassia fistula* around the beekeeping area may reduce the damage to the bee hives by this moth larvae. However, further studies are warranted for the outcome whether prefer this new host plants more than the wax hives or not. If so, this will give both-way benefits. It is very known to us that the ability to feed on multiple host species permits them to avail more resources. The larvae of the greater wax moth will get options and not depend fully on beehives. On the other hand, the practice of beekeeping or the apiary will be benefited to some extent and, so the apiculture industry. In the future, we have plans to explore more on it.

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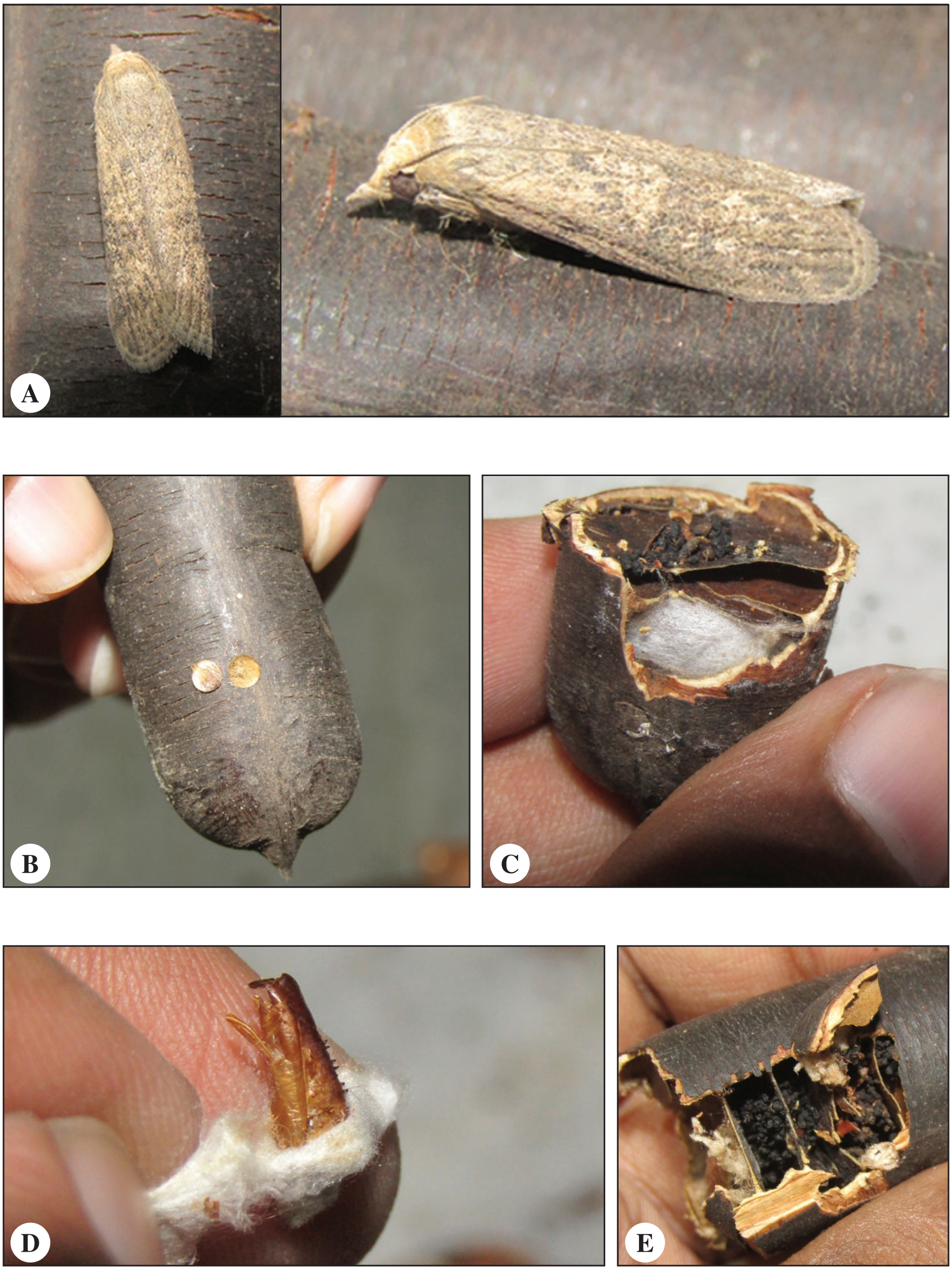

Figure 2. New larval host plant, *C. fistula* for *Galleria mellonella*. **A)** Adult moth. **B)** Exit hole of adult moth on the surface of *C. fistula* fruit. **C)** A silk-like cover of pupa of *G. mellonella* (L.) inside the fruit of *C. fistula*. **D)** Exuviae of a pupa inside silk-like cover. **E)** Excreta of larvae inside the plant fruit.

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A morphological comparative study of proboscis sensilla between Pierinae and Coliadinae (Lepidoptera: Pieridae)

Yağmur Mengi & Selma Seven Çalışkan

Abstract

Pontia edusa (Linnaeus, 1758) and *Colias croceus* (Geoffroy, 1785, in Fourcroy), which are in different subfamilies within Pieridae, feed on nectar. In this study, we tested the hypothesis that sensilla differ in the subfamily category. For this purpose, we investigated the ultrastructural structure of proboscis and sensilla in *Pontia edusa* (Pierinae) and *Colias croceus* (Coliadinae) by scanning electron microscopy (SEM). The composition of the wall of proboscis, their surface structure, the shape and distribution of different types of sensilla were compared. Three sensillum types are located on the proboscises of both species, sensilla chaetica, sensilla basiconica, and sensilla styloconica being most common in Lepidoptera. It was determined that the size and distribution of sensilla and especially the structure of sensilla styloconica differ in two species. The results will contribute to studies on food and proboscis morphology of Lepidoptera, and will also be beneficial in further studies on the significance of proboscis and sensilla structure in classification.
Keywords: Lepidoptera, Pieridae, scanning electron microscopy, sensory organ, proboscis, sensilla.

Estudio morfológico comparativo de la sensila de la probóscide entre Pierinae y Coliadinae (Lepidoptera: Pieridae)

Resumen

Pontia edusa (Linnaeus, 1758) y *Colias croceus* (Geoffroy, 1785, in Fourcroy), que pertenecen a subfamilias diferentes dentro de Pieridae, se alimentan de néctar. En este estudio, pusimos a prueba la hipótesis de que las sensilas difieren en la categoría de subfamilia. Para ello, investigamos la estructura ultraestructural de la probóscide y la sensila en *Pontia edusa* (Pierinae) y *Colias croceus* (Coliadinae) mediante microscopía electrónica de barrido (SEM). Se compararon la composición de la pared de la probóscide, su estructura superficial, la forma y la distribución de los distintos tipos de sensila. Tres tipos de sensilla se localizan en las probóscides de ambas especies, siendo la sensilla chaética, la sensilla basicónica y la sensilla estilocónica las más comunes en los Lepidoptera. Se determinó que el tamaño y la distribución de la sensilla y, especialmente, la estructura de la sensilla estilocónica, difieren en las dos especies. Los resultados contribuirán a los estudios sobre la alimentación y la morfología de la probóscide de los Lepidoptera y también serán beneficiosos en estudios posteriores sobre la importancia de la probóscide y la estructura de las sensilas en la clasificación.
Palabras clave: Lepidoptera, Pieridae, microscopía electrónica de barrido, órgano sensorial, probóscide, sensilla.

Introduction

Most adult lepidoptera feed on liquid foods through their proboscis. The proboscis consists of two extremely long galeas (Faucheux, 2013). These surround the food canal, interlocking with the cuticular processes on the dorsal and ventral sides called legulae (Bourgogne, 1951; Charlanes & Gaumont, 1960). The morphology of the proboscis changes depending on food-seizing habits (Büttiker et al. 1996; Krenn & Kristensen, 2000; Molleman et al. 2005; Faucheux, 2013). Sensilla in the proboscis of Lepidoptera plays a major role in host location and feeding behavior (Zaspel et al. 2013; Gilbert, 1972; Monaenkova, et al. 2012). The most common sensilla can be subdivided into six groups based on their external morphology (Krenn, 2010; Faucheux, 2013). All of them are located on the outer wall of the hose. The food canal contains only one-pore sensilla basiconica (Faucheux, 2013). Sensilla styloconica consists of a variety of differently shaped styli and shorter terminal sensory cones (Krenn, 1998, 2010; Kvello et al. 2006). There is an astonishing variety of Sensilla styloconica lengths and shapes in different families. The plesiomorphic features of the proboscis of Papilionoidea are that it contains vertically elongated exocuticular ribs forming the galeal wall, cuticular spines limited to the ventral side of the proximal galea, and 2-rows of grooved sensilla styloconica limited to the apex (Paulus & Krenn, 1996). Paulus & Krenn (1996) studied 71 species with a light microscope and 20 species with SEM. In the study, the length, surface structures, number, distribution, and shape of Sensilla styloconica were analyzed. In the study in which plesiomorphic and apomorphic characters were given for the Pieridae family, it was stated that the species were very similar to each other and show slight differences, but comparative sensilla photographs were not given for the species. Evaluation results were mostly limited by the length, surface structures, number, distribution, and shape of Sensilla styloconica. Dismorphinae (*Leptidea sinapis* (Linnaeus, 1758)) is in a separate group from Pierinae with the 2-row arrangement of sensilla styloconica. The phylogeny of Papilionidae and the monophyletic group was considered uncertain.

In this study, sensilla styloconica images from previous studies and sensilla photographs of samples from Turkey were compared and discussed. The aim of this study is to examine the sensilla types in the Pieridae family and to reveal the similarities and differences between the taxa. For this purpose, we examined, defined and compared the morphology of proboscis sensilla of *P. edusa* and *C. croceus* using scanning electron microscopy (SEM).

Materıal and Methods

The specimens examined in this study are the collection samples of the second author and are kept in the Gazi University Zoology Museum. A total of 10 specimens belonging to two species were examined. The heads of some of the samples were cut off and imaged, and the proboscis of the other samples were separated from the head with the help of forceps. The proboscis was cleaned with an alcohol-moistened brush and photographed under the Olympus SZX7 stereomicroscope (SM). The cut and cleaned samples were air dried; and after drying, the hose was placed on the studs and gold plated in a Polaron SC 502 brand vacuum coating device. It was then examined with the JEOL JSM 6060 LV scanning electron microscope (SEM) and photographed. Then it was scanned under electron microscope (SEM) (JEOL JSM 6060 LV) at 10 kV. The study was produced from the master's thesis of the first author.

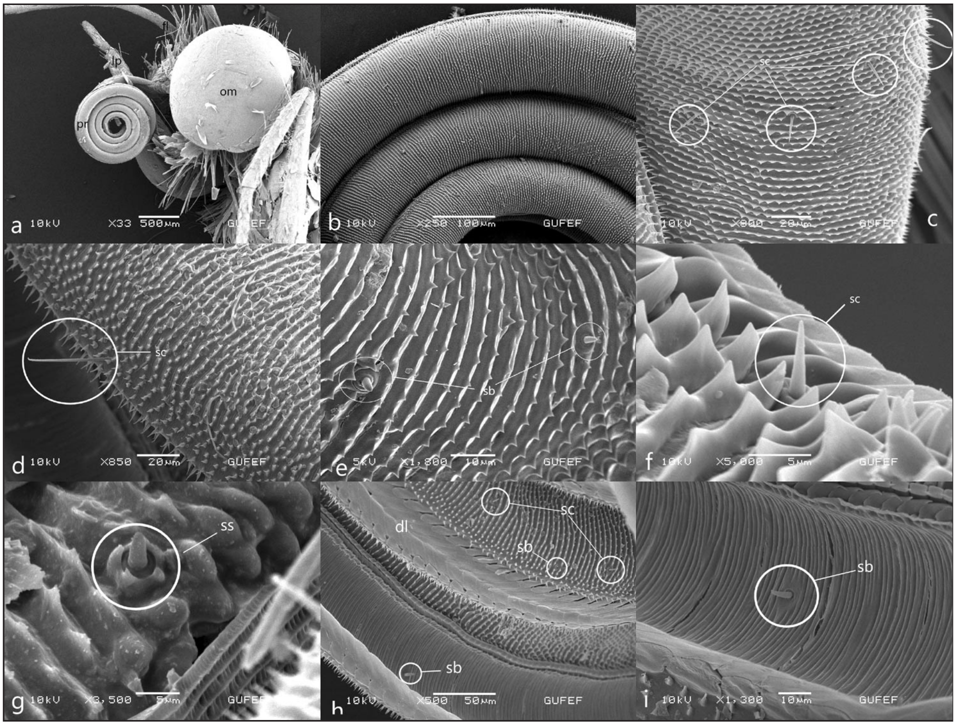
Pontia edusa (Türkiye, Antalya: Akseki, Çukurköy, Mahmutlu, 830 m, 19-V-2008 2 ex, leg.S. Seven Çalışkan; Türkiye, Adana, Kabasakal, 89 m, 28-IV-2008 leg. S. Seven Çalışkan 2 ex). *Colias croceus* (Türkiye, Gökçeada, 90 m, 20-V-2006 2ex., leg. S. S. Çalışkan & E. Çalışkan; Türkiye, Erzincan, Dutluca, 1182 m, 17-VII-2007 2ex., leg. S. S.Çalışkan; Türkiye, Balıkesir, Kaz Mountain, Hasanboguldu, 120 m, 06-VI-2005 2 ex., leg. S. S. Çalışkan.

Results

In Pieridae members, the proboscis is a tubular structure consisting of two long galeae (Figs.1a, 2a). The bodies of *Pontia edusa* and *Colias croceus* have typical sensillae commonly seen in Lepidopters (s.basiconica (sb), s.chaetica (sc) and s.styloconica (ss)).

Pontia edusa (Fabricius, [1777])

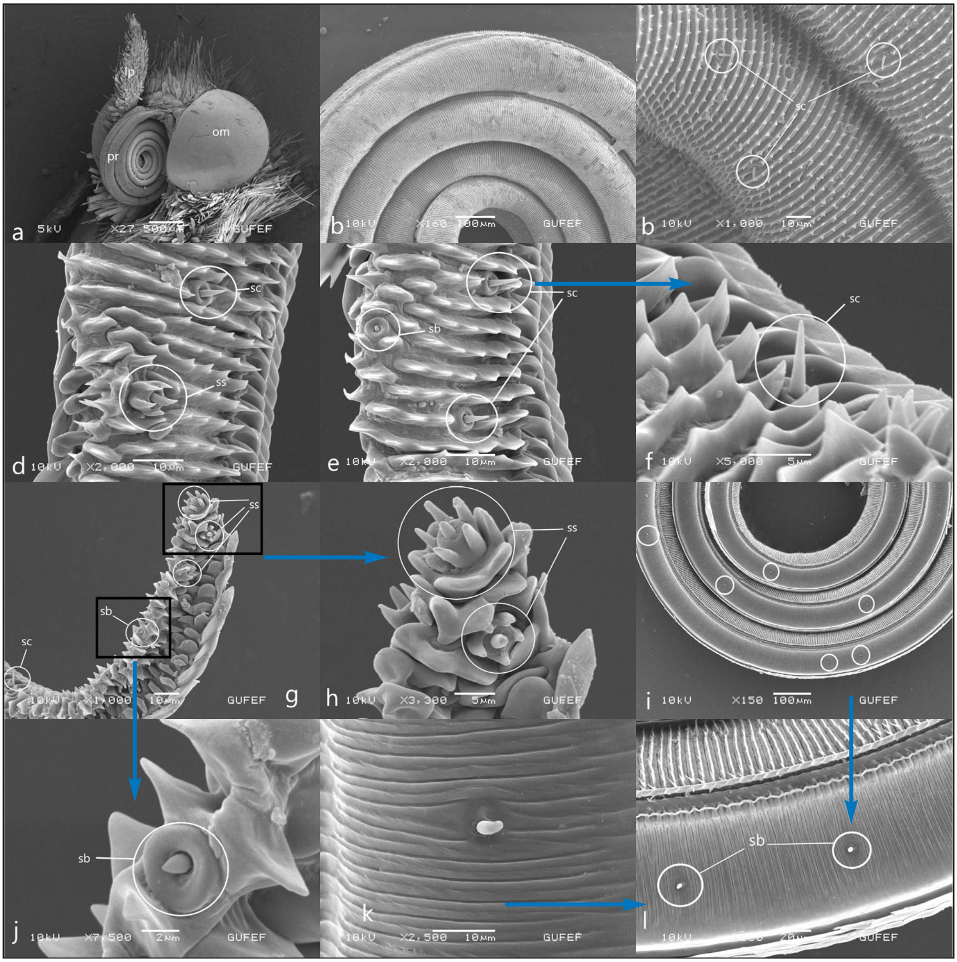
The proboscis forms 4-5 spirals in a curled state at rest (Figure 1b). The surface of the galea bears cuticular spines (Figures 1b, 1c). Cuticular spines, arranged parallel to each other on the dorsal of the galea, are scattered on the ventrally (Figure 1d). The dorsal legulae consists of finger-like, double rows of partially overlapping plates (Figure 1h). Sensilla are in regular rows. The sensilla basiconica of the outer proboscis surface, between the cuticular spines, consists of a short stylus and a long sensory cone with a perforated blunt tip (Figures 1e, 1f). Sensilla basiconica is arranged in an irregular, single row in the food canal. It consists of a long sensory cone resting on a bulging base (Figures 1h, 1ı). In the dorsal galea, there are many hair-shaped sensilla chaetica. They are arranged scattered on the surface of the galea (Figures 1c, 1d). Sensilla styloconicas, which is distributed over the distal part of the proboscis, consists of a short stylus with 5 spines and a peg embedded in the base (Figures 1g). The length of the peg is longer than the stylus'.



Figures 1. Head and mouthparts of *Pontia edusa*, **a.** proboscis (pr), complex eye (om), labial palpus (lb) **b.** Coil count of proboscis **c,d.** galea surface and sensilla chaetica (sc) **e,f**. cuticuler spine on galea surface, external sensilla basiconica (sb) **g**. sensilla styloconica (ss) with 5 short spines **h.** dorsal surface of the galea and food-canal on the inner galeal wall of the proboscis. **i.** Internal sensillum basiconicum in food canal (sb).

Colias croceus (Geoffroy, 1785, in Fourcroy)

The proboscis forms five rings at rest (Figure 2a). The surface of the galea bears cuticular spines (Figure 2b). These cuticular spines are arranged in parallel rows dorsally and independently from each other ventrally (Figures 2c, 2d). Sensilla are in regular rows. The external sensilla basiconica of the proboscis surface consists of a short stylus between the spines and a short sensory cone with a blunt tip (Figures 2e, 2g, 2j). The internal sensilla basiconica are arranged in a single row at irregular intervals in the food canal (Figures 2i, 2l). It consists of a short stylus and a long sensory cone (Figure 2k). Sensilla chaetica of varying lengths are numerous and are distributed over the surface of the galea (Figures 2c, 2e, 2f). Sensilla styloconica is concentrated in the distal part of the galea (Figure 2g). It consists of a relatively long five finger-shaped ribs stylus and a peg (Figures 2h). The length of the peg is close to the length of the stylus spines or may be slightly shorter.



Figures 2. Head and mouthparts of *Colias croceus*, **a.** proboscis (pr), complex eye (om), labial palpus (lb) **b**. Coil count of proboscis **c.** galea surface and sensilla chaetica (sc) **d,e,f.** Cuticular spines on galea surface, external sensilla basiconica (sb), sensilla styloconica (ss) sensilla chaetica (sc) **g, h, j**. distal part of the galea, sensilla chaetica (sc), sensilla basiconica, sensilla styloconica (ss), star-shaped sensilla styloconica with 5 long spines **i**. Distribution of internal s.basiconica in the food canal **k**, **l.** Sensillum basiconicum (sb) of the food canal.

Discussion

The surface of the galea differs between families. In many species, the outer surface of the galea may have distinct ribs, cuticular spines, hair-like cuticular processes, or scales that may appear convex (Krenn, 1990; Krenn & Kristensen, 2000; Paulus & Krenn, 1996; Speidel et al. 1996). Vertical, often branched galea wall ridges, which are densely covered with triangular cuticle spines all around, are the characteristics of all Pieridae (Paulus & Krenn, 1996). In *P. edusa* and *C. croceus*, the outer surface of the galeal wall is similar. Both have parallel outstretched cuticular spines.

Sensilla chaetica, which has nutritional localizations and mechanical functions, is found throughout the proboscis, but is longer in the proximal region than in other regions (Faucheux, 2013; Xue et al. 2016). In both studied species, sensilla chaetica is distributed on the outer surface of the proboscis and is more abundant proximally. Sensilla chaetica of *P.edusa* is significantly longer than that of *C. croceus*. Surrounded by a flexible shallow slot, sensilla basiconica has a sensory cone in the form of a dome or peg of varying lengths (Ma et al. 2019). It is of two types, inner and outer sensilla basiconica. The outer sensilla basiconica forms a single line on the entire surface of the galea, while the inner sensilla basiconica forms a single line in the digestive tract (Zhang et al. 2021). The external sensilla basiconica consists of a short sylus and a blunt-tipped sensory cone in *C. croceus*, whereas *P. edusa* consists of a short sylus and a long cone. The morphology and size of the inner sensilla are similar to that of the outer sensilla, but are usually blunt tipped (Fauchex, 2013). In *C. croceus*, s.basiconica, consisting of a short stylus and a long cone, are arranged in a single row in the food canal, but are not evenly spaced. On the other hand, it consists of a long sensory cone resting on a bulging base and is arranged in a single row (middle and side) irregularly in *P. edusa*. Internal sensilla basiconica is longer and less numerous than the external sensilla basiconica (Ma et al. 2019). Similarly, the internal sensilla basiconica are longer than the external sensilla basiconica in both studied species.

The sensilla styloconica in various forms are the characteristic sensilla of the Lepidopteran proboscis (Börner, 1939; Sellier, 1975; Altner & Altner, 1986). In some groups, the stylus is smooth and ellipsoid, or longitudinally spine-like cuticular ribs and is star-shaped. Some species have pale spines around the sensory cone, some have serrated ribs, some have nothing at all (Faucheux, 1991; Walters et al. 1998; Krenn, 1998; Faucheux, 1999; Krenn & Kristensen, 2000; Krenn et al. 2001; Kvello et al. 2006; Paulus & Krenn, 1996; Petr & Stewart, 2004). It is thought that sensilla styloconica can be used as a tool to distinguish taxa from each other in the lepidopteran systematics (Ma et al. 2019).

The Papilionidae and Pieridae are relatively uniform, and each can be clearly defined as a monophyletic group (Paulus & Krenn, 1996). The similarity between the sensilla styloconica of Pieridae members and Papilioninae members supports their closeness.

Pieridae is divided into three subfamilies. The slender, short, and very few sensilla styloconica in the family Pieridae have 4-5 strongly protruding ribs (Paulus & Krenn, 1996).

Paulus & Krenn (1996) stated that there were minor differences between the sensilla of the Pieridae species in their study, and only the distribution of the sensilla styloconica in *Leptidea sinapis* was different. Due to the difference in the distribution of sensilla, Dismorphiinae is given as a separate branch from Pierinae.

Pierinae and Coliadinae are closer to each other compared to Dismorphiinae due to the similar distribution of sensilla styloconica. Differences were detected in the sensilla of the two species examined in our study. In both cases, s.styloconica is of the excoronate type with 5 protruding short pegs and a smooth stylus. The sensilla of *Colias croceus* are similar to the sensilla of the *Colias fieldii* species in Ma et al. (2019) study. In *Colias croceus*, s.styloconica is not embedded in the pedestal. The ribs on the peg are more prominent, the spines on the ribs are longer, and the stylus is shorter than the peg.

The sensilla styloconica of *Pontia edusa* was compared and found to be similar to the sensilla styloconica of *A. crataegi* (Candan & Koçakoğlu, 2021) and *P. rapae* (Candan et al. 2018, unpublished). The common feature of all three species is that the ribs are very slightly convex and relatively short in length. In *Pontia edusa*, the sensilla styloconica consists of a short piece of nail embedded in the base and a relatively long piece of stylus.

The results support the hypothesis that the differences seen in the sensilla of members of different categories may be in the subfamily category. Comparative studies with more species are needed to reach a definitive conclusion. These morphological results likely suggest that the proboscis and related sensilla may provide potential value for systematic studies and phylogenetic analysis at the subfamily level within Pieridae.

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Re-description of three little known species of Palaearctic *Chrysoesthia* Hübner, [1825], with description of the hitherto unknown female of *Chrysoesthia falkovitshi* Lvovsky & Piskunov, 1989 (Lepidoptera: Gelechiidae)

Oleksiy V. Bidzilya

Abstract

Additions to original descriptions are provided for three little-known species - *Chrysoesthia falkovitshi* Lvovsky & Piskunov, 1989, *C. mironovi* Bidzilya, 2001 and *C. tuvella* Bidzilya, 2005. The colour photographs of adults and ventral view of the male genitalia are given for all three species for the first time, and their diagnostic characters are discussed. The hitherto unknown female genitalia of *C. falkovitshi* are described. The diagnosis of the genus and its differences from closely related *Metanarsia* Staudinger, 1871 are briefly discussed.
Keywords: Lepidoptera, Gelechiidae, *Chrysoesthia*, *Metanarsia*, diagnoses, Palaearctic.

Redescripción de tres especies Paleárticas poco conocidas de *Chrysoesthia* Hübner, [1825], con descripción de una hembra hasta ahora desconocida de *Chrysoesthia falkovitshi* Lvovsky & Piskunov, 1989 (Lepidoptera: Gelechiidae)

Resumen

Se añaden descripciones originales de tres especies poco conocidas: *Chrysoesthia falkovitshi* Lvovsky & Piskunov, 1989, *C. mironovi* Bidzilya, 2001 y C. *tuvella* Bidzilya, 2005. Para las tres especies se ofrecen por primera vez fotografías en color de adultos y una vista ventral de la genitalia del macho y se discuten sus caracteres diagnósticos. Se describen la genitalia de la hembra de *C. falkovitshi*, hasta ahora desconocida. Se discuten brevemente el diagnóstico del género y sus diferencias con *Metanarsia* Staudinger, 1871.
Palabras clave: Lepidoptera, Gelechiidae, *Chrysoesthia*, *Metanarsia*, diagnóstico, Paleártica.

Introduction

The genus *Chrysoesthia* Hübner, [1825] comprises about 26 species distributed in Holarctic (22 species) and Afrotropical (4 species) regions. Twenty species are known in the Palaearctic, of which 11 occur in Europe (Huemer & Karsholt, 2020, pp. 81-82). Despite the genus remains unrevised and status of some taxa is uncertain (Huemer & Karsholt, 2020, p. 124), several new species have been described over the past two decades from Central Asia (Bidzilya, 2001, 2005), Eastern Asia (Omelko & Omelko, 2010) and Europe (Bidzilya & Budashkin, 2015). Some of these descriptions are based on single, sometimes worn specimen, lack the photographs of adult and accompanied by rather schematic drawings of the male genitalia that make some difficulties with separation of these taxa from similar species of the genus. This is especially true for

Chrysoesthia mironovi Bidzilya, 2001 and *Chrysoesthia tuvella* Bidzilya, 2005 described from Turkmenistan and Tuva Republic of Russia respectively. In this contribution, I provide the photographs of adults and slides of the male genitalia of these species, as well as give additions to original descriptions, which clear indicate their differences from related species. Particularly, *Chrysoesthia tuvella* is compared with *Chrysoesthia falkovitshi* Lvovsky & Piskunov, 1989. The latter species is re-described based on additional material, inclusive the hitherto unknown female.

Material and methods

Male and female genitalia were dissected and prepared using standard methods (Huemer & Karsholt, 2010). Male genitalia were spread using the unrolling technique as described by Pitkin (1986) and Huemer (1988). The genitalia preparation temporary stored in glycerol vials, inclusive the holotype of *C. tuvella* were remounted in euparal. Pinned specimens and details of external morphology were photographed with a Canon EOS 5DSR DSLR camera attached to light box. Slide-mounted genitalia were photographed with a Canon EOS Rebel T5 DSLR camera mounted on an Olympus U-CTR30-2 trinocular head combined with a Carl Zeiss compound microscope. For each photographed specimen, sets of 10–20 images were taken at different focal planes and focus-stacked using Helicon Focus 6 with the final image edited further in Adobe Photoshop CS5.

The material examined is deposited in Zoological Museum Kyiv Taras Shevchenko National University, Kyiv, Ukraine (ZMKU).

Results

Chrysoesthia falkovitshi Lvovsky & Piskunov, 1989 (Figures 1, 2, 5, 8, 9, 12)
Chrysoesthia falkovitshi Lvovsky & Piskunov, 1989. *Nasekom. Mongol., 10*, 553, figs 41, 42
TL: MONGOLIA, Bayan-Khongor aimak, 120 km S of Shine-Dzhinsta.

Material examined: UKRAINE, Crimea, Nanikovo vil. env., Barakol lake, saline marsh, 1 ♂, 18-VI-2004 (Budashkin) (gen. slide 150/22, O. Bidzilya); Primorskiy, Kamyshin Lug, 1 ♀, 31-VIII-2010 (Budashkin) (gen. slide 190/22, O. Bidzilya); Primorskiy, Kamyshin Lug, 4 ♂, 28-VIII-2010 (Budashkin) (gen. slide 3/23, O. Bidzilya) (all ZMKU).

Chrysoesthia falkovitshi was described from single male collected 26-VII-1981 in Mongolia, Bayan-Khongor aimak, 120 km S of Shine-Dzhinsta. The specimen was cough at daytime on *Chenopodium album* L. (Lvovsky & Piskunov, 1989, p. 554). The holotype lacks labial palpus and unscaled in head and thorax. Here I re-described the species based on material of both sexes from Ukraine. The female genitalia are described for the first time.

Additions to original description: Adult (figures 1-2, 5). Head smooth, shine, light brown with yellow frons, labial palpus almost straight, segment 2 about as long and slightly narrower than segment 3, acute, scape and flagellomeres shine, dark brown; thorax and tegulae light brown. Forewing 2.2-2.7 mm in length, yellow with extensive black pattern mixed with silver: basal 1/5-1/4 black densely suffused with silver from outer side, costal margin with black irroration from base to large black irregular spot in medial 1/3 of costa edged from both side with silver, black patch at 2/5 of dorsal margin almost connected in fold with medial black spot, tornus and apex black mixed with silver, black transverse touch edged with silver on costal margin before apex, fringes greyish-brown; hindwing greyish brown.

Male genitalia (figures 8-9): Uncus triangular, apex pointed or rounded; distal portion of gnathos heart-shaped, membranous, densely covered with minute spines, equal to uncus; tegumen trapezoid, as broad at base as long and about 1.5 times as long as uncus, band of pocket of coremata extending posterio-medially from basal corners to 3/4 length; cucullus digitate, uniform in width throughout except very slender base, apex rounded; sacculus strongly sclerotized, triangular; saccus very short triangular; phallus sigmoidal, broadest in middle, distal portion slender with distinct apical hook, base bifurcate.

Female genitalia (figure 12): Papillae anales very large, densely sclerotized, broad at base, then gradually narrowed posteriorely towards strongly sclerotized, laterally compressed, slender, lanceolate and turned dorsally processes; sternum VIII band-shaped, anterior margin gradually bent and protruded ventrally, strongly edged, posterior margin weakly bent anteriorely; apophyses anteriores short, straight, ostium opening large, rounded; ductus bursae slender, with gradual transition to elongated corpus bursa, posterior portion finely spinose, ductus seminalis arises from its anterior part; no signum.

Remark 1: The species in unique in respect of papillae anales in the female genitalia. The latter are extremely large and terminated into lanceolate, turned dorsally sclerites without bristles. Somewhat similar but much slender at base papillae anales are known in *C. gaditella* (Staudinger, 1859) (LEPIFORUM, 2023).

Remark 2: According to original description, the holotype of *C. falkovitshi* resembles *C. sexguttella* f. *naeviferella* (Duponchel, 1843) with reduced yellow pattern on the forewing: “black, shiny forewing with basal half covered with blackish-brown scales mixed with light yellow. Three transverse silver spots on costal margin: the first one near the apex, the second on 1/3 from the apex and the third one on 2/3. The first spot is surrounded with blackish-brown scales. The area between 1-st and 2nd spot covered with light yellow scales except blackish-brown stripe along outer margin” (translation from Lvovsky & Piskunov, 1989, p. 553). This description suggests that the holotype differs from specimens from Ukraine in darker appearance without yellow spot in middle length of dorsal margin and yellow pattern at basal half of the wing. Despite these differences, the description and drawing of the male genitalia of the holotype in the original description match in all details males from Ukraine. Taking into consideration the considerable variability in the forewing pattern in some species of *Chrysoesthia* (e. g. *C. sexguttella* (Thunberg, 1794)) I suggest that differences between the holotype of *C. falkovitshi* and specimens from Ukraine is the individual variation.

Distribution: Ukraine, Crimea (Bidzilya & Budashkin, 2009, p. 16), Russia, S Ural, Lower Volga (Junnilainen et al. 2010, p. 18), Mongolia (Lvovsky & Piskunov, 1989, p. 553). The colour photograph of adult from S Ural (Junnilainen et al. 2010, p. 19, fig. 17) more resembles *C. tuvella* than *C. falkovitshi*. This record should be verified by examination of the genitalia.

Chrysoesthia tuvella Bidzilya, 2005 (Figures 3, 6, 10)
Chrysoesthia tuvella Bidzilya, 2005. *Proc. Zool. Mus. Kiev Taras Shevchenko Nat. Univ., 3*, 7, figs 1, 2
TL: RUSSIA, Tuva Republic, Ujukskii khrebet in 30 km S of Kyzyl.

Material examined: Holotype ♂, Tuva, 30 km S of Kyzyl, Ujukskii khrebet, 1000 m, 14-VI-2001 (Ustjuzhanin) (gen. slide 149/22, O. Bidzilya) (ZMKU).

Chrysoesthia tuvella was described from a single male collected in the vicinity of Kyzyl, Tuva Republic of Russia. The original description is accompanied with monochrome photograph of adult and drawing of the male genitalia in lateral view. Here I provide the colour photograph of the holotype and its genitalia in ventral view mounted in euparal using “unrolling” technique. The species is also compared with externally similar *C. falkovitshi*.

Additions to original description: Male genitalia (figure 10). Uncus subovate, laterally setose, gnathos long, slender, membranous, distal portion weakly broadened; tegumen about 3/4 length of uncus, trapezoid, slightly longer than broad at base; cucullus digitate, gradually broadened apically, with distinct longitudinal ridge, apex membranous, rounded, extending to posterior margin of uncus; sacculus subrectangular, both dorsal and ventral margins weakly bent, posterior margin with three short teeth; saccus short, subtriangular, with rounded apex; phallus distinctly broadened in middle, apex slender, with distinct hook, base bifurcate.

Distribution: Russia: Tuva Republic.

Comparative remarks: The species resembles both superficially and in the male genitalia *C. falkovitshi*. The latter differs by more extensive dark pattern on the forewing with basal 1/4 completely black (slightly darkened under costa in *C. tuvella*) and narrowly connected (not connected in *C. tuvella*) with black medial spot-on costal margin and black spot at 1/3 of dorsal margin. The male genitalia differ from those of *C. falkovitshi* in ovate rather than triangular uncus, slender (broad, heart-shaped in *C. falkovitshi*) gnathos, longer and narrower tegumen, apically serrate rather than acute sacculus and broadly rounded (triangular in *C. falkovitshi*) saccus.

Chrysoesthia mironovi Bidzilya, 2001 (Figures 4, 7, 11)
Chrysoesthia mironovi Bidzilya, 2001. *SHILAP Revta. lepid., 29*(114), 161, figs 1a, b.
TL: TURKMENISTAN, Mary, Vatan kolkhos.

Material examined: TURKMENISTAN, Mary vic., Vatan kolkhoz, 1 ♂, 19-VIII-1990 (Mironov) (gen. slide 187/22, O. Bidzilya) (ZMKU).

Chrysoesthia mironovi was described from single male collected in Mary, Turkmenistan. Original description is accompanied with drawing of the male genitalia in lateral view. Here I provide the photographs of adult of specimen collected in synpatry with the holotype, and its genitalia from ventral view mounted in euparal using “unrolling” technique.

Addition to original description: Adult (figures 4, 7). Head greyish-brown, frons light grey, weakly shine; labial palpus brown mixed with white, inner surface of segment 2 white, segment 3 slightly slender and about 1/2 length of segment 3, acute, scape brown, flagellomeres brown ringed with white; forewing 3.3 mm in length, covered with blackish-brown, grey or white to silver-tipped slightly shining scales, the latter forming diffuse transverse irregular lines at base, at 1/3 and 2/3, small yellow spot at 1/3 in mid width, two joined yellow spots on 1/2 near dorsal margin, small yellow spot on 3/4 under costal margin, white elongated spot on costal margin before apex, fringes grey, tipped with brown; hindwing and fringes light grey.

Male genitalia (figure 11): Uncus subovate, covered with short hairs in distal half; gnathos short, membranous, distal part rounded, covered with minute spines; tegumen equal to uncus, trapezoid, slightly broader at base than long, with pocket of coremata on anterior 1/3; cucullus digitate, nearly uniform in width throughout, apex rounded; sacculus subrectangular with slender, weakly curved dorsal process and dense brush of setae on ventral margin; saccus triangular; phallus about fl length of cucullus, broadest in middle, with distinct distal hook, base rounded.

Distribution: Turkmenistan.

Comparative remarks: *Chrysoesthia mironovi* is recognizable by dark blackish-brown forewing with yellow spots and slender irregular white to silver, slightly shining transverse bands. The species resembles dark forms of *C. sexgutella* but differs in the presence of yellow spot on 1/3. The male genitalia are characteristic by having distinct dorsal process on sacculus.

Discussion

Palaearctic species of *Chrysoesthia* is a rather homogenous in respect to the male genitalia. The latter are characteristic in having membranous spinose gnathos, short tegumen normally with group of coremata pockets, valva divided into elongate digitate cucullus and short, broad sacculus usually with denticles, brush of hairs or process on ventral margin, as well as phallus with normally bifurcate base, inner trunk and apical hook, with or without spines in the vesica. Two Afrotropical species are distinct in having very slender, straight or strongly curved sigmoidal phallus (Vári, 1963). The female genitalia of the large majority of species have large strongly sclerotized papillae anales with dense bristles, short apophyses, anteriorely protruded band-shaped anterior margin of sternum VIII and membranous ductus bursae without signum (Gregersen & Karsholt, 2022). Two species, *C. falkovitshi* and *C. gaditella* differ clearly from other of *Chrysoesthia* in modified, extremely large papillae anales without bristles. Forewing pattern of species of *Chrysoesthia* is variable, but silver spots or bands are characteristic for most of species.

Within the tribe Apatetrini *Chrysoesthia* was considered as most related to *Metanarsia* Staudinger, 1871 based on similarity of male and female genitalia characters (Bidzilya, 2005; Karsholt & Vives Moreno, 2014; Bidzilya et al. 2019). Absence of antennal scape in *Chrysoesthia* was treated as most constant feature that separates the genus from *Metanarsia* (Karsholt & Vives Moreno, 2014). Based on analyse of male genitalia of *Chrysoesthia* one can consider that pockets of coremata on dorsal wall of tegumen and at basal half of valva is another character that separates *Chrysoesthia* from *Metanarsia* and other genera of Apatetrini. Despite this character is not found in some species of the genus (e. g. *C. mironovi*), it can be considered as presumed autapomorphy of *Chrysoesthia*.

The genus needs revision to clarify the status of some South European/North African taxa (Huemer & Karsholt, 2020, p. 124). Several undescribed species are found in Eastern Africa (Bidzilya in prep.), and one can expect that further species of *Chrysoesthia* can be discovered in the Afrotropical region and Central Asia when the fauna of Gelechiidae from this area becomes better explored.

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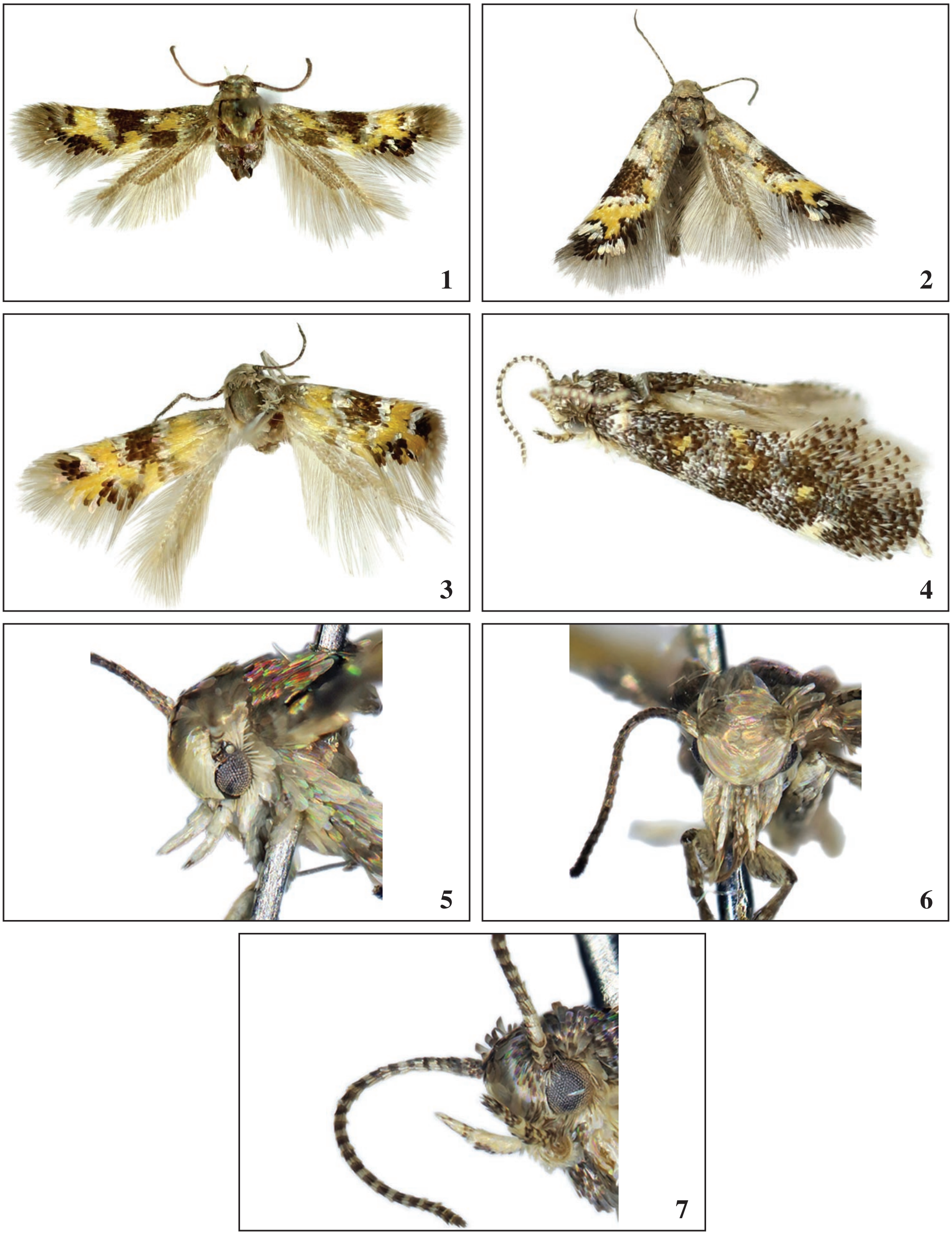

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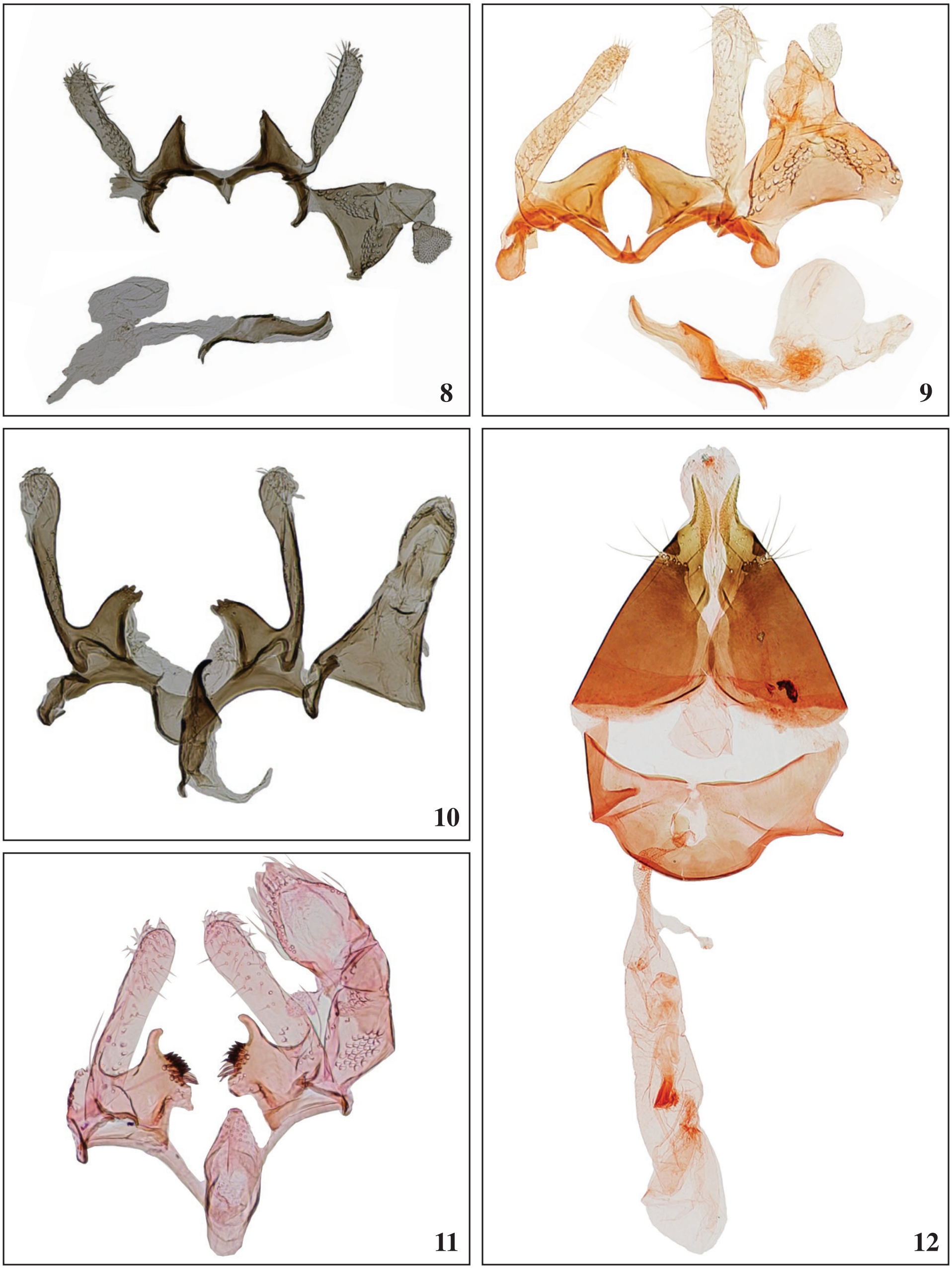

Figures 8-12. 8-11. *Chrysoesthia* spp., male genitalia: **8-9.** *C. falkovitshi*. **8.** Gen. slide 150/22, O. Bidzilya. **9.** Gen. slide 236/14, O. Bidzilya. **10.** *C. tuvella*, HT (gen. slide 149/22, O. Bidzilya). **11.** *C. mirinovi* (gen. slide 187/22, O. Bidzilya). **12.** *C. falkovitshi*, female genitalia (gen. slide 237/14, O. Bidzilya).

