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SHILAP

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Madrid
2025

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Notodontidae of Iberian Peninsula: an update on geographical distribution (Insecta: Lepidoptera)

Fernando de Juana & João Nunes

Abstract

This study compiles bibliographical data on the 40 species of Notodontidae listed in faunistic catalogues of the Iberian Peninsula published to date. Of these, 37 are confirmed in this territory, while one species, *Odontosia carmelita* (Esper, 1798), is considered extinct. No reliable records were found for the remaining two species, *Clostera anastomosis* (Linnaeus, 1758) and *Notodonta torva* (Hübner, [1809]). The updated list of Iberian Notodontidae is provided, along with distribution maps for each species based on a 10×10 km UTM grid. The results are analysed and discussed considering the sampling efforts conducted in each province.
Keywords: Insecta, Lepidoptera, Notodontidae, distribution, Andorra, Portugal, Spain.

Notodontidae de la península ibérica: una actualización sobre su distribución geográfica (Insecta: Lepidoptera)

Resumen

Este estudio recopila datos bibliográficos sobre las 40 especies de la familia Notodontidae que figuran en los catálogos faunísticos de la península ibérica publicados hasta la fecha. De estas, 37 están documentadas actualmente en esta región, mientras que una especie, *Odontosia carmelita* (Esper, 1798), se considera extinta. No se encontraron registros fidedignos para las dos especies restantes, *Clostera anastomosis* (Linnaeus, 1758) y *Notodonta torva* (Hübner, [1809]). Se presenta la lista actualizada de Notodontidae ibéricos, junto con mapas de distribución conocida de cada especie sobre la retícula UTM de 10×10 km. Los resultados se analizan y discuten teniendo en cuenta el esfuerzo de muestreo realizado en cada provincia.
Palabras clave: Insecta, Lepidoptera, Notodontidae, distribución, Andorra, Portugal, España.

Notodontidae da Península Ibérica: uma atualização sobre a sua distribuição geográfica (Insecta: Lepidoptera)

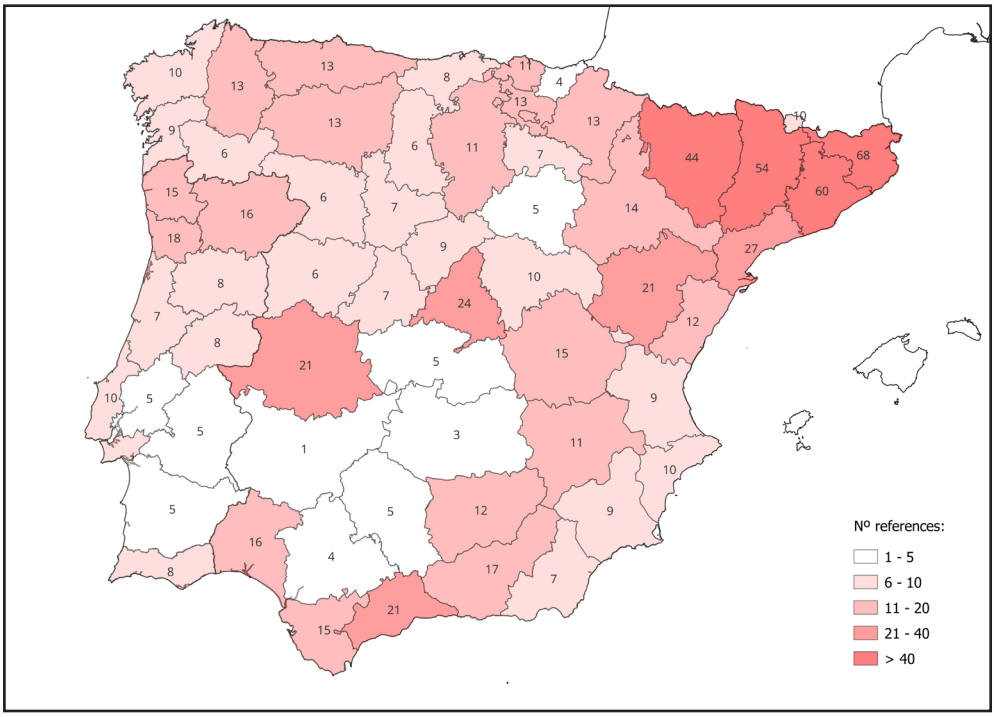
Resumo

Este estudo apresenta dados bibliográficos sobre as 40 espécies da família Notodontidae que constam dos levantamentos faunísticos da Península Ibérica publicados até à data. Destas, 37 estão atualmente presentes neste território e uma, *Odontosia carmelita* (Esper, 1798), é considerada extinta. Das duas espécies restantes, *Clostera anastomosis* (Linnaeus, 1758) e *Notodonta torva* (Hübner, [1809]), não foram encontrados registos fidedignos. É apresentada a lista atualizada dos Notodontidae ibéricos, bem como mapas da distribuição conhecida de cada espécie em grelha UTM de 10×10 km. Os resultados são analisados e discutidos considerando o esforço de amostragem realizado em cada uma das províncias.
Palavras-chave: Insecta, Lepidoptera, Notodontidae, distribuição, Andorra, Portugal, Espanha.

Introduction

Ignorance regarding the geographical distribution of species poses a significant hurdle to understanding biodiversity on a large scale (Hortal et al. 2015). In the context of Iberian Notodontidae, specific studies on their distribution have been scarce, with exceptions such as Agenjo (1941) work on the Thaumetopoeinae subfamily, Templado (1967) and Templado & Ortiz (1975) research on *Cerura iberica* (Templado & Ortiz, 1966), and more recent studies by de Juana & Macià (2023a & 2023b) and de Juana et al. (2024) on *Spatalia argentina* ([Denis & Schiffermüller], 1775), *Rhegmatophila alpina* (Bellier, 1880), and *Gluphisia rurea* (Fabricius, 1787), respectively. Corley (2015a) offers insights into the distribution of notodontids in Portugal, but with limited detail. Although works by Gómez-Bustillo (1979) and Pérez de-Gregorio et al. (2001) provide distribution maps for various species, in many cases, these are conjectures based on the few previously published data, casting doubt on their reliability. This underscores the need for updated information, especially as recent publications still reference these outdated maps for species' chorology (Leraut, 2006; Schintlmeister, 2008; Roques et al. 2014). With the present work, we aim to update the knowledge on the geographical distribution of notodontids in the Iberian Peninsula based exclusively on the information published to date.

Figure 1. Number of publications with original records of Notodontidae referred to each of the Iberian provinces.



Material and methods

For this study, a compilation of bibliographic records of notodontids in the Iberian Peninsula was conducted. Alongside articles in scientific journals and books, we consulted three datasets from the Global Biodiversity Information Facility (GBIF) on Lepidoptera of Portugal (Beja et al. 2018; Corley & Afonso, 2021; Nunes et al. 2024). The resulting database, includes fields such as species, observation date, life stage, locality, province, country, altitude, UTM coordinates, 10×10 km UTM grid, geographic coordinates (latitude and longitude), and bibliographic reference.

For the search of French records, the bibliographic portal of the association "Oreina, les papillons de

France", available at https://oreina.org/artemisiae/biblio/, was used.

QGIS software was employed for the creation of distribution maps. Global distribution information for species, unless otherwise specified, was sourced from Schintlmeister (2008).

The systematic classification adheres to the proposal by Kobayashi & Nonaka (2016) for subfamilies and tribes. Nomenclature and the order of genera and species follow Schintlmeister (2008) and Basso et al. (2017), except for *Gluphisia rurea* (Fabricius, 1787), where we followed Bellavista (2021).

Results and discussion

A total of 9,871 records of 38 species were gathered from 461 bibliographic sources. Out of these records, 51 (0.5%) were excluded, primarily due to biogeographical or phenological considerations, as explained in each species entry. Annex I provide the bibliographic references categorized by species and provinces. Table I indicates the number of compiled records for each species, which can be considered proportional to its abundance in the Iberian Peninsula and the ease of detection using standard sampling methods. It should be noted, however, that some species have been the subject of specific studies, for which special efforts have been made to compile unpublished data. This applies to *C. iberica*, *S. argentina*, *R. alpina*, and *G. rurea* (Templado, 1967; Templado & Ortiz, 1975; de Juana & Macià, 2023a and 2023b; de Juana et al. 2024).

Table I. Number of records compiled for each species, in descending order.

Species	Number of records	Species	Number of records
Thaumetopoea pityocampa	1136	*Notodonta tritophus*	182
Pterostoma palpina	707	*Thaumetopoea processionea*	120
Harpyia milhauseri	703	*Ptilodon capucina*	100
Cerura iberica	681	*Neoharpyia verbasci*	98
Peridea anceps	573	*Ptilodon cucullina*	90
Phalera bucephala	566	*Drymonia dodonaea*	74
Rhegmatophila alpina	557	*Drymonia velitaris*	65
Drymonia querna	536	*Cerura erminea*	60
Spatalia argentina	462	*Thaumetopoea pinivora*	60
Notodonta ziczac	462	*Furcula furcula*	58
Furcula bifida	339	*Dicranura ulmi*	53
Stauropus fagi	287	*Ptilophora plumigera*	35
Pheosia tremula	279	*Phalera bucephaloides*	32
Clostera pigra	259	*Clostera anachoreta*	24
Drymonia ruficornis	255	*Furcula bicuspis*	17
Gluphisia rurea	254	*Drymonia obliterata*	16
Thaumetopoea herculeana	239	*Cerura vinula*	15
Clostera curtula	209	*Pheosia gnoma*	12
Notodonta dromedarius	202	*Odontosia carmelita*	2

Figure 1 depicts the number of publications containing original records of Notodontidae for each province, serving as a rough indicator of the distribution of sampling effort. However, it's worth noting that each published study may reflect varying degrees of sampling intensity.

Figure 2 displays distribution maps of each species known occurrence across the 10×10 km UTM grid. Only records assignable to specific grid cells are represented, excluding those referring to entire regions or provinces.

The interpretation of the presented distribution maps should consider that the compiled data exhibit significant sampling bias due to uneven sampling efforts. Historical lepidopterological studies, like floristic and faunistic inventories in general, have shown considerable discrepancies in the sampling efforts allocated to different regions. Moreover, within these territories, sampling has primarily focused on easily accessible locations, often near researchers' residences or workplaces, or in areas known to be species rich (Hortal et al. 2008). The map illustrating the number of publications featuring original records of notodontid moths for each province (Figure 1) generally mirrors the distribution of faunistic data for butterflies in Iberian Peninsula (García-Barros et al. 2023). There's a broad insufficiently studied area encompassing the provinces of Ribatejo, Alto and Baixo Alentejo, Badajoz, Seville, Córdoba, Ciudad Real, and Toledo. Furthermore, moth sampling efforts are not evenly distributed throughout the year, disadvantaging species that fly late in the autumn, such as *Ptilophora plumigera* ([Denis & Schiffermüller], 1775). Nevertheless, we believe that the information compiled in this work provides valuable insights into the distribution patterns of each species of the Notodontidae family in the Iberian Peninsula, as outlined below.

Subfamily Pygaerinae

Gluphisia rurea (Fabricius, 1787): Euroasian species that, as suggested by Schintlmeister (1989), is believed to have spread from Manchuria to Western Europe during the post-glacial period. Its distribution on the Iberian Peninsula, examined by de Juana et al. (2024), reveals two distinct clusters: one situated in the Cantabrian region, stretching from northwest Navarra to northern Lugo, and another centered in the provinces of Gerona and Barcelona, with occasional sightings in Lérida, Huesca, and Tarragona.

Rhegmatophila alpina (Bellier, 1880): Mediterranean species that displays a fragmented distribution: *R. alpina alpina* is found in southeastern France and the Iberian Peninsula, while *R. alpina osmana* inhabits Greece, Bulgaria, and the Anatolian Peninsula. According to Schintlmeister (1989), the glacial refuges for these two taxa were situated in the Adriatic-Mediterranean and Pontic-Mediterranean regions, respectively. A recent analysis by de Juana & Macià (2023b) has identified two distinct population centers in the Iberian Peninsula: one spanning the Douro valley, the Cantabrian Mountain range, and the Iberian and Central Systems, and another concentrated around the Pyrenees and the pre-Pyrenean mountain ranges.

Clostera curtula (Linnaeus, 1758): Eurosiberian species widespread throughout much of Europe and Asia Minor. In the Iberian Peninsula, it is primarily found in the northern regions, extending to the north of Cáceres and the southern Iberian System (Guadalajara, Cuenca, Teruel). While the possibility of isolated populations in more southern areas cannot be dismissed, caution is warranted regarding reports from Alfacar (Ribbe, 1908) and Cazorla mountains (Fuentes et al. 1999), as well as their alleged presence in other Andalusian provinces along the Mediterranean coast (Gómez Bustillo, 1979). Thus, we diverge from Pérez de-Gregorio et al. (2001), who suggest a wider distribution of this species across the entire Iberian territory.

Clostera pigra (Hufnagel, 1776): This species originates from western Siberia and expanded during the postglacial period, reaching as far east as northern China and Korea, and as far west as Morocco (Schintlmeister, 1989), thus classifying it as Palearctic. While it is extensively distributed in the northern half of the Iberian Peninsula, extending to the Tagus River in Portugal, its presence in the southern half appears to be confined to Andalusia and the southeast. Although these regions are generally underexplored, the absence of data for the provinces of Algarve and Cáceres is noteworthy.

Clostera anachoreta ([Denis & Schiffermüller], 1775): This species is believed to have originated from a Central Asian refuge and expanded across much of the continent during the postglacial period, reaching the Iberian Peninsula in the west and Japan in the east (Schintlmeister, 1989), thus qualifying as Eurasian. In mainland Spain, reliable records are limited to northern Navarra, the three Basque provinces, Cantabria, Asturias, and Lugo. The record from the surroundings of Barcelona by Cuní i Martorell (1897), considered by Staudinger & Rebel (1901), is clearly attributable to *C. curtula*, as argued by Xaus (2012). The sole record in Catalonia (Xaus, 2012) corresponds to the Aran Valley, lying outside the Peninsula. We also agree with Pérez de-Gregorio et al. (2001) in considering the records from Teruel (Zapater & Korb, 1892; Weiss, 1920)

and Granada (Ribbe, 1908), the latter considered by subsequent authors such as Gómez-Bustillo (1979), Díaz (1998), and Schintlmeister (2008), as erroneous.

Clostera anastomosis (Linnaeus, 1758): Eurasian species that inhabits central and eastern Europe. Agenjo (1946) lists it in his catalog of Lepidoptera of Spain as "not formally cited yet". Gómez-Bustillo (1979) mentions its presence "in a few scattered locations within the Cantabrian Mountain range," which likely influenced Schintlmeister (2008) to extend its distribution area to northern Spain. Oliver et al. (2024) argues, however, that all the Cantabrian specimens checked are attributable to *C. pigra* and consider that *C. anastomosis* should be removed from the regional checklist. Vives Moreno (2014) includes it in his catalogue of the Iberian Peninsula, while Redondo et al. (2015) describe it as "rare in Spain, with limited data from Atlantic communities". However, we have found no evidence of its presence south of the Pyrenees. In mainland France, the only known record from the southern half, specifically from the Aude department, dates back to 1874 (Mabille, 1895).

Subfamily Thaumetopoeinae

Thaumetopoea pinivora (Treitschke, 1834): European species that displays a fragmented distribution: in Northern Europe, it occupies the vicinity of the Baltic Sea and extends from northern Germany to southern Russia, while in Southern Europe, it is confined to some mountainous regions of France and Spain. Its glacial refuge remains unidentified (Hódar et al. 2016). In the Iberian Peninsula, it has been documented in the eastern Pyrenees (Lérida, Gerona), the Iberian System (Soria, Guadalajara, Cuenca, Teruel, Valencia), the Central System (Cáceres, Ávila, Segovia, Madrid), and the Baetic mountain ranges (Albacete, Granada).

Thaumetopoea pityocampa ([Denis & Schiffermüller], 1775): Mediterranean species found across Southern Europe, North Africa, the Middle East, and Asia Minor. Widely distributed in the Iberian Peninsula, with published records from Andorra and from all provinces of Portugal and Spain, except for Orense, where it is also likely present.

Thaumetopoea herculeana (Rambur, 1837): Atlanto-Mediterranean species, known from mainland Spain, Portugal, and the Canary Islands. Data from North Africa and the Middle East are outdated and require confirmation (Roques et al. 2014). In the Iberian Peninsula, it is distributed in the southern, central, and western regions, while it appears to be absent from much of Galicia, the Cantabrian coast, and the northeastern quadrant.

Thaumetopoea processionea (Linnaeus, 1758): European species distributed across Western, Southern, and Eastern Europe, Asia Minor, and the Middle East (Groenen & Meurisse, 2012). In the Iberian Peninsula, it is primarily reported from the Cantabrian-Pyrenean system and the Iberian and Central systems, however, there are also records from the provinces of Estremadura, Alto Alentejo, Toledo, and Córdoba.

Subfamily Spataliinae
Tribe Spataliini

Spatalia argentina ([Denis & Schiffermüller], 1775): European species that ranges from the Iberian Peninsula to the Volga River, Asia Minor, and the Middle East. According to Leraut (2006), it extends as far as Iran and Iraq, suggesting a Euro-Turanian distribution. It is believed to have sought refuge in the Pontomediterranean region during the glacial periods (Schintlmeister, 1989). Data compiled by de Juana & Macià (2023b) reveal three distinct population centers in Iberia: one located north of the Ebro River, spanning from Álava to the Catalan coast, another in the Iberian and Central Systems, and a third in Trás-os-Montes, with an isolated sighting from the province of León.

Tribe Ceirini

Pterostoma palpina (Clerck, 1759): Eurosiberian species widely distributed across almost all of Europe, the Caucasus, Asia Minor, and Central Asia, reaching as far as lake Baikal and northwest China. According to Schintlmeister (1989), it likely expanded from a Pontomediterranean refuge during the postglacial period, although it could also be classified among Mongolian-Siberian faunal elements. In the Iberian Peninsula,

it is extensively distributed, with records from Andorra, all Portuguese provinces, and nearly all Spanish provinces, except for Valencia, Sevilla, Córdoba, and Cádiz.

Subfamily Phalerinae

Phalera bucephala (Linnaeus, 1758): Palearctic species with a broad distribution spanning North Africa, Europe, the Caucasus, Asia Minor, northern Iran, Central Asia, Siberia, northeastern China, and Korea. Following Schintlmeister (2008) classification, we consider the taxon *bucephalina* as a subspecies of *bucephala*. According to Schintlmeister (1989), the nominal subspecies likely expanded from western Siberia across the entire continent following the glaciations. Widely distributed in the Iberian Peninsula, it has been recorded in Andorra, all Portuguese provinces, and nearly all Spanish provinces, except for Valencia, Alicante, Almería, and Sevilla.

Phalera bucephaloides (Ochsenheimer, 1810): Distributed across Southern Europe, Asia Minor, the Middle East, and northwest Iraq, this species can be classified as a Euro-Turanian element. Its glacial refuge is believed to have been located in the Pontomediterranean region (Schintlmeister, 1989). In the Iberian Peninsula, it has been documented in the provinces of Huesca, Lérida, Barcelona, Gerona, Tarragona, and Valencia. Redondo (1980) mistakenly reported its presence in the province of Teruel (Redondo, pers. comm.). Similarly, records from the provinces of Cáceres (Callejo, 1977), Cuenca (Fernández, 1920), Segovia (Vázquez-Figueroa, 1894), and Toledo (Notario et al. 2007) are likely erroneous.

Subfamily Notodontinae
Tribe Stauropini

Stauropus fagi (Linnaeus, 1758): Eurosiberian species that, as suggested by Schintlmeister (1989), might have a polycentric origin, with glacial refuges possibly located in the Pontomediterranean and Transcaucasian regions for the nominal subspecies. In the Iberian Peninsula, it has been recorded in Andorra, northern Spain, and the Iberian System (although notably absent from much of the Douro valley and the Central System), as well as in nearly all of Portugal, reaching as far as Algarve.

Tribe Dicranurini

Cerura vinula (Linnaeus, 1758): Eurosiberian species that, as noted by Schintlmeister (1989), is believed to have expanded from western Siberia into Europe during the postglacial period, reaching the Pyrenees in the west and Asia Minor in the south. Following the description of *C. iberica* in 1966, the first record of this species in the Iberian Peninsula was reported by Flores (1974) in Vallès oriental (Barcelona). Although Gómez de-Aizpúrua (1974a) listed it in a dozen locations across the three Basques provinces, Navarra, and Huesca, Gómez de-Aizpúrua (1988) later attributed these same specimens to *C. iberica*, pointing out that "some may be *vinula*, pending confirmation." Subsequently, Pérez de-Gregorio & Romañá (1982) recorded it in several locations in Lérida and Gerona, speculating that it likely inhabits the entire northern region of the peninsula ("Aragón, País Vasco, Cantabria..."). However, to date, outside of Catalonia, its presence has only been confirmed in the province of Álava (de Juana et al. 2021) and in the Condado de Treviño (de Juana et al. 2023a). We have not found the record from Jaca mentioned by Gómez-Bustillo (1979).

Cerura iberica (Templado & Ortitz, 1966): Species that can be classified as Atlanto-Mediterranean or Western Mediterranean, given its distribution across the entire Iberian Peninsula, and presence in the Balearic Islands (Cuello, 1981) and the eastern French Pyrenees (Leraut, 2006). It has been reported in Andorra and in all mainland Portuguese and Spanish provinces.

Cerura erminea (Esper, 1783): Eurosiberian species that is thought to have migrated to Europe from a refuge located in the easternmost part of Asia during the postglacial period, reaching as far as northern Iberia (Schintlmeister, 1989). It is found throughout northern Spain, spanning from La Coruña to Gerona, and extends southward to the Ebro River in La Rioja and Navarra.

Furcula furcula (Clerck, 1759): Eurasian species, fragmented into numerous subspecies, that inhabits a vast expanse of the continent, stretching from Western Europe to Japan. Its glacial refuge may have been located in either the Mediterranean region or the western Mongolian-Siberian region (Schintlmeister,

1989). In the Iberian Peninsula, it appears in two distinct nuclei: one encompassing the provinces of Gerona, Barcelona, and Lérida, and another in northern Navarra, the Basque Country, Cantabria, Asturias, Galicia, Minho, Trás-os-Montes, northern Castilla y León, and the northern Iberian System. The material supporting the record by Mendes (1902) from Beira Baixa was examined and identified as *F. bifida* (Corley, 2015b). We believe that the reports from the provinces of Málaga (Rambur, 1858; Ribbe, 1908) and Valencia (Székely, 2018) can also be attributed to this species.

Furcula bicuspis (Borkhausen, 1790): Eurasian species that extends across central and northern Europe, stretching from Siberia to Japan. According to Schintlmeister (1989), its glacial refuge may have been located in the western Mongolian-Siberian region or Manchuria. In the Iberian Peninsula, it has a Cantabrian-Pyrenean distribution, with occasional sightings reported from the provinces of Gerona, Lérida, Huesca, Navarra, Guipúzcoa, Vizcaya, Álava, Burgos, Cantabria, León, and Lugo. Gómez-Bustillo (1979) wrongly attributes its presence to the north of the province of Badajoz.

Furcula bifida (Brahm, 1787): This species has a Palearctic distribution, ranging from Siberia and Mongolia to Europe, Northwest Africa, and Asia Minor. Its center of expansion may have been in either the Mediterranean region or the western Mongolian-Siberian area (Schintlmeister, 1989). Widely distributed throughout the Iberian Peninsula, it is recorded in Andorra and nearly all mainland Portuguese and Spanish provinces, except for Asturias, Toledo, Ciudad Real, and Alto Alentejo.

Neoharpyia verbasci (Fabricius, 1798): Atlantic-Mediterranean endemic species confined to the Iberian Peninsula and southern France. Within Iberia, its distribution appears to be fragmented, with populations identified north of the Ebro River (Navarra, Huesca, Zaragoza, Catalonia), northeastern Portugal (Beira Alta, Trás-os-Montes), the southern Iberian System and Tagus valley (Teruel, Guadalajara, Madrid, Toledo, southern Ávila, Cáceres, Beira Baixa), and the Betic mountain ranges (Albacete, Jaén, Granada, Málaga). While cited from Bilbao by Fernández (1920), this record must be scrutinized, as with other records by this author. Instead, Oliver's (2010) record for southern Cantabria, in the upper Ebro basin, is substantiated by two existing specimens in his collection, whose photographs we have had the opportunity to examine, courtesy of E. Oliver and J. L. Yela. We believe that the almost hundred bibliographic records here compiled may be insufficient to obtain a reliable representation of the species' actual distribution.

Dicranura ulmi ([Denis & Schiffermüller], 1775): According to Schintlmeister (1989), this species is believed to have expanded from a Pontomediterranean refuge across southern Europe to the Iberian Peninsula during the postglacial period, extending eastward into Central Asia, thus qualifying it as Euro-Central Asian. In the Iberian Peninsula, it has been reported in the northeastern quadrant (Gerona, Barcelona, Huesca, Navarra, Zaragoza, Teruel, Guadalajara, Cuenca) and the central-western area (Zamora, Trás-os-Montes, Beira Baixa, Cáceres, Madrid). Ribbe (1908) claims sightings in Alhambra (Granada), but considering the uncertainty surrounding this author's records, it's prudent not to accept them without confirmed evidence of the species' presence in the area. Nevertheless, Pérez de-Gregorio et al. (2001) inaccurately assert that this species has been found in scattered populations throughout the entire Iberia.

Harpyia milhauseri (Fabricius, 1775): According to Schintlmeister (1989), this species is thought to have expanded from a Pontomediterranean refuge across Europe, Asia Minor, and the Middle East during the postglacial period. Nonetheless, based on its chorology, it can be classified as European. In the Iberian Peninsula, it is widespread, being recorded in Andorra as well as in all mainland Portuguese and Spanish provinces.

Tribe Notodontini

Drymonia dodonaea ([Denis & Schiffermüller], 1775): This species, found throughout Europe, the Caucasus, and Asia Minor, appears to have expanded northward from its Mediterranean refuges during the postglacial period (Schintlmeister, 1989). Based on its distribution pattern, it can be classified as European. In the Iberian Peninsula, it shows two distinct nuclei: one in the provinces of Gerona, Barcelona, and Lérida, and another along the entire Cantabrian region, from northern Navarra to La Coruña, including the province of Álava and the northern parts of Burgos, Palencia, León, and Minho. Considering this data, we question the record by García de-Viedma & Gómez-Bustillo (1981) from Cazorla (Jaén), as well as those by Monteiro & Passos de Carvalho (1984) for the Algarve, the latter mentioned by Schintlmeister (2008) but dismissed by Corley (2015a).

Drymonia ruficornis (Hufnagel. 1766): Similar to the preceding species, this is a European element of Mediterranean origin (Schintlmeister, 1989) that extends throughout Europe, the Caucasus, Asia Minor, and the Middle East, with a subspecies, *D. ruficornis vivida*, found in southern Spain and northwest Africa. In the Iberian Peninsula, it is widely distributed in the northern half, reaching Sierra Morena (Ciudad Real) and the Sierra de Alcaraz (Albacete). It appears to be absent from the Spanish Levante coast and Andalusia, except for an isolated population in the province of Cádiz. Corley (2015a) discredited records from the Portuguese Estremadura (Carneiro-Mendes, 1951) and Algarve (Monteiro & Passos de Carvalho, 1984).

Drymonia obliterata (Esper, 1785): European species that inhabits the central and southeastern regions of the continent, as well as Asia Minor and the Caucasus. According to Schintlmeister (1989), it is thought to have expanded during the postglacial period from a refuge in the Pontomediterranean region. In the Iberian Peninsula, it has been reported in the provinces of Cantabria, Palencia, Burgos, Álava, La Rioja, Guipúzcoa, and Navarra, with an isolated record from Lérida.

Drymonia querna ([Denis & Schiffermüller], 1775): A European species that ranges across central and southern Europe, Asia Minor, and the Middle East. The strictly European subspecies, *D. querna querna*, is thought to have expanded during the postglacial period from an Adriatic-Mediterranean refuge (Schintlmeister, 1989). In the Iberian Peninsula, it is widely distributed, with records from Andorra, all Portuguese mainland provinces, and nearly all Spanish provinces, except for Valencia, Alicante, Almería, Sevilla, and Badajoz.

Drymonia velitaris (Hufnagel, 1767): Like its congeneric species, this is a European element of Mediterranean origin (Schintlmeister, 1989). It has two subspecies distributed disjointedly, one in Europe (*D. velitaris velitaris*) and the other in the Caucasus and eastern Turkey (*D. velitaris pontica*). In the Iberian Peninsula, it occupies the Cantabrian-Pyrenean system, Galicia, and northern Portugal, extending to the northern Iberian System and the Serra da Estrela. Corley (2015a) erroneously cited it from Beira Litoral (pers. comm.).

Notodonta torva (Hübner, [1803]): Holarctic species widely distributed in Eurasia. It is included in the catalogue of Vives Moreno (2014). In the map presented by Schintlmeister (2008), two locations in the Pyrenees are marked. However, we have not found any records from the Iberian Peninsula, with the closest ones being from central France. According to Gómez-Bustillo & Arroyo-Varela (1981), there may have been confusion between *N. torva* (Hübner, [1803]) (= *tritophus* sensu Esper, 1786) and *N. tritophus* ([Denis & Schiffermüller], 1775).

Notodonta dromedarius (Linnaeus, 1767): Eurosiberian element. The nominate subspecies, widely distributed across Europe, is thought to have its center of expansion in Mongolia or western Siberia (Schintlmeister, 1989). In the Iberian Peninsula, it occupies the northern regions from Catalonia to Galicia, extending through Portugal to the Serra da Estrela.

Notodonta tritophus ([Denis & Schiffermüller], 1775): It ranges from Western Europe, Asia Minor, and the Caucasus eastward to the Altai Mountains, thus falling within the Eurosiberian elements. The nominate subspecies, which inhabits Europe south of the Alps, likely found its glacial refuge in the Mediterranean region (Schintlmeister, 1989). In the Iberian Peninsula, it predominantly occupies northern regions but also extends southward to the Central System (Gata and Béjar Mountain ranges) and the southern Iberian System (Alto Tajo, Serranía de Cuenca).

Notodonta ziczac (Linnaeus, 1758): Palearctic species spread across Europe, Northwest Africa, Asia Minor, Central Asia, and Siberia. Its glacial refuge could have been located in either the Mediterranean or Western Siberia (Schintlmeister, 1989). Widely distributed in the Iberian Peninsula, it has been recorded in Andorra and most Portuguese and Spanish provinces, except for Valencia, Alicante, Almería, Málaga, Córdoba, Sevilla, Toledo, Badajoz, Estremadura, and Baixo Alentejo. These data suggest a scarcity of the species towards the southern Iberian Peninsula and the Spanish Levante coast or its confinement to wetter enclaves, as observed in North Africa (Schintlmeister, 2008).

Peridea anceps (Goeze, 1781): European species that expanded during the postglacial period from a Mediterranean refuge to Northwest Africa, Europe, the Caucasus, and Asia Minor (Schintlmeister, 1989). It has a wide distribution in the Iberian Peninsula, with records from Andorra, all Portuguese provinces, and almost all Spanish provinces, except for Badajoz and Sevilla.

Pheosia tremula (Clerck, 1759): Eurosiberian species distributed from Western Europe, Asia Minor, and the Caucasus to the Altai Mountains. Its center of expansion could have been situated in either the Pontomediterranean region or western Siberia (Schintlmeister, 1989). In the Iberian Peninsula, it mainly

occupies the northern half. Although there are no records from the Central System, we have information about its presence in the Sierra de Guadarrama (K. Leahy, pers. comm.). The record by Ribbe (1908) from the Sierra de Alfacar (Granada), considered by later authors like Gómez-Bustillo (1979), Pérez de-Gregorio et al. (2001), Díaz (1998), or Schintlmeister (2008), we believe should be considered erroneous. The absence of ancient records in Portugal, even in areas where it is now frequently observed, suggests that this species has expanded southward in recent decades, reaching at least Douro Litoral (Martin Corley pers. comm).

Pheosia gnoma (Fabricius, 1776): European species that ranges from northern Spain to the Ural Mountains, avoiding the Mediterranean region. Its glacial refuge likely resided in Mongolia or western Siberia (Schintlmeister, 1989). In the Iberian Peninsula, there are only a dozen records divided into two separate nuclei: one in the western end of the Cantabrian Mountains (Lugo, Asturias, León) and the other in the Pyrenees (Huesca, Andorra, Lérida).

Ptilodon capucina (Linnaeus, 1758): Eurasian species that extends from Western Europe to Japan. According to Schintlmeister (1989), the nominal subspecies, which occupies Europe and Asia Minor, likely took refuge in the Mediterranean region during the glacial periods. In the Iberian Peninsula, it inhabits the Cantabrian-Pyrenean system, stretching from La Coruña to Gerona, extending into northern Portugal (Minho), the northern Iberian System and the Central System. From the Central System, the sole existing record is documented by Vázquez-Figueroa (1894) and is corroborated by three specimens collected from San Ildefonso (Segovia), which are now housed in the collection of the National Museum of Natural Sciences in Madrid (Spain). Nevertheless, it's worth noting that both Agenjo (1970, 1974) and Yela (1992) cautioned against the reliability of certain labels attributed to this author.

Ptilodon cucullina ([Denis & Schiffermüller], 1775): European species, with its center of expansion situated, according to Schintlmeister (1989), in the Adriatic-Mediterranean region. In the Iberian Peninsula, its distribution area is more limited compared to *P. capucina*, with records from Cantabria, Vizcaya, Álava, La Rioja, Navarra, northern Zaragoza, Huesca, and the four Catalan provinces.

Odontosia carmelita (Esper, 1799): Euro-Siberian species that occurs from Central to Northern Europe, extending to western Siberia. It was cited as rare near Barcelona by Cuní i Martorell (1874), with an unequivocal description: "Carmelite-colored with a yellow spot on the anterior edge of the first wings". The reported month, May, also corresponds well with the species' flight period, and the presence of alders (*Alnus glutinosa* (L.) Gaertn.), one of its known host plants, is documented in the area (R. Macià, pers. comm.). Despite this record and the existence of a specimen from Barcelona deposited by A. Vázquez in the National Museum of Natural Sciences in Madrid (Spain) (M. París, pers. comm.), Agenjo (1946) lists this species in his comprehensive catalogue of Spanish Lepidoptera as "not formally cited yet," likely due to his skepticism regarding Vázquez's labels (Agenjo, 1970, 1974). The record of Fernández (1920) from Bilbao must be viewed with caution, similar to other records by this author. Gómez-Bustillo (1979) mentions its presence in the Navarrese Pyrenees, and Schintlmeister (2008) marks it on the distribution map, but there is a lack of bibliographic evidence to support this information. Vives Moreno (2014) includes *O. carmelita* in the Spanish checklist, while Bellavista (2021) does not include it in the Catalan checklist. The only known record from the southern half of France, specifically from the Aude Department, dates back to 1874 by Mabille (1895). This, along with Cuní i Martorell's (1874) record, suggests a regression in the species' distribution area since the late 19th century.

Ptilophora plumigera ([Denis & Schiffermüller], 1775): European species that, according to Schintlmeister (1989), had its glacial refuge in the Adriatic-Mediterranean region. In the Iberian Peninsula, it is known from the northeastern quadrant, with records from Álava, Navarra, Huesca, Lérida, Gerona, Barcelona, Tarragona, and Cuenca. Its flight period, primarily in November and December, may be contributing to it being overlooked in other regions.

Conclusion

According to the information gathered in this study, the Notodontidae family is currently represented in the Iberian Peninsula by 37 species. Additionally, there is historical evidence of *Odontosia carmelita* (Esper, 1799) presence 150 years ago, however, given the time elapsed without any further sightings, we consider this species extinct on the Peninsula. Concerning the two other species discussed, *Clostera anastomosis* (Linnaeus, 1758) and *Notodonta torva* (Hübner, [1803]), reportedly part of the Iberian fauna (Vives Moreno,

2014), we found no evidence of their current or past occurrence in the studied territory.

Checklist of Iberian Notodontids

Notodontidae Stephens, 1829
Subfamily Pygaerinae Duponchel, 1845
Gluphisia rurea (Fabricius, 1787)
Rhegmatophila alpina (Bellier, 1880)
Clostera curtula (Linnaeus, 1758)
Clostera pigra (Hufnagel, 1776)
Clostera anachoreta ([Denis & Schiffermüller], 1775)
Subfamily Thaumetopoeinae Aurivillius, 1889
Thaumetopoea pinivora (Treitschke, 1834)
Thaumetopoea pityocampa ([Denis & Schiffermüller], 1775)
Thaumetopoea herculeana (Rambur, 1837)
Thaumetopoea processionea (Linnaeus, 1758)
Subfamily Spataliinae Matsumura, 1929
Tribe Spataliini Matsumura, 1929
Spatalia argentina ([Denis & Schiffermüller], 1775)
Tribe Ceirini Matsumura, 1929
Pterostoma palpina (Clerck, 1759)
Subfamily Phalerinae Butler, 1886
Phalera bucephala (Linnaeus, 1758)
Phalera bucephaloides (Ochsenheimer, 1810)
Subfamily Notodontinae Stephens, 1829
Tribe Stauropini Matsumura, 1925
Stauropus fagi (Linnaeus, 1758)
Tribe Dicranurini Duponchel, 1845
Cerura vinula (Linnaeus, 1758)
Cerura iberica (Templado & Ortitz, 1966)
Cerura erminea (Esper, 1783)
Furcula furcula (Clerck, 1759)
Furcula bicuspis (Borkhausen, 1790)
Furcula bifida (Brahm, 1787)
Neoharpyia verbasci (Fabricius, 1798)
Dicranura ulmi ([Denis & Schiffermüller], 1775)
Harpyia milhauseri (Fabricius, 1775)
Tribe Notodontini Stephens, 1829
Drymonia dodonaea ([Denis & Schiffermüller], 1775)
Drymonia ruficornis (Hufnagel. 1766)
Drymonia obliterata (Esper, 1785)
Drymonia querna ([Denis & Schiffermüller], 1775)
Drymonia velitaris (Hufnagel, 1767)
Notodonta dromedarius (Linnaeus, 1767)
Notodonta tritophus ([Denis & Schiffermüller], 1775)
Notodonta ziczac (Linnaeus, 1758)
Peridea anceps (Goeze, 1781)
Pheosia tremula (Clerck, 1759)
Pheosia gnoma (Fabricius, 1776)
Ptilodon capucina (Linnaeus, 1758)
Ptilodon cucullina ([Denis & Schiffermüller], 1775)
Ptilophora plumigera ([Denis & Schiffermüller], 1775)

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Conflict of interests

The authors declare that there is no known financial interests or personal relationships that could have influenced the work presented in this article.