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Rhopalocera in modified landscape: The Mizoram University Campus, Aizawl, Mizoram, India (Lepidoptera: Papilionoidea)

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Abstract

A survey for the diversity of Rhopalocera at the Mizoram University (MZU) campus was carried out in selected areas with different habitat types. Pollard walks sampling method was adopted, and 16 randomly selected permanent line transects were established in three different sites. The length of the studied transacts was 500 m and the breadth was a region covered by visual observation on both sides from the point of observation along the length. Survey was carried out during September to November 2016 and from February to May 2017. A total of 3,618 individuals of 78 species of these insects belonging to six families were recorded. Maximum number of species recorded belonged to the family Nymphalidae while the family Riodinidae is represented by one species only. Three rare species namely, *Parthenos sylvia* (Cramer, 1775), *Elymnias patna* (Westwood, 1851), and *Tanaecia lepidea* (Butler, 1868) were also recorded. Another consequential aspect in this study is the record of *Euploea midamus* (Linnaeus, 1758), *Castalius rosimon* (Fabricius, 1775), *Jamides allectus* (Grose-Smith, 1894), *Euploea mulciber* (Cramer, [1777]), and *Polytremis discreta* (Elwes & Edwards, 1897), which are categorized into different conservation schedules of the Indian Wildlife (Protection) Act of 1972 with amendment made in 2022. Nymphalidae is the most diverse (H = 3.295) and dominant species (D = 22.727) while evenness is highest for the family Pieridae (E = 0.973) and diversity, dominance, and evenness (H = 1.818, D = 5.646, E = 0.826) is least for the family Lycaenidae. This study manifest that the modified habitats are also important repository for biodiversity which also need attention for conservation.

Keywords: Lepidoptera, Papilionoidea, Rhopalocera, survey, biodiversity, conservation, habitat, India.

Rhopalocera en un paisaje modificado: El campus universitario de Mizoram, Aizawl, Mizoram, India (Lepidoptera: Papilionoidea)

Resumen

Se realizó un estudio de la diversidad de Rhopalocera en el campus de la Universidad de Mizoram (MZU) en zonas seleccionadas con diferentes tipos de hábitat. Se adoptó el método de muestreo Pollard walks y se establecieron 16 transectos lineales permanentes seleccionados al azar en tres lugares diferentes. La longitud de los transectos estudiados era de 500 m y la anchura era una región cubierta por la observación visual a ambos lados desde el punto de observación a lo largo de la longitud. El estudio se llevó a cabo de septiembre a noviembre de 2016 y de febrero a mayo de 2017. Se registró un total de 3.618 individuos de 78 especies de estos insectos pertenecientes a seis familias. El mayor número de especies registradas pertenecía a la familia Nymphalidae, mientras que la familia Riodinidae está representada por una sola especie. También se registraron tres especies raras: *Parthenos sylvia* (Cramer, 1775), *Elymnias patna* (Westwood, 1851) y *Tanaecia lepidea* (Butler, 1868). Otro aspecto importante de este estudio es el registro de *Euploea midamus* (Linnaeus, 1758), *Castalius rosimon* (Fabricius, 1775), *Jamides allectus* (Grose-Smith, 1894), *Euploea mulciber* (Cramer, [1777]) y *Polytremis discreta* (Elwes & Edwards, 1897), que están clasificadas en diferentes listas de conservación de la Ley de la Fauna India (Protección) Acto 2022. Nymphalidae es la especie más diversa (H = 3,295) y dominante (D = 22,727), mientras que la uniformidad es mayor para la familia Pieridae (E = 0,973) y la diversidad, dominancia y uniformidad (H = 1,818, D = 5,646, E = 0,826) es menor para la familia Lycaenidae. Este estudio pone de manifiesto que los hábitats modificados son también importantes depósitos de biodiversidad a los que hay que prestar atención para su conservación.

Palabras clave: Lepidoptera, Papilionoidea, Rhopalocera, estudio, biodiversidad, conservación, hábitat, India.

Introduction

These insects are severely affected by the vegetation structure and composition because they have a close dependency on different vegetation types. (Pollard & Yates, 1993). Various Lepidoptera species firmly show seasonal availability and prefer a particular set of habitat conditions (Kunte, 1997), and habitat quality (Kocher & Williams, 2000). Thus, like other animals and birds, rhopaloceron species are now studied as dynamic biotic components of an ecosystem (Kehimkar, 2008).

Declining of global biodiversity is mainly due to habitat fragmentation, change in land use pattern, and over-exploitation (Fahrig, 2003; Pereira et al. 2012). Widespread urbanization, modern agriculture practices, and unregulated resource extraction has impacted upon loss of earth's biodiversity by 13 to 75 % (Haddad et al. 2015; Wintle et al. 2018). The fragmentation of larger landscapes has developed into small and isolated patches which are functioning as a refuge for local biodiversity in degraded habitats and increasing their conservation value (Wintle et al. 2018). Since rapid urbanization has several negative impacts on the native flora and fauna; nevertheless, it also serves as valuable habitat and corridor for dispersal of some local animal species (Opdam et al. 2003; Fernandez & Simonetti, 2013). The universities and other academic campuses also hold good green patches and different landscapes that support rich biodiversity (Liu et al. 2017, 2021). Such landscapes and modified habitats within the campus of academic institutions also serve the potential habitat for small to medium sized faunal groups (Vallejo et al. 2008; Mazumdar et al. 2011; Voon et al. 2014; Nerlekar et al. 2016).

Mizoram, a state in north-eastern part of India, represents a rich biodiversity in this region because it shares Indo-Myanmar biodiversity hotspot. The influence of Eastern Himalayan biodiversity hotspot is evident in this region because few species of Lepidoptera including threatened ones which occur in Central Nepal are also present in Mizoram and adjoining areas (Khanal et al. 2013). The expansion of area under shifting cultivation and urbanization in the region has however led to a change in landscape form, rate of deforestation, and ecosystem modification (Teegalapalli et al. 2009; Yadav, 2013; Hossain & Ahmed, 2017). Anthropogenic activities in the region have created a mosaic of residue forest patches of different size which is demarcated by a network of roads, and settlements areas (Mazumdar et al. 2011).

Mizoram University (MZU) campus is a large area with lush green landscape having several patches of natural vegetation. Some of the faunal groups namely herpetofauna (Vanlalhlimpuia, 2012), spiders (Lalthafamkima, 2017), birds (Sailo et al. 2019), mammals (Zothanpuii et al. 2020) were studied in and around the campus area which have indicated a rich biodiversity profile of this campus. A study recorded here on the diversity of the rhopalocera in this campus will enrich the diversity status academic campus and highlights the importance of the modified habitats.

Materials and Methods

STUDY AREA

The Mizoram University (MZU) campus encompasses the area of 978.20 acres and lies between 23.7394º N and 92.6651˚ E. It is 15 km away from the Aizawl town, the state capital of Mizoram. The elevation of campus ranges from 300 m to 880 m above mean sea level. Climate of Aizawl is tropical type and experiences an average low temperature is 11.4ºC in January, and average high temperature of 20.4ºC in April. The average annual precipitation is 2161.4 mm. The administrative block, academic blocks, hostels, playgrounds, and other facilities are there inside university campus encompasses which are sparsely embedded within regenerating tropical wet evergreen and semi-evergreen forests (Map).

Additionally, a protected forested and water catchment reserve in the north and a small biodiversity Park are also there inside the campus. Adjoining to the campus area there are few settlements and agricultural fields, several small seasonal streams also flow through the campus. The vegetation profile is dominated by the trees comprised of 384 species under 290 genera and 107 families (Lalchhuanawma, 2008) apart from second layer vegetations and lianas and climbers.

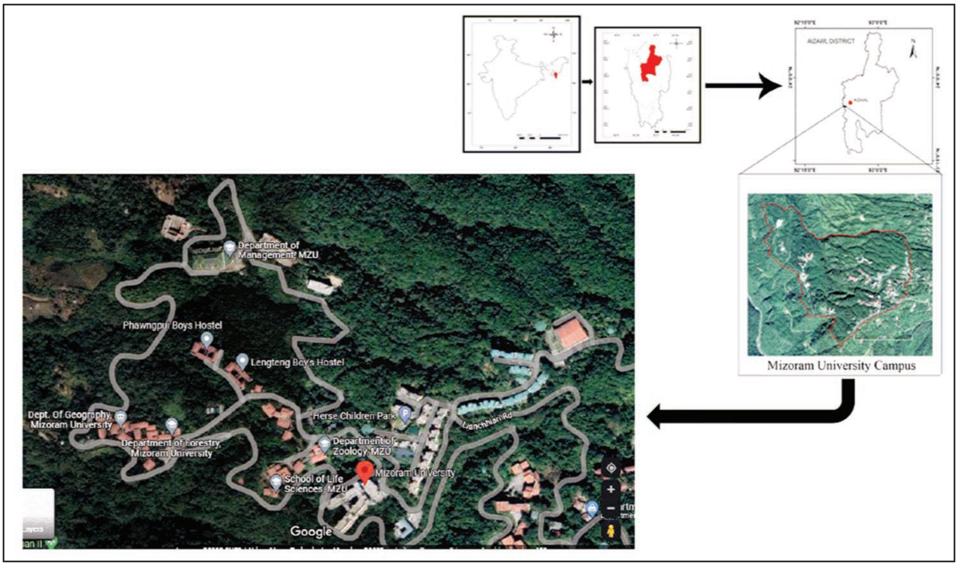
Methods

Sampling Techniques

The Pollard Walk sampling method (Pollard & Yates, 1993) was followed for scanning the butterflies. Line-transect distance sampling and a point-count method were considered together for total sampling. Altogether, 16 randomly selected permanent line transects were established in three selected sites inside the campus area. Surveys were conducted on three sites which are at three different locations from September to November 2016 and from February to May 2017. A visual search was done on sunny days between 9 am and 3 pm. The length of the studied transacts was 500 m and the breadth was a region covered by eyesight on both sides from the point of observation along the length. Some random observations on point count were also recorded.

Identification of Rhopalocera species

Identification of the observed species of Rhopalocera was confirmed with the help of field guides and photographs taken in the field. The confused species were captured with the help of a net and released after proper identification. Relevant literatures and books like, Swinhoe (1905-1910), Evans (1932), Talbot (1947) and photographic guides of Kehimkar (2008) were consulted for identification.



Map. Study site at Mizoram University Campus area. (Source: https://www.google.com/search?sca_esv=577441552&q=Satellite+Map)

DATA ANALYSIS

The recorded data was analyzed by for the Species Diversity using Shannon Index (H) (Shannon, 1948), Species Dominance using Simpson Index (D) (Simpson, 1949) and Evenness using Pielou's Evenness index (J) (Pielou, 1969).

Shannon Index indicates degree of representation of species in a sample. The Shannon Index (H) was calculated using the following equation: $H = \sum pi\ (\ln pi)$, where, pi is the proportion (n/N), n is no. of individuals of a species of one particular family, N is a total number of individuals of the family, ln is the natural log.

Simpson Index gives weightage to the species, common or dominant. The Simpson Index (D) was calculated using the following equation: $D = \sum pi\ (pi-1)/N\ (N-1)$. Where pi is the proportion (n/N), n is the number of individuals of a species of one particular family, N is the total number of individuals of the family, $\sum$ is the sum of the pi2.

Evenness refers to number of species and their closeness to the environment. The evenness (J) was calculated using the following equation: $J = H/Hmax$, Where H is the Shannon Index and Hmax is the natural log of S, where S is the total number of species in the sample.

Results and Discussion

78 species of Rhopalocera from six families were recorded from three sampling sites inside campus area (Table 1). The highest species record was made from the family Nymphalidae (50%), which included 39 species, followed by family Papilionidae (15%) with 12 species, Hesperiidae (13%) with 10 species, Lycaenidae (11%) with 9 species, Pieridae (10%) with 8 species and Riodinidae with 1 species only (Table 2).

Zoological Survey of India (2007) has reported 84 species from Mizoram State and 96 species were recorded by Ghosh and Majumdar (2007), Gupta (2007), and Gupta & Maulick (2007). The survey of Rhopalocera conducted by the Zoological Survey of India described for the geographical area of 21,081 km^2 of the entire Mizoram State while the present survey recorded 78 Rhopalocera species from 3.96 km^2 area of the Mizoram University. Geographical ratio between Mizoram University (MZU) campus and Mizoram state is 1:5323 and the ratio of the record of the Rhopalcocera species between these areas is 1:1.23. Proportionally the rhopaloceron richness is quite evident in this campus area. However, 125 Rhopalocera species of five families were recorded from Dampa Tiger Reserve, a largest protected area of 500 km^2 and 488 km^2 as buffer to Mizoram (Zothansangi et al. 2018). All other surveys carried out in Mizoram have reported only five families while six families reported in this study generated a hypothesis that the modified habitats or an academic campus are living repositories (Guthala et al. 2022) and support rich biodiversity components. The family Riodinidae was reported for the first time in this study.

A similar study reported 96 species of Rhopalocera from the nearby areas of the Assam University (Bora & Meitei, 2014) and 140 species from the Gauhati University Campus of the northeast India (Saikia, 2014). The older campus shows stability in vegetation cover and land use changes that brings stability and richness in biodiversity (Liu et al. 2021). Rhopalocera are sensitive group of biotas which is severely affected by the environmental variations and changes in the forest structure and composition (Pollard & Yates, 1993). Modified habitat and/or fragmented habitat exbibits more negative impact on the biodiversity in comparison to the natural habitat of that area (Fahring, 2003).

The peak season for the Rhopalocera in this part starts from July to September. Family Nymphalidae is always dominant in the tropical areas due to their polyphagous nature, and preference for diverse range of habitats. Moreover, many species of this family are strong, and active fliers that enable them to search large areas for rich food resources availability (Eswaran & Pramod, 2005; Kumar et al. 2007). Report of three rare species *Parthenos sylvia*, *Elymnias patna*, and *Tanaecia lepidea* is important findings in this study. Of the recorded Rhopalocera, five species are included in the schedule categories as per Wildlife (Protection) Amendment Act, 2022. These species are *Euploea* *midamus* WPA schedule-I, *Castalius rosimon* schedule-I, *Jamides alecto* schedule-II, *Euploea mulciber*, schedule-IV and *Polytremis discreta* schedule-IV (Table 1). Presence of these threatened species was also reported from the Dibang valley in the Arunachal Pradesh of eastern Himalaya (Gogai, 2012).

Table 1. List of recorded Rhopalocera in Mizoram campus area. Related photographs of some mentioned species are provided in Appendix I.

SN	Family	Scientific Name
1.	Papilionidae	*Papilio polytes* (Linnaeus, 1758)
2.		*Papilio clytia* (Linnaeus, 1758)
3.		*Papilio bianor (*Boisduval, 1836)
4.		*Pachliopta aristolochia* (Fabricius, 1775)
5.		*Papilio helenus* (Linnaeus, 1758)
6.		*Graphium doson* (Felder & Felder, 1864)
7.		*Graphium antiphates* (Cramer, 1775)
8.		*Papilio nephelus* (Boisduval, 1836)
9.		*Triodes helena* (Linnaeus, 1758)
10.		*Graphium sarpedon* (Linnaeus, 1758)
11.		*Papilio demoleus* Linnaeus, 1758
12.		*Papilio alcmenor* C. & R. Felder, 1864
13.	Hesperiidae	*Oriens goloides* (Moore, 1881)
14.		*Polytremis discreta* (Elwes & Edwards, 1897)
15.		*Koruthaialos sindu* (C. & R. Felder, 1860)
16.		*Iambrix salsala* (Moore, 1865)
17.		*Matapa cresta* Evans, 1949
18.		*Borbo bevani* (Moore, 1878)
19.		*Spialia galba* (Fabricius, 1793)
20.		*Tagiades japetus* (Stoll, 1782)
21.		*Pseudocoladenia dan* (Fabricius, 1787)
22.		*Pelopidas mathias* Fabricius, 1798
23.	Pieridae	*Eurema hecaba* (Linnaeus, 1758)
24.		*Catopsilia pomona* (Fabricius, 1775)
25.		*Catopsilia pyranthe* (Linnaeus, 1758)
26.		*Pieris rapae* (Linnaeus, 1758)
27.		*Delias pasithoe* (Linnaeus, 1767)
28.		*Delias descombesi* Boisduval, 1836
29.		*Appias lyncida* (Cramer, 1777)
30.		*Eurema blanda* Boisduval, 1836
31.	Lycaenidae	*Iraota timoleon* (Stoll, 1790)
32.		*Pseudozizeeria maha* (Kollar, 1844)
33.		*Castalius rosimon* (Fabricius, 1775)
34.		*Everes lacturnus* (Godart, [1824])
35.		*Jamides celeno* (Cramer, 1775)
36.		*Zizeeria karsandra* (Moore, 1865)
37.		*Jamides alecto* (C. Felder,1860)
38.		*Surendra quercetorum* (Moore, 1857)
39.	Riodinidae	*Zemeros flegyas* (Cramer, 1780)
40.	Nymphalidae	*Danaus genutia* (Cramer, 1779)
41.		*Neptis sappho* (Pallas, 1771)

42.		*Ypthima baldus* (Fabricius, 1775)
43.		*Charaxes solon* Fabricius, 1793
44.		*Discophora sondaica* Boisduval, 1836
45.		*Lethe confusa* Aurivillius, 1898
46.		*Junonia lemonias* (Linnaeus, 1758)
47.		*Parthenos sylvia* (Cramer, [1776])
48.		*Cirrochroa tyche* C. & R. Felder, 1861
49.		*Junonia hierta* (Fabricius, 1798)
50.		*Cethosia biblis* (Drury, 1773)
51.		*Melanitis leda* (Linnaeus, 1758)
52.		*Ariadne merione* (Cramer, 1777)
53.		*Lethe rohria* (Fabricius, 1787)
54.		*Ypthima huebneri* Kirby, 1871
55.		*Parantica aglea* (Stoll, 1782)
56.		*Cirrochroa aoris* Doubleday, 1847
57.		*Lethe chandica* (Moore, [1858])
58.		*Junonia orithiya* (Linnaeus, 1758)
59.		*Euploea midamus* (Linnaeus, 1758)
60.		*Elymnias patna* Westwood, 1851
61.		*Elymnias hypermnestra* (Linnaeus, 1763)
62.		*Vindula erota* (Fabricius, 1793)
63.		*Mycalesis mineus* (Linnaeus, 1758)
64.		*Euploea sylvester* Fabricius, 1793
65.		*Hypolimnas bolina* (Linnaeus, 1758)
66.		*Tanaecia lepidea* (Butler, 1868)
67.		*Polyura athamas* (Drury, 1773)
68.		*Vanessa indica* (Herbst, 1794)
69.		*Cethosia cyane* (Drury, 1773)
70.		*Euploea algae* (Godart, 1819)
71.		*Euploea radamanthus* (Fabricius, 1793)
72.		*Kallima inachus* (Doyère, 1840)
73.		*Vanessa cardui* (Linnaeus, 1758)
74.		*Euploea mulciber* Cramer, 1777
75.		*Euthalia phemius* Doubleday, 1848
76.		*Mycalesis perseus* (Fabricius, 1775)
77.		*Danaus chrysippus* (Linnaeus, 1758)
78.		*Symbrenthia lilaea* (Hewitson, 1864)

Table 2. Details of the families recorded.

S.N.	Family	Species in numbers	Species in percentage
1.	Papilionidae	12	15.4
2.	Hesperiidae	10	12.8
3.	Pieridae	8	10.3
4.	Lycaenidae	8	10.3
5.	Nymphalidae	39	50.0
6.	Riodinidae	1	1.3

The highest and lowest records of indivudal of each family is presented in Table 3. Species richness in tropical regions was also reported by De Vries (1987, 1997) in his studies in Costa Rica, where family Riodinidae and Nymphalidae together constitute nearly 90% of the rainforest's butterfly fauna. The geographical distribution of Punchinello in India ranges from Uttarakhand to Northeastern India (Varshney & Smetacek, 2015).

Table 3. Number of individuals recorded for each family. Numbers mentioned within paraenthesis are the percentage value of the total individuals.

Family	Papilionidae	Hesperiidae	Pieridae	Lycaenidae	Nymphalidae	Riodinidae
Total no.of individuals of the family	642	125	699	507	1608	37
Highest no. individuals of the family)	110 (17.13	20 (16)	122 (17.45)	123(22.61)	148 (9.2)	
Lowest no.of individuals of the family	25(3.89)	2 (1.6)	42 (6.01)	5 (0.92)	2 (0.12)	

Pieridae are mosly nector foragers thus they may be monophagus or polyphagus in their habit (Courteny, 1986). Members of the Papilionidae are largely associated with pristine forest and their abundance is directly related with loss of the forest cover due to logging and human disturbances (Barua, 2007). The entire campus represents a mixed type of habitat where a diverse rhopaloceron species (78) are accomodated which equals to 80% of the species of the entire Mizoram state. This testifies the hypothesis that the habitat modification also accomodates a rich insect diversity in a particular area.

Diversity indices of the recorded species provided in Table 4 indicate that the Nymphalidae has the highest diversity and dominance values (H=3.295) (D=22.727) while Pieridae shows the highest evenness index (E=0.973). The family Lycaenidae has the least H (1.818), D (5.464) and E (0.862) values with a low diversity but evenness in distribution. Riodinidae has one species only with zero diversity. Traditional practices of shifting cultivation, deforestation, and forest fire in Mizoram lead to modification to their habitats, atmosphere, local weather, and climate. Plant diversity and local distributions of vegetations can also affect the distribution patterns of rhopalocerons and is regarded as a co-evolved situation (Singh, 2010). Thirty-six species of Nymphalidae (Table 2) clearly indicates a rich abundance of its host plants in study area. Regular monitoring of the Rhopalocera in the university area may help to develop a congregate database on diversity of this insect which also reveals the ecological value of modified habitats.

Table 4. Biodiversity indices, Shannon Index (H), Simpson Index (D) and Evenness (E) for families of the recorded Rhopalocera.

Family	Shannon index (H)	Simpson Index (D)	Evenness (E)
Papilionidae	2.244	9.804	0.905
Hesperiidae	2.196	8.606	0.955
Pieridae	2.024	7.299	0.973
Lycaenidae	1.818	5.464	0.826
Nymphalidae	3.295	22.727	0.900
Riodinidae	0	0	0

Conclusion

This study suggests that a large portion of the biodiversity is also sheltered in human modified landscapes and private properties besides academic institutions. Out of 78 species of Rhopalocera noted in this work, three were rare including nine locally common species. Five species belonged to the schedule categories as per the Wildlife (Protection) Act that requires adequate conservation measures. Nymphalidae is the most dominant and diverse family and Pieridae showed an even pattern in distribution. The majority of the mentioned species also extend their range to the eastern Himalayas, China, Nepal, Bhutan, and Burma.

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Appendix 1


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Figures 1-7. **1**. *Papilio polyctor.* **2**. *Pachiliopta aristoclochia.* **3.** *Graphium antiphates.* **4.** *Troides helena.* **5.** *Papilio nephelus.* **6.** *Appias lyncida.* **7.** *Delias pasithoe.*


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Figures 8-14. 8. *Catopsilia pomana.* **9.** *Castalius rosimon.* **10.** *Iraota timeleon.* **11.** *Zizeeria karsandra.* **12**. *Jamaides Alecto.* **13.** *Oriens goloids.* **14**. *Iambrix salsala.*

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Los estados inmaduros y el ciclo de vida de una *Megalopyge* Hübner, [1820] causante de dermatitis en la ciudad de Córdoba, Argentina (Lepidoptera: Megalopygidae)

Pablo Alejandro Acosta & Adriana Inés Zapata

Resumen

En las últimas décadas en Argentina se han incrementado notablemente los reportes de casos de erucismo, con algunos brotes de importancia epidemiológica. En diciembre de 2019, un vecino de la ciudad de Córdoba fue afectado por el contacto con orugas de una especie de *Megalopyge* Hübner, [1820] que se encontraban en un arbusto del arbolado urbano. Considerando la escasa información disponible sobre la familia en esta región del país y el riesgo sanitario potencial que podrían representar estas orugas, se propuso determinar la especie, describir su ciclo biológico y los estados inmaduros, y evaluar la potencialidad de utilización de especies hospedadoras alternativas. Los adultos y los estados inmaduros se asemejan más a los descriptos bajo el nombre de *Megalopyge undulata vulpina* Berg, 1882 que a cualquier otra especie del género. Sin embargo, algunas diferencias morfológicas y cromáticas conducen a proponer que se tratase de dos taxones afines pero diferentes. A la latitud de Córdoba la especie se comporta como bivoltina, con un tiempo promedio de embriogénesis de 6 días y 58 de desarrollo larval en la segunda generación. El tiempo de permanencia dentro del capullo fue muy variable. El escaso éxito en el intento de alimentar a las larvas con hospedadores alternativos indicaría que la especie no representaría, por el momento, un problema sanitario urbano emergente.

Palabras clave: Lepidoptera, Megalopyggidae, erucismo, fauna urbana, dermatitis, Argentina.

Immature stages and life cycle of a *Megalopyge* Hübner, [1820] causing dermatitis in the city of Córdoba, Argentina (Lepidoptera: Megalopygidae)

Abstract

During the last decades in Argentina, the cases of erucism have increased notably, with some outbreaks of epidemiological importance. In December 2019, a resident of the city of Córdoba reported a case of erucism caused by contact with caterpillars of *Megalopyge* Hübner, [1820] present in a shrub in the sidewalk. Taking into account the little information available in the literature about the family in general, and in this region of the country in particular, and the potential health risk that these caterpillars could represent, our goals were to know what species it is, to describe the immature stages and the development times of this species, and to evaluate the possibility of the caterpillars using some common tree species as alternative hosts. Adults and immatures reared in the laboratory are more similar to those described as *Megalopyge undulata vulpina* Berg, 1882 than any other species of the genus, but some morphological and chromatic differences lead to the proposition that these are two related but different taxa. According to our observations, at the latitude of Córdoba the species seems to be bivoltine, with an average embryogenesis time of 6 days and 58 days of larval development time for the second generation. The time spent inside the cocoon was highly variable. On the other hand, the limited success in the development of the larvae with the alternative hosts that we offered them would indicate that the species does not represent, at the moment, an emerging health problem.

Keywords: Lepidoptera, Megalopygidae, erucism, urban fauna, dermatitis, Argentina.

Introducción

En las últimas décadas en Argentina, especialmente en las provincias de Misiones, Jujuy y Buenos Aires, se ha registrado un incremento en el reporte de casos de erucismo, hecho acompañado por el incremento de la población humana, la expansión de los centros poblados y la modificación de los ecosistemas silvestres (Gómez et al. 2018; Martínez et al. 2019). Los Lepidoptera responsables de la mayor parte de estos accidentes pertenecen a las familias Megalopygidae Herrich Schäffer, 1855, Saturniidae Boisduval, 1837 y Limacodidae Duponchel, 1844, con predominancia de las dos primeras (De Roodt et al. 2000; Martínez et al. 2019; Zapata, 2022).

La familia Megalopygidae, con más de 300 especies, constituye un grupo monofilético de distribución exclusivamente americana y mayor diversidad en la región Neotropical (Becker, 1995; Epstein et al. 1998; Heppner, 2008). Las orugas presentan una densa cubierta pilosa con dos tipos de cerdas. Las más largas, flexibles, a menudo pinnadas y de variados colores, les dan el aspecto velludo o cabelludo característico y son inofensivas. Las otras, cortas, rígidas y punzantes, con glándulas de veneno en la base y ocultas bajo las primeras, son las responsables de la acción urticante (Barth,1954; Stehr, 1987).

Si bien algunas especies de la familia Megalopygidae fueron descriptas a partir de material proveniente de Argentina entre fines del siglo XIX y principios del XX, los estudios realizados en el país sobre esta familia en los últimos 70 años son escasos. Las últimas sistematizaciones de información mencionan entre 10 y 15 especies incluidas en tres géneros: *Megalopyge* Hübner, [1820], *Podalia* Walker, 1856 y *Norape* Walker, 1855, algunas con determinación dudosa, cambios repetidos de género y muchas de biología desconocida (Cordo et al. 2004; Pastrana, 2004; Martínez et al. 2019). De los tres, *Megalopyge* es el de mayor riqueza, con entre seis y nueve especies (Cordo et al. 2004; Hayward, 1969; Pastrana, 2004).

Según la bibliografía, al menos ocho especies de *Megalopyge* serían polífagas, habiéndose encontrado orugas sobre diferentes especies de árboles y arbustos de una amplia variedad de familias (Cordo et al. 2004; Gómez, 2014; Hall, 2019; Hayward, 1969; Pastrana, 2004). Sin embargo, no siempre los registros reflejan las plantas hospedadoras de las que realmente se alimentan las orugas, sólo dónde ellas o sus capullos fueron encontrados (Hall, 2019). El conocimiento de los hábitos de vida y de las plantas hospederas espontáneas y potenciales de cada especie permitiría anticipar riesgos de encuentro y accidentes, y podría ser el punto de partida para la construcción de mapas epidemiológicos que sirvan para un programa de vigilancia en salud pública.

En diciembre de 2019, un vecino de la ciudad de Córdoba (Argentina) denunció por redes sociales el doloroso contacto accidental con unas orugas presentes en *Punica granatum* L. (Lythraceae), un arbusto del arbolado urbano conocido como granado. Las orugas fueron reconocidas por su aspecto como del género *Megalopyge* por A. Zapata, y los síntomas incluyeron una dermatitis ligera y una neuralgia aguda que se extendió por el miembro afectado, pero remitió espontáneamente a las pocas horas (Manuel Vázquez, com. pers).

De todas las especies y subespecies de *Megalopyge*, sólo de 12 son conocidos algunos de sus estados inmaduros y/o ciclos biológicos: *M. albicollis* (Walker, 1855) (Bourquin, 1941), *M. amita* (Schaus, 1900) (Bourquin, 1951, como *M. lanceolata* (Dognin, 1923)), *M. braulio* Schaus, 1924 (Diniz et al. 2013), *M. chacona* Schaus, 1920 (Bourquin, 1948; Orfila, 1967), *M. dyari* Hopp, 1935 (Martínez, 2022), *M. hina* (Dognin, 1911) (Sihezar, 2019), *M. lanata* (Cramer, 1780) (Bourquin, 1942), *M. nuda* (Stoll, 1780) (Dyar, 1928; Schreiter, 1943), *M. opercularis* (Smith, 1797) (Bishopp, 1923; Hall, 2019), *M. undulata vulpina* Berg, 1882 (Bourquin, 1945a, b), *M. urens* Berg, 1882 (Bourquin, 1936) y *M. uruguayensis* Berg, 1882 (Specht & Corseuil, 2008).

Considerando la importancia sanitaria que podría tener la especie de *Megalopyge* encontrada en Córdoba, se propuso indagar sobre su identidad, biología y su potencialidad de colonizar especies vegetales comunes del arbolado urbano.

Materiales y métodos

Los adultos con los que se iniciaron los ensayos (Figura 1) se obtuvieron en febrero de 2020 a partir de orugas silvestres procedentes del sitio del incidente (31º 22’ 49’’ S, 64º 14’ 23’’O, 428 msnm), las que completaron su desarrollo en el laboratorio alimentadas con *P. granatum*. Las parejas se dispusieron en recipientes plásticos de 500 ml con tapa y papel tisú como sustrato para sujeción y oviposición. Los huevos (Figuras 2-3) fueron removidos diariamente, dispuestos dentro de cajas de Petri, y observados hasta la eclosión. En sendas cajas de Petri de 5 cm de diámetro con fondo de papel tisú, se dispusieron grupos de 10 orugas neonatas junto con hojas de *P. granatum* o de una de las cuatro especies vegetales alternativas en evaluación. La selección de estas se basó en especies de familias mencionadas como hospedadoras del género y que, a su vez, fueran especies frecuentes en el arbolado público de Córdoba (Plan Forestal de la Ciudad de Córdoba, 2018). Las elegidas fueron: *Lagerstroemia indica* (L.) Pers. (Lythraceae), *Fraxinus pennsylvanica (*Marshall) (Oleaceae), *Ligustrum lucidum* (L.) (Oleaceae) y *Platanus* x *hispanica* (Platanaceae). Se realizaron tres réplicas con cada una. Todas las cajas se mantuvieron a temperatura ambiente y fotoperiodo natural junto a un termómetro digital. Cada 48 horas se retiraron las mudas, se renovó el alimento y el papel, se contabilizó el número de orugas en cada estadio y se registraron las temperaturas máxima y mínima de los dos días previos. Cuando el desarrollo de los individuos lo requirió, se trasladó cada conjunto de larvas a contenedores plásticos de 500 cm^3 para permitir el adecuado crecimiento y alimentación. Las mudas se almacenaron en seco en tubos Eppendorf y los individuos muertos fueron conservados en etanol al 70%. Los capullos se dispusieron en recipientes individuales rotulados por fecha de confección y con una tira de papel tisú que permitiera la sujeción de los adultos. Al emerger los imagos, se registró fecha y el sexo.

Las descripciones se realizaron a partir de ejemplares vivos y conservados con utilización de microscopio estereoscópico (Zeiss Stemi 508) y fotografías digitales (Nikon 5100, Axiocam ERc5s y Samsung Galaxy 2016). La nomenclatura utilizada es la propuesta por Stehr (1987) para las larvas y Mosher (1917) para las pupas. La longitud corporal de larvas (sin considerar los pelos) fue medida cuando éstas se disponían a mudar. Dimensiones inferiores a 5 mm fueron tomadas con ocular micrométrico, las mayores con regla. Los colores utilizados en la descripción se aproximan, por comparación visual a la codificacióm hexadecimal disponible en https://encycolorpedia.es (código entre paréntesis).

Resultados

Descripción de los Estados Inmaduros

Huevo (Figuras 2-3): Color amarillo algo pálido (f3da0b), cilíndrico, con polos redondeados, adherido fuertemente al sustrato por un lateral o un polo con una sustancia cementicia ambarina. Corion con pequeñas depresiones dispersas sobre toda la superficie. Oviposturas unicapa de varias decenas de huevos, en general pegados en sentido longitudinal, uno al lado del otro, y cubiertos por escamas piliformes del abdomen de la hembra. Dimensiones: 1,21 ± 0,02 mm de longitud y 0,70 ± 0,02 mm de diámetro (n=10).

Larva: primer estadio (Figuras 4-5): tegumento beige amarillento (f3a505) uniforme, con una línea media dorsal longitudinal blanquecina entre T3 y A9. Forma general trapezoidal, con la región torácica notablemente más ancha que la caudal. En cada segmento, excepto en T1 y en A10, presenta verrugas dorsales, sub dorsales y laterales, del mismo color que el general, de las que emergen numerosas cerdas largas, pinnadas, flexibles y casi transparentes (pelos), y otras cortas, lisas, rígidas y más oscuras (espinas). T1 con dos verrugas dorsales aplanadas de las que emergen 6 pelos que se dirigen hacia anterior a modo de pestañas. Cabeza, patas torácicas y espuripedios del mismo color general. Cabeza siempre contra el sustrato, retraída dentro de T1 y ambos cubiertos por T2. A ventral de cada espiráculo se observa una protuberancia carnosa digitiforme. En A2 y A7 espuripedios inermes. Longitud: 2,68 ± 0,34 mm, rango: 2,2-3 mm (n=5).

Segundo estadio (Figura 6): similar al primero con mayor abundancia y longitud de las cerdas, especialmente los pelos en la zona media del cuerpo, cuyos extremos distales pueden doblarse hacia posterior. Longitud: 4,00 ± 0,14 mm; rango: 3,8-4,2 mm (n=5).

Tercer estadio (Figura 7): cubierta pilosa de color beige anaranjado algo apagado (ecd886), que cubre por completo el tegumento claro y oculta las espinas. Se destacan tres manojos de pelos más largos que el resto, flexibles y ondulados, uno dorsal y dos laterales, que surgen en la parte interna de las verrugas dorsales y subdorsales entre A3 y A5. Los manojos laterales se rizan hacia posterior. Cabeza castaña (804000) con stemmata y mandíbulas negras. Patas torácicas castañas. Longitud: 6,58 ± 0,43, rango: 6-7 mm (n=5).

Cuarto estadio (Figura 8): tegumento como en los estadios anteriores. Pelos de color como en el estadio anterio cerca del tegumento y más anaranjados en el ápice de los más largos. Los tres manojos de pelos largos observados en la etapa anterior se destacan aún más, con ápices curvados o enrulados. Presenta otros dos manojos largos, uno dirigido hacia anterior desde la zona media de T2 y otro dirigido hacia posterior desde la zona media de A9. En A5-A8 los pelos que surgen de las verrugas dorsales hacia la línea media y los dorsales de las verrugas subdorsales presentan sus extremos distales alineados y sus puntas blanquecinas comienzan a insinuar tres líneas longitudinales de guiones. Cabeza y patas torácicas como en el estadio anterior. Longitud: 8,40 ± 0,89; rango: 8-10 mm (n=5).

Quinto estadio (Figura 9): tegumento beige muy claro. Color de la cubierta pilosa muy variable entre individuos, desde un beige anaranjado algo apagado (ecd886), hasta un castaño cobrizo (a25e2a) y, en algunos ejemplares, con sectores o casi completamente negra. Los manojos de pelos largos se vuelven más rígidos y el dorsal, como una cresta, es más compacto y con las puntas dirigidas hacia posterior. Casi todas las puntas de los pelos son blancas, pero en los dorsales de las verrugas dorsales y subdorsales el sector blanco se extiende hasta casi la mitad por lo que las líneas de guiones dorsal y laterales observadas en el estadio anterior se vuelven más conspicuas. Longitud: 12,6 ± 0,55; rango: 12-13 mm (n=5).

Sexto estadio: se observaron dos fenotipos, uno muy similar en aspecto al estadio anterior, con los pelos de la cresta dorsal curvados hacia posterior, y otros con los pelos completamente rectos (Figuras 10-12). Mientras las que presentaron el primero mudaron una vez más, las que presentaron el segundo tejieron su capullo al finalizar el desarrollo. Coloración muy variable desde beige anaranjado claro apagado (ecd886) marrón oscuro (5b3a29) o rojo ladrillo (9b111e), con las hileras de guiones blancos dorsal y laterales bien marcadas. En muchos ejemplares se observaron zonas de pelos negros en el margen de T2-T3 contra el sustrato, y en el manojo que se dirige hacia anterior. Longitud de los individuos que pasaron al estadio siguiente: 16,4 ± 2,19 mm; rango: 15-20 mm (n=5).

Séptimo estadio (último): similar en aspecto y variación de color que en el estadio anterior. Cresta dorsal sólo con pelos rectos. Longitud: 20,6 ± 2,19 mm; rango: 18-23 mm (n=5).

La oruga neonata se alimenta desde el mismo momento del nacimiento comenzando con el corion y continuando con las hojas. Durante los tres primeros estadios roe o raspa la superficie foliar, especialmente la inferior, mientras que a partir del cuarto estadio mastica completamente la lámina, comenzando por los bordes, sujetando a la hoja con los segmentos torácicos a modo de pinza. Se desplazan lentamente y la cabeza queda, casi todo el tiempo, protegida por los segmentos torácicos. La alimentación es solitaria. En ocasionales encuentros con sus congéneres no se observaron comportamientos de agresión o canibalismo. Cada proceso de ecdisis, en general, no supera las 24 horas. Al completar su desarrollo cada individuo busca un espacio protegido, preferentemente sobre alguna rama, en donde confecciona el capullo.

Capullo (Figuras 13-15): al finalizar su desarrollo, la larva de último estadio confecciona un capullo de color beige grisáceo (898176), forma ahusada y, en general, adosado a lo largo de una rama. En la parte media dorsal, a la altura de donde se encontraba la cresta dorsal, se destaca una protuberancia. Bajo la capa superficial y tenue, se encuentra una segunda capa de un tejido más denso y resistente, entretejido con los pelos de la oruga. Esta segunda capa es redondeada a posterior y roma en la parte anterior, zona que quedará obliterada por una tapa u opérculo de seda. Dicho opérculo será desplazado por el adulto y en él quedará retenida la exuvia pupal. Dimensiones: externa 20 ± 2 mm x 8 ± 0,1 mm; interna 15 ± 2 mm x 8 ± 0,2 mm (n=5).

Pupa (Figura 14): exarada. Color general beige amarillento (dc9d00), abdomen más claro. Segmentos abdominales 4-6 móviles. Tergos abdominales con bandas anteriores de espinas pequeñas. Cremáster reducido a un parche de ganchos en A10. Dimorfismo sexual en las ceratotecas y muescas genitales. Dimensiones: 11 ± 1,2 mm x 5 ± 0,2 mm (n=5).

CICLO DE VIDA

Los tiempos medios, mínimos y máximos de desarrollo de los estados inmaduros alimentados con granado y la temperatura diaria media promedio se resumen en la Tabla I. No se registraron diferencias entre los tiempos de permanencia en el capullo de individuos machos y hembras, por lo que se proporciona un valor único para el estado. No se verificó el momento exacto de la muda a pupa dentro del capullo, por lo que se informa el tiempo de permanencia dentro de capullo.

Tabla I. Tiempos de desarrollo de los estados inmaduros de *Megalopyge* cf. *undulata vulpina* sobre *Punica granatum* en Córdoba, generación de otoño. d.e.= desvío estándar.

Estado	**Tiempo de desarrollo en días ± d.e (rango)**	**Temperatura promedio** (ºC)
Huevo	6 ± 1 (6-7)	27 ± 3
Larva	58 ± 3 (52-60)	28 ± 7
Capullo	60 ± 6 (55-70)	17.1 ± 5

DESARROLLO SOBRE DIFERENTES HOSPEDADORES

En la mayoría de los ensayos, a excepción de las alimentadas con *P. granatum*, al colocar las larvas de primer estadio sobre las hojas, éstas comenzaron a deambular de forma continua. En ocasiones, algunos individuos rasparon las hojas ofrecidas, pero la mayoría las evitaron y se desplazaron hacia la tapa del recipiente en un evidente comportamiento de huida. La mortalidad en todos los casos fue alta, produciéndose el deceso de la mayoría de los individuos en un rango de entre 7 y 15 días. En *L. indica*, *P. x hispanica* y *L. lucidum* el 100% de las larvas de primer estadio murieron por inanición. En *P. granatum* y *F. pennsylvanica*, algunas orugas lograron completar el desarrollo, con una temperatura promedio de 28ºC durante el estado larval (52-60 días en *P. granatum* y 77 días en *F. pennsylvanica*) y 17ºC durante el estado pupal. Los tiempos de desarrollo promedio y la mortalidad por estadio en los casos en los que el desarrollo se completó se resumen en la Tabla II. Al haberse producido una mortalidad elevada, las proporciones se indican sobre el total de individuos y no como promedio por grupo.

Tabla II. Tiempos de desarrollo en días (rango) y mortalidad (proporción) por estado y estadio de *Megalopyge* cf. *undulata vulpina* sobre *Punica granatum* y *Fraxinus pennsylvanica*. No se diferenciaron las etapas de larva no activa y pupa dentro del capullo.

	Punica granatum		*Fraxinus pennsylvanica*	
Larva	**Tiempo de desarrollo**	**Mortalidad**	**Tiempo de desarrollo**	**Mortalidad**
1º estadio	5-7	32/60	5	43/59
2º estadio	12-14	11/28	15	15/16
3er estadio	16-18	7/17	30	0/1
4º estadio	13-15	0/10	7	0/1
5º estadio	9-11	0/10	9	0/1
6º estadio	13-15	0/10	11	0/1
7º estadio	12-14	0/10	-	-
Dentro del capullo	55-70	3/10	39	0/1

Discusión

Los adultos de la especie de *Megalopyge* estudiada en el presente trabajo (Figura 1) son muy similares en envergadura alar, forma y patrón de diseño a los de *M. undulata vulpina*, *M. opercularis* y *M.*

amita (Bourquin, 1945b; Hopp,1934), pero más cercanos a los de la primera por los colores. Debido a que los adultos de este género en general son variables, se descaman fácilmente y las descripciones originales se basan principalmente en el diseño de las alas, sería necesario comparar en directo los tipos, o ejemplares de la misma procedencia, estudiar las estructuras genitales de todas y realizar análisis moleculares para dilucidar si todas son especies válidas y si la aquí estudiada es alguna de las ya descriptas. En Buenos Aires, Argentina, Bourquin describió el ciclo de una especie de *Megalopyge* a partir de huevos de un ejemplar capturado en El Tigre (Bourquin, 1945a, b). Esa especie fue inicialmente determinada por Köhler como *M. uruguayensis* Berg (Bourquin, 1945a) pero, posteriormente, Bourquin (1945b) publicó su ciclo de vida como *M. undalata vulpina*, con determinación de Schaus. Teniendo en cuenta las descripciones disponibles, así como la distribución, se consideró que la determinación como *Megalopyge* cf. *undulata vulpina* sería la más apropiada hasta que se revise la taxonomía del género.

El huevo (Figuras 2-3) es similar en aspecto, dimensiones y disposición durante la ovipostura que el de las otras especies del género de las que se conoce este estado (Bishopp, 1923; Bourquin, 1936, 1941, 1942, 1945b, 1951; Hall, 2019). El tiempo que demoró en promedio la embriogénesis de esta segunda generación en Córdoba (6 días, Tabla I), fue similar al tiempo reportado para *M. opercularis* (seis a ocho días, Bishopp, 1923) y *M. undalata vulpina* (seis días, Bourquin, 1945b), y aproximadamente la mitad que el de *M. albicollis* (13 días, Bourquin, 1941), *M. lanata* (14 días, Bourquin, 1942) y *M. urens* (14 días, Bourquin, 1936), mientras que *M. amita* tendría un valor intermedio (10 días, Bourquin, 1951). Diferentes factores podrían explicar estas diferencias, entre ellos, el número de generaciones anuales que puede desarrollar cada especie, la época del año en se realizaron los registros y la temperatura a la que se produjo el desarrollo. Así, mientras la mayoría de las especies con ciclo conocido serían bivoltinas, *M. urens*, quien presenta el tiempo de embriogénesis más prolongado, sólo tendría una generación anual. Por otra parte, en todas las especies en las que los tiempos fueron más prolongados, los registros se realizaron a fines de la primavera o comienzos del verano. Habría que conocer el tiempo de embriogénesis de la primera generación en las especies bivoltinas cuyo tiempo conocido es el de la segunda generación, para establecer si este fuese una característica propia de estas especies o las condiciones de fotoperíodo y/o temperaturas tendrían una influencia mayor en esta etapa del desarrollo.

Durante el desarrollo larval se registraron entre seis y siete estadios, con una morfología general similar a la de *M. undalata vulpina* (Bourquin, 1945a, b), aunque de ella sólo se informan entre cinco y seis estadios, igual que en *M. opercularis* (Bishopp, 1923). En los Lepidoptera no es inusual que el número de estadios larvales sea fluctuante, especialmente en camadas de larvas que se desarrollan durante otoño, llegando incluso a confundirse el número efectivo de estadios, como en *M. opercularis* (Bishopp, 1923). En general, se ha encontrado que las especies del género presentan entre cinco y nueve estadios larvales, con mayor número en aquellas con tiempo de desarrollo larval activo más prolongado y que presentan mayores dimensiones en el estado adulto, como *M. albicollis* (Bourquin, 1941) y *M. urens* (Bourquin, 1936).

Las larvas de la especie estudiada muestran características propias de la familia, como la presencia de espuripedios inermes en A2 y A7, y la retracción de la cabeza dentro del primer segmento torácico (Epstein, 1996). También la presencia de una protuberancia digitiforme glandular debajo de cada espiráculo (= sencilla digitada según Epstein, 1996). A semejanza de *M. amita* (Bourquin, 1951), *M. opercularis* (Bishopp, 1923; Hall, 2019) y *M. undalata vulpina* (Bourquin, 1945a, b), las orugas en los últimos estadios son cromáticamente variables (Figuras 9 a 12), lo que contrasta con la uniformidad de los primeros estadios (Figuras 4 a 8). Otra característica notable es la aparición de una cresta dorsal de pelos largos (Figuras 7 a 12), algo también observado en *M. amita* (Bourquin, 1951), *M. opercularis* (Bishopp, 1923; Hall, 2019) y *M. undalata vulpina* (Bourquin, 1945a, b). Sin embargo, mientras en *M. opercularis* la cresta es continua, incluyendo tórax y abdomen, en *M. amita*, *M. undalata vulpina* y las larvas estudiadas, dicha cresta se presenta solo en la región media (A2-A4). Por otra parte, si bien las orugas ilustradas y descriptas como de *M. nuda* por Stoll (1791) guardan cierta semejanza en cuanto a la presencia de cresta dorsal media elevada, en la misma no se observa el manojo de pelos largos hacia anterior y, por la descripción, parecería muy similar a la larva de *M. uruguayensis* cuya imagen aparece en Specht & Corseuil (2008). Un aspecto diferente muestra la oruga descripta por Dyar (1928), que se corresponde con la descripta e ilustrada por Schreiter (1943) bajo el nombre de *M. nuda*, y el de *M. chacona* (Bourquin, 1948; Orfila, 1967) que no presentan cresta dorsal, sino una densa cubierta de pelos claros aplanados sobre el cuerpo y dirigidos hacia posterior. Por su parte, las larvas de *M. albicollis* (Bourquin, 1941), *M. braulio* (Diniz et al., 2013) y *M. dyari* (Martínez, 2022) exhiben una densa cubierta pilosa con pelos muy largos y de aspecto esponjoso, que recubren todo el cuerpo y se unen en la línea media, mientras que las de *M. hina* serían más cortos, pero igualmente parejos y esponjosos (Sihezar, 2019). Realizando una comparación morfológica general de todo el estado larval, la especie estudiada se asemeja más a *M. undalata vulpina* (Bourquin, 1945a, b) que a cualquier otra especie del género con ciclo biológico conocido. A pesar de ello, es posible señalar algunas diferencias consistentes entre ambas. En primer lugar, y aunque puede ser subjetivo, el color de la larva de primer estadio, descripto como amarillo rojizo en *M. undalata vulpina*, mientras que las observadas durante el presente trabajo fueron siempre beige amarillento con una línea dorsal blancuzca (Figuras 4-5). Otra diferencia mucho más llamativa se documentó a partir del quinto estadio: las orugas estudiadas presentaron tres hileras de manchas blancas correspondientes a la mitad apical de los pelos de las verrugas dorsales A6-A9 y subdorsales A6-A8 (Figuras 10-12), mientras que en *M. undalata vulpina* se mencionan e ilustran sólo en los correspondientes a las de las verrugas subdorsales de tales segmentos (Bourquin, 1945b).

Si bien el tiempo de desarrollo larval total (Tabla I) fue similar al publicado sobre otras especies del género, fue notablemente más extenso que el reportado para la más semejante, *M. undalata vulpina* (35 días, Bourquin, 1945b). Quizás las condiciones artificiales de luz y temperatura a las que Bourquin sometió a sus larvas a fin de mantenerlas vivas pudieron modificar en el ritmo natural de desarrollo, ya que no estuvieron expuestas a las variaciones diarias naturales. Sin embargo, al haberlas mantenido a una temperatura media inferior respecto a la registrada en el presente trabajo (24,7 ºC vs. 28 ºC), se esperaría que el ciclo fuese más extenso y no más corto. En virtud de haber obtenido el desarrollo completo de una única larva en fresno, no es posible analizar la existencia de diferencias en el tiempo de desarrollo utilizando diferentes hospedadores. La elevada mortalidad de los primeros estadios larvales en crías en cautiverio es algo también mencionado en otras especies del género (Bishopp, 1923; Bourquin,1936, 1942).

En lo que se refiere al comportamiento de alimentación, es habitual en las orugas del género que durante los primeros estadios las larvas sólo raspen la superficie foliar, mientras que los últimos mastican las hojas desde los bordes, ingiriéndolas en su totalidad o apenas respetando la nervadura central. Lo que varía según las especies es el estadio en el que la larva deja de raspar y comienza a masticar. Esto ocurriría más temprano en las especies con menor número de estadios larvales como *M. opercularis* (Bishopp, 1923), *M. undalata vulpina* (Bourquin, 1945b) y la aquí estudiada, que lo hicieron en cuarto, mientras que *M. amita* (Bourquin, 1951), *M. lanata* (Bourquin, 1942) y *M. urens* (Bourquin, 1936) con ocho estadios, lo hicieron en el quinto. Por su parte, en *M. albicollis*, que presenta nueve estadios, las orugas empiezan a masticar la hoja completa recién en el séptimo (Bourquin, 1941). Sin embargo, como las especies hospedadoras utilizadas en todos los casos fueron diferentes, no se puede descartar que características anatómicas de ellas, como dureza o pubescencia puedan también condicionar este comportamiento de alimentación.

En cuanto a la forma de construir el capullo, pegado a lo largo de una rama, y su aspecto general, con una región anterior roma y tapada con un opérculo, es similar a todas las especies del género en las que se lo conoce. Sin embargo, por su forma ahusada (Figura 13), se parece más a los de *M. opercularis* (Bishopp, 1923; Hall, 2019), *M. undalata vulpina* (Bourquin, 1945a, b), *M. dyari* (Martínez, 2022) y *M. amita* (Bourquin, 1951) que al resto, cuya forma es mucho más ovoide (Bourquin, 1936, 1941, 1948; Orfila 1967; Schreiter, 1943; Specht & Corseuil, 2008). Una característica llamativa en los capullos de la especie estudiada es una saliente en la parte media, correspondiente con la región más alta de la cresta en la oruga. Esta particularidad es compartida con los capullos de *M. opercularis* (Bishopp, 1923; Hall, 2019), *M. undalata vulpina* (Bourquin, 1945a, b) y *M. dyari* (Martínez, 2022), característica mucho más pronunciada en esta última.

La pupa de la especie estudiada también presenta las características típicas de la familia. Como indica Mosher (1917), podo, cerato y pterotecas se encuentran separadas entre sí y del resto del cuerpo, y los segmentos abdominales 4 a 6 son móviles. Cuando el imago emerge por la boca del capullo empujando el opérculo, la exuvia queda parcialmente retenida, observándose particularmente separadas las ceratotecas (Figura 15), como se ha ilustrado en otras especies del género (Bishopp, 1923; Bourquin, 1936, 1941, 1942, 1945b, 1951; Hall, 2019; Schreiter, 1943). Por otra parte, como en *M. undalata vulpina* (Bourquin, 1945b), la pieza vítrea del ojo es del mismo color beige amarillento del resto del tegumento, a diferencia de las pupas de *M. albicollis* (Bourquin, 1941), *M. amita* (Bourquin, 1951) y *M. opercularis* (Bishopp, 1923; Hall, 2019), en las que dicha pieza es de color negro. Sin embargo, a diferencia de *M. u. vulpina*, las pterotecas son castañas en lugar de pardinegras (Figura 14). En cuanto a la permanencia dentro del capullo, en la generación de otoño se observaron tanto individuos no invernantes como invernantes. El tiempo mínimo en los individuos no invernantes (55 días) fue algo superior que el registrado en pupas equivalentes de *M. opercularis* (41 días, Bishopp, 1923), mientras que el tiempo máximo (70 días) fue inferior al mínimo registrado para *M. u. vulpina* (88 días, Bourquin, 1945b). Asimismo, el tiempo mínimo de permanencia en el capullo de la especie estudiada fue aproximadamente el mismo que los de la primera generación de *M. albicollis* (43 días, Bourquin, 1941) y *M. lanata* (55 días, Bourquin, 1942), pero superior al mínimo de la primera generación de *M. amita* (30 días, Bourquin, 1951) y de *M. opercularis* (28 días, Bishopp, 1923). Sin dudas, las condiciones ambientales de temperatura y fotoperíodo, no siempre informadas en la bibliografía, condicionan la permanencia en este estado. Registros ocasionales de la primera generación de la especie encontrada en Córdoba (Zapata, obs. pers.), sugieren que el tiempo de permanencia dentro del capullo en ésta es inferior al mínimo registrado en la segunda generación.

En cuanto a la evaluación de utilización de hospedadoras alternativas, el éxito fue escaso. La imposibilidad de completar el ciclo con una de las especies hospedadoras espontáneas utilizada por Bourquin (1945a, b) para criar a *M. undalata vulpina* (*Platanus* x *hispanica* referido como *P. orientalis*) es otro de los aspectos en los que se diferencian. Esto sugiere que la especie en cuestión tiene una preferencia diferente a la criada por Bourquin y no sería ampliamente polífaga como *M. opercularis*, una de las especies del género con mayor registro incidentes dermatitógenos en el continente americano (Hall, 2019). Sin embargo, habría que identificar cuál o cuáles son sus hospedantes naturales, para considerar cuán amplia podría ser su dieta y, por extensión, cuál podría ser el riesgo potencial de encuentros con estas larvas.

En síntesis, la especie de *Megalopyge* encontrada en la ciudad de Córdoba, Argentina, cuyo ciclo y estados inmaduros se describen aquí, presenta dos generaciones anuales, con un período amplio de permanencia en estado de larva durante la época cálida (octubre-abril) y pasa el invierno como larva de último estadio y pupa dentro de un capullo sedoso y resistente. Por las características de los adultos es una especie próxima a *M. undulata vulpina*, *M. opercularis* y *M. amita*. Si bien parecería más semejante a la primera mencionada, existen diferencias consistentes entre las larvas y pupas que permiten diferenciarlas. Sería necesaria la realización de una revisión taxonómica del género. Respecto al aspecto sanitario, si bien las larvas permanecen en el ambiente durante la mayor parte de la estación cálida y su contacto puede producir cuadros de dermatitis local y neuralgia, esta especie mostró en laboratorio escasa afinidad por las especies comunes del arbolado urbano evaluadas. Además de indagar sobre cuál o cuáles podrían ser los hospedadores naturales, habría que considerar también la posibilidad de que otras especies arbóreas o arbustivas comunes pudieran servir como hospedantes alternativos y, en tal caso, la presencia de las orugas pudiera volverse un problema sanitario.

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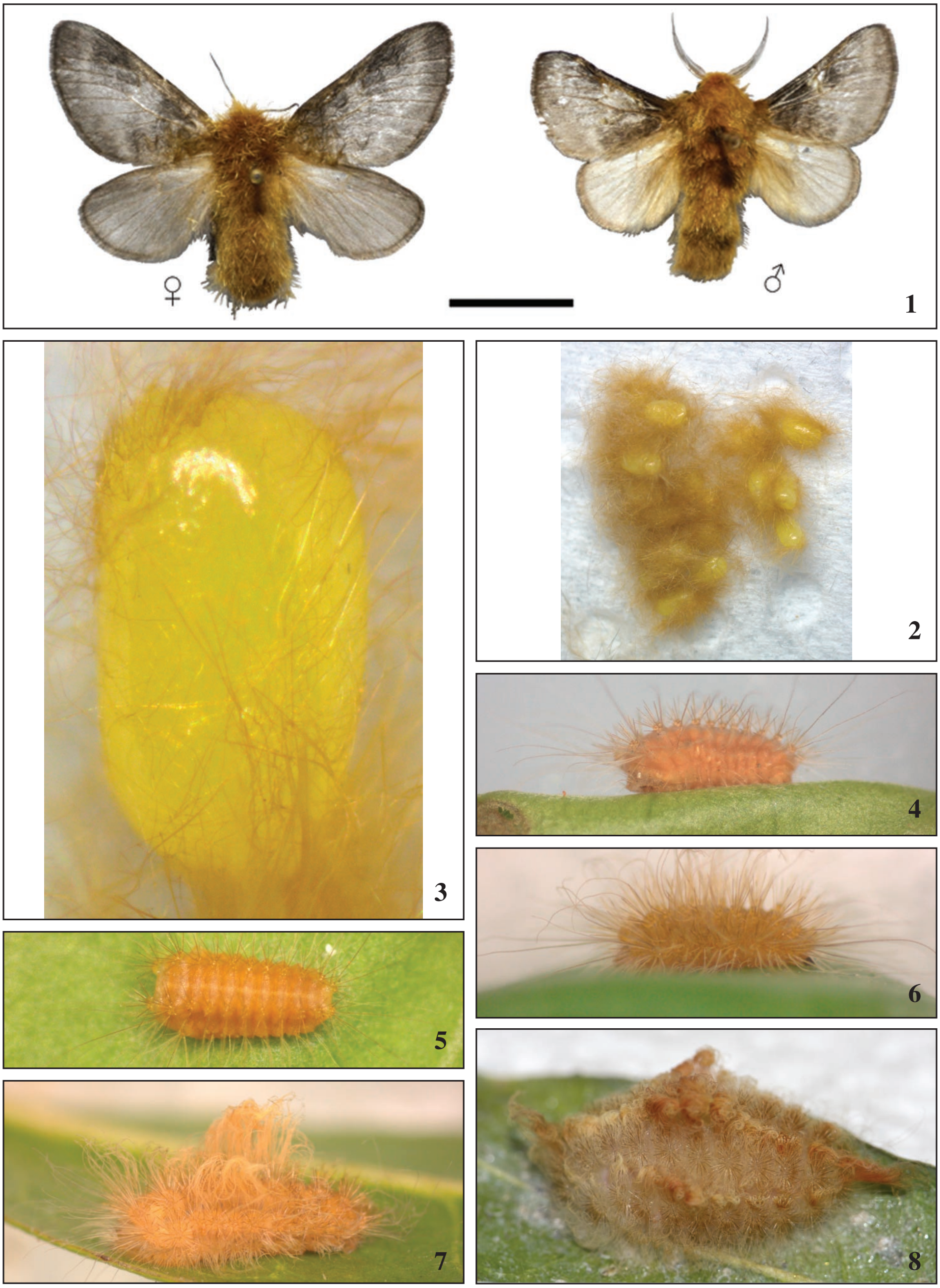

Figuras 1-8. Estados del desarrollo de *Megalopyge* cf. *undulata vulpina*. **1.** Adultos (barra = 1 cm). **2-3.** Huevos. **4-5.** Primer estadio. **6.** Segundo estadio. **7.** Tercer estadio. **8.** Cuarto estadio.


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Figuras 9-15. 9. Quinto estadio. **10-12.** Último estadio. **10.** fenotipo claro; **11.** fenotipo oscuro; **12.** vista dorsal mostrando las tres líneas de guiones blancos. **13.** Capullo. **14.** Pupa. **15.** Capullo y exuvia pupal.

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Two new species of *Pelagodes* Holloway, 1996 from Eastern New Guinea (Lepidoptera: Geometridae, Geometrinae, Thalassodini)

Aare Lindt, Lennart Lennuk & Jaan Viidalepp

Abstract

Two new species of the Indo-Australian genus *Pelagodes* Holloway, 1996 are described as new. *Pelagodes sebastiani* Lindt, Lennuk & Viidalepp, sp. nov. resembles *Pelagodes rana* Holloway, 1996 in the shape of its frog-leg-like appendages on the male eighth abdominal sternite. The appendages are strongly curved in *P. rana*, while almost straight in *P. sebastiani* Lindt, Lennuk & Viidalepp, sp. nov. The second newly described species, *Pelagodes tristani* Lindt, Lennuk & Viidalepp, sp. nov., somewhat resembles *Pelagodes furcatus* Inoue, 2006 but differs in many aspects in the ornamentation of the male genitalia. The adults and their male genitalia structures are described and illustrated. It is noteworthy that both Papuan species of *Pelagodes* share massive processes on their eight sternites.

Keywords: Lepidoptera, Geometridae, Geometrinae, Thalassodini, Pelagodes, new species, New Guinea.

Dos nuevas especies de *Pelagodes* Holloway, 1996 de Nueva Guinea oriental (Lepidoptera: Geometridae, Geometrinae, Thalassodini)

Resumen

Se describen como nuevas dos especies del género indoaustraliano *Pelagodes* Holloway, 1996. *Pelagodes sebastiani* Lindt, Lennuk & Viidalepp, sp. nov. se parece a *Pelagodes rana* Holloway, 1996 en la forma de sus apéndices en forma de patas de rana en el octavo esternito abdominal del macho. Los apéndices están fuertemente curvados en *P. rana*, mientras que son casi rectos en *P. sebastiani* Lindt, Lennuk & Viidalepp, sp. nov. La segunda especie recién descrita, *Pelagodes tristani* Lindt, Lennuk & Viidalepp, sp. nov., se parece en cierto modo a *Pelagodes furcatus* Inoue, 2006, pero difiere en muchos aspectos en la ornamentación de la genitalia del macho. Se describen e ilustran los adultos y la estructuras de su genitalia del macho. Cabe destacar que ambas especies papúes de *Pelagodes* comparten procesos masivos en sus ocho esternitos.

Palabras clave: Lepidoptera, Geometridae, Geometrinae, Thalassodini, Pelagodes, nueva especie, Nueva Guinea.

Introduction

Pelagodes Holloway is a speciose Indo-Australian genus of the tribe Thalassodini (Ban et al. 2018), which has been intensively studied in recent decades following its separation from *Thalassodes* Guenée, 1857 by Holloway (1996): Inoue (2006), Han & Xue (2010, 2011), Viidalepp et al. (2012), Sommerer & Tautel (2022), Lindt et al. (2022). Some species groups are separated from *Pelagodes* as genera of their own - *Reniformvalva* Inoue, 2006 and *Sternitornantodes* Sommerer & Tautel, 2022. The aim of the present article is to add the descriptions of two hitherto unknown species from New Guinea to this group.

Material

During late April and May 2012, the first author and Dr I. Renge (Tartu University, Estonia) collected Heterocera during their trip to the eastern part of the Indonesian New Guinean province of Highland Papua, near Womena, on both the northern and southern slopes of the Baliem Valley. Two collecting sites in tropical rainforest fragments in this dense, populated agricultural district yielded two new species of *Pelagodes* as part of the rich material that is mounted and deposited in the insect collection of the Estonian Museum of Natural History for study. This is the third publication dealing with moths from this tropical island (Lindt et al. 2017).

Methods

When mounting and identifying the geometrid moth material collected 2012 in the Papua Highlands, a series of two small green moths with appendages on the last sternite of the male abdomen were labelled as belonging to *Pelagodes rana* Holloway, 1996 and *Pelagodes furcatus* Inoue, 2006. We made a side-by-side comparison of morphological characteristics of adult moths and their genitalia slides in a series of specimens across the available populations.

A side-by-side comparison of male genitalia slides of the Malaysian *P. rana*, and Papuan series of similar specimens with frog-leg-like processes on the male last abdominal sternites yielded some differences, which together allow us to assign the Papuan population the rank of species - *Pelagodes sebastiani* Lindt, Lennuk & Viidalepp, sp. nov. - as described below. Another series is similar in appearance to *P. furcatus* Inoue, 2006 but has appendages on the eighth sternite that are broad and blade-like with a large, flat, sharply pointed lateral spine, instead of being twig- or thorn-like with some additional thin spines.

Taxonomy

Genus *Pelagodes* Holloway, 1996

Holloway, when revising the moth fauna of Borneo, separated from the widespread genus *Thalassodes* Guenée, 1857 all species with lateral appendages on the eighth sternite of male abdomen in the new genus *Pelagodes* Holloway. The males of these species also have simple hindlegs, which are slender and provided with two pairs of spurs but lack the tibial hair pencils that characterize *Thalassodes*. The moths have a bluish green colour to the wings, densely speckled with pale strigulae, and whitish lines traversing the wings (two fasciae on forewing, one fascia on hindwing). Despite the uniform wing pattern of adult moths (Figures 1, 7, 9), the species are diagnosed according to structures on underside of male abdomen without dissection (Figures 4, 5, 6).

***Pelagodes sebastiani* Lindt, Lennuk & Viidalepp, sp. nov.** (Figures 1, 2, 4, 7, 8)

Material: Holotype, ♂, INDONESIA, Papua, Jayapura, 80 m, 27-IV-2012, 02º45'06"S/140º37'04"'E, (A. Lindt), Type id. TAMZ0227602. Paratypes (24 ♂, 2 ♀: Indonesia, Papua, 1 ♂, Jayapura, 50 m, 25-IV-2012, 02º39'09"'S/140º52'27"'E; 5 ♂, Jayapura, 80 m, 26-IV-2012, 02º45'18"S/140º37'40"'E (gen. 41) Type id. TAMZ0227604; 17 ♂, 1 ♀, Jayapura, 80 m, 27-IV-2012, 02º45'06"S/140º37'04"E (gen. 680, 715) Type id. TAMZ0227605; 1 ♀, Sentani SW, 550 m, 01-V-2012, 02º46'03"S/140º10'39"E; 1 ♂, Dracis, 400 m, 02-V-2012, 02º45'06"S/140º37'04"E (A. Lindt). The holotype is deposited in the zoological collection of the Estonian Museum of Natural History (Tallinn). The paratypes are in the Estonian Museum of Natural History, in the IZBE insect collection (Tartu) and in the private collection of A. Lindt.

Description. Wingspan, 28-30 mm in males (Figure 1) and 35-36 mm in females (Figure 7). Frons colour green. Fillet white, head bluish green, thorax and abdomen bluish green. Male antennae pectinate in basal third, length of rami reaching 1.25 mm. Forewing external margin rounded, hindwing external margin angulate at middle. Forewing and hindwing concolorous, postmedian fascia whitish, fringe pale greenish. Male hind legs slender. Wings underside pale greenish.

Male genitalia (Figure 3 [gen. 680]) typical for the genus *Pelagodes*, uncus and gnathos projecting and of equal length, valva with costal sclerite strong, outcurving as dorsal process at 2/3, not sharp-tipped. Transtilla continuous, downcurved, juxta tipped with plate-shaped sclerite dorsally. Aedeagus slender. The last sternite with lateral appendages broader than in *P. rana* Holloway (compare Figure 302 in Holloway (1996)), rounded basally, connected by a flexible membrane, which has a small black sclerite posteriorly. The lateral processes are tipped with fleshy, finger-shaped, small processes, as in arboreal frogs. The last tergite broader than in *P. rana*, with its distal margin weakly concave.

Female genitalia: (Figure 8 [gen. 715]).

Discussion: The processes on the last sternite are usually slender, but broad and flat in *Pelagodes rana* (Holloway, 1996, fig. 302 and fig. 3 below), *P. waterstradti* (Holloway, 1996, fig. 304), *P. tridens* (Holloway, 1996, fig. 305) and *P. semirana* (Inoue, 2006). *Pelagodes rana* only has the processes rectangularly elbowed at the basal third (the other three species listed have generally slenderer and straight lateral processes on the sternites).

The processes on the last sternite of the new species, *Pelagodes sebastiani*, are ornamented, equally short and in a cluster at their distal ends (one distal spine much long than the others). The frog-leg-shaped ornamentation is pointed at the tips in *P. rana* (Holloway, 1996, fig. 5) but fleshy and rounded in the new species (Figure 4). The lateral processes in the newly described species are tipped with fleshy ornamentation, recalling the adhesive fingers in arboreal frogs, and do not taper to points. The sclerite between the bases of processes is V-shaped in *P. rana*. There is no V-shaped sclerite between the bases of processes of the sternite of *P. sebastiani*, and the posterior edge of the last tergite is slightly concave or nearly straight.

***Pelagodes tristani* Lindt, Lennuk & Viidalepp, sp. n.** (Figures 6, 9, 10, 11, 12)

Material: Holotype, ♂, INDONESIA, Papua, Sentani, 220 m, 24-IV-2012, 02º32’45”S/140º30’33”E, (A. Lindt), Type id. TAMZ0227603. Paratypes (1 ♂, 1 ♀): Indonesia, Papua, 1 ♂, Sentani SW, 550 m, 01-V-2012, 02°46’03”S/140°10’39”E (gen. 52); 1 ♀, Jayapura, 80 m, 26-IV-2012, 02º45’18”S/140º37’40”E (gen. 716) (A. Lindt). The holotype is deposited in the zoological collection (TAMZ) of the Estonian Museum of Natural History (Tallinn) and the paratype in the private collection of A. Lindt.

Description: Wingspan, 26-29 mm in males (Figure 11) and 29 mm in females (Figure 9). Male antennae pectinate in basal third, length of rami reaching 1.05 mm. Frons scaled, dark green. Forewing and hindwing concolorous bluish green, postmedian fascia whitish, fringe pale greenish. Dorsum of abdomen green, without ornamentation. Wing underside pale greenish. Forewing external margin smoothly rounded, hindwing external margin angulate at middle (smoothly rounded in *P. forceps*). Fillet white, head bluish green, thorax and abdomen bluish green without markings. Male hind legs slender.

Male genitalia (Figure 12 [gen. 52]) typical for the genus *Pelagodes*. Uncus and socii equal in length. The costa of the valva sclerotized with its distal quarter free, slender-tipped and upcurved (straight in *P. forceps* Inoue and almost reaching beyond the valvula), sacculus smoothly fused to valvula. Lateral processes on the last sternite arising from oblong bases (bases roundish in *P*. *forceps*), fairly curved with a pointed tip and a strong lateral spine. The medial sclerite between bases of lateral processes wide and is a deeply incised V-shape (almost straight in *P. forceps*). The last tergite is broad, smoothly roundish posteriorly. Aedeagus without sclerotization.

Female genitalia: (Figure 10 [gen. 716]).

Etymology: The new species are named after the first author’s grandsons Sebastian and Tristan Truu.

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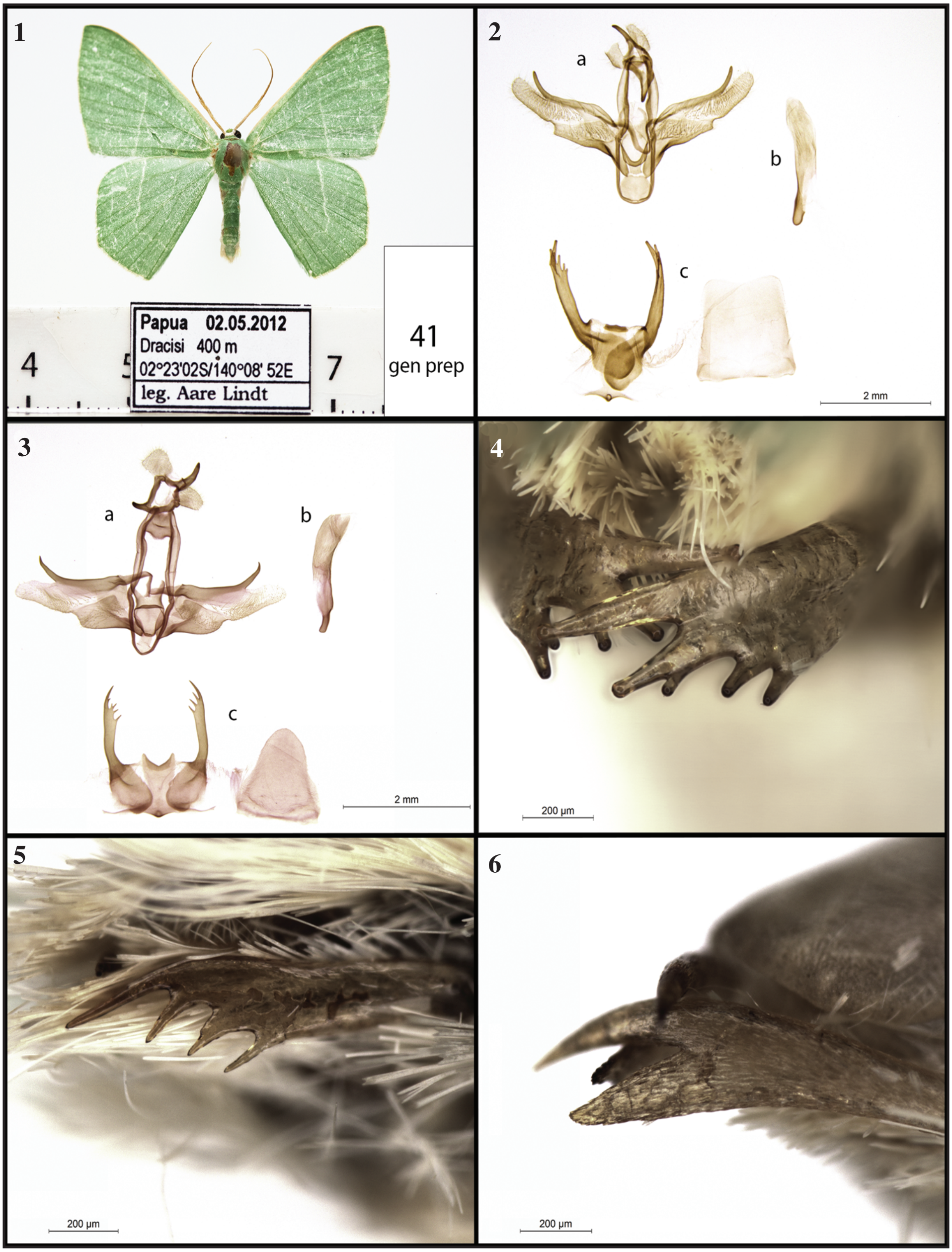
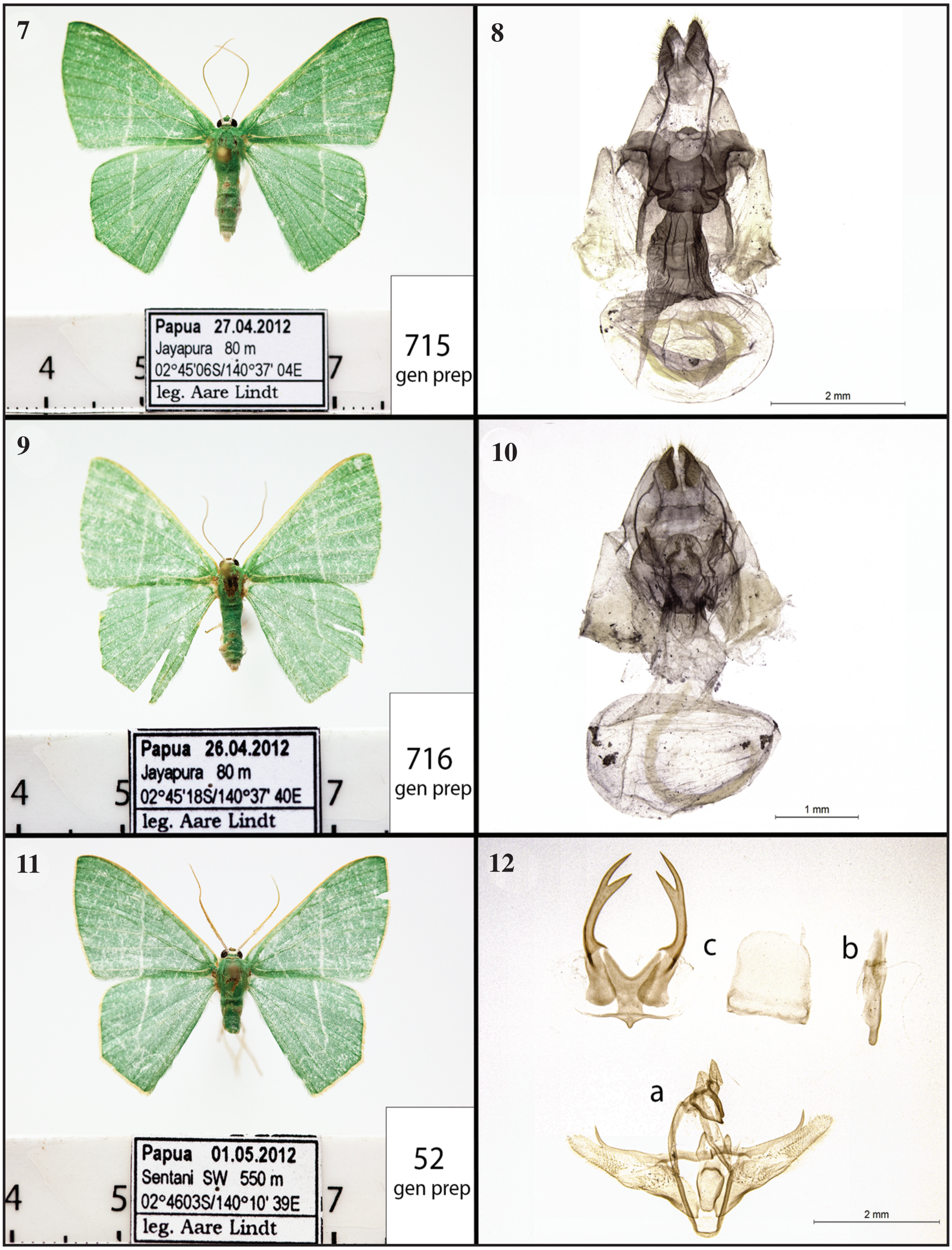


Figures 1-6. Genus *Pelagodes* Holloway: **1.** *P. sebastiani* nov. sp., ♂ paratype. **2.** *P. sebastiani* nov. sp., ♂ paratype, male genitalia: (**a.** armature, **b.** aedeagus, **c.** sternite). **3.** *P. rana*, male genitalia: (**a.** armature, **b.** aedeagus, **c.** sternite). **4.** *P. sebastiani* nov. sp., ♂ paratype, the processes on the sternite. **5.** *P. rana*, male, the processes on the sternite. **6.** *P. tristani* nov. sp., ♂ paratype, the processes on the sternite.



Figures 7-12. Genus *Pelagodes* Holloway: **7.** *P. sebastiani* nov. sp., ♀ paratype. **8.** *P. sebastiani* nov. sp., ♀ paratype, female genital armature. **9.** *P. tristani* nov. sp., ♀ paratype. **10.** *P. tristani* nov. sp., ♀ paratype, female genital armature. **11.** *P. tristani* nov. sp., ♂ paratype. **12.** *P. tristani* nov. sp., ♂ paratype, male genitalia: (**a.** armature, **b.** aedeagus, **c.** sternite).

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The northern distribution limit of *Theresimima ampellophaga* (Bayle-Barelle, 1809) in Albania: results obtained by sex pheromone traps (Lepidoptera: Zygaenidae, Procridinae)

Blerina Vrenozi & Teodora B. Toshova

Abstract

Theresimima ampellophaga (Bayle-Barelle, 1809) (Lepidoptera: Zygaenidae, Procridinae), occurs as a partly harmful species in vineyards in the Mediterranean region, where it has the proper conditions for larvae development, including the host plants and hilly relief. In 2017, has been registered as a new country record in the vineyards of the western lowland in Albania on the base of a large-scale study using traps baited with the synthetic sex pheromone of *Th. ampellophaga* females or the sex attractant EFETOV-2. The further field works in 2018 and 2019 using sex pheromone traps aimed to establish in new localities in Albania and determine the northern distribution limit of *Th. ampellophaga* in this country. In 2019, low numbers males were captured in three vineyards in Apolloni, Radostinë (district of Fier) and Dukat i Ri (district of Vlorë), southern Albania in the first half of July, all from the first generation. As a preliminary result, the northern distribution limit in Albania is reported.

Keywords: Lepidoptera, Zygaenidae, Procridinae, *Theresimima*, autochthonous grapevine, monitoring, (2*R*)-butyl (7*Z*)-tetradecenoate, Albania.

El límite de distribución septentrional de *Theresimima ampellophaga* (Bayle-Barelle, 1809) en Albania: resultados obtenidos mediante trampas de feromonas sexuales (Lepidoptera: Zygaenidae, Procridinae)

Resumen

Theresimima ampellophaga (Bayle-Barelle, 1809) (Lepidoptera: Zygaenidae, Procridinae), se presenta como una especie parcialmente dañina en los viñedos de la región mediterránea, donde tiene las condiciones adecuadas para el desarrollo de las larvas, incluyendo las plantas alimenticias y el relieve montañoso. En 2017, se ha registrado como un nuevo registro del país en los viñedos de las tierras bajas occidentales de Albania sobre la base de un estudio a gran escala utilizando trampas cebadas con la feromona sexual sintética de las hembras de *Th. ampellophaga* o el atrayente sexual EFETOV-2. Los trabajos de campo adicionales en 2018 y 2019 utilizando trampas de feromona sexual tenían como objetivo establecer en nuevas localidades de Albania y determinar el límite de distribución septentrional de *Th. ampellophaga* en este país. En 2019, se capturó un bajo número de machos en tres viñedos de Apolloni, Radostinë (distrito de Fier) y Dukat i Ri (distrito de Vlorë), al sur de Albania, en la primera quincena de julio, todos de la primera generación. Como resultado preliminar, se informa del límite de distribución septentrional en Albania.

Palabras clave: Lepidoptera, Zygaenidae, Procridinae, *Theresimima*, vid autóctona, seguimiento, (2R)-butil (7Z)-tetradecenoato, Albania.

Introduction

Theresimima ampellophaga (Bayle-Barelle, 1809), (Lepidoptera, Zygaenidae) is an oligophagous species whose larvae feed on Vitaceae hosts - grape vine *Vitis vinifera* L. and ornamental vines of *Parthenocissus* ssp. (Tarmann, 1998). Recently Efetov et al. (2023) reported the correct date of description and type locality of this species. *Theresimima ampellophaga* was documented for the first time in Albania in 2017 (Vrenozi et al. 2019). Male moths of this species were attracted to transparent Delta sticky traps using the (2*R*)-butyl (7*Z*)-tetradecenoate (the main sex pheromone compound of the conspecific females) (Subchev et al. 1998), and the racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate (sex attractant EFETOV-2) (Efetov et al. 2014). The vineyards with these first records were located in the villages of Sarandë, Vlorë, and Fier, in the southwestern Albania. The species is univoltine or bivoltine and the number of generations is different from one country to another and even in a particular country. According to the literature sources the flight of the 1st generation is from the beginning of May till late July- beginning of August, and the 2nd in between mid-August to the second part of September (Chireceanu et al. 2020; Nahirnić-Beshkova et al. 2021a; Tarmann et al., 2019; Toshova et al. 2017). Accorging to some authors univoltine and partially bivoltine populations of *Th. ampellophaga* have been also documented in Bulgaria, South Russia, Georgia, and Azerbaijan (see Toshova et al. 2017). In Albania, two generations of *Th. ampellophaga* were reported (Vrenozi et al. 2019). Similarly, two generations are known in Bulgaria (Mumun et al. 2018; Toshova et al. 2017), Greece (Subchev et al. 2006; Tarmann et al. 2019), Turkey (Can et al. 2010; Can Cengiz et al. 2012), Syria and Lebanon (Talhouk, 1969).

The larvae cause damage to leaves and buds and young grape growth, which results in the loss of photosynthesizing and fewer blossoms and reduced fruit yield (Voigt et al. 2000). The domestication of the grape varieties Shesh i Bardhë and Shesh i Zi named after the village "Shesh" in Tirana, is an established grape variety found in every village of Albania (Gixhari & Ramadani, 2016). Vrenozi et al. (2019) revealed that the male adults were attracted by the pheromone traps placed in the autochthonous grapevine varieties.

The present research work aimed to add additional data about the occurrence *Th. ampellophaga* using pheromone traps at different altitudes and grapevine varieties in Albania.

Materials and methods

Based on the results for distribution in Albania obtained in 2017 (Vrenozi et al. 2019), in this study, we focused the fieldwork on bigger vineyards from May-September, 2018. These vineyards occupied large areas, and the presence of wineries suggests they are associated with the wine-making industry. For monitoring the occurrence of *Th. ampellophaga*, vineyards randomly selected in the Western Lowland of Albania, districts of Vlorë, Fier, Lushnje, Kavajë, Tiranë, and Shkodër, either large ones or smaller ones for family production of grappa and wine. Grape varieties were mainly the autochthon Sheshi Bardhë and Sheshi Zi, but also some other varieties such as Cabernet Sauvignon, Chardonnay, Merlot, Muscat, Roditis, and Vranac. The fieldwork started with the placement of the traps in the vineyard in late May, followed by weekly inspection of them from June till September, both in 2018 and 2019. In each vineyard, two Delta sticky traps baited with the synthetic sex pheromone (2*R*)-butyl (7*Z*)-tetradecenoate (Subchev et al. 1998) (dose of 100 µg), were placed at 10 m distance and hanged 1-1.5 m from the ground.

Details about studied sites, grape varieties, presence of winery in the area, and dates when pheromone traps were set up in the vineyards are present in Table 1. Information about the management of pests in vineyards is not available.

Table 1. The monitored vineyards during 2018-2019 in Albania.

Locality	Municipality	Coordinates	Altitude (m a.s.l.)	Grapevine variety	Presence of winery	placement date
Kavajë	Kavajë	N 41º11’42.9” E 19º32’38.5”	10	Chardonnay, Cabernet Sauvignon	Yes	19-VI-2018
Maminas	Shijak	N 41º22’09” E 19º36’17”	37	Shesh i Bardhë, Shesh i Zi	Yes	19-VI-2018
Romanat	Durrës	N 41º17’30.7” E 19º35’11.6”	43	Shesh i Bardhë, Shesh i Zi	Yes	19-VI-2018
Gjokaj	Tiranë	N 41º21’55” E 19º40’33”	91	Shesh i Bardhë, Shesh i Zi	Yes	19-VI-2018
Dukat i Ri	Vlorë	N 40º16’41.3” E 19º30’11.6”	3	Shesh i Bardhë, Shesh i Zi	No	20-V-2019
Tragjas	Vlorë	N 40º19’55.7” E 19º30’06.9”	18	Merlot	No	20-V-2019
Babicë e madhe	Vlorë	N 40º28’29.9” E 19º31’18.3”	73	Shesh i Bardhë, Shesh i Zi, Muscat, Merlot	No	20-V-2019
Panaja	Vlorë	N 40º32’23.2” E 19º28’10.2”	6	Shesh i Bardhë, Shesh i Zi	No	21-V-2019
Skrofotinë	Vlorë	N 40º34’43.9” E 19º28’44.4”	6	Shesh i Bardhë, Shesh i Zi	No	21-V-2019
Libofshë	Fier	N 40º49’12.4” E 19º33’54.6”	9	Vranac, Rhoditis	No	22-V-2019
Frakull e madhe	Fier	N 40º38’48.6” E 19º30’38.1”	31	Shesh i Zi	No	22-V-2019
Ardenicë	Fier	N 40º49’37.8” E 19º35’14.9”	108	Merlot, Cabernet Sauvignon	No	22-V-2019
Hajmel	Vau i Dejës	N 41º57’51.6” E 19º38’25.2”	34	Kallmet, Shesh i Bardhë	No	22-VI-2018
Radostinë	Fier	N 40º43’56.1” E 19º29’39.8”	35	Shesh i Bardhë, Shesh i Zi	No	23-V-2019
Apolloni	Fier	N 40º43’45” E 19º28’48”	35	Shesh i Bardhë, Shesh i Zi	No	23-V-2019

Results

In 2018, no *Th. ampellophaga* males were captured by the pheromone traps placed in central and northern Albania. This led us to set up the traps in the southern vineyards in 2019, where we already had some results from the previous study in 2017 (Vrenozi et al. 2019), and 14 km more northern.