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Figure 2. Maps of distribution of Iberian Notodontidae over the 10×10 km UTM grid. **2.1.** *Gluphisia rurea* (Fabricius, 1787). **2.2.** *Rhegmatophila alpina* (Bellier, 1880). **2.3.** *Clostera curtula* (Linnaeus, 1758). **2.4.** *Clostera pigra* (Hufnagel, 1776). **2.5.** *Clostera anachoreta* ([Denis & Schiffermüller], 1775). **2.6.** *Thaumetopoea pinivora* (Treitschke, 1834). **2.7.** *Thaumetopoea pityocampa* ([Denis & Schiffermüller], 1775). **2.8.** *Thaumetopoea herculeana* (Rambur, 1837).

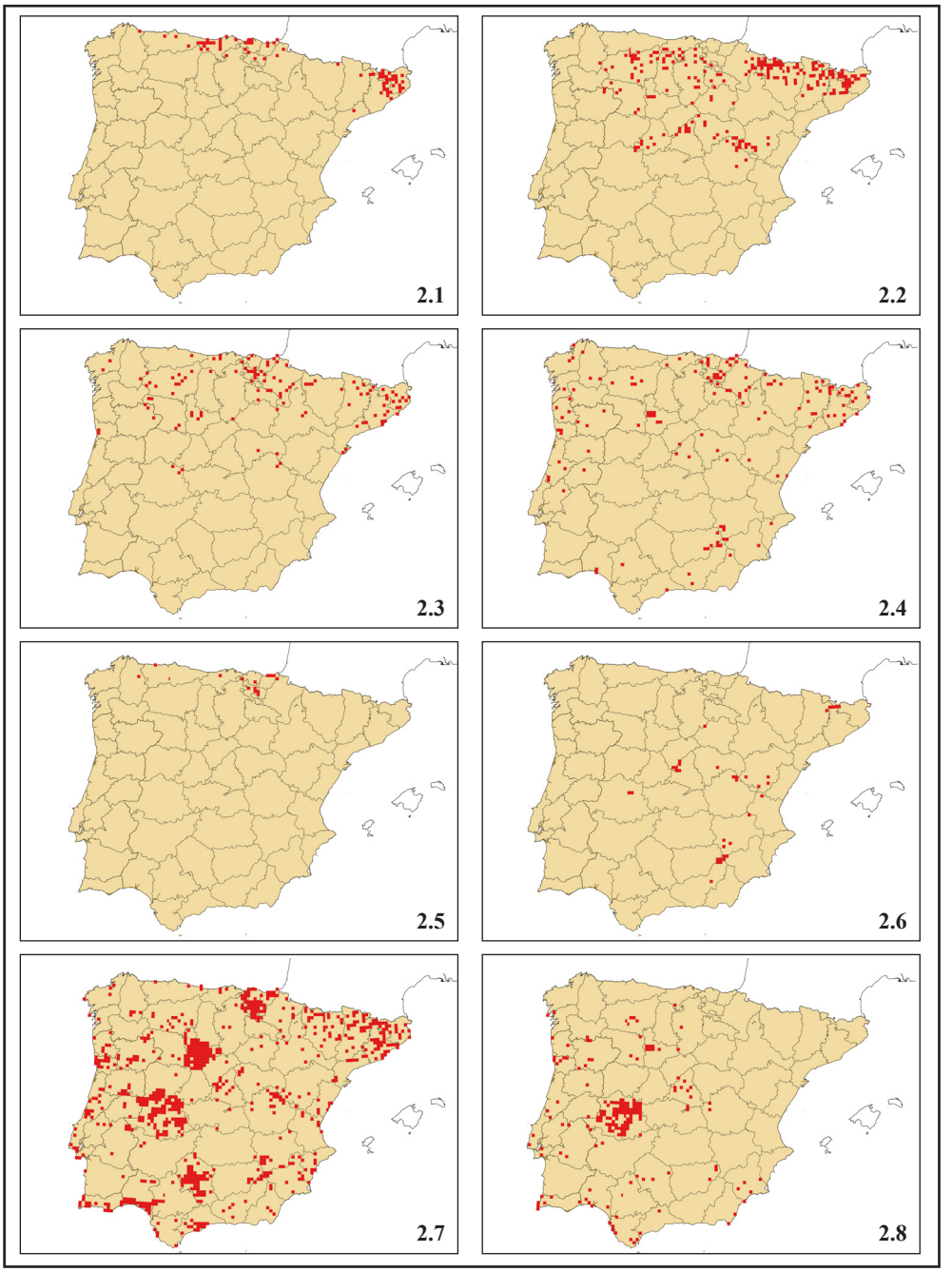


Figure 2. Maps of distribution of Iberian Notodontidae over the 10×10 km UTM grid. **2.9.** *Thaumetopoea processionea* (Linnaeus, 1758). **2.10.** *Spatalia argentina* ([Denis & Schiffermüller], 1775). **2.11.** *Pterostoma palpina* (Clerck, 1759). **2.12.** *Phalera bucephala* (Linnaeus, 1758). **2.13.** *Phalera bucephaloides* (Ochsenheimer, 1810). **2.14.** *Stauropus fagi* (Linnaeus, 1758). **2.15.** *Cerura vinula* (Linnaeus, 1758). **2.16.** *Cerura iberica* (Templado & Ortiz, 1966).

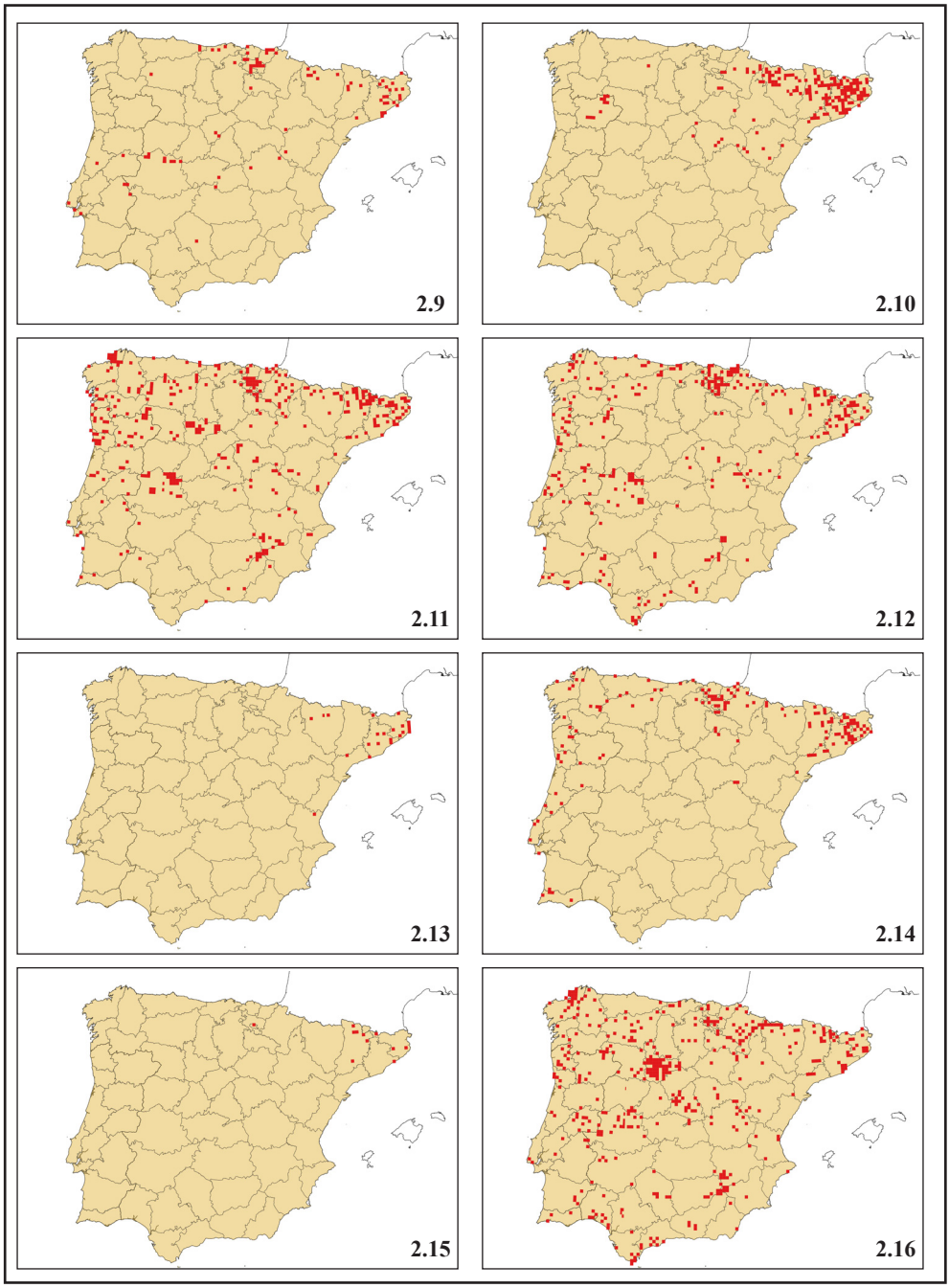


Figure 2. Maps of distribution of Iberian Notodontidae over the 10×10 km UTM grid. **2.17.** *Cerura erminea* (Esper, 1783). **2.18.** *Furcula furcula* (Clerck, 1759). **2.19.** *Furcula bicuspis* (Borkhausen, 1790). **2.20.** *Furcula bifida* (Brahm, 1787). **2.21.** *Neoharpyia verbasci* (Fabricius, 1798). **2.22.** *Dicranura ulmi* ([Denis & Schiffermüller], 1775). **2.23.** *Harpyia milhauseri* (Fabricius, 1775). **2.24.** *Drymonia dodonaea* ([Denis & Schiffermüller], 1775).

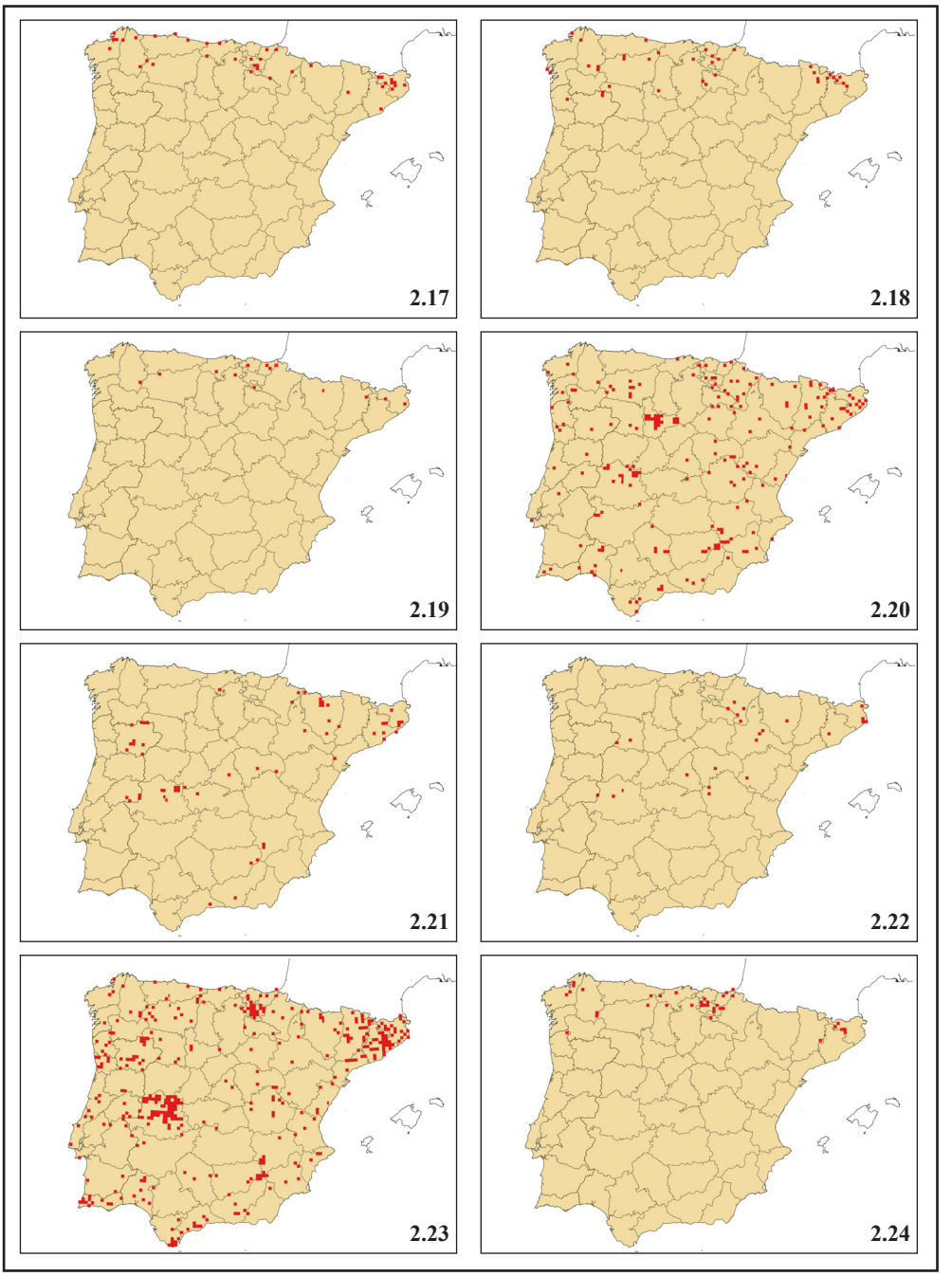


Figure 2. Maps of distribution of Iberian Notodontidae over the 10×10 km UTM grid. **2.25.** *Drymonia ruficornis* (Hufnagel. 1766). **2.26.** *Drymonia obliterata* (Esper, 1785). **2.27.** *Drymonia querna* ([Denis & Schiffermüller], 1775). **2.28.** *Drymonia velitaris* (Hufnagel, 1767). **2.29.** *Notodonta dromedarius* (Linnaeus, 1767). **2.30.** *Notodonta tritophus* ([Denis & Schiffermüller], 1775). **2.31.** *Notodonta ziczac* (Linnaeus, 1758). **2.32.** *Peridea anceps* (Goeze, 1781).

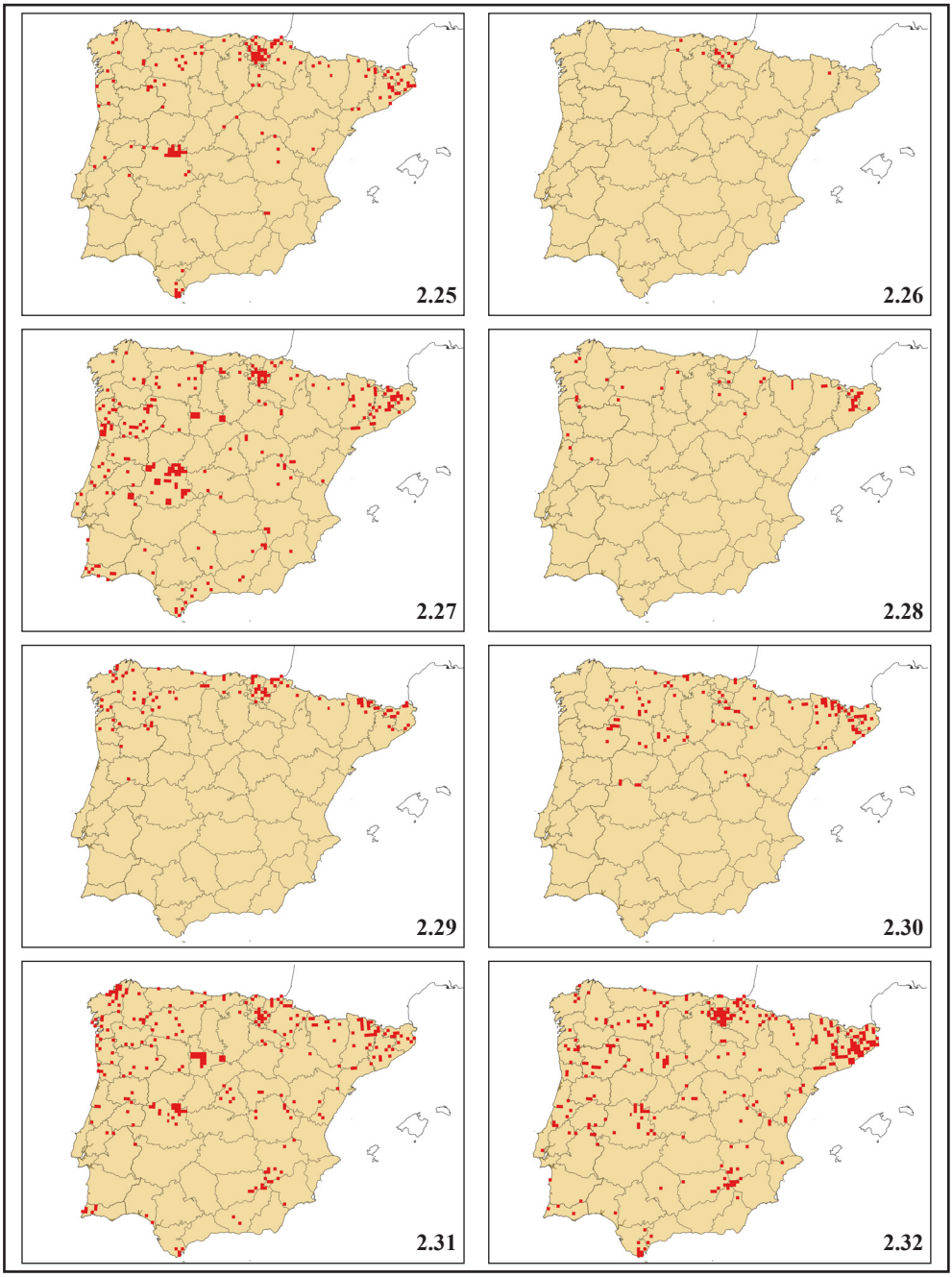
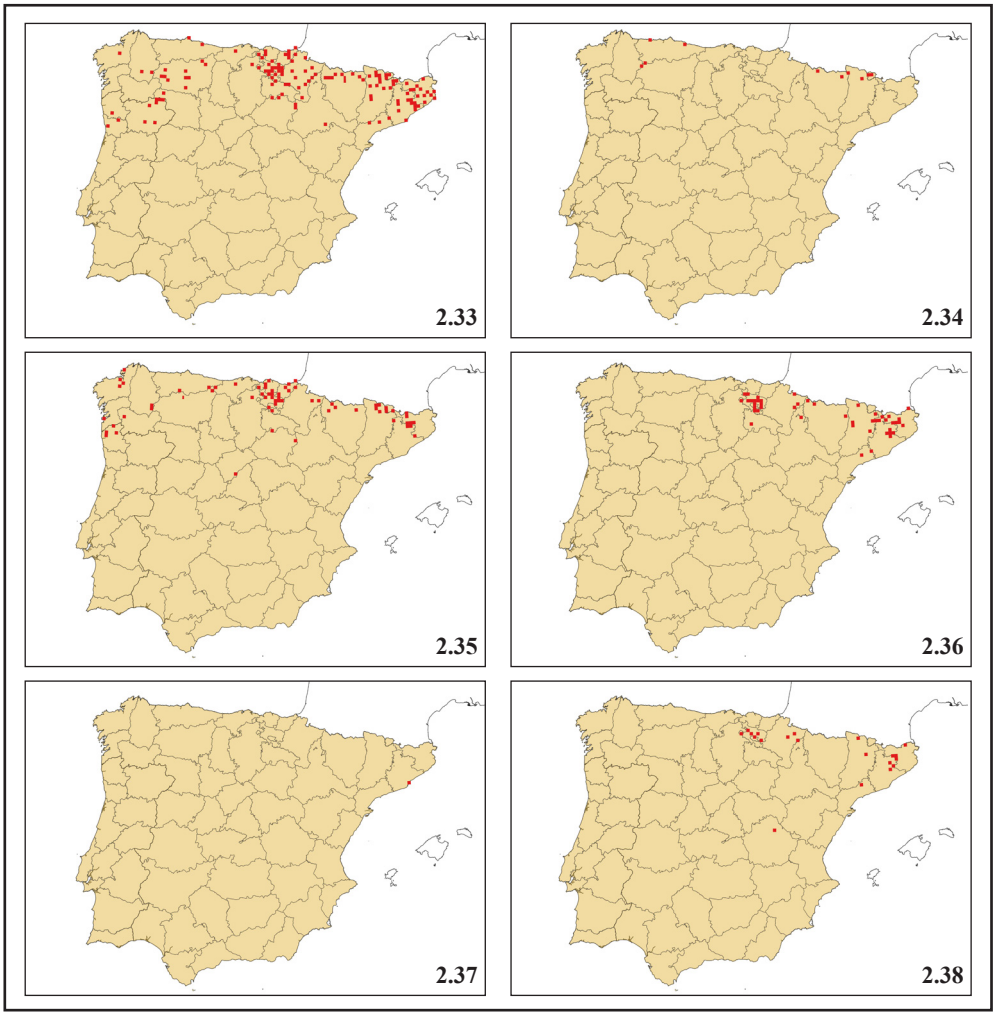


Figure 2. Maps of distribution of Iberian Notodontidae over the 10×10 km UTM grid. **2.33.** *Pheosia tremula* (Clerck, 1759). **2.34.** *Pheosia gnoma* (Fabricius, 1776). **2.35.** *Ptilodon capucina* (Linnaeus, 1758). **2.36.** *Ptilodon cucullina* ([Denis & Schiffermüller], 1775). **2.37.** *Odontosia carmelita* (Esper, 1799). **2.38.** *Ptilophora plumigera* ([Denis & Schiffermüller], 1775).



Annex I. Bibliographic references by species and provinces.

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Clostera anachoreta: Álava (Redondo et al. 2015; Olano et al. 1986; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Asturias (Landeira, 1980), Cantabria (Oliver, 2010), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Lugo (Pérez de Gregorio et al. 2001), Navarra (Gómez de Aizpúrua, 1974a), Vizcaya (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a).

Clostera curtula: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Andorra (Dantart et al. 1989), Asturias (Waring & Thomas, 1990), Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Sagarra, 1915; Rius, 1987; Flores, 1979; Flores, 1974; Dantart et al. 2018; Dantart & Jubany, 2007; Cuní i Martorell, 1897; Cuní i Martorell, 1874), Burgos (Méndez Garnica, 2001; Fernández, 1933; de Juana et al. 2023a), Cáceres (Novoa et al. 2002; Hernández et al. 1999; Blázquez et al. 1997), Cantabria (Oliver, 2010), Cuenca (Garre et al. 2015; De Arce et al. en preparación), Douro Litoral (Nunes et al. 2024; Corley et al. 2016), Gerona (Ylla, 1997; Pibernat et al. 2010b; Pérez de-Gregorio & Dantart, 1990; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Lafranchis et al. 2020; Kraus, 1999; Guzmán, 2013; Dantart, 1990; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Cervelló et al. 2017; Abós et al. 2012b), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Parrack, 1982; Palanca, 1972; Palanca & Galante, 1977; Ortiz et al. 2017; Abós Castel, 1985a), La Coruña (Waring & Thomas, 1990; Fernández Vidal, 2011), La Rioja (Latasa et al. 2001; Agenjo, 1977), León (Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Guzmán et al. 2021; Garre et al. 2013; Dantart et al. 2010; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2009), Lugo (Pino et al. 2005; Ortiz et al. 2016a; López Vaamonde et al. 1995; Fernández Vidal, 2016), Navarra (Sánchez Eguialde, 1982; Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Orense (Pino et al. 2005), Palencia (Jubete, 2015), Salamanca (Magro & Jambrina, 2014), Soria (Sánchez Eguialde, 2001), Tarragona (Segarra, 2018; Orozco et al. 2009; Orozco & Orozco, 1986; Dantart, 2021; Dantart & Miquel, 2000), Teruel (Redondo, 1990), Trás-os-Montes (Corley et al. 2016), Valladolid (Magro, 1989), Vizcaya (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Redondo, 1977a).

Clostera pigra: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Alicante (Tormo, 1995), Almería (Garre et al. 2020), Andorra (Dantart et al. 1989), Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Rius, 1987; Requena, 1995; Orozco et al. 1997; Flores, 1979; Flores, 1974; Dantart et al. 2018; Cuní i Martorell, 1897; Cuní i Martorell, 1874; Cervelló et al. 2007), Beira Alta (Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902), Beira Litoral (Nunes et al. 2024; Corley, 2015a; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001; Méndez Garnica, 1983; de Juana et al. 2023a), Cantabria (Oliver, 2010), Castellón (Calle, 1983), Cuenca (Ortiz et al. 2009; Lencina et al. 2022), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Cruz & Wattison, 1934; Corley, 2015a; Corley & Afonso, 2021), Gerona (Weiss, 1915; Stefanescu, 1995; Pibernat et al. 2010a; Pérez de Gregorio, 1982; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2020; Dantart & Jubany, 2011; Cervelló et al. 2017; Abós et al. 2012b; Abós et al. 2012a), Granada (Schwingenschuss, 1931; Schmidt-Koehl, 1968; Albaladejo et al. 2018), Guadalajara (De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Huertas-Dionisio, 2007; Fuentes et al. 1999), Huesca (Parrack, 1982; Palanca & Galante, 1977; Ortiz et al. 2017; Kraus, 1999; Fasnidge, 1934; Abós Castel, 1985a), Jaén (Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Rodríguez Saldaña, 2023), León (Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Pérez de Gregorio, 2003; Guzmán, 2018; Garre et al. 2011; Dantart, 2022; Dantart, 2014a; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Ahola & Kohonen, 1985), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Flores, 1945), Málaga (Rambour, 1858), Minho (Cruz & Wattison, 1929; Nunes et al. 2024; Corley

& Afonso, 2021), Murcia (Calle et al. 2000), Navarra (Sánchez Eguialde, 1984; Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Orense (Pino et al. 2005), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Vázquez Figueroa, 1894), Sevilla (Palma et al. 1995), Tarragona (Vallhonrat et al. 2006; Orozco & Orozco, 1986), Teruel (Kraus, 1999; Koschwitz et al. 1985), Trás-os-Montes (Corley & Afonso, 2021), Valladolid (Magro, 1989), Vizcaya (Staudinger & Rebel, 1901; Seebold, 1879; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Jambrina et al. 2003), Zaragoza (Redondo et al. 2015; Redondo, 1977).

Dicranura ulmi: Barcelona (Bolland, 1985), Beira Baixa (Corley et al. 2018b), Cáceres (García-Santano et al. 2002; Blázquez et al. 2000), Cuenca (Fernández, 1920), Gerona (Stefanescu & Miralles, 1993; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a), Guadalajara (De Arce et al. en preparación; Castro, 1975), Huesca (Abós Castel, 1980a), Madrid (Flores, 1945), Navarra (Sánchez Eguialde, 1982; Cifuentes, 1997), Teruel (Kraus, 1999; Koschwitz et al. 1985), Trás-os-Montes (Corley et al. 2008), Zamora (Jambrina et al. 2003), Zaragoza (Redondo, 1990; Redondo, 1977a).

Drymonia dodonaea: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Barcelona (Ylla, 1980b; Turet & Ylla, 1982), Burgos (Méndez Garnica, 2001), Cantabria (Oliver, 2010), Gerona (Pérez De-Gregorio, 2000; Dantart, 2015b; Cervelló et al. 2017; Bellavista & Bellavista, 1984; Abós et al. 2012a), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), La Coruña (Pino & Castro, 2013; López-Vaamonde et al. 1995; Fernández Vidal, 2011), León (González & Manceñido, 2012), Lérida (Vallhonrat et al. 2018; Dantart, 2021), Lugo (Fernández Vidal, 2016; Fernández Vidal, 2011), Minho (Cruz & Wattison, 1929; Corley & Afonso, 2021), Navarra (Gómez Bustillo & Gómez de Aizpúrua, 1978), Palencia (Jubete, 2015), Vizcaya (Redondo et al. 2015; de Juana et al. 2023a).

Drymonia obliterata: Álava (Olano et al. 1986; Gastón, 1984; de Juana et al. 2023a; de Juana et al. 2019; de Juana et al. 2018), Burgos (Méndez Garnica, 2001), Cantabria (Agenjo, 1975), Guipúzcoa (Gómez de Aizpúrua, 1974a), La Rioja (Rodríguez Saldaña, 2023), Lérida (Ahola & Kohonen, 1985), Navarra (Rodríguez Saldaña, 2002), Palencia (Jubete et al. 2017).

Drymonia querna: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Lencina et al. 2011; Albert & Lencina, 1984), Algarve (Passos de Carvalho & Corley, 1995; Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley & Afonso, 2021), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (Dantart et al. 1989; Dantart & Jubany, 2011), Asturias (Ortiz et al. 2016b; Hurlé, 1980), Ávila (García-Santano et al. 2002), Baixo Alentejo (Corley, 2015a; Corley, 2004), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1964; Stefanescu & Miralles, 1997; Romañà & Pérez de-Gregorio, 1981; Requena, 1995; Dantart, 2021; Dantart, 2017b; Dantart, 2017a; Dantart & Jubany, 2011; Dantart & Jubany, 2007), Beira Alta (Cruz & Wattison, 1934; Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902; Marabuto et al. 2013), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001; de Juana et al. 2023a), Cáceres (Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2011; Blázquez et al. 2009; Blázquez et al. 2000; Blázquez, 2014; Blázquez, 2008), Cádiz (Zerny, 1927b; Mateo Lozano et al. 2022; Mateo Lozano, 2000; Gaona, 2020b; Gaona, 2020a), Cantabria (Oliver, 2010), Castellón (Huemer & Wieser, 2010; Huemer & Wieser, 2006), Ciudad Real (Lencina-Gutiérrez et al. 2019; Hurtado et al. 2011), Córdoba (Gomáriz, 2021; Fuentes et al. 1999), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; Aistleitner & Aistleitner, 1998), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Nunes, 2022; Nunes, 2021b; Nunes, 2021a; Nunes & Gil, 2023; Corley & Afonso, 2021), Estremadura (Nunes et al. 2024; Mendes, 1910; Corley, 2015a), Gerona (Pibernat et al. 2009; Pérez De-Gregorio, 2000; Guzmán, 2013; Flores, 1979; Dantart, 2017b; Dantart, 2017a; Dantart, 2007; Dantart, 1990; Cervelló et al. 2017; Abós et al. 2012b; Abós et al. 2012a), Granada (Pérez López, 1989; Albaladejo et al. 2018), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Huertas-Dionisio, 1982; Bernabé-Ruiz et al. 2019), Huesca (Parrack, 1982; Maux, 2021; Abós Castel, 1980b), Jaén (Pérez López, 1989; Guerrero et al. 2019; Fuentes, 1999), La Coruña (Fernández Vidal, 2011), La Rioja (Latasa et al. 2001), León (Manceñido et al. 2009; González & Manceñido, 2012),

Lérida (Vallhonrat et al. 2018; Societat Catalana de Lepidopterologia, 2005; Guzmán et al. 2021; Garre et al. 2013; Garre, 2008; Dantart, 2017b; Dantart, 2015b; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2011; Dantart & Jubany, 2007), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Expósito Hermosa, 1979), Málaga (Moreno-Benítez, 2021; Moreno-Benítez, 2017; Moreno-Benítez et al. 2020; Moreno-Benítez et al. 2016; Moreno Benítez & Coto Gilabert, 2023a; Moreno Benítez & Coto Gilabert, 2023b), Minho (Cruz & Wattison, 1931; Nunes et al. 2024; Cruz, 1935; Cruz & Wattison, 1934; Corley & Afonso, 2021), Murcia (Ortiz et al. 2016), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Orense (Torres Vila, 1983), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Magro & Jambrina, 2014), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2006; Segarra, 2018; Dantart, 2019; Dantart & Miquel, 2005; Dantart & Jubany, 2012; Dantart & Jubany, 2007), Teruel (Redondo et al. 2015; Kraus, 1999; Koschwitz et al. 1985; Grustán & Redondo, 1998), Toledo (Notario et al. 2007; De Arce et al. en preparación), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valladolid (Magro, 1989), Vizcaya (Gómez de Aizpúrua, 1974a), Zamora (Vallhonrat, 1997; Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Redondo, 1980).

Drymonia ruficornis: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Tormo, 1993; Lencina et al. 2011; Albert & Lencina, 1984), Alto Alentejo (Corley et al. 2023), Asturias (Vega Escandón, 1980; Landeira, 1980), Ávila (Blázquez, 2008), Barcelona (Weiss, 1915; Vilarrubia, 1974b; Vilarrubia, 1964; Stefanescu & Miralles, 1997; Rius, 1987; Flores, 1979; Flores, 1974; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2005), Beira Alta (Corley et al. 2015), Beira Baixa (Corley et al. 2018), Beira Litoral (Nunes et al. 2024; Corley et al. 2015), Burgos (Méndez Garnica, 2001; Cruz & Gonçalves, 1950), Cáceres (Yela, 1984; Novoa et al. 2002; Masó, 1991; Hernández et al. 1999; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2016; Blázquez et al. 2000; Blázquez et al. 1997; Blázquez, 2008), Cádiz (Zerny, 1927b; Mateo Lozano et al. 2022; Mateo Lozano, 2000; Gaona, 2020b; Gaona, 2020a), Cantabria (Oliver, 2010), Ciudad Real (Aistleitner & Aistleitner, 1998), Cuenca (Lencina et al. 2022; Guerrero et al. 2020a; Gómez Bustillo, 1977), Douro Litoral (Monteiro, 1964), Gerona (Pibernat et al. 2010a; Pérez de Gregorio, 1982; Pérez de Gregorio & Rondós, 2005a; Kraus, 1999; Guzmán, 2013; Dantart & Jubany, 2009; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Guadalajara (Gómez Bustillo, 1977; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Parrack, 1982; Maux, 2021; Abós Castel, 1995; Abós Castel, 1994), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018), León (Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Kraus, 1999; Dantart et al. 2010; Dantart & Jubany, 2009), Lugo (Fernández Vidal, 2016), Málaga (Moreno-Benítez, 2016b), Minho (Cruz & Wattison, 1931; Cruz & Wattison, 1929; Corley & Afonso, 2021), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979; Mendes, 1914; Cruz & Gonçalves, 1950), Salamanca (Magro & Jambrina, 2014), Segovia (Soria, 1987; Gómez Bustillo, 1977), Soria (Magro & Jambrina, 2014), Tarragona (Vallhonrat et al. 2009; Pérez de Gregorio & Rondós, 2005b; Dantart & Miquel, 2005), Teruel (Redondo et al. 2015; Redondo, 1990), Trás-os-Montes (Corley et al. 2015; Corley & Afonso, 2021), Valladolid (Magro & Jambrina, 2014), Vizcaya (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Saz Fucho, 1985), Zaragoza (Redondo, 1990).

Drymonia velitaris: Álava (de Juana et al. 2023b; de Juana et al. 2018), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1974b; Vilarrubia, 1964; Romañà & Pérez de-Gregorio, 1981; Masó et al. 1981; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart & Jubany, 2007), Beira Alta (Corley et al. 2013), Beira Litoral (Corley, 2015a), Douro Litoral (Cruz, 1971), Gerona (Stefanescu, 1995; Kraus, 1999; Guzmán, 2013; Dantart, 2015b; Cervelló et al. 2017; Abós et al. 2012a), Guipúzcoa (Gómez de Aizpúrua, 1974a), Huesca (Maux, 2021; Grustán & Redondo, 1998; Abós Castel, 1988), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011), La Rioja (Rodríguez Saldaña, 2023), León (Manceñido & González, 2016), Lérida (Garre et al. 2019; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2011), Lugo (Fernández Vidal, 2016), Minho (Monteiro, 1962; Corley et al. 2013; Corley & Afonso, 2021), Navarra (Antón & Miguel, 2017), Orense (Pino et al.

2005), Palencia (Jubete, 2015), Pontevedra (López Vaamonde et al. 1991), Zamora (Jambrina et al. 2003), Zaragoza (Redondo, 1990).

Furcula bicuspis: Álava (Olano et al. 1986; de Juana et al. 2018), Burgos (Magro & Jambrina, 2014), Cantabria (Oliver, 2010), Gerona (Pérez de Gregorio, 1977b; Cervelló et al. 2017), Guipúzcoa (Gómez de Aizpúrua, 1974a), Huesca (Maux, 2021), León (Manceñido-González, 2022), Lérida (Dantart & Vallhonrat, 2013), Lugo (Fernández Vidal, 2016), Navarra (Gómez de Aizpúrua, 1974a), Vizcaya (de Juana et al. 2023a).

Furcula bifida: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Albacete (Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley et al. 2000), Alicante (Tormo & Muñoz, 1995; Tormo & Muñoz, 1985), Almería (Garre et al. 2020), Andorra (De Laever, 1958; Dantart et al. 1989), Ávila (Magro & Jambrina, 2014; García-Santano et al. 2002), Badajoz (Novoa et al. 2002), Baixo Alentejo (Marabuto, 2018), Barcelona (Vilarrubia, 1974a; Vilarrubia, 1964; Sagarra, 1915; Rius, 1987; Masó et al. 1978; Flores, 1974; Dantart et al. 2018; Cuní i Martorell, 1874), Beira Alta (Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902; Corley, 2015a), Beira Litoral (Pires & Corley, 2007), Burgos (Méndez Garnica, 2001), Cáceres (Orellana & de Castro, 1996; Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2019; Blázquez et al. 2013; Blázquez et al. 2000; Blázquez et al. 1997), Cádiz (Walker, 1890; Gaona, 2020a), Cantabria (Oliver, 2010), Castellón (Calle, 1983), Córdoba (Rodríguez & Guerrero, 2020; Gomáriz, 2021; Fuentes et al. 1999), Cuenca (Ortiz et al. 2009; Lencina et al. 2022; De Arce et al. en preparación), Douro Litoral (Nunes, 2021a; Corley, 2015a; Corley & Afonso, 2021), Estremadura (Nunes et al. 2024; Corley, 2015a), Gerona (Ylla, 1997; Ribera & Dantart, 2017; Pibernat et al. 2010b; Pérez de Gregorio, 1982; Pérez de Gregorio, 1978a; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2017b; Dantart, 1990; Dantart & Jubany, 2012; Dantart & Jubany, 2007), Granada (Fuentes et al. 1999; Albaladejo et al. 2018; Agenjo, 1977), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación; Castro, 1975; Álvarez, 1985), Guipúzcoa (Gómez de Aizpúrua, 1974a), Huelva (Huertas-Dionisio, 2019b; Huertas-Dionisio, 2019a; Huertas-Dionisio, 2007; Fuentes et al. 1999; Bernabé-Ruiz & Huertas-Dionisio, 2018; Aistleitner & Aistleitner, 1998), Huesca (Parrack, 1982; Abós Castel, 1988; Abós Castel, 1980b; Abós Castel, 1978), Jaén (Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018; Cifuentes, 1989), León (Vega Escandón, 1980; Vega Escandón, 1974; Moya, 2018; Manceñido et al. 2009), Lérida (Vallhonrat et al. 2018; Vallhonrat et al. 2005; Pérez de Gregorio, 2003; Guzmán et al. 2021; Guzmán, 2007; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2019; Dantart, 2015b; Dantart, 2014b; Dantart & Vallhonrat, 2017), Lugo (Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Gómez de Aizpúrua et al. 2003; Flores, 1945), Málaga (Sánchez Florido & Moreno-Benítez, 2020; Pérez Ortigosa & Moreno-Benítez, 2023; Moreno-Benítez, 2016b; Fuentes et al. 1999), Minho (Cruz & Gonçalves, 1961; Corley & Afonso, 2021), Murcia (Ortiz et al. 2007; Calle et al. 2000), Navarra (Sánchez Eguialde, 1982; Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Fernández Vidal, 1989), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Cruz & Gonçalves, 1961; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Magro & Jambrina, 2014), Sevilla (Palma et al. 1995), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2004; Segarra, 2020; Orozco & Orozco, 1986), Teruel (Zerny, 1927a; Zapater & Korb, 1892; Weiss, 1920; Kraus, 1999; Koschwitz et al. 1985; Hull, 1982; Derra & Hacker, 1982), Trás-os-Montes (Corley, 2015a; Corley & Afonso, 2021), Valencia (Domínguez et al. 1989), Valladolid (Magro, 1995; Magro, 1989), Vizcaya (Staudinger & Rebel, 1901; Gómez de Aizpúrua, 1974a), Zamora (Jambrina et al. 2003), Zaragoza (Redondo, 1977a).