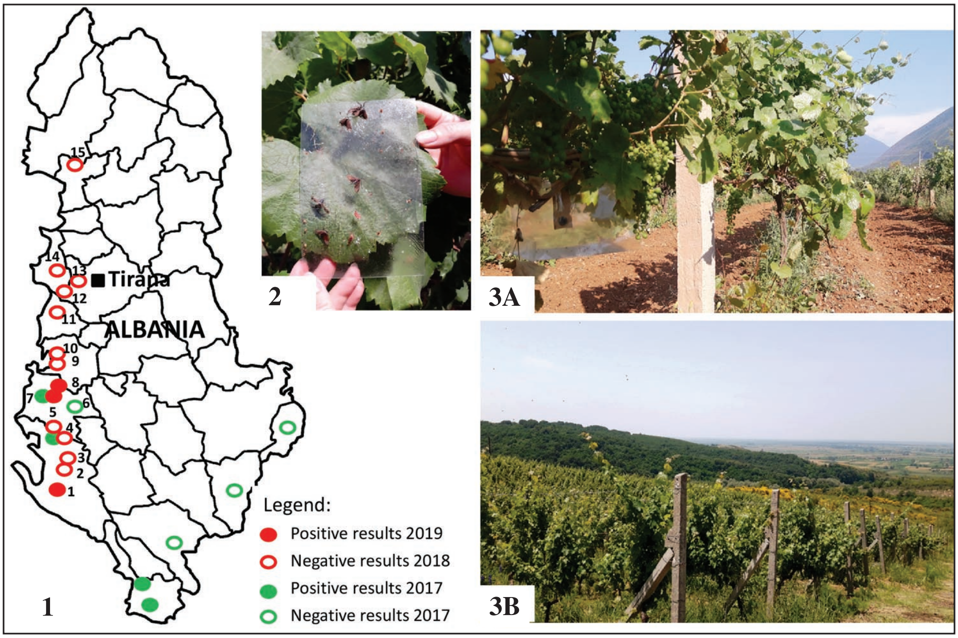
The results of the field monitoring in 2019 revealed the presence of *Th. ampellophaga* in vineyards in two new localities in Albania - Dukat i Ri (Vlorë) and Radostinë (Fier) (Table 2).

Table 2. Total catches of *Th. ampellophaga* males in the study localities in Albania in 2019.

Locality	Placement	**Total number of *Th. ampellophaga* per given period**	
		01-06-VII-2019	07-14-VII-2019
Dukat i Ri	20-V-2019	6 ♂	-
Apolloni	23-V-2019	1 ♂	-
Radostinë	23-V-2019	-	1 ♂

At the two localities, where autochthonous grapevine varieties Shesh i Bardhë and Shesh i Zi are present, the relative abundance of the target species was low. In addition to that, there were higher expectations on the vineyard in Apolloni (Fier) that had a previous documented case of the presence of the moth (Vrenozi et al. 2019), nevertheless, only a single male specimen was registered.

Southern vineyards with positive results for the vine bud moth presence were in the municipalities Vlorë and Fier (Figures 1-3), and the vineyards northern to Fier, such as in Lushnje, Kavajë, Shijak, Durrës, Tiranë, and Vau i Dejës municipalities showed the absence of this species.



Figures 1-3. 1. Distribution map of the monitored vineyards in Albania: red color - expeditions from this study; green color - results of 2017 (Vrenozi et al. 2019): filled circle - positive results, empty circle - no results. **2**. Male adults in sticky traps. **3**. New vineyards with presence of vine bud moth: **A** - Dukat i Ri, **B** - Radostinë

Discussion

The absence of the target species in 2018 could relate to the influence of climatic factors, natural enemies, use of pesticides, vine variety or complex factors (Anastasova & Georgieva, 1975; Dominici & Pucci, 1987; Pucci & Dominici, 1986). Pucci & Dominici (1986) reported that in addition to the rainfalls, winds and higher temperatures that kill the preadult instar of the vine bud moth, fungicide and insecticide commonly sprayed in summer against other pests (mites and grape berry moth) are dangerous for *Th. ampellophaga*. Considering the lack of moths during the fieldwork of 2018, the year later, we placed the traps in small vineyards (Apolloni) for family usage, with mainly the autochthones grape varieties, close to the areas with previous confirmed data on the presence of the vine bud moth and a bit further in the northern vineyards. The results showed the presence of the target species in relatively low population density, similar to Vrenozi et al. (2019). The new records in the vineyard of the village Radostinë revealed the northern limit of this species in Albania. The northern limit is not related to the higher altitudes, except to the different latitudes, different grapevine varieties, and to the association with the wine-making industry (Table 1).

Presence of *Th. ampellophaga* in 2019 in the vineyards with the resistant variety of French hybrid (a crossing between *V. vinifera* and another *Vitis* species) in Apolloni, reinforces that the limited usage of chemical pesticides in the vineyards is the main reason of the moth occurrence (Pucci & Dominici, 1986). Shesh i Bardhë and Shesh i Zi were confirmed in this study as varieties susceptible (Vrenozi et al. 2019), in the two new vineyards in the villages Dukat i Ri and Radostinë. These two varieties are among the most important cultivars for Albanian viticulture (Kullaj et al. 2015). The autochthonous grape varieties have gone through the natural selection of many decades and have shown to be resistant to harsh climate conditions, low soil quality, pest species, and diseases. Therefore, the usage of pesticides is a minor necessity, and this doesn't impact sustainable grape production (Gixhari & Ramadani, 2016).

Both grape varieties belong to the small to medium vineyards, positioned on the western and eastern sides of the hills, which have a maximum altitude of up to 35 m a.s.l. Nevertheless, studies have shown that *Th. ampellophaga* is present also in higher altitudes in the southern Balkans, such as in Bulgaria (478 m a.s.l., Gornoslav, 231-239 m a.s.l., Lozitsa, Toshova et al. 2017; 254 m a.s.l., Mumun et al. 2018, 270 m a.s.l, Nahirnić-Beshkova et al. 2021b), Greece (90 m a.s.l., May & Tarmann 2020), North Macedonia (168-715 m a.s.l., Nahirnić-Beshkova et al. 2021a), Turkey (115 m a.s.l., Can Cengiz et al. 2018; 310 m a.s.l., Can et al. 2022).

Catches of *Th. ampellphaga* males at the first half of July, 2019 revealed that they are from the first generation of this species. In the previous study in 2017 in Albania (Vrenozi et al. 2019), catches during the period of end of June - beginning of July and September were recorded, that showed two generations of the vine bud moth. Similarly, variation in voltinism of *Th. ampellophaga* was reported in Bulgaria (Toshova & Subchev, 2002; Toshova et al. 2017; Mumun et al. 2018), Greece (Subchev et al. 2006; Tarmann et al. 2019) and Turkey (Can et al. 2010). The vine bud moth usually develops two generations annually in southern areas of its distribution. Usually many species and populations are bivoltine or multivoltine at lower latitude and univoltine - at higher latitude. The location and environmental conditions are important factors that explained most of the variation in phenologies of many insect species (Altermatt 2010; Marchioro et al. 2021; Numata & Shintani 2023).

Conclusions

In 2019, low numbers of males were captured in three vineyards of Fier (Apolloni, Radostinë) and Vlorë (Dukat i Ri) in the first half of July. All specimens were from the first generation. Northern limit presence in Albania was so far in the district of Fier (village Radostinë).

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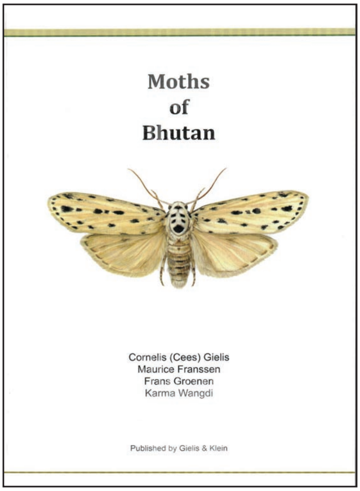

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Moths of Buthan
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Tenemos en nuestras manos la segunda edición, más extensa, sobre la fauna de Lepidoptera Heterocera de este país montañoso y desconocido, entomológicamente, como es Bután, llegando a registrarse e identificarse unas 1.938 especies, de las que se representan en color 1.424 especies en 196 planchas, gracias al trabajo y dedicación de los autores.

Después de la introducción y los agradecimientos, nos hablan de los métodos utilizados y las localidades visitadas, continuando con el grueso del libro donde se representan las especies conocidas de las superfamilias Eriocranioidea, Hepialoidea, Nepticuloidea, Tineoidea, Gracillarioidea, Yponomeutoidea, Gelechioidea, Alucitoidea, Pterophoroidea, Carposinoidea, Choreutoidea, Tortricoidea, Cossoidee, Zygaenoidea, Thyridoidea, Hyblaeoidea, Pyraloidea, Depranoidea, Lasiocampoidea, Bombycoidea, Geometroidea y Noctuoidea.

De cada una de las especies consideradas, nos presentan los datos taxonómicos y las localidades donde han sido capturados, así como algunas de las sinonimias más significativas.

La importancia del trabajo aumenta, con la descripción de 14 especies nuevas, a saber: *Glyphipterix maculangulata* Gielis & Wandgi, *Ethmia weleda* Gielis & Wangdi, *Capua similiana* Groenen & Wangdi, *Eupoecilia aurantiacus* Groenen & Wangdi, *Acrolita grandmacula* Groenen & Wangdi, *Dasodis dorsomacula* Groenen & Wangdi, *Peridaedala tresidana* Groenen & Wangdi, *Phiaris himalayana* Groenen & Wangdi, *Thaumatotibia plicara* Groenen & Wangdi, *Sesia gielisi* Garrevoet & Wangdi, *Micromelatopha schintimeisteri* Gielis & Wangdi, *Cranionycta keeskleini* Gielis & Kiss, *Cranionycta punakhae* Gielis & Kiss y *Thalsthoides deothangae* Gielis & Wangdi, de las que se presentan fotografía de los adultos y de su genitalia.

La obra termina con un Addendum, en el que se incluyen nuevas especies para la fauna de Bután, anteriormente no mencionadas; de unas referencias muy detalladas que afectan a la zona estudiada y de un índice.

No podemos terminar estas líneas sobre este excelente trabajo, sin felicitar a los autores por la realización de tan importante contribución, que no debe de faltar en ninguna biblioteca que se precie, tanto institucional como particular

El precio de este libro es de 35 euros y los interesados lo pueden pedir a:

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Descripción de la hembra de *Coleophora alfacarensis* Baldizzone, 1998 y otras citas de interés para España (Lepidoptera: Coleophoridae, Gelechiidae, Tortricidae)

Javier Gastón

Resumen

Se describe la hembra de *Coleophora alfacarensis* Baldizzone, 1998, desconocida hasta ahora. Se aportan registros que constituyen primeras citas para España, como *Coleophora pulmonariella* Zeller, 1839; *Coleophora aleramica* Baldizzone & Stübner, 2007; *Coleophora asteris* Mühlig, 1864; *Coleophora thurneri* Glaser, 1969; *Coleophora pseudociconiella* Toll, 1952 y *Psamathocrita dalmatinella* Huemer & Tokar, 2000. Se presenta el segundo registro confirmado de *Coleophora albidella* ([Denis & Schiffermüller], 1775) y tercero de *Coleophora quadristraminella* Toll, 1961, en España. Por último, se representa por primera vez la genitalia hembra de *Cochylimorpha sparsana* (Staudinger, 1880).

Palabras clave: Lepidoptera, Coleophoridae, Gelechiidae, Tortricidae, nuevas especies, España.

Description of the female *Coleophora alfacarensis* **Baldizzone, 1998 and other records of interest for Spain (Lepidoptera: Coleophoridae, Gelechiidae, Tortricidae)**

Abstract

Unknown until now, the female of *Coleophora alfacarensis* Baldizzone, 1998 is also described. Records are provided that constitute first records for Spain, such as *Coleophora pulmonariella* Zeller, 1839; *Coleophora aleramica* Baldizzone & Stübner, 2007; *Coleophora asteris* Mühlig, 1864; *Coleophora thurneri* Glaser, 1969; *Coleophora pseudociconiella* Toll, 1952 and *Psamathocrita dalmatinella* Huemer & Tokar, 2000. The second confirmed record of the *Coleophora albidella* ([Denis & Schiffermüller], 1775) and the third of *Coleophora quadristraminella* Toll, 1961, in Spain is presented. Finally, the genitalia female of *Cochylimorpha sparsana* is represented for the first time (Staudinger, 1880).

Keywords: Lepidoptera, Coleophoridae, Gelechiidae, Tortricidae, new species, Spain.

Introducción

Como consecuencia de una revisión de la familia Coleophoridae de mi colección, he detectado algunas especies que, aunque frecuentes, o no raras fuera de España, constituyen primeras o segundas citas o para nuestro país, a las que habría que añadir una especie de Gelechiidae que por su pequeño tamaño puede pasar desapercibida en los muestreos de campo como *Psamathocrita dalmatinella* Huemer & Tokár, 2000.

Entre los Coleophoridae, me llamó la atención especialmente una hembra procedente de Casla (Segovia), recolectada en el mismo biotopo que una serie de machos todos ellos identificados por genitalia como *Coleophora alfacarensis* Baldizzone, 1998. Realizada la genitalia, demostró ser la hembra de esa especie, dato que corroboré al estudiar otros exx., también hembras, del mismo lote, por lo que a sabiendas de que no se conocía hasta este momento la hembra de esta especie, paso a describirla.

Material y métodos

El material utilizado para este estudio se ha obtenido mediante muestreos nocturnos y diurnos, con trampas de luz actínica distribuidas en los biotopos apropiados en las diferentes regiones afectadas. Para su identificación nos hemos basado en el examen comparativo de los caracteres morfológicos externos y, sobre todo, en el análisis de la estructura genital de los ejemplares. La preparación de la genitalia se ha efectuado siguiendo las técnicas estándar (Robinson, 1976), con modificaciones.

Para la documentación fotográfica de las preparaciones de la genitalia se han utilizado el microscopio Nikon Eclipse E400, Nikon SMZ1 Stereo microscope y la cámara digital NIKON D3100. Para la documentación fotográfica de los ejemplares adultos, se ha utilizado la cámara digital Sony á100 DSLR-A100K con objetivo AF 100 MACRO 1:2.8 (32), para los retoques fotográficos se han realizado con el programa Adobe Photoshop ©.

Abreviaturas

JG	Javier Gastón
ER	Emili Requena
LT	Localidad Tipo
prep. gen.	preparación de genitalia

Resultados

COLEOPHORIDAE

Coleophora alfacarensis Baldizzone, 1998 (figura 3)
Coleophora alfacarensis Baldizzone, 1998. *SHILAP Revta lepid., 26*(101), 49
LT: ESPAÑA, Sierra de Alfacar, Granada.

Material examinado: ESPAÑA, BURGOS, La Vid, a 950 m, 1 ♂, 31-VIII-2022, J. Gastón leg. y col., prep. gen. 10043JG. SEGOVIA, Casla (Sierra de Arcones), a 1.150 m, 1 ♂, 29-VIII-2021, J. Gastón leg. y col.; Idem, 2 ♂, J. Gastón leg. y col., prep. gen. 9713JG (figura 19) y 9938JG; Idem, 1 ♀, 29-VIII-2021, J. Gastón leg. y col., prep. gen. 9716JG (figura 20); Idem, 1 ♂, 9-IX-2021, J. Gastón leg. y col., prep. gen. 10050JG; Idem, 1 ♀, 9-IX-2021, J. Gastón leg. y col., prep. gen. 9801JG.

Descripción de la hembra (figura 3): Envergadura, 10 mm (n=2). La morfología de las hembras no difiere de la de los machos. Me remito a la descripción original (Baldizzone, 1998).

Genitalia de la hembra (figuras 20, 20a y 20b): Papilas anales relativamente pequeñas, ovaladas y alargadas. Apófisis posteriores 3,3 veces más largas que las anteriores, que son muy cortas. Sterigma (8º sternito) de forma prácticamente rectangular, casi trapezoidal, con los bordes laterales ligeramente convexos y muy esclerotizado. El sinus vaginalis es muy pequeño ya que el ostium bursae se encuentra en la parte posterior del sterigma, cercano al 9º segmento. Ostium bursae en forma de una U abierta con base amplia. Antrum bursae troncocónico, en forma de copa alargada y muy esclerotizado. Colliculum membranoso con dos placas simétricas en posición vertical levemente esclerotizadas. El ductus busae, estrecho y de gran longitud, es transparente excepto en su parte central, donde presenta un tramo levemente esclerotizado. En su parte posterior, junto al colliculum, presenta una pequeña zona (similar en longitud al colliculum) cubierta de escamas en cuyo interior se vislumbra una lámina mediana. El corpus bursae es ovoidal y bastante pequeño en comparación con el resto de la estructura, con un signum de gran tamaño muy esclerotizado, formado por una amplia base y un pequeño gancho curvado hacia el interior.

Biología: Desconocida.

Distribución: Endemismo ibérico conocido hasta el momento del sur de España y del Algarve, en Portugal (Baldizzone, 1998). Las citas que se aportan en este trabajo amplían su distribución a la parte central de España. Por lo tanto, se trata de una especie bien distribuida por la Península Ibérica, con poblaciones en diferentes pisos bioclimáticos; el supramediterráneo en el centro de la Península, el mesomediterráneo en la zona de Alfacar y el termomediterráneo en El Algarve portugués (Rivas-Martínez, 1987). Seguramente esta especie esté mucho más extendida en la Península Ibérica, pudiendo pasar desapercibida dado el pequeño tamaño y su poca llamativa morfología externa.

Coleophora pulmonariella Ragonot, 1875 (figura 6)
Coleophora pulmonariella Ragonot, 1875. *Annls Soc. ent. Fr.*, (5) *4*, 593
LT: FRANCIA, Seine-et- Oise, Forêt de Sénart.

Material examinado: ESPAÑA, BURGOS, Castrobarto, a 770 m, 1 ♂, 27-VII-2020, J. Gastón leg. y col.; Idem, 12-VIII-2021, J. Gastón leg. y col., prep. gen. 9774JG, (figura 13).

Biología: Larva sobre varias Boraginaceae. Se ha criado con *Buglossoides purpurocaerulea* (L.) I. M. Johnst. Se trata de una especie monovoltina, que vuela desde finales de mayo y durante todo el mes de junio (Baldizzone, 2019). Las citas españolas no coinciden con lo expuesto por Baldizzone (2019), ya que las capturas se han realizado a finales de julio hasta mediados de agosto.

Distribución: Se trata de un elemento Sibirico-Europeo. Se conoce su presencia en Suecia, Dinamarca, Portugal, Francia, Italia, Austria, Alemania, República Checa, Eslovaquia, Hungría, Rumania, Polonia, Sur de Siberia hacia el este hasta Altai, (Baldizzone, 2019). El registro de Burgos supone la **primera cita para España**, ya era conocida de Portugal.

Coleophora aleramica Baldizzone & Stübner, 2007 (figura 4)
Coleophora aleramica Baldizzone & Stübner, 2007, *in* Stübner. *Nota lepid., 30*(1), 160
LT: ITALIA, Piemonte, Asti, Valmanera.
Material examinado: ESPAÑA, BURGOS, Castrobarto, a 770 m, 1 ♂, 27-VI-2020, J. Gastón leg. y col., prep. gen. 9883JG; Idem, 1 ♂, 13-VI-2021, J. Gastón leg. y col., prep. gen. 9898JG. (figuras 12 y 12a).

Biología: Desconocida.

Distribución: Italia (incluida Sicilia), Austria, Eslovaquia, Hungría, Croacia, Montenegro, Macedonia, Grecia, Turquía y Jordania (Baldizzone, 2019). El registro de Burgos supone la **primera cita para España**. Siguiendo a VIVES MORENO (2014), habría que colocarla delante de ***C. hieronella* Zeller, 1849**.

Coleophora quadristraminella Toll, 1961 (figuras 1 y 2)
Coleophora quadristraminella Toll, 1961. *Sber. öst. Akad. Wiss., 170*, 285
LT: MACEDONIA, Valle del fiume Treska.
= *Multicoloria pontica* Reznik, 1984. *Ent. Obozr., 63*, 773 (Budashkin, 2013, p. 5)
LT: UCRANIA, Crimea, Karadag.

Material examinado: ESPAÑA, BURGOS, La Vid, a 950 m, 1 ♂, 31-VIII-2022, J. Gastón leg. y col., prep. gen. 10007JG. TERUEL, Tramacastilla, a 1.265 m, 1 ♂, 3-IX-1994, J. Gastón leg. y col., prep. gen. 9982JG. SORIA, Aldehuela de Calatañazor, a 1.125 m, 1 ♂, 19-VIII-2020, J. Gastón leg. y col., prep. gen. 9839JG (figura 10); Segovia, Casla, 1165 m, 1 ♂, 7-IX-2018, J. Gastón leg. y col., prep. gen. 9954JG; Idem, 1 ♀, J. Gastón leg. y col., prep. gen. 9800JG; Casla, a 1.165 m, 1 ♀, 29-VIII-2022, J. Gastón leg. y col., prep. gen. 9948JG (figuras 21, 21a y 21b). ZARAGOZA, Torralba de los Frailes, a 1.050 m, 1 ♂, 5-IX-1997, J. Gastón leg. y col., prep. gen. 10004JG.

Biología: Las larvas se desarrollan sobre *Achilea millefolium* L. y *A. odorata* L. (Asteraceae). La nutrición comienza en septiembre con la construcción del estuche primario donde la larva se alimenta hasta finales de octubre, momento en el que entra en diapausa invernal hasta comienzo de abril, en que continúa alimentándose. El desarrollo se completa en julio y crisálida en el mes de agosto. El adulto es monovoltino, presente en agosto-septiembre (Baldizzone, 2019).

Distribución: Especie termófila que vuela en España, Francia meridional, Italia (incluida Sicilia), Croacia, Rumanía, Macedonia, Grecia, Ucrania, Crimea, Turquía, Armenia, Rusia (Urales meridionales) y Egipto (Baldizzone, 2019). Ya era conocida de España, concretamente de Cataluña (Dantart (2015), p. 50) y (Requena et al. 2021), siendo ésta la primera cita fuera de Cataluña.

Coleophora asteris Mühlig, 1864 (figura 7)
Coleophora asteris Mühlig, 1864. *Stettin. Ent. Ztg., 25*, 162
LT: ALEMANIA, Biberer Höhe cerca de Offenbach
= *Coleophora tripoliella* Hodgkinson, 1875. *Entomologist, 8*, 55
LT: GRAN BRETAÑA, Fleetwood.

Material examinado: ESPAÑA, SEGOVIA, Casla (Sierra de Arcones), a 1.150 m, 1 ♂, 9-IX-2021, J. Gastón leg. y col.; Idem, 1 ♂, prep. gen. 10051JG, (figura 14).

Biología: Planta nutricia: *Aster amellus* L.*, Aster sedifolius* L.*, Aster linosyris* (L.) Bernh.*, Tripolium pannonicum* (L.) Greuter (Asteraceae) (Emmet et al. 1996). Especie monovoltina, presente desde junio a comienzos de septiembre (Baldizzone, 2019).

Distribución: Gran Bretaña, Noruega, Suecia, Finlandia, Italia, Bélgica, Holanda, Austria, Rumanía, Creta, Ucrania y Marruecos (Baldizzone, 2019). Se trata de la **primera cita para España**. Siguiendo a VIVES MORENO (2014), habría que colocarla delante de ***C. asteris* Mühling, 1864**.

Coleophora thurneri Glaser, 1969 (figura 8)
Coleophora thurneri Glaser, 1969. *Z. Wien. ent. Ges., 53*, 6
LT: ITALIA, Friuli, Gemona, Lago di Cavazzo.

Material examinado: ESPAÑA, BURGOS, Castrobarto, a 770 m, 1 ♂, 13-IX-2020, J. Gastón leg. y col., prep. gen. 10068JG, (figura 11).

Biología: Planta nutricia: *Artemisia alba* Turra (Asteraceae). Especie monovoltina, presente desde comienzo de junio a mediados de agosto (Baldizzone, 2019). El material examinado demuestra que en España se encuentra hasta mediados de septiembre.

Distribución: Francia, Italia, Croacia, Macedonia, Bulgaria (Baldizzone, 2019). El registro de Burgos es la **primera cita para España**. Siguiendo a VIVES MORENO (2014), habría que colocarla detrás de ***C. trochilella* (Duponchel, [1843] 1842, *in* Godart & Duponchel)**.

Coleophora albidella ([Denis & Schiffermüller], 1775)
Tinea albidella [Denis & Schiffermüller], 1775. *Wien. Verz.,* 137
LT: AUSTRIA, alrededores de Viena.
Phalaena (Tinea) trembleyella Villers, 1789. *Caroli Linn. Ent.,* (2), 527
LT: EUROPA.
Ornix palliipennella Treitschke, 1833, in Ochsenheimer. *Europe Schmett., 9*(2), 212
LT: ALEMANIA, Sachsen, HUNGRIA.
Coleophora incanella Tengström, 1848. *Notis, Sällsk. Fauna & Fl. Feen. Förh., 1*, 140
LT: FINLANDIA, Oulu.
Coleophora razowskii Căpuşe, 1971. *Alexanor, 7*(4), 162
LT: SUECIA, Vännäs, Vännäsby.

Material examinado: ESPAÑA, BARCELONA, Anoia, Òdena, a 380 m, 1 ♂, 25-VI-2006, E. Requena leg. y col., prep. gen. ER3351, (figura 16).

Biología: Frecuenta los bosques húmedos, riberas de ríos y torrentes. Especie monovoltina que vuela en junio y julio (Baldizzone, 2019).

Distribución: Casi toda Europa llegando a Siberia central, Altai y el extremo oriente de Rusia hasta el Japón (Baldizzone, 2019). Hay una primera mención de su presencia en España (Kautz, 1928), de Granada (Vives Moreno, 1987), aunque el mismo autor indica posteriormente que dicha presencia debería confirmarse (Vives Moreno, 2014). La confirmación definitiva se produjo mediante la cita de un ejemplar macho capturado en Cantabria, Carmona, 8-VI-2015 (Laπtùvka et al. 2017) El ejemplar estudiado en este trabajo sería el segundo registro confirmado de la especie; fue citado erróneamente como *Coleophora bernoulliella* (Goeze, 1783), (Requena et al. 2021) (figura 17).

Coleophora pseudociconiella Toll, 1952 (figura 5)
Coleophora pseudociconiella Toll, 1952. *Z. wien. ent. Ges., 37*, 163
LT: AUSTRIA, Viena.
= *Hamuliella patrascui* Nemeş, 2003. *Coleophoridae Rom.*, 40
LT: RUMANIA, Gura Văii.

Material examinado: ESPAÑA, Burgos, San Martín de Don, a 950 m, 1 ♂, 6-IX-1986, J. Gastón leg. y col., prep. gen. 10126JG, (figura 18).

Biología: Planta nutricia: *Polygonum aviculare.* Especie monovoltina, presente desde mediados de agosto a mediados de septiembre (Baldizzone, 2019).

Distribución: Especie distribuida por la parte oriental de Europa desde Austria hacia el Este llegando hasta China. No está presente en la zona del Mediterránea excluyendo Cerdeña y Turquía. Considerando esta disyunción con nuestro territorio, sería conveniente analizar molecularmente las poblaciones españolas para asegurarse de que no se trata de una especie diferenciada de la de Europa del Este. Es, por lo tanto, la **primera cita para España**. Siguiendo a VIVES MORENO (2014), habría que colocarla detrás de ***C. burmanni*** **Toll, 1952**.

GELECHIIDAE

Psamathocrita dalmatinella Huemer & Tokár, 2000 (figura 9)
Psamathocrita dalmatinella Huemer & Tokár, 2000. *Z. ArbGem. öst. Ent., 52*, 2, Abb. 1, 5-8.
LT: CROACIA, Dalmacia, vic. Gravosa.

Material examinado: ESPAÑA, Burgos, 1 ♂, Castrobarto, a 770 m, 13-VI-2021, J. Gastón leg. y col. prep. gen. 9937JG, (figura 15).

Biología: Los datos conocidos sobre su biología son algo confusos (Huemer et al. 2000). Estos autores precisan que, según lo indicado en su etiqueta original, las larvas se criaron sobre *Achillea holosericea* Sm.

Distribución: La especie se distribuye por Croacia, Francia, Portugal, y ahora, como **primera cita, España**. Tanto el género ***Psamathocrita*** **Meyrick, 1925**, como la especie ***P. dalmatinella*** **Huemer & Tokár, 2000**, son nuevos para España y siguiendo a VIVES MORENO (2014), habría que colocarlos detrás del género ***Megacraspedus*** **Zeller, 1839**.

TORTRICIDAE

Cochylimorpha sparsana (Staudinger, 1879)
Cochylis sparsana Staudinger, 1879, *Horae Soc. Ent. Ross., 15*, 239
LT: TURQUIA [Amasia].

Material examinado: ESPAÑA, Ávila, Muñochas, a 1174 m, 1 ♀, 19-V-2022, J. Gastón leg. y col., prep. gen. 9597JG.

Genitalia de la hembra (figuras 22 y 22a): Papilas anales membranosas, de buen tamaño, ovaladas y alargadas. Apófisis posteriores algo más cortas que las anteriores, que son 1,2 veces más largas que el 8º segmento, y que por su longitud alcanzan la base del corpus bursae. El 8º segmento es de forma rectangular, alargado. El ostium bursae tiene la forma de una U muy abierta y es membranos, con base muy amplia. Antrum bursae troncocónico, en forma de copa alargada y membranoso. Ductus bursae membranoso, ancho y muy corto, con grandes pliegues sinuosos en posición vertical que se prolongan parcialmente por la parte posterior del corpus bursae. El corpus bursae es ovoidal y bastante grande en comparación con el resto de la estructura; sin signum.

Biología: Desconocida

Distribución: Especie conocida de España eItalia, así como de Asia Menor (Razowski, 2002), también se ha citado de Crimea. Se representa por primera vez la genitalia de la hembra.

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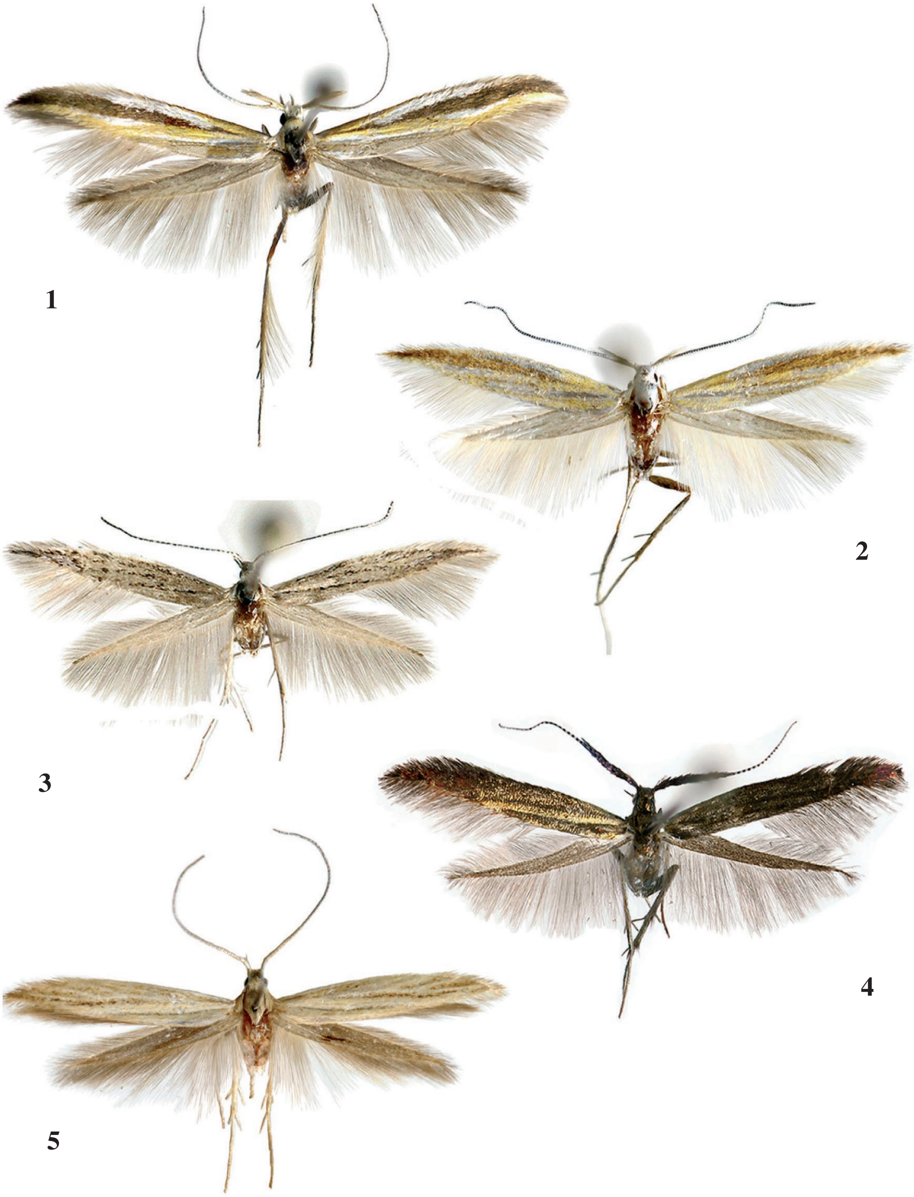
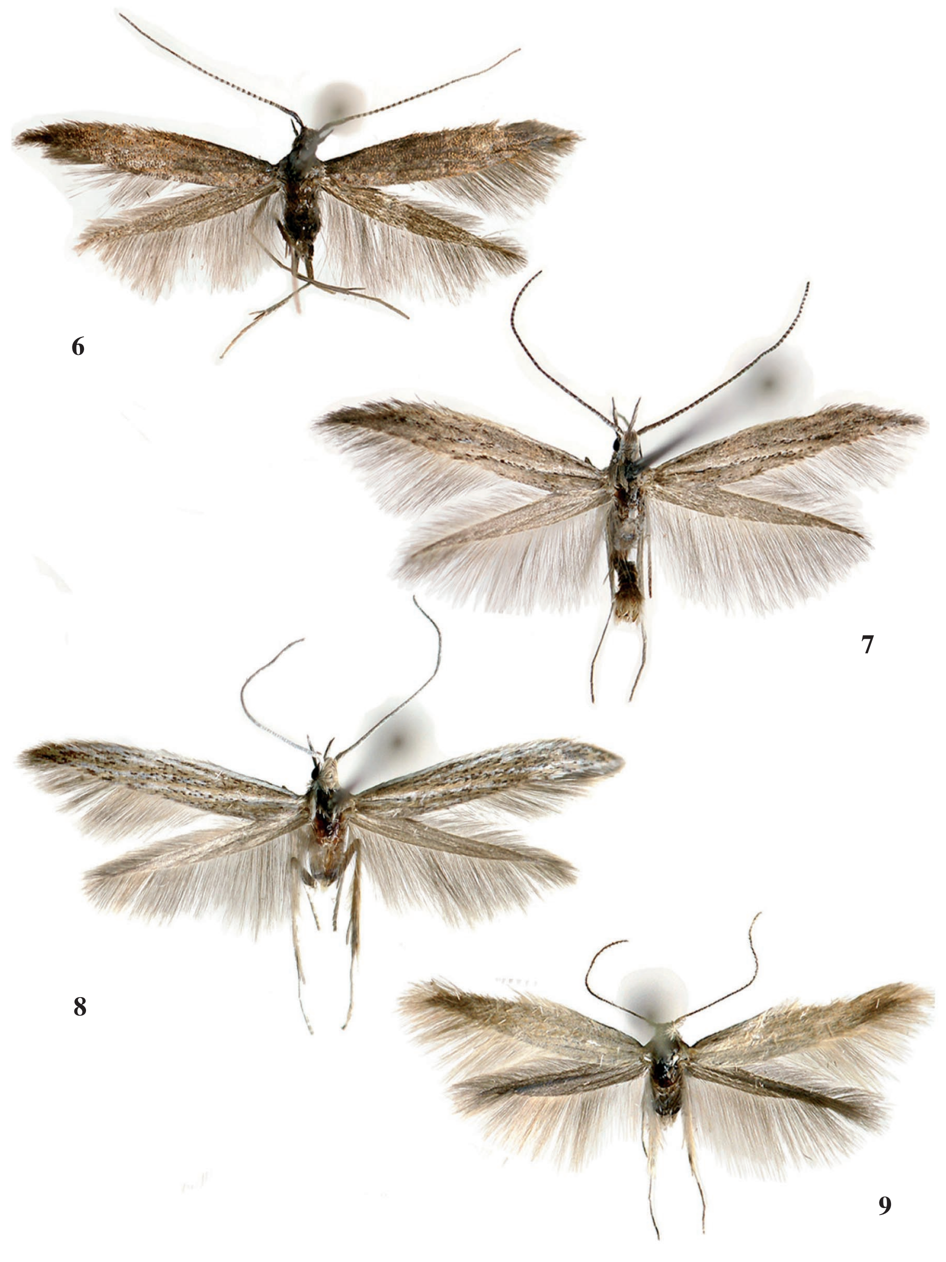
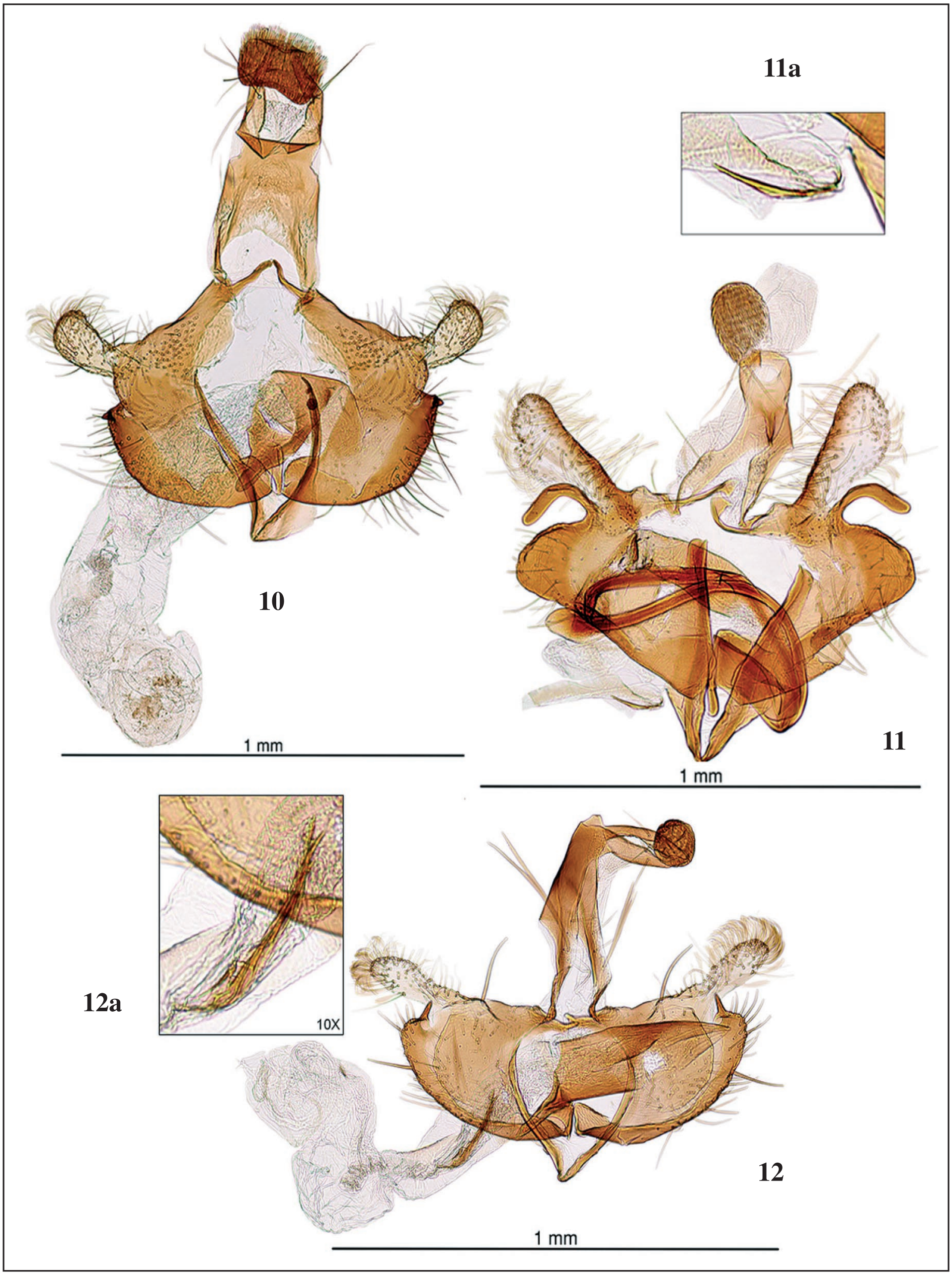


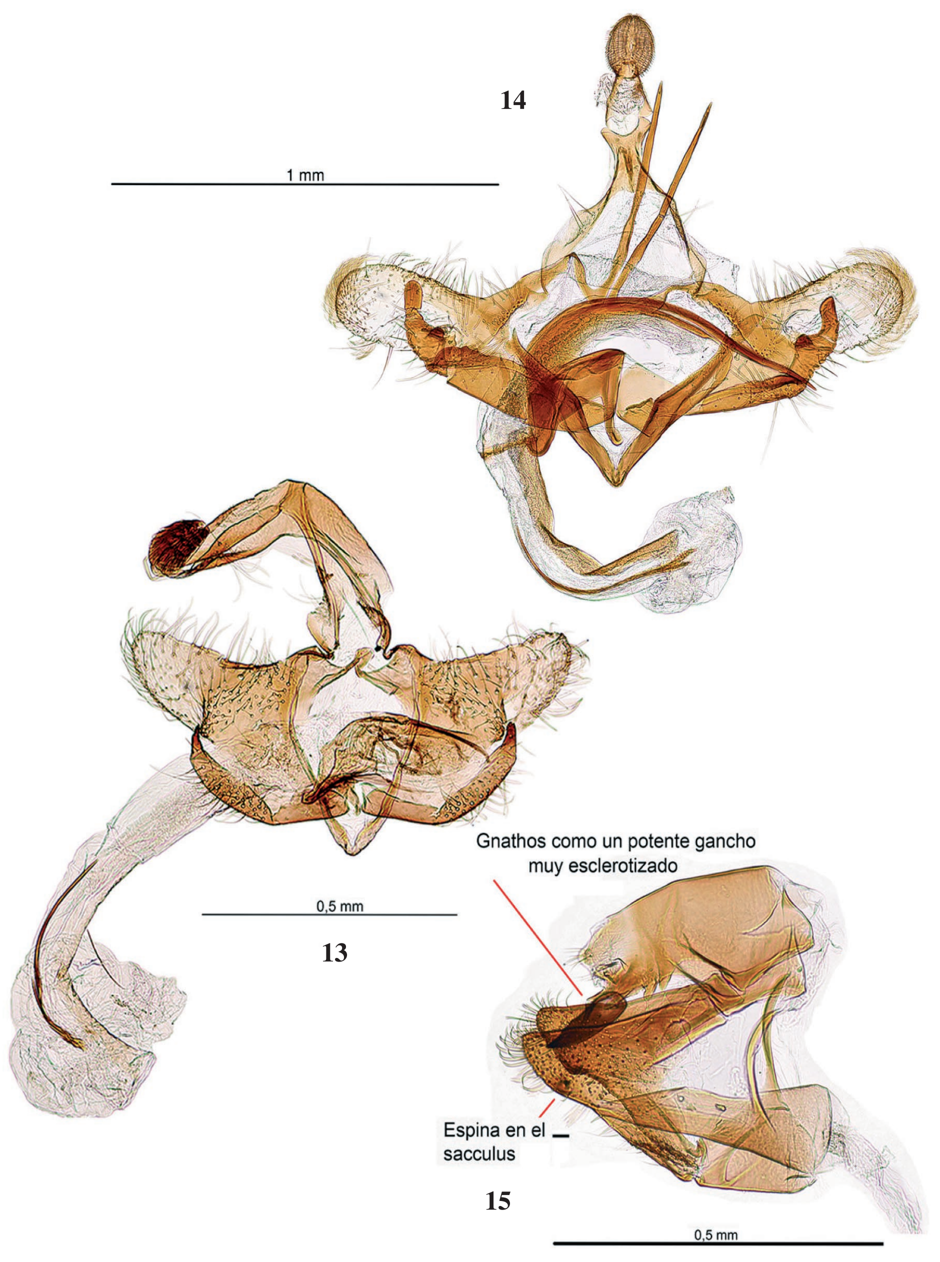
Figuras 1-5. Adultos. **1.** *Coleophora quadristraminella* Toll, 1961, ♂, Aldehuela de Calatañazor, Soria. **2.** *Coleophora quadristraminella* Toll, 1961, ♀, Casla, Segovia. **3.** *Coleophora alfacarensis* Baldizzone, 1998, ♀, Casla, Segovia. **4.** *Coleophora aleramica* Baldizzone & Atübner, 2007, ♂, Castrobarto, Burgos. **5.** *Coleophora pseudociconiella* Toll, 1952, ♂, San Martín de Don, Burgos.



Figuras 6-9. Adultos. **6.** *Coleophora pulmonariella* Ragonot, 1875, ♂, Castrobarto, Burgos. **7.** *Coleophora asteris* Mühlig, 1864, ♂, Casla, Segovia. **8.** *Coleophora thurneri* Glaser, 1969, ♂, Castrobarto, Burgos. **9.** *Psamathocrita dalmatinella* Huemer & Tokár, 2000, ♂, Castrobarto, Burgos.



Figuras 10-12. Genitalia macho: **10.** *Coleophora quadristraminella* Toll, 1961, prep. gen. 9839JG. **11.** *Coleophora thurneri* Glaser, 1969, prep. gen. 10068JG. **11a.** Ídem, detalle del cornuti. **12.** *Coleophora aleramica* Baldizzone & Atübner, 2007, prep. gen. 9898JG. **12a.** Ídem, detalle del cornuti.



Figuras 13-15. Genitalia macho: **13.** *Coleophora pulmonariella* Ragonot, 1875, prep. gen. 9774JG. **14.** *Coleophora asteris* Mühlig, 1864, prep. gen. 10051JG. **15.** *Psamathocrita dalmatinella* Huemer & Tokár, 2000, prep. gen. 9937JG.

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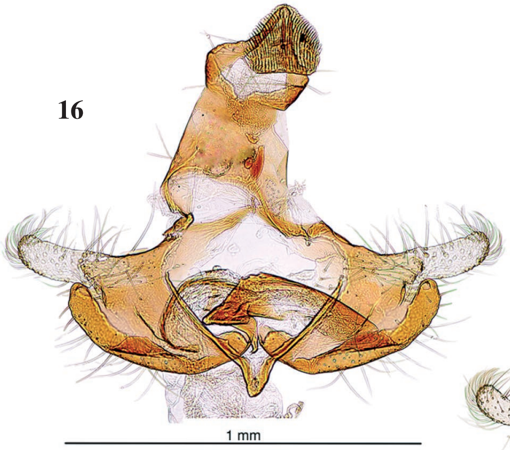

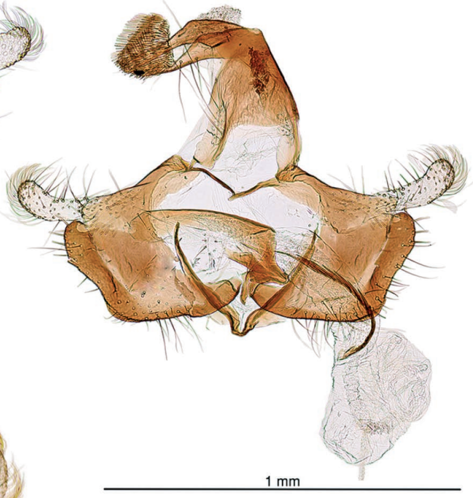

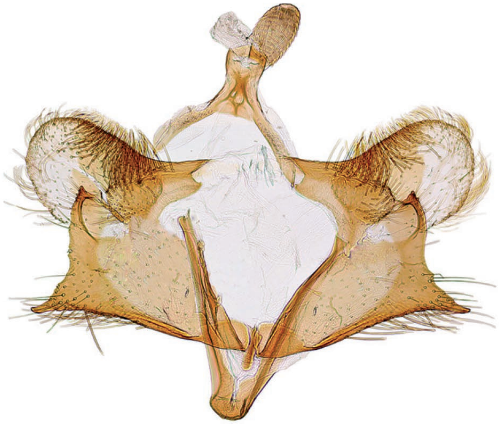

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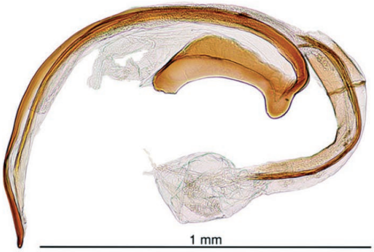

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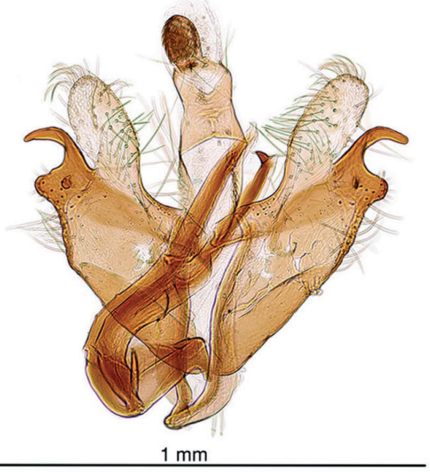
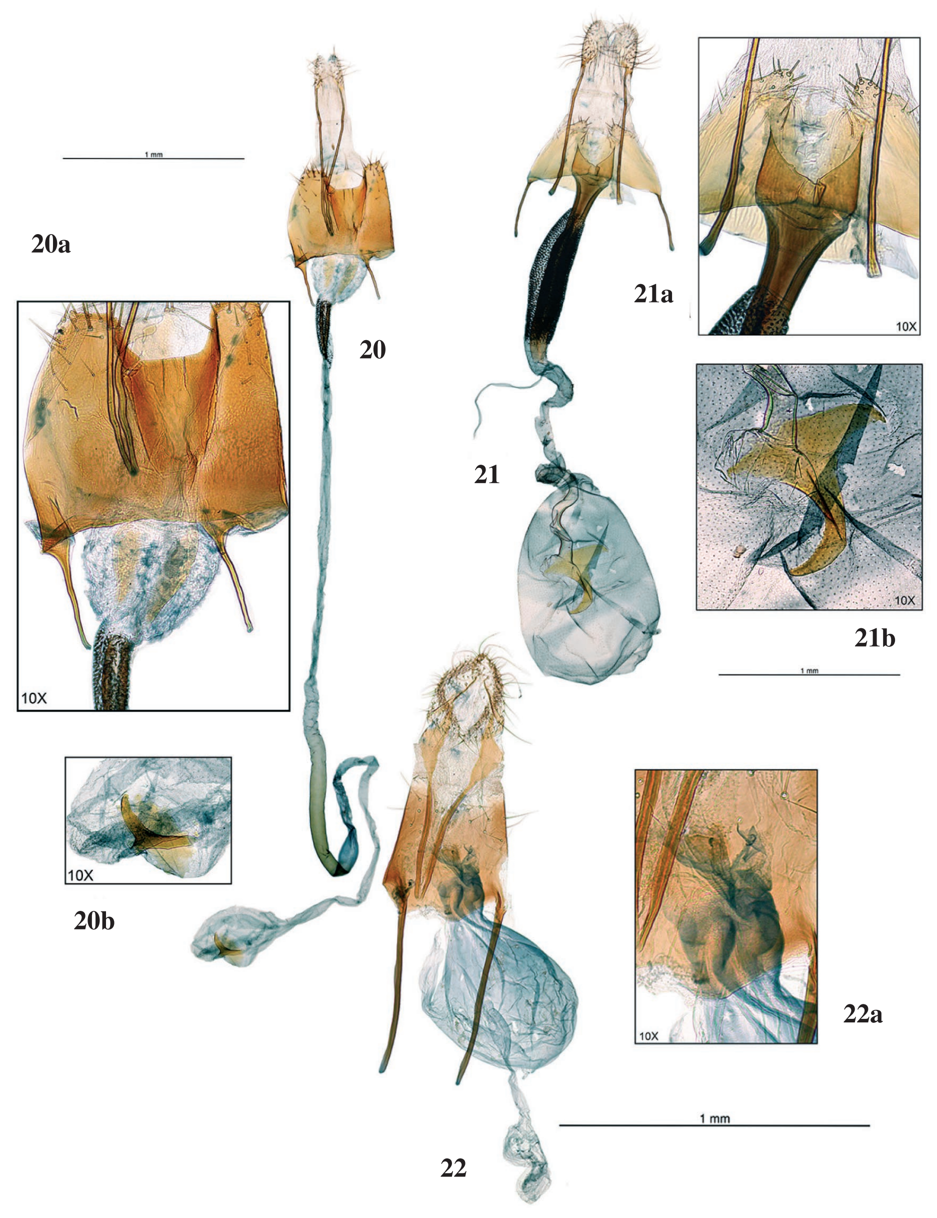


Figuras 16-19. Genitalia macho: **16.** *Coleophora albidella* ([Denis & Schiffermüller], 1775), prep. gen. ER3351. **17.** *Coleophora bernoulliella* (Goeze, 1783), prep. gen. 9925JG. **18.** *Coleophora pseudociconiella* Toll, 1952, prep. gen. 10126JG. **19.** *Coleophora alfacarensis* Baldizzone, 1998, prep. gen. 9713JG.



Figuras 20-22. Genitalia hembra; **20.** *Coleophora alfacarensis* Baldizzone, 1998, prep. gen. 9716JG. **20a.** Ídem, detalle del sterigma, ostium bursae, antrum bursae y collicolum. **20b.** Ídem, detalle del signum. **21.** *Coleophora quadristraminella* Toll, 1961, prep. gen. 9948JG. **21a.** Ídem, detalle del sterigma, ostium y antrum bursae. **21b.** Ídem, detalle del signum. **22.** *Cochylimorpha sparsana* (Staudinger, 1879), prep. gen. 9597JG. **22a.** Ídem, detalle del ostium y antrum bursae.

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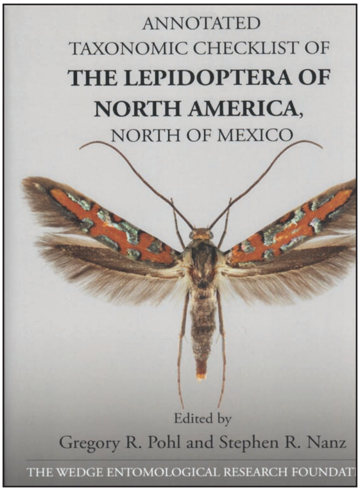

G. R. Pohl & S. R. Nanz
Annotated taxonomic checklist of the Lepidoptera of North America, North of Mexico
580 páginas
Formato 28 x 21,50 cm
The Wedge Entomological Research Foundation, 2023
ISBN: 978-0-933003-21-7

Tenemos en nuestras manos la segunda edición, de este interesante trabajo que vio la luz por primera vez en 2016, teniendo una mayor extensión y aportando muchas novedades.

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Si bien con esta información, que nos proporcionan los autores, sería más que suficiente para considerar que este trabajo como una fuente excelente de información, se aumenta, si cabe, con el establecimiento de 81 nuevas combinaciones, tres nuevos estatus, nueve nuevas combinaciones, 22 estatus revisados, 61 nuevas sinonimias y siete sinonimias revisadas y designadas.

No podemos terminar estas líneas sobre este excelente trabajo, sin felicitar a los autores por la realización de esta importante contribución, que no debe de faltar en ninguna biblioteca que se precie, tanto institucional como particular.

El precio de este libro es de 92 euros, más gastos de envío y los interesados lo pueden pedir a:

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The Antillean genus *Pogrima* Schaus, 1940 (Lepidoptera: Pyralidae, Galleriinae)

Vitor O. Becker

Abstract

Pogrima Schaus, 1940 is represented by three species: *P. palmasalis* Schaus, 1940, from Cuba, Puerto Rico and the Lesser Antilles, *P. borinqualis* Becker, sp. nov., from Puerto Rico, and *P. tainalis* Becker, sp. nov., from Cuba.
Keywords: Lepidoptera, Pyralidae, Galleriinae, Thiratabini, *Pogrima,* new species, Neotropical, West Indies.

El género antillano *Pogrima* Schaus, 1940 (Lepidoptera: Pyralidae, Galleriinae)

Resumen

Pogrima Schaus, 1940 está representado por tres especies: *P. palmasalis* Schaus, 1940, de Cuba, Puerto Rico y Pequeñas Antillas, *P. borinqualis* Becker, sp. nov., de Puerto Rico, y *P. tainalis* Becker, sp. nov., de Cuba.
Palabras clave: Lepidoptera, Pyralidae, Galleriinae, Thiratabini, *Pogrima,* especies nuevas, Neotropical, Antillas.

O gênero antilhano *Pogrima* Schaus, 1940 (Lepidoptera: Pyralidae, Galleriinae)

Resumo

Pogrima Schaus, 1940 está representado por três especies: *P. palmasalis* Schaus, 1940, de Cuba, Porto Rico e Pequenas Antilhas, *P. borinqualis* Becker, sp. nov., de Porto Rico, e *P. tainalis* Becker, sp. nov., de Cuba.
Palavras-chave: Lepidoptera, Pyralidae, Galleriinae, Thiratabini, *Pogrima,* espécies novas, Neotropical, Antilhas.

Introduction

Pogrima Schaus, 1940, was established in the Galleriinae, as a monotypic genus, and was assigned to the Tirathabini by Whalley (1964) and maintained as such by Munroe (1995, p. 88).

Material and methods

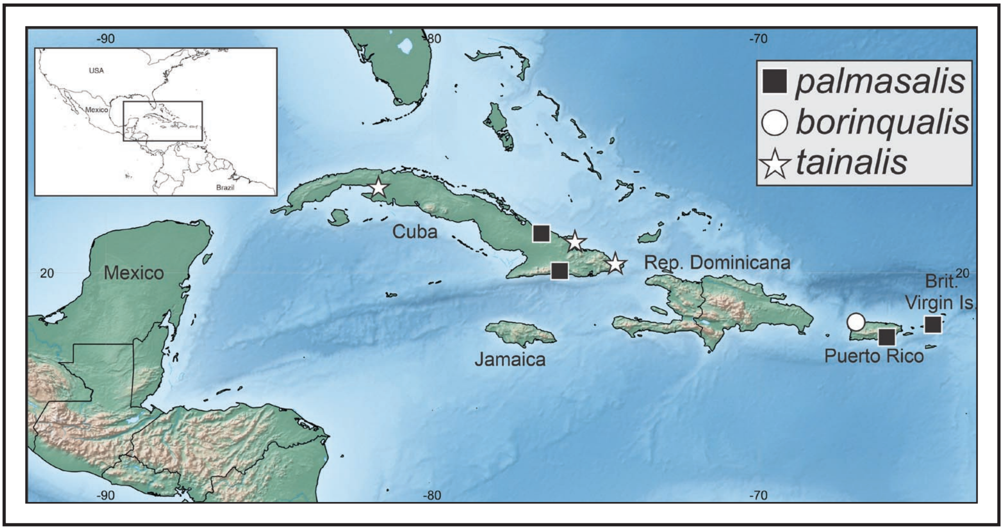
This work is based on the vast material belonging to these and related species in the author's collection (VOB) and in the collections of other major museums (USNM, IES), and on the pertinent literature. A synoptic collection, representing all the species, was taken to USNM and NHMUK and compared with the material deposited in these institutions. The holotypes of the new species are provisionally deposited in VOB, and will be transferred, together with the collection, to a Brazilian institution in the future. Genitalia were prepared following the methods described by Robinson (1976). Terms for morphological characters follow Hodges (1971).

Abbreviations

FW = Forewing
g. s. = genitalia slides
HW = Hind wing
IES = Instituto de Ecología y Sistemática, Habana, Cuba
NHMUK = Natural History Museum, London, United Kingdom
USNM = Smithsonian National Museum of Natural History, Washington DC, USA
VOB = Vitor O. Becker collection, Serra Bonita Reserve, Camacan, Bahia, Brazil

Results and discussion

Examination of specimens revealed that *Pogrima* is represented by three species, two of them undescribed.

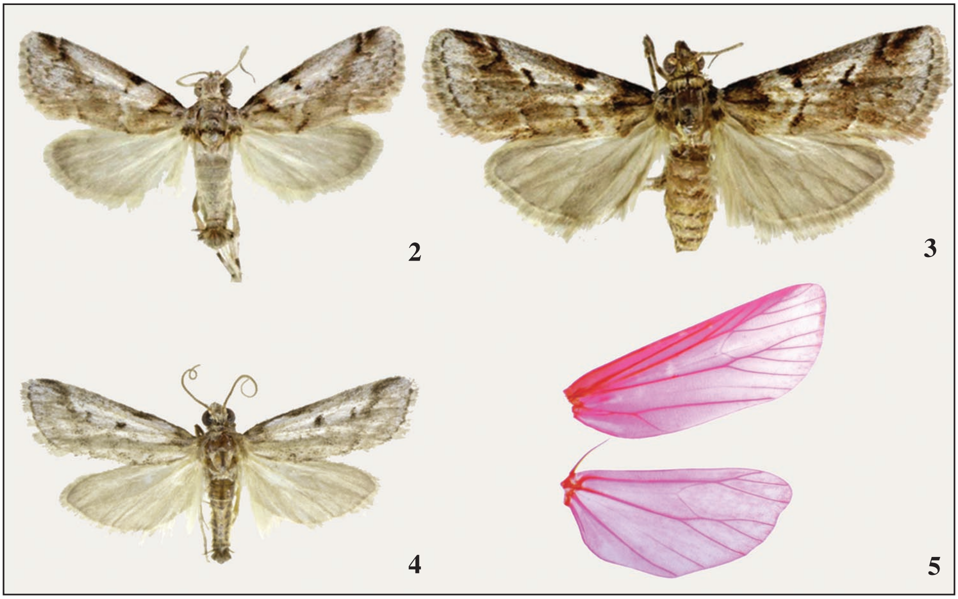


Pogrima Schaus, 1940
Pogrima Schaus, 1940. *Scient. Surv. P. Rico, 12*, 396
TS: *P. palmasalis* Schaus, 1940. *Scient. Surv. P. Rico, 12*, 396, by monotypy

Diagnosis: Small. FW length 4-8 mm (10-18 mm wingspan), grey, markings dark grey, orbicular spot black, well defined; diffuse, whitish area above cell, from base to costa before postmedial band; R3+4 (Figure 5) to costa before apex, stalked halfway between R2 and apex; M1 from upper angle of cell, close to Rs; M1+M2+CuA1 stalked, from lower angle of cell; CuA2 from near lower angle. HW with Sc+Rs+M1 from upper angle of cell, Sc+Rs stalked halfway between M1 and apex; M2 absent, M3+CuA1 stalked beyond lower angle of cell. Labial palpus short in males, 1/2 size of eye diameter; long, porrect, 3x eye diameter in females. Male genitalia with uncus short, broad, densely covered with long setae dorsally; valva spatulate, 3-4x as long as wide; vinculum round; phallus straight, vesica with no spines. Female genitalia as described for *P. palmasalis* (below).

Distribution: Antillean.

Remarks: Presumably related to *Tineopaschia minuta* Hampson, 1916, a smaller species with similar pattern.



Figures 2-5. *Pogrima* species. **2.** *P. palmasalis,* adult male, dorsal view, Guana Id. **3.** *P. borinqualis* Becker, holotype male, dorsal view, Puerto Rico. **4.** *P. tainalis* Becker, holotype male, dorsal view, Cuba. **5.** *P. palmasalis,* wing venation.

Key to species

1. FW male length 7 mm or more .... *borinqualis*
   FW male length 6 mm or less 2

2. FW with postmedial line from before apex to basal third of dorsum .... *palmasalis*
   FW with postmedial band from before apex to distal third of dorsum .... *tainalis*

Pogrima palmasalis Schaus, 1940 (Figures 1, 2, 5, 6, 7, 12)
Pogrima palmasalis Schaus, 1940. *Scient. Surv. P. Rico, 12,* 396. Holotype ♂, PUERTO RICO, Palmas Abajas (USNM) [examined].

Diagnosis: Grey. Sexes similar, except for the labial palpi: small, about 1/2 eye diameter in males; long, porrect, 3x eye diameter in females. Male (Figure 2), gray. FW length 4-6 mm (10-14 mm wingspan), Female 5-7 mm (12-16 mm). FW with a broad white area below costa, between antemedial and postmedial bands; orbicular and reniform black; termen whitish, cilia fuscous, with black dots on veins. HW whitish. Abdomen whitish.

Male genitalia (Figure 6): Uncus broad, densely covered with long setae dorsally, constricted towards middle into a short projection; valva broad, nearly three times longer than wide, margins nearly parallel; vinculum projected basad into a blunt triangle; juxta a broad shield; phallus (Figure 7) thin, long, straight.

Female genitalia (Figure 12): Ostium broad, deeply concave; antrum conical; ductus bursae almost as long as abdomen; corpus bursae globose, signum a long, spined ridge.

Material examined (24 ♂, 3 ♀, 3 g. s. 119 specimens [not sexed]): BRITIS VIRGIN ISLANDS: Guana, 10 ♂, 1 ♀, g. s. 5927, 5028, 5031 (VOB), 94 specimens, not sexed (USNM), 9-23-VII-1987 (Becker & Miller) (VOB 66684); 6 ♂, Idem, X-1989 (Becker 70867) (VOB); 68 specimens, not sexed, 1-4-VII-1984, 5-23-VII-1985 (S. E. & P. M. Miller) (USNM), 13-26-VII-1986 (S. E. Miller & M. Pogue) (USNM). Tortola: 22 specimens, Soper's Hole, 5-IV-1958 (Clarke); 2 specimens, Mt. Sage, 460 m, 7-8-VII-1985 (S. E. & P. M. Miller) (USNM). 1 ♂, 1 ♀, US VIRGIN ISLANDS: St. Thomas, 300 m, 25-30-VII-1987 (Becker 67046) (VOB). 4 ♂, PUERTO RICO: Guanica, 170 m, 20-VIII-1987 (Becker 67813) (VOB); 1 specimen, Mayaguez, 9-16-VII-1955 (Ramos); 1 specimen, San German, 16-IV-1930, g. s. H. W. Capps 15.700 [not traced] (Forbes) (USNM). 1 ♂, 1 ♀, CUBA: Holguin, Pinares de Mayari, 640 m, VII-1990 (Becker 71573) (VOB); 2 ♂, Santiago, Siboney, 20 m, 23-VII-1990 (Becker 73091) (VOB).

Distribution (Figure 1): Cuba, Puerto Rico, Virgin Islands, from lowland dry vegetation.

Remarks: The most common of the three species. Similar to *P. tainalis,* darker, easily distinguished by the position of the FW postmedial band: from before apex to basal third of dorsum in *P. palmasalis,* from apex to distal third in *P. tainalis.*

***Pogrima tainalis* Becker, sp. nov.** (Figures 1, 4, 8, 9)

Material examined 4 ♂, 2 ♀, 1 g. s. (VOB), 1 specimen, not sexed (USNM): Holotype ♂, CUBA: Guantanamo, Imias, La Farola, 15-VII-1990 (Becker 72613). Paratypes: 2 ♂, 2 ♀, same data as holotype, g. s. 5933; 1 ♂, Holguin, Pinares de Mayari, 750 m, VII-1990 (Becker, 72207) (VOB); excluded from the type series: 1 specimen, PINAR DEL RIO, Soroa, 22º47'N - 83º01'W, 220 m, 4-6-XII-1994 (Davis) (USNM).

Diagnosis: Sexes similar, except for the size of labial palpi: 1/2 eye diameter in males; 3x eye diameter in females. Light gray. FW with broad white area above cell, between antemedial and postmedial bands; margin white distad of postmedial band; cilia dotted black between veins. HW whitish. Abdomen with row of small blackish dots along middle.

Description: Sexes similar, light gray. Male (Figure 4) FW length 6 mm (14-16 mm wingspan). Female FW length 6-8 mm (14-18 mm wingspan). Light gray. Head whitish. Thorax white. FW white, dusted gray below cell; antemedial band reduced to traces below cell; postmedial band ill-defined, almost straight; orbicular small, black; reniform hardly visible; margin with black dots between veins; cilia white. HW white, dusted gray towards margins.

Male genitalia (Figure 8): Uncus broad, densely covered with long setae dorsally, with a thin projection distally; valva straight, slightly broadened basally, nearly three times as long as wide; juxta a nearly round shield; vinculum slightly expanded based; phallus (Figure 9) straight, long.

Distribution (Figure 1): Cuba, from high elevation forests.

Etymology: From *Taino* = the original inhabitants, and owners, of Cuba.

Remarks: Same size as *P. palmasalis,* whiter.

***Pogrima borinqualis* Becker, sp. nov.** (Figures 1, 3, 10, 11)

Material examined: 2 ♂ (VOB), 2 specimens, not sexed (USNM), 1 g. s. Holotype ♂, PUERTO RICO: [12 km N of] Patillas, 590 m, VIII-1987 (Becker, 68115). Paratype ♂, same data as holotype, g. s. 5932 (VOB); not included as paratypes: 1 specimen, El Yunque Biol.[ogical] Sta.[ation], Molindero

Road, 2,100 feet, Luquillo Forest, 16-XII-1962 (Spangler) (USNM); 1 specimen, Centro Vacacional, Monte del Estado, near Maricao, 650 m, 1-9-IV-1971 (Kimball) (USNM).

Diagnosis: Fuscous gray. FW with antemedial band broad, curved, white, edged with black; an obliquous whitish band from cell to costa before apex; termen white, cilia fuscous.

Description: Male (Figure 3), FW length 7-8 mm (16-18 mm wingspan); head dark fuscous, vertex fuscous; thorax fuscous; legs whitish, tibia and tarsi articulations blackish; tegula with two large blackish dots; FW fuscous; antemedial band broad, curved, whitish, edged distad with blackish, thin line; costa gray, gradually whitish towards postmedial band; broad, diffuse, oblique band from cell to costa before postmedial band; orbicular small, black; reniform a fine half-moon; postmedial band diffuse, strongly arched outwards from R3 to M3, than parallel to termen to distal third of dorsum; margin whitish; cilia fuscous. HW pale fuscous, cilia fuscous. Abdomen fuscous dorsally, whitish ventrally.

Male genitalia (Figure 10): Uncus broad, densely covered with long setae dorsally, with a short, narrow projection medially; valva broad, nearly twice as long as wide, margins nearly parallel; juxta a broad shield; phallus (Figure 11) long, straight, slightly expanded basally.

Distribution (Figure 1): Puerto Rico, from high elevation rain forests.

Etymology: From *Borinquensis* =an inhabitant of Puerto Rico.

Remarks: The larger of the three species of *Pogrima*.

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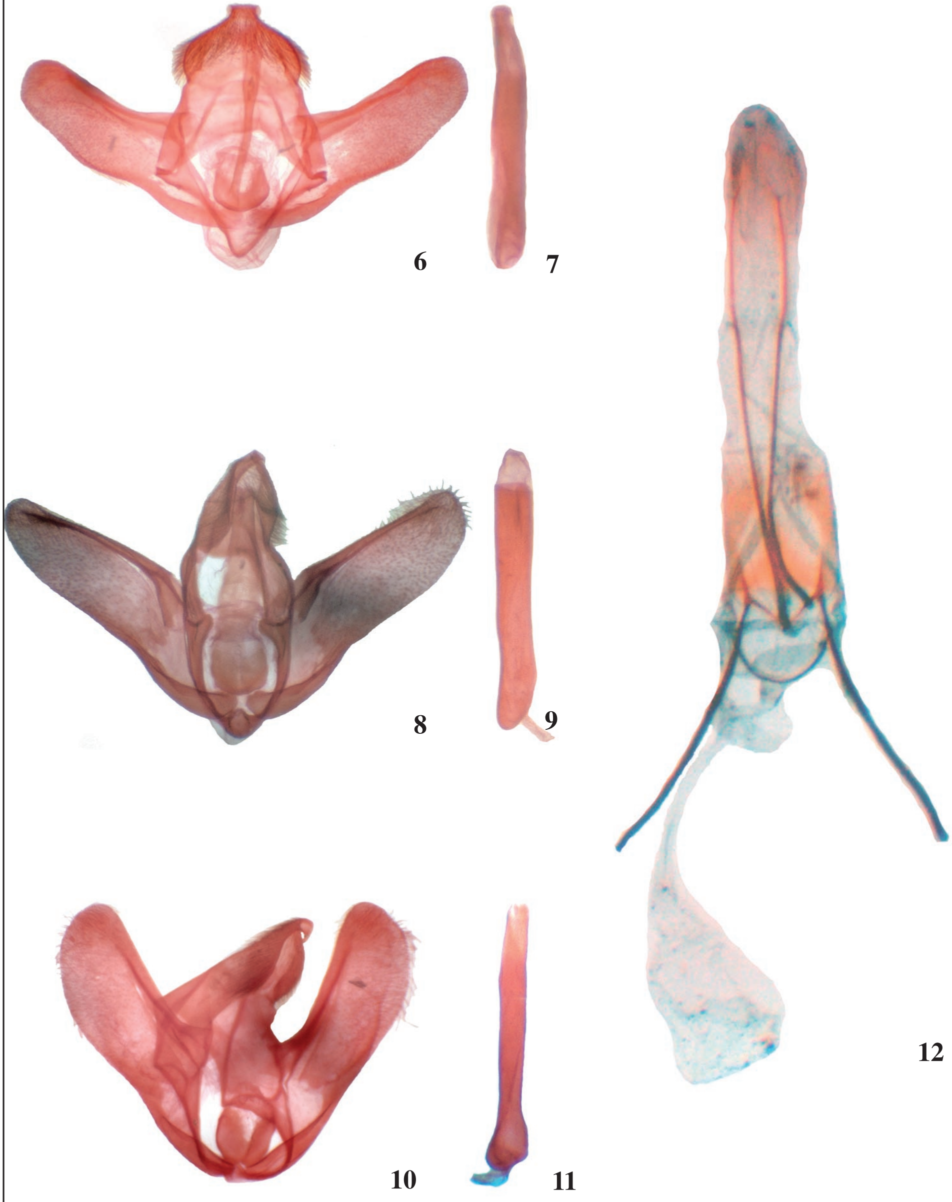

Figures 6-12. 6-7. *P. palmasalis,* male genitalia: **6.** Ventral view. **7.** Phallus, lateral view. **8-9.** *P. tainalis* Becker, male genitalia, paratype, Puerto Rico: **8.** Ventral view. **9.** Phallus, lateral view. **10-11.** *P. borquinalis* Becker, male genitalia, paratype, Cuba: **10.** Ventral view. **11.** Phallus, lateral view. **12.** *P. palmasalis,* female genitalia, Guana Id., ventral view.

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NOTICIAS GENERALES / *GENERAL NEWS*

SHILAP REVISTA DE LEPIDOPTEROLOGÍA* EN LOS ÍNDICES DE IMPACTO INTERNACIONALES 2023, ALCANZA EL Q2 / SHILAP REVISTA DE LEPIDOPTEROLOGIA *IN THE INTERNATIONAL IMPACT INDEXES 2023, REACH Q2*.–** Según SCOPUS en su Índice SJR 2023 de *SCImago Journal Rank*, aparecemos con un **Indicador SJR: 0.358** FI, **Índice H: 14**, **Categoría: Ciencia Animal y Zoología: 243/492 (Q2), Ecología, Evolución, Comportamiento y Sistemática: 419/722 (Q3), Ciencia de los insectos: 101/184 (Q3)**. **/** *According to SCOPUS in their Index SJR 2023 of* SCImago Journal Rank*, we appear with a* ***SJR Indicator: 0.358 *FI,* ***H Index: 14****,* ***Rank: Animal Science and Zoology 243/492 (Q2), Ecology, Evolution, Behavior and Systematic: 419/722 (Q3), Insect Science*****:** ***101/184 (Q3)****. According to* **DETALLES /** ***DETAILS*****:** SHILAP; Apartado de correos, 331; E-28010 Madrid; ESPAÑA / *SPAIN* (E-mail: avives1954@outlook.es).

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Unveiling the Hidden Gem: An Observational Report, Taxonomic Insights and First Photographic Evidence of *Pseudochazara baldiva* Moore, 1865, from India (Lepidoptera: Nymphalidae)

Lovish Garlani

Abstract

A field survey of the Spiti and Pin Valley of Himachal Pradesh in September 2023 revealed the presence of *Pseudochazara baldiva* Moore, 1865 in the region. In the earlier studies recently conducted in the region, the species is believed to have been misidentified by many authors as *Pseudochazara lehana* Moore, 1878. The identification of the species was done based on the phenotypic description given in Moore (1865), Evans (1932), and Talbot (1947). The study also provides the first photographic evidence of *Pseudochazara baldiva* Moore, 1865, from the region.
Keywords: Lepidoptera, Nymphalidae, *Pseudochazara*, Himachal Pradesh, Western Himalayas, India.

Revelando la joya escondida: un informe de observación, conocimientos taxonómicos y primera evidencia fotográfica de *Pseudochazara baldiva* Moore, 1865, de la India (Lepidoptera: Nymphalidae)

Resumen

Un estudio de campo realizado en septiembre de 2023 en el valle de Spiti y Pin, en Himachal Pradesh, reveló la presencia de *Pseudochazara baldiva* Moore, 1865 en la región. En los estudios anteriores realizados recientemente en la región, se cree que la especie ha sido identificada erróneamente por muchos autores como *Pseudochazara lehana* Moore, 1878. La identificación de la especie se hizo basándose en la descripción fenotípica dada en Moore (1865), Evans (1932) y Talbot (1947). El estudio también proporciona la primera evidencia fotográfica de *Pseudochazara baldiva* Moore, 1865, de la región.
Palabras clave: Lepidoptera, Nymphalidae, *Pseudochazara*, Himachal Pradesh, Himalaya occidental, India.

Introduction

Pseudochazara baldiva Moore, 1865 is an uncommon but local species that flies in the Himalayan inner ranges, 3000 to 3900 m, in the Lahaul & Spiti, and Kinnaur districts of Himachal Pradesh (Gasse, 2018). The species is named after the region where it is predominantly found and is commonly known as Spiti Rockbrown. The species is given as *Eumenis mniszechii* in Evans (1932), and as *Hipparchia mniszechii* in Talbot (1947), later placed in the genus *Pseudochazara* by de Lesse, 1951 (Gasse, 2018). There are three sub-species of *Pseudochazara baldiva* Moore, 1865, in the Indian subcontinent: *baldiva* Moore 1865; *balucha* Evans, 1932; and *baltistana* which was described in 1949 and was considered a synonym of *lehana*. Subspecies *balucha* Evans, 1932, is common in Pakistan in North Baluchistan, between 1800 to 2400 m; subspecies *baltistana* occurs in Chitral, Gilgit-Baltistan, and possibly in Ladakh between 2200 to 4000 m; and subspecies *baldiva* is typically found in the Lahaul Spiti and Kinnaur district of Himachal Pradesh, India between 3000 to 3900 m (Gasse, 2018).

The study of the androconia scale of *Pseudochazara* specie-group type specimens provides that *Pseudochazara baldiva* Moore, 1865, and *Pseudochazara lehana* Moore, 1878 have distinctively shaped androconia (Wakeham-Dawson et al. 2007).

Materials and Methods

During the first two weeks of September 2023, many field surveys of the Lahaul, Spiti, and Pin Valley were conducted to study the Rhopalocera diversity in the region. The altitude of the studied area extends from 3000 m to 4500 m which supports a good number of Rhopalocera diversity. About 15 specimens of *Pseudochazara baldiva* Moore, 1865, were observed and studied in Kaza, Kibber, Langza, and Mud village. The species prefers to visit the Thistle plant (*Cirsium spp*.) and is often seen puddling over the mud and basking over the rocks. The study was conducted mostly during the early hours of the day when the individuals of the species were more active.

Results and Discussions

Description (Adult) (Figure 1-2): *Pseudochazara baldiva* Moore, 1865, is a rockbrown species of the Nymphalidae family, sized about 50-55 mm. Underside: grey in males and greyish-white in females with numerous black striae on the hindwings. Forewing in males with single black spots and females with two black spots (Moore, 1865). Forewing apical ocellus with white pupil and yellow iride, there are two white spots in spaces 3 and 4 just below the apical ocellus. Hindwing with post-discal and submarginal lines strongly marked. The submarginal line is sinuous or zigzag (Talbot, 1947). There is a black spot near the hindwing tornus, also with a white pupil and yellow iride. Hindwing cilia silvery grey. Upperside: forewing with posterior ocellus larger than *lehana* and *gilgitica* (Talbot, 1947). The post-discal area of the upper wings is paler. Forewing with two black spots, centred with white. Hindwing with one black spot also centred with a white dot. The author provides that the hindwing tornal spot is obscure in *Pseudochazara lehana* Moore, 1878 which closely resembles *Pseudochazara baldiva* Moore, 1865.

During the field surveys, both male and female specimens were studied and photographed (Figures 1-2). A detailed study of recent literature on Indian Rhopalocera (Kehimkar, 2016; Sondhi & Kunte, 2018) reveals no photographic evidence of *Pseudochazara baldiva* Moore, 1865. Other publications specifically focused on Himachal Pradesh (de Rhe-Philipe 1931; Talbot 1939; Wynter-Blyth 1940-1947; Arora et al. 2009) do not provide any photographic evidence of the species. It is worth mentioning that there is no photographic record of *Pseudochazara baldiva* Moore, 1865, given on the Rhopalocera of India website (Kunte et al. 2023).

Hence, the study and record of *Pseudochazara baldiva* Moore, 1865, is the first photographic documentation from the Indian subcontinent and it will definitely contribute to the awareness and conservation of species. Moreover, the taxonomic inputs provided in this article will simplify future studies on *Pseudochazara baldiva* Moore, 1865.

Acknowledgments

The author is thankful to the Himachal Pradesh State Forest Department for providing permission to conduct the study in high-altitude regions of the state. The study is self-funded by the author, but it couldn’t have been possible without the immense support of Mr. Sanjeev Kumar, Range Forest Officer, Bhattiyat Forest Range, Himachal Pradesh. The author acknowledges the cooperation of local communities for helping during the study.

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Figure 1-2. 1. *Pseudochazara baldiva* Moore, 1865, (male) with single black spot on Under forewing. **2.** *Pseudochazara baldiva* Moore, 1865, (female) with two black spots on Under forewing. (Pictures © Lovish Garlani).

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First record of genus *Lakshmia* Yakovlev, 2004 from India along with description of a new species (Lepidoptera: Cossidae, Zeuzerinae)

Navneet Singh, Jalil Ahmad, Roman V. Yakovlev & Rahul Joshi

Abstract

The present manuscript deals with description of a new species of genus *Lakshmia* Yakovlev, 2004, *Lakshmia narayani* Singh, Ahmad, Yakovlev & Joshi, sp. nov. is described from specimens of Mizoram, India. This also represents the first record of genus *Lakshmia* from India. Images of the adult and genitalia along with a complete checklist of the species is also provided.
Keywords: Lepidoptera, Cossidae, Zeuzerinae, *Lakshmia narayani,* new species, taxonomy, Mizoram, India.

Primer registro del género *Lakshmia* Yakovlev, 2004 de la India, junto con la descripción de una nueva especie (Lepidoptera: Cossidae, Zeuzerinae)

Resumen

El presente manuscrito trata de la descripción de una nueva especie del género *Lakshmia* Yakovlev, 2004, *Lakshmia narayani* Singh, Ahmad, Yakovlev & Joshi, sp. nov. se describe a partir de ejemplares de Mizoram, India. También representa el primer registro del género *Lakshmia* en la India. Se proporcionan imágenes del adulto y de la genitalia junto con una lista completa de las especies.
Palabras clave: Lepidoptera, Cossidae, Zeuzerinae, *Lakshmia narayani*, nueva especie, taxonomía, Mizoram, India.

Introduction

Genus *Lakshmia* Yakovlev, 2004, was established for placement of two new species, *Lakshmia zolotuhini* Yakovlev, 2004 (type species by original designation) and *L. hauensteini* Yakovlev, 2004 from Thailand. Yakovlev (2006) described two more species, *Lakshmia sirena* Yakovlev, 2006 (South Vietnam) and *L. dea* Yakovlev, 2006 (Nepal). However, *L. dea* was shifted under genus *Sansara* Yakovlev, 2004 in the world catalogue of Cossidae (Yakovlev, 2011). *Lakshmia pandava* Yakovlev & Nakao, 2013 was added in the genus from Thailand. The presence of an ochreous brown band on the forewing, elongate valvae with parallel edges, and a greatly reduced saccus in the male genitalia are diagnostic characters of *Lakshmia* (Yakovlev & Nakao, 2013). The genus comprises four species and is distributed in Thailand and Southern Vietnam.

In the present paper, a new species of genus *Lakshmia* is described from Mizoram, India that also represents the first record of this genus from India. Images of the adults and genitalia are provided. A complete checklist of the known species of genus *Lakshmia* is also provided.

Material and methods

Collection of adult moths was done from the Mizoram (Dampa Tiger Reserve) by using vertical sheet light trap illuminated by 160W mercury vapor lamp. The collected specimens were processed as per standardized techniques in Lepidopterology. The collected specimens and slides of genitalia are deposited in the National Zoological Collections of Zoological Survey of India (NZCZI), Kolkata.

Taxonomy

Lakshmia Yakovlev, 2004
Lakshmia (Zeuzerinae) Yakovlev, 2004. *Atalanta, 35*(3/4), 347
Type species: *Lakshmia zolotuhini* Yakovlev, 2004

Distribution: Thailand and Southern Vietnam (Yakovlev, 2004), India (present study).

Lakshmia narayani **Singh, Ahmad, Yakovlev & Joshi, sp. nov.** (Figures 1-6)

Material examined: Holotype: 1 ♂, INDIA, Mizoram, Aizawl, Dampa Tiger Reserve, Teirei Rest House, 03-XII-2019, (N 23º43’27.728, E 92º43’7.143) leg. Sandeep Kushwaha (Coll. NZCZSI). Paratype: INDIA, Mizoram, Aizawl, Dampa Tiger Reserve, Teirei Rest House, 1 ♂, 28-XI-2019, (N 23º43’27.728, E 92º43’7.143) leg. Sandeep Kushwaha (Coll. NZCZSI)

Description: Forewing length 19 mm. Antennae bipectinate. Head, thorax, and abdomen densely covered with pale yellow scales; basal area of abdomen with a tuft of dark brown hairs dorsally. Forewing brownish yellow with a broad oblique brown band, slightly interrupted in the middle towards inner margin; costal margin brown at base; marginal fringe dark brown at veins with pale yellow patches between them. Hindwing light yellow with some fuscous suffusion and fringe of hairs on inner margin; terminal patched similar to forewing. Male genitalia with uncus hood-like, narrowing towards apex; Juxta in the form of pair of long lateral processes; valva long with curved apex; saccus short; aedeagus long slightly shorter than valva; vesica with a sclerotized long patch present laterally. Female unknown.

Diagnosis: The new species, *Lakshmia narayani* Singh, Ahmad, Yakovlev & Joshi, sp. nov., is closely allied to *Lakshmia zolotuhini* Yakovlev, 2004 and *Lakshmia pandava* Yakovlev & Nakao, 2013. However, *Lakshmia narayani* sp. nov. is medium in size with forewing length 19 mm (22-24 mm in *L. zolotuhini* and 15 mm in *L. pandava*) and have uninterrupted and evenly curved black band on forewings (FW with band interrupted in the middle third in *L. zolotuhini* and is humped at upper angle of the cell in *L. pandava*). Male genitalia of *L. narayani* sp. nov. is having valves longer, going beyond tip of uncus (shorter than uncus in *L. zolotuhini* and *L. pandava),* and apex of valva is more evenly rounded (broader in broad in *L. zolotuhini* and saccular margin strongly curved before apex).

Distribution: India, Mizoram (present study).

Etymology: The new species is named after Vedic deity Narayan (husband of goddess Lakshmi).

Checklist of the species in genus *Lakshmia*

Genus *Lakshmia* Yakovlev, 2004
Lakshmia (Zeuzerinae) Yakovlev, 2004. *Atalanta, 35*(3/4), 347
Type species *Lakshmia zolotuhini* Yakovlev, 2004 (by original designation).

Lakshmia hauensteini Yakovlev, 2004
Lakshmia hauensteini Yakovlev, 2004. *Atalanta, 35*(3/4), 350

Type material: (holotype) in the private collection of Armin Hauenstein (Untermünkheim, Germany).

Type locality: North Thailand, Prov. Chiang Mai, 450 m, Mok Fa Garden Resort.

Distribution: N. Thailand.

Lakshmia narayani **Singh, Ahmad, Yakovlev & Joshi, sp. nov.**

Type material: (holotype) in NZCZSI.
Type locality: India, Mizoram, Aizawl, Dampa Tiger Reserve, Teirei Rest House.
Distribution: India, Mizoram.

Lakshmia pandava Yakovlev & Nakao, 2013

Lakshmia pandava Yakovlev & Nakao, 2013. *Zootaxa, 3736*(2), 198
Type locality: Thailand, Chiang Mai, Chae Son National Park.
Type material: (holotype) in Museum Witt (Munich, Germany).
Distribution: N. Thailand.

Lakshmia sirena Yakovlev, 2006

Lakshmia sirena Yakovlev, 2006. *Tinea, 19*(3), 208
Type locality: Süd Vietnam, Bao Lok, Rung Kat Tien.
Type material: (holotype) in Museum Witt (Munich, Germany).
Distribution: South Vietnam (Yakovlev, 2014).

Lakshmia zolotuhini Yakovlev, 2004

Lakshmia zolotuhini Yakovlev, 2004. *Atalanta, 35*(3/4), 348
Type locality: Thailand, Changwat Nan, 5 km E of Bo Luang.
Type material: (holotype) in Museum Witt (Munich, Germany).
Distribution: N. Thailand.

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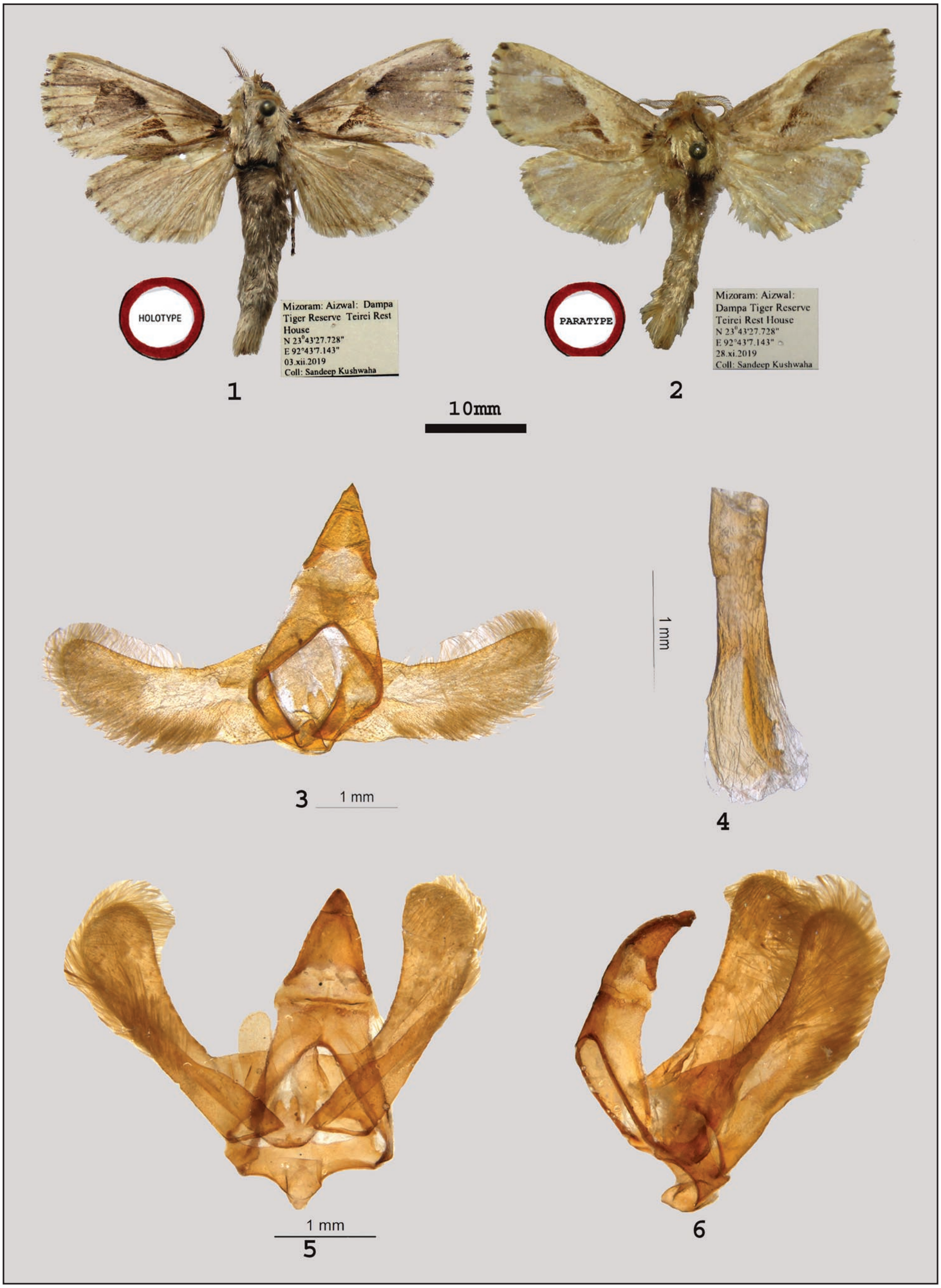

Figures 1-6. *Lakshmia narayani* sp. nov.: **1.** Adult male, Holotype. **2.** Adult male, Paratype. **3-4.** Male genitalia and aedeagus (holotype). **5.** Dorsal view. **6.** Lateral view

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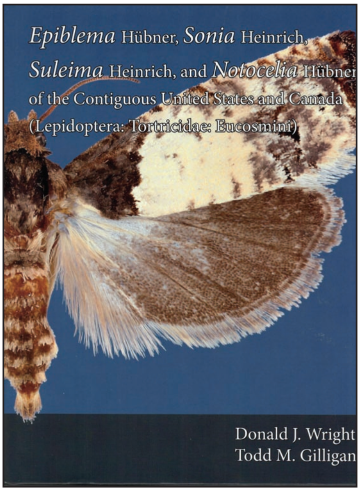

Epiblema Hübner, *Sonia* Heinrich, *Suleima* Heinrich, and *Notocelia* Hübner of the Contiguous United States and Canada (Lepidoptera: Tortricidae: Eucosmini)

Donald J. Wright
Todd M. Gilligan

D. J. Wright & T. M. Gilligan
***Epiblema* Hübner, *Sonia* Heirinch, *Suleima* Heinrich, and *Notocelia* Hübner of the Contiguous United States and Canada (Lepidoptera: Tortricidae: Eucosmini)**
280 páginas
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En esta ocasión, los autores tratan, dentro de la tribu Eucosmini, los siguientes géneros *Epiblema* Hübner, [1825] 1816, con 51 especies, *Sonia* Heirinch, 1923, con 15 especies, *Suleima* Heirinch, 1923, con 11 especies y *Notocelia* Hübner, [1825] 1816 con 6 especies, dentro de la tribu Eucosmini Meyrick, 1909 y de la familia Tortricidae Latreille, [1802] 1803, presentes en Norteamérica.