Furcula furcula: Álava (Olano et al. 1986; de Juana et al. 2021), Asturias (Hurlé, 1980), Barcelona (Ylla & Turet, 1984), Burgos (Méndez Garnica, 2001; Méndez Garnica, 1983), Cantabria (Oliver, 2010), Gerona (Ylla & Turet, 1984; Pérez De-Gregorio, 1987; Dantart, 2015b; Dantart & Jubany, 2011; Cervelló et al. 2017; Abós et al. 2012b; Abós et al. 2012a), Guipúzcoa (Gómez de Aizpúrua, 1974a), La Coruña (Hiernaux et al. 2010; Fernández Vidal, 1989), La Rioja (Rodríguez Saldaña, 2023), León (González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Garre et al. 2019; Derra & Hacker, 1982; Dantart et al. 2010; Dantart & Vallhonrat, 2017; Ahola & Kohonen, 1985), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989),

Minho (Cruz & Wattison, 1929), Navarra (Gómez de Aizpúrua, 1974a), Palencia (Jubete, 2015), Pontevedra (Hiernaux et al. 2010), Trás-os-Montes (Corley, 2015b; Corley & Afonso, 2021), Vizcaya (Staudinger & Rebel, 1901; Seebold, 1879; de Juana et al. 2023a), Zamora (Jambrina et al. 2003).

Gluphisia crenata: Álava (De Juana et al. , 2024; de Juana et al. 2023b; de Juana et al. 2019), Asturias (De Juana et al. , 2024), Barcelona (Vilarrubia, 1974a; Stefanescu et al. 1993; Societat Catalana de Lepidopterologia, 1993b; Sagarra, 1915; De Juana et al. , 2024; Dantart, 2017b), Burgos (De Juana et al. , 2024), Cantabria (De Juana et al. , 2024; Oliver, 2010), Gerona (Ylla, 1997; Romañà & Pérez de-Gregorio, 1981; Pibernat et al. 2010b; Pérez de Gregorio, 1984; Pérez de Gregorio, 1982; Pérez De-Gregorio, 1978b; Pérez De-Gregorio, 1977a; Pérez de Gregorio & Rondós, 2005a; Masó & Pérez De-Gregorio ; Kraus, 1999; Guzmán, 2013; De Juana et al. , 2024; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart, 1990; Dantart & Jubany, 2012; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b), Guipúzcoa (De Juana et al. , 2024; Gómez de Aizpúrua, 1974a), Huesca (De Juana et al. , 2024), Lérida (Dantart, 2015b; Ahola & Kohonen, 1985), Lugo (De Juana et al. , 2024), Navarra (De Juana et al. , 2024; Cifuentes, 1997), Tarragona (De Juana et al. , 2024), Vizcaya (De Juana et al. , 2024; Gastón, 1984; Redondo et al. 2015).

Harpyia milhauseri: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Albacete (Tormo, 1993; Navarro-Gosálbez, 1995; Monreal et al. 1992; Martín-Cano et al. 1990; Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Passos de Carvalho & Corley, 1995; Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley et al. 2000; Corley & Afonso, 2021), Alicante (Tormo & Muñoz, 1995; Tormo & Muñoz, 1985), Almería (Ortiz et al. 2018; Garre et al. 2020), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (De Laever, 1958; Dantart et al. 1989; Dantart, 2021; Dantart & Jubany, 2012), Asturias (Vega Escandón, 1980; Ortiz et al. 2016b; Landeira, 1980; Landeira, 1979; Hurlé, 1980), Ávila (Magro & Jambrina, 2014; García-Santano et al. 2002), Badajoz (Novoa et al. 2002), Baixo Alentejo (Marabuto, 2018), Barcelona (Ylla & Macià, 2007; Weiss, 1915; Vilarrubia, 1964; Stefanescu et al. 1993; Stefanescu & Miralles, 1997; Rius, 1987; Masó et al. 1978; Flores, 1979; Flores, 1974; Dantart, 2022; Dantart, 2021; Dantart, 2019; Dantart, 2017a; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Dantart & Jubany, 2005; Cervelló, 2012; Bolland, 1985; Bolland, 1975), Beira Alta (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1912; Marabuto et al. 2013; Corley & Afonso, 2021), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001), Cáceres (Yela, 1984; Orellana & de Castro, 1996; Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2011; Blázquez et al. 2009; Blázquez et al. 2000; Blázquez, 2012; Blázquez, 2008), Cádiz (Moberg, 1981; Mateo Lozano et al. 2022; Mateo Lozano, 2000; Gaona, 2020b; Gaona, 2020a), Cantabria (Oliver, 2010), Castellón (Kraus, 1999; Huemer & Wieser, 2010; Huemer & Wieser, 2006; Calle, 1983; Aistleitner & Aistleitner, 1998), Ciudad Real (Hurtado et al. 2011; Aistleitner & Aistleitner, 1998), Córdoba (Gomáriz, 2021; Fuentes et al. 1999), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; Aistleitner & Aistleitner, 1998), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Nunes, 2022; Nunes & Gil, 2023; Monteiro, 1964), Estremadura (Passos de Carvalho, 1980; Nunes et al. 2024; Corley, 2015a; Carneiro-Mendes, 1951), Gerona (Ylla, 1997; Pibernat et al. 2010a; Pibernat et al. 2009; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2022; Dantart, 2021; Dantart, 2019; Dantart, 2017b; Dantart, 2014b; Dantart, 1990; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012a), Granada (Travesi, 1983; Pérez López, 1989; Fuentes et al. 1999; Albaladejo et al. 2018), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación; Castro, 1975; Álvarez, 1985), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Moberg, 1981; Huertas-Dionisio, 2019b; Huertas-Dionisio, 1982; Fuentes et al. 1999; Bernabé-Ruiz et al. 2020), Huesca (Zapater & Korb, 1892; Redondo, 1990; Ortiz et al. 2017; Murria, 1994; Maux, 2021; Kraus, 1999; Gómez de Aizpúrua, 1974a; Abós Castel, 1982b; Abós Castel, 1985a), Jaén (García de Viedma & Gómez Bustillo, 1981; Fuentes et al. 1999; Agenjo, 1951a), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018), León (Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2018; Vallhonrat et al. 2005; Kraus, 1999; Guzmán et al. 2021;

Garre et al. 2013; Dantart et al. 2010; Dantart, 2022; Dantart, 2021; Dantart, 2019; Dantart, 2015b; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2009; Dantart & Jubany, 2007), Lugo (Pino & Castro, 2013; Ortiz et al. 2016a; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Expósito Hermosa, 1979; Castro, 1975), Málaga (Sánchez Florido & Moreno-Benítez, 2020; Pérez Ortigosa & Moreno-Benítez, 2023; Moreno-Benítez, 2018; Moreno-Benítez, 2016; Moreno-Benítez & Gallego-Domínguez, 2016; Moreno-Benítez et al. 2020; Moreno-Benítez et al. 2016; Moreno Benítez & Coto Gilabert, 2023a; Moberg, 1981; Gallego-Domínguez & Moreno-Benítez, 2023), Minho (Sousa, 1929; Nunes et al. 2024; Nunes, 2021a; Cruz & Wattison, 1934; Cruz & Wattison, 1931; Corley & Afonso, 2021), Murcia (Ortiz et al. 2007; Guerrero et al. 2011; Calle et al. 2000), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Fernández Vidal, 1989), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014; Blázquez et al. 2019), Segovia (Magro & Jambrina, 2014), Sevilla (Palma et al. 1995), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2006; Vallhonrat et al. 2004; Segarra, 2018; Pérez de Gregorio, 2001; Pérez de Gregorio & Rondós, 2005b; Dantart, 2021; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart & Miquel, 2000; Dantart & Jubany, 2012; Dantart & Jubany, 2009), Teruel (Zerny, 1927a; Weiss, 1920; Kraus, 1999; Koschwitz et al. 1985), Toledo (Notario et al. 2007; De Arce et al. en preparación), Trás-os-Montes (Cruz & Wattison, 1934; Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valencia (Székely, 2018; Domínguez et al. 1989), Valladolid (Magro, 1989), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988), Zamora (Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Redondo, 1980).

Neoharpyia verbasci: Albacete (Lencina et al. 2011; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Ávila (Castro, 1976), Barcelona (Vilarrubia, 1964; Rius, 1987; Flores, 1979; Flores, 1974; Cuní i Martorell, 1897; Cuní i Martorell, 1874), Beira Alta (Corley et al. 2019), Beira Baixa (Mendes, 1902; Marabuto et al. 2013), Cáceres (Hernández et al. 1999; Blázquez et al. 2021; Blázquez et al. 2013; Blázquez et al. 2011; Blázquez et al. 2000; Blázquez et al. 1997), Cantabria (Oliver, 2010), Gerona (Pérez de Gregorio & Rondós, 2005a; Masó et al. 1981; Kraus, 1999; Guzmán, 2013; Ahola & Kohonen, 1985), Granada (Pérez López, 1993; Albaladejo et al. 2018), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Huesca (Redondo et al. 2015; Ortiz et al. 2017; Maux, 2021; Louis-Augustin, 1992; Kraus, 1999; Abós Castel, 1980a), Jaén (Gómez Bustillo, 1980), Lérida (Pérez de Gregorio, 2003), Madrid (Flores, 1945), Málaga (Ribbe, 1908), Navarra (Gómez de Aizpúrua, 1974a; Abós Castel, 1986b), Orense (Pino & Pino, 2014), Segovia (Magro & Jambrina, 2014), Tarragona (Pérez de Gregorio, 2001), Teruel (Redondo, 1990), Toledo (Agenjo, 1977), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Vizcaya (Agenjo, 1977), Zaragoza (Redondo, 1975; Grustán & Redondo, 1998).

Notodonta dromedarius: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Andorra (Dantart et al. 1989), Asturias (Vega Escandón, 1980; Ortiz et al. 2016b; Landeira, 1980; Landeira, 1979; Hurlé, 1980; Aistleitner & Aistleitner, 1998), Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Stefanescu et al. 1993; Masó et al. 1978; Flores, 1979; Flores, 1974; Cuní i Martorell, 1874), Beira Alta (Corley, 2015a; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001; Méndez Garnica, 1983), Cantabria (Oliver, 2010), Douro Litoral (Corley et al. 2020), Gerona (Stefanescu, 1995; Pérez de Gregorio, 1982; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Kraus, 1999; Hoegh-Guldberg, 1986; Guzmán, 2013; Flores, 1979; Dantart, 2017b; Dantart, 2017a; Dantart, 2014b; Dantart & Jubany, 2011; Cervelló et al. 2017; Abós et al. 2012b; Abós et al. 2012a), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Redondo et al. 2015; Maux, 2021; Grustán & Redondo, 1992; Abós Castel, 1980b), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 2010; Fernández Vidal, 1989), León (Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Guzmán, 2018; Garre et al. 2019; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2015b; Dantart & Vallhonrat, 2017; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Ahola & Kohonen, 1985), Lugo (Pino & Castro, 2013; Ortiz et al. 2016a; Fernández Vidal, 2016; Fernández Vidal, 1989), Minho (Cruz & Wattison, 1934; Corley & Afonso, 2021), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Orense (Torres Vila, 1983; Fernández Vidal, 1989), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979; Fernández Vidal, 1989), Trás-os-Montes (Corley, 2015a; Corley & Afonso, 2021), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988;

Gómez de Aizpúrua, 1974a; de Juana et al. 2023a).

Notodonta tritophus: Álava (de Juana et al. 2023a; de Juana et al. 2019; de Juana et al. 2018), Andorra (Dantart et al. 1989), Asturias (Landeira, 1980; Hurlé, 1980), Ávila (Magro & Jambrina, 2014), Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Sagarra, 1915; Masó et al. 1978; Flores, 1974; Dantart, 2022; Dantart, 2014b; Dantart & Jubany, 2011; Dantart & Jubany, 2005), Burgos (Méndez Garnica, 2001), Cáceres (Blázquez et al. 2021; Blázquez et al. 2020), Cantabria (Oliver, 2010), Cuenca (Lencina et al. 2022), Gerona (Pibernat et al. 2010a; Pérez de Gregorio, 1982; Kraus, 1999; Flores, 1979; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart, 2007; Dantart, 1990; Dantart & Jubany, 2012; Dantart & Jubany, 2007; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1974a), Huesca (Ortiz et al. 2017; Maux, 2021; Grustán & Redondo, 1992; Abós Castel, 1990; Abós Castel, 1982b; Abós Castel, 1980b), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018), León (Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Redondo et al. 2015; Kraus, 1999; Guzmán, 2018; Derra & Hacker, 1982; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2022; Dantart, 2015b; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2012; Dantart & Jubany, 2011), Lugo (López Vaamonde et al. 1991; Fernández Vidal, 2016), Navarra (Sánchez Eguialde, 1983; Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Palencia (Aistleitner & Aistleitner, 1998), Salamanca (Magro & Jambrina, 2014), Segovia (Magro & Jambrina, 2014), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2004; Dantart, 2017b; Dantart & Jubany, 2005), Trás-os-Montes (Monteiro & Maravalhas, 1987; Corley & Afonso, 2021), Valladolid (Magro, 1995; Magro, 1989), Zamora (Saz Fucho, 1985; Jambrina et al. 2003).

Notodonta ziczac: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Tormo, 1993; Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Passos de Carvalho & Corley, 1995; Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley et al. 2000; Corley & Afonso, 2021), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (De Laever, 1958; Dantart et al. 1989; Dantart, 2017b), Asturias (Vega Escandón, 1980; Ortiz et al. 2016b; Landeira, 1979; Hurlé, 1980; Hurlé, 1979; Aistleitner & Aistleitner, 1998), Ávila (Magro & Jambrina, 2014; García-Santano et al. 2002), Barcelona (Vilarrubia, 1964; Stefanescu et al. 1993; Rius, 1987; Flores, 1979; Flores, 1974; Dantart, 2022; Dantart, 2020; Dantart, 2019; Cuní i Martorell, 1874), Beira Alta (Marabuto et al. 2004; Cruz & Gonçalves, 1974; Corley & Afonso, 2021), Beira Baixa (Mendes, 1905; Marabuto et al. 2013; Marabuto et al. 2004), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024), Burgos (Méndez Garnica, 2001; de Juana et al. 2023a), Cáceres (Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2000; Blázquez et al. 1997; Blázquez, 2014), Cádiz (Gaona, 2020a), Cantabria (Oliver, 2010; Gómez de Aizpúrua, 1974a), Castellón (Pérez de Gregorio, 2001; Domínguez et al. 1989; Calle, 1983), Ciudad Real (Hurtado et al. 2011), Cuenca (Ortiz et al. 2012; Lencina et al. 2022), Douro Litoral (Cruz, 1971; Nunes, 2021b; Nunes, 2021a; Monteiro, 1964; Cruz & Wattison, 1934; Corley, 2015a), Gerona (Ylla, 1997; Stefanescu, 1995; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2017b; Dantart, 2015b; Dantart, 1990; Dantart & Jubany, 2012; Cervelló et al. 2017; Abós et al. 2012b; Abós et al. 2012a), Granada (Ribbe, 1908; Fuentes et al. 1999; Albaladejo et al. 2018), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación; Castro, 1975), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Fuentes et al. 1999), Huesca (Parrack, 1982; Palanca, 1972; Palanca & Galante, 1977; Ortiz et al. 2017; Maux, 2021; Abós Castel, 1988; Abós Castel, 1982b; Abós Castel, 1985a), Jaén (Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Pino & Castro, 2013; Hiernaux et al. 2010; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001), León (Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Prins, 1983; Kraus, 1999; Guzmán et al. 2021; Guzmán, 2018; Guzmán, 2007; Garre et al. 2011; Dantart et al. 2010; Dantart, 2022; Dantart, 2017b; Dantart, 2015b; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Cervelló et al. 2019), Lugo (Rubio et al. 2016; Pino & Castro, 2013; Ortiz et al. 2016a; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Vázquez Figueroa, 1894; Gómez de Aizpúrua, 1974b; Flores, 1945; Expósito Hermosa, 1979; Agenjo, 1977), Minho (Cruz & Wattison, 1929; Corley & Afonso, 2021), Murcia (Calle et al. 2000),

Navarra (Sánchez Eguialde, 1982; Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Fernández Vidal, 1989), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979; Hiernaux et al. 2010; Fernández Vidal, 1989), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Soria, 1987), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2006; Segarra, 2018; Dantart & Jubany, 2005), Teruel (Zerny, 1927a; Zapater & Korb, 1892; Weiss, 1920; Kraus, 1999), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valladolid (Magro, 1995; Magro, 1989), Vizcaya (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Zapater & Korb, 1892; Redondo, 1977a).

Odontosia carmelita: Barcelona (Cuní i Martorell, 1874).

Peridea anceps: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Albacete (Tormo, 1993; Navarro-Gosálbez, 1995; Monreal et al. 1992; Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Passos de Carvalho & Corley, 1995; Nunes et al. 2024; Corley & Afonso, 2021), Alicante (Huemer & Wieser, 2006), Almería (Garre et al. 2020), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (Dantart et al. 1989; Dantart, 2021), Asturias (Soria, 1987; Ortiz et al. 2016b; Hurlé, 1980), Ávila (Magro & Jambrina, 2014; García-Santano et al. 2002), Baixo Alentejo (Corley, 2015a; Corley, 2004), Barcelona (Weiss, 1915; Vilarrubia, 1964; Stefanescu & Miralles, 1997; Rius, 1987; Masó et al. 1978; Flores, 1974; Dantart, 2021; Dantart, 2019; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2005; Cuní i Martorell, 1874; Bolland, 1985), Beira Alta (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Corley et al. 2018b; Corley & Afonso, 2021), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001), Cáceres (Yela, 1984; Novoa et al. 2002; Masó, 1991; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2013; Blázquez et al. 2011; Blázquez, 2008), Cádiz (Mateo Lozano, 2000; Gaona, 2020b; Gaona, 2020a), Cantabria (Oliver, 2010), Castellón (Huemer & Wieser, 2006; Calle, 1983; Aistleitner & Aistleitner, 1998), Ciudad Real (Hurtado et al. 2011; Aistleitner & Aistleitner, 1998), Córdoba (Fuentes et al. 1999), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; Aistleitner & Aistleitner, 1998), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Corley, 2015a), Estremadura (Nunes et al. 2024; Corley, 2015a), Gerona (Ylla, 1997; Stefanescu & Miralles, 1993; Pibernat et al. 2010b; Pibernat et al. 2010a; Pérez de Gregorio, 1990; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Kraus, 1999; Guzmán, 2013; Dantart, 2021; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2005; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Granada (Ribbe, 1908; Albaladejo et al. 2018), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación; Castro, 1975), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Toimil, 1989; Huertas-Dionisio, 1982), Huesca (Zapater & Korb, 1892; Ortiz et al. 2017; Maux, 2021; Abós Castel, 1995; Abós Castel, 1982b; Abós Castel, 1978; Abós Castel, 1994; Abós Castel, 1985a), Jaén (Notario & Castresana, 2002; Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001), León (Vega Escandón, 1980; Vega Escandón, 1974; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2018; Vallhonrat et al. 2005; Kraus, 1999; Garre et al. 2015b; Dantart et al. 2010; Dantart, 2021; Dantart, 2019; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2005; Ahola & Kohonen, 1985), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Toimil & Soria, 1983; Templado, 1990; Soria, 1987; Obama et al. 1988; Gómez de Aizpúrua, 1974b; Flores, 1945), Málaga (Moreno-Benítez, 2016c; Moreno-Benítez et al. 2020), Minho (Cruz & Wattison, 1931; Nunes et al. 2024; Cruz & Wattison, 1929; Corley & Afonso, 2021), Murcia (Guerrero et al. 2011; Calle et al. 2000), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Pino et al. 2005), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Soria, 1987), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2006; Vallhonrat et al. 2004; Segarra, 2018; Pérez de Gregorio, 2001; Pérez de Gregorio & Rondós, 2005b; Dantart, 2021; Dantart, 2019; Dantart & Miquel, 2000; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2005), Teruel (Zerny, 1927a; Zapater & Korb,

1892; Zapater & Korb, 1883; Weiss, 1920; Kraus, 1999; Koschwitz et al. 1985), Toledo (Soria, 1987; Notario et al. 2007), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valencia (Domínguez et al. 1989), Valladolid (Magro, 1989), Vizcaya (Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Zamora (Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Redondo, 1980).

Phalera bucephala: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Lencina et al. 2011; Albert & Lencina, 1984), Algarve (Passos & Corley, 1995; Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley & Afonso, 2021; Corley, 2015a; Corley et al. 2000), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (Dantart et al. 1989), Asturias (Vega Escandón, 1980; Ortiz et al. 2016b; Landeira, 1979; Hurlé, 1980; Hurlé, 1979), Ávila (Magro & Jambrina, 2014), Badajoz (Novoa et al. 2002), Baixo Alentejo (Marabuto, 2018; Corley, 2004; Corley & Afonso, 2021), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1974b; Vilarrubia, 1964; Rius, 1987; Requena, 1995; Masó et al. 1978; Flores, 1979; Flores, 1974; Dantart, 2017a; Dantart et al. 2018; Dantart, 2022; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Cuní i Martorell, 1874), Beira Alta (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902; Marabuto et al. 2013), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Cruz & Wattison, 1934; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001), Cáceres (Redondo et al. 2015; Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2009; Blázquez, 2012; Blázquez, 2008), Cádiz (Walker, 1890; Schwingenschuss, 1931; Mateo Lozano, 2000; Gaona, 2020b; Gaona, 2020a), Cantabria (Oliver, 2010; Gómez de Aizpúrua, 1974a), Castellón (Huemer & Wieser, 2010), Ciudad Real (Hurtado et al. 2011), Córdoba (Gomáriz, 2021; Fuentes et al. 1999), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; Aistleitner & Aistleitner, 1998), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Nunes, 2022; Cruz & Wattison, 1934; Corley & Afonso, 2021), Estremadura (Nunes et al. 2024), Gerona (Ylla, 1997; Stefanescu, 1995; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Kraus, 1999; Guzmán, 2013; Dantart, 2017b; Dantart, 2017a; Dantart, 2007; Dantart, 1990; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Granada (Ribbe, 1908; Rambour, 1858; Fuentes et al. 1999; Derra & Hacker, 1982; Albaladejo et al. 2018; Aistleitner & Aistleitner, 1998), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Huertas-Dionisio, 2019b; Huertas-Dionisio, 1982; Fuentes et al. 1999; Bernabé-Ruiz & Huertas-Dionisio, 2018), Huesca (Zapater & Korb, 1892; Parrack, 1982; Palanca, 1972; Ortiz et al. 2017; Maux, 2021; Abós Castel, 1995; Abós Castel, 1988), Jaén (Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Pino & Castro, 2013; Macho Velado, 1893; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001), León (Vega Escandón, 1980; Vega Escandón, 1974; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Societat Catalana de Lepidopterologia, 2005; Guzmán et al. 2021; Garre et al. 2015; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart & Vallhonrat, 2017; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2011; Dantart & Jubany, 2007), Lugo (Rubio et al. 2016; Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989; Eiroa Álvarez et al. 2011), Madrid (Flores, 1945; Expósito Hermosa, 1979), Málaga (Sánchez Florido & Moreno-Benítez, 2020; Pérez Ortigosa & Moreno-Benítez, 2023; Moreno-Benítez, 2018; Moreno-Benítez, 2015; Moreno-Benítez et al. 2020; Fuentes et al. 1999), Minho (Sousa, 1929; Cruz & Wattison, 1931; Nunes et al. 2024; Nunes, 2021a; Cruz & Wattison, 1934; Cruz & Wattison, 1929; Corley & Afonso, 2021), Murcia (Ortiz et al. 2007; Calle et al. 2000), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Cifuentes & San Martín, 1997; Abós Castel, 1986b), Orense (Fernández Vidal, 1989), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2009; Segarra, 2018; Pérez de Gregorio, 2001; Dantart, 2022; Dantart, 2017b; Dantart, 2017a; Dantart & Miquel, 2000), Teruel (Zerny, 1927a; Zapater & Korb, 1892; Zapater & Korb, 1883; Weiss, 1920; Redondo et al. 2015; Kraus, 1999; Koschwitz et al. 1985), Toledo (Notario et al. 2007), Trás-os-Montes (Marabuto & Maravalhas, 2008; Corley & Afonso, 2021), Valladolid (Magro & Jambrina, 2014), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Jambrina et al. 2003), Zaragoza (Redondo, 1980).

Phalera bucephaloides: Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Rius, 1987; Masó et al. 1978; Dantart, 2022; Dantart, 1990; Alonso de Medina & Olivella, 1987), Gerona (Romañà & Pérez de-Gregorio, 1981; Pérez de Gregorio, 1982; Pérez de Gregorio & Rondós, 2005a; Masó et al. 1981; Lafranchis et al. 2020; Kraus, 1999; Dantart, 1990; Cleve & Gerstberger, 1981; Bolland, 1976; Ahola & Kohonen, 1985), Huesca (Redondo et al. 2015; Redondo, 1991; Maux, 2021), Tarragona (Vallhonrat et al. 2006; Dantart, 1990), Valencia (Domínguez et al. 1989).

Pheosia gnoma: Andorra (De Laever, 1958; Dantart et al. 1989), Asturias (Landeira, 1980; Hurlé, 1979), Huesca (Redondo et al. 2015; Grustán & Redondo, 1998; Abós Castel, 1990), León (Manceñido-González & González-Estébanez, 2015), Lérida (Garre et al. 2015b; Derra & Hacker, 1982), Lugo (López Vaamonde et al. 1995).

Pheosia tremula: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Andorra (Dantart et al. 1989), Asturias (Vega Escandón, 1974; Hurlé, 1980), Barcelona (Vilarrubia, 1964; Stefanescu et al. 1993; Societat Catalana de Lepidopterologia, 1993b; Rius, 1987; Masó et al. 1978; Flores, 1974; Dantart et al. 2018; Dantart, 2022; Dantart, 2021; Dantart, 2014b; Dantart & Jubany, 2013; Dantart & Jubany, 2009; Dantart & Jubany, 2005; Cuní i Martorell, 1874), Burgos (Méndez Garnica, 2001), Cantabria (Oliver, 2010), Douro Litoral (Nunes & Gil, 2023; Corley et al. 2023; Corley et al. 2022), Gerona (Ylla, 1997; Weiss, 1915; Ribera & Dantart, 2017; Pérez de Gregorio, 1982; Pérez de Gregorio, 1978a; Pérez de Gregorio & Rondós, 2005a; Lafranchis et al. 2020; Kraus, 1999; Guzmán, 2013; Dantart, 2021; Dantart, 2020; Dantart, 2018; Dantart, 1990; Dantart & Jubany, 2013; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Cervelló et al. 2017), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Schmidt-Koehl, 1977; Parrack, 1982; Palanca, 1972; Ortiz et al. 2017; Maux, 2021; Abós Castel, 1982b; Abós Castel, 1980b), La Coruña (Fernández Vidal, 2011), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018), León (Waring & Thomas, 1990; Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Ortiz et al. 2010; Guzmán et al. 2021; Guzmán, 2018; Guzmán, 2007; Guzmán, 2003; Derra & Hacker, 1982; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2022; Dantart, 2015b; Dantart, 2014b; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016), Minho (Nunes et al. 2024), Navarra (Sánchez Eguialde, 1982; Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Palencia (Magro & Jambrina, 2014), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2007; Segarra, 2018; Dantart, 2017b), Trás-os-Montes (Monteiro & Maravalhas, 1987; Corley & Afonso, 2021; Beja et al. 2018), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Saz Fucho, 1985), Zaragoza (Zapater & Korb, 1892; Redondo et al. 2015; Redondo, 1990).

Pterostoma palpina: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a; de Juana et al. 2019), Albacete (Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley, 2005), Alicante (Tormo & Muñoz, 1995), Almería (Garre et al. 2020), Alto Alentejo (Corley, 2015a; Corley & Afonso, 2021), Andorra (Dantart et al. 1989; Dantart & Jubany, 2012), Asturias (Ortiz et al. 2016b; Landeira, 1979; Hurlé, 1980; Hurlé, 1979; Aistleitner & Aistleitner, 1998), Ávila (Magro & Jambrina, 2014; Blázquez, 2008), Badajoz (Novoa et al. 2002), Baixo Alentejo (Marabuto, 2018; Corley, 2004; Corley & Afonso, 2021), Barcelona (Vilarrubia, 1974b; Vilarrubia, 1964; Stefanescu & Miralles, 1997; Rius, 1987; Pérez de Gregorio et al. 2015; Masó et al. 1978; Flores, 1979; Flores, 1974; Dantart et al. 2018; Dantart, 2022; Dantart, 2021; Dantart, 2017a; Dantart & Jubany, 2013; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Cuní i Martorell, 1897; Cuní i Martorell, 1874), Beira Alta (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902; Corley & Afonso, 2021), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001), Cáceres (Novoa et al. 2002; Hernández et al. 1999; García-Santano et al. 2002; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2009; Blázquez et al. 2000; Blázquez et al. 1997), Cantabria (Oliver, 2010), Castellón (Huemer & Wieser, 2006; Calle, 1983), Ciudad Real (Hurtado et al. 2011), Cuenca (Ortiz et al. 2009; Lencina et al. 2022), Douro Litoral (Nunes et al. 2024; Nunes, 2021b; Nunes & Gil, 2023; Monteiro, 1964; Cruz,

1971; Cruz & Wattison, 1934; Corley & Afonso, 2021), Estremadura (Vieilledent, 1905; Passos de Carvalho, 1980; Cruz & Wattison, 1934; Carneiro-Mendes, 1951), Gerona (Ylla, 1997; Stefanescu, 1995; Stefanescu & Miralles, 1993; Ribera & Dantart, 2017; Pibernat et al. 2010a; Pérez de-Gregorio & Dantart, 1990; Pérez de Gregorio, 1990; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a; Masó et al. 1992; Masó & Vallhonrat, 1989; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart, 1990; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Granada (Fuentes et al. 1999; Albaladejo et al. 2018; Agenjo, 1977), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación; Castro, 1975), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huelva (Bernabé-Ruiz & Huertas-Dionisio, 2018), Huesca (Zapater & Korb, 1892; Parrack, 1982; Ortiz et al. 2017; Maux, 2021; Gómez de Aizpúrua, 1974a; Fasnidge, 1934; Abós Castel, 1995; Abós Castel, 1990; Abós Castel, 1980b; Abós Castel, 1978), Jaén (Gómez Bustillo, 1980; Fuentes et al. 1999), La Coruña (Pino & Castro, 2013; Hiernaux et al. 2010; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001; Agenjo, 1977), León (Waring & Thomas, 1990; Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2005; Ortiz et al. 2010; Kraus, 1999; Hoegh-Guldberg, 1986; Guzmán, 2018; Guzmán, 2007; Guzmán, 2003; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2022; Dantart, 2019; Dantart, 2017a; Dantart, 2015b; Dantart & Vallhonrat, 2017; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Ahola & Kohonen, 1985), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Fernández Vidal, 1989), Madrid (Gómez de Aizpúrua, 1974b; García-Barros et al. 1993; Flores, 1945; Expósito Hermosa, 1979), Málaga (Rambour, 1858), Minho (Cruz & Wattison, 1931; Cruz & Wattison, 1929; Nunes et al. 2024; Cruz, 1935; Cruz & Wattison, 1934; Corley & Afonso, 2021), Murcia (Calle et al. 2000), Navarra (Sánchez Eguialde, 1984; Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Fernández Vidal, 1989), Palencia (Aistleitner & Aistleitner, 1998), Pontevedra (Templado & Outerelo, 1979; Hiernaux et al. 2010; Fernández Vidal, 1989), Ribatejo (Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina, 2014), Segovia (Vázquez Figueroa, 1894), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2006; Segarra, 2018; Pérez de Gregorio, 2001; Dantart, 2017b; Dantart & Miquel, 2000), Teruel (Zerny, 1927a; Zapater & Korb, 1883; Weiss, 1920; Kraus, 1999; Koschwitz et al. 1985; Hull, 1982), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valladolid (Magro, 1995; Magro, 1989), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zamora (Vallhonrat, 1997; Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Zapater & Korb, 1892; Redondo, 1977a).

Ptilodon capucina: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Andorra (Dantart et al. 1989), Asturias (Ortiz et al. 2016b), Barcelona (Vilarrubia, 1964; Dantart, 2022; Dantart & Jubany, 2009), Burgos (Méndez Garnica, 2001), Cantabria (Oliver, 2010), Gerona (Stefanescu, 1995; Masó et al. 1981; Gavaldà et al. 1984; Flores, 1979; Dantart, 2022; Dantart & Jubany, 2007; Cervelló et al. 2017; Abós et al. 2012b), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Redondo, 1980; Parrack, 1982; Ortiz et al. 2017; Grustán & Redondo, 1992), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001), León (González & Manceñido, 2012), Lérida (Garre et al. 2019; Dantart et al. 2010; Dantart et al. 2003; Dantart & Vallhonrat, 2013; Dantart & Vallhonrat, 2001; Dantart & Jubany, 2007), Lugo (Fernández Vidal, 2016), Minho (Corley et al. 2020; Corley et al. 2014), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Pino et al. 2005), Palencia (Magro & Jambrina, 2014), Pontevedra (Pino et al. 2005), Vizcaya (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Zaragoza (Redondo, 1990).

Ptilodon cucullina: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1964; Romañà & Pérez de-Gregorio, 1981; Dantart, 2022; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2011), Burgos (de Juana et al. 2023a), Cantabria (Oliver, 2010), Gerona (Stefanescu, 1995; Pibernat et al. 2010a; Pibernat et al. 2009; Masó & Pérez de-Gregorio, 1980; Lafranchis et al. 2020; Guzmán, 2013; Dantart, 2017a; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Huesca (Redondo, 1980; Ortiz et al. 2017), La Rioja (Rodríguez Saldaña, 2019), Lérida (Vallhonrat et al. 2018; Masó

& Pérez de-Gregorio, 1980; Dantart et al. 2010; Dantart et al. 2003; Dantart & Vallhonrat, 2013; Dantart & Vallhonrat, 2001; Dantart & Jubany, 2012), Navarra (Antón & Miguel, 2017), Tarragona (Segarra, 2018; Dantart & Miquel, 2005), Vizcaya (de Juana et al. 2023a), Zaragoza (Murria, 2012).

Ptilophora plumigera: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; de Juana et al. 2023a), Barcelona (Ylla, 1980b; Ylla, 1980a; Turet et al. 1985; Turet & Ylla, 1982; Romañà, 1983; Pérez De-Gregorio, 2000), Burgos (de Juana et al. 2023a), Cuenca (Guerrero et al. 2014), Gerona (Societat Catalana de Lepidopterologia, 1993a; Pérez De-Gregorio, 2000; Muñoz-Batet et al. 2011; Cervelló et al. 2017; Cervelló et al. 1992; Bellavista & Bellavista, 1984), Huesca (Redondo, 1990), Lérida (Vallhonrat et al. 2005; Pérez De-Gregorio, 2000), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997), Tarragona (Escolà, 1986).

Rhegmatophila alpina: Álava (de Juana et al. 2023b; De Juana & Macià, 2023b), Andorra (De Juana & Macià, 2023b), Ávila (De Juana & Macià, 2023b), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1964; De Juana & Macià, 2023b; Dantart, 2021; Dantart, 2019; Dantart & Jubany, 2009; Dantart & Jubany, 2007), Burgos (Méndez Garnica, 2001; Fernández, 1933; De Juana & Macià, 2023b), Cáceres (Blázquez et al. 2020), Cantabria (Oliver, 2010; De Juana & Macià, 2023b), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; De Juana & Macià, 2023b), Gerona (Ribera & Dantart, 2017; Pérez de-Gregorio, 1978b; Masó & Pérez de-Gregorio, 1980; Guzmán, 2013; Flores, 1979; De Juana & Macià, 2023b; Dantart, 2017a; Dantart, 2015b; Dantart & Jubany, 2012; Cervelló et al. 2017; Cervelló et al. 2016; Abós et al. 2012a), Guadalajara (Lencina et al. 2022; De Juana & Macià, 2023b; De Arce et al. en preparación), Huesca (Redondo et al. 2015; Redondo, 1980; Ortiz et al. 2017; Maux, 2021; Kraus, 1999; De Juana & Macià, 2023b; Abós Castel, 1995; Abós Castel, 1982a), La Rioja (Rodríguez Saldaña, 2023; Rodríguez Saldaña, 2018; De Juana & Macià, 2023b), León (Vega Escandón, 1980; Moya, 2018; Manceñido et al. 2009; González-Estébanez & Manceñido-González, 2012; De Juana & Macià, 2023b; Agenjo, 1951b), Lérida (Vallhonrat et al. 2004; Perez de Gregorio, 1978b; Kraus, 1999; Hoegh-Guldberg, 1986; Guzmán et al. 2021; Garre et al. 2015b; Derra & Hacker, 1982; De Juana & Macià, 2023b; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart & Vallhonrat, 2013; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Ahola & Kohonen, 1985), Lugo (Fernández Vidal, 2016), Madrid (Expósito Hermosa, 1979; De Juana & Macià, 2023b), Navarra (Gómez de Aizpúrua, 1974a; De Juana & Macià, 2023b; Cifuentes, 1997; Abós Castel, 1986b), Orense (De Juana & Macià, 2023b), Palencia (Jubete, 2015; De Juana & Macià, 2023b), Segovia (De Juana & Macià, 2023b), Soria (Sánchez Eguialde, 2001; De Juana & Macià, 2023b), Teruel (Zerny, 1927a; Weiss, 1920; Kraus, 1999; Koschwitz et al. 1985; De Juana & Macià, 2023b), Trás-os-Montes (De Juana & Macià, 2023b; Corley et al. 2015), Valladolid (De Juana & Macià, 2023b), Zamora (Saz Fucho, 1985; Jambrina et al. 2003; De Juana & Macià, 2023b), Zaragoza (De Juana & Macià, 2023b).