De la mano de los autores nos dan una detallada revisión de las especies que se encuentran en Norteamérica, fruto de veinticinco años de trabajo, pudiendo considerarla como la más completa y extensa obra realizada hasta el momento y que es el tercer volumen, que los autores nos indicaron después de la publicación del primer volumen en 2015 y del segundo en el 2017, ya revisados anteriormente.

Esta es la tercera parte de un proyecto que abarca todas las especies conocidas de los géneros *Epiblema*, *Sonia*, *Suleima* y *Notocelia*. Si bien este trabajo se ha publicado con un formato propio, hay que considerarlo como un fascículo más, de la extensa y, ya clásica, publicación *The Moths of American North of Mexico,* que, en este caso, sería el Fascículo 9.6.

Sin lugar a dudas, este tercer libro forma parte del trabajo más extenso de los publicados en los últimos 90 años, revisandose 83 especies que se encuentran en Canadá y los Estados Unidos, describiéndose 20 especies nuevas, estableciéndose una nueva combinación y se designan 10 Lectotipos, lo que ha permitido resolver algunos problemas.

Comienza la obra con una Introducción con dos subapartados sobre la historia taxonómica y el material y métodos empleados, llegando a examinarse unos 4.100 ejemplares y realizándose unas 1.330 preparaciones de genitalia aproximadamente.

De cada especie se indican todos los datos de descripción, donde está el material tipo, fotografías de los adultos a todo color (540 fotografías) y dibujos de la genitalia del macho y de la hembra (612 dibujos), seguido de unos detallados comentarios extremadamente valiosos, finalizando con una detallada bibliografía y un índice.

No podemos terminar estas líneas, sin felicitar a *The Wedge Entomological Research Foundation* por su excelente línea editorial que se ha visto plasmada con excelentes publicaciones y a los autores por tan detallado trabajo, por lo que recomendamos su adquisición.

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First Global Report on Mud-puddling by Pyraloidea from India (Insecta: Lepidoptera)

Avishek Talukdar & Soumyajit Chowdhury

Abstract

Mud-puddling though very common phenomenon in case of Rhopalocera (especially males) is not so common for Heterocera. The phenomenon was observed during one trapping night at Tippi village in Arunachal Pradesh, India. Here the authors present the first global report of Pyraloidea from India.

Keywords: Insecta, Lepidoptera, Pyraloidea, Arunachal Pradesh, Eastern Himalaya, India.

Primer informe global sobre los charcos de barro por los Pyraloidea de la India (Insecta: Lepidoptera)

Resumen

Los charcos de barro, aunque es un fenómeno muy común en el caso de los Lepidoptera (especialmente los machos), no lo es tanto en el de los Heterocera. El fenómeno se observó durante una noche de trampeo en el pueblo de Tippi en Arunachal Pradesh, India. Aquí los autores presentan el primer informe global de Pyraloidea de la India.

Palabras clave: Insecta, Lepidoptera, Pyraloidea, Arunachal Pradesh, Himalaya oriental, India.

Introduction

One of the most common behaviour documented in Lepidoptera where adults are attracted towards moist ground, perspiration, tears, excrements or animal carcasses for the purpose of sucking salts and dissolved nutrients (Adler, 1982; Adler & Pearson, 1982; Bänziger, 1973). The males usually display such behaviour as the dissolved nutrients and minerals are necessary for transferring them to their female counterpart as part of nuptial gifts (Drummond, 1984; Smedley & Eisner, 1995, 1996; Lai-Fook, 1991; Eisner & Meinwald, 1995; Boggs & Gilbert, 1979). Mudpuddling though very common in Rhopalocera, has rarely been reported in case of Heterocera. Previous records include belonging to family Notodontidae (Smedley & Eisner, 1995), Sesiidae (Volponi, 2020) and Noctuidae (Xiao et al. 2010). An Erebidae, *Hemiceratoides hieroglyphica* (Saalmüller, 1891) from Madagascar was reported by Hilgartner et al. (2007) to suck tears from sleeping bird's eyes (*Newtonia brunneicauda* (Newton, 1863) and *Copsychus albospecularis* (Eydoux & Gervais, 1835)). The current article presents first global report of mud-puddling behaviour by Pyraloidea from India.

Methodology

The unique mud-puddling behaviour by Heterocera was observed in Tippi, Arunachal Pradesh, India (Coordinates: Lat. 27.022425, Long. 92.624201; Altitude, 233 m) on 14-IX-2022 during a month-long field visit for documentation of moth diversity in north-eastern India (Figure 1). Tippi is a small village situated on the west bank of Kameng River, adjoining the Pakke Tiger Reserve on the eastern bank of the river. The area falls under the biogeographic zone of 'Himalayas' under the Biogeographic Province of 'East Himalayas (Zone 2D)' (Rodgers & Panwar, 1988), characterized by a warm and moist tropical climate.

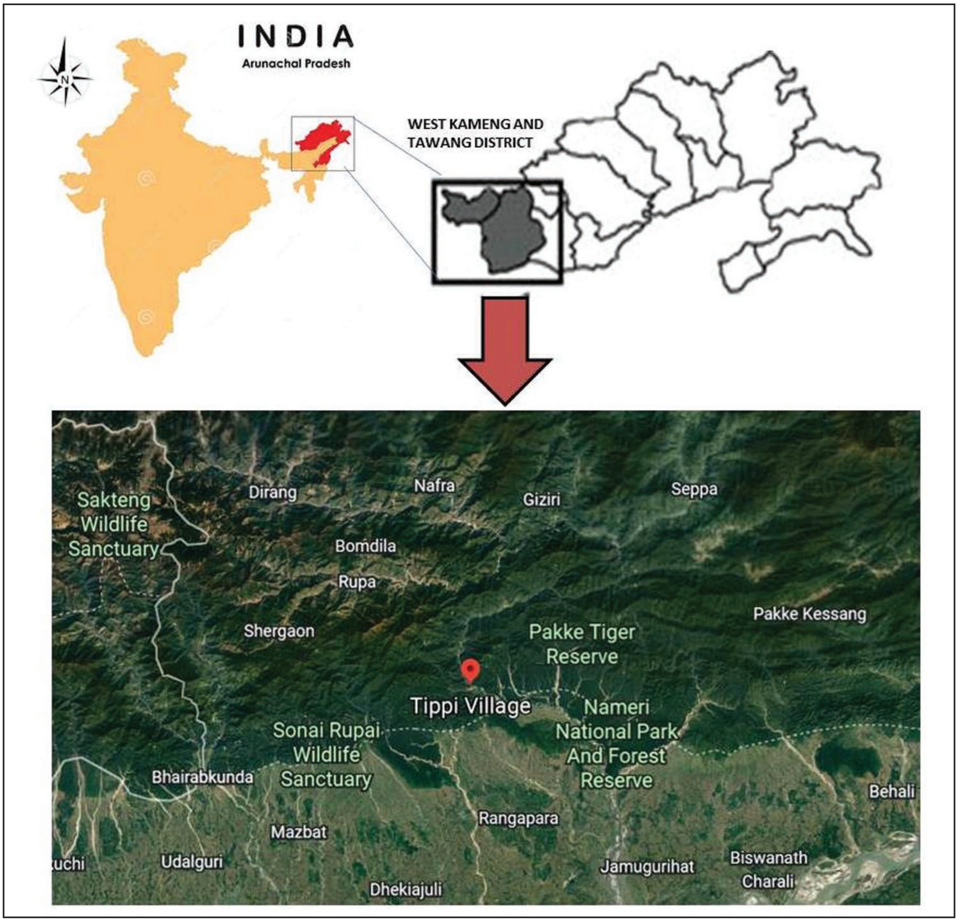

Figure 1. Location map of Tippi village, Arunachal Pradesh, India.

The behaviour was recorded during the nighttime (18.00 - 21.00 hrs) when the authors were returning from the light-trap site in Tippi, when several Heterocera were found puddling on a muddy patch by the side of motorable road. Moths were also recorded to gather on the freshly splashed mud patches on the vehicle surface and puddling from the same source. The entire event was videographed using mobile camera (Model: Samsung A 20) and all the images used in the article were extracted as JPEG format from the videos recorded in the mobile itself. Classification of Pyraloidea up to their "tribe" category has been followed after Nuss et al. (2003-2023).

Results

All the Heterocera recorded during the puddling event in Tippi belonged to the family Crambidae under the superfamily Pyraloidea. A total of nine moth species were identified from the event (Table 1), namely *Herpetogramma basalis* (Walker 1866), *Conogethes punctiferalis* (Guenée 1854), *Endocrossis flavibasalis* (Moore 1868), *Glyphodes stolalis* Guenée 1854, *Omiodes milvinalis* (Swinhoe 1886), *Talanga sexpunctalis* (Moore 1877), *Cnaphalocrocis trebiusalis* Walker 1859, *Cydalima laticostalis* Guenée 1854, and *Crocidolomia* sp. Five species belonged to the tribe Margoronini, two to the tribe Spilomelini, and a single species to the tribe Herpetogrammatini - all under the subfamily Spilomelinae. The subfamily Glaphyriinae was represented by a single species, *Crocidolomia* sp. All species recorded in the present event were carrying out their puddling from the mud substrate. The individual moths were found extending their proboscis, and moving the uncoiled proboscis over the mud surface scattered on the vehicle to puddle for the necessary resources (Figure 2).

Table 1. Crambidae identified while puddling from the mud patches in Tippi, Arunachal Pradesh on 14-IX-2022

Sl. No.	Species	Family	Subfamily	Tribe	Individual Number
1	*Herpetogramma basalis* (Walker, [1866])	Crambidae	Spilomelinae	Herpetogrammatini	02
2	*Conogethes punctiferalis* (Guenée, 1854)	Crambidae	Spilomelinae	Margaroniini	01
3	*Endocrossis flavibasalis* (Moore, [1868])	Crambidae	Spilomelinae	Margaroniini	01
4	*Glyphodes stolalis* Guenée, 1854	Crambidae	Spilomelinae	Margaroniini	01
5	*Omiodes milvinalis* (Swinhoe, [1886])	Crambidae	Spilomelinae	Margaroniini	01
6	*Talanga sexpunctalis* (Moore, 1877)	Crambidae	Spilomelinae	Margaroniini	02
7	*Cnaphalocrocis trebiusalis* (Walker, 1859)	Crambidae	Spilomelinae	Spilomelini	04
8	*Cydalima laticostalis* (Guenée, 1854)	Crambidae	Spilomelinae	Spilomelini	03
9	*Crocidolomia* sp.	Crambidae	Glaphyriinae	-	02

Regarding their positioning of wings during puddling, a species-specific character for moths (Adler, 1982), all crambids were observed with wings spread flat over the substrate, with vigorous shaking of their antennae from side to side and continuously probing their proboscis over the mud patch. In terms of their activity, most individuals were found to remain stationary while feeding from their substrates and even when disturbed by neighbouring individuals for sharing the mud patches, except for *Cnaphalocrocis medinalis* (Guenée, 1854) and *Crocidolomia* sp. which showed unrest during the period of observation, with intermittent flights in search of best substrate or disturbed by some other moths. However, *Endocrossis flavibasalis* immediately extended its proboscis just at the moment of landing on or near the preferred substrate. All individuals seemed unaffected by the light or proximity of the observers.

Discussion

Pyraloidea show diverse host preferences with unique behavioural tendencies. Their larvae in particular are major pests of important crops like sugarcane, corn, rice etc. and stored products such as seeds and grains (Clausen, 1978; Solis, 1997); with some living concealed in silken webs, within rolled leaves, boring inside stem, root, shoot or galls (Solis, 2007), while some others are scavengers, myrmecophilous and even insectivores (Munroe, 1972; Gumhalter, 2022). The feeding behaviour of adult Pyraloidea is not well-known but can be assumed to effectively feed from an aqueous environment. Bänziger (1973) reported Lacryphagy (feeding on tears and other salt-containing liquids) in Pyraustinae and Spilomelinae.

Taking salts and other nutritional benefits from mud substrate through mudpuddling is commonly reported in Rhopalocera. Alternatively, reports on mudpuddling by Heterocera are very rare may be due to the fact that they are mostly nocturnal and hence not encountered in the wild at night. Moreover, night-flying Lepidoptera avoid the intense competition for essential salt components in soil with day-flying Lepidoptera through such temporal partitioning of resources. The present report on such evidence of nocturnal mudpuddling among some Pyraloidea illustrates the resource utilisation through temporal shift in their feeding behaviour.

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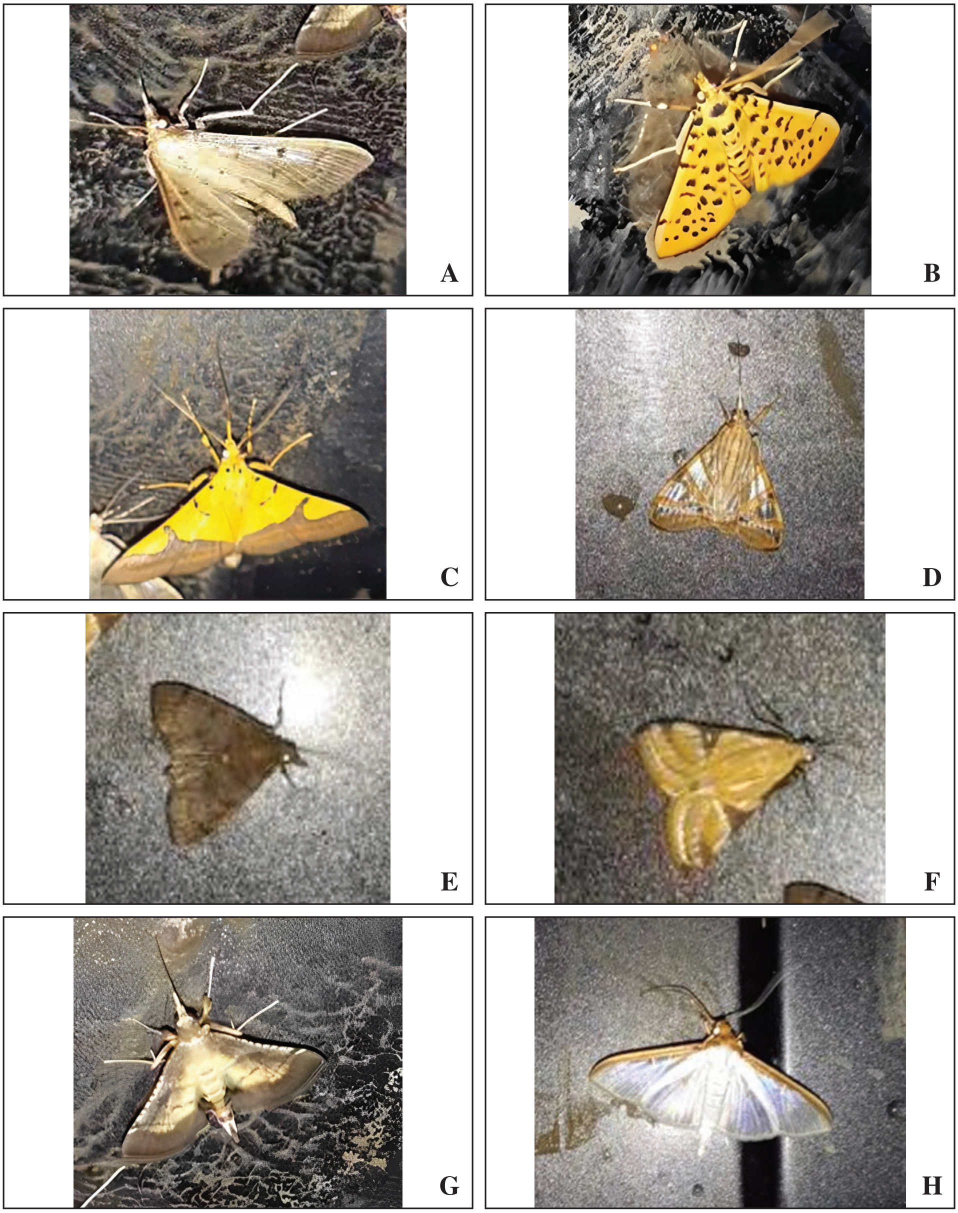

Figure 2. Adult moths of family Crambidae (Spilomelinae, Glaphyriinae) found puddling on mud substrates in Tippi, Arunachal Pradesh (14-XI-2022): **A.** *Herpetogramma basalis* (Walker 1866). **B.** *Conogethes punctiferalis* (Guenée 1854). **C.** *Endocrossis flavibasalis* (Moore 1868); **D.** *Glyphodes stolalis* Guenée 1854. **E.** *Omiodes milvinalis* (Swinhoe 1886); **F.** *Talanga sexpunctalis* (Moore 1877). **G.** *Cnaphalocrocis trebiusalis* (Walker 1859). **H.** *Cydalima laticostalis* (Guenée 1854).

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Evaluation of the type of bait in catching Nymphalidae in Van Someren-Rydon traps in the National Park Yanachaga-Chemillén-Paujil sector, Pasco, Peru (Lepidoptera: Papilionoidea)

Yeison Vega-Garrido & Oscar Mahecha-J.

Abstract

The use of baited traps for the study of Lepidoptera has increased in recent decades, offering advantages and disadvantages compared to direct methods of capture. However, studies evaluating the attractiveness of different types of different baits are scarce, and published works are limited to using the standard bait consisting of fermented fruit with sugar. This study evaluates the variation in the attractiveness and effectiveness of three types of bait (fermented fruit, rotting fish, and human feces) in the capture of Lepidoptera in Van Someren-Rydon traps (VSR) in the National Park Yanachaga-Chemillén (PNYCh), sector Paujil, by the use of VSR located in sites with different canopy cover. Certain species were found to visit all three types of bait, e.g. *Archaeoprepona demophon* (Linnaeus, 1758) and *Diaethria clymena* (Cramer, 1775), others only two of these, e. g. *Memphis glauce* (C. Felder & R. Felder, 1862), *Memphis moruus* (Fabricius, 1775), *Adelpha mesentina* (Cramer, 1777), *Temenis laothoe* (Cramer, 1777), and some were unique to one type of bait, e. g. *Zaretis itys* (Cramer, 1777), *Ancyluris etias* (Saunders, 1859), *Catoblepia berecynthia* (Cramer, 1777), *Catonephele numilia* (Cramer, 1775). Furthermore, it was found that the fruit bait presents significant differences concerning the rotting fish and feces baits, however, it presented the least number of individuals and species attracted. Meanwhile, rotting fish and feces presented a similar attractiveness in species number and quantity of individuals. The results suggest the bait's importance in capturing Lepidoptera and, consequently, their potential relevance in the elaboration of subsequent ecological studies.

Keywords: Lepidoptera, Papilionoidea, Nymphalidae, biological monitoring, diversity, faunistic studies, frugivorous, sampling techniques, tropical forest, Peru.

Evaluación del tipo de cebo-atrayentes en la captura de Nymphalidae en trampas tipo Van Someren-Rydon en el Parque Nacional Yanachaga-Chemillén-Sector Paujil, Pasco, Perú (Lepidoptera: Papilionoidea)

Resumen

El uso de trampas con cebo para el estudio de los Lepidoptera se ha incrementado en las últimas décadas, ofreciendo ventajas e inconvenientes en comparación con los métodos directos de captura. Sin embargo, los estudios que evalúan el atractivo de los distintos tipos de cebos son escasos, y los trabajos publicados se limitan a utilizar el cebo estándar consistente en fruta fermentada con azúcar. Este estudio evalúa la variación en el atractivo y la eficacia de tres tipos de cebo (fruta fermentada, pescado podrido y heces humanas) en la captura de Lepidoptera en trampas Van Someren-Rydon (VSR) en el Parque Nacional Yanachaga-Chemillén (PNYCh), sector Paujil, mediante el uso de VSR situadas en lugares con diferente cobertura de copas. Se encontró que algunas especies visitaban los tres tipos de cebo, por ejemplo *Archaeoprepona demophon* (Linnaeus, 1758) y *Diaethria clymena* (Cramer, 1775), otras sólo dos de ellos, por ejemplo *Memphis glauce* (C. Felder & R. Felder, 1862), *Memphis moruus* (Fabricius, 1775), *Adelpha mesentina* (Cramer, 1777), *Temenis laothoe* (Cramer, 1777), y algunos eran exclusivos de un tipo de cebo, p. ej. *Zaretis itys* (Cramer, 1777), *Ancyluris etias* (Saunders, 1859), *Catoblepia berecynthia* (Cramer, 1777), *Catonephele numilia* (Cramer, 1775). Además, se comprobó que el cebo de fruta presenta diferencias significativas respecto a los cebos de pescado podrido y heces, sin embargo, presentó el menor número de individuos y especies atraídos. Mientras, el pescado podrido y las heces presentaron un atractivo similar en número de especies y cantidad de individuos. Los resultados sugieren la importancia de los cebos en la captura de Lepidoptera y, en consecuencia, su relevancia potencial en la elaboración de estudios ecológicos posteriores.

Palabras clave: Lepidoptera, Papilionoidea, Nymphalidae, diversidad, estudios faunísticos, frugívoros, monitoreo biológico, técnicas de muestreo bosque tropical, Perú.

Introduction

Protected areas have a fundamental role in the conservation of interactions and populations of various organisms, as well as in the provision of ecosystem services essential for society. (Figgis et al. 2015). In this way, it is evident the need for and importance of monitoring the state of these areas and studying their internal ecological dynamics to understand how they respond to the constant changes caused by the continuous growth of the human population. However, monitoring the entire diversity of a tropical forest is an impossible task, leading to certain groups being selected based on their response to environmental changes, ease of capture, short generation times, identification, or other desirable characteristics, facilitating the monitoring (Whitworth et al. 2018). Because Lepidoptera are sensitive to changes in their habitat and for their diversity of ecological roles, they have been considered good bioindicators (Bonebrake et al. 2010; Whitworth et al. 2018), thus becoming ideal organisms for numerous ecological studies, for example, have been extensively studied in topics about fragmentation (Ockinger et al. 2009; Jew et al. 2015; Filgueiras et al. 2019), edge effect (Bossart & Opuni-Frimpong, 2009; Sung-Soo & Tae-Sung, 2018), in comparison to habitats with different level of disturbance (Devries et al. 1997; Ribeiro & Freitas, 2012; Barbosa et al. 2017) and in monitoring programs (Pozo et al. 2008; Costa-Pereira et al. 2013).

The study of Lepidoptera may be carried out through several methodologies, where the most frequent is the establishment of linear transects in open areas (grassland, heathlands, dunes, clearings, and less dense areas in general) capturing adult individuals, storing them, and processing them as reported by Van Swaay et al. (2015). However, this methodology has several disadvantages, for example, it is strongly influenced by the researcher’s experience in detecting and capturing individuals (Ebert, 1969; Brown, 1972; Iserhard et al. 2013). Furthermore, the vertical gradient of diversity cannot be effectively sampled, and sometimes independent samples cannot be established for comparison in ecological studies (Freitas et al. 2014). In this way, in recent decades the use of barley traps for the study of Lepidoptera has increased since they do not suffer from the same inconveniences (Freitas et al. 2014).

For ecological and comparative studies, the most used bait traps are the Van Someren-Rydon (VSR), which consist of a cylinder of black or white tulle fabric with the top sealed and the bottom open where the bait is held by a base attached to the trap (Rydon, 1964; Andrade-C et al. 2013; Freitas et al. 2014; Purwanto et al. 2015; Bokelaar, 2017). The principle of operation of the trap lies in the attraction of Lepidoptera by the bait they feed on the bottom, due to the small diameter of the cylinder that limits the maneuverability to fly, the Lepidoptera ascends and is trapped inside (Bokelaar, 2017). It should be mentioned that not all Lepidoptera can be caught using traps, constituting a major disadvantage for diversity and composition studies (Devries et al. 1997).

Various types of baits can be used in VSR traps, including fermented fruits, rotting fish, decaying seafood, and feces (Andrade-C et al. 2013; Freitas et al. 2014; Checa et al. 2018; Olarte-Quiñonez et al. 2021). Preferably fermented bananas mixed with sugar are used and it is this type of bait that predominates in diversity studies in the Neotropical region (Hughes et al. 1998; Aduse-Poku et al. 2012; Martins et al. 2017; Panjaitan et al. 2019). The other baits are usually used in a complementary way to the fruit bait, in addition, they are less used by its strong and unpleasant odor, by the difficulty of standardization in the preparation, because it attracts other groups of unwanted insects, but the negative results in the use of alternative baits are rarely reported by the authors (Freitas et al. 2014).

The baits effectiveness lies in supplying salts and minerals from the diet of Lepidoptera, which are relatively limited under natural conditions and affect key aspects of reproduction (number of eggs, the viability of the pups, etc.) and survival of the individual (Geister et al. 2008). Moreover, each type of bait is preferred by certain groups of Lepidoptera and even certain genera are only attracted by a particular type of bait, e. g. the genus *Adelpha* Hübner, [1819] and the pronophilines in general (Olarte-Quiñonez et al. 2021), is attracted by rotting fish, the feces attract many Charaxinae and nectarivores Lepidoptera (Molleman et al. 2005; Freitas et al. 2014; Fucilini, 2014). Nevertheless, the only study found where a comparison was made on the attractiveness of the baits was carried out by Bokelaar (2017), finding that there are no significant differences in the preference between baits, but it is noted that in terms of abundances that the rotting fish as bait was the least effective bait and that the effectiveness of the traps showed variations between the different types of plant cover (Bokelaar, 2017).

In this study, the variation in attractiveness and effectiveness of three types of baits (rotting fish, human feces, and fermented fruit) in the capture of Lepidoptera in VSR traps in the Yanachaga-Chemillén National Park (PNYCh) - Paujil sector, was evaluated. In this way, with our study, we may contribute to the study about using bait traps for future ecological studies and monitoring of protected areas and consequently provide relevant information for conservation plans and strategies.

Materials and method

Study Area

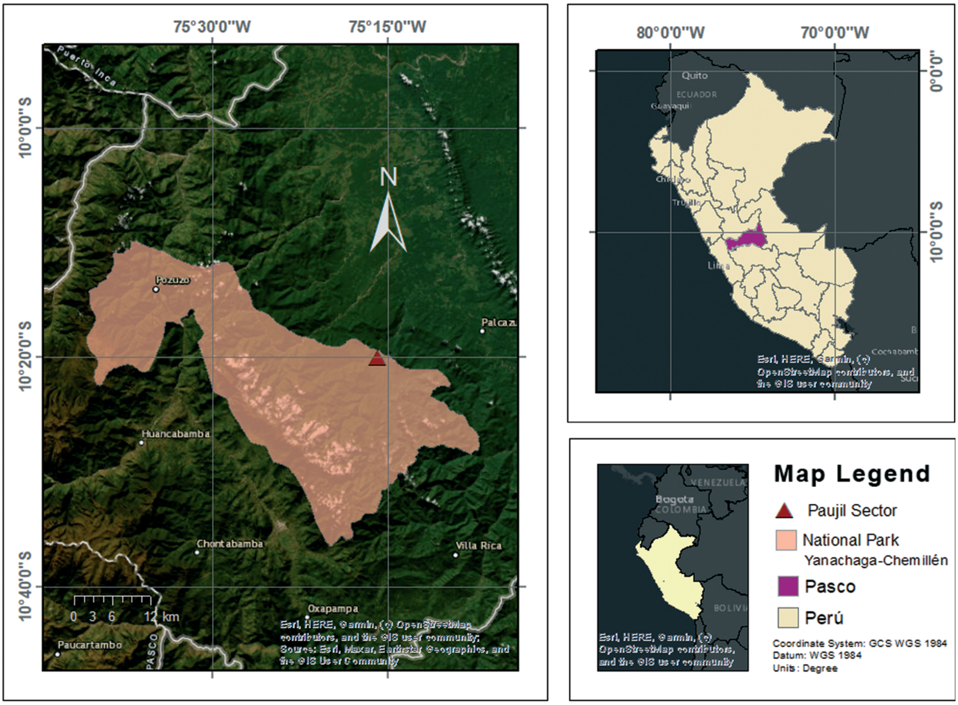

Figure 1. Location of the study area.

The work was carried out in the Yanachaga-Chemillén National Park (PNYCh), located in the department of Pasco, Peru. Specifically, the study was carried out in the Paujil sector (Figure 1). The area is typically a tropical humid forest and is located at an altitude between 300 and 800 a.s.l. with average temperatures of 25ºC and the rainy season from November to April. The Paujil sector has several types of vegetation, for example, gallery forests where trees of the species *Ficus* spp. (Linnaeus), *Inga marginate* (Willd.), *Zygia longifolia* ((Humb. & Bonp. ex Willd.) Britton & Rose) dominate, alluvial terraces with relatively flat terrain, characterized by primary canopy-dominated forests of the Fabaceae, Lauraceae, Lecythidaceae, Moraceae, Myristicaceae and Malvaceae families, in the middle stratum are found Annonaceae, Fabaceae, Malvaceae, Moraceae, Myristicaceae and Rubiaceae. In the shrub layer predominate Melastomataceae, Piperaceae, and Rubiaceae. Finally, in the area there are low and medium hills where a transition from the change of vegetation to the montane forest is observed (Laura, 2007).

METHODS OF CAPTURE AND IDENTIFICATION

Three linear transects were established in three types of vegetation cover in the Paujil sector: 1) in the paths to the lookout, 2) near the banks of the Iscozacín river, and 3) in the surrounding primary forest near a small watercourse, following the methodology proposed by Andrade-C et al. (2013). The sampling period comprised 8 effective days and was carried out in the rainy season in the sector in the month of February.

In the transect near the small watercourse, *Pourouma guianensis* (Aubl.), *P. minor* (Benoist), *Cedrelinga* sp. and *Socratea salazarii* (H. E. Moore) predominated in the tree stratum and easily exceeded the 15 m of height, the shrub layer was predominantly represented by *Schizocalyx* sp. and *Zygia* sp.; and, finally, the herbaceous stratum was represented by Maranthaceae and Cyclanthaceae families. In the transect of the lookout, the vegetation was scrubbier with respect to the surrounding premontane forest, dominating species of *Wettinia* sp., *Chrysophyllum* sp., and several species of Ericaceae. It is emphasized that in the herbaceous stratum dominated by *Iriartella* sp. and *Pariana* (Aubl.), the height of the canopy was between 8 to 15 m and the canopy was more open. Finally, the transect located on the banks of the Iscozacín river presented open areas, numerous bare rocks, and exposed sand regions, features of a gallery forest, where *Calliandra angustifolia* (Spruce ex Beth.) was the dominant species reaching the 5 to 8 m of height.

In this way, one VSR trap was placed at a height between 2 and 5 m from the ground, depending on the architecture of the vegetation in the area, with a different bait for every two traps, i. e. two traps had fermented fruit bait, two traps had rotting fish, and two traps had human feces. Each trap was checked every 10 to 30 minutes to minimize the risk of Lepidoptera escaping, from 9:00 to 15:30. The captured individuals were stored on parchment paper marked with the date, time, and bait of the trap. Later they were kept in a cold chain until their assembly and the identification was made with the taxonomic keys from Le Crom et al. (2004), Willmott (2003), Pinzón-C (2006), Garwood & Jaramillo (2017 a, b, c, d), Rengifo & Montero (2010), Gallice (2016) and with the database of type specimens Butterflies of America (Warren et al. 2019).

DATA ANALYSIS

Abundance histograms were made of the number of individuals caught and of the species recorded in relation to the type of bait in the R software (R Core Team, 2020). Additionally, a linearized correspondence analysis (DCA) was performed to evaluate the association of the species with the type of bait. Because the data is not normal, a Kruskal-Wallis analysis was performed to assess whether there are significant differences between bait types. Subsequently, a post hoc test of Dunn was conducted to determine which baits presented these differences (Sheskin, 2003). These tests were performed on the PAST software (Hammer et al. 2001) (Figure 2).

Results

In the 8 days of sampling, 60 individuals were captured with an effort of 54 hours/trap. The individuals were distributed in four families: Hesperiidae, Lycaenidae, Riodinidae, and Nymphalidae. The family Nymphalidae had the most records (54 individuals and 26 species), followed by Riodinidae (3 individuals, 3 species), Lycaenidae (2 individuals, 2 species) and finally Hesperiidae (1 individual, 1 species) (Figure 2C). For the lockout site (premontane forest), 37 specimens were captured, for the transect near the small watercourse (primary forest) 9 specimens were captured, and for the site located on the banks of the river Iscozacín (gallery forest) 14 specimens were captured. In the lockout transect, the feces bait was the more effective with 19 specimens collected, followed by rotting fish with 14 specimens collected, and finally the fermented fruits bait with 4 specimens collected. Besides, for the banks of the river Iscozacín transect, the feces bait was the more effective with 8 specimens collected, followed by rotting fish with 4 specimens collected, and finally the fermented fruits bait with 2 specimens collected. Finally, for the transect near the small watercourse, the rotting fish was the more effective bait with 5 specimens collected, followed by feces bait with 4 specimens collected, and the fermented fruits bait did not show specimens collected. In total, 33 species were collected in the VSR traps, representing 32.7% of the diversity as found by Vásquez (in prep.) and 25.6% according to the study by Grados et al (2008). It should be noted that 17 species are new records for the PNYCh-Sector Paujil (Figure 4), which are not included in the work of Grados et al. (2008).

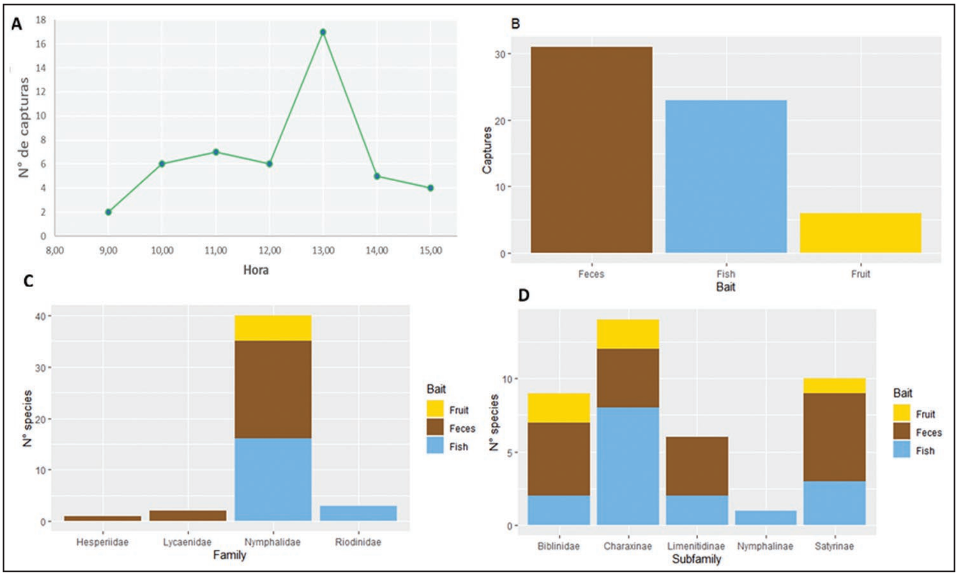

Figure 2. Effectiveness of different types of baits in Van Someren-Rydon traps. **A)** Variation in catch rate throughout the day. **B)** Number of individuals caught relative to bait type. **C)** Number of species from each family caught in each bait type. **D)** Number of species from each Nymphalidae subfamily caught in each bait type.

The most abundant genera were *Adelpha* Hübner, [1819] with 8 individuals captured and *Memphis* Hübner, [1819] with 9 individuals. The species captured for these two genera were 3 species for each, highlighting that *Adelpha capucinus* (Walch, 1775) and *Memphis glauce* (C. Felder & R. Felder, 1862) are the species with the highest abundance, with 5 and 6 individuals, respectively. It is important to note that most individuals of these two genera were not caught using fermented fruit bait, except for one individual from *Memphis moruus* (W. Comstock, 1961). Moreover, catches of the genus *Adelpha* were more frequent in the viewing sector (premontane forest). Other frequent species were *Archaeoprepona demophon* (Linnaeus, 1758) and *Diaethria clymena* (Cramer, 1775) with 4 individuals each, where this late species was collected only in the banks of the Iscozacín river (gallery forest).

To respect to the effectiveness of the baits, it was found that there is an increase in the catch rate in the VSR traps from noon for the three sites, extending for one hour and decreasing in the subsequent hours (Figure 2A). By discriminating the effectiveness of baits by families it is evident that individuals captured of Hesperiidae and Lycaenidae are attracted exclusively by feces, while individuals of Riodinidae are attracted by decaying fish. On the other hand, the family Nymphalidae is attracted by the three types of bait, however, more individuals are recorded in fish baits and feces (Figure 2C). At the subfamily level within Nymphalidae, it was observed that baits attracted individuals from 5 subfamilies, with feces being the bait that recorded the highest number of species within Biblidinae, Limenitidinae, and Satyrinae, while rotting fish recorded the highest number of species within Charaxinae (Figure 2D). It is worth mentioning that the fruit recorded species within Biblininae, Charaxinae, and Satyrinae, but did not attract species from the subfamily Limenitidinae; the decomposing fish attracted species from the 5 subfamilies caught in the VSR traps; the fish and fruit recorded the same number of catches in the subfamily Biblininae. Finally, only one species, *Siproeta stelenes* (Linnaeus, 1758), of Nymphalinae was collected and this one was attracted by the decomposing fish (Figure 2D).

Also, a difference was observed in the capture of Lepidoptera depending on the type of bait used (Kruskal-Wallis p-value=$7,5*10^{-5}$; $\alpha=0,05$), where the largest number of individuals collected corresponds to feces bait, followed by decomposing fish and finally fermented fruit, with 31, 23 and 5 individuals captured, respectively (Fig. 2B). However, Dunn's post hoc test showed that the differences occurred between the fruit and the other two types of bait (Dunn fruit-feces: $7,91*10^{-5}$; Dunn fruit-fish: 0,006); in other words, rotting fish bait does not differ significantly from feces in terms of the number of individuals caught (Dunn's post hoc fish-feces: p-value= 0,81). On the other hand, it was found that the species attracted by bait are not the same, even reporting exclusive species for each type of bait, e.g. *Adelpha erotia* (Hewitson, 1847), *Catoblepia berecynthia* (Cramer, 1777), *Catonephele acontius* (Linnaeus, 1771), *Chloreuptychia agatha* (A. Butler, 1867), *Hermeuptychia harmonia* (A. Butler, 1867), *Nessaea hewitsonii* (C. Felder & R. Felder,1859), *Siderone galantis* (Cramer, 1775) were exclusive for the feces bait, *Fountainea euripyle confuse* (A. Hall, 1929), *Opsiphanes cassina* (C. Felder & R. Felder,1862), *Prepona claudina* (Godart, [1824]), *Prepona dexamenus dexamenus* (Hopffer, 1874), *Siproeta steleness*, *Zaretis itys* (Cramer, 1777) were exclusive for the rotting fish bait, and *Catonophele numilia* (Cramer, 1775), *Pseudodebis marpessa* (Hewitson, 1862) were exclusive for the fermented fruit bait (Figure 3; Table 1). This observation is supported by the result of the DCA, in which it is evident that there are species strongly associated with a type of bait (Figure 3). Note that rotting fish and feces baits has a similar number in unique species, 10 and 12 species, respectively, while fermented fruit bait have only two unique species. It is important to mention that there were Lepidoptera that were caught on more than one type of bait, for example, *Archaeoprepona demophon* visited all three types of bait with the same frequency, as *Diaethria clymena*, but one more individual was caught in the bait of feces, other species were common to two types of bait, mostly between feces and fish. Likewise, no attracted species shared between fermented fruit and feces baits were recorded, only one species (*Memphis moruus*) was reported shared between fermented fruit and rotting fish baits, and the the largest number of species shared between baits was between rotting fish and feces, e.g. *A. capucinus capucinus*, *A. mesentina* (Cramer, 1777), *Hermeuptychia hermes* (Fabricius, 1775), *M. glauce*, *Morpho helenor* (Cramer, 1776), *Temenis laothoe* (Cramer, 1777) (Tabla 2).

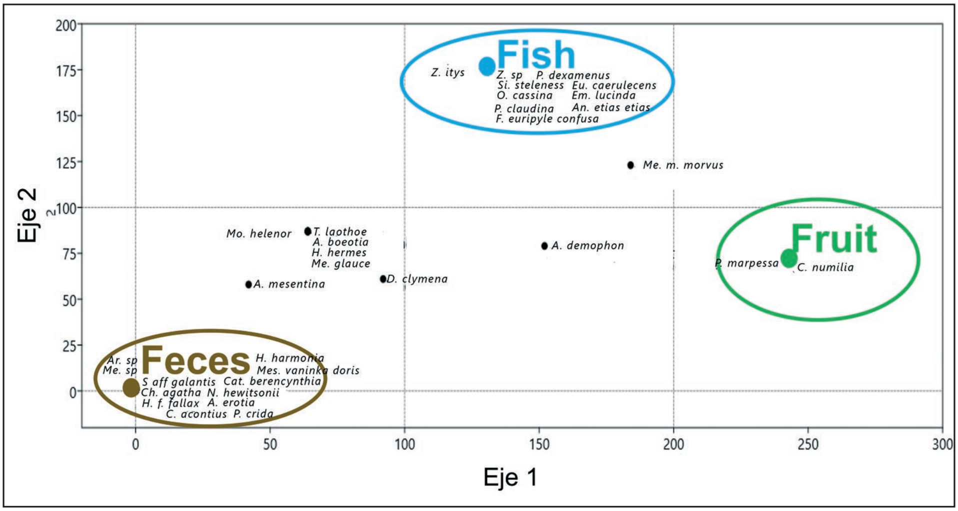

Figure 3. Detrended correspondence analysis (DCA) between species and bait type.

Table 1. Species caught exclusively on one type of bait.

Bait	Species
Fermented fruit	*Catonephele numilia*
	Pseudodebis marpessa
Rotting fish	*Ancyluris etias etias*
	Emesis lucinda
	Eurybia caerulecens
	Fountainea euryphile confusa
	Opsiphanes cassina
	Prepona claudina
	Prepona dexamenus
	Siproeta steleness
	Zaretis itys
	Zaretis sp.
Feces	*Adelpha erotia*
	Arzecla sp.
	Catoblepia berecynthia
	Catonephele acontius
	Chloreuptychia agatha
	Hermeuptychia fallax
	Hermeuptychia harmonia
	Memphis sp.
	Mesotaenia vaninka doris
	Nessaea hewitsonii
	Pyrrhopyge crida
	Siderone galantis

Table 2. Occurrence of Papilionoidea species in each type of bait. Note that *Archaeoprepona demophon* and *Diaethria clymena* visit all three types of baits, that some species visit more than one type of bait and that there are species registered exclusively for one type of bait.

	Fruit	**Feces**	**Fish**
Species			
Adelpha boeotia		3	2
Adelpha erotia		1	
Adelpha mesentina		2	1
Ancyluris etias			1
Archaeoprepona demophon	2	1	1
Arzecla sp.		1	
Catoblepia berecynthia		2	
Catonephele acontius		2	
Catonophele numilia	1		
Chloreuptychia agatha		1	
Diaethria clymena	1	2	1
Emesis lucinda			1
Eurybia caerulecens			1
Fountainea euripyle confusa			1
Hermeuptychia fallax		2	
Hermeuptychia harmonia		1	
Hermeuptychia hermes		1	1
Indeterminado (Lycaenidae)		1	
Memphis glauce		3	3
Memphis morvus	1		1
Memphis sp.		1	
Mesotaenia vaninka doris		2	
Morpho helenor		1	1
Nessaea hewitsonii		1	
Opsiphanes cassina			1
Prepona claudina			1
Prepona dexamenus			1
Pseudodebis marpessa	1		
Pyrrhopyge crida		1	
Siderone galantis		1	
Siproeta steleness			1
Temenis laothoe		1	1
Zaretis itys			2
Zaretis sp.			1
Total	**6**	**31**	**22**

Discussion

Although it is a low percentage compared to other capture methods, it was indispensable to record rare species such as *Prepona claudina*, *Prepona dexamenes*, *Siderone galantis*, which are usually not captured by performing transects with the entomological network. This high number of new reports can be explained due to the methodology used by the authors, which was limited exclusively to the use of entomological networks and therefore causes canopy species and/or species with low abundances to be unlikely to collect (Devries et al. 1997; Schulze et al. 2001). Another possible explanation may be that the Lepidoptera community presents differences according to the time of year as found in other sites (Hamer et al. 2005; Checa et al. 2009; Bandini et al. 2010). Thus, the Lepidoptera community may differ in the rainy season in which the present study was conducted during 8 days with respect to the periods immediately after the rains and the dry season in which the study was conducted Grados et al. (2008). However, Grados et al. (2008) only a difference of 3 species between the times evaluated, leading to the unlikely occurrence of this pattern in the Paujil sector.

Baits showed significant differences in catch rates and a slight preference of certain subfamilies to certain types of baits is observed, a trend that is more evident at the species level, although this was only evident between the fruit and the other two types of bait. To surprise and contrary to predictions made a priori, fermented fruit bait was the least effective in attracting the lowest number of individuals and species. This result differs from that found by Bokelaar (2017) and Checa et al. (2018), who found this type of bait to be the most efficient in primary forest and in any season, when considering abundance as an indicator. Possibly the flowering and fruiting season of several plant species in the sector will cause this type of resource to be more widely distributed in the area, thus altering the dispersion of the species (Stevens et al. 2010) and consequently the effectiveness of the bait. An alternative to explain the low effectiveness of fermented fruit as bait is the effect of climate. Bokelaar (2017) records that the effectiveness of sugar-macerated bananas decreases under rainy conditions, being predominant during the sampling days in this study. Furthermore, it seems that the dry and rainy season does have an impact on the attractiveness of the baits (Checa et al. 2018), so it is conjectured that, if this study were conducted in the dry season in the Paujil sector, it would present differences with the results found in the present study.

It is noted that the rotting fish in the Bokelaar study (2017) was one of the baits with the lowest number of collects, contrasting with the results obtained. In this last study he used coffee baits, macerated fruit, or cut with sugar, rotting fish in different environments with different degree of disturbance, causing the results to be affected by the configuration of the landscape, microclimatic conditions, and fragmentation as suggested Rochat et al. (2017) and Orlandín et al. (2019). As opposed to the findings of Bokelaar (2017), Freitas et al. (2014) mentions that this type of bait has a high effectiveness and can attract several groups of Lepidoptera, coinciding with what was found. Likewise, a similar pattern is reported by Checa et al. (2018) using shrimp as bait, where they found a higher species richness compared to fermented banana bait.

With respect to feces as bait, it is evident that their effectiveness is comparable to that of rotting fish and even recorded the highest number of individuals in the study, also attracted some species of nectarivores Lepidoptera (Hesperiidae, Lycaenidae). However, this bait did not attract all groups of frugivorous Lepidoptera, possibly limiting their potential to record Lepidoptera diversity. It should be noted that feces were more effective than rotting fish to attract species of the genus *Adelpha* Hübner, [1819], but less effective in attracting species of Charaxinae. The above differs partially with what Freitas et al. (2014) mentioned, where it indicates that feces are most effective in attracting Charaxinae and rotting fish as the best attractant for the genus *Adelpha*. Moreover, several species of the Satyrini tribe were attracted exclusively by feces bait, for example, *Chloreuptychia agatha*, *Hermeuptychia fallax fallax*, *H. harmonia* y *H. hermes*, contrasting with what is reported in literature where it is mentioned that one of the disadvantages is its ineffectiveness in attracting Lepidoptera in this tribe. Nevertheless, this difference can be caused by the type of cover where the traps were installed and the height at which they were placed, leading to the assessment of both the type of cover and the height of the traps in the assessment of the attractiveness of the baits.

On the contrary, several of the results mentioned by Freitas et al. (2014), Garwood & Jaramillo (2017d), agree with the observations made, for example, feces more effectively attracted individuals of the species *Memphis glauce*, *Nessaea hewitsonii* was only caught on this kind of bait, *Catonephele numilia* (Cramer, 1775) was collected in fermented fruits bait, and the rotting fish was good attractant for *Emesis lucinda* (Cramer, 1775), *Eurybia caerulescens* (H. Druce, 1904) of the family Riodinidae. In addition, some individuals of nectarylvorous Lepidoptera such as *Heliconius* (Kluk, 1780) and some Hesperiidae were observed flying over the traps with this bait; although they did not enter the trap, that might suggest that feces also attract these species. Other findings complement the records of Freitas et al. (2014), highlighting the fact that genus *Prepona* (Boisduval,1836) was caught exclusively on rotting fish bait and not on feces bait. It should be noted that this exclusivity in attracting certain taxa to specific baits may be influenced by the short sampling time. Additionally, it has been reported that species composition varies with the season and years (Checa et al. 2018), causing them to respond differentially to being attracted by a specific bait.

Added to the above and as additional result outside to the study aim, the three types of baits were also efficient attracting other arthropods, especially flies, crickets, and bees. In this last group, the presence of numerous females and some males of the tribe Euglossini of the family Apidae stands out. Individuals who visited the baits were observed feeding on the exudate and exhibited a pattern like that previously discussed with Lepidoptera, more abundance in fish baits and feces and less abundance in fruit bait. Similarly, it was observed that females of *Eulaema mocsaryi* (Friese, 1899) collected feces in the neckties, possibly to make their nests, and, equivalently, *Eufriesea* sp. collected fish possibly to feed their broods. These records complement the work of Günther Gerlach for the sector, highlighting that species of Euglossinii were collected that were not recorded using scent bait. These findings may be useful for later comparative studies on the effectiveness of baits, obtaining more data with the same sampling effort, as suggested by Freitas et al. (2014).

In conclusion, our results suggest the importance of bait in the capture of Lepidoptera and even reflect a preference of certain species for a specific type of bait. These preferences should be considered in further research to maximize sampling effectiveness to know the diversity and community of Lepidoptera, for the to assess the conservation status at a site, and to develop conservation strategies involving other organisms.

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BOOK REVIEWS

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FIBIGERIANA SUPPLEMENT. Book series of Taxonomy and Faunistics. Volume 3
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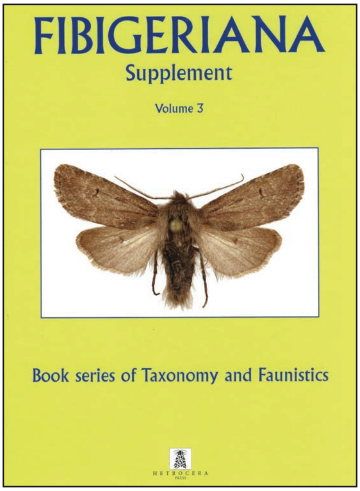

Cuando nos encontrábamos más que satisfechos con las dos series que sobre Noctuoidea había publicado la editorial *Heterocera Press*, una de ellas *"Noctuidae Europaeae*" ya finalizada con trece volúmenes y otra en pleno desarrollo *"Taxonomic Atlas of the Euroasian and North Africa Noctuoidea"* con nueve volúmenes ya publicados y otros en preparación, una nueva serie de monografías sobre esta superfamilia llega a nuestras manos, se trata de FIBIGERIANA SUPPLEMENT nombre en honor a nuestro querido amigo Michael Fibiger (1945-2011) y que pretende recopilar e informarnos del estado de las colecciones lepidopterológicas depositadas en los principales Museos.

En este suplemento del tercer volumen, sus 14 autores, tratan los Noctuoidea a lo largo de 12 trabajos, en los que se tratan diferentes monografías sobra diferentes géneros, a saber: *Manoba* Walker, 1863 (Nolidae), *Cheipolia* Staudinger, 1896, *Mudaria* Moore, 1893, *Chodapsaphidae* gen. nov., *Oncocnemis* Lederer, 1853, *Anaplectoides* McDunnough, 1928, *Actebia* Strephens, 1829, *Feliniosis* Roepke, 1938, Dasypolia Guenée, 1852, *Kollariana* Hacker, 1996, *Calamia* Hübner, [1821] y *Dasythorax* Staudinger, 1889 (Noctuidae) encontrados en las regiones Paleártica y Oriental.

Para aumentar la importancia de este volumen, es de destacar la monografía *"Illustrated catalogue of the genus Manoba Walker, 1863 (Lepidoptera, Noctuoidea, Nolidae, Nolini)*", así como la designación de 18 Lectotypes, la descripción de cuatro géneros y de un subgénero nuevos; completándose con la descripción de 23 especies y 16 subespecies nuevas.

No podemos terminar estas líneas, sin felicitar a los autores por tan excelentes trabajos, así como a la Editorial, que como siempre, no ha escatimado en medios para mantener el mismo nivel de calidad de los volúmenes precedentes de las series anteriormente mencionadas, por lo que recomendamos vivamente esta nueva serie, que no puede faltar en ninguna biblioteca específica que se precie.

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New larval host plants of *Euchrysops cnejus* (Fabricius, 1798) and *Rapala manea schistacea* (Moore, 1879) from Eastern India (Lepidoptera: Lycaenidae)

Arajush Payra & Chintan Bhatt

Abstract

In the present communication we report *Vigna stipulacea* (Lam). Kuntze as a larval host plant of *Euchrysops cnejus* (Fabricius, 1798) and *Caesalpinia bonduc* (L.) Roxb. as a larval host plant of *Rapala manea schistacea* (Moore, 1879) for the first time from the coastal areas of Purba Medinipur district, West Bengal, India. The study also report new record of *Vigna stipulacea* for the state West Bengal.
Keywords: Lepidoptera, Lycaenidae, new records, Fabaceae, Purba Medinipur, India.

Nuevas plantas nutricias de larvas de *Euchrysops cnejus* (Fabricius, 1798) y *Rapala manea schistacea* (Moore, 1879) de la India oriental (Lepidoptera: Lycaenidae)

Resumen

En la presente comunicación registramos a *Vigna stipulacea* (Lam). Kuntze como planta nutricia de *Euchrysops cnejus* (Fabricius, 1798) y *Caesalpinia bonduc* (L.) Roxb. como planta nutricia de *Rapala manea schistacea* (Moore, 1879) por primera vez en las zonas costeras del distrito de Purba Medinipur, Bengala Occidental, India. El estudio también informa de un nuevo registro de *Vigna stipulacea* para el estado de Bengala Occidental.
Palabras clave: Lepidoptera, Lycaenidae, nuevos registros, Fabaceae, Purba Medinipur, India.

Introduction

Recording data on the larval host plants of Lepidoptera is very crucial in order to understand their ecology, as well as significant for the formulation of conservation strategies. The diversity and distribution of Lepidoptera chiefly governed by the diversity and distribution of their larval host plants. Some of the major contributions to the documentation of larval host plants of Indian Lepidoptera are of Bell (1909, 1910, 1927), Wynter-Blyth (1957), Kunte (2000), Kalesh & Prakash (2007), Naik & Mustak (2015), Nitin et al. (2018) and Karmakar et al. (2018). In recent five years several authors have reported new larval host plants of Lepidoptera from different parts of the West Bengal (Dey, 2021; Payra, 2021; Mukherjee 2021, 2022; Banerjee et al. 2023). In the present communication, we report for the first time *Vigna stipulacea* (Lam). Kuntze as a larval host plant of *Euchrysops cnejus* (Fabricius, 1798) and *Caesalpinia bonduc* (L.) Roxb. as host plant of *Rapala manea schistacea* (Moore, 1879) from the coastal areas of Purba Medinipur district, West Bengal, India.

Results and discussions

E. cnejus is widely distributed from Indian Subcontinent to Myanmar, China, Thailand, Lao PDR, Cambodia, Vietnam, Taiwan, Japan, West Malaysia, Singapore to New Guinea, Northeastern Australia, Fiji and Samoa (Inayoshi, 2023). In India, it occurs throughout the country except in some parts of north Indian states (western Rajasthan, western Haryana and southern Punjab) and in some states of Northeast India (Arunachal Pradesh and Mizoram) (Varshney & Smetacek, 2015; Kehimkar, 2016; van Gasse, 2021). In the adjoining coastal areas of Purba Medinipur district, West Bengal the status of the Lycaenidae is "Common" (Payra et al. 2017).The larval stages of this Lycaenidae are known to feed mainly on the members of Fabaceae family (Robinson et al. 2010) and the previously recorded larval host plants of this species are *Acacia caesia* (L.) Willd., *Butea monosperma* (Lam.) Taub., *Cajanus cajan* (L.) Millsp., *Canavalia ensiformis* (L.) DC, *Lablab purpureus* (L.) Sweet, *Ougeinia oojeinensis* (Roxb.) Hochr., *Paracalyx scariosus* (Roxb.) Ali, *Phaseolus*, *Pisum satvum* L., *Pueraria phaseoloides* (Roxb.) Benth., *Vigna cylindrica* (L.) Skeels, *Vigna radiata* (L.) R. Wilczek, *Vigna trilobata* (L.) Verdc., and *Vigna unguiculata* (L.) Walp. (Wynter-Blyth, 1957; Kunte, 2000; Robinson et al. 2010; Nitin et al. 2018). On 09-VII-2020 a female of *Euchrysops cnejus* was observed laying eggs underneath the leaves of a *Vigna* plant near Kuliyata village (21º39'47.93"N, 87º34'11.44!E), Purba Medinipur, West Bengal (Figure 1. A-H). On the same day several caterpillars were also observed underneath the leaves, on stem, stipule, flowers and pods of the plant. Later on, during July-August 2020 several caterpillars were observed at the same place. A final instar caterpillar was collected from the field during August and reared. The *Vigna* plant was identified as *V. stipulacea* by the characteristics of angular stem, large stipule, raceme above foliage, compact inflorescence, purple keel, oblong shaped hilum, and which can easily be separated from its closely allied species *V. trilobata*. Aforementioned records show *V. stipulacea* was unreported as larval host plant of this Lycaenidae. Moreover, previous distribution records of this plant indicate, it has never been reported from West Bengal (Yadav et al. 2014, Bhattacharjee et al. 2019; Gore et al. 2019). Hence the present record from Purba Medinipur district represents new locality of this plant and resulting in 11th *Vigna* spp. of the state West Bengal. This study also reports *V. stipulacea* as the first larval host plant of an Indian Lepidoptera.

R. manea schistacea widely occurs in Oriental region, distributed from Indian subcontinent to Myanmar, southern China, Thailand, Lao PDR and Vietnam (Inayoshi, 2023). It occurs throughout India, except northern Arid region and Northeastern state Mizoram (Varshney & Smetacek, 2015; Kehimkar, 2016; van Gasse, 2021). This Lycaenidae stated as "Not Rare" in the adjoining coastal areas of Purba Medinipur district, West Bengal (Payra et al. 2017). Until now, the recorded larval host plants of *R. manea schistacea* are *Mangifera indica* L. and *Spondias pinnata* (L.f.) Kurz (Anacardiaceae); *Combretum indicum* (L.) DeFilipps (Combretaceae); *Mallotus repandus* (Willd.) Müll.Arg. (Euphorbiaceae); *Acacia caesia* (L.) Willd., *Acacia megaladena* Desv., *Acacia pennata* (L.) Willd. *Calliandra heamatocephala* Hassk. *Mimosa diplotricha* C. Wright ex Sauvalle, *Saraca asoca* (Roxb.) Willd., *Senegalia torta* (Roxb.) Maslin, Seigler & Ebinger and *Senna tora* (L.) Roxb. (Fabaceae); *Clerodendrum infortunatum* L. (Lamiaceae); *Syzygium* sp. (Myrtaceae); *Urena lobata* L. (Malvaceae); *Averrhoa bilimbi* L. (Oxalidaceae); *Antidesma acidum* Retz. and *Antidesma ghaesembilla* Gaertn. (Phyllanthaceae); *Ziziphus* spp. (Rhamnaceae); *Ixora* sp. (Rubiaceae); *Lepisanthes tetraphylla* Radlk. and *Litchi chinensis* Sonn. (Sapindaceae); *Camellia sinensis* (L.) Kuntze (Theaceae); *Lantana camara* (Verbenaceae) (Wynter-Blyth, 1957; Kunte, 2000; Robinson et al. 2010; Bhakare & Ogale, 2018; Nitin et al. 2018; Naik & Mustak, 2020; Mukherjee 2021, 2022; Banerjee et al. 2023). On 22-VIII-2020, two females of *R. manea schistacea* were observed laying eggs on the inflorescence and leaves of *C. bonduc* near Shankarpur (21º38'47.17"N, 87º34'18.09"E), Purba Medinipur, West Bengal (Figure 2 A-F). On the same day a caterpillar was also observed inside the inflorescence. Later on 26-X-2020, an individual was observed laying eggs on the inflorescence of *C. bonduc*, near Nilpur Village (21º39'1.50"N, 87º33'52.29"E). Although, the caterpillar was not reared, findings of caterpillar and egg laying observations suggest *C. bonduc* as a putative larval host plant of *Rapla manea schistacea*. *C. bonduc* already been reported as larval host plant of *Nacaduba beroe gythion* Fruhstorfer, 1916, *Nacaduba kurava canaraica* Toxopeus, 1927 (Lycaenidae). *Charaxes bharata* C. Felder & R. Felder, [1867] (Nymphalidae); *Eurema blanda* (Boisduval, 1836) (Pieridae) (Nitin et al. 2019, Payra, 2020).

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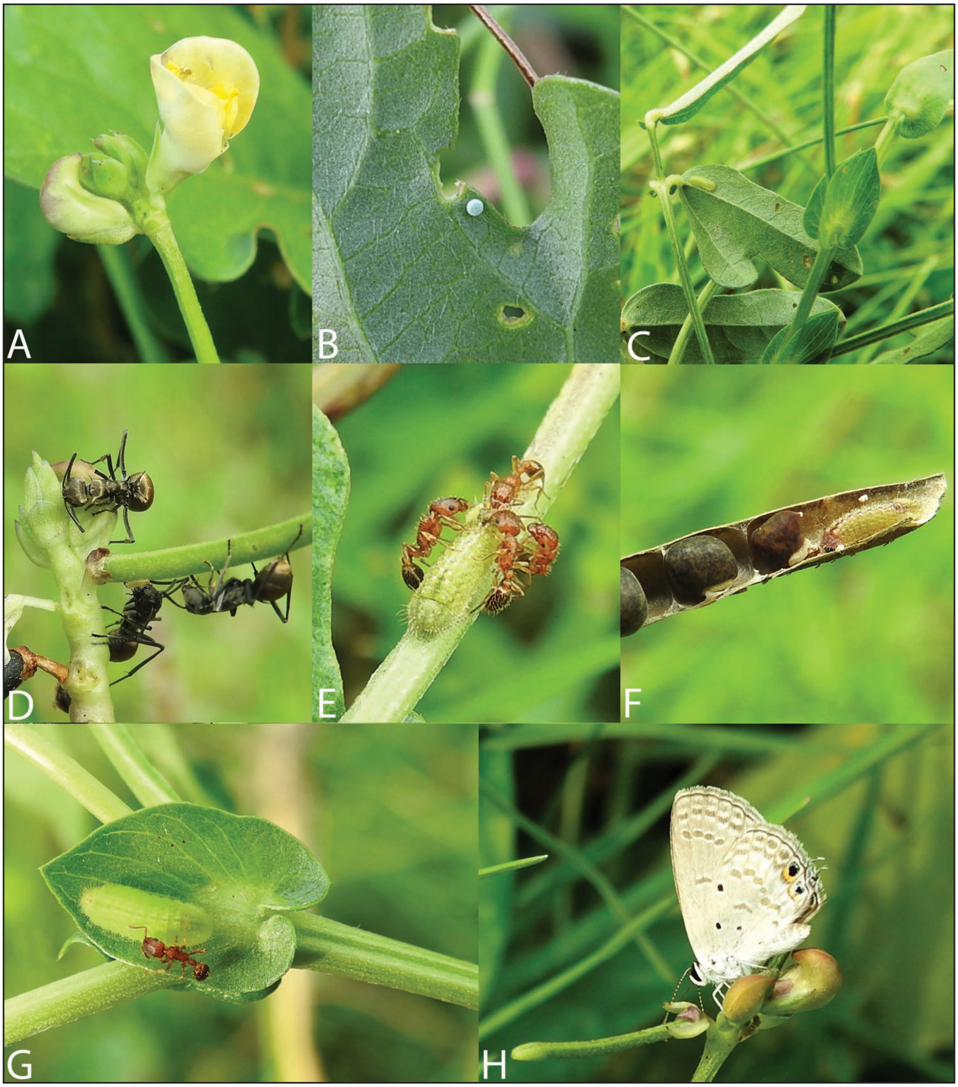

Figure 1. A. Flowers of *Vigna stipulacea* (09-VII-2020). **B.** Egg of *Euchrysops cnejus* underneath the leaf (09-VII-2020). **C.** Caterpillar of *E. cnejus* underneath the leaf (09-VII-2020). **D.** Caterpillar of *E. cnejus* associated with *Polyrhachis* ants (16-VIII-2020). **E.** Caterpillar of *E. cnejus* associated with *Tetramorium* ants (16-VIII-2020). **F.** Caterpillar of *E. cnejus* inside the pod (16-VIII-2020). **G.** Final instar caterpillar of *E. cnejus* on stipule (09-VII-2020). **H.** *Euchrysops cnejus* (09-VII-2020) (Photos: A Payra).

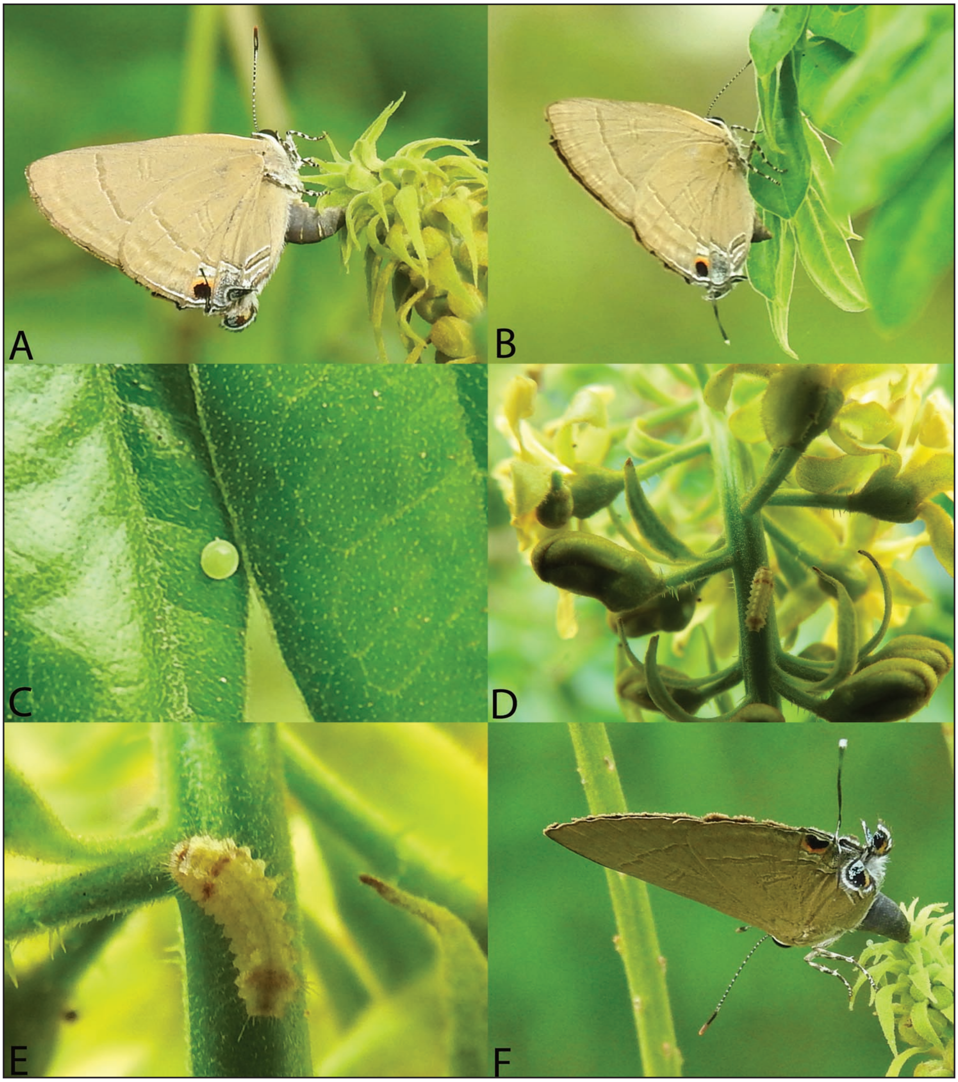

Figure 2. A. *Rapala manea schistacea* laying eggs on the inflorescence of *C. bonduc* (22-VIII-2020). **B.** *R. manea schistacea* laying eggs on the leaf (22-VIII-2020). **C.** Egg of *R. manea schistacea* (22-VIII-2020). **D-E.** Caterpillar of *R. manea schistacea* (22-VIII-2020). **F.** *R. manea. schistacea* laying eggs on the inflorescence (26-X-2020) (Photos: A Payra).

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Plusiinae of Kashmir: Taxonomy, distribution and new faunistic records (Lepidoptera: Noctuoidea)

Muzafar Riyaz & Savarimuthu Ignacimuthu

Abstract

The present study encompasses twelve Plusiinae species, shedding light on their taxonomy, and geographical distribution. Among these, four species viz. *Chrysodeixis acuta* (Walker, [1858]), *Cornutiplusia circumflexa* (Linnaeus, 1767), *Autographa nigrisigna* (Walker, [1858]), and *Sclerongenia jessica* (Butler, 1878) are reported for the first time from the union territory of Jammu and Kashmir, India thereby adding novel insights to the local lepidopteran fauna. For future scientific endeavors, each of these newly reported species has been meticulously prepared and preserved with mounted specimens and genitalia, ensuring that researchers have access to valuable reference material for further studies.

Keywords: Lepidoptera, Noctuoidea, Plusiinae, new records, Himalayas, Kashmir, India.

Plusiinae de Cachemira: Taxonomía, distribución y nuevos registros faunísticos (Lepidoptera: Noctuoidea)

Resumen

El presente estudio abarca doce especies de Plusiinae, arrojando luz sobre su taxonomía y distribución geográfica. Entre ellas, cuatro especies, *Chrysodeixis acuta* (Walker, [1858]), *Cornutiplusia circumflexa* (Linnaeus, 1767), *Autographa nigrisigna* (Walker, [1858]) y *Sclerongenia jessica* (Butler, 1878), se han descrito por primera vez en el territorio de la unión de Jammu y Cachemira, India, añadiendo así nuevos datos a la fauna local de Lepidoptera. Para futuros esfuerzos científicos, cada una de estas nuevas especies ha sido meticulosamente preparada y conservada con especímenes montados y genitalia, asegurando que los investigadores tengan acceso a un valioso material de referencia para futuros estudios.

Palabras clave: Lepidoptera, Noctuoidea, Plusiinae, nuevos registros, Himalaya, Cachemira, India.

Introduction

Boisduval (1829) established the subfamily Plusiinae within the Noctuidae family of moths, using *Plusia* Ochsenheimer (1816) as the type of the genus. The Plusiinae subfamily is notable for its large and well-organized taxonomy. It comprises approximately 500 species globally distributed, found in tropical, temperate, and polar climates (Zahiri & Fibiger, 2008; Ronkay et al. 2008, 2010). The subfamily Plusiinae originated in the Southeastern Palearctic and Eastern Oriental regions, where the majority of plesiomorphic plusiine are located (Kitching, 1987). Members of the Plusiinae subfamily hold agricultural significance. Adult Plusiinae moths are characterized by large scale tufts on the thorax, a convex occiput, few apical styloconic sensilla, semicircular strengthening bars on the most apical portion of the proboscis, dorsal scale tufts on one or more abdominal segments, and a quadrifid hindwing (vein Cu appears 4-branched) (Kitching, 1987; Shashank & Singh, 2014; Muddasar et al. 2020).

Hampson (1894) described 31 species of Plusiinae belonging to the genus *Plusia* and one species under the genus *Abrostola* Ochsenheimer (1816) from India. Subsequently, Ronkay (1986), Ronkay (1987), and Ronkay et al. (2008, 2010) documented much of the Indian Plusiinae fauna. Sivasankaran et al. (2012) compiled a list of 21 species under Plusiinae as part of the Noctuidae family, recorded from India. Shashank & Singh (2014) provided a thorough inventory of Indian Plusiinae, comprising 59 species. On the other hand, Sinha et al. (2018) documented *Antoculeora ornatissima* (Walker, 1858) as a novel range record from the western Himalayan region of India, and in a separate study, Twinkle and Shashank (2018) recorded *Ctenoplusia kosemponensis* (Strand, 1920) from Karnataka, India. In another study, Sondhi et al. (2018) documented *Plusiopalpa adrasta* (Felder and Rogenhofer, 1874) and *Scriptoplusia nigriluna* (Walker, 1858) as new records from Kerala, India. More recently, Twinkle et al. (2018) reported eight species and Twinkle et al. (2020) reported 31 species of Plusiinae from India, along with DNA barcoding and taxonomic accounts. The larvae of most Plusiinae species are polyphagous and cause damage to various agricultural crops, including *Glycine max* L.-Soybean, *Brassica oleracea* var. *botrytis*-Cauliflower, *Brassica oleracea* var. *capitata*-Cabbage, *Solanum tuberosum* L.-Potato, *Solanum lycopersicum* L.-Tomato, *Raphanus sativus* L.-Radish, *Phaseolus vulgaris* L.-Common Bean, *Vigna unguiculata* L.-Cowpea, *Solanum melongena* L.-Eggplant and several aromatic and Oleraceae plant species (Sarwar et al. 2021).

In Jammu and Kashmir, Dar (2014) had documented five species with four new records from subfamily Plusiinae, while Riyaz & Sivasankaran (2022a) recently reported *Anadevidia peponis* as a new record from Jammu and Kashmir. In this study, we provide taxonomic descriptions, distributions, of eight Plusiinae members along with their precisely mounted photographs, which facilitate their straightforward identification.

Materials and methods

During insect explorations in the Kashmir Himalayas, nine adult specimens belonging to the subfamily Plusiinae were collected in the agroecosystems of Tehsil Herman of District Shopian, Kashmir (Figure 1). The study area experiences a total annual precipitation of 660 mm and has an average temperature of 25º. It is mainly rural and contains vast agricultural areas. (Riyaz & Sivasankaran, 2022b). The major vegetable crop species around the site were *Brassica oleracea var. botrytis, Brassica oleracea var. capitata, Raphanus sativus* L., *Solanum melongena* L., *Phaseolus vulgaris* L., *Solanum tuberosum* L., *Solanum lycopersicum* L., *Brassica oleraceae* var. *virdis*, *Cucurbita maxima*, *Lagenaria siceraria, Cyclanthera pedata and Pisum sativum L.* The collected specimens were deposited in the museum of the Xavier Research Foundation, St. Xavier's College, Palayamkottai, India with specimen voucher numbers (XRF-KMR-279-87 and XRF-KMR-GS-280-84). The samples were collected at night using a ProTac HL Headlamp and cotton-wrapped ethyl acetate vials. Photographs of the species were captured using a Xiaomi Redmi Note 8 Pro smartphone equipped with a 20 mm macro lens. The first author collected the specimen during his exploration of the insect diversity in the Kashmir Valley of India. Further taxonomic studies, including the removal and preparation of the genitalia, were conducted. The specimen's abdomen was cleaned with KOH at 135ºC for several minutes before preparing the genitalia. The prepared genitalia were then rinsed with distilled water, placed in glycerin, and preserved for future analysis.

The identification of the newly recorded species was accomplished by examining the specimen's morphological characteristics and the genitalia. This process involved utilizing relevant literature such as works of (Zahiri & Fibiger, 2008; Dar, 2014; Twinkle et al. 2018; Twinkle et al. 2020). Through these resources, the species were precisely identified.

Results and Discussion

Systematic account

Family Noctuidae Latreille, 1809
Subfamily Plusiinae Boisduval, 1829
Tribe Argyrogrammatini Eichlin & Cunningham, 1978

Anadevidia peponis (Fabricius, 1775) (Figure 2)

Material examined: 1 ♂, India, Jammu and Kashmir, Herman, 33º42’18”’N, 74º56’23”’E, 1596 m, 20-X-2021, Muzafar Riyaz. (Coll. ERIB-KMR-271).

Distribution: India, Jammu and Kashmir (Riyaz & Sivasankaran, 2022), Himachal Pradesh, Delhi, Punjab, Karnataka, Bihar, Sikkim. Elsewhere: Korea, Japan, Australia, Russia, Indonesia, Japan, China, Sunderland (Twinkle et al. 2020).

Chrysodeixis acuta (Walker, [1858]) (Figures 3, 10)

Material examined: 1 ♀, India, Jammu and Kashmir, Herman, 33º42’18”’N, 74º56’23”’E, 1596 m, 18-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-279, XRF-KMR-GS-280).

Distribution: India, Himachal Pradesh, Arunachal Pradesh, Punjab, Delhi, Kerala, Tamil Nadu, West Bengal, Meghalaya. Elsewhere: Africa, Canary Islands, South Asia, Indonesia, Japan, China (Twinkle et al. 2017; 2020). **New Record for Jammu and Kashmir.**

Chrysodeixis eriosoma (Doubleday, 1843)

Material examined: 2 ♀, India, Jammu and Kashmir, Affarwatt, 34º03’17”N, 74º25’35”E, 4000 m, 21-VIII-2011, Kongdori, 34º02’38”’N, 74º25’06”’E, 3300 m, 2 ♀, 25 ♂, 2-IX-2010. Mudasir Ahmad Dar. (Coll. Dept. of Zoology & Env. Sciences, Punjabi University Patiala, India).

Distribution: India, Jammu and Kashmir (Dar, 2014), Uttarakhand, Punjab, Delhi, Sikkim. Elsewhere: Indonesia, New Guinea, New Zealand, Australia, Malaysia, Sunderland, China (Twinkle et al. 2020).

Cornutiplusia circumflexa (Linnaeus, 1767) (Figures 4, 11)

Material examined: 1 ♀, India, Jammu and Kashmir, Herman, 33º42’18”’N, 74º56’23”E, 1596 m, 17-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-280, XRF-KMR-GS-281).

Distribution: India, Punjab, West Bengal. Elsewhere: Italy-Greece, South-West-Russia, South Urals, Africa, Canary Islands, Arabia, Southwest Asia, Sri Lanka, Nepal, South-East China, Japan, Turkey, England (Twinkle et al. 2020). **New Record for Jammu and Kashmir**.

Ctenoplusia albostriata (Bremer & Grey, 1853) (Figure 5)

Material examined: 6 ♂, India, Jammu and Kashmir, Ramban, 33º14’25”’N, 75º14’32”’E, 1780 m, 26-IX-2010, Mudasir Ahmad Dar. (Coll. Dept. of Zoology & Env. Sciences, Punjabi University Patiala, India).

Distribution: India, Jammu and Kashmir (Dar, 2014), Himachal Pradesh, Arunachal Pradesh, Uttarakhand, Punjab, Delhi, Kerala, Tamil Nadu, Karnataka, Orissa, Meghalaya. Elsewhere: China, Indonesia, Sri Lanka, Australia, New Guinea, New Zealand (Twinkle et al. 2020).

Thysanoplusia orichalcea (Fabricius, 1775) (Figure 6)

Material examined: 1 ♂, India, Jammu and Kashmir, Herman, 33º42’18”N, 74º56’23”E, 1596 m, 18-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-282).

Distribution: India, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Delhi, Kerala, Tamil Nadu, Karnataka, Bihar, West Bengal, Meghalaya, Manipur, Sikkim. Elsewhere: South Asia, Taiwan, Philippines, Indonesia, Indochina, Europa, New Guinea, Africa, Southern Palearctic region. (Twinkle et al. 2018; 2020).

Tribe Plusiini Boisduval, 1928

Antoculeora ornatissima (Walker, 1858)

Material examined: 2 ♂, 1 ♀, India, Jammu and Kashmir, Srinagar, 34º11’70”N, 74º77’60”E, 1585 m, 05-IX-2007 (Coll. Rajesh).

Distribution: India, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Delhi, Kerala, Tamil Nadu, Karnataka, Bihar, West Bengal, Meghalaya, Manipur, Sikkim. Elsewhere: South Asia, Taiwan, Philippines, Indonesia, Indochina, Europa, New Guinea, Africa, Southern Palearctic region. (Twinkle et al. 2018, 2020; Sinha et al. 2018).

Autographa gamma (Linnaeus, 1758)

Material examined: 6 ♂, 1 ♀, India, Jammu and Kashmir, Baramulla (Gulmarg), 34º04’84”N, 74º38’05”’E, 3000 m, 15-VI-2012. Mudasir Ahmad Dar. (Coll. Dept. of Zoology & Env. Sciences, Punjabi University Patiala, India).

Distribution: India, Jammu and Kashmir (Dar, 2014). Elsewhere: Greenland (Lafontaine & Poole, 1991), Countries in Europe, Africa, USA, Asia (Sullivan & Molet, 2014).

Autographa nigrisigna (Walker, [1858]) (Figsures 7, 12)

Material examined: 1 ♀, India, Jammu and Kashmir, Herman, 33º42’18”N, 74º56’23”E, 1596 m, 18-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-281, XRF-KMR-GS-282).

Distribution: India, Himachal Pradesh, Uttarakhand, Delhi, Punjab. Elsewhere: Pakistan, Afghanistan, Nepal, Bhutan, Russia, Korea, Japan, China (Twinkle et al. 2018; 2020). **New record for Jammu and Kashmir.**

Euchalcia orophasma (Boursin, 1960)

Material examined: 1 ♀, India, Jammu and Kashmir, Taglang La (present day, Union Territory of Ladakh), 34º05’14”N, 74º47’51”E, 5328 m, 03-VII-1994, H. Hacker & W. Ludwig (Coll. NPC-IARI).

Distribution: India, Previously Jammu and Kashmir (Now Ladakh UT). Elsewhere: Pakistan, Afghanistan, Tajikistan (Twinkle et al. 2020).

Macdunnoughia confusa (Stephens, 1850) (Figure 8)

Material examined: 1 ♀, India, Jammu and Kashmir, Herman, 33º42’18”N, 74º56’23”E, 1596 m, 16-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-282).

Distribution: India, Jammu and Kashmir (Dar, 2014). Elsewhere: Japan, Korea, Siberia, China, France, Austria, Hungary (Twinkle et al. 2020).

Sclerogenia jessica (Butler, 1878) (Figures 9, 13)

Material examined: 1 ♀, India, Jammu and Kashmir, Herman, 33º42’18”N, 74º56’23”E, 1596 m, 18-X-2022, Muzafar Riyaz. (Coll. XRF-KMR-283, XRF-KMR-GS-282).

Distribution: India, Himachal Pradesh, Uttarakhand. *Elsewhere:* Japan, Korea, Taiwan, Russia, Indo China (Twinkle et al. 2020). **New Record for Jammu and Kashmir.**

Kashmir’s rich biodiversity in both agricultural and natural ecosystems presents a unique opportunity for further studies and exploration. The relatively unexplored nature of the region’s biodiversity underscores the need for continued efforts to document, understand, and conserve the diverse array of species that inhabit the area. As scientific knowledge advances, there is potential for uncovering even more hidden facets of Kashmir’s ecosystems, contributing not only to academic understanding but also to informed conservation efforts and sustainable management of the region’s natural resources. The present study has provided a checklist of the Plusiinae species in the Kashmir region, shedding light on their taxonomy, and distribution. The findings of four previously unreported species in Jammu and Kashmir highlights the potential for ongoing biodiversity exploration and research in the area. The meticulously prepared and preserved specimens, along with their genitalia preparations, offer valuable reference materials for future scientific endeavors. The availability of such specimens will undoubtedly contribute to the advancement of research in the field of lepidopterology and promote a deeper understanding of the intricate relationships between different Plusiinae species and their environment.

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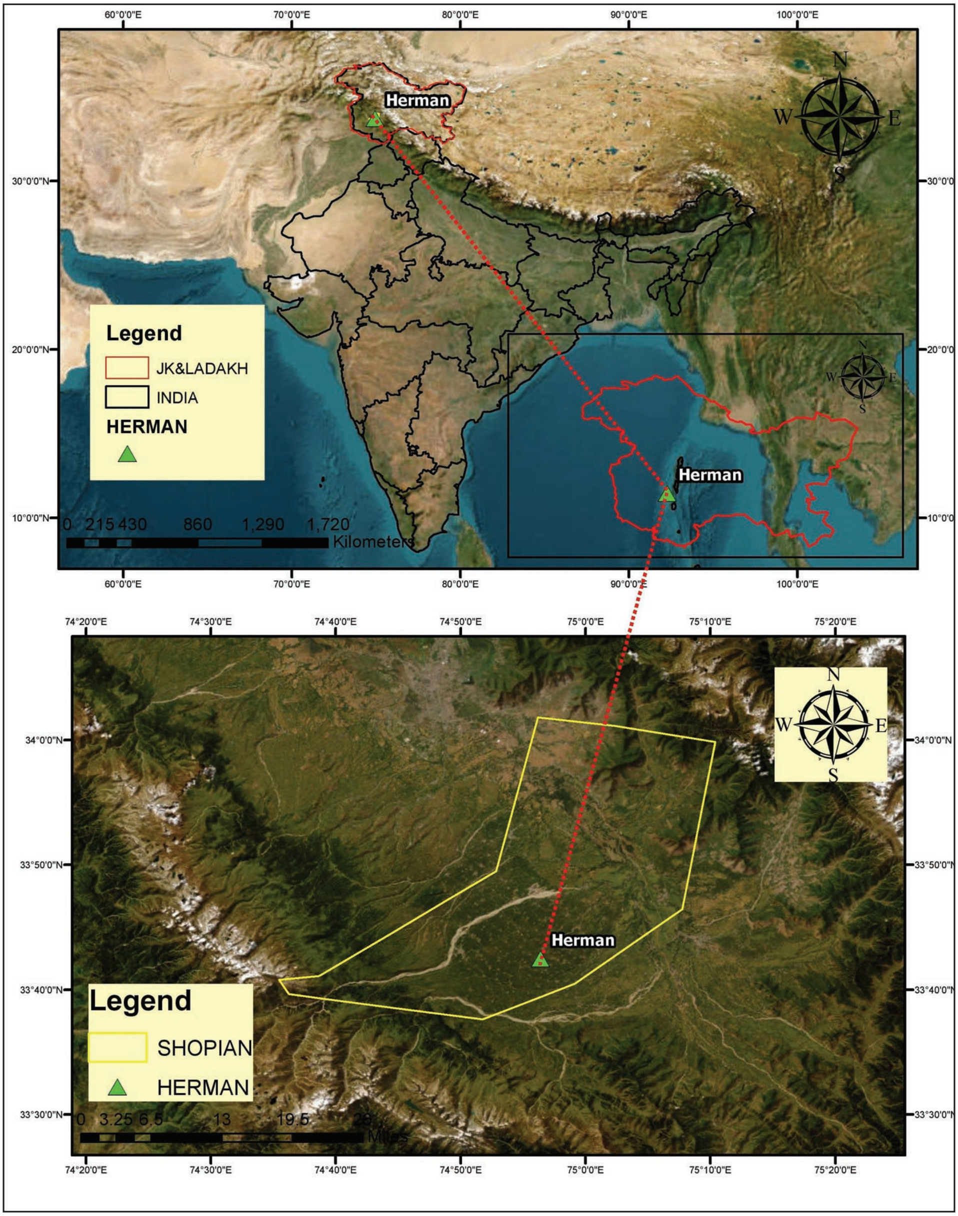
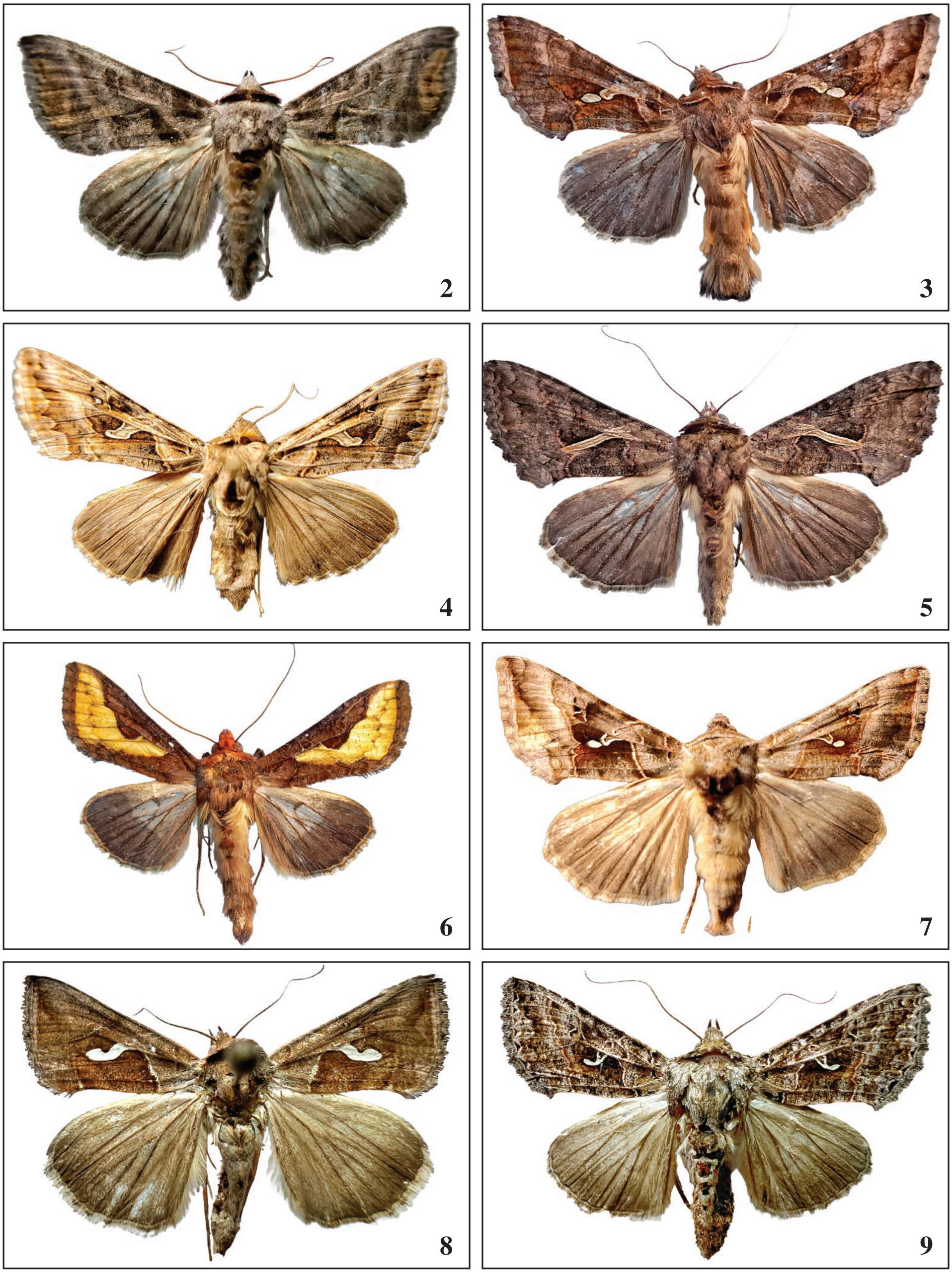
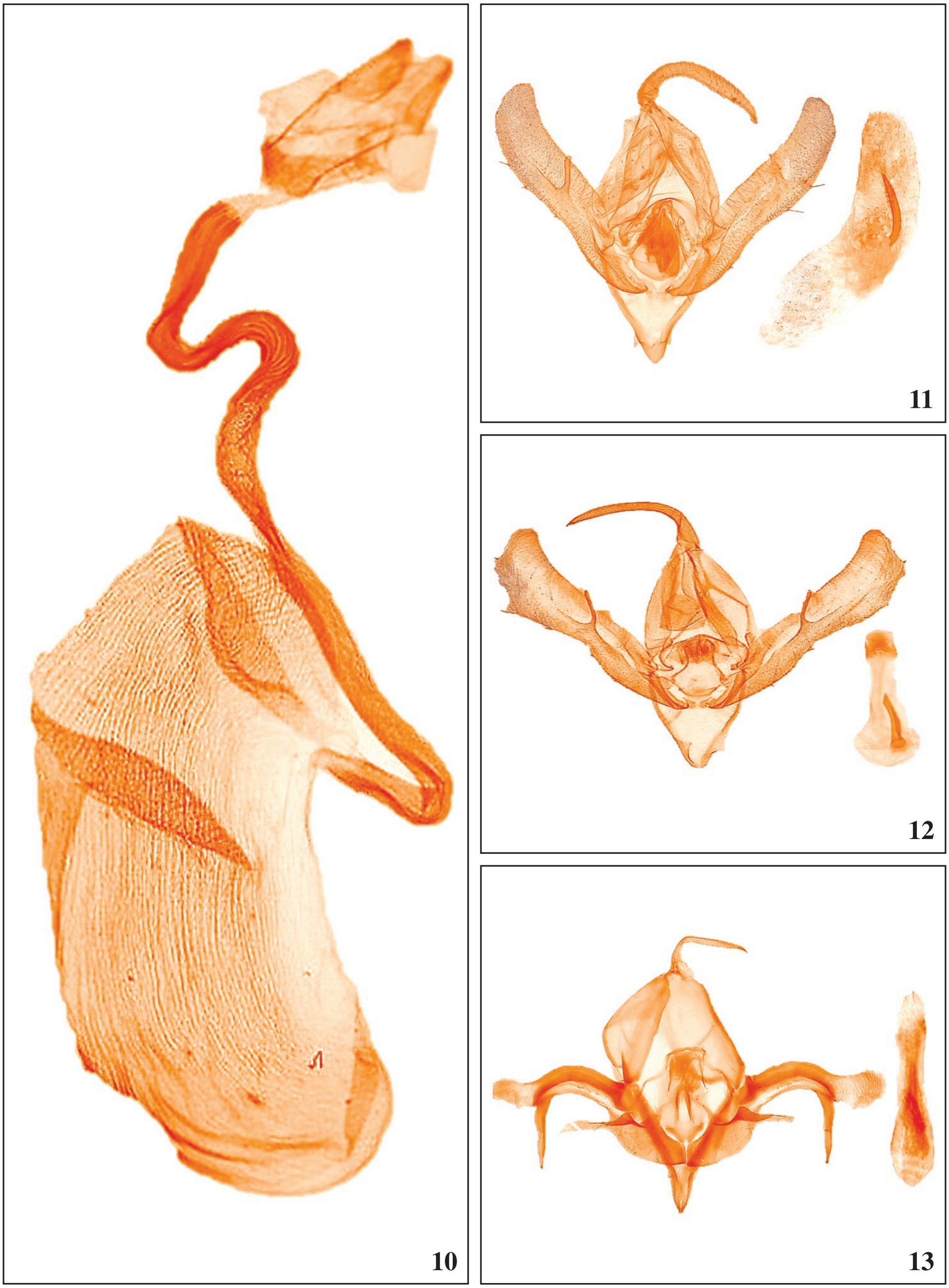


Figure 1. Map of the Tehsil Herman, District Shopian, Kashmir, showing the study area.