Spatalia argentina: Álava (de Juana et al. 2023b; de Juana et al. 2021; De Juana & Macià, 2023a), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1974b; Vilarrubia, 1964; Romañà & Pérez de-Gregorio, 1981; Rius, 1987; Flores, 1974; Fernández, 2017; De Juana & Macià, 2023a; Dantart, 2021; Dantart, 2019; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Dantart & Jubany, 2005; Cuní i Martorell, 1874; Bolland, 1985), Castellón (De Juana & Macià, 2023a), Gerona (Romañà & Pérez de-Gregorio, 1981; Pibernat et al. 2010a; Pérez De Gregorio & Dantart, 1990; Masó et al. 1981; Kraus, 1999; Flores, 1979; De Juana & Macià, 2023a; Dantart, 2019; Dantart, 2007; Dantart, 1990; Cervelló et al. 2017; Bolland, 1987; Ahola & Kohonen, 1985; Abós et al. 2012a), Guadalajara (Lencina et al. 2022; García-Barros, 1981; De Juana & Macià, 2023a), Huesca (Redondo et al. 2015; Maux, 2021; De Juana & Macià, 2023a; Abós Castel, 1988; Abós Castel, 1980a), La Rioja (Rodríguez Saldaña, 2023), León (Manceñido-González & González-Estébanez, 2017), Lérida (Vallhonrat et al. 2018; Societat Catalana de Lepidopterologia, 2005; Prins, 1983; Ortiz et al. 2010; Kraus, 1999; Hull, 1982; Guzmán et al. 2021; Guzmán, 2018; González & Vila, 1989; De Juana & Macià, 2023a; Dantart, 2021; Dantart, 2019; Dantart, 2015b; Dantart & Vallhonrat, 2001; Dantart & Jubany, 2012; Dantart & Jubany, 2011; Dantart & Jubany, 2007; Dantart & Jubany, 2005; Ahola & Kohonen, 1985), Madrid (Expósito Hermosa, 2002), Navarra (De Juana & Macià, 2023a; Cifuentes, 1997; Abós Castel, 1986b), Segovia (De Juana & Macià, 2023a), Soria (De Juana & Macià, 2023a), Tarragona (Vallhonrat et al. 2004; Segarra, 2018; Pérez de Gregorio & Rondós,

2005b; De Juana & Macià, 2023a; Dantart, 2022; Dantart, 2019; Dantart, 2017b; Dantart & Miquel, 2000; Dantart & Jubany, 2012), Teruel (Redondo, 1980; De Juana & Macià, 2023a), Trás-os-Montes (De Juana & Macià, 2023a; Corley et al. 2011; Corley et al. 2006), Zaragoza (De Juana & Macià, 2023a).

Stauropus fagi: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Algarve (Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley et al. 2021), Andorra (Dantart et al. 1989), Asturias (Ortiz et al. 2016b; Landeira, 1979; Hurlé, 1980), Baixo Alentejo (Corley et al. 2020), Barcelona (Ylla & Macià, 2007; Vilarrubia, 1964; Stefanescu et al. 1993; Stefanescu & Miralles, 1997; Societat Catalana de Lepidopterologia, 1993b; Masó et al. 1978; Flores, 1979; Flores, 1974; Dantart, 2022; Dantart, 2021; Dantart, 2019; Dantart, 2018; Dantart, 2017b; Dantart, 2017a; Dantart & Jubany, 2012; Dantart & Jubany, 2009; Dantart & Jubany, 2007; Cuní i Martorell, 1874), Beira Alta (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Corley & Afonso, 2021), Burgos (Méndez Garnica, 2001), Cantabria (Oliver, 2010), Douro Litoral (Nunes & Gil, 2023; Cruz, 1971; Cruz & Wattison, 1934; Corley et al. 2019), Estremadura (Passos de Carvalho, 1980; Nunes et al. 2024; Corley, 2015a; Corley & Afonso, 2021; Carneiro-Mendes, 1951), Gerona (Ylla, 1997; Stefanescu, 1995; Pibernat et al. 2010b; Pibernat et al. 2009; Pérez de Gregorio, 1982; Pérez de Gregorio, 1977b; Pérez de Gregorio & Rondós, 2005a; Kraus, 1999; Guzmán, 2013; Flores, 1979; Dantart, 2021; Dantart, 2017b; Dantart, 2017a; Dantart, 2015b; Dantart, 2014b; Dantart, 1990; Dantart & Jubany, 2013; Dantart & Jubany, 2012; Cervelló et al. 2017; Ahola & Kohonen, 1985; Abós et al. 2012b; Abós et al. 2012a), Guadalajara (Lencina et al. 2022), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a), Huesca (Ortiz et al. 2017; Maux, 2021; Gómez de Aizpúrua, 1974a; Abós Castel, 1995), La Coruña (Pino & Castro, 2013; Fernández Vidal, 2011; Fernández Vidal, 1989), La Rioja (Latasa et al. 2001), León (Moya, 2018; González & Manceñido, 2012), Lérida (Vallhonrat et al. 2018; Vallhonrat et al. 2005; Societat Catalana de Lepidopterologia, 2005; Garre et al. 2015b; Dantart et al. 2010; Dantart, 2021; Dantart, 2019; Dantart, 2015b; Dantart, 2015a; Dantart & Vallhonrat, 2013; Dantart & Vallhonrat, 2001; Dantart & Jubany, 2012; Dantart & Jubany, 2007), Lugo (Rubio et al. 2016; Pino & Castro, 2013; Ortiz et al. 2016a; Fernández Vidal, 2016; Fernández Vidal, 1989), Minho (Nunes et al. 2024; Cruz & Wattison, 1929; Corley & Afonso, 2021), Navarra (Gómez de Aizpúrua, 1974a; Cifuentes, 1997; Abós Castel, 1986b), Orense (Torres Vila, 1983), Palencia (Magro & Jambrina, 2014), Pontevedra (Templado & Outerelo, 1979), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2004; Segarra, 2018; Pérez de Gregorio, 2001; Pérez de Gregorio & Rondós, 2005b; Dantart, 2021; Dantart, 2019; Dantart & Jubany, 2009), Trás-os-Montes (Corley et al. 2018a; Corley & Afonso, 2021), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Zaragoza (Redondo, 1990).

Thaumetopoea herculeana: Algarve (Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley et al. 2000; Corley & Afonso, 2021), Almería (Kraus, 1997; Hacker & Wolf, 1982; Garre et al. 2018), Alto Alentejo (Cruz & Wattison, 1934; Corley, 2015a; Corley & Afonso, 2021), Ávila (Magro & Jambrina, 2014), Badajoz (Novoa et al. 2002), Beira Alta (Cruz & Wattison, 1934; Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021), Beira Baixa (Marabuto et al. 2013), Beira Litoral (Nunes et al. 2024; Corley, 2015a; Corley & Afonso, 2021), Burgos (Agenjo, 1941), Cáceres (Redondo et al. 2015; Orellana & de Castro, 1996; Novoa et al. 2002; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2013; Blázquez et al. 2011; Blázquez et al. 2009; Blázquez et al. 2000; Blázquez et al. 1997; Blázquez, 2014; Blázquez, 2012; Blázquez, 2008), Cádiz (Schwingenschuss, 1931; Ribbe, 1908; Rambour, 1858; Hacker & Wolf, 1982; Gaona, 2020a; Agenjo, 1941), Cantabria (Oliver, 2010), Córdoba (Gomáriz, 2021; Fuentes et al. 2000; Dobado, 2019), Cuenca (Redondo, 1990; Fernández, 1920), Douro Litoral (Nunes, 2021a; Nunes & Gil, 2023; Monteiro, 1957; Cruz & Wattison, 1934; Corley & Afonso, 2021; Agenjo, 1941), Estremadura (Vieilledent, 1905; Cruz & Wattison, 1934; Carneiro-Mendes, 1951), Huelva (Huertas-Dionisio, 1982; Hacker & Wolf, 1982; Fuentes et al. 2000), Jaén (Gómez Bustillo, 1980; Fuentes et al. 2000), La Coruña (Hiernaux et al. 2010), León (Vega Escandón, 1980; Manceñido et al. 2009), Madrid (Martín & Izquierdo, 2006; Kraus, 1999; Gómez de Aizpúrua et al. 2003; Gómez de Aizpúrua, 1974b; Flores, 1945; Expósito Hermosa, 1979; Castro, 1976; Agenjo, 1941), Málaga (Moreno-Benítez et al. 2020), Minho (Agenjo, 1941), Murcia (Ortiz et al. 2007; Garre, 2007; Calle et al. 2000), Orense (Fernández Vidal & Bergantiños, 2012), Palencia (Magro & Jambrina, 2014), Pontevedra (Rodríguez de Rivera Ortega, 2012; Mendes, 1914), Ribatejo (Nunes et al. 2024; Cruz, 1967; Corley, 2015a), Salamanca (Magro & Jambrina,

2014), Segovia (Vázquez Figueroa, 1894), Sevilla (Palma et al. 1995), Soria (Magro & Jambrina, 2014), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley, 2015a; Corley & Afonso, 2021; Beja et al. 2018), Valladolid (Vázquez Figueroa, 1900; Magro, 1989; Agenjo, 1941), Zamora (Redondo et al. 2015; Jambrina et al. 2003).

Thaumetopoea pinivora: Albacete (Lencina et al. 2011; Hódar et al. 2016; Guerrero et al. 2020b), Ávila (Agenjo, 1941), Cáceres (Blázquez et al. 2019; Blázquez et al. 2016), Cuenca (Pérez de Gregorio et al. 2001; Ortiz et al. 2012; Lencina et al. 2022; De Arce et al. en preparación; Agenjo, 1941), Gerona (Pérez de Gregorio & Rondós, 2011; Pérez de Gregorio & Redondo, 1994; Dantart, 2017b), Granada (Hódar et al. 2016; Albaladejo et al. 2018), Lérida (Dantart, 2017b; Dantart & Vallhonrat, 2013), Madrid (Montoya & Robredo, 1972; Cassel-Lundhagen et al. 2013; Agenjo, 1958; Agenjo, 1941), Segovia (Agenjo, 1941), Soria (Redondo, 1977b), Teruel (Redondo et al. 2015; Redondo, 1990; Pérez de Gregorio & Redondo, 1994; Gómez-Bustillo, 1979; Frérot & Demolin, 1993; Cassel-Lundhagen et al. 2013), Valencia (López-Sebastián et al. 2002).

Thaumetopoea pityocampa: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; De Juana et al. 2023a; de Juana et al. 2019), Albacete (Tormo, 1993; Lencina et al. 2011; Guerrero et al. 2011; Guerrero, 2021; Albert & Lencina, 1984; Aistleitner & Aistleitner, 1998), Algarve (Nunes et al. 2024; Monteiro & Passos de Carvalho, 1984; Corley & Afonso, 2021), Alicante (Tormo, 1998; Tormo, 1985; Huemer & Wieser, 2010; Hacker & Wolf, 1982; Aistleitner & Aistleitner, 1998; Agenjo, 1941), Almería (Hacker & Wolf, 1982; Garre et al. 2020; Fuentes et al. 2000; Agenjo, 1941), Alto Alentejo (Nunes et al. 2024; Corley & Afonso, 2021), Andorra (Dantart et al. 1989; Dantart, 2022; Dantart, 2019; Dantart & Jubany, 2013), Asturias (Landeira, 1979; Hurlé, 1980; Fernández, 1920; Aistleitner & Aistleitner, 1998), Ávila (Agenjo, 1941), Badajoz (Novoa et al. 2002), Baixo Alentejo (Marabuto, 2018; Corley, 2004; Corley & Afonso, 2021), Barcelona (Weiss, 1915; Ventalló, 1905; Turet et al. 1985; Stefanescu & Miralles, 1997; Rius, 1987; Flores, 1974; Fernández, 2017; Dantart et al. 2018; Dantart, 2022; Dantart, 2017b; Dantart, 2017a; Dantart, 2014b; Dantart & Jubany, 2013; Cuní i Martorell, 1897; Cuní i Martorell, 1874; Codina, 1914; Agenjo, 1941), Beira Alta (Marabuto et al. 2004; Cruz & Wattison, 1934; Cruz & Gonçalves, 1974; Corley & Afonso, 2021), Beira Baixa (Mendes, 1902; Marabuto et al. 2013; Marabuto et al. 2004; Corley & Afonso, 2021), Beira Litoral (Pires & Corley, 2007; Nunes et al. 2024; Cruz & Wattison, 1934; Corley & Afonso, 2021), Burgos (Méndez Garnica, 1979; Agenjo, 1941), Cáceres (Orellana & de Castro, 1996; Novoa et al. 2002; Hernández et al. 1999; Callejo, 1977; Blázquez et al. 2023; Blázquez et al. 2021; Blázquez et al. 2020; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 2000; Blázquez et al. 1997; Blázquez, 2014), Cádiz (Gaona, 2020b; Fuentes et al. 2000; Agenjo, 1941), Cantabria (Oliver, 2010; Agenjo, 1941), Castellón (Huemer & Wieser, 2010; Calle, 1983; Calle, 1977; Agenjo, 1977; Agenjo, 1964; Agenjo, 1941), Ciudad Real (Hurtado et al. 2011), Córdoba (Gomáriz, 2021; Fuentes et al. 2000; Dobado, 2019), Cuenca (Ortiz et al. 2012; Lencina et al. 2022; Fernández, 1920; De Arce et al. en preparación; Aistleitner & Aistleitner, 1998; Agenjo, 1941), Douro Litoral (Cruz, 1971; Nunes et al. 2024; Nunes, 2022; Nunes, 2021b; Nunes & Gil, 2023; Monteiro, 1964; Cruz & Wattison, 1934; Cruz & Gonçalves, 1974; Corley & Afonso, 2021), Estremadura (Vieilledent, 1905; Passos de Carvalho, 1980; Nunes et al. 2024; Cruz & Wattison, 1934; Corley & Afonso, 2021; Carneiro-Mendes, 1951), Gerona (Ylla, 1997; Stefanescu & Miralles, 1993; Ribera & Dantart, 2017; Pibernat et al. 2010a; Pérez de Gregorio & Redondo, 1994; Lafranchis et al. 2020; Dantart, 2022; Dantart, 2017b; Dantart, 2017a; Dantart, 2014b; Dantart, 1990; Dantart & Jubany, 2013; Cuní i Martorell, 1885; Cervelló et al. 2017; Agenjo, 1941; Abós et al. 2012b), Granada (Schwingenschuss, 1931; Schmidt-Koehl, 1968; Reisser, 1928; Fuentes et al. 2000; Aistleitner & Aistleitner, 1998), Guadalajara (Lencina et al. 2022; De Arce et al. en preparación), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; De Juana et al. 2023a; Agenjo, 1941), Huelva (Huertas-Dionisio, 2019b; Huertas-Dionisio, 1978; Hacker & Wolf, 1982; Fuentes et al. 2000; Bernabé-Ruiz & Huertas-Dionisio, 2018; Aistleitner & Aistleitner, 1998), Huesca (Zapater & Korb, 1892; Weiss, 1920; Parrack, 1982; Palanca, 1987; Palanca, 1972; Palanca & Galante, 1977; Ortiz et al. 2017; Maux, 2021; Hacker & Wolf, 1982; Fassnidge, 1934; Agenjo, 1941; Abós Castel, 2013; Abós Castel, 1995; Abós Castel, 1988; Abós Castel, 1986a; Abós Castel, 1985b; Abós Castel, 1983; Abós Castel, 1978), Jaén (Hacker & Wolf, 1982; Gómez Bustillo, 1980; Fuentes et al. 2000; Aistleitner & Aistleitner, 1998), La Coruña (Pino & Castro, 2013; Hiernaux et al. 2010; Fernández Vidal, 2011; Agenjo, 1941), La Rioja (De Juana et al. 2023a; Cifuentes, 1989), León (Vega Escandón, 1974; Manceñido et al. 2009), Lérida (Vallhonrat et al. 2005; Societat Catalana de Lepidopterologia, 2005; Prins, 1983; Kraus, 1999; Guzmán et

al. 2021; Guzmán, 2018; Guzmán, 2003; Garre et al. 2011; Garre, 2008; Dantart et al. 2010; Dantart et al. 2003; Dantart, 2022; Dantart, 2017b; Dantart, 2017a; Dantart, 2014b; Dantart & Vallhonrat, 2017; Dantart & Vallhonrat, 2013; Dantart & Vallhonrat, 2001; Dantart & Jubany, 2013; Agenjo, 1941), Lugo (Pino & Castro, 2013; Fernández Vidal, 2016; Agenjo, 1941), Madrid (Vázquez Figueroa, 1894; Martín & Izquierdo, 2006; Gómez de Aizpúrua et al. 2005; Gómez de Aizpúrua, 1974b; Flores, 1945; Expósito Hermosa, 1979; Castro, 1976; Agenjo, 1977; Agenjo, 1941), Málaga (Sánchez Florido & Moreno-Benítez, 2020; Moreno-Benítez et al. 2016; Moreno-Benítez, 2015; Moreno-Benítez & Gallego-Domínguez, 2016; Moreno-Benítez et al. 2020; Fuentes et al. 2000; Agenjo, 1941), Minho (Nunes et al. 2024; Cruz, 1935; Cruz & Wattison, 1934; Corley & Afonso, 2021), Murcia (Lencina et al. 2011; Kheil, 1910; Guerrero et al. 2011; Garre, 2007; Calle et al. 2000; Aistleitner & Aistleitner, 1998; Agenjo, 1941), Navarra (Sánchez Eguialde, 1982; Gómez de Aizpúrua, 1974a; Abós Castel, 1986b), Palencia (Jubete, 2015), Pontevedra (Mendes, 1914; Agenjo, 1941), Ribatejo (Nunes et al. 2024; Cruz, 1967), Salamanca (Agenjo, 1941), Segovia (Vázquez Figueroa, 1894; Agenjo, 1941), Sevilla (Palma et al. 1995; Fuentes et al. 2000), Soria (Sánchez Eguialde, 2001), Tarragona (Vallhonrat et al. 2004; Segarra, 2018; Pérez de Gregorio, 2001; Orozco & Orozco, 1986; Dantart, 2022; Dantart, 2017b; Dantart & Jubany, 2013; Agenjo, 1941), Teruel (Zerny, 1927a; Zapater & Korb, 1883; Weiss, 1920; Redondo, 1990; Kraus, 1999; Koschwitz et al. 1985; Aistleitner & Aistleitner, 1998; Agenjo, 1941), Toledo (Notario et al. 2007; De Arce et al. en preparación), Trás-os-Montes (Cruz & Gonçalves, 1974; Corley & Afonso, 2021; Beja et al. 2018), Valencia (López Sebastián, 2014; Huemer & Wieser, 2010; Domínguez et al. 1989; Agenjo, 1941), Valladolid (Vázquez Figueroa, 1900; Magro, 1989; Agenjo, 1977; Agenjo, 1941), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; De Juana et al. 2023a; Agenjo, 1941), Zamora (Saz Fucho, 1985; Jambrina et al. 2003), Zaragoza (Zapater & Korb, 1892; Redondo et al. 2001; Redondo, 1977c; Redondo, 1977a).

Thaumetopoea processionea: Álava (Olano et al. 1986; Gómez de Aizpúrua, 1988; de Juana et al. 2023a; de Juana et al. 2019), Alto Alentejo (Corley & Afonso, 2021), Asturias (Fernández, 1920; Agenjo, 1941), Barcelona (Ylla & Macià, 2007; Turet et al. 1985; Stefanescu & Miralles, 1997; Orozco & Orozco, 1989; Flores, 1974; Dantart & Jubany, 2013; Cuní i Martorell, 1897; Cuní i Martorell, 1874; Agenjo, 1941), Beira Baixa (Mendes, 1902), Beira Litoral (Corley et al. 2019), Burgos (Méndez Garnica, 1979), Cáceres (Novoa et al. 2002; Blázquez et al. 2019; Blázquez et al. 2016; Blázquez et al. 1997), Cantabria (Oliver, 2010; Agenjo, 1941), Córdoba (Fuentes et al. 2000), Cuenca (Garre et al. 2015a; Fernández, 1920), Estremadura (Vieilledent, 1905; Cruz & Wattison, 1934; Carneiro-Mendes, 1951), Gerona (Pibernat et al. 2010a; Pérez De-Gregorio, 2000; Lafranchis et al. 2020; Kraus, 1999; Guzmán, 2013; Dantart, 2014b; Dantart, 1990; Dantart & Jubany, 2013; Cuní i Martorell, 1885; Cervelló et al. 2017; Agenjo, 1941; Abós et al. 2012b; Abós et al. 2012a), Guipúzcoa (Gómez de Aizpúrua, 1988; Gómez de Aizpúrua, 1974a; Agenjo, 1941), Huesca (Redondo et al. 2015; Parrack, 1982; Palanca, 1987; Gómez de Aizpúrua, 1974a; Abós Castel, 1980b), La Rioja (Rodríguez Saldaña, 2023), León (Manceñido et al. 2009), Lérida (Vallhonrat et al. 2005; Vallhonrat et al. 2004; Dantart, 2014b), Navarra (Gómez de Aizpúrua, 1974a), Salamanca (Soria, 1987), Segovia (Vázquez Figueroa, 1894; Fernández, 1920), Tarragona (Dantart, 2017b; Dantart & Miquel, 2000), Teruel (Redondo et al. 2015; Grustán & Redondo, 1998), Toledo (Soria, 1987; Notario et al. 2007), Vizcaya (Seebold, 1879; Gómez de Aizpúrua, 1988; de Juana et al. 2023a), Zaragoza (Zapater & Korb, 1892).

COMITÉ PARA LA PROTECCIÓN DE LA NATURALEZA, PROYECTO DE INVESTIGACIÓN CIENTÍFICA DE SHILAP / *COMMITTEE FOR THEPROTECTION 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 applyin for the permits.

2.– To send an electronic mail the General Secretary o SHILAP, with all the personal data, including name, sur-name, 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 Lepidopterain 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 Macaronesianregion"*.

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 (1X1)or GPS coordinates, province, dates of capture, collector and numbers ofmales and females captured **(only 5 specimens per taxonand 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 Collectionof 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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New data on Gracillariidae from the Canary Islands, Spain. Part 1. Gracillariinae, Oecophyllembiinae (Insecta: Lepidoptera)

Per Falck

Abstract

Two new species are described from the Canary Islands, Spain, *Caloptilia coriarella* Falck sp. nov. from La Palma and Madeira, Portugal and *Metriochroa carreteriaella* Falck sp. nov. from Gran Canaria. *Aspilapteryx anagensis* Klimesch, 1979, reinst. stat. is removed from synonymy of *Aspilapteryx multipunctella* (Chrétien, 1917) and reinstated as a distinct species. *Aspilapteryx multipunctella* (Chrétien, 1917) and *Dextellia dorsilineella* (Amsel, 1935) are recorded as new to the Canary Islands. *Caloptilia perseae* (Busck, 1920) is removed from the list of Canary Islands Lepidoptera due to misidentification, *Dialectica imperialella* (Zeller, 1847) and *Leucospilapteryx omissella* (Stainton, 1848) are removed from the same list because of the unconfirmed and probably erroneous records. Photographs of the adults of the new species are provided. Photographs of the genitalia of the discussed species are provided, or references are given to literature where they are figured. All the new species are barcoded.
Keywords: Insecta, Lepidoptera, Gracillariidae, Gracillariinae, Oecophyllembiinae, new species, new records, Canary Islands, Spain.

Nuevos datos sobre Gracillariidae de las Islas Canarias, España. Parte 1. Gracillariinae, Oecophyllembiinae (Insecta: Lepidoptera)

Resumen

Se describen dos nuevas especies de las Islas Canarias, España, *Caloptilia coriarella* Falck sp. nov. de La Palma y Madeira, Portugal, y *Metriochroa carreteriaella* Falck sp. nov. de Gran Canaria. *Aspilapteryx anagensis* Klimesch, 1979, reinst. stat. se retira de la sinonimia de *Aspilapteryx multipunctella* (Chrétien, 1917) y se reinstala como especie distinta. *Aspilapteryx multipunctella* (Chrétien, 1917) y *Dextellia dorsilineella* (Amsel, 1935) se registran como nuevas para las Islas Canarias. *Caloptilia perseae* (Busck, 1920) se elimina de la lista de los Lepidoptera canarios debido a una identificación errónea, *Dialectica imperialella* (Zeller, 1847) y *Leucospilapteryx omissella* (Stainton, 1848) se eliminan de la misma lista debido a los registros no confirmados y probablemente erróneos. Se muestran fotografías de los adultos de las nuevas especies. Se proporcionan fotografías de la genitalia de las especies tratadas se dan referencias a la literatura donde están figuradas. Todas las nuevas especies tienen código de barras.
Palabras clave: Insecta, Lepidoptera, Gracillariidae, Gracillariinae, Oecophyllembiinae, nuevas especies, nuevos registros, Islas Canarias, España.

Introduction

The subfamilies Gracillariinae Stainton, 1854 and Oecophyllembiinae Balachowsky, 1996, comprises more than 40 genera worldwide (De Prins & De Prins, 2005). In the latest catalogue of Lepidoptera from the Canary Islands, Spain (Vives Moreno, 2014) four genera (*Caloptilia* Hübner, [1825], *Aspilapteryx* Spuler,

1910, *Dialectia* Walsingham, 1897, and *Leucospilapteryx* Spuler, 1910) are recognized with a total of nine species. Since then, only *C. perseae* (Busck, 1920) is recorded as new to the Canary Islands (Gaston et al. 2018). Fieldwork during the last decade on the Canary Islands has revealed new data on these subfamilies which are presented below. Two species are described as new. *Caloptilia coriarella* Falck, sp. nov. is described from La Palma and Madeira, Portugal, and it is compared with *C. laurifoliae* (M. Hering, 1927) and two North American species *C. sassafrasella* (Chambers, 1876) and *C. perseae* (Busck, 1920). The genitalia of all four species and of both sexes are figured. *Metriochroa carreteriaella* Falck, sp. nov. is described from Gran Canaria. Its genitalia are figured and compared with other named species of the genus. *Aspilapteryx anagensis* Klimesch, 1979 is reinstated as a distinct species. *Aspilapteryx multipunctella* (Chrétien, 1917) and *Dextellia dorsilineella* (Amsel, 1935) are recorded as new to the Canary Islands. Three species are removed from the list of Canary Islands Lepidoptera. *Caloptilia perseae* (Busck, 1920) due to misidentification, *Dialectica imperialella* (Zeller, 1847) and *Leucospilapteryx omissella* (Stainton, 1848) because of unconfirmed records.

Abbreviations used

PF Collection of Per Falck, Neksø, Denmark
MNCN Collection of Antonio Vives, Museo Nacional de Ciencias Naturales, Madrid, Spain
ZMUC Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark

Material and methods

Most of the specimens were collected by the author and attracted to an 8-watt super actinic light, and some were collected as larvae.

Male and female genitalia were dissected and prepared following Robinson (1976).

Adults from the Canary Islands were photographed with a Canon EOS 700D camera equipped with a Canon EF 100 mm objective. The genitalia slide from specimens from the Canary Islands were photographed using a Soptop CX40T Trinocular microscope in conjunction with a Toup Tek P10500AE3 / E3ISPM05000KPA-E3 / 5.0MP USB3 camera.

The author examined the morphology of all species from the Canary Islands and the DNA barcodes from new and cryptic species. DNA samples were prepared as described by Falck & Karsholt (2023: 271). Details of successfully sequenced voucher specimens are publicly available through the dataset DS-GRACAIS at www.boldsystems.org. and at dx.doi.org/10.5883/DS-GRACAIS.

Plant names are according to World Flora Online (2024).

Checklist

Synonyms used in the literature on Gracillariidae of the Canary Islands are included.

Gracillariidae Stainton, 1854
Gracillariinae Stainton, 1854

Caloptilia aurantiaca (Wollaston, 1858)
Caloptilia coruscans (Walsingham, 1907)
= *schinella* Walsingham, 1908
Caloptilia laurifoliae (M. Hering, 1927)
= *roscipennella* sensu Walsingham, 1894
= *laurifoliella* (Rebel, 1939)
***Caloptilia coriarella* Falck, sp. nov.**
Caloptilia staintoni (Wollaston, 1858)
Aspilapteryx multipunctella (Chrétien, 1917)
Aspilapteryx anagensis Klimesch, 1979, **stat. reinst.**
Dialectica hedemanni (Rebel, 1896)
Dialectica scalariella (Zeller, 1850)

Dextellia dorsilineella (Amsel, 1935)

Oecophyllembiinae Balachowsky, 1996

***Metriochroa carreteriaella*, Falck sp. nov.**

Results

Gracillariinae

***Caloptilia coriarella* Falck, sp. nov.** (Figures 1, 2, 10, 10a, 10b, 10c, 17)
https://zoobank.org/90CCDA05-D376-48E9-A430-DD09142F3FCD

Holotype ♂: SPAIN, La Palma, Barranco de la Madera, 500 m, larva on *Rhus coriaria* L., 10-30-XI-2023, leg. P. Falck. Deposited in the MNCN.

Paratypes: SPAIN, La Palma, Barranco de la Madera, 500 m, 2 ♂, 29-VII-11-VIII-2023. leg. P. Falck, DNA samples Lepid Phyl 1356PF/CILEP1355-23, 1357PF/CILEP1356-23, same data but 6 ♂, 5 ♀, larvae on *Rhus coriaria* L., 10-30-XI-2023, leg. P. Falck, genitalia slide 4031PF, 4032PF. Portugal, São Jorge, 200 m, 1 ♂, 1 ♀, larvae on *Rhus coriaria* L., 29-XI-2001, leg. O. Karsholt, genitalia slide ZM4308PF (ZMUC).

Diagnosis: *C. coriarella* resembles *C. laurifoliae* (M. Hering, 1927) and especially the two North American species *C. sassafrasella* (Chambers, 1876) and *C. perseae* (Busck, 1920).

It differs from *C. laurifoliae* by the smaller wingspan (10-12.5 mm), the almost pure white labial palp, the white face and the white tarsus of fore- and midlegs. In *C. laurifoliae* the wingspan is 15-17 mm, the labial palp and face are reddish-brown, and tarsus is cream-white and brown. It was not possible to separate *C. coriarella* externally from *C. sassafrasella* and *C. perseae* based on the available material.

In the male genitalia it is characterized by the curved ventral margin of valva to cucullus without a clear distal margin, the pointed apex of phallus and a longitudinal row of 17-18 relatively robust cornuti. In the female genitalia it is characterized by the sclerotized, corrugate lamella ante-vaginalis, the relatively short bursa copulatrix, with almost undifferentiated ductus and corpus bursae, the relatively short, broad and membranous ductus bursae and the large, slightly curved signa.

Description (Figures 1, 2): Wingspan 10-12.5 mm. Labial palp slender, upturned, segment 2 white, segment 3 white, apically blackish brown. Maxillary palp white. Antenna pale grey, darker grey from 2/5 to apex. Head with vertex light reddish brown, face pure white. Tegula and thorax light reddish brown. Forewing reddish brown with slight violet gloss; from ¼ a cream-white, diffuse patch from costa to cell, narrowing apically and reaching costa at ½; margin of costa and dorsum with several small, brownish-grey dots. Fringe dark grey with indistinct, white fringe line, paler around tornus. Hindwing grey, with grey fringe. Abdomen reddish grey. Fore- and midlegs dark brown with tarsus white; hindlegs whitish buff.

Variation: Only minor variation in the forewing colour is observed.

Male genitalia (Figures 10, 10a, 10b, 10c): Tuba analis membranous, slightly narrower than distal part of tegumen, protruded over the top of tegumen; subscaphium slender, basally T-shaped; tegumen oblong, lateral margins convex, antero-medial margin with deep emargination; valva curved, gradually widening to the middle, then narrowing towards rounded cucullus, distal half covered with dense long setae; vinculum subtriangular, apically rounded; phallus straight, subapically rounded with thorn-shaped, acute apex; a longitudinal row of 17-18, relatively robust cornuti, which may be bent if the vesica is everted (Figure 10b). Sternum VIII subrectangular, coremata relatively short. Sternum VII narrow with median projection, coremata long (Figure 10c).

Female genitalia (Figure 17): Papillae anales membranous, short, covered with short setae; posterior apophysis short, slightly longer than anterior apophysis; segment VIII subrectangular; lamella post-vaginalis narrow, subrectangular, anterior margin convex; lamella ante-vaginalis heavily sclerotized, subrectangular, posterior margin with rounded emargination, laterally and anteriorly corrugated; ostium funnel-shaped; bursa copulatrix relatively short, with almost undifferentiated ductus and corpus bursae; ductus bursae membranous, relatively short and broad; corpus bursae small and rounded; signa large, claw-shaped, weakly curved.

DNA barcodes: We obtained full length DNA barcode (658 bp) from two specimens. The barcodes fall within Barcode Index Number (BIN) BOLD: AAD4936. The maximum intraspecific p-distance within BIN

is 1.61% (n=25). The minimum p-distance to nearest neighbour (*C. diversilobiella* Opler, 1969) is 4.22 %. *C. coriarella* shares BIN with *C. sassafrasella* (Chambers, 1876).

Biology: Two specimens were collected at light in a steep ravine and later, at the same location, larvae were found mining the leaves or inside cones on *Rhus coriaria* L. (Anacardiaceae). The vegetation is a mixture of open dry *Pinus* forest and open Laurisilva forest. *Rhus coriaria* is native to the Canary Islands, Madeira, the Azores, northwest Africa, southern Europe and southwest Asia (World Flora Online, 2024).

Distribution: Known only from Barranco de la Madera and Barranco de Juan Mayor (empty cones) in the western part of the island La Palma, Spain and São Jorge in the northern part of Madeira, Portugal.

Etymology: The species is named after its hostplant *Rhus coriaria* L.

Remarks: In 2018 *C. perseae* was recorded from the Canary Islands, La Palma by Gaston et al. (2018). An attempt was made to find the larva in cones of *Persea americana* Mill., however, only *C. staintoni* (Wollaston, 1858) hatched. A few days later two specimens were attracted to light and provisionally identified as *C. perseae.* Both specimens were barcoded and surprisingly they shared BIN with the North American species *C. sassafrasella.* At a later visit to the same location larvae were found in cones of *Rhus coriaria* L. (Anacardiaceae) and hatched about one month later. During the present study it became apparent that the specimens belonged to an undescribed species, but also that *C. perseae* was incorrectly recorded from the Canary Islands due to a misidentified specimen of *C. laurifoliae.* The morphologically differences in the genitalia and the different family of host plant supports the status of *C. coriarella* as a distinct species. The known host plants for *C. perseae*, *C. sassafrasella* and *C. laurifoliae* all belongs to the family Lauraceae.

For comparison the genitalia of both sexes of *C. perseae*, *C. sassafrasella* and *C. laurifoliae* are figured.

C. coriarella also resembles the North American *rhus*-feeding species *C. ovatiella* Opler, 1969, *C. diversilobiella* Opler, 1969 and *C. rhoifoliella* (Chambers, 1876). It differs from them by differences in the genitalia morphology and the DNA barcode. The adult and the genitalia are figured by Opler (1969).

The holotype of *C. coruscans* (Walsingham, 1907) is reared from *Rhus dioica* Brouss. ex Willd. which is a synonym of *Searsia tripartita* (Ucria) Moffett (World Flora Online, 2024). It differs distincly both in adult and genitalia morphology.

Caloptilia perseae (Busck, 1920)
Gracillaria perseae Busck, 1920. *Can. Ent., 52*, 239

C. perseae (Busck, 1920) should be deleted from the list of Lepidoptera found in the Canary Islands (see remarks under *C. coriarella*).

Aspilapteryx multipunctella (Chrétien, 1917) (Figures 5, 14, 14a, 14b)
Gracilaria tringipennella multipunctella Chrétien, 1916. *Ann. Soc. ent. France, 85*(3-4), 497

Material examined: SPAIN, Fuerteventura, Caldereta, 220 m, 2 ♂, 30-V-12VI-2023, leg. P. Falck, genitalia slide 4087PF, 4089PF, DNA samples Lepid Phyl 1352PF/CILEP1351-23, 1353PF/CILEP1352-23 (PF). **New to the Canary Islands, Spain.**

Diagnosis: See under next species.

Genitalia (Figures 14, 14a, 14b): The female genitalia is figured by Triberti (1985, pls IV).

DNA barcode: We obtained full length DNA barcode (658 bp) from two specimens. The barcodes fall within Barcode Index Number (BIN) BOLD: AAV4380. The maximum intraspecific p-distance within BIN is 0.64% (n=5). The minimum p-distance to nearest neighbor (*A. anagensis* Klimesch, 1979) is 3.77 %.

Biology: The larva is bred from *Plantago albicans* L. (Triberti, 1985).

Distribution: Algeria, Tunisia (Chrétien, 1917), Spain (Triberti, 1985), Portugal (Corley et al. 2000) and France (Nel, 2003).

Remarks: Previous records of *C. multipunctella* from the Canary Islands all belongs to *C. anagensis*.

Aspilapteryx anagensis Klimesch, 1979, **stat. reinst.** (Figures 6, 15, 15a, 15b)
Aspilapteryx anagensis Klimesch, 1979, *Vieraea, 8*, 153-155, pl. 14-17.

Material examined: SPAIN, Tenerife, Las Mercedes, 750 m, 4 ♂, 21-V-3-VI-2019, leg. P. Falck, genitalia slide 4088PF, DNA samples Lepid Phyl 0784PF/CILEP783-21, 0785PF/CILEP784-21, 0786PF/CILEP785-21, same data but 1 ♂, 1-13-VI-2022 leg. P. Falck, genitalia slide 4086PF, same data but 1 ♀, 30-III-5-IV-2024, leg. P. Falck (PF).

Diagnosis: In the male genitalia *A. anagensis* is characterized by a row of 5-7 small cornuti and by the divided distal part of phallus of which apex is sub-triangular, apically with 3-4 small spines and beneath it a relatively broad twisted projection. It resembles *A. multipunctella*, which has 7-10 larger cornuti, apex of phallus is thorn-shaped and the twisted projection is much narrower and longer.

Genitalia (Figures 15, 15a, 15b): The female genitalia are figured by Klimesch (1979, figs 16-17).

DNA barcode: We obtained DNA barcode fragments of 657bp, 577bp and 321bp from three specimens. The barcodes fall within Barcode Index Number (BIN) BOLD: AEI7891. The maximum intraspecific p-distance is 0.18 %. The minimum p-distance to nearest neighbour (*A. multipunctella*) is 3.77 %.

Biology: Klimesch (1979, p. 154) bred *A. multipunctella* only from *Plantago arborescens* L. and describes the larva as a temporary miner, completing its larval development feeding among spun leaves.

Distribution: Known only from Tenerife. Endemic to the Canary Islands, Spain.

Remarks: *A. anagensis* was described in detail by Klimesch (1979, pp. 153-155). It was synonymized with *A. multipunctella* by Triberti (1985, p. 4) due to the rather similar genitalia. However, Triberti was aware that there were small differences in the male genitalia between the two species "Klimesch (1979) pointed out five cornuti in *anagensis* whereas I noticed 8-10 in Mediterranean specimens". The divergence in the DNA barcodes, the clear morphologically differences in the phallus and the different host plant supports the status of *A. anagensis* as a distinct species.

Dialectica imperialella (Zeller, 1847)
Euspilopteryx imperialella Zeller, 1847. *Linn. Ent., 2*, 365

D. imperialella is recorded from the Canary Islands by Kuznetzov & Baryshnikova (1998, p. 20) and later by (De Prins & De Prins, 2005, p. 173). It has not been possible to trace a specific record from the Canary Islands neither by J. De Prins (in litt.) nor the author, and the record is probably due to an error. *D. imperialella* (Zeller, 1847) should be deleted from the list of Lepidoptera found in the Canary Islands.

Dextellia dorsilineella (Amsel, 1935) (Figure 7)
Leucospilapteryx dorsilineella Amsel, 1935. *Mitt. Zool. Mus. Berl., 20*, 307-308, pl. 12

Material examined: SPAIN, Gran Canaria, El Sao, 110 m, 1 ♂, 1 ♀, 17-30-IX-2018, leg. P. Falck, DNA sample Lepid Phyl 0006PF/CILEP6-19; same data but 1 ♂, 4-23-III-2019, leg. P. Falck; Puntilla de la Caleta, 10 m, 1 ♂, 4-23-III-2019, leg. P. Falck; Pie de la Cuesta, 500 m, 3 ♂, 1 &, 21-VIII-4-IX-2020, leg. P. Falck; Barranco Moya, 80 m, 1 ♀, 8-20-VIII-2020, leg. P. Falck. La Gomera, Valle Gran Rey, 150 m, 1 ♂, 24-X-12-XI-2021, leg. P. Falck (PF). **New to the Canary Islands, Spain.**

DNA barcodes: One specimen was successfully barcoded with Barcode Index Number (BIN): BOLD ADD7653. The minimum p-distance to nearest neighbour, an unnamed Gracillariidae species from Thailand, is 7.7 %.

Distribution: *D. dorsilineella* is known from North Africa (Morocco, Tunisia), South Europe (Spain, France, Italy, Malta, Cyprus, Greece), Israel, Turkmenistan and China (De Prins & De Prins, 2024; Pathpiva, 2024).

Biology: The early stages are undescribed.

Remarks: The genitalia of both sexes are figured by (Pathpiva, 2024).

Leucospilapteryx omissella (Stainton, 1848)
Argyromiges omissella Stainton, 1848. *Zoologist, 6*, 2163

L. omissella is recorded from the Canary Islands in De Prins & De Prins (2005, p. 196). It has not been possible to trace a specific record from the Canary Islands neither by J. De Prins (in litt.) nor the author, and the record is probably due to an error. *L. omissella* (Stainton, 1848) should be deleted from the list of Lepidoptera found in the Canary Islands.

Oecophyllembiinae

***Metriochroa carreteriaella*, Falck sp. nov.** (Figures 8, 9, 16, 21)
https://zoobank.org/AA9DE1E1-1FFF-4429-BCEF-6B0D55602925

Holotype ♂: SPAIN, Gran Canaria, Carreteria, 455 m, 9-22-VI-2021, leg. P. Falck, genitalia slide 4090PF, DNA sample Lepid Phyl 0859PF/CILEP857-21. Deposited in the MNCN.

Paratype: SPAIN, Gran Canaria, Carreteria, 455 m, 1 ♀, 1-13-IV-2022, leg. P. Falck, genitalia slide 4091PF (PF).

Diagnosis: *M. carreteriaella* resembles several of the brownish *Metriochroa*-species e.g. *M. latipennella* (Millière, 1887), *M. fraxinella* Kumata, 1998, *M. pergularia* Vári, 1961 and *M. symplocosella* Kobayashi, Huang & Hirowatari, 2013. It is distinguished by the wing-pattern of the forewing which has a yellowish white dorsum, an indistinct, black fascia and three whitish spots at costa in outer half. In the male genitalia the pointed cucullus, the long saccus and the phallus with pointed apex, a large projection dorsally and without cornuti are characteristic. In the female genitalia the relatively broad, ring-shaped antrum and the corpus bursae without signum are characteristic.

Description (Figures 8, 9): Wingspan 6 mm. Labial palp slender, segment two yellowish white, dorsally mottled dark grey, segment three yellowish, medially ringed dark grey. Antenna almost as long as forewing, fuscous. Head yellowish white mottled with greyish brown. Neck yellowish white. Tegula and thorax greyish brown mottled with few yellowish white scales. Forewing dark greyish brown, yellowish white along dorsum from near base to tornus; at ½ an outwardly angled, diffuse blackish fascia, distally edged white; in distal ½ at costa three indistinct, yellowish white spots, above tornus two indistinct, whitish spots. Fringe dark grey. Hindwing grey, fringe lighter grey.

Male genitalia (Figure 16): Tegumen sub-triangular, laterally slightly curved; tuba analis bilobed, moderately setose; valva as long as tegumen, dorsal margin almost straight, costal margin slightly upcurved, in distal ½ with partite scales, cucullus pointed; vinculum y-shaped; saccus almost as long as valva, slightly tapering towards rounded apex; phallus large, about three times longer than valva, apex pointed, dorsally with a long projection reaching to near apex.

Female genitalia (Figure 21): Papillae anales long, tapering distally, covered with long setae; posterior apophysis slightly shorter than anterior apophysis; antrum relatively broad, sclerotized, ring-shaped; ductus bursae membranous; corpus bursae elongate, membranous, without signum.

DNA barcodes: We obtained full length DNA barcode (658 bp) from one specimen. The barcode fall within Barcode Index Number (BIN): BOLD AEN8024. The minimum p-distance to nearest neighbour, *Metriochroa latifoliella* (Millière, 1886), is 7.06 %.

Biology: Early stages unknown. The specimens were attracted to light just above a steep ravine.

Distribution: Known only from the type locality in the northern part of the island Gran Canaria, Spain. It is probably endemic to the Canary Islands.

Etymology: The species is named after its type locality, Carreteria.

Remarks: The genus *Metriochroa* is rather small, with 13 currently named species (Bai et al. 2016). There are three in the Palearctic region, two in the Oriental region, seven in the Afrotropical region and one in the Nearctic region. Only *Metriochroa latifoliella* (Millière, 1886) is known from Europe. Their larvae are leaf-miners. The mine is placed under the upper cuticle of leaves (Oleaceae and Symplocaceae) and the pupation takes place inside the mine (Kumata, 1998; Kobayashi et al. 2013).

Discussion

Despite the lack of barcode dissimilarities and differences in external appearance from *C. sassafrasella* the clear differences in genitalia structure and biology support the description of *C. coriarella* as a new species, see Kaila (2024, p. 381).

Checklists and catalogues are important tools for both field work and taxonomic studies, but during the work with an extensive amount of data there is of course a risk that errors will occur. Species may be incorrectly recorded or omitted from a given area, species previously listed in the literature are not always critically evaluated or they are incorrectly identified or labelled. During the preparation of the present paper the author became aware of three species (*Caloptilia perseae* (Busck, 1920), *Dialectica imperialella* (Zeller, 1847) and *Leucospilapteryx omissella* (Stainton, 1848)) recorded from the Canary Islands, which - due to different mistakes - do not belong to the fauna. It is much easier to add a new species, than it is to remove one from checklists or catalogues. The present author pleads that reference should be made to at least one specific record and preferably with a photo of the adult or its genitalia, when recording a new species to such lists.

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Conflict of Interest

The author declares that there are no known financial interest or personal relationships that could have influenced the work presented in this article.

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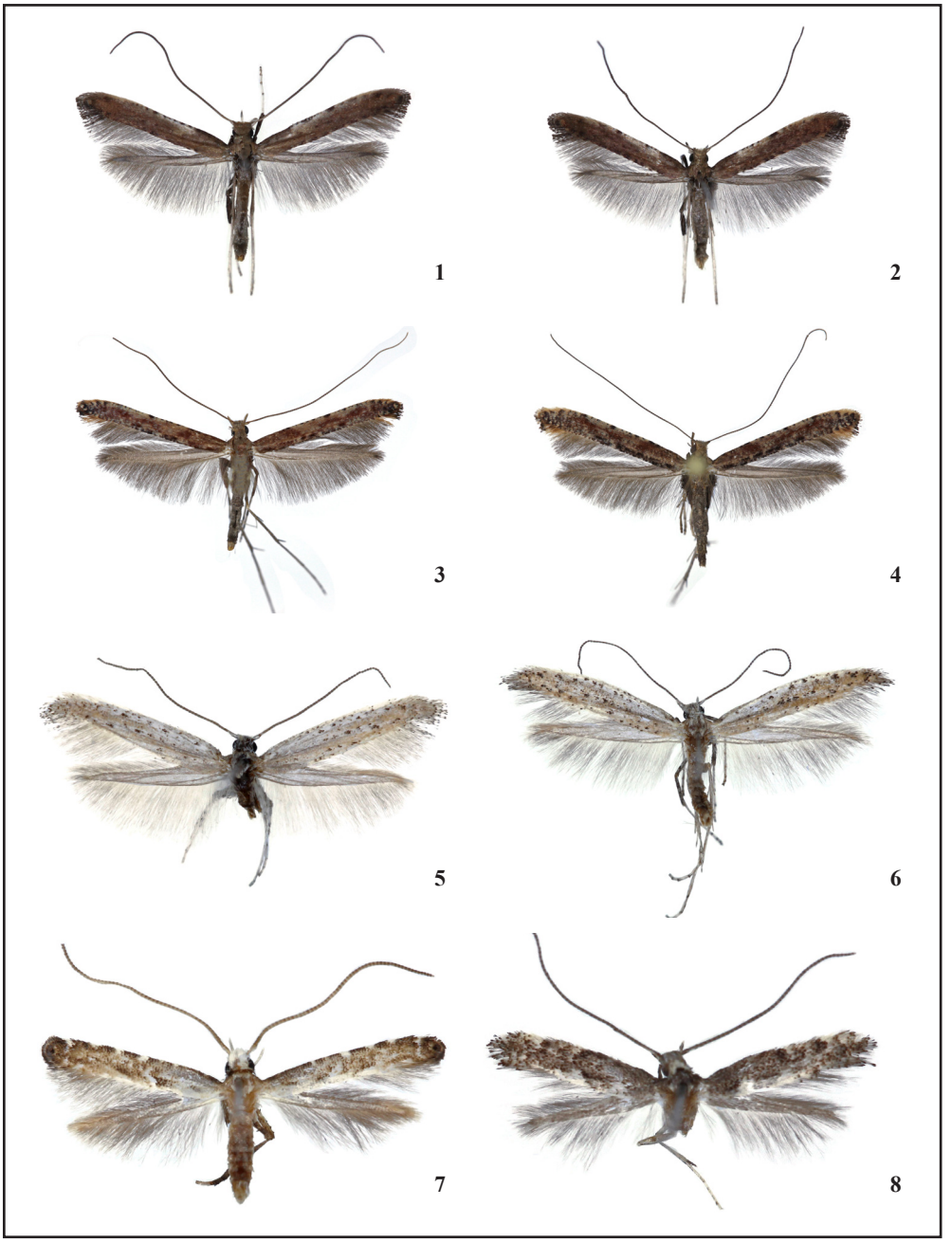
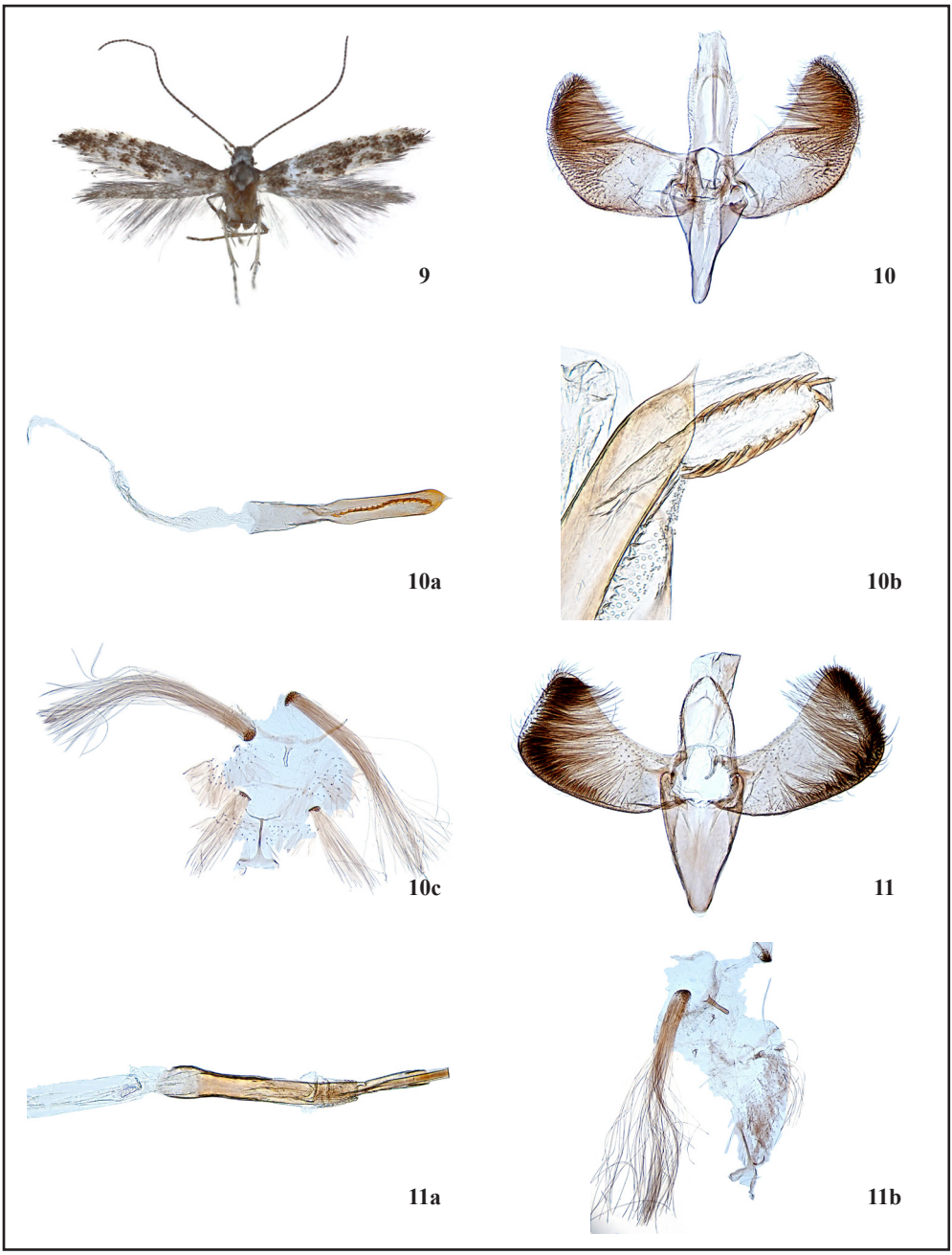
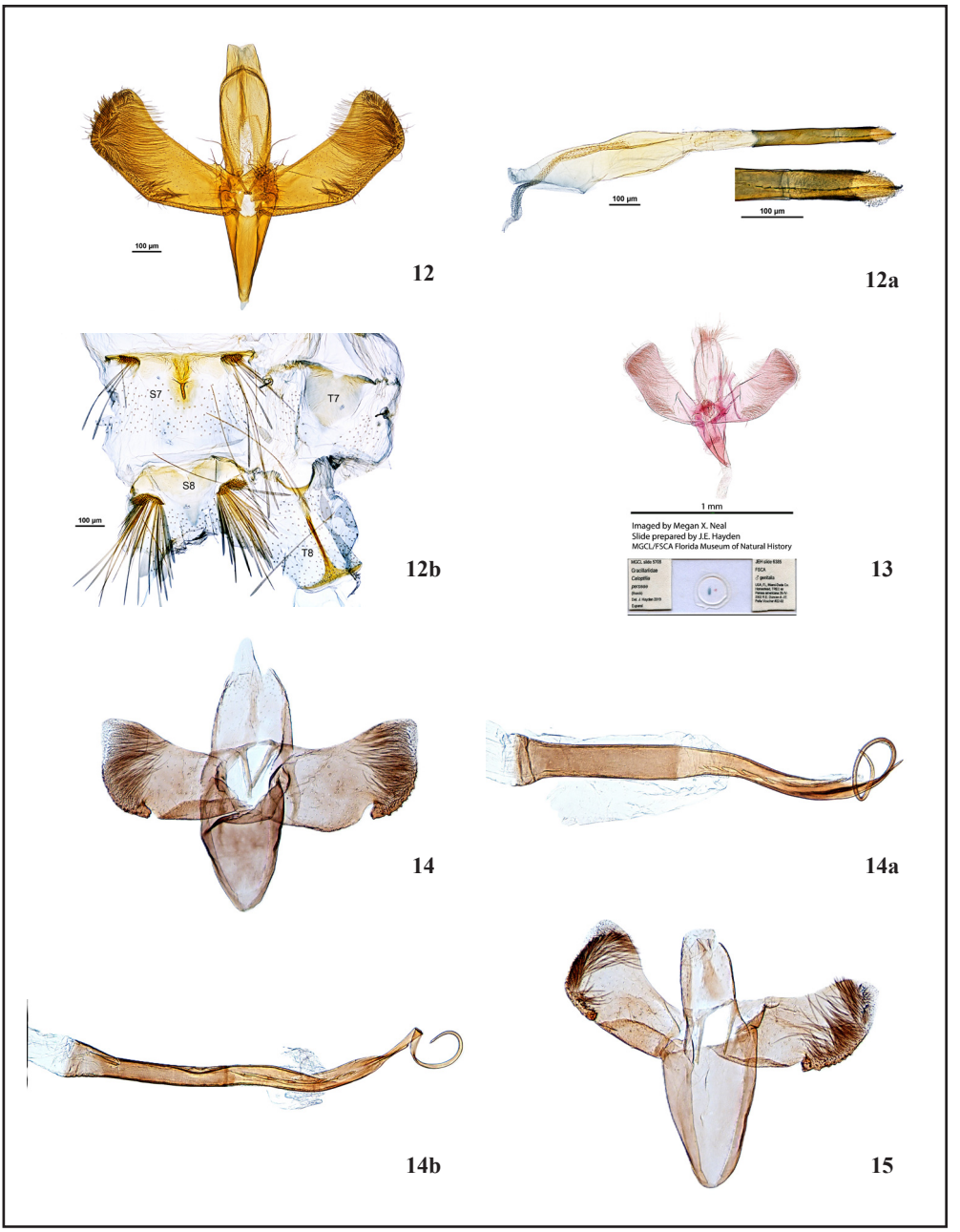
Figures 1-8. 1. *Caloptilia coriarella* Falck, sp. nov., ♂, La Palma, 11.5 mm. **2.** *Caloptilia coriarella* Falck, sp. nov., ♀, La Palma, 11 mm. **3.** *Caloptilia laurifoliae* (M. Hering, 1927), ♂, Tenerife, 16 mm. **4.** *Caloptilia laurifoliae* (M. Hering, 1927), ♀, Tenerife, 15.5 mm. **5.** *Aspilapteryx multipunctella* (Chrétien, 1917), ♂, Fuerteventura, 9.5 mm. **6.** *Aspilapteryx anagensis* (Klimesch, 1979), ♂, Tenerife, 9.5 mm. **7.** *Dextellia dorsilineella* /Amsel, 1935), ♂, Gran Canaria, 8 mm. **8.** *Metriochroa carreteriaella* Falck, sp. nov., ♂, Gran Canaria, 6 mm.



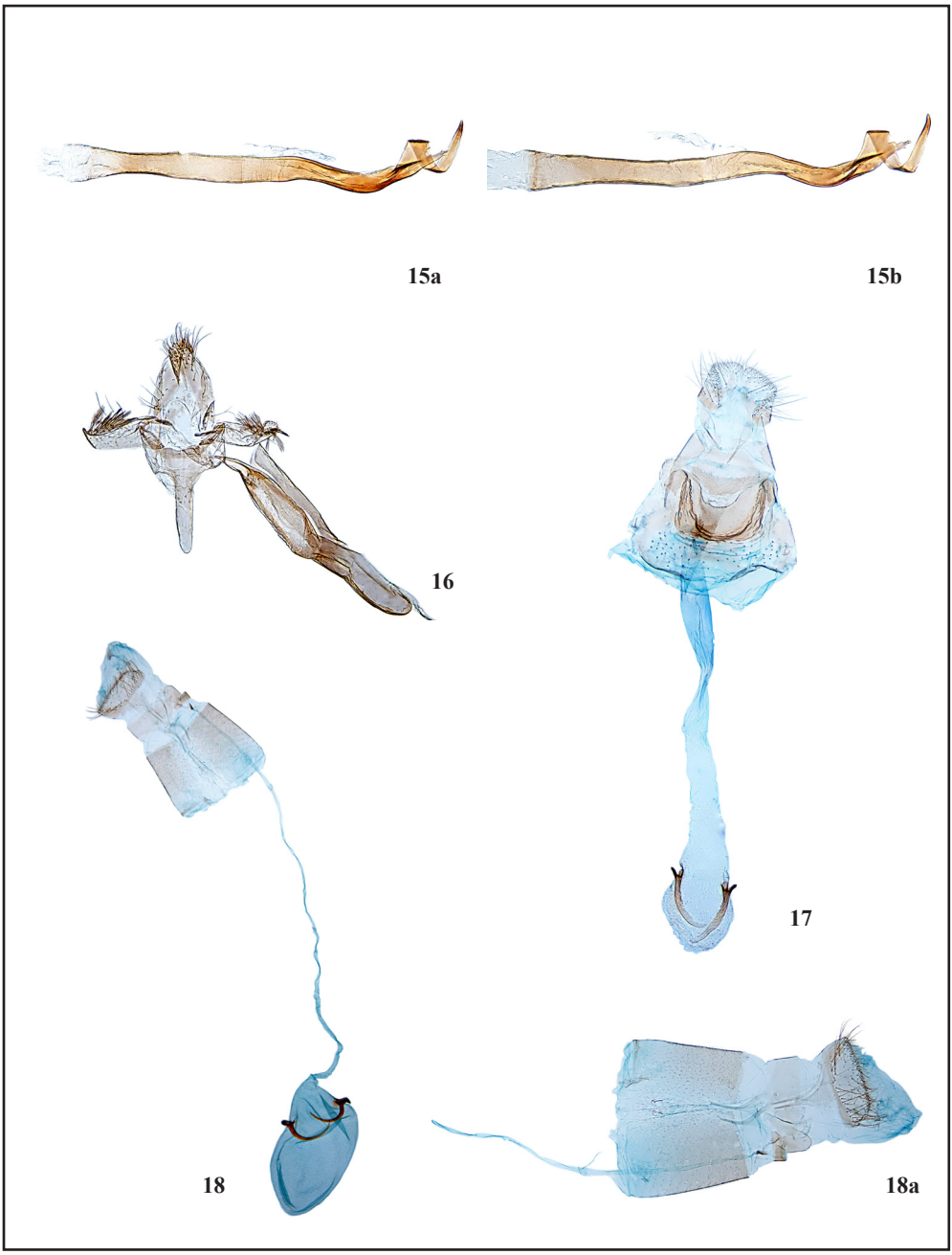
Figures 9-11b. 9. *Metriochroa carreteriaella* Falck, sp. nov., ♀, Gran Canaria, 6 mm. **10.** *Caloptilia coriarella* Falck, sp. nov., ♂, La Palma, GP4094PF. **10a.** *Caloptilia coriarella* Falck, sp. nov., ♂, phallus, GP4094PF. **10b.** *Caloptilia coriarella* Falck, sp. nov., ♂, apex of phallus with cornuti, GP4031PF. **10c.** *Caloptilia coriarella* Falck, sp. nov., ♂, segment 7-8, GP4094PF. **11.** *Caloptilia laurifoliae* (M. Hering, 1927), ♂, Tenerife, GP4093PF. **11a.** *Caloptilia laurifoliae* (M. Hering, 1927), ♂, phallus, GP4093PF. **11b.** *Caloptilia laurifoliae* (M. Hering, 1927), ♂, segment 7-8, GP4093PF.



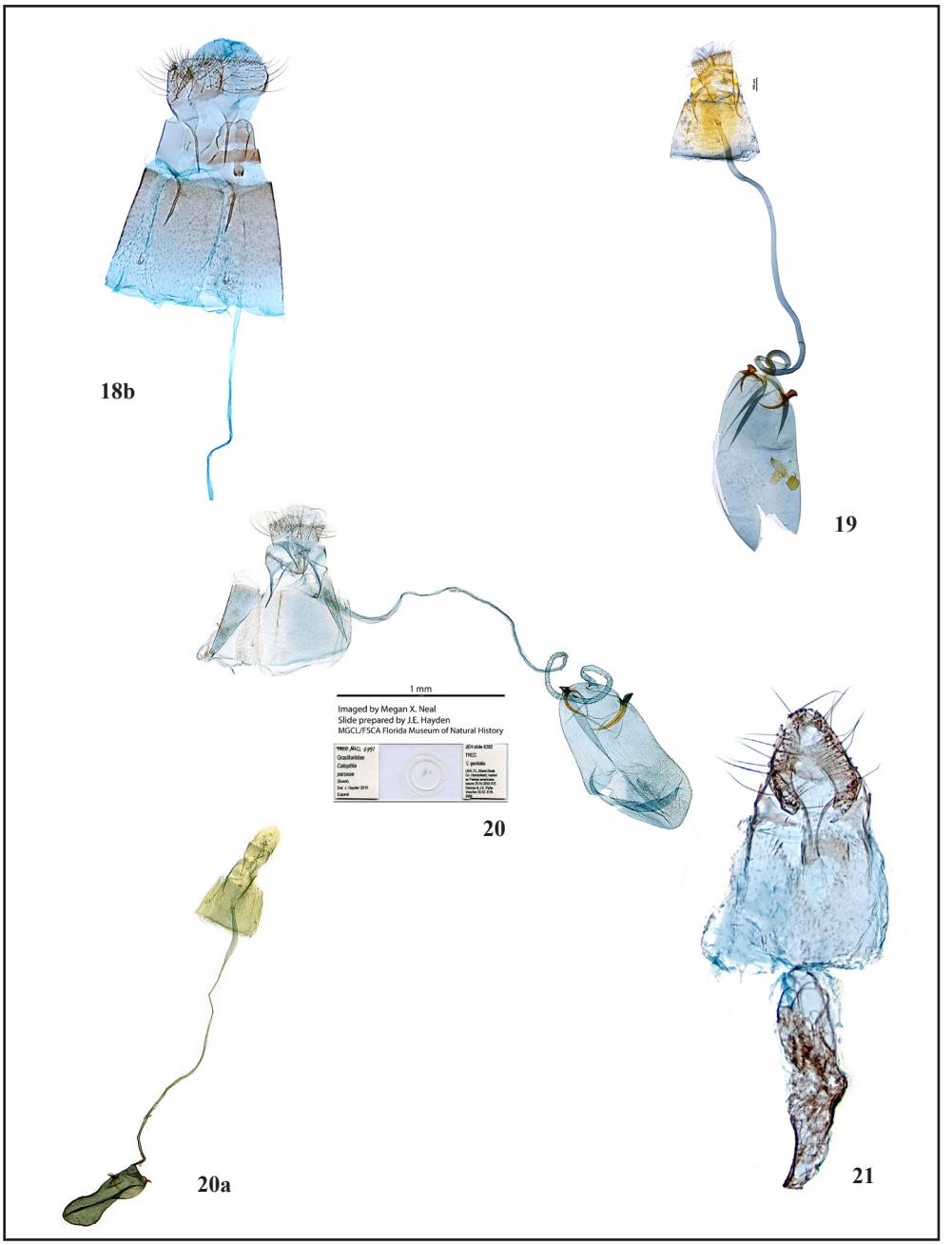
Figures 12-15. 12. *Caloptilia sassafrasella* (Chambers, 1876), ♂, Canada, MIC8680. Photo J-F Landry. **12a.** *Caloptilia sassafrasella* (Chambers, 1876), ♂, phallus, MIC8680. Photo J-F Landry. **12b.** *Caloptilia sassafrasella* (Chambers, 1876), ♂, segment 7-8, MIC8678. Photo J-F Landry. **13.** *Caloptilia perseae* (Busck, 1920), ♂, Miami, USA, MGCL5708-JEH6385. Photo S. V. Bennett. **14.** *Aspilapteryx multipunctella* (Chrétien, 1917), ♂, Fuerteventura, GP4087PF. **14a.** *Aspilapteryx multipunctella* (Chrétien, 1917), ♂, phallus, GP4087PF. **14b.** *Aspilapteryx multipunctella* (Chrétien, 1917), ♂, phallus, GP4089PF. **15.** *Aspilapteryx anagensis* (Klimesch, 1979), ♂, Tenerife, GP4086PF.



Figures 15a-18a. 15a. *Aspilapteryx anagensis* (Klimesch, 1979), ♂, phallus, GP4086PF. **15b.** *Aspilapteryx anagensis* (Klimesch, 1979), ♂, phallus, GP4088PF. **16.** *Metriochroa carreteriaella* Falck, sp. nov., ♂, Gran Canaria, GP4090PF. **17.** *Caloptilia coriarella* Falck, sp. nov., ♀, La Palma, GP4095PF. **18.** *Caloptilia laurifoliae* (M. Hering, 1927), ♀, Tenerife, GP4033PF. **18a.** *Caloptilia laurifoliae* (M. Hering, 1927), ♀, lamella ante-vaginalis lateral view, GP4033PF.



Figures 18b-21. 18b. *Caloptilia laurifoliae* (M. Hering, 1927), ♀, lamella ante-vaginalis ventral view, GP4078PF. **19.** *Caloptilia sassafrasella* (Chambers, 1876), ♀, Canada, MIC8681. Photo J-F Landry. **20.** *Caloptilia perseae* (Busck, 1920), ♀, Miami, USA, MGCL6991-JEH6382. Photo S. V. Bennett. **20a.** *Caloptilia perseae* (Busck, 1920), ♀, GP21162-aMontage. Photo T. Simões. **21.** *Metriochroa carreteriaella* Falck, sp. nov., ♀, Gran Canaria, GP4091PF.



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Assessment of Papilionoidea Diversity and Host Plant Correlations amid Anthropogenic Impacts in District Barabanki, Uttar Pradesh (India) (Insecta: Lepidoptera)

Sushmita Prakash, Babita Sharma & Ashok Kumar

Abstract

This study evaluates the impact of anthropogenic activities on Papilionoidea diversity in Barabanki district, Uttar Pradesh (India), by analyzing the relationship between Papilionoidea and their host plants across urban, rural, and forest gradients. Field surveys documented 76 Papilionoidea species across five families, with Nymphalidae being the most prevalent (36.84%). Species richness was highest in forests (66 species), followed by rural (53) and urban areas (39). Among 156 plant species recorded, 89 were identified as host plants. Statistical analysis highlighted significant correlation between Papilionoidea and plant diversity, emphasizing the importance of host plant availability. Forest habitats showed the highest Shannon and Simpson indices (3.92 and 0.97 for Lepidoptera; 3.41 and 0.95 for plants), indicating rich biodiversity, while urban areas showed the lowest, illustrating adverse effect of Urbanization. Despite reduced species' richness, plant evenness was higher in urban areas, potentially due to fewer dominant species. These results emphasize that human-driven habitat loss reduces biodiversity, advocating for conservation strategies, such as afforestation and habitat protection, to sustain Lepidoptera populations and ecological stability. This study provides baseline data crucial for future research and conservation planning in Barabanki and similar regions.
Keywords: Insecta, Lepidoptera, Papilionoidea, anthropogenic activities, diversity, host plants availability, urban-rural-forest gradient, conservation, correlation, species richness, evenness, Uttar Pradesh, India.

Evaluación de la diversidad de Papilionoidea y correlaciones con plantas huésped en medio de impactos antropogénicos en el distrito de Barabanki, Uttar Pradesh (India) (Insecta: Lepidoptera)

Resumen

Este estudio evalúa el impacto de las actividades antropogénicas en la diversidad de Papilionoidea en el distrito de Barabanki, Uttar Pradesh (India), analizando la relación entre Papilionoidea y sus plantas hospedadoras en gradientes urbanos, rurales y forestales. Los estudios de campo documentaron 76 especies de Papilionoidea de cinco familias, siendo Nymphalidae la más prevalente (36,84%). La mayor riqueza de especies se registró en los bosques (66 especies), seguidos de las zonas rurales (53) y urbanas (39). De las 156 especies vegetales registradas, 89 fueron identificadas como plantas hospedadoras. El análisis estadístico puso de manifiesto una correlación significativa entre Papilionoidea y la diversidad de plantas, lo que subraya la importancia de la disponibilidad de plantas hospedadoras. Los hábitats forestales mostraron los índices de Shannon y Simpson más altos (3,92 y 0,97 para los Lepidoptera; 3,41 y 0,95 para las plantas), indicando una rica biodiversidad, mientras que las zonas urbanas mostraron los más bajos, ilustrando los efectos adversos de la urbanización. A pesar de la menor riqueza de especies, la uniformidad de las plantas fue mayor en las zonas urbanas, lo que podría deberse a un menor número de especies dominantes. Estos resultados ponen de relieve que la pérdida de hábitat provocada por el hombre reduce la biodiversidad, lo que aboga por estrategias de

conservación, como la repoblación forestal y la protección del hábitat, para mantener las poblaciones de Lepidoptera y la estabilidad ecológica. Este estudio proporciona datos de referencia cruciales para futuras investigaciones y planes de conservación en Barabanki y regiones similares.
Palabras clave: Insecta, Lepidoptera, Papilionoidea, actividades antropogénicas, diversidad, disponibilidad de plantas hospedadoras, gradiente urbano-rural-forestal, conservación, correlación, riqueza de especies, uniformidad, Uttar Pradesh, India.

Introduction

Papilionoidea are phytophagous, relying on green plants for sustenance in various life stages (larvae/caterpillar or adult). They form close relationships with their host plants, which provide food, mating, and oviposition sites, and act as a habitat for a significant part of their life cycle (Forister et al., 2015). These adaptations require Papilionoidea to cope with plant phenology and chemical defenses, often limiting them to specific host plant species (Futyma & Agrawal, 2009; Futyma & Moreno, 1998). The availability of these plant resources significantly impacts butterfly diversity within a habitat (Shihan & Kabir, 2015), with Lepidoptera being opportunistic foragers of nectar, puddles, carrion, and excreta, influenced by factors like color and odor (Porter et al. 1992).

Plant diversity generally correlates with butterfly diversity as most Lepidoptera are dependent on specific plant species throughout their life cycles (Croxton et al. 2005; Kitahara et al. 2008; Simonson et al. 2001). However, some studies report a weaker relationship between plant species richness and Papilionoidea diversity, suggesting that while both may respond similarly to environmental conditions, plant diversity does not always directly impact diversity (Hawkins & Porter, 2003). Human activities, including habitat loss and landscape transformation, have increasingly affected ecosystems and species diversity, contributing to global declines and extinction rates that are 100 to 1000 times higher than natural rates (Dennis et al. 2013; Wagner et al. 2021; Kumar, 2017).

This study evaluates Papilionoidea and plant species richness and abundance across urban, rural, and forest landscapes to contribute data critical for conservation strategies in Barabanki, Uttar Pradesh, India. The findings aim to predict distribution patterns based on plant diversity and identify key food sources. The study underlines the importance of protecting remaining forested areas and promoting afforestation to bolster green cover and maintain biodiversity.

Study Area

The present study was conducted in the district of Barabanki, Uttar Pradesh (India), and categorized into three distinct habitat types. The forest gradient was represented by the reserve forest of Ram Sanehi Ghat (N 26º 47’ 14.0” E 081º 32’ 05.1”), while the rural gradient included the agricultural lands of Village Malinpur (N 26º 51’ 20.2” E 081º 31’ 43.8”) and for the urban gradient, the urban park in Safedabad was selected (N 26º 54’ 58” E 081º 06’ 57”).

Materials and Methods

The study was conducted in Barabanki district, Uttar Pradesh, from August 2023 to July 2024. Observations were carried out in two shifts: from 08:00 am to 12:00 pm and from 03:00 pm to 06:00 pm, encompassing all three major seasons-winter, summer, and monsoon. The surveyed habitats included a forest gradient, agricultural fields, and an urban gradient. Three sampling sites were selected, and at each site, three 1 km line transects were established. Each transect was surveyed for two hours per session.

Papilionoidea observed during the study were identified directly in the field using photography and identification manuals (Evans, 1932; Smetacek, 2017; Kehimkar, 2016; Bhakare and Ogale, 2018). No specimens were collected; instead, photographs were taken to ensure accurate species identification. Larval host plants were also identified and recorded in the field, along with observations of larvae and adults. For plant identification, reference books and articles such as (Robinson et al. 2010; Nitin et al. 2018; Smetacek and Smetacek, 2011; Kishor et al. 2011) were utilized.

Results and Discussion

During study, 76 species of Papilionoidea belonging to five families were recorded in district Barabanki. Out of 76 species 28 belong to the family Nymphalidae, 25 to Lycaenidae, 12 to Pieridae, 4 to Papilionidae and 7 to Hesperiidae. Species belonging to the family Nymphalidae were most dominant (36.84%) followed by Lycaenidae (32.89%), Pieridae (15.78%), Hesperiidae (9.21%) and Papilionidae (5.26%). Out of 76 species, 66 species were recorded from forest, 53 from rural and 39 from urban biotopes.

There is a total of 156 species of plants present in the study areas out of which 89 host plants of Papilionoidea were identified in the study area (Table 1). The family wise categorization of the host plants indicated that 37.07 % of the plant family reported in present study was used by family Nymphalidae, followed by Lycaenidae 23.59%, 21.34% by family Hesperiidae, 8.98% by family Pieridae and 6.74% by family Papilionidae.

Table 1. Checklists of Papilionoidea and their host plants are available at the study site. Abbreviation used: F- Forest; U- Urban and R- Rural, habitat.

Species Name	Biotope	Host Plants
Telicota bambusae (Moore, 1878)	FR	*Oryza sativa*, *Saccharum officinarum*, *Imperata cylindrica*, *Bambusa vulgaris*
Matapa aria (Moore, 1865)	F	*Bambusa vulgaris*, *Bambusa arundinacea*, *Dendrocalamus strictus*
Borbo cinnara (Wallace, 1866)	FUR	*Oryza sativa*, *Axonopus compressus*
Borbo bevani (Moore, 1878)	FR	*Saccharum officinarum*, *Imperata cylindrica*
Pelopidas mathias (Fabricius, 1798)	FR	*Axonopus compressus*, *Imperata cylindrica*, *Oryza sativa*, *Saccharum officinarum*
Pelopidas conjuncta (Herrich-Schäffer, 1869)	F	*Oryza sativa*, *Saccharum officinarum*, *Zea mays*, *Bambusa spp*., *Sorghum bicolor*
Spialia galba (Fabricius, 1793)	R	*Hibiscus rosa sinensis*, *Tridex procumbens*, *Sida rhombifolia*
Curetis thetis (Drury, 1773)	FR	*Butea monosperma*, *Pongamia pinnata*
Arhopala atrax (Hewitson, 1862)	FR	*Shorea robusta*
Rapala iarbus (Fabricius, 1787)	FU	*Ougeinia dalbergioides*
Rapala manea (Hewitson, 1863)	F	*Acacia pennata, Saraca asoca, Lantana camara, Mangifera indica*
Anthene emolus (Godart, 1824)	FR	*Mangifera indica*, *Combretum latifolium*, *Cassia fistula*, *Saraca asoca, Terminalia arjuna*
Tarucus indica (Evans, 1932)	FU	*Ziziphus jujube*
Tarucus callinara (Butler, 1886)	FR	*Ziziphus jujube*
Tarucus nara (Kollar, 1848)	FUR	*Ziziphus jujube*
Castalius rosimon (Fabricius, 1775)	FUR	*Ziziphus jujuba*, *Ziziphus rugosa*
Tarucus balkanicus (Freyer, 1844)	FR	*Ziziphus jujube*
Prosotas dubiosa (Semper, 1879)	FR	*Acacia nilotica*, *Mimosa pudica*
Jamides celeno (Cramer, 1782)	F	*Butea monosperma*, *Crotolaria retusa*, *Pongamia pinnata, Cajanus cajan*
Catochrysops strabo (Fabricius, 1793)	FUR	*Ougeinia dalbergioides*, *Butea monosperma, Pongamia pinnata*
Lampides boeticus (Linnaeus, 1767)	FR	*Pisum sativum*, *Pongamia pinnata*, *Cajanus cajan*, *Butea monosperma*, *Crotolaria retusa*
Pseudozizeeria maha (Kollar, 1844)	FUR	*Oxalis corniculata*

Zizeeria karsandra (Moore, 1865)	FUR	*Amaranthus spinosus*, *Oxalis corniculata*
Azanus jesous (Guérin-Méneville, 1847)	F	*Acacia catechu*, *Mimosa pudica*
Chilades pandava (Horsfield, 1829)	FUR	*Acacia nilotica*, *Cycas revolute, Cajanus cajan, Phaseolus vulgaris, Bauhinia variegate, Butea monosperma, Saraca asoca*
Euchrysops cnejus (Fabricius, 1798)	F	*Butea monosperma*, *Ougeinia dalbergioides*, *Pisum sativum, Acacia nilotica*, *Cajanus cajan*
Chilades lajus (Stoll, 1780)	FUR	*Murraya paniculata*, *Citrus aurantifolia*, *Citrus maxima, Murraya koenigii, Mangifera indica*
Spindasis vulcanus (Fabricius, 1775)	UR	*Cadaba fruticosa, Ziziphus jujube, Dioscorea wallichii, Carissa carandas, Cassia fistula*
Talicada nyseus (Guérin-Méneville, 1843)	UR	*Bryophyllum pinnatum*
Leptotes plinius (Fabricius, 1793)	R	*Albizia lebbeck*, *Indigofera spp.*, *Sesbania bispinosa*, *Mimosa pudica*
Prosotas nora (C. Felder, 1860)	FR	*Acacia catechu*, *Mimosa pudica*
Freyeria putli (Kollar, 1844)	R	*Pisum sativum*, *Oxalis corniculata*, *Indigofera spp.,*
Danaus genutia (Cramer, 1779)	FUR	*Tylophora indica, Calotropis spp.*
Danaus chrysippus (Linnaeus, 1758)	FUR	*Calotropis procera*, *Tylophora indica*
Tirumala limniace (Cramer, 1775)	FU	*Calotropis procera*, *Tylophora indica*, *Ageratum conyzoides*, *Crotolaria retusa*
Parantica aglea (Stoll, 1782)	F	*Tylophora indica*, *Calotropis procera*
Euploea core (Cramer, 1780)	FU	*Tylophora indica, Ficus racemosa Ficus benghalensis, Ficus religiosa, Nerium spp., Ageratum conyzoides*
Polyura athamas (Drury, 1770)	F	*Acacia pennata*, *Albizia lebbeck*, *Acacia catechu*, *Caesalpinia pulcherrima*, *Delonix regia*
Melanitis leda (Linnaeus, 1758)	FUR	*Oryza sativa*, *Sorghum bicolor*, *Zea mays*, *Saccharum officinarum*
Lethe europa (Fabricius, 1775)	F	*Bambusa vulgaris*, *Dendrocalamus strictus*
Mycalesis perseus (Fabricius, 1775)	FR	*Oryza sativa*, *Axonopus compressus*
Ypthima asterope (Klug, 1832)	FUR	*Axonopus compressus*
Ypthima huebneri (Kirby, 1871)	FR	*Axonopus compressus, Musa paradisiacal*
Phalanta phalantha (Drury, 1773)	FR	*Gymnosporia senegalensis*, *Xylosma longifolia*
Moduza procris (Cramer, 1777)	FUR	*Cadaba fruticosa*, *Neolamarckia cadamba*
Euthalia aconthea (Cramer, 1777)	FUR	*Mangifera indica*
Euthalia lubentina (Cramer, 1777)	F	*Loranthus longiflorus*
Ariadne merione (Cramer, 1777)	FUR	*Ricinus communis*
Ariadne ariadne (Linnaeus, 1763)	FUR	*Ricinus communis*
Junonia orithya (Linnaeus, 1758)	FR	*Sida rhombifolia*, *Mimosa pudica, Asystasia gangetica*
Junonia iphita (Cramer, 1779)	FR	*Asystasia gangetica*
Junonia atlites (Linnaeus, 1763)	F	*Nelsonia canescens, Limnophila indica*
Junonia almana (Linnaeus, 1758)	FU	*Mimosa pudica*
Junonia lemonias (Linnaeus, 1758)	FU	*Cannabis sativa*, *Sida rhombifolia*
Junonia hierta (Fabricius, 1798)	R	*Asystasia gangetica*

Hypolimnas bolina (Linnaeus, 1758)	FUR	*Sida rhombifolia, Hibiscus rosa sinensis, Asystasia gangetica*
Hypolimnas misippus (Linnaeus, 1764)	FUR	*Sida rhombifolia, Hibiscus rosa sinensis, Asystasia gangetica*
Charaxes solon (Fabricius, 1793)	UR	*Bauhinia racemosa*, *Tamarindus indica, Dalbergia sissoo*
Vanessa cardui (Linnaeus, 1758)	UR	*Hibiscus rosa sinensis, Pisum sativum, Cullen corylifolium*
Acraea violae (Fabricius, 1758)	UR	*Ipomoea carnea, Passiflora spp., Hybanthus emneaspermus*
Eurema hecabe (Linnaeus, 1758)	FUR	*Albizia lebbeck*, *Cassia fistula*, *Acacia nilotica*, *Sesbania bispinosa*, *Mimosa pudica*
Eurema andersonii (Moore, 1886)	F	*Ventilago maderaspatana*
Eurema brigitta (Stoll, 1780)	FUR	*Chamaecrista kleinii*
Ixias pyrene (Linnaeus, 1764)	FR	*Capparis zeylanica, Capparis sepiaria*
Leptosia nina (Fabricius, 1793)	FR	*Cleome rutidosperma, Crateva religiosa, Crateva adansonii, Capparis zeylanica*
Pareronia hippia (Fabricius, 1787)	FUR	*Capparis zeylanica*
Cepora nerissa (Fabricius, 1775)	FUR	*Capparis zeylanica*, *Capparis sepiaria*
Belenois aurota (Fabricius, 1793)	FUR	*Capparis zeylanica*, *Cadaba fruticosa*
Delias eucharis (Drury, 1773)	FUR	*Butea monosperma*, *Loranthus longiflorus*
Ixias marianne (Cramer, 1779)	R	*Capparis sepiaria, Cadaba fruticosa*
Catopsilia pomona (Fabricius, 1775)	FUR	*Butea monosperma, Bauhinia raecemosa, Cassia fistula*
Catopsilia pyranthe (Linnaeus, 1758)	FUR	*Sesbania bispinosa*, *Cassia fistula*
Graphium doson (C. & R. Felder, 1864)	FU	*Polyalthia longifolia*
Papilio polytes Linnaeus, 1758	FUR	*Citrus maxima*, *Aegle marmelos*, *Murraya koenigii*
Pachliopta aristolochiae (Fabricius, 1775)	FUR	*Aristolochia spp., Thottea siliquosa*
Papilio demoleus Linnaeus, 1758	FUR	*Murraya koenigii*, *Ziziphus jujuba, Todalia asiatica, Citrus spp.*

The statistical analysis revealed a decline in species richness and individual counts for both Papilionoidea and plants, progressing from forest to rural to urban areas, indicative of the detrimental impacts of human activity and habitat degradation. Despite this, Simpson's Index remained relatively high across all area types, suggesting that moderate diversity was preserved even as overall numbers and richness decreased. The Shannon Index further underscored that forest areas harbored the greatest diversity, while urban zones consistently displayed the lowest diversity levels. Interestingly, plant evenness was higher in urban areas (0.64) compared to forest and rural zones, potentially highlighting a reduced presence of dominant plant species in urban environments (Figure 1).

The correlation analysis of diversity indices across forest, rural, and urban habitats demonstrates significant relationships between Papilionoidea and plant diversity. A near-perfect positive correlation ($r = 0.999$) was observed between Papilionoidea and plant species richness, indicating that plant-rich habitats also support diverse populations, highlighting their dependence on host plant availability. Similarly, the correlation between total individual counts of Papilionoidea and plants was exceptionally strong ($r = 0.998$), emphasizing the crucial role of plant abundance in sustaining higher populations across habitats. The Shannon diversity index correlation ($r = 0.857$) suggests that higher plant diversity generally supports greater Papilionoidea

diversity, though not in a strictly linear manner, while the correlation for Simpson's index (r = 0.693) was weaker, indicating variable distribution patterns in areas of higher plant diversity (Figure 2).

Figure 1. Diversity Indices comparison of Papilionoidea and plants across different habitats.

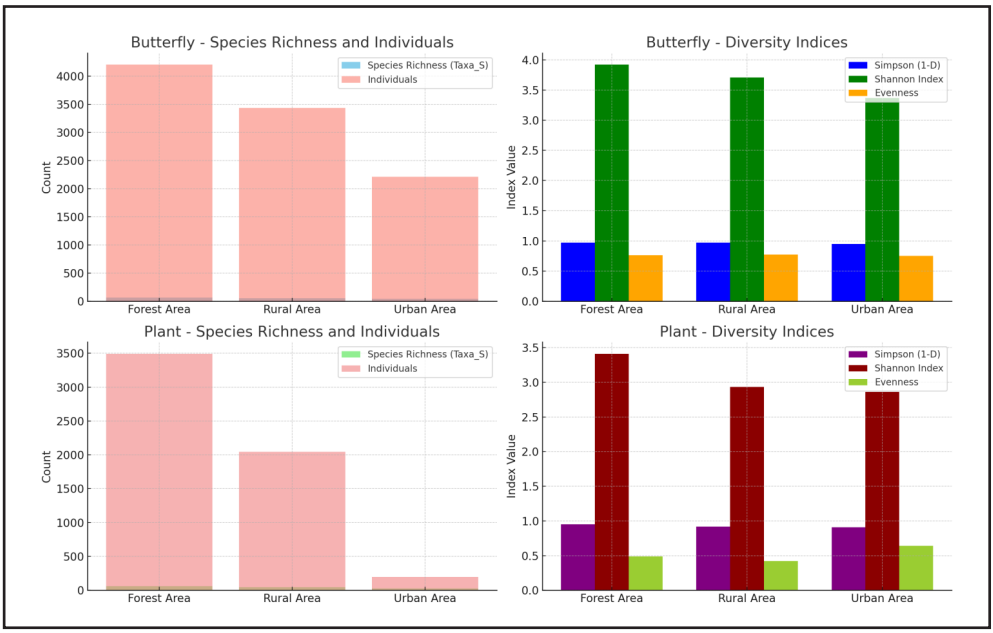
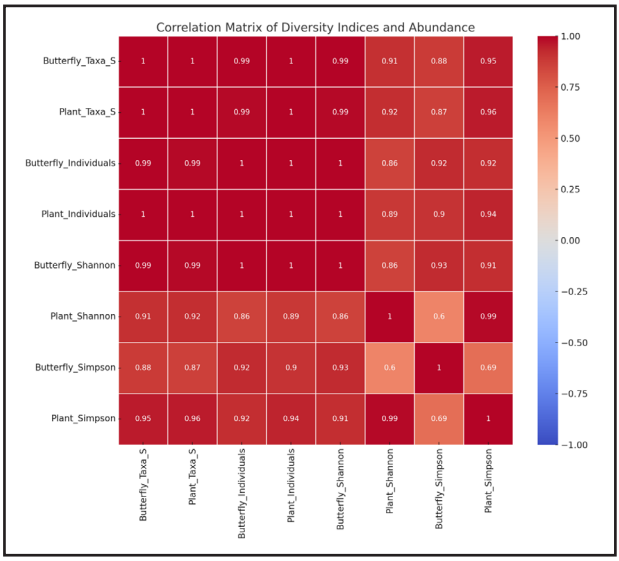


Figure 2. The heatmap showing correlation matrix between host plant and Papilionoidea diversity indices and abundance data of Papilionoidea and plants across different habitats.



Habitat-specific analysis of abundance revealed that forests support the highest numbers of both Papilionoidea (4,204) and plants (3,492), with elevated Shannon (3.92 for Papilionoidea; 3.41 for plants) and

Simpson indices (0.97 for Papilionoidea; 0.95 for plants), underlining the importance of dense vegetation in promoting biodiversity. Rural areas showed reduced counts (3,434 Papilionoidea s; 2,044 plants) but still maintained notable diversity (Shannon indices of 3.71 for Papilionoidea and 2.93 for plants), suggesting a moderate capacity for supporting species diversity. Urban habitats presented the lowest abundance (2,209 Papilionoidea; 199 plants) and the lowest Shannon indices (3.37 for Papilionoidea; 2.86 for plants), indicating significant reductions in host plant availability and subsequent impacts on Papilionoidea populations (Table 2-3).

Table 2. Diversity indices of Papilionoidea species across three different habitat types.

Diversity Indices	Forest Area Papilionoidea	Rural Area Papilionoidea	Urban Area Papilionoidea
Taxa_S	66	53	39
Individuals	4204	3434	2209
1-D (Simpson)	0.97	0.97	0.95
Shannon	3.92	3.71	3.37
Evenness	0.76	0.77	0.75

Table 3. Diversity indices of plant species across three different habitat types.

Diversity Indices	Forest Area Plants	Rural Area Plants	Urban Area Plants
Taxa_S	61	44	27
Individuals	3492	2044	199
1-D (Simpson)	0.95	0.92	0.91
Shannon	3.41	2.93	2.86
Evenness	0.49	0.42	0.64

The findings emphasize that host plant diversity and abundance are key drivers of Papilionoidea population health, with urbanization posing a major threat to biodiversity due to habitat loss and associated pressures. These results advocate for the conservation of plant diversity and abundance to support robust Papilionoidea populations, highlighting forests as ideal environments for sustaining biodiversity, while suggesting that targeted conservation measures are necessary to counteract biodiversity decline in urban areas. These findings collectively emphasize that forests support more resilient and varied populations of both Papilionoidea and plants, whereas urbanization imposes a significant reduction in both species' richness and diversity.

Conflict of Interests

The authors declare that there is no known financial interests or personal relationships that could have influenced the work presented in this article.

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Dos nuevas especies del género *Teldenia* Moore, 1882 de las islas Buru en Indonesia y Mindanao en Filipinas (Lepidoptera: Drepanidae, Drepaninae)

Andrés Expósito-Hermosa

Resumen

Se describen *Teldenia buruanae* Expósito, sp. nov. de Indonesia y *Teldenia apoe* Expósito, sp. nov. de Filipinas. Se incluyen ilustraciones de los adultos y genitalias.
Palabras clave: Lepidoptera, Drepanidae, Drepaninae, *Teldenia,* nuevas especies, Indonesia, Filipinas.

Two new species of the genus *Teldenia* Moore, 1882 from the islands of Buru in Indonesia and Mindanao in the Philippines (Lepidoptera: Drepanidae, Drepaninae)

Abstract

Teldenia buruanae Expósito, sp. nov. from Indonesia and *Teldenia apoe* Expósito, sp. nov. from Philippines are described. Illustrations of the adults and genitalia are included.
Keywords: Lepidoptera, Drepanidae, Drepaninae, *Teldenia,* new species, Indonesia, Philippines.

Introducción

Algunas especies del género *Teldenia* han sido mencionadas, en varias ocasiones, de la isla de Buru, como, por ejemplo, *T. vestigiata* Butler, 1880 (Gaede, 1931, p. 10), que Warren (in Seitz, 1933, p. 452) mantiene. Sin embargo, los estudios efectuados con posterioridad no confirman su presencia de Buru y, por consiguiente, todo aconseja a considerar la cita de Buru como una probable determinación equivocada. Por lo tanto, la distribución de *vestigiata* quedaría limitada a la India, de donde fue descrita, y posiblemente a territorios adyacentes.

Otra especie, que también fue citada de Buru, es *Teldenia specca* Wilkinson, 1967, (Wilkinson, 1967, p. 315). Esta especie, al contrario de la precedente, sí se ha podido confirmar de Buru, con ayuda del material de la zona del Lago Rana 1.350 m, III-2023 (Figuras 3 y 7 genitalia ♀ AEH 3499). Aunque es necesario prevenir qué, en el análisis del mencionado material, se ha localizado una placa cilíndrica situada en el ductus bursae cerca de ostium bursae, que no está figurada en Wilkinson (1967, fig. 19), pero, en general, el resto de los caracteres corresponden indudablemente a *specca.*

Otra especie sería *Teldenia argeta* Wilkinson, 1967 que fue descrita, con material del Monte Dulangan, Mindoro en Filipinas y que el texto también hace referencia a la posible presencia de Buru.

Teldenia argeta Wilkinson, 1967 forma parte del grupo *T. pura* Warren, 1899 que incluye cinco especies.

La distribución precedente, es decir, Mindoro y Buru es mantenida por Yazaki (2012) que recuerda que la ausencia de nuevo material de *T. argeta* Wilkinson, 1967 no permite confirmar su presencia de Buru y, desde luego, la segura de Filipinas.

Hace algún tiempo también se analizó el material depositado en la colección AEH, con etiqueta de Buru y asignado provisionalmente a *argeta*. Posteriormente, un análisis más minucioso del mismo ha puesto de manifiesto la falta de coincidencias, con las imágenes de la descripción de *argeta* aportadas en Wilkinson (1967,

figs. 103-105 genitalia ♀ y fig. 106 genitalia ♀) y, por consiguiente, la asignación a *argeta* se debe considerar como una determinación no correcta.

Para complementar el estudio, se ha contrastado, el citado material, con la descripción de *Teldenia psara* Wilkinson, 1967 de la cercana isla de Ceram a la de Buru (Wilkinson, 1967, figs. 35-37 genitalia ♀ y fig. 39 genitalia ♀) y, además, con otras especies ya descritas de *Teldenia*.

Concluyendo: la falta de coincidencias notables, con otras especies ya censadas de *Teldenia* y con las de otras de géneros afines, aconseja que el material de Buru, de la colección AEH, se describa como una especie nueva.

Asimismo, se ha localizado y estudiado, en la misma colección AEH, material del Monte Apo de la isla de Mindanao en Filipinas, con morfología interna semejante al de Buru. Su estudio ha puesto de manifiesto que no encaja con ninguna de las especies de *Teldenia* ya conocidas e igualmente, se describe como otra especie nueva.

Abreviaturas utilizadas

AEH: Colección y preparación de genitalia de Andrés Expósito Hermosa. Móstoles (Madrid), ESPAÑA.

Sistemática

Teldenia buruanae **Expósito, sp. nov.** (Figuras 1, 4-5)
https://zoobank.org/E04E18C0-020C-4588-8396-B97E56B806CE

Holotipo ♀ Indonesia. Lago Rana, a 1.350 m, Isla de Buru, III-2023 colector local. Paratipos: Indonesia, Wagrahi vil. S. Buru, a 1.400 m, 1 ♂ Genitalia AEH 3501, VI-2013, colector local. Lago Rana, a 1.350 m, Isla de Buru, 1 ♂ Genitalia AEH 3494, III-2023, colector local y Lago Rana, a 1350 m, Isla de Buru, 3 ♀ ♀, III-2023 colector local. El holotipo, así como el resto de los paratipos están depositados en la colección del autor AEH en Móstoles, Madrid (España).

Descripción: Envergadura del macho de 19-20 mm, con las antenas bipectinadas típicas de *Teldenia*. El color del fondo de las alas, así como el abdomen, tórax, etc. son de un uniforme color blanco puro, también clásico en *Teldenia,* pero sin rastro de las bandas discontinuas presentes en otras especies. Además, las alas anteriores muestran un fino borde marrón oscuro, casi negro en la costa: En las alas posteriores este borde es sólo vestigial. Asimismo, el fondo de las alas anteriores tiene paralelo a la costa un débil tono marrón rojizo que también se extiende a la base de las alas anteriores. En las alas posteriores el tono marrón rojizo es sustituido por el uniforme blanco puro. El reverso es similar.

Envergadura de la hembra de 20-22 mm; las antenas son serradas (serrates) clásicas en *Teldenia*, el resto de los caracteres son similares a los del macho.

Genitalia ♂ (Figura 4): Semejante a *niveata* de Sulawesi (Wilkinson, 1967, figs. 7-9; Watson, 1961, figs. 8-10). En la cápsula: Uncus simple y más largo. Socii delgados y con diminuta uña en su zona terminal. Gnathos corto y trapezoidal con los brazos próximos al tegumen más marcados. Zona distal de las valvas puntiagudo, algo más escleritificado que el resto y borde dorsal piloso. Juxta con forma de semi corona circular con los dos brazos laterales gruesos y apuntando hacia arriba. Aedeagus: espatulado en su área proximal, con el resto cilíndrico hasta la vesica y guarnecido de hileras paralelas de diminutas espinitas oscuras que destacan sobre vistoso tono amarillento del fondo. En el 8º segmento: El octavo esternito (sternite) con cuello, en su zona central, más largo y el área terminal bifurcado, pero más alargado (hendidura más marcada y de caras internas curvas); el octavo terguito (tergite) con los apodemas (apodemes) no redondeados.

Genitalia ♀ (Figura 5): Semejante a *niveata* de Sulawesi (Wilkinson, 1967, fig. 10; Watson, 1961, fig. 7). Papilas anales extendidas lateralmente. Las apófisis anteriores son más uniformes y gruesas y planas por su lado distal. Las apófisis posteriores son como las anteriores, ostium cuadrangular. El ductus es continuo con delgada bursa copulatrix que va decreciente hacia el saco accesorio (accesory sac). La bursa copulatrix forma una doble ondulación y el relieve lateral globular. El ductus seminalis emerge de la zona alta de la bursa copulatrix.

Distribución: Endemismo de la isla de Buru en Indonesia.

Etimología: Se denomina esta especie nueva como *buruanae,* que hace referencia a la fauna de Buru.

***Teldenia apoe* Expósito, sp. nov.** (Figuras 2 y 6)
https://zoobank.org/D509B744-20F0-40E0-8202-C025B9798984

Holotipo ♀, genitalia AEH 3500. Filipinas, Mt. Apo, a 2.954 m, IV-2005 Isla de Mindanao, colector local. El holotipo está depositado en la colección del autor AEH en Móstoles, Madrid (España).

Envergadura de la hembra 20 mm, las antenas son serradas (serrates) y resto de la morfología externa semejante a *Teldenia niveata.*

Genitalia de la hembra (Figura 6): Semejante a *niveata* de Sulawesi (Wilkinson, 1967, fig. 10; Watson, 1961, fig. 7). El ostium es cuadrangular más estrecho que en *buruanae* El ductus es continuo con la bursa copulatrix decreciente hasta la intersección con el saco accesorio (accesory sac). La bursa copulatrix es más ancha que en *buruanae* y más recta, el relieve lateral también es globular, pero menos desarrollado. Asimismo, el ductus seminalis surge de la zona alta de la bursa copulatrix.

El macho es desconocido.

Distribución: Endemismo del Monte Apo en la isla de Mindanao, Filipinas, aunque no se excluye su presencia en otras áreas adyacentes.

Etimología: Se denomina esta especie nueva *apoe,* que hace referencia al toponímico del Monte Apo en la isla de Mindanao.

Agradecimientos

Se agradece la colaboración prestada por el Dr. Antonio Vives (Madrid, España).

Conflicto de interés

El autor declara que no tiene ningún interés financiero ni relación personal que pudiera influir en el trabajo presentado en este artículo.

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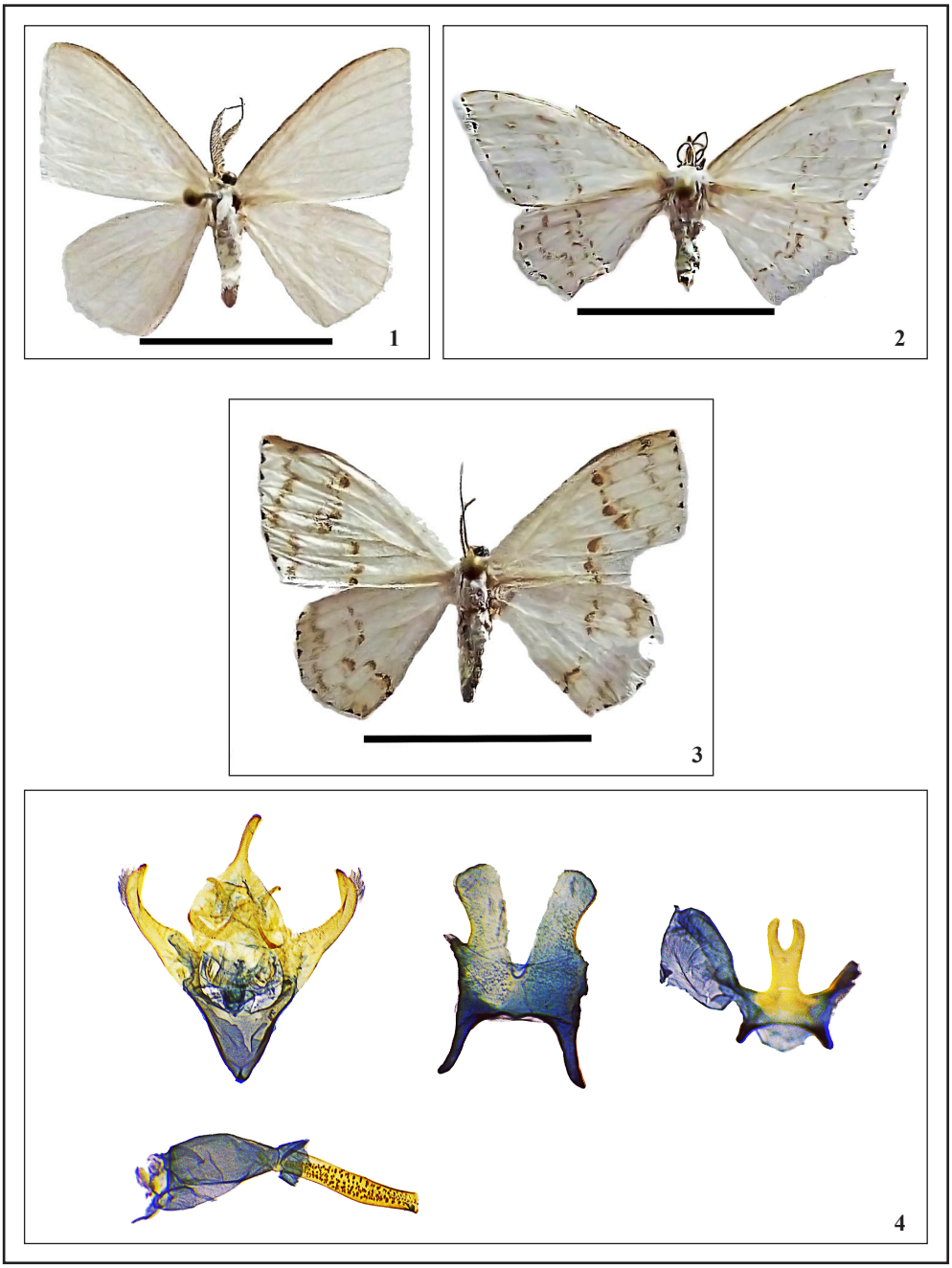
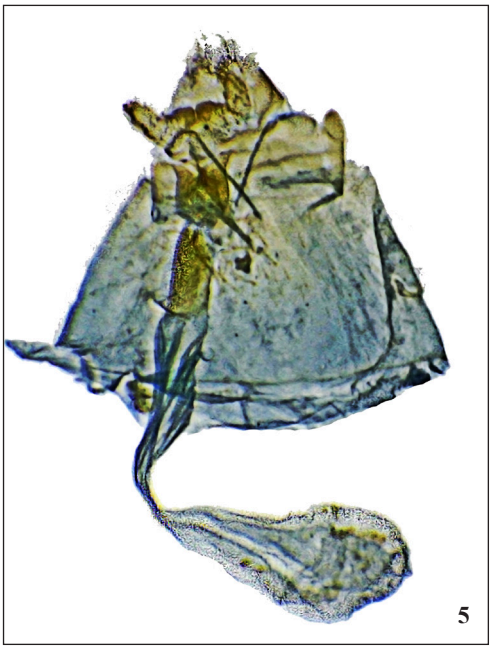
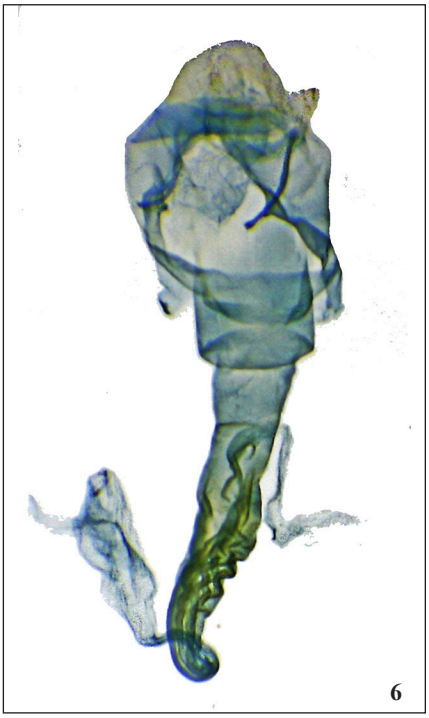
Figuras 1-4. 1. *Teldenia buruanae*, sp. nov., holotipo ♀ anverso **2.** *Teldenia apoe* Expósito, sp. nov., holotipo ♀. **3.** *Teldenia specca* Wilkinson ♀. **4.** *Teldenia buruanae* Expósito, sp. nov., genitalia ♂. paratipo preparación AEH 3494.



Figuras 5-7. 5. *Teldenia buruanae* Expósito, sp. nov., genitalia ♀ paratipo preparación AEH 3495. **6.** *Teldenia apoe* Expósito, sp. nov., holotipo ♀, genitalia preparación AEH 3500. **7.** *Teldenia specca* Wilkinson ♀, genitalia preparación AEH 3499. (escala 1 cm).





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Aspectos bioecológicos de *Pseudautomeris luteata* (Walker, 1865), Argentina (Lepidoptera: Saturniidae)

María Victoria Boaglio, Hernán Sebastián Figueredo, Samanta Molina, Daniela Silvana Ayala & Cecilia Isabel Fernández-Díaz

Resumen

Se investigaron los aspectos bioecológicos de *Pseudautomeris luteata* (Walker, 1865) en la provincia de Misiones, registrándose por primera vez a *Belvosia* sp. parasitando las pupas y *Solanum granulosoleprosum* Dunal como planta nutricia de la especie; asimismo, se proporciona una actualización de la distribución de *P. luteata* en Sudamérica, contribuyendo con información que puede ser utilizada para establecer estrategias de conservación y control para aquellas especies de interés médico o agronómico.
Palabras clave: Lepidoptera, Saturniidae, *Solanum granulosoleprosum*, planta nutricia, parasitoide, Tachinidae, relaciones tróficas, *Belvosia* sp., Argentina.

Bioecological aspects of *Pseudautomeris luteata* (Walker, 1865), Argentina (Lepidoptera: Saturniidae)

Abstract

Bioecological aspects of *Pseudautomeris luteata* (Walker, 1865) were investigated in the province of Misiones, with the first record of *Belvosia* sp. parasitizing the pupae and *Solanum granulosoleprosum* Dunal, as a nutritional plant for the species. Additionally, an update on the distribution of *P. luteata* in South America is provided, contributing valuable information for the establishment of conservation and control strategies for medically or agronomically important species.
Keywords: Lepidoptera, Saturniidae, *Pseudautomeris lutea*, *Solanum granulosoleprosum*, host plant, parasitoid, Tachinidae, trophic relationships, *Belvosia* sp., Argentina.

Introducción

La familia Saturniidae está constituida por 3.454 especies de las cuales alrededor de 70% se distribuye en la región neotropical (Decaëns et al. 2021; GBIF, 2024; Kitching et al. 2018). En Argentina, se han registrado más de 140 especies pertenecientes a esta familia (Zapata et al. 2012). El género *Pseudautomeris* Lemaire, 1974, abarca 35 especies y se diferencia en dos grupos de especies basados, principalmente, en la distribución y características del aparato reproductor (Lemaire, 2002).

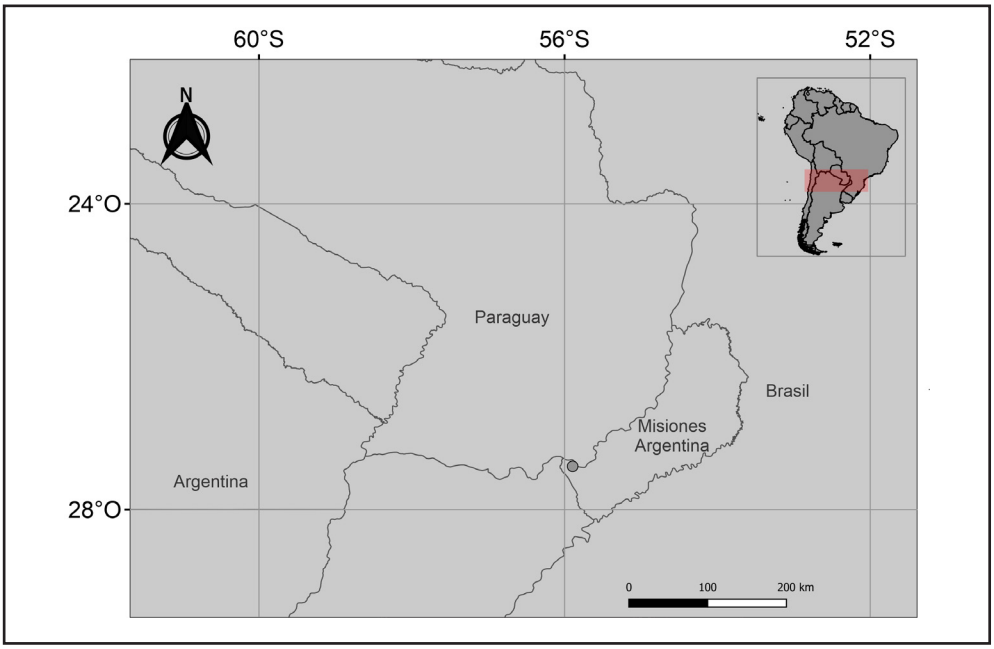
En Argentina los reportes de *Pseudautomeris luteata* (Walker, 1865) citan a la especie en las regiones del Noreste Argentino (NEA) y Noroeste Argentino (NOA), además, en la provincia de Misiones ha sido señalada de importancia en salud pública debido a que las larvas causan dermatitis en humanos al contacto con sus setas (Martínez et al. 2019; Nuñez-Bustos, 2015). Hasta la fecha se ha documentado información para la especie en Paraguay y Brasil relacionada a las plantas nutricias, datos secundarios obtenidos de observaciones en plataformas de ciencia ciudadana como iNaturalist, y el registro de un ejemplar ginandromorfo en la

colección entomológica del museo de historia natural de Paraguay (Diniz et al. 2001; PYBIO, 2024; Sánchez-Soto et al. 2003). No obstante, aún no se ha investigado a fondo las interacciones tróficas relacionadas con *P. luteata*. Entender esta dinámica nos proporcionará información sobre cómo se relacionan las plantas, los herbívoros y sus enemigos naturales. En este contexto, el objetivo de este trabajo fue describir los aspectos bioecológicos de *P. luteata*, considerando los datos recolectados en el área de recursos ambientales (ARA) Zaimán, Misiones, Argentina y los obtenidos mediante el seguimiento del ciclo de vida en condiciones de laboratorio.

Materiales y Métodos

Se recolectaron de forma directa 12 especímenes en estadío larval en noviembre de 2017 en el Área de Recursos Ambientales (ARA) Zaimán (27º25'59,803"S; 55º53'41,391"O) en la ciudad de Posadas, provincia de Misiones, Argentina (Figura 1). El ARA Zaimán es una reserva urbana y periurbana que comprende 62 hectáreas (Entidad Binacional Yacyretá, 2024) ubicada en los márgenes del arroyo El Zaimán. Se encuentra situada en la ecorregión de los Campos y Malezales, que se caracteriza por estar dominada por pastizales con parches aislados de bosques que bordean las márgenes fluviales (Burkart et al. 1999).

Figura 1. Área de muestreo. Área de Recursos Ambientales Zaimán, Misiones, Argentina.

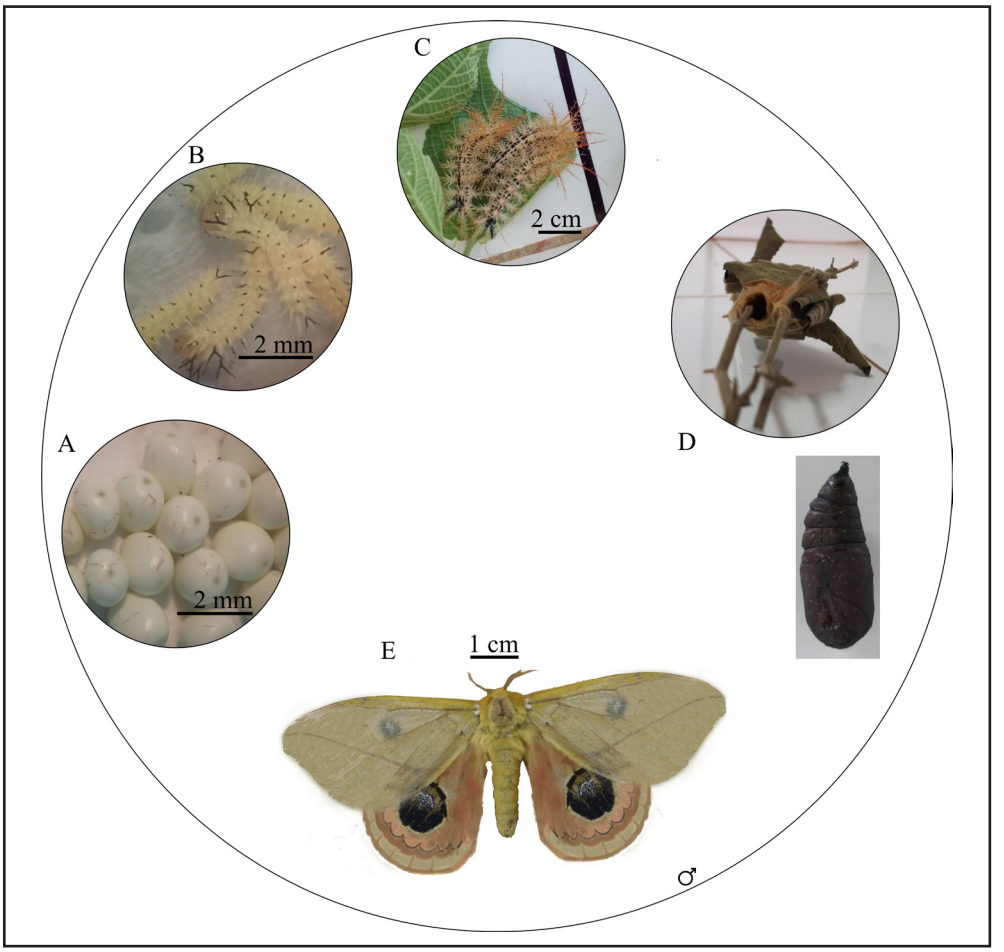


Las larvas recolectadas fueron trasladadas y acondicionadas en un laboratorio de la Facultad de Ciencias Exactas, Químicas y Naturales (FCEQyN - UNaM) y mantenidas en recipientes plásticos cilíndricos (25 cm x 15 cm) hasta completar el ciclo. De algunas pupas emergieron parasitoides adultos de moscas de la familia Tachinidae, los cuales fueron inmediatamente conservados en alcohol al 97%. Su posterior identificación taxonómica se realizó siguiendo a Monty Wood & Zumbado (2010). Todos los parasitoides fueron depositados en la colección entomológica del Programa de Investigación Entomología de Misiones (PrEM), de la Universidad Nacional de Misiones (UNaM).

Aquellas larvas no afectadas por el parasitoide completaron su ciclo y posteriormente dieron lugar a huevos, que fueron removidos diariamente y almacenados en cajas de Petri plásticas revestidas en su base con papel tisú para mantenerlos húmedos hasta la eclosión. Una vez eclosionadas las larvas, fueron colocadas en cajas de cría para su seguimiento. Para confirmar los números de estadios larvales se siguió la Ley de

Dyar. Las mediciones se realizaron en una lupa Leica MZ6 con ocular micrométrico según el tamaño de los ejemplares. Los valores medios diarios de temperatura y humedad relativa fueron registrados con un termohigrómetro digital.

Figura 2. Ciclo de vida de *Pseudautomeris luteata*. **A.** Huevo. **B.** Primer estadio larval. **C.** Últimos estadíos larvales. **D.** Pupa. **E.** Adulto.



Para confirmar la identidad taxonómica de las plantas hospedadoras se realizó una comparación con materiales herborizados del Darwinion.

Finalmente, a partir de datos recolectados de la literatura específica y de diferentes puntos de ocurrencia en bases de datos (i.e. Bold System, GBIF, iNaturalist) tanto de las plantas nutricias como de la especie en estudio, se construyó un mapa de distribución geográfica destacando las regiones biogeográficas (Morrone, 2014; Löwenberg-Neto, 2014, 2015). Para la construcción del mapa se utilizó el programa QGIS3 versión 3.16.13-Hannover (https://www.qgis.org/es/site/).

Resultados y Discusión

Pseudautomeris luteata (Walker, 1865), es una especie cuya presencia ha sido previamente reportada en Argentina y en la provincia de Misiones (Martínez et al. 2019; Nuñez-Bustos, 2015).

El ciclo de *P. luteata* tuvo una duración total de 105±5 días, bajo condiciones de temperatura promedio de 28,3ºC (con máximas de 31,6ºC y mínimas de 20ºC), humedad promedio de 56,46% y fotoperiodo de luz-oscuridad 13/11 (Figura 2). Los huevos presentaron un tiempo de desarrollo promedio de 16±2 días, coloración blanquecina y tamaño de 3,14 mm de diámetro por 2 mm de longitud. En estado de larva permanecieron 55±5 días, alcanzando un tamaño que varió de 5 mm a 26 mm en promedio. Las recientes neonatas son oligópodas, con cabeza anaranjada, coloración corporal amarillo-verdosa muy clara con setas traslúcidas recubriendo toda la superficie dorsal y lateral, además caudalmente presentan una seta apical negra de mayor grosor y longitud. Los instares más avanzados presentaron cabeza marrón con antenas y setas amarillas ramificadas, y un patrón de manchas corporales negras con una línea dorsal de igual color que se extiende desde la cabeza hasta la región caudal. Las larvas tuvieron un comportamiento gregario en el envés de la hoja y se desplazaban de manera procesionaria (Figuras 3a, b). La cantidad de estadios larvales constatados mediante mediciones de las cápsulas cefálicas fueron 7 (Figura 4). El estado de pupa duró 24±4 días, el capullo está formado por hojas y seda. Los adultos vivieron 10±3 días en cautiverio exhibiendo una coloración amarillo-anaranjado y alas posteriores con los ocelos característicos.

A partir de la duración de los diferentes estados obtenidos en condiciones controladas y utilizando datos secundarios de los registros de ocurrencias en iNaturalist se reconstruyó la fenología de *P. luteata* que se muestran en la Figura 5. Con esto se determinó la existencia de dos generaciones por año (bivoltina).

Posterior a los 99 días desde la colecta, a través de una abertura apical en la envoltura pupal emergieron parasitoides adultos pertenecientes a la familia Tachinidae (Diptera). El porcentaje de parasitismo de los especímenes recolectados fue del 25% (3 de 12). Siguiendo a Monty Wood & Zumbado (2010), los parasitoides fueron identificados como *Belvosia* Robineau-Desvoidy, 1830 (Exoristinae) (Figura 6). Esto coincide con la bibliografía que señala que los ejemplares de la familia Tachinidae, extensamente reportados en Argentina, son importantes enemigos naturales de los lepidópteros, por tanto, son considerados buenos agentes de biocontrol (Bautista-Zamora, 2019; Cortés, 1979; Gramajo, 1998; Hernández-García et al. 2016; Mulieri et al. 2023; Ruiz, 2021). Por otro lado, existen diversos registros de ejemplares del género *Belvosia* parasitando Lepidoptera de la familia Saturniidae (Chadee et al. 1982; Fleming et al. 2023; Hernández et al. 2009; Quezada et al. 1989; Ramírez et al. 2004; Silva et al. 2023; Voitier et al. 2017). Este hallazgo constituye el primer registro de *Belvosia* sp. parasitando a *P. luteata*.

La planta nutricia sobre la que se realizó la colecta fue identificada como *Solanum granulosoleprosum* Dunal 1852 (Solanacea). Si bien este trabajo registra por primera vez a *Pseudautomeris luteata* alimentándose de la especie *S. granulosoleprosum*, existen reportes previos que describen distintas especies de Solanaceae como plantas nutricias de Lepidopptera de la familia Saturnidae (Diniz et al. 2001; Soares et al. 2019). En la tabla 1 se listan las plantas nutricias de *P. luteata* publicadas hasta el momento en la bibliografía. Por otro lado, los autores realizaron observaciones directas de larvas de *P. luteata* sobre *Celtis tala* Gillies ex Planch. Al momento de hacer seguimiento del ciclo de vida en condiciones controladas de laboratorio se probó la resistencia de ambas especies vegetales. Resultando que *S. granulosoleprosum* fue menos resistente al marchitamiento que *C. tala*; la que presentó mayor versatilidad al ser una especie leñosa.

Tabla 1. Plantas nutricias citadas para *Pseudautomeris luteata*.

Lepidoptera			**Planta nutricia**			**Cita**
Familia	**Género**	**Especie**	**Familia**	**Género**	**Especie**	
Saturniidae	*Pseudautomeris*	*P. luteata*	Rubiaceae	*Alibertia*	*A. edulis*	Diniz et al. 2001
Saturniidae	*Pseudautomeris*	*P. luteata*	Metteniusaceae	*Emmotum*	*E. nitens*	Diniz et al. 2001
Saturniidae	*Pseudautomeris*	*P. luteata*	Poaceae	*Zea*	*Z. mays*	Sanchez-Soto et al. 2003
Saturniidae	*Pseudautomeris*	*P. luteata*	Cannabaceae	*Celtis*	*C. tala*	Este trabajo
Saturniidae	*Pseudautomeris*	*P. luteata*	Solanaceae	*Solanum*	*S. granulosoleprosum*	Este trabajo

En la Figura 7 se ilustra la distribución de *Pseudautomeris luteata* y de sus plantas nutricias registradas hasta el momento para Sudamérica. La distribución de *P. luteata* abarca desde Venezuela, Surinam hasta el norte de Argentina. Particularmente en el nordeste argentino, los datos muestran que la especie se distribuye a lo largo de la provincia de Misiones. Estos datos permiten complementar aquellos informados por Nuñez-Bustos (2015) y Martínez et al. (2019), actualizando y ampliando el área de distribución conocida de la especie. Además, debido a que existen reportes sobre la importancia médica, conocer el área de ocupación de la especie es importante para implementar programas de vigilancia y monitoreo.

Las investigaciones sobre los aspectos biológicos y ecológicos de los lepidópteros de la familia Saturniidae suelen ser escasos. En este contexto, este artículo contribuye proporcionando información sobre el ciclo de vida, plantas nutricias y enemigos naturales que puede ser utilizada para comprender y establecer tanto estrategias de conservación como de control para aquellas especies de interés médico o agronómico (Bórquez et al. 2012; Zapata et al. 2012).

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Conflicto de interés

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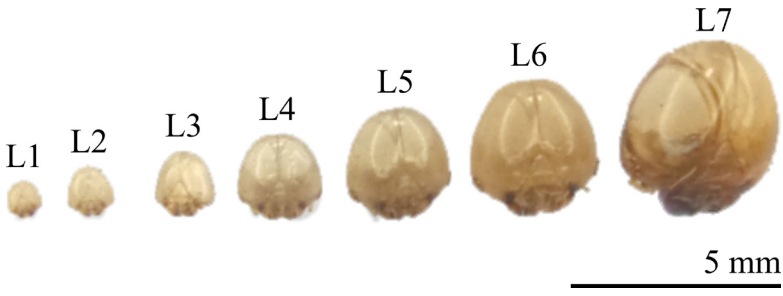
Figuras 3-4. 3. A. Larvas gregarias en envés de hoja. **B.** Movimiento en tándem de larvas. **4.** Cápsulas cefálicas de los estadios larvales.

3A

3B



4

Figuras 5-6. 5. Fenología: Duración de los estados de *Pseudautomeris luteata*. **6.** *Belvosia* sp. (Diptera: Tachinidae).

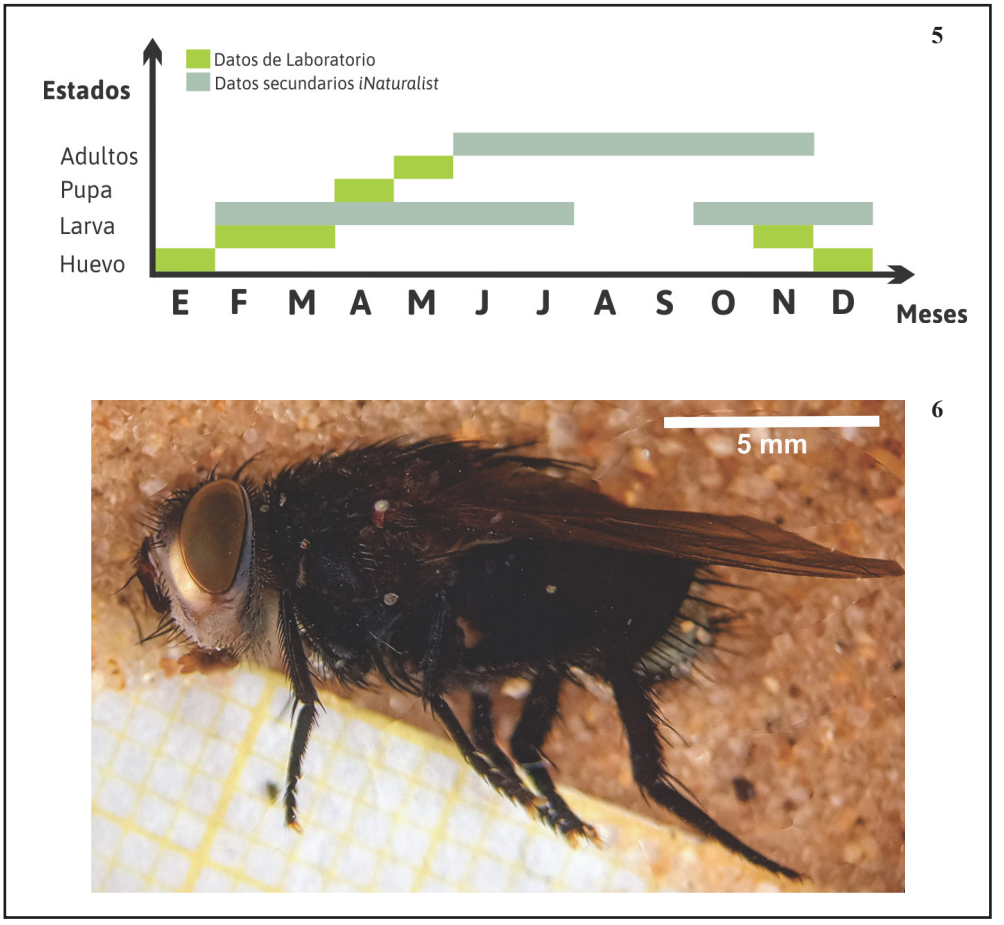
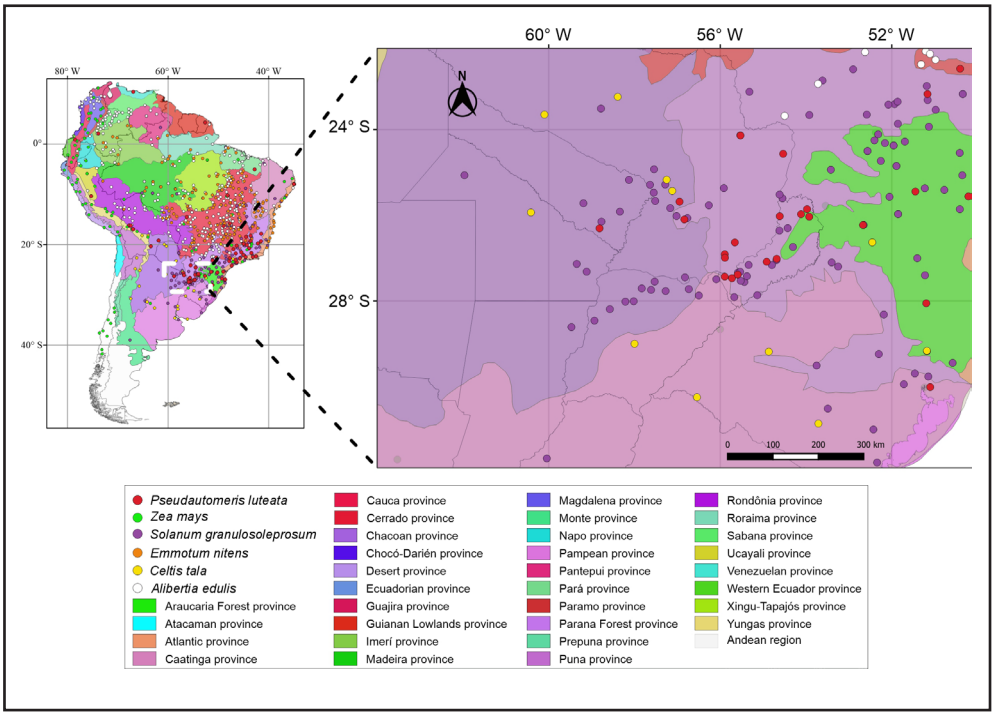


Figura 7. Distribución de *Pseudautomeris luteata* y las plantas nutricias en la Región Neotropical.



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New larval host plants association of *Pieris brassicae nepalensis* Gray, 1846 from India (Lepidoptera: Pieridae)

Monish Kumar Thapa, Sandip Limboo, Dilip Dhakal Sharma, Sonam Wangchuk Lepcha & Sonam Pintso Sherpa

Abstract

A survey conducted in Uttarey village, located in the western district of Sikkim, India, has revealed important findings regarding the larval host plants of the *Pieris brassicae nepalensis* Gray, 1846. This study is particularly noteworthy as it implicates *Matthiola incana* (L.) W. T. Aiton from the Brassicaceae family and *Spinacia oleracea* (L.) from the family Chenopodiaceae as new larval host plants for this species. This discovery is the first report of these plants serving as host plants for *Pieris brassicae nepalensis* Gray, 1846 in India. It adds valuable knowledge to the ecology of the Papilionoidea and expands the known range of larval food sources for this species.
Keyword: Lepidoptera, Pieridae, *Pieris brassicae nepalensis*, new host plants, Sikkim, India.

Nueva asociación de plantas nutricias de *Pieris brassicae nepalensis* Gray, 1846 de la India (Lepidoptera: Pieridae)

Resumen

Un estudio realizado en el pueblo de Uttarey, situado en el distrito occidental de Sikkim (India), ha revelado importantes hallazgos sobre las plantasnutricias de larvas de la *Pieris brassicae nepalensis* Gray, 1846. Este estudio es especialmente digno de mención, ya que implica a *Matthiola incana* (L.) W. T. Aiton, de la familia Brassicaceae, y a *Spinacia oleracea* (L.), de la familia Chenopodiaceae, como nuevas plantas hospedadoras de larvas de esta especie. Este descubrimiento es el primer informe de estas plantas como plantas nutricia de *Pieris brassicae nepalensis* Gray, 1846 en la India. Añade valiosos conocimientos a la ecología de los Papilionoidea y amplía la gama conocida de fuentes de alimento larvario para esta especie.
Palabra clave: Lepidoptera, Pieridae, *Pieris brassicae nepalensis*, nuevas plantas hospedadoras, Sikkim, India.

Introduction

Pieris brassicae (Linnaeus, 1758) belong to the family Pieridae within the order Lepidoptera. There is only one subspecies of *Pieris brassicae* found in India; that is *P. brassicae nepalensis* Gray, 1846. *P. brassicae nepalensis* is distributed from Jammu and Kashmir to the Northeast India, reaching Uttar Pradesh, Delhi, Bihar, and Punjab (Varshney & Smetacek, 2015).

The Brassicaceae family, formerly known as Cruciferae, boasts a diverse range of economically important crops such as cabbage, cauliflower, knoll khol/kohlrabi, turnips, broccoli, kale, and others, which are cultivated on a large scale throughout the world (Rasool & Mir, 2023). This rise in popularity of Brassicaceae products is due to their nutritional richness and their recognized properties such as anti-cancer, antioxidant and anti-inflammatory properties (Jaiswal et al. 2011). *Matthiola incana* (L.) W. T. Aiton is a

popular ornamental plant used for bedding or cut flowers, known for its variety of vibrant flower colours (Tatsuzawa et al. 2012) and has become an economically important floral plant (Hisamatsu et al. 2000).

Spinacia oleracea L. belongs belonging to the Chenopodiaceae family, a leafy green vegetable that originated in southwestern Asia, is now cultivated worldwide. It is primarily known for its culinary uses but also boasts medicinal properties. It is rich in vitamins, including vitamin A, vitamin C and vitamin E, and minerals such as magnesium, manganese, iron, calcium, and folic acid (Gaikwad et al. 2010).

Annex 1. Previous records of some host plants of *Pieris brassicae nepalensis.*

Species	**Host Plants**	**References**
Pieris brassicae nepalensis	*Brassica nigra* (L.)	Karmakar et al. 2018; Robinson et al. 2010
	Brassica juncea (L.)	Thapa et al. 2023
	Brassica oleracea var. *capitata* (L.)	Rasool & Mir, 2023; Das, 2017
	Brassica oleracea var. *botrytis* (L.)	Rasool & Mir, 2023; Das, 2017
	Brassicae oleracea var. *acephala* (DC.)	Rasool & Mir, 2023
	Brassicae oleracea var. *gongylodes* (L.)	Rasool & Mir, 2023
	Brassicae campestris L.	Das, 2017
	Tropaeolum majus (L.)	Das, 2017; Karmakar et al. 2018; Negi & Joshi, 2018
	Cleome rutidosperma DC	Das, 2017

The lifecycle of Lepidoptera depends heavily on larval host plants because caterpillars, usually herbivorous, rely heavily on a select range of plants to meet their nutritional and chemical requirements (Nitin et al. 2018; Sharma et al. 2023). But still the knowledge about the larval host plants of butterflies and early life stages were rare (Sharma et al. 2023). Now-a-days, few works have been done regarding the larval host or food plants of Indian Lepidoptera. Robinson et al. (2010) prepared a database of the World's Lepidopteran Hostplants. Das (2017) studied on the larval food preferences of *Pieris brassicae nepalensis* in the laboratory. Rasool & Mir (2023) studied about the distribution and host plant preferences of *Pieris species* in Kashmir Valley. Mukherjee & Mondal (2023) prepared a preliminary checklist of larval host plants of butterflies of Bankura and Purulia district of West Bengal. Recently, Sharma et al. (2023) reported new larval host plant of *Tagiades menaka* butterfly from Sikkim, India. Very recently, Thapa et al. (2023) studied about the butterflies' larval hostplants' specificity in Garbhanga Reserve Forest (Proposed Wildlife Sanctuary) and Rani Reserve Forest of Kamrup district of Assam, India. But they didn't record that *Matthiola incana* and *Spinacia oleracea* L. as a larval host plant of *P. brassicae nepalensis* (Annex 1).

Materials and Methods

An opportunistic field survey was conducted in SL's backyard garden. On 01-IV-2024, the first author observed an adult female of *P. brassicae nepalensis* laying eggs on leaves of *Matthiola incana* (Figure 2b) at Uttarey village in the district of West Sikkim, India at an altitude of around 6600 ft. from the mean sea level and the coordinates were recorded as (27º16'28.4"N latitude and 88º06'01.5"E longitude) (Figure 1). Four days later, the yellow-coloured eggs successfully hatched into yellowish 1st instar larvae, which began to feed on the leaves of the same plant (Figure 2d). The author closely monitored the caterpillar during this period and note down its feeding and shelter patterns. After few days, the caterpillar goes into second instar with some black dots on the body (Figure 2e). On the day 16th, the same larva was observed as third instar

and transformed his body into green colour (Figure 2f). After 24 days of hatching, the larva, it moves into another plant (*Spinacia oleracea* L.) and started to feed the leaves of the spinach plant (Figures 2g-h). On the day 30, the larva goes into fifth larval stage. The caterpillar continued its life cycle by feeding on the leaves of *Spinacia oleracea* L. and two days later, the caterpillar goes to pupal stage (Figure 2i). Thirteen days after (45th day) pupating, an adult *P. brassicae nepalensis* emerged from the chrysalis (Figure 2j). The life history and larval host plants of this species in India have not been previously recorded on *Matthiola incana* and *Spinacia oleracea* plant. The identification of the enclosed Papilionoidea was based on Kehimkar (2016), and observations of immature stages were also made in the natural environment.

Figure 1. The map shows the study area Uttarey village in the district of West Sikkim, India.

Result

The host plants of *P. brassicae nepalensis* were observed to be *Matthiola incana* and *Spinacia oleracea* which had not been recorded before. It took a total of 45 days to emerge as an adult butterfly from the egg stage. The life cycle of *P. brassicae nepalensis* in the plants *Matthiola incana* and *Spinacia oleracea* in India have not been illustrated or recorded to date. Therefore, this will be the first record of the larval host plants and the life cycle of *P. brassicae nepalensis* in *Matthiola incana* and *Spinacia oleracea*.

Discussion

Survey at Uttarey village of West Sikkim reveals that *Matthiola incana* (L.) and *Spinacia oleracea* (L.) are the new larval host plants for the large cabbage white butterfly, *Pieris brassicae nepalensis* Gray, 1846, a first in India. The discovery expands the known range of larval food sources, highlighting the adaptability of the species to different environments and plants. Previously, the larval hosts of *P. brassicae* in India were mainly restricted to cruciferous vegetables. The inclusion of these new plants suggests greater flexibility in the butterfly's larval diet, indicating potential resilience to habitat change and the implications for pest management in agriculture. This information is crucial for further studies on growth and plant interactions of *P. brassicae*.

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Conflict of Interest

The authors declare that there is no known financial interest or personal relationships that could have influenced the work presented in this article.

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Figure 2. (a) Host plant *Matthiola incana* (L.) of *Pieris brassicae nepalensis*. **(b)** *P. brassicae* laying eggs. **(c)** Egg of *P. brassicae*. **(d)** First instar larva. **(e)** Second instar larva. **(f)** Third instar larva.

Figure 2. (g) Fourth instar larva moves to *Spinacia oleracea* plant and started to feed the leaves. **(h)** Larva feeding *Spinacia oleracea* plant. **(i)** Pupa. **(j)** Freshly emerged adult *P. brassicae*.

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Uncovering the grape-like aroma of *Atlides polybe* (Linnaeus, 1763) (Lepidoptera: Lycaenidae, Theclinae)

Carlos Eduardo Beserra Nobre, Daniela Maria do Amaral Ferraz Navarro & Artur Campos Dália Maia

Abstract

In our study, we examined the volatile androconial scent chemistry of *Atlides polybe* (Linnaeus, 1763), a Lycaenidae species known for its distinctive "grape-like" aroma. This is the first Theclinae species to have its androconial secretions chemically investigated. Analysis of solvent sample using gas chromatography-mass spectrometry revealed 13 ion peaks corresponding to distinct volatile compounds. Among these, methyl anthranilate emerged as the dominant compound, primarily associated with the aldehydes heptanal, octanal, and (*E*)-2-decenal. This study marks the first report of methyl anthranilate as a volatile compound in Papilionoidea. Interestingly, methyl anthranilate is widely used as the primary grape flavoring agent in the flavor and fragrance industry, matching the scent emitted by *A. polybe*. The presence of methyl anthranilate as an androconial constituent, along with aldehydes imparting fruity odors, delineates a unique chemical bouquet among Papilionoidea. This composition likely serves as a sex pheromone and may also fulfill complementary functions, such as predator deterrence.
Keywords: Lepidoptera, Lycaenidae, Theclinae, androconia, CG-MS, male pheromones, secondary sexual organs, semiochemicals, VOCs.

Descubriendo el aroma de uva de *Atlides polybe* (Linnaeus, 1763) (Lepidoptera: Lycaenidae, Theclinae)

Resumen

En nuestro estudio, analizamos los compuestos químicos volátiles de los aromas de las androconias de *Atlides polybe* (Linnaeus, 1763), una especie de Lycaenidae que es conocida por su aroma que se asemeja al de las uvas. Esta es la primera especie de Theclinae que posee secreciones androcónicas analizadas bajo una óptica química. Los análisis de muestras de solventes utilizando cromatografía de gases-espectrometría de masas permitió observar 13 picos de iones correspondientes a diferentes compuestos volátiles. Entre ellos, el antranilato de metilo se destacó como el compuesto dominante y estuvo primariamente asociado con los aldehídos heptanal, octanal y (*E*)-2-decenal. Este estudio representa el primer registro de antranilato de metilo como un compuesto volátil en Papilionoidea. Curiosamente, el antranilato de metilo es ampliamente utilizado como el agente saborizante primario de uvas dentro de la industria de los sabores y olores, combinado con el aroma emitido por *A. polybe*. La presencia del antranilato de metilo como un compuesto androcónico, juntamente con aldehídos que están relacionados a los olores frutales, representan un ramo químico único entre los Papilionoidea. Esta composición probablemente sirve como una feromona sexual y puede también poseer funciones complementaras, para evitar a los depredadores.
Palabras clave: Lepidoptera, Lycaenidae, Theclinae, androconia, CG-MS, feromonas masculinas, órganos sexuales secundarios, semioquímicos, COV.

Desvendando o aroma de uva da *Atlides polybe* (Linnaeus, 1763) (Lepidoptera: Lycaenidae, Theclinae)

Resumo

Em nosso estudo, analisamos os compostos químicos voláteis das androcônias de *Atlides polybe* (Linnaeus, 1763), um Lycaenidae conhecido por seu aroma que se assemelha ao de uva. Esta é a primeira espécie de Theclinae a ter suas secreções androconiais examinadas do ponto de vista químico. A análise por cromatografia de gases/espectrometria de massas do extrato androconial de *A. polybe* permitiu a observação de 13 picos de íons, correspondentes a diferentes compostos voláteis. Entre eles, antranilato de metila se destacou como composto dominante, associado principalmente aos aldeídos heptanal, octanal e (*E*)-2-decenal. Este estudo representa o primeiro registro de antranilato de metila como composto volátil em Papilionoidea. Curiosamente, antranilato de metila é amplamente usado como o principal agente flavorizante de uva pela indústria de aromas e combina com o odor de *A. polybe* percebido pelo olfato humano. A presença de antranilato de metila como principal constituinte androconial, juntamente a aldeídos que emitem odores frutados, delineia um buquê químico único entre os Papilionoidea. Tal composição provavelmente atua como feromônio sexual e pode desempenhar funções complementares, como deterrência de predadores.

Palavras-chave: Lepidoptera, Lycaenidae, Theclinae, androconia, CG-MS, feromonas masculinas, órgãos sexuais secundários, semioquímicos, COVs.

Introduction

The term "pheromone" was coined in 1959 by Peter Karlson and Mark Lürscher in close association with the chemical characterization of bombykol, a volatile unsaturated fatty alcohol secreted by female silk moths (*Bombyx mori* Linnaeus, 1758; Bombycidae) that stimulates the sex-oriented behavior of conspecific males (Butenandt et al. 1959). Since then, many species of Lepidoptera have been found to use a variety of volatile organic compounds in their chemical communication, with a particular focus on agronomical pests (El-Sayed, 2024).

While not all volatile organic compounds (VOCs) emitted by lepidopterans are perceivable to humans as scents, lepidopterologists have long described the perfumes of collected specimens (see Ando et al. 2004; Ehlers & Schulz, 2023). Among the Papilionoidea, for example, unpleasant and noxious smells are emitted by the larvae of *Parnassius* spp. (Papilionidae) and *Danaus* spp. (Nymphalidae), which are derived - at least partially - from glycosides and alkaloids sequestered from toxic plants they feed on (Bjarnholt et al. 2012; Schulz, 1998). Conversely, adult males of *Pieris napi* (Linnaeus, 1758) (Pieridae) give off a citric aroma during flight, attributed to the emission of geranial and neral (Bergström & Lundgren, 1973). Among the Lycaenidae, male theclines (Eumaeini) are known for the pleasant perfumes in their androconia, described as intensely floral, chocolaty, or fruity (Longstaff, 1912; Müller, 1878). However, very little is known about the chemistry of androconial volatile organic compounds (VOCs) in this group (Ehlers & Schulz, 2023).

Atlides polybe (Linnaeus, 1763) (Figure 1), is a Neotropical species widely distributed from Mexico through Central America to northern Argentina (Warren et al. 2023). Despite its widespread distribution, it seems to be a naturally rare species in nature (Brown, 1992; Godman & Salvin, 1887). Like other species in the *Atlides* Section of Eumaeini, it is recognizable and praised for its exuberant colors. Furthermore, collectors have also reported a distinctive "grape-like" aroma from male specimens (Nobre & Schlindwein, 2016; Robbins et al. 2012), presumably originating from their forewing androconial organs (Müller, 1878). These secondary sexual structures are composed of a proximal scent pad that contains secretory cells inside a cavity between the wing membranes, and a distal scent patch of clustered black scales (Martins et al. 2019; Robbins et al. 2012). Our objective was to investigate the volatile scent chemistry of the wing androconia of *A. polybe* and identify the likely compound(s) responsible for the characteristic aroma of this species.

Material and methods

We collected an adult male of *A. polybe* in the municipality of Areia Branca (10º45'35"S, 37º20'36"W; 170 m.a.s.l.), state of Sergipe, northeastern Brazil, for the characterization of androconial VOCs. Following capture, the specimen was sacrificed by thorax pinching, sealed into a clean PTFE plastic envelope (5 x 5 cm), and kept under -24º C refrigeration for ~ 120 h until processing.

Sample collection and preparation were performed following standard protocols for solvent extraction (refer to Nobre et al. (2021) for details). The hind and forewings of the collected specimen were excised using micro scissors and placed in a clear 2 mL silanized glass vial containing 1.5 mL hexane (≥ 99.7% purity, Sigma-Aldrich, USA). The crude solvent extract was filtered through a silanized glass Pasteur pipette plugged with silanized glass wool (Sigma-Aldrich, USA) to remove floating scales and other debris. The sample was then concentrated to 0.25 mL under a laminar N_2 flow and stored at -24ºC until analysis (see below). A solvent negative control was obtained under the same conditions.

Samples were analyzed on a gas chromatograph coupled to a mass spectrometer (GC-MS; Agilent 7890A™ gas chromatograph, Agilent 5975C Series MSD™ mass spectrometer) and equipped with a non-polar HP-5ms column (Agilent J&W; 30 m x 0.25 mm i. d., 0.25 µm film thickness. A split/splitless inlet was fitted with an Agilent Thermal Separation Probe (TSP). For the analysis of samples, 1 µL was injected into a quartz micro vial which was then inserted in the TSP vial holder. The GC inlet operated on split mode (1:5) and the injector temperature was set to 250º C. The GC oven temperature started at 40º C for 1 minute and then increased at a rate of 6º C/min up to 270º C. Helium (He) carrier gas flow was maintained at 1.5 mL/min. MS source and quadrupole temperatures were set at 230º C and 150º C, respectively. Mass spectra were taken at 70 eV (in EI mode) with a scanning speed of 1.0 scan/s from m/z 35-450.

Compounds were tentatively identified by comparison of linear retention indices (RIs) based on a series of n-alkanes (C7-C30; Van den Dool & Kratz, 1963) and mass spectral data available in reference libraries (FFNSC 2, MACE r04, NIST20). Confirmation of the identity of targeted compounds was further obtained by comparison with authentic synthetic standards (Sigma-Aldrich Co./Supelco, USA). For analysis, only ion chromatogram peaks which contributed to at least 0.5 % of the total ion signal were contemplated, and contaminants were ignored. Since our objective was focused on volatile compounds, we only considered those that eluted earlier than pentacosane (RI = 2500), following Mann et al. (2017).

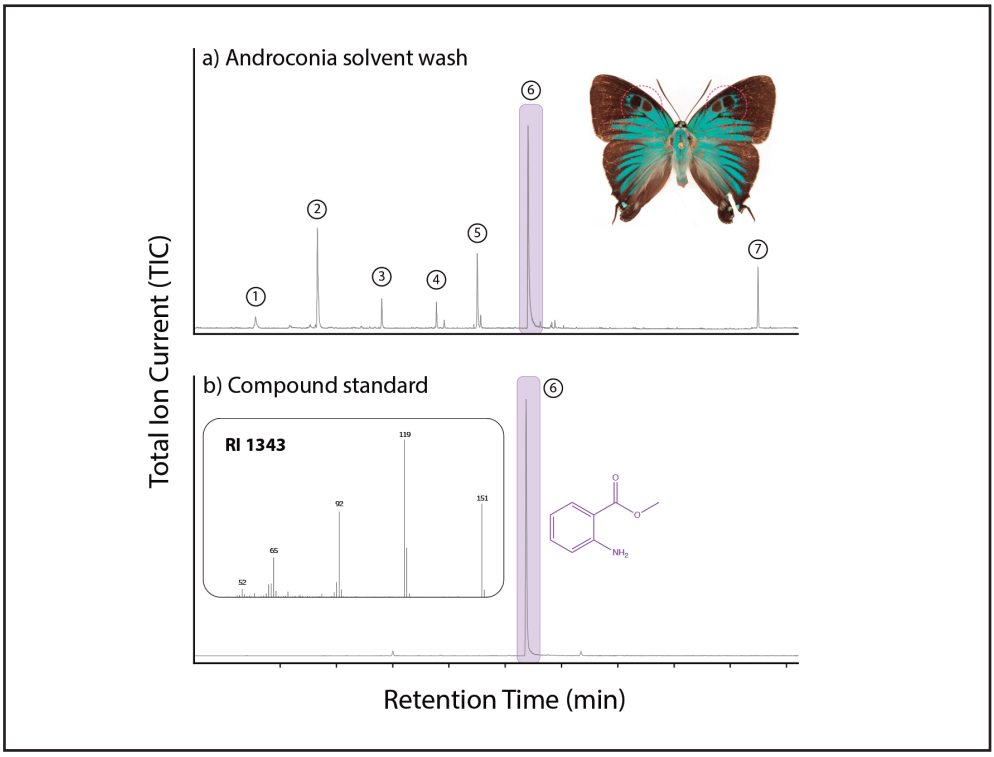
Results

Table 1. Total relative amounts of representative compounds isolated from solvent extract of androconia of *Atlides polybe*.

Kovats Index (RI)	Compound	Relative Amount (%)
902	Heptanal	9.89
999	Decane	1.89
1002	Octanal	21.60
1103	Nonanal	5.21
1192	2-decanone	3.89
1261	(E)-2-decenal	10.13
1341	Methyl anthranilate	26.68
1398	Tetradecane	1.15
1498	Pentadecane	1.25
1586	*m/z*: 135, 150, 43, 79, 151	1.14
1815	Hexadecanal	6.87
2093	Heneicosane	1.53
2296	Tricosane	1.07
-	Other compounds	7.71

The collected male specimen of *A. polybe* emitted a strong fruity fragrance, which, after excision of the wings, was much more intensely perceived in the androconial areas. The ion chromatogram of the androconial extract sample showed a dominant peak at 16.47 min (corresponding to *RI* 1343) (Figure 1A, Table 1). The *RI* and mass fragmentation spectrum of this peak was identical to those of methyl anthranilate (methyl 2-aminobenzoate) (Figure 1B). Additionally, we tentatively identified 12 other volatile compounds from the androconial extract sample. Among these, octanal, (*E*)-2-decenal, heptanal, hexadecanal, and nonanal were found to have the highest relative amounts, comprising 21.6%, 10.13%, 9.89%, 6.87%, and 5.21% of the total sample, respectively (see Figure 1A; Table 1).

Figure 1. Chromatograms of **(a)**, solvent extract from androconia of *Atlides polybe*, and **(b)**, methyl anthranilate standard sample, along with its mass spectrum and molecular structure. Numbered peaks: **1**, Heptanal; **2**, Octanal; **3**, Nonanal; **4**, 2-decanone; **5**, (*E*)-2-decenal; **6**, Methyl anthranilate; **7**, Hexadecanal. The purple-highlighted peaks indicate methyl anthranilate.



Discussion

The idiosyncratic "grape aroma" of the male *A. polybe* specimen was found to persist even after 120 hours of refrigeration prior to processing. Through our analysis we have identified the main compound responsible for this odor as methyl anthranilate, which corresponds to the dominant VOC peak in the androconial extract chromatogram (Figure 1). This nitrogen-containing benzoate ester is a natural compound and serves as the primary flavoring agent for artificial grape aromas in the flavor and fragrance industry (Furia & Bellanca, 1975). The biosynthesis of methyl anthranilate involves the condensation of anthranilic acid with methanol, catalyzed by a methyltransferase enzyme (Wang & Luca, 2005). Anthranilic acid, an intermediate

in the tryptophan metabolic pathway, is produced through the decarboxylation of indole-3-acetic acid or tryptophan. In plants, methyl anthranilate is mostly found in flowers (Knudsen et al. 2006), where it serves as a deterrent to herbivores (Bernklau et al. 2016) and an attractant to pollinators (Murai et al. 2000), being reported as semiochemical in multitrophic plant-herbivore-predator interactions (Landolt et al. 2000). The fact that methyl anthranilate is also a powerful and widely used avian repellent (see references in Aronov & Clark, 1996) suggests multiple functions in the chemical signaling repertoire of papilionoids, which require further investigation.

Among other less representative compounds, the following linear-chained aldehydes: octanal, (*E*)-2 decenal, heptanal and nonanal also appeared in substantial amounts in our samples, together with hexadecanal. These compounds are extensively used as pheromones, allomones and kairomones among various insect taxa (see El-Sayed, 2024). In the likeness of methyl anthranilate, all abovementioned aldehydes have strong fruity odors (Kim et al. 2023) and seem to be complementary compounds in composing the characteristic fragrant blend of *A. polybe*.

Among insects, methyl anthranilate has been most notably documented as a constituent of the alarm pheromones of ants (Duffield & Wheeler, 1980; Oldham et al. 1994). Lavogez et al. (2017) identified methyl anthranilate along with other volatile aromatic benzenoids, in the hair pencil androconia of *Prophantis smaragdina* (Butler, 1875) (Lepidoptera: Crambidae) and speculated on its role in mating behavior. To our knowledge, this is the first report of methyl anthranilate in Papilionoidea. Similarly, (*E*)-2-decenal and octanal, though the latter was previously identified in the hairpencils of *Amauris* spp. (Nymphalidae: Danainae) (Schulz et al. 1993), but not documented in the wings of papilionoids until now. Likewise, hexadecanal has been sparsely reported in Papilionoidea, with previous mentions limited to the androconial blends of *Byciclus anyana* (Butler, 1879) (Nymphalidae: Satyrinae) (Nieberding et al. 2008) and *Phoebis argante* (Fabricius, 1775) (Pieridae: Coliadinae) (Nobre et al. 2021). Conversely, heptanal and nonanal appear to have been widely identified in Papilionoidea. Heptanal is present in the wings of both sexes of *Erynnis montanus* (Bremer, 1861) (Hesperiidae: Pyrginae) (Ômura & Honda, 2011) and, along with nonanal, as minor compounds in the wings several species of Papilionidae (Honda, 1980; Ômura et al. 2001; Ômura & Honda, 2005; Yoshimori et al. 2017). Nonanal has also been found in low relative concentration on the wings of *Anthocharis scolymus* (Butler, 1866) (Pieridae: Pierinae) (Okumura et al. 2016), as well as a constituent of the androconial secretions of many species of *Heliconius* (Nymphalidae: Heliconiinae) (Darragh et al. 2020), and of *Plebejus argyrognomon* (Virgstrassir, 1779) (Lycaenidae: Polyommatinae) (Lundgren & Bergström, 1975).

Although not the primary focus of our investigation, we speculate that the putative fixative properties of the lowly volatile fatty acyls found in the analyzed sample may explain why dry-mounted individuals of *A. polybe* retain their fragrance even after months of storage in collection drawers (Nobre & Schlindwein, 2016).

This study marks only the third investigation into the chemistry of androconial secretions in Lycaenidae and the first to address a species within the large, mainly Neotropical subfamily Theclinae. By focusing on one of the least studied Papilionoidea families in this regard, there are limited comparisons to be drawn regarding compound composition. Apart from nonanal, which is the only compound shared with *A. polybe*'s bouquet, hexadecyl acetate, δ-cadinol (Lundgren & Bergström, 1975), lavender lactone, and δ-decalactone (Ômura et al. 2013) are the only reported androconial compounds for lycaenids.

To date, the scent chemistry of *A. polybe* appears to be as divergent as the androconial morphology between the two subfamilies of Lycaenidae. The secreting structures of the referred polyommatines are "battledore" scales, scattered between ordinary scales throughout their wings (Lundgren & Bergström, 1975; Ômura et al. 2013), whereas in *A. polybe*, typical for theclines, the androconial scales are densely arranged in patches, pads, or pouches on the wings (Martins et al. 2019; Robbins et al. 2012). Nonetheless, the androconial blend of *A. polybe* appears unique compared to what is known among Papilionoidea, prompting speculation about the relationship between androconial form and secretion composition in the Theclinae, potentially related to divergent biosynthetic pathways adopted by the group. However, this is highly conjectural, and significant effort is required to draw any firm conclusions.

It would be desirable to investigate an array of phylogenetically related taxa to *A. polybe* to determine if the identified compounds (or classes of) are recurrent. The scent-producing/secreting organs of the Eumaeini are unique and diverse (Martins et al. 2019; Robbins, 1991), and it would be fascinating to ascertain if the androconial chemistry of its VOCs follows suit.

The dominant presence of methyl anthranilate, associated with complementary fragrant compounds in the androconia of *A. polybe*, aligns with empirical observations that fruity, strong odors are a distinct feature of males bearing androconial brands in Eumaeini (Müller, 1878; Robbins et al. 2012). Combined with the fact that wing androconia in the *Atlides* Section primarily function for intraspecific recognition (Martins et al. 2019), our findings provide strong evidence that methyl anthranilate and associated aldehydes outline a distinct chemical bouquet acting as a sex pheromone.

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Conflict of interests

The authors declare that there is no known financial interests or personal relationships that could have influenced the work presented in this article.

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Diversity of Papilionoidea in the Tamanduá Farm, Septentrional Sertaneja Depression Ecoregion, Caatinga, Semiarid, Santa Teresinha, Paraíba, Northeast, Brazil (Insecta: Lepidoptera)

Aurino Ferreira-Júnior, Dilcemar Ferreira de Almeida-Filho & Solange Maria Kerpel

Abstract

The objective of this study was to know the composition, richness and abundance of Papilionoidea with entomological net, in different environments and distinct periods in the Caatinga biome or Semiarid region during 12 months in the Tamanduá Farm. A total of 5556 individuals were recorded, with 82 species of Papilionoidea in a systematic survey and subsequently 93 species. The estimators of richness or diversity extrapolated from 85.5 (Chao 1) to 121.75 (ChaoRichness - Incidence) and highlighted the ICE with 93.4 species. Hesperiidae and Nymphalidae were the most representative families, followed by others. An unprecedented record was found for Northeast and two for Semiarid-Caatinga, five new records were described to the state of Paraíba and 24 unpublished records for the ecoregion of the Septentrional Sertaneja Depression. The importance of the remaining of ciliary forest for the protection of Papilionoidea was evidenced, allowing the permanence of certain species in the area even in dry period, which has a strong influence on the conservation of this group in population dynamics and community resilience.
Keywords: Insecta, Lepidoptera, Papilionoidea, abundance, biodiversity, composition, richness, Brazil.

Diversidad de Papilionoidea en la Hacienda Tamanduá, Ecorregión de la Depresión Sertaneja Septentrional, Caatinga, Semiárido, Santa Teresinha, Paraíba, Nordeste, Brasil (Insecta: Lepidoptera)

Resumen

El objetivo de este estudio fue conocer la composición, riqueza y abundancia de Papilionoidea con red entomológica, en ambientes diferentes y períodos distintos en el bioma Caatinga o región Semiárida durante 12 meses en la Hacienda Tamanduá. Se registraron un total de 5.556 individuos, con 82 especies de Papilionoidea en un levantamiento sistematizado y posteriormente 93 especies. Los estimadores de riqueza o diversidad extrapolaron de 85.5 (Chao 1) hasta 121.75 ("ChaoRichness - Incidence") y se destacó el ICE con 93.4 especies. Hesperiidae y Nymphalidae fueron las familias más representativas, seguidas de otras. Se encontró un registro inédito para el Nordeste y dos para el Semiárido-Caatinga, se describieron cinco nuevos registros para el estado de Paraíba y 24 registros sin precedentes para la ecorregión de la Depresión Sertaneja Septentrional. Se evidenció la importancia del remanente de bosque ciliar para la protección de los Papilionoidea, al permitir la permanencia de determinadas especies en el área incluso en período seco, lo que tiene una fuerte influencia en la conservación de este grupo en dinámicas poblacionales y resiliencia de la comunidad.
Palabras clave: Insecta, Lepidoptera, Papilionoidea, abundancia, biodiversidad, composición, riqueza, Brasil.

Diversidade de Papilionoidea na Fazenda Tamanduá, Ecorregião da Depressão Sertaneja Setentrional, Caatinga, Semiárido, Santa Teresinha, Paraíba, Nordeste, Brasil (Insecta: Lepidoptera)

Resumo

O objetivo deste estudo foi conhecer a composição, riqueza e abundância de Papilionoidea com rede entomológica, em diferentes ambientes e períodos distintos no bioma Caatinga ou região Semiárida durante 12 meses na Fazenda Tamanduá. Foram registrados 5556 indivíduos, com 82 espécies de Papilionoidea em um levantamento sistemático e posteriormente 93 espécies. Os estimadores de riqueza ou diversidade extrapolaram de 85,5 (Chao 1) para 121,75 (ChaoRichness - Incidência) e destacaram o ICE com 93,4 espécies. Hesperiidae e Nymphalidae foram as famílias mais representativas, seguidas de outras. Um registro inédito foi encontrado para o Nordeste e dois para o Semiárido-Caatinga, cinco novos registros foram descritos para o estado da Paraíba e 24 registros inéditos para a ecorregião da Depressão Sertaneja Setentrional. Foi evidenciada a importância dos remanescentes de mata ciliar para a proteção dos Papilionoidea, permitindo a permanência de determinadas espécies na área mesmo em período seco, o que tem forte influência na conservação desse grupo na dinâmica populacional e resiliência da comunidade.
Palavras-chave: Insecta, Lepidoptera, Papilionoidea, abundância, biodiversidade, composição, riqueza, Brasil.

Introduction

The order Lepidoptera, emphasizing Papilionoidea, as observed in annual compilations of Lamas (2024), is one of the most studied groups of hyperdiverse insects in the Neotropical region and world. However, in Brazil and specifically in the Northeast geopolitical region there is still no adequate characterization of diversity (Kerpel et al. 2014). Evidence that unfolds by the accentuated inequalities at spatial levels, where most studies and inventories with Papilionoidea converge to the Southeast and South regions in Atlantic Forest areas (Brandão & Yamamoto, 2003; Carneiro et al. 2008; Freitas & Marini-Filho, 2011), due to a higher concentration of researchers or zoological collections (Basílio et al. 2024), for example (https://collectory.sibbr.gov.br/collectory).

Various works on the Caatinga biome emphasized the importance of areas for biodiversity conservation, scarcity of studies and information on several groups with invertebrate species (Brandão et al. 2000; Tabarelli & Silva, 2003; Brandão & Yamamoto, 2003; Araújo et al. 2005; Silva et al. 2017; Joly et al. 2019). The Caatinga represents one of the biggest gaps in Brazilian knowledge about Lepidoptera (Brandão & Yamamoto, 2003; Carneiro et al. 2008; Freitas & Marini-Filho, 2011; Lewinsohn et al. 2022), even with the emerging mitigation promoted by projects supported through the Research Program on Biodiversity of the Semiarid (PPBio Semiárido in Portuguese for "Programa de Pesquisa em Biodiversidade do Semiárido") (Kerpel et al. 2014; Kerpel et al. 2016), National Biodiversity Research System (SISBIOTA Brasil in Portuguese for "Sistema Nacional de Pesquisa em Biodiversidade") (Oliveira et al. 2024) and others (Santos et al. 2023).

For the set of publications in the Northeast of Brazil, with exclusive application of entomological net or with net and trap, 24 lists of Papilionoidea species stand out (Table I), currently without publication for Sergipe of the nine states that constitute the Northeast region and for portion of the Caatinga in the north of Minas Gerais in the Southeast region. Of these inventories, considered hybrid areas, ecotones or different physiognomies in stricto sensu or lato sensu classifications in the Brazilian biomes, 15 were focused on areas of the Atlantic Forest in the states of Alagoas, Paraíba, Rio Grande do Norte, Bahia and Pernambuco (Cardoso, 1949; Kesselring & Ebert, 1979; Duarte-Júnior et al. 2001; Vasconcelos et al. 2009; Zacca et al. 2011; Paluch et al. 2011; Paluch et al. 2016; Melo et al. 2019; Vila-Verde et al. 2020; Vila-Verde & Paluch, 2020; Bezerra et al. 2021; Dantas et al. 2021; Medeiros et al. 2021; Gonçalves et al. 2021; Gualberto et al. 2024), seven other studies include areas of the Caatinga in the states of Pernambuco, Bahia, Ceará, Piauí and Paraíba (Nobre et al. 2008; Zacca & Bravo, 2012; Roque et al. 2014; Lima & Zacca, 2014; Kerpel et al. 2014; Câmara et al. 2017; Ferreira-Júnior, 2021), while two were described for areas of the Cerrado and Amazon in the state of Maranhão (Martins et al. 2017; Pereira et al. 2018).

Table I. Papilionoidea inventories published for the Northeast region of Brazil, exclusively with entomological net (N) or with mixed collection method (N/T), with periods that represent interposed quantities of collections

per hours per day or days per month or months per year or years and do not express that the collection effort was applied at all the hours of days or on all the days of months or not necessarily in all months of the year. AL = Alagoas, PB = Paraíba, RN = Rio Grande do Norte, PE = Pernambuco, BA = Bahia, CE = Ceará, PI = Piauí, MA = Maranhão; FAT = Atlantic Forest, CAA = Caatinga, CER = Cerrado, AMA = Amazon; N = Entomological net, T = Van Someren-Rydon trap.

Work	State	Biome	Period	Method	Richness
Cardoso (1949)	AL	FAT	≈ 5 years	N	225
Kesselring & Ebert (1979)	PB	FAT	≈ 5 years	N	291
Duarte-Júnior et al. (2001)	RN	FAT	12 months	N	22
Nobre et al. (2008)	PE	CAA	12 months	N/T	121
Vasconcelos et al. (2009)	BA	FAT	6 months	N/T	70
Zacca et al. (2011)	BA	FAT	7 months	N	140
Paluch et al. (2011)	PE	FAT/CAA	12 months	N/T	197
Zacca & Bravo (2012)	BA	CAA	7 months	N/T	169
Roque et al. (2014)	CE	CAA	12 months	N	73
Lima & Zacca (2014)	BA	CAA	7 months	N/T	121
Kerpel et al. (2014)	PI, CE, PB, PE, BA	CAA	≈ 3 years	N/T	389
Paluch et al. (2016)	BA	FAT	12 months	N	260
Câmara et al. (2017)	CE	CAA	2 months	N/T	150
Martins et al. (2017)	MA	CER/AMA	24 months	N/T	189
Pereira et al. (2018)	MA	AMA	19 months	N/T	91
Melo et al. (2019)	PE	FAT	20 months	N	288
Vila-Verde et al. (2020)	BA	FAT	12 months	N/T	235
Vila-Verde & Paluch (2020)	BA	FAT	17 months	N/T	228
Ferreira-Júnior (2021)	PB	CAA	10 months	N	90
Bezerra et al. (2021)	AL	FAT	7 months	N	44
Dantas et al. (2021)	BA	FAT/CAA	9 months	N/T	114
Medeiros et al. (2021)	PB	FAT	7 months	N/T	89
Gonçalves et al. (2021)	BA	FAT	6 months	N/T	205
Gualberto et al. (2024)	PB	FAT	6 months	N/T	212

Recently, a study on regeneration in the Caatinga evaluated the successional stages through multitaxa, including fruit-feeding bPapilionoidea at Tamanduá Farm with 13 species and concluded that diversity was higher in the initial succession phases than in the late growth phases, but varied widely in the intermediate stages (Oliveira et al. 2024). Concerning Papilionboidea, the knowledge is still incipient in the state of Paraíba; aggravated not only in the semiarid portion, including herbaceous-shrubby-arboreal caatinga environments, ciliary forests and high-altitude wetlands, where studies are scarce or practically non-existent in certain indispensable localities (Ministério do Meio Ambiente e Mudança do Clima, 2023) and crucial to promote conservation (Cardoso et al. 2011; Hortal et al. 2015).

Furthermore, to achieve goals since the year 2000 for the Millennium Development Goals (MDGs) in Goal 7 (Ensure Environmental Sustainability) and until the year 2015 through of the 2030 Agenda (Agenda 2030 para o Desenvolvimento Sustentável, 2015) by Sustainable Development Goals (SDGs) (United Nations, 2023; Organização das Nações Unidas no Brasil, 2023), in the state of Paraíba (Objetivos de Desenvolvimento Sustentável na Paraíba, 2023a) in the geoadministrative region (GAR) of Patos (Objetivos de Desenvolvimento Sustentável na Paraíba, 2023b) and in the municipality of Santa Teresinha (Objetivos de Desenvolvimento Sustentável na Paraíba, 2023c; Índice de Desenvolvimento Sustentável das Cidades-Brasil, 2024), in Brazil and as an example for Goal 13 (Climate Action) or Goal 15 (Life on Land). Also to align with nature-based solutions for climate change, area protections and ecosystem restorations (UN Biodiversity Lab, 2024).

There were harmful situations in Brazil which have been and are still going through legal regulations for mitigation and adaptation actions, via diverse movements, such as environmental or socioenvironmental issues addressed by the Federal Supreme Court (STF in Portuguese for "Supremo Tribunal Federal") and that became known as STF green package or green agenda (#PacoteVerdeNoSTF, #PautaVerde), to the ecologically balanced environment in Brazil (https://portal.stf.jus.br/textos/verTexto.asp?servico=informativoSTF), highlight for Claim of Non-compliance with a Fundamental Precept (ADPF in Portuguese for "Arguição de Descumprimento de Preceito Fundamental") - ADPF 651/DF in defense of the democracy with participation of organized civil society groups (Informativo-STF, 2022). Moreover, other characteristics through the Constitution of the Federative Republic of Brazil, in chapter VI "Environment" and other parts, to the instances, for noting the expression of species in plural (Brasil, 1988; Brazil, 1988) to the context of Biological Sciences or Ecology ("The Economy of Nature"), until reflection on the unified concept of species and other aspects (Ferreira-Júnior, 2021), and to the context of Economic Sciences (Brasil, 1988; Brazil, 1988), splitter in English (species, specie) and lumper in Portuguese ("espécie", "espécies"), with representations, about translation and origin/etymology (probably metaplasm from Latin to Portuguese, possibly also in some other languages) or change/transformation and values, via species in singular/species in plural and specie in singular/specie in plural (paronymy and relationships with synonyms, two signifiers with different signifieds depending on the specific contexts), and for the integrated concept of "espécie" (singular)/"espécies" (plural) in Portuguese (homonymy and relationships with synonyms, one signifier with more than one signified depending on the specific contexts).

Thus, the aim was to generate data on the composition, richness and abundance of Papilionoidea taxocenosis at the Tamanduá Farm, Santa Teresinha, Paraíba, Brazil, contributing to a better representation and conservation of the Papilionoidea fauna in the Caatinga or Semiarid with species; in the "Patos-Santa Terezinha" demarcation area of high biological importance, with priority for the knowledge and conservation of invertebrates, in addition to the recommendation of integral protection for being considered a transition area between ecoregions in the Caatinga (Ministério do Meio Ambiente, 2002; Silva et al. 2002; Tabarelli & Silva, 2003; Brandão et al. 2003; Silva et al. 2003), with update (Ministério do Meio Ambiente e Mudança do Clima, 2023).

Material and Methods

Study area

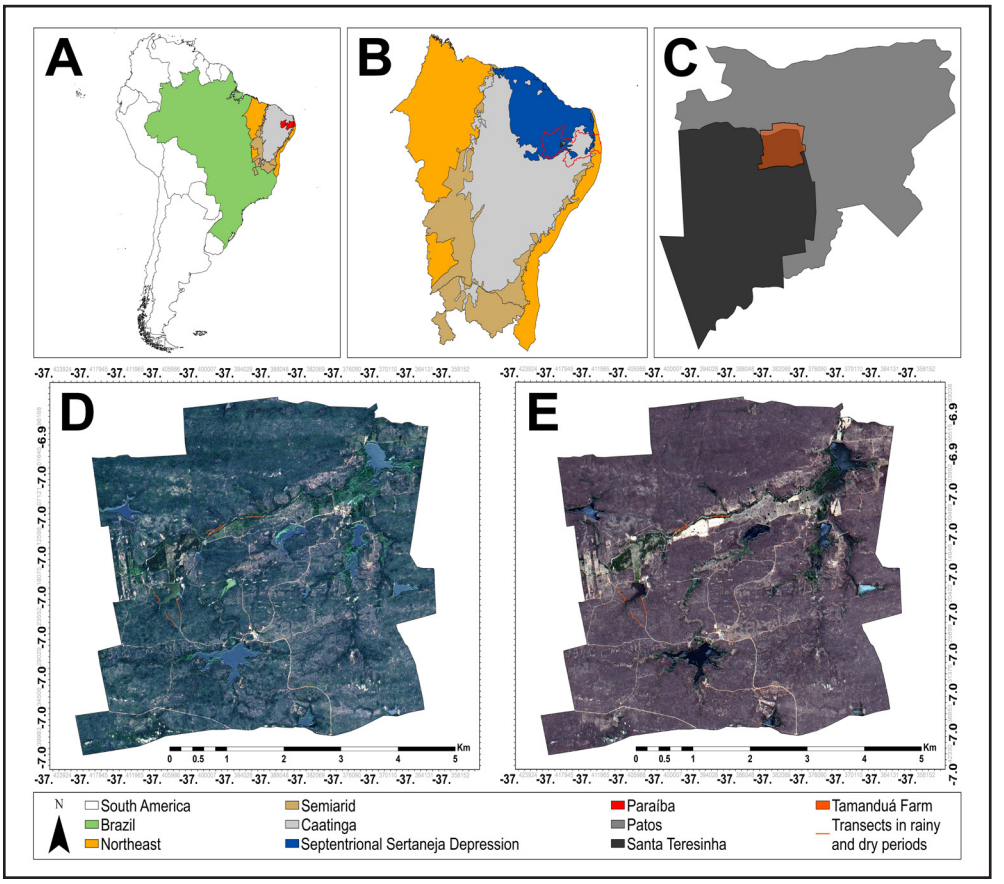
The Tamanduá Farm (FATA in Portuguese for "Fazenda Tamanduá"), property of "Mocó Agropecuária Ltda.", is located between the municipalities of Patos and Santa Teresinha (Leal et al. 2018), "Sertão" mesoregion in the state of Paraíba, Brazil (7º01'31" S and 37º23'31" W), inserted in the Semiarid region, Caatinga biome, Septentrional Sertaneja Depression ecoregion (Velloso et al. 2002), with other characterizations (Figure 1). It represents an important forest remnant with preserved or conserved vegetation in the Paraíba semiarid and has one of the relevant conservation units in the state (Sistema Informatizado de Monitoria de RPPN, 2023a; Superintendência de Administração do Meio Ambiente, 2023a, b; Unidades de Conservação Estaduais, 2023; Paraíba, 2023). It is approximately 400 km from the coast or littoral, with an average altitude of 240 m (Fazenda Tamanduá, 2023), typical vegetation of xerophytic caatinga and classified as Steppic-Savanna: Seasonal Deciduous Forest or Deciduous Tropical Forest (Instituto Brasileiro de Geografia e Estatística, 2012), Deciduous Stationary Forest or Tropical Deciduous Forest, susceptible to desertification (Figure 2).

The area has a remnant of riparian forest or ciliary forest, which is part of the Permanent Protection Area (PPA or APP in Portuguese for "Área de Proteção Permanente") and where part of the inventory was conducted, relief with deeper soil and intermittent river (Figure 2). The topography varies from plain, smooth to wavy and accentuated, mountainous by rocky outcrops, surface with soils of crystalline origin, predominantly Litholic Neosol and Luvisols, relatively shallows, with differences in hydric deficiency, stony, sandy and low to medium fertility, with deposition of litter that varies between months or periods (Alves et al. 2006; Andrade et al. 2008; Henriques et al. 2016; Santos et al. 2018).

The area has historic of disturbances by livestock or agriculture of greater damage to the environment and from a given time until the present the production system has become organic. In addition to having primary forest area preserved for approximately 70 years and fragments of secondary forest conserved for approximately 25 or 47 years, representing different successional stages (Santos et al. 2014); covering 1344 ha or nearly one-

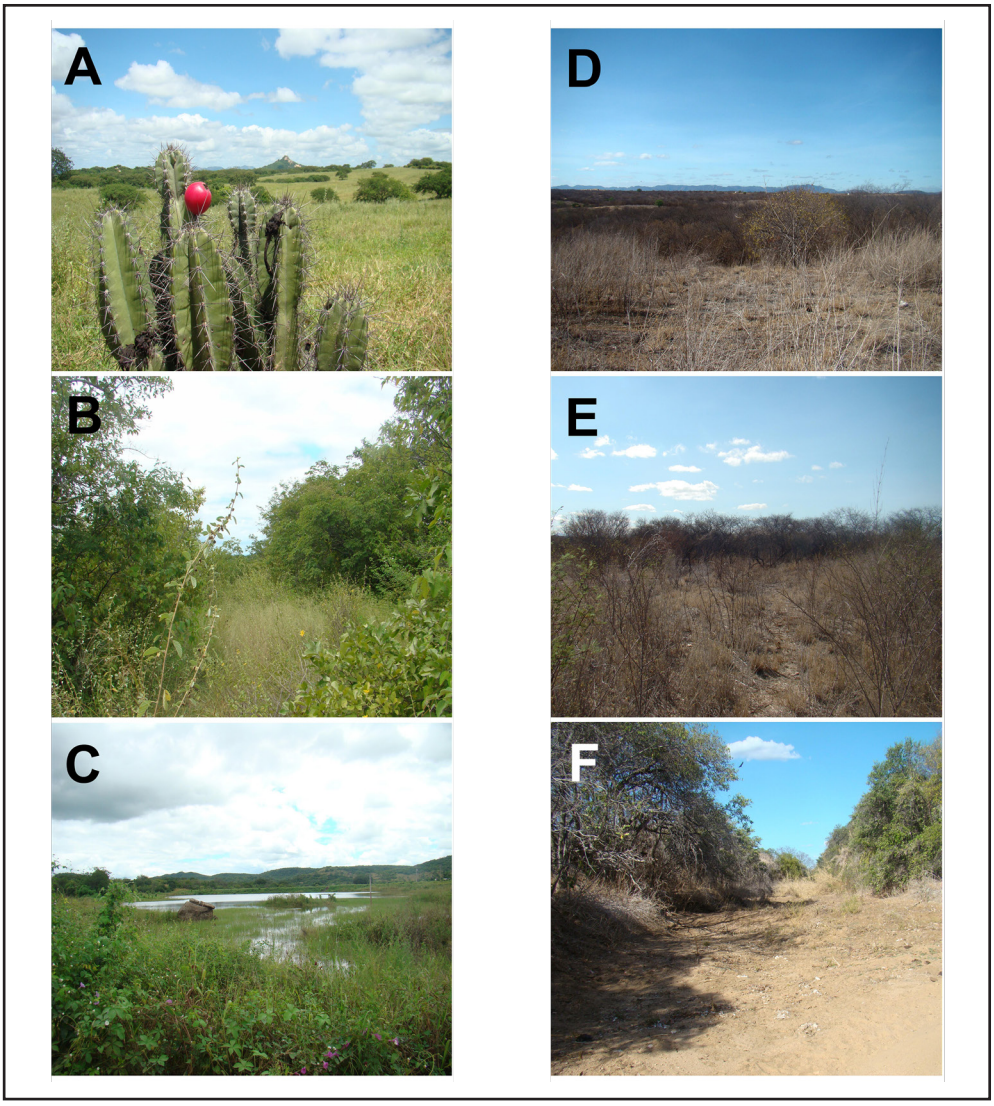
third of the total area of 4135 ha (Figure 1, Figure 2), which contains a Legal Reserve (LR or RL in Portuguese for "Reserva Legal") of 1019 ha and where part of the inventory was conducted, still to include a Private Natural Heritage Reserve (PNHR or RPPN in Portuguese for "Reserva Particular do Patrimônio Natural") of 325 ha created in July 1998 (The Nature Conservancy do Brasil & Associação Caatinga, 2003; Sistema Informatizado de Monitoria de RPPN, 2023b; Oliveira et al. 2024). The RPPN is a quality or type of federal conservation unit of perennial character, irrevocable, designated for protection through preservation, also for educational and scientific activities or ecotourism (Fonseca et al. 2017).

Figure 1. Location of the Tamanduá Farm (FATA). **A)** South America subcontinent in white, Brazil country in green, Northeast geopolitical region in yellow, Caatinga biome in light gray, Paraíba state in red, Patos and Santa Teresinha municipalities in medium gray and dark gray respectively; **B)** Northeast geopolitical region in yellow by highlight, Semiarid climatic region in brown, Septentrional Sertaneja Depression ecoregion in blue, Paraíba state in red line, Patos and Santa Teresinha municipalities in medium gray and dark gray respectively; **C)** Patos and Santa Teresinha municipalities in medium gray and dark gray respectively, by highlight, delimitation of the Tamanduá Farm area in black line with orange fill between Patos and Santa Teresinha municipalities; **D)** Tamanduá Farm area during the rainy period and transects in orange lines; **E)** Tamanduá Farm area during the dry period and transects in orange lines.



Among the species of woody plants recorded the families Fabaceae, Euphorbiaceae, and Apocynaceae were most representative, along with other families of shrubby or arboreal habit (Guedes et al. 2012). With greater species richness in the late community and proportionally decrescent in the other stages of ecological succession (Cabral et al. 2013). Poaceae, Fabaceae, Malvaceae, Convolvulaceae, Asteraceae, Amaranthaceae, Boraginaceae, and Rubiaceae were highlighted as the most representative families in number of species with herbaceous habit, followed by others (Silva et al. 2012; Laine et al. 2017).

Figure 2. Different environments in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil. **A)** Open area with pasture and sparse trees in rainy period. **B)** Edge of the shrubby-arboreal caatinga with herbaceous plants in rainy period. **C)** Herbaceous vegetation at the weir edge in rainy period. **D)** Open area and secondary forest at the beginning of the dry period. **E)** Shrubby caatinga in dry period. **F)** Intermittent River with ciliary forest in dry period. Pictures by Solange M. Kerpel.



In the Caatinga the climate is mainly tropical(A)/dry(B)/semiarid(S) with two climatic qualities (As, BSh), dry (B) and semiarid (S) in hot of low latitude/altitude (h) in this portion of the state (BSh), according to the Köppen classification (Alvares et al. 2013), with drought regimes on distinct scales and variabilities recognized by historical series (Marengo et al. 2017). In addition to the climatic influence mainly by the Intertropical Convergence Zone (ITCZ) and El Niño-Southern Oscillation (ENSO) or other direct/indirect climatological phenomena, air masses not only from the Amazon that can reach the Semiarid or Caatinga, with variations in temperature and precipitation or for other variables (Ferreira & Mello, 2005; Marengo et al. 2011; Francisco & Santos, 2017;

Paraíba, 2017; Paraíba, 2023), during months or groups of months, seasons or periods, in years or groups of years. Combined with low precipitations and annual average of 500 to 800 mm, configuring a strongly seasonal environment, with rains concentrated in a short period of the year or approximately two to four months (Velloso et al. 2002; Santos et al. 2014), when streams and other intermittent bodies of water are formed, followed by a longer period of drought that results in xerophilia or deciduousness and possibility of extemporaneous rainfall. In the study area there were records of average annual temperatures of 27º C (Telino-Júnior et al. 2005) and 32.8° C (Silva et al. 2012).

Sampling and procedures

The sampling was standardized and adapted through of "Pollard walks" (Caldas & Robbins, 2003; Pellet et al. 2012; Freitas et al. 2021). Six transects of 300 m of length were established, three in shrubby-arboreal caatinga (CAA) and three in ciliary forest (CIL), which included areas of open vegetation, forest interiors and borders or weir margin. The Papilionoidea were captured with an entomological net, part of the counted individuals were collected and deposited in envelopes or marked with a non-toxic pen and released, visual counts of the individuals of species in population explosions were also made, with registration of transects, from May 2011 to April 2012 (12 months), one day per month, from 8 am to 4 pm, one hour and twenty minutes per transect, traversed alternately during the different months and times on sampling days, totaling a sampling effort of 96 hours/network/one collector plus another person to take notes in envelopes and spreadsheets. Authorization expedited via ICMBio nº 27173/SISBIO for capture or marking and collection/transport of Lepidoptera specimens from the wild fauna in situ as biological material through the activities with scientific purpose.

The rainy period was considered from May to June 2011 and plus January to April 2012 (six months), while the dry period was considered from July to December 2011 (six months), by relative alignment with meteorological or astronomical seasons in the Southern Hemisphere (National Oceanic and Atmospheric Administration, 2022). Average monthly precipitation data were obtained from the meteorological station of Tamanduá Farm and checked with public data from the Executive Agency for Water Management of the State of Paraíba (Agência Executiva de Gestão das Águas do Estado da Paraíba, 2021), while the public data on the monthly compensated average temperature were obtained through of the National Institute of Meteorology and to the nearest conventional station with code 82791 in the municipality of Patos (Instituto Nacional de Meteorologia, 2022).

The specimens were deposited in the Lepidoptera collection via the Laboratory of Ecology and Interactions of Insects of the Caatinga (LEIIC in Portuguese for "Laboratório de Ecologia e Interações de Insetos da Caatinga") at the Federal University of Campina Grande (UFCG in Portuguese for "Universidade Federal de Campina Grande"), Patos, Paraíba, Brazil and part in the Father Jesus Santiago Moure Entomological Collection (DZUP in Portuguese for "Departamento de Zoologia da UFPR" or "Coleção Entomológica Padre Jesus Santiago Moure") via the Laboratory of Studies of Neotropical Lepidoptera (LABLEPNEO in Portuguese for "Laboratório de Estudos de Lepidoptera Neotropical") at the Federal University of Paraná (UFPR in Portuguese for "Universidade Federal do Paraná"), Curitiba, Paraná, Brazil. To complement the composition or richness were added Lepidoptera specimens not collected during the sampling period or outside of the sample and coming from the Collection of the LEIIC (CLEIIC in Portuguese for "Coleção do Laboratório de Ecologia e Interações de Insetos da Caatinga").

Systematics and taxonomy in subsumptions and confluences follow for Lepidoptera with Kawahara & Breinholt (2014), Kawahara et al. (2019) and Rota et al. (2022), followed for the Papilionoidea with propositions by Lamas (2004, 2008), Wahlberg et al. (2005), Kim et al. (2010), Heikkilä et al. (2012), Espeland et al. (2018), Chazot et al. (2019), Wiemers et al. (2020), Kawahara et al. (2023), and Warren et al. (2024) with other references.

Data analysis

For ecological modeling of the diversity, Papilionoidea community structure, were used information on the compositions, richness and abundance of species, subfamilies and families, absolute frequencies and relative frequencies by percentage, presence and absence of species in rainy period (RAI) and dry period (DRY), also in the environments of shrubby-arboreal caatinga (CAA) and ciliary forest (CIL), as well other proportions, simi-

larities and dissimilarities between taxocenoses, collection effort, species accumulation or sampling sufficiency, when were considered only the data in collection period of 12 months to the biostatistical analyses.

The constancy and dominance were obtained as in correspondence for Ferreira-Júnior (2021), with value modifications of the category of Friebe (1983) to the rarity qualification: eudominant > 10%, dominant > 5-10%, subdominant > 2-5%, recessive = 1-2% and rare < 1%, now rare < 1-0.2% and ultrarare < 0.2%.

The PAST 4.05 software (https://www.nhm.uio.no/english/research/resources/past) of January 2021 (Hammer et al. 2001) was used to obtain diversity indexes (Maurer & McGill, 2011; Mittelbach & McGill, 2019) by Dominance (DO)/ Equitability (J) in probabilities of the diversity permutation test (TPD*p*) and by Shannon (H')/ Gini-Simpson (1-D) in probabilities of the diversity *t* test (T*p*). Additionally, to the utilization of the EstimateS 9.1 software (https://www.robertkcolwell.org/pages/estimates) by version of May 2019 (Colwell, 2013) to obtain extrapolations through the richness estimators based on data of species abundance or incidence in Jackknife 1 and 2, Bootstrap, Chao 1 and 2, Incidence-based Coverage Estimator - ICE and Abundance-based Coverage Estimator - ACE (Dias, 2004; Gotelli & Colwell, 2011). The rest of the analyses and all the graphs were obtained using the R software (R Core Team, 2021), for Analysis of Similarities (ANOSIM) or Similarity Percentages (SIMPER) and the Non-metric Multidimensional Scaling (NMDS) (Melo & Hepp, 2008; Silva et al. 2022a) with function Fits an Environmental Vector or Factor onto an Ordination (envfit) via vegan 2.6-4 package (https://cran.r-project.org/web/packages/vegan/index.html and https://cran.r-project.org/web//packages/vegan/vignettes/intro-vegan.pdf) of October 2022 (Oksanen et al. 2022), in addition to the diversity estimators q0 (Richness)/ q1 (Shannon)/ q2 (Simpson) or curves of interpolation (rarefaction) and extrapolation (prediction) by abundance or incidence data in 1000 bootstrap replications via iNEXT 3.0.0 package (https://cran.r-project.org/web/packages/iNEXT/index.html) of July 2022 (Hsieh et al. 2016; Hsieh et al. 2022a, b). With related parts for instance in probability theory and information theory or mathematical theory of communication (Martins & Santos, 1999; Dias, 2004; Melo, 2008; Lima et al. 2016), statistical theories of sampling, estimation or inference (Chao & Jost, 2012; Chao et al. 2014) and approximation theory.

Simple comparisons were also made to the composition or richness of species of the FATA with the available inventories for the Caatinga biome and other biomes in the Northeast of Brazil, to identify new records in the region based on Table I, in addition to finding simple relationships of the occurrence of (sub)species in common with other areas of biomes outside of the Northeast