Figures 2-9. (Mounted specimens). **2.** *Anadevidia peponis* ♂. **3.** *Chrysodeixis acuta* ♀. **4.** *Cornutiplusia circumflexa* ♀. **5.** *Ctenoplusia albostriata* ♂. **6.** *Thysanoplusia orichalcea* ♂. **7.** *Autographa nigrisigna* ♀. **8.** *Macdunnoughia confusa* ♀. **9.** *Sclerogenia jessica* ♀.



Figures. 10-13. 10. *Chrysodeixis acuta* female genitalia. **11.** *Cornutiplusia circumflexa* male genitalia. **12.** *Autographa nigrisigna* male genitalia. **13.** *Sclerogenia jessica* male genitalia.

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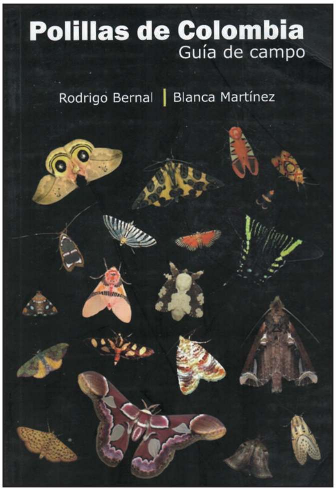

R. Bernal & B. Martínez
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696 páginas y 304 láminas en color
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Tenemos en nuestras manos, la primera guía de los Heterocera (polillas) que se publica en Colombia, después del ingente trabajo realizado por los autores, para ordenar más de 16.000 fotografías, que han dado lugar a la presentación de sólo 2.065 especies, que, sin lugar a dudas, es el primer paso, para conocer las 29.000 especies, que aproximadamente, se estima podrían encontrarse en este país.

En esta ocasión, los autores tratan 34 familias de las superfamilias Bombycoidea, Lasiocampoidea, Geometroidea, Noctuoidea, Drepanoidea, Mimallonoidea, Pyraloidea, Thyridoidea, Alucitoidea, Pterophoroidea, Gelechioidea, Papilionoidea, Cossoidea, Zygaenoidea, Sesioidea, Tortricoidea, Choreutoidea, Yponomeutoidea, Tineoidea y Hepialoidea.

Después de unas generalidades, como: ¿qué son las polillas?, los nombres de las polillas, importancia ecológica y económica, estrategia de supervivencia y como observar y fotografiar polillas, clasificación y como usar esta guía.

Ya dentro del grueso del libro, nos presenta cada una de las familias consideradas y de cada una de las especies tratadas, nos dan su nombre científico, su tamaño, su distribución conocida y altitudinal, la zonas colombianas de donde se conocen, con su referencia bibliográfica, abundancia y/o rareza, seguida de las fotografías de cada una de ellas, siempre en vivo, para ayudar en su identificación.

La obra finaliza con un apéndice, en el que se encuentran las "localidades para observar polillas", informándonos señaladas en el texto, como los lugares donde se han observados las especies consideradas en esta guía, animando a los interesados en estos Lepidoptera, a que aumenten las informaciones conocidas con nuevos registros y nuevas especies.

No podemos terminar estas líneas, sin felicitar a los autores, por tan excelente trabajo, que sin lugar a duda, servirá como una primera guía, para todos aquellos deseen empezar con el estudio del maravilloso mundo de los Heterocera, por lo que recomendamos su adquisición.

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The secret of ancient images of Lepidoptera in the Egyptian tomb of Nakht - Nabokov's opinion and the contemporary view (Insecta: Lepidoptera)

Konstantin A. Efetov & Gerhard M. Tarmann

Abstract

The Lepidoptera images in the ancient Egyptian tomb of Nakht have been studied. The opinion of V. Nabokov on these images is discussed. Most probably, not *Zygaena* sp. but the dimorphic butterfly *Hypolimnas misippus* (Linnaeus, 1767) was the model for the ancient painters.
Keywords: Insecta, Lepidoptera, Zygaenidae, *Zygaena*, Nymphalidae, *Hypolimnas misippus*, Nabokov, tomb of Nakht, Ancient Egypt.

El secreto de las antiguas imágenes de Lepidoptera en la tumba egipcia de Nakht - La opinión de Nabokov y la visión contemporánea (Insecta: Lepidoptera)

Resumen

Se han estudiado las imágenes de Lepidoptera de la antigua tumba egipcia de Nakht. Se discute la opinión de V. Nabokov sobre estas imágenes. Muy probablemente, no *Zygaena* sp. sino la mariposa dimórfica *Hypolimnas misippus* (Linnaeus, 1767) fue el modelo de los antiguos pintores.
Palabras clave: Insecta, Lepidoptera, Zygaenidae, *Zygaena*, Nymphalidae, *Hypolimnas misippus*, Nabokov, tumba de Nakht, Antiguo Egipto.

Introduction

By this work the authors continue their series of publications dealing with various aspects of Zygaenidae study (Can Cengiz et al. 2018; Efetov et al. 2015a, 2015b, 2018; Efetov & Tarmann, 2016; Razov et al. 2017; Subchev et al. 2016) including Zygaenidae in art (Efetov & Tarmann, 2008; Nazari & Efetov, 2023). In 2008 the authors published a paper in the Entomologist's Gazette (Efetov & Tarmann, 2008) in which they mentioned one of the oldest images of *Zygaena* Fabricius, 1775 (Insecta, Lepidoptera, Zygaenidae), painted in the 17th century by the Dutch artist Otto Marseus Van Schrieck approximately 100 years before the "Systema Natura" of Carolus Linnaeus. The editor of the journal, Dr W. G. Tremewan, advised us to mention the publication of Parent (1987) in which the author wrote about the ancient fresco from the Egyptian tomb of Nakht with seven images of insects, some of them, according to his opinion, looking like *Zygaena* (Parent, 1987, pp. 22, 41, pl. 1, fig. 2). However, we think that Nakht's images do not show a *Zygaena*.

Results and discussion

At first, we need to give some information about the history of the tomb of Nakht. A detailed overview has been published on the Internet by O. E. Akimov under the title “Problems of Egyptology” (http://sceptic-ratio.narod.ru/rep/kn18.htm). Nakht served as an astrologer and scribe under the Egyptian pharaoh Thutmose IV (who ruled 1402-1392 BC or 1397-1388 BC, New Kingdom, 18th Dynasty) and possibly under Amenhotep III (who ruled 1391-1353 BC or 1388-1351 BC, New Kingdom, 18th Dynasty). Nakht’s burial place is situated in Sheikh Abd el-Qurna, a part of the Theban Necropolis on the west bank of the Nile opposite to Luxor (Thebes [Theban tomb No TT52]).

The local people informed Europeans about the position of the burial place of Nakht in 1889. The wall painting of the tomb shows the theme of hunting in the thickets of the Nile. There is a drawing preserved by Faucher-Gudin from a photograph by Alexander Gayet taken most probably at 1892 (Figure 1). This drawing is published in the second volume of Gaston Maspero’s 12-volume “History of Egypt, Chaldea, Syria, Babylon, and Assyria” (Maspero, 1903).

However, the first professional Egyptologist, Norman de Garis Davies, visited the site only in 1907, after the first reconstruction of the Nakht’s tomb made by non-professionals. Most likely, sometime between 1892 and 1902, there was a serious collapse of the tomb. This conclusion can be made because on the next picture taken by A. Beato in 1902, we see many differences from the drawing of Faucher-Gudin. The frescoes of the tomb became well-known only when their copies made between 1907 and 1910 appeared in the New York Metropolitan Museum of Art. It means that the well-known images of these Egyptian masterpieces are a result of non-professional restoration (Figures 2-3) and strongly differ from the original figure by Faucher-Gudin (Figure 1). On his drawing one can see at least five insects which look like butterflies. All of them have good visible antennae. On the fresco after restoration there are seven insects. Two of the original five changed and now look like dragonflies (Figures 2-3). In one butterfly the antennae have disappeared. It is possible to recognise two additional butterflies, one without antennae, the second with only the right wings visible.

Nazari (2015) published a paper in which he wrote that these images in Nakht’s tomb are more likely Nymphalidae, most probably the Danaid Eggfly *Hypolimnas misippus* (Linnaeus, 1767) or the Plain Tiger *Danaus chrysippus* (Linnaeus, 1758). It is necessary to note that the females of *Hypolimnas misippus* copy the wing coloration of *Danaus chrysippus* as a result of mimicry, while males have a different wing pattern (Figures 4-5).

The famous Russian and American writer Vladimir V. Nabokov mentioned these Egyptian Lepidoptera images in 1942 in his letter to his wife Vera (Nabokov et al. 2017). According to his opinion these images represent butterflies of the family Nymphalidae. He wrote on 20-X-1942:

“My love, I’m writing to you on the way from Atlanta to Cowan - the train hasn’t started yet. Please, write a few words to Miss Read - my husband has been telling me so much about you in his letters that I almost feel as if I knew you - something like that - and thank her for all the kindness that you and your wonderful college showed him. She… presented me with a huge print of details from an Egyptian fresco with butterflies, about which I’ll write something…KISSES…V.”

Nabokov wanted to use these images in his book “Butterflies in Art”. He began this book in the mid-1960s but did not complete the project.

Dieter Zimmer in a large monograph “A Guide to Nabokov’s Butterflies and Moths” (Zimmer, 2001) wrote:

“In his research for a book on Lepidoptera in art, Nabokov came across a very special Plain Tiger [*Danaus chrysippus* (Linnaeus, 1758)]: “This butterfly has the distinction of being the oldest known to have been represented by man. Seven specimens of it (with a typical white-dotted *Danaus* body but somewhat *Vanessa cardui* like wingtips) are shown flitting over the papyrus swamp in a fowling scene from a Theban tomb (XVIII Dynasty. 1580-1350 BC), Brit.Mus.” About Alice Ford’s edition of Audubon’s butterfly drawings, he wrote, “She [Ford] might have traveled back some thirty-three centuries to the times of Tuthmosis IV or Amenophis III and, instead of the obvious scarab, found there frescoes with a marvelous Egyptian butterfly (subtly combining the pattern of our Painted Lady [*Vanessa cardui* (Linnaeus, 1758)] and the body of an African ally of the Monarch [*Danaus plexippus* (Linnaeus, 1758)].*”* The butterflies Nabokov was speaking of are on one of the murals in the Tomb of Nakht, a scribe and official at the temples of Karnak, in the necropolis of Thebes-West. The mural is known as "Hunt in the Papyrus Swamp" and believed to have been painted during the reign of Thutmosis IV (1402-1392 BC), 18th Dynasty. The butterflies fly among eleven birds of several species and are flanked by two large hunters and seven smaller persons. Behind and underneath them there is a green wall of papyrus. In the foreground there is blue water with a "mountain" of fishes. The tomb was opened in 1889 and is still in place (and not at the British Museum). Between 1907 and 1910 all its wall paintings were carefully copied by the British egyptologist Norman de Garies Davis and his wife Nina for the New York Metropolitan Museum of Art which subsequently published them and made them famous."

We do not agree with the determination of Nabokov. As these images in Nakht's tomb are clearly dimorphic (Figures 1-3) they represent most probably the Danaid Eggfly *Hypolimnas misippus* (Linnaeus, 1767) which has a strongly pronounced sexual dimorphism (Figures 4-5) and its range covers Egypt. The male of *Hypolimnas misippus* (Figure 5) has two large white spots on the forewing and one on the hindwing. This wing pattern is clearly visible now in two of the seven insects on the fresco (Figures 2-3).

Conclusions

1. The ancient Egyptian images of Lepidoptera in Nakht's tomb have nothing to do with *Zygaena*
2. Most probably they are showing the dimorphic Nympalidae *Hypolimnas misippus*, a species occurring in Egypt.

Acknowledgments

The authors want to express their thanks to Dr Vazrick Nazari (Padova, Italy) for fruitful discussions, to Mr Ajith Unnikrishnan (Bengalore, India) for photos of *Hypolimnas misippus*, and to Dr Adrian Spalding (Truro, Great Britain) for editing the English text.

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Figures 1-2. 1. A fresco from the tomb of Nakht (XIVth century BC), drawing by Faucher-Gudin from a photograph by Alexander Gayet taken in 1892. **2.** The same fresco after restoration, contemporary view.

Figures 3-5. 3. A detail from the fresco from the tomb of Nakht after restoration, contemporary view. **4.** Female of *Hypolimnas misippus* (photo: Ajith Unnikrishnan). **5.** Male of *Hypolimnas misippus* (photo: Ajith Unnikrishnan).

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The discovery of a localized colony of *Brithys crini* (Fabricius, 1775) in the Maltese archipelago (Lepidoptera: Noctuidae)

Aldo Catania & Stephen Mifsud

Summary

Brithys crini (Fabricius, 1775) is here recorded after many years from the Maltese archipelago.

Keywords: Lepidoptera, Noctuidae, *Brithys crini*, Maltese archipelago.

El descubrimiento de una colonia localizada de *Brithys crini* (Fabricius, 1775) en el archipiélago de Malta (Lepidoptera: Noctuidae)

Resumen

Brithys crini (Fabricius, 1775) se registra aquí después de muchos años procedente del archipiélago de Malta.

Palabras clave: Lepidoptera, Noctuidae, *Brithys crini*, Malta.

Introduction

The genus *Brithys* Hübner, [1821] is represented by the species *Brithys crini* (Fabricius, 1775), which has a wide distribution across the globe. This species has been recorded from Europe in all the countries bordering the Mediterranean, including most of the larger islands. It is also known from Australia, eastern and south-eastern Asia, Africa, and Central America (GBIF Secretariat, 2022). It is typically found in coastal areas and is known to be highly variable in terms of forewing colour and pattern intensity. Larvae feeding on *Pancratium maritimum* L. used to prevail in sheltered small bays in the North of Malta, during the months of November and December, with only one brood emerging in May-June (Valletta, 1973). Unexplainably, the species was never recorded after the year 1990.

During a field study in Comino on the 12th of February 2023, one of the authors, S. Mifsud, discovered larvae of *Brithys crini* (Fabricius, 1775), feeding on their food plant *Pancratium maritimum* L. at Santa Marija Bay. This is a small bay about 120 m long with fragmented pockets of sand dune vegetation including *Pancratium maritimum* L. A second visit on the 18th of February by both authors, revealed that a colony of *Brithys crini* (Fabricius, 1775) larvae, mostly in the last instar, was present on all *Pancratium maritimum* L. plants across Santa Marija Bay.

The presence of *Brithys crini* (Fabricius, 1775) on the small island of Comino is unexpected since it was only recorded from the sandy bays of Armier, Golden Bay, Slug Bay, and Marfa (Valletta, 1973) at the North of Malta, each harboring populations of *Pancratium maritimum* L. Comino is a small island located between the islands of Malta and Gozo, typically having hot, dry summers and mild wet winters, with an average precipitation of 500 mm. It is largely an uninhabited island known for its stunning beaches, clear blue waters, and rugged terrain. Comino's total area is just 3.5 km^2 with a terrain that is mostly rocky garrigue or derelict fields, featuring limestone cliffs and hills that rise to around 80 meters above sea level.

Despite its rocky terrain, rich vegetation of some 440 species (Mifsud, unpublished data) occurs on Comino, mostly native species but also some introduced ornamental species at the hotel and pig farm. These include antique olive trees, carob trees, Tamarisk trees, and Aleppo pines, as well as scrubland and garrigue shrubs and annual plants. The island is also home to several endemic and subendemic plant species, including *Limonium melitense* Brullo, *L. zeraphae* Brullo, *Matthiola incana melitensis* Brullo, Lanfr., Pavone & Ronsisv., *Salsola melitensis* Botsch. and *Allium lojaconoi* Brullo, Lanfr. & Pavone, amongst others. A fragmented population of *Pancratium maritimum* L. of approximately 200 mature plants is found in Santa Marija Bay on which larvae of *Brithys crini* (Fabricius, 1775) were discovered.

Discussion

It is most probable that *Brithys crini* (Fabricius, 1775) has been introduced to Comino through deliberate or accidental human activity. A natural dispersion from the closest site in Vendicari, Sicily (ca. 176 km away) is unlikely. The fact that there has never been any record of *Brithys encausta* (Hübner, [1808]) from Comino, during the years when it was common in the North of Malta is questionable. The relatively short distance from Santa Marija Bay (Comino) to Armier Bay sand dune in the north of Malta, is less than 3 km and the distance from Armier Bay to Ramla l-Hamra Bay, a potential sand dune with a stable population of *Pancratium maritimum* L. in Gozo is 10 km. *Brithys encausta* (Hübner, [1808]) was quite common in both these two sites in the North of Malta, so the fact that this species has poor flying capabilities explains its poor dispersal.

Brithys encausta (Hübner, [1808]) was reported to feed on other bulbous plants including *Narcissus tazetta* L. by Valletta (1973), but larvae were never found naturally in gardens. This fact indicates that dispersal is through connected beaches where the foodplant grows and is not dependent on flying moths. Larvae collected from Comino produced both the dark and light forms of adults. All the previous records of *Brithys encausta* (Hübner, [1808]) from Malta were greyish brown. This colour may have favored the species to camouflage better on dry areas like the Maltese beaches. A dark or black specimen is more conspicuous and may have less chance of mimicking the environment. Black moths have a disadvantage in the light-colored sand and the black moths are easily hunted down by predators.

There are conflicting ideas about *Brithys crini* (Fabricius, 1775) and *Brithys encausta* (Hübner, [1808]) and its status as a taxon. Thirty larvae were collected from Comino and all produced moths from which three were light greyish brown like *Brithys encausta* (Hübner, [1808]) and twenty-seven of the black form *Brithys crini* (Fabricius, 1775). Specimens that have been previously recorded from the Maltese islands are of the greyish brown form. Valletta (1973) states that *Brithys encausta* (Hübner, [1808]) is a species known to occur in Sicily, but in later years, it was also reported in Greece. However, Zilli et al. (1992) consider *Brithys encausta* (Hübner, [1808]) to be a light-coloured form of *Brithys crini pancratii* (Cyrillo, 1787).

Research conducted by Fibiger & Hacker (2007) revealed that *Brithys crini* (Fabricius, 1775), is a highly variable species in terms of forewing colour and pattern intensity. The researchers noted that there were several colour forms of the moth that had been previously regarded as distinct species, but upon further analysis, it was determined that all these forms represented the same taxon. However, Leraut (2019) disagrees with Fibiger & Hacker (2007) that this is one variable taxon. Instead, based on his examination of the general habitus and genitalia, Leraut (2019) suggests that *Brithys crini* (Fabricius, 1775), *B. pancratii* (Cyrillo, 1787), and *B. encausta* (Hübner, [1808]) are in fact distinct species. He further suggests that the European taxa should be classified under the species names *Brithys pancratii* (type locality "Naples" in Italy) and *Brithys encausta* (Hübner, [1808]), (type locality "Europe").

Sammut (2020) treats *Brithys encausta* (Hübner, [1808]) as a synonym of *Brithys crini* (Fabricius, 1775), and only mentions the latter species in his work. Given these conflicting opinions, further research and possibly DNA analysis would be necessary to definitively resolve the taxonomic status of this species.

Material examined:

MALTA, Comino, (36º0’58.95”N, 14º20’15.18”E), 18-II-2023, A. Catania, leg. Thirty larvae mostly in stage L5 were collected, all pupated and produced moths.

Larvae of *Brithys crini* (Fabricius, 1775) collected from Comino on the 18th of February were reared and pupated on the 4th of March. Moths emerged from the twenty fourth of March and pairings were noticed late at night. Egg laying took place on the leaf blades of *Pancratium maritimum* L. and on the sides of the rearing container but did not yet hatch until the time of writing this paper.

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The Pterophoridae fauna of Mali (Insecta: Lepidoptera)

Petr Ya. Ustjuzhanin, Vasily N. Kovtunovich, Alexey M. Prozorov, Mohamed M. Traore & Günter C. Müller

Abstract

Nine species of Pterophoridae are recorded for the Republic of Mali. All species except *Exelastis pumilio* (Zeller, 1873) are recorded for the fauna of the country for the first time.

Keywords: Insecta, Lepidoptera, Pterophoridae, new records, Mali.

La fauna de Pterophoridae de Malí (Insecta: Lepidoptera)

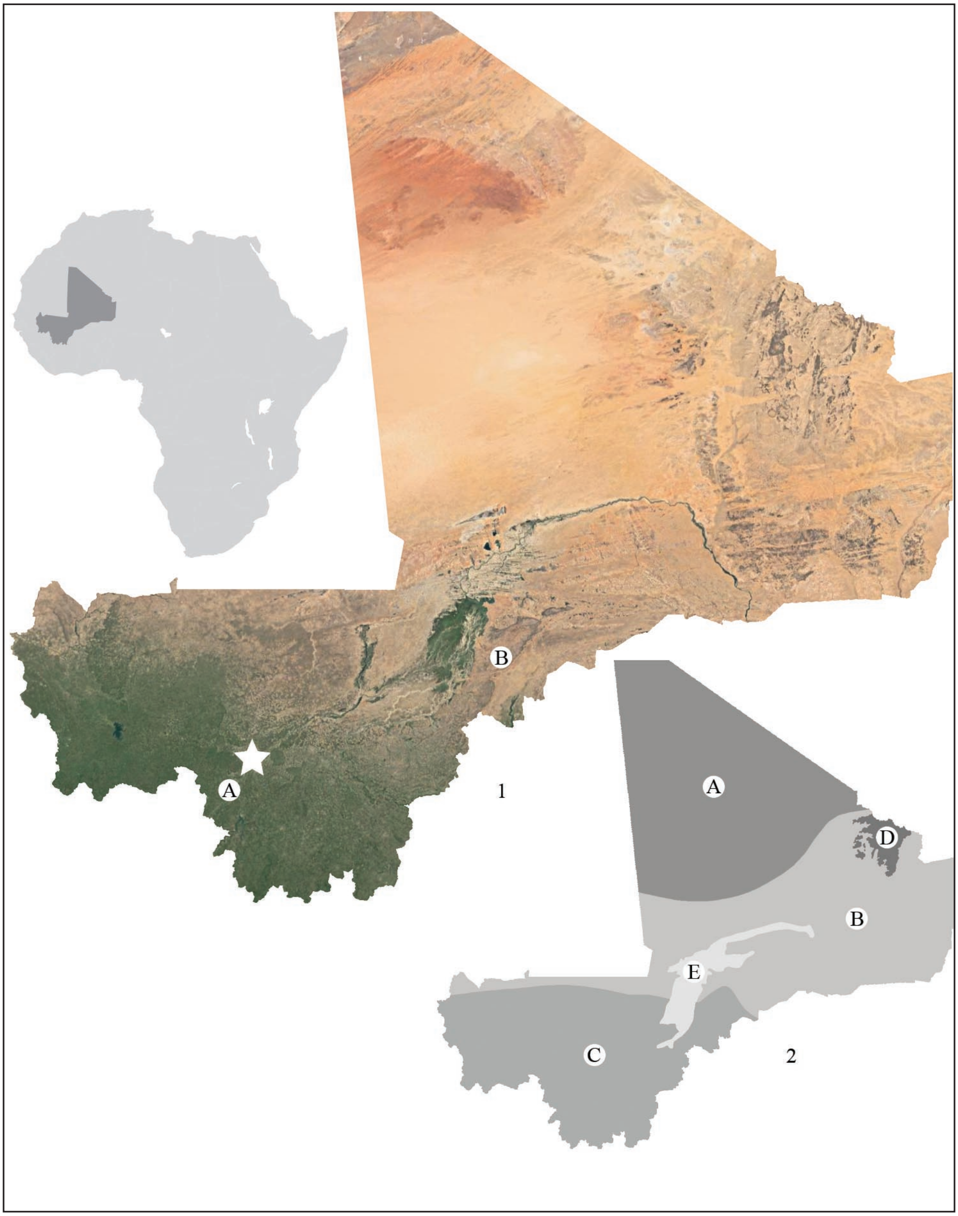
Resumen

Se han registrado nueve especies de Pterophoridae para la República de Malí. Todas las especies, excepto *Exelastis pumilio* (Zeller, 1873), se registran por primera vez en la fauna del país.

Palabras clave: Insecta, Lepidoptera, Pterophoridae, nuevos registros, Malí.

Introduction

The Republic of Mali (Figure 1), with an area of 1.2 million square kilometers, is the second largest country in West Africa after Niger (UN, 2022). The territory of Mali is spread over 1600 km from north to south and includes five ecoregions (Figure 2; Dinerstein et al. 2017); the vast South Sahara Desert in the northern part of the country (Figure 2A), Sahelian *Acacia* savanna in the central part (Figure 2B), West Sudanian savanna in the southern part (Figure 2C), smaller West Saharan montane xeric woodlands in the north-eastern Kidal Region (Figure 2D), and inner Niger Delta flooded savanna in the central Mopti Region, which is along the River Niger (Figure 2E). Three seasons are distinguished: 1) a dry season from March to June with maximum day temperatures often exceeding 40º C, relative humidity slightly above 20% and almost no rainfall; 2) a rainy season from July to September with daily maximum temperatures exceeding 30º C, relative humidity above 70% and plenty of rain; and 3) an off-season from October to February with cooler nights (Nicholson, 2018). Annual precipitation varies broadly from 100 mm and less in the north to 1500 mm in the extreme south, while the overall rainfall in the whole West Africa tending to decrease (Tano et al. 2023). Annual maximum day temperatures, above 30º C, tending to grow up from decade to decade caused by climate change (Sylla et al. 2016). Reduced rainfall and growing temperatures contribute to desertification spreading southwards from the Sahara Desert resulting in the steady decrease of fertile areas (Nicholson, 2000; Nicholson, 2001; Thomas & Nigam, 2018).



Figures 1-2. 1. Situation of Mali in Africa and the satellite view over it: star marks Bamako. **1. A.** Ouronina and Kenieroba. **B.** Bandiagara (Figure 1). **2.** Ecoregions in Mali. **2. A** vast South Sahara Desert. **B.** Sahelian *Acacia* savanna. **C.** West Sudanian savanna **D.** West Saharan montane xeric woodlands. **E.** inner Niger Delta flooded savanna.

Mali with a fast-growing population, above 21 million people, is the fifth most populated country in West Africa after Nigeria, Ghana, Ivory Coast, and Niger (UN, 2022). Around 65% of the population lives in the rural areas and are involved in crop and livestock production, which represents around 35% of Gross Domestic Product (Wani et al. 2018). Forests near the villages are slowly replaced with fields as the forest wood is used for charcoal production (Morton, 2007) Agriculture areas expand over time to increase the ability to produce larger amounts of crops due to worsening climate conditions (Akumaga & Tarhule, 2018; Raza et al. 2019). This leads to a decrease of natural habitats and a loss of biodiversity.

No special insect biodiversity surveys have been conducted in Mali except for those devoted to the control of human disease vectors (e.g. Goodwin, 1982). The Pan African tsetse and trypanosomiasis eradication campaign in Mali reported only an unstated number of unidentified species from three Rhopalocera genera (*Colias, Lycaena, Limenetis*) collected between 2005 and 2013 (DNEF, 2014). Larsen stated that documented data on the Rhopalocera fauna of the country “would be helpful in determining the northern and western limits of certain species” (Larsen, 2005). Altogether 197 taxa of Heterocera (De Prins & De Prins, 2011-2023) were recorded for the country.

Fauna of the family Pterophoridae of some West African countries have been published: Republic of Côte d’Ivoire (Bigot, 1962, 1970; Bigot & Boireau, 2002, 2006), Ghana (Ustjuzhanin & Kovtunovich, 2015), Liberia (Ustjuzhanin et al. 2017), Sierra Leone (Ustjuzhanin et al. 2020), and Republic of Guinea (Ustjuzhanin et al., 2022a). While no species except for *Exelastis pumilio* (Zeller, 1873) was known from Mali (Gielis, 2003). Eight out of the nine forementioned species are reported for the first time for the fauna of Mali, none of them is new to science.

Figure 3. Collecting sites: **A.** valley near Ouronina (June 2021). **B.** valley from uphill near Ouronina (October 2022). **C.** the Niger Riverbank near Kenieroba (January 2023). **D.** Malaise trap set on the Niger Riverbank near Kenieroba (January 2023).

Materials and methods

The material of the present study was obtained from by-catches from long-term malaria research conducted from 2008 to 2023 by the University of Sciences, Techniques, and Technologies of Bamako, Mali (USTTB). Adults were collected with Malaise traps, UV-CDC traps, and different types of larger UV traps (Kline et al. 2011; Sheikh et al. 2016) around the following localities: Kenieroba and Ouronina in the Koulikoro Region (Figures 1A, 3A-D), and Bandiagara on the Dogon Plateau (Figure 1B). The collected material was identified and stored partially in the first author's collection and collection of the USTTB.

List of the Pterophoridae species of the Republic of Mali

Deuterocopus socotranus Rebel, 1907
Deuterocopus socotranus Rebel, 1907. *Lep. Sokotr.*, 85, fig. 37
Type locality: W Socotra [YEMEN].

Material examined MALI, 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, 1-5-IX-2021, R. and L. Yakovlev, A. Prozorov leg.

Distribution: Yemen, Rep. S. Africa, Somalia, Malawi, Zambia, Zimbabwe, Mozambique, Ivory Coast, Democratic Republic of Congo, Ghana, Kenya, Namibia, Nigeria, Tanzania, Uganda (De Prins & De Prins, 2023), Ethiopia (Ustjuzhanin et al. 2022b); Oman, Japan, India, Sri Lanka, Thailand, Taiwan, Myanmar, Indonesia, New Guinea, Australia (De Prins & De Prins, 2023), Mali. **New record for Mali.**

Titanoptilus serrulatus Meyrick, 1935
Titanoptilus serrulatus Meyrick, 1935. *Ex. Micr., 4*, 554
Type locality: NIGERIA N, Azare.

Material examined: MALI, Ouronina Camp, N 12º6', W 8º24', 1 ♂, 10-30-IX-2015, Sáfián Sz. leg.; MALI, 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, X-2022, the USTTB field team leg.

Distribution. Nigeria, Malawi (De Prins & De Prins, 2023), Mali. **New record for Mali.**

Stenoptilodes taprobanes (Felder & Rogenhofer, 1875)
Amblyptilia taprobanes Felder & Rogenhofer, 1875. *Reise Novara*, pl. 140, fig. 54
Type locality: CEYLON, [SRI LANKA].
= *Platyptilia brachymorpha* Meyrick, 1888. *Trans. ent. Soc. London, 1888(2)*, 240
Type locality: Hawaii, [USA].
= *Amblyptilia seeboldi* Hofmann, 1898. *D. ent. Zeit. Iris, 11(1)*, 33
Type locality: Akbès, Syria.
= *Platyptilia terlizzii* Turati, 1926. *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano, 65(1)*, 67
Type locality: Derna, Cyrenaica, [Libya].
= *Amblyptilia zavatterii* Hartig, 1953. *Bollettino della Società entomologica italiana, 83*, 67
Type locality: Zannone Island, Italy.
= *Platyptilia legrandi* Bigot, 1962. *Bull. Soc. ent. Fr., 67*, 86
Type locality: Mahé, Beau Vallo, SEYCHELLES.
= *Stenoptilodes vittata* Service, 1966. *Proc. R. ent. Soc. Lond. (B), 35*, 139
Type locality: Anara, ca 14 miles NNE of Kaduna, N NIGERIA.

Material examined: MALI, Dogon Plateau, at light, 9 ex. XI-2010, V. Kravchenko leg; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, 01–05-IX-2021, R. & L. Yakovlev, A. Prozorov leg.; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♀, 18-IX-2021, the USTTB field team leg.; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 4 ex, X-2022, the USTTB field team leg.; Kangaba Distr., 25 km NW Kangaba, 100 km W Bamako, Mature deciduous Forest Savanah Mosaic, 1 ♀, IX-2012, the USTTB field team leg.

Distribution. Widespread throughout tropical and subtropical regions (Ustjuzhanin et al. 2022b). **New species for Mali.**

Megalorhipida leucodactylus (Fabricius, 1794)
Pterophorus leucodactylus Fabricius, 1794. *Ent. syst., 3*(2), 346
Type locality: Americae meridionalis [VIRGIN ISLANDS].
= *Pterophorus defectalis* Walker, 1864. *Cat. Lep. Het. B. M., 30*, 943
Type locality: SIERRA LEONE.
= *Pterophorus congrualis* Walker, 1864. *Cat. Lep. Het. B. M., 30*, 943
Type locality: South Hindostan [INDIA].
= *Pterophorus oxydactylus* Walker, 1864. *Cat. Lep. Het. B. M., 30*, 943
Type locality: Ceylon [SRI LANKA].
= *Aciptilia hawaiiensis* Butler, 1881. *Ann. Mag. nat. Hist*., (5)*7*, 408
Type locality: Uoluolu, Maui, Hawaii Islands [USA].
= *Trichoptilus ochrodactylus* Fish, 1881. *Can. Ent., 13*, 142
Type locality: Texas, USA.
= *Trichoptilus centetes* Meyrick, 1886. *Trans. Ent. Soc. London, 1886*, 16
Type locality: Port Moresby, NEW GUINEA.
= *Trichoptilus compsochares* Meyrick, 1886. *Trans. Ent. Soc. London, 1886*, 16
Type locality: St. Vicent, CAPE VERDE ISLANDS.
= *Trichoptilus adelphodes* Meyrick, 1887. *Trans. Ent. Soc. London, 1887*(3), 266
Type locality: Carnarvon, AUSTRALIA.
= *Trichoptilus ralumensis* Pagenstecher, 1900. *Zoologica, 29*, 239
Type locality: Ralum, BISMARCK ISLANDS.
= *Trichoptilus derelictus* Meyrick, 1926. *Trans. Ent. Soc. London, 74*, 276
Type locality: Galapagos Islands ECUADOR.
= *Megalorhipida palaestinensis* Amsel, 1935. *Mitt. Zool. Mus. Berlin, 20*, 293, pl. 10, fig. 27
Type locality: Palestine, Jerusalem [ISRAEL].

Material examined: MALI, Dogon Plateau, at light, 2 ♀, XI-2010, V. Kravchenko leg; Ouronina Camp, N 12º6', W 8º24', 1 ♂, 10-30-IX-2015, Sáfián Sz. leg.; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, 1 ♀, X-2022, the USTTB field team leg.

Distribution**.** Widespread throughout tropical and subtropical regions. (Ustjuzhanin et al. 2022). **New species for Mali.**

Prichotilus tara Ustjuzhanin & Kovtunovich, 2011
Prichotilus tara Ustjuzhanin & Kovtunovich, 2011. *Amurian Zool. J., 3*(4), 358-359, pl. 5
Type locality: Uzuzu Hill, Manizimu Forest Reserve, 25 km E of Mangochi, Mangochi District, MALAWI.
=*Prichotilus tanzanicus* Gielis, 2011. *Bol. Soc. Entom. Aragon., 49*, 33-63, 49-50, figs 23, 40
Type locality: Kibirizi, Kigoma District, TANZANIA.

Material examined: MALI, 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, 18- IX-2022, R. and L. Yakovlev, A. Prozorov leg.; Kangaba Distr., 25 km NW Kangaba, 100 km W Bamako, Mature deciduous Forest Savanah Mosaic, 1 ♂, IX-2012, the USTTB field team leg.; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, X-2022, the USTTB field team leg.

Distribution: Malawi, Tanzania (Kovtunovich et al. 2014), Mali. **New species for Mali.**

Sphenarches anisodactylus (Walker, 1864)
Oxyptilus anisodactylus Walker, 1864. *Cat. Lep. Het. B. M., 30*, 934
Type locality: SRI LANKA.

=*Pterophorus diffusalis* Walker, 1864. *Cat. Lep. Het. B. M., 30*, 945
Type locality: AUSTRALIA.
=*Sphenarches synophrys* Meyrick, 1886. *Trans. Ent. Soc. London, 1886*(1), 21
Type locality: NEW HEBRIDES.
= *Platyptilia pygmaeana* Strand, 1913. *Archiv für Naturgeschichte, 78*(A) (1912) (12), 30-84, pls 1-2
Type locality: Benitogebiet [EQUATORIAL GUINEA].
= *Sphenarches chroesus* Strand, 1913. *Archiv für Naturgeschichte*, *78*(A) (12), 66
Type locality: Alén, Benitogebiet, [Equatorial Guinea].
= *Megalorhipida rishwani* Makhan, 1994. *SHILAP Revista de lepidopterología, 22*, 353
Type locality: SURINAME.

Material examined: MALI, 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 1 ♂, 1 ♀, X-2022, the USTTB field team leg.

Distribution: Nepal, Japan, China, Sri Lanka, India, Taiwan, Thailand, Cambodia, Vietnam, Malaysia, Indonesia, Solomon Islands, New Guinea, Bismarck Islands, Australia, Cameroun, Seychelles, Reunion Island, Madagascar, Kenya, Tanzania, Zaire, Gambia, Guinea, Nigeria, Tchad, Malawi, Swaziland, Cote d'Ivoire, Ghana, USA, Brazil, Dominica, Grenada, Panama, Virgin Islands, Bahamas, St. Thomas, Puerto Rico, Peru, Paraguay, Fiji Islands, New Hebrides, Tonga Islands, New Caledonia, Palau, Bonin Island, Guam (De Prins & De Prins, 2023), Mali. **New record for Mali.**

Exelastis pumilio (Zeller, 1873)
Mimeseoptilus pumilio Zeller, 1873. *Verh. zool.-bot. Ges. Wien, 23*, 324
Type locality: Dallas, Texas, USA.
= *Marasmarcha liophanes* Meyrick, 1886. *Trans. ent. Soc. Lond., 1886*, 19
Type locality: Saint-Denis, RÉUNION ISLAND [FRANCE].
= *Mimaesoptilus gilvidorsis* Hedemann, 1896 nec Zeller, 1877. *Stettin. ent. Ztg., 57*, 8
Type locality: St. Croix, VIRGIN ISLANDS [USA].

Material examined: MALI, Dogon Plateau, at light, 2 ♂, 2 ♀, XI-2010, V. Kravchenko; Ouronina Camp, N 12º6', W 8º24', 9 ex., 10-30-IX-2015, Sáfián Sz. leg; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 9 ex., 18-IX-2021, R. and L. Yakovlev, A. Prozorov leg.; 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 349 ex., IX-X-2022, the USTTB field team leg.; Kangaba Distr., 25 km NW Kangaba, 100 km W Bamako, Mature deciduous Forest Savanah Mosaic, 13 ex., IX-2012, the USTTB field team leg.

Distribution: Chad, The Gambia, Tanzania, Mali, Zimbabwe, Eswatini, Rep. S. Africa, Seychelles, Reunion Island, Madagascar, Nigeria, Kenya (DE PRINS & DE PRINS, 2020), Sierra Leone; Nepal, Cambodia, Myanmar, Philippines, New Guinea; USA, Argentina, Brazil, Ecuador, Bolivia, Colombia, Suriname, Costa Rica, Cuba, Puerto Rico, Guadeloupe, Mexico, Jamaica, Virgin Islands, Fatu-Hiva, Guam, Palau (Ustjuzhanin et al. 2019).

Hellinsia aethiopicus (Amsel, 1963)
Leioptilus aethiopicus Amsel, 1963. *Stuttgart. Beitr. Naturk., 121*, 6, pl. 3, fig. 4
Type locality: Gembi, ETHIOPIA.

Material examined: MALI, Dogon Plateau, at light, 1 ♂, XI-2010, V. Kravchenko.

Distribution: Democratic Republic of the Congo, Ethiopia, Ghana, Nigeria, South Africa (De Prins & De Prins, 2023), Mali. **New record for Mali.**

Hellinsia namizimu Kovtunovich & Ustjuzhanin, 2014
Hellinsia namizimu Kovtunovich & Ustjuzhanin, 2014. *Zootaxa, 3847*(4), 451-494, figs 45-48
Type locality: Mutinondo, ZAMBIA.

Material examined: MALI, 80 km SW of Bamako, near Ouronina, N 12º6', W 8º24', 2 ♂, 1 ♀, X-2022, the USTTB field team leg.

Distribution: Zambia, Malawi (De Prins & De Prins, 2023), Mali. **New species for Mali.**

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REVISIÓN DE PUBLICACIONES
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Tenemos en nuestras manos una excelente guía, con más de tres años de dedicación y trabajo del autor, que ha dado como resultado un buen trabajo realizado, que, sin duda, servirá para futuros aficionados al mundo de las mariposas (Lepidoptera) y, quien sabe, si esta nueva dedicación, nos lleva a la aparición de nuevos y necesarios especialistas en este campo científico, formando nuevas promociones de investigadores.

Parafraseando al autor, el estudio de las mariposas, se realiza por su valor estético, valor en los ecosistemas, valor educativo, valor para la salud, valor económico, valor real y, sobre todo, valor científico.

Todo el libro está profusamente ilustrado con unas fotografías que permiten observar todas las especies consideradas, desde el estado adulto, al estado de larva y, a veces también algunas crisálidas, lo que permite a cualquiera que desee ver estos miríficos insectos, le facilitará poder identificarlos con facilidad, no sólo de España peninsular, si no también algunas especies de las Islas Canarias, e incluso africanas, permitiendo identificar algunas especies introducidas.

También nos presenta la especie *Actias (Graellsia) isabelae* (Graells, 1849), que tiene actividad nocturna, pero sin lugar a dudas, como la denominaba el Prof. Ramón Agenjo, "*la mariposa mas bella de Europa*" y algunos microlepidópteros de las familias Adelidae, Psychidae, Pterophoridae y Sesiidae, así como algunas especies de Zygaenidae.

Destacamos las fotografías de especies en peligro de extinción, como es el caso de *Euchloe bazae* (Fabiano, 1993), o las conocidas "hormigueras" como son *Phengaris arion* (Linnaeus, 1758) y *Ph. nausithous* (Bergesträsser, 1779), consideradas como vulnerables, si bien la afección más directa al estatus de estas especies, es la eliminación de su hábitat, finalizando la obra con un índice y una bibliografía.

No podemos terminar estas líneas, sin felicitar al autor, por tan excelente y detallado trabajo, que sin lugar a duda, servirá como una primera guía de orientación, para todos aquellos que quieran empezar a estudiar este maravillosos mundo de los Lepidoptera de actividad diurna y, en un paso más adelantado entrar en el mundo de las especies nocturnas, por lo que recomendamos su adquisición.

El precio de este libro es de 38 euros más gastos de envío y los interesados pueden dirigirse a:

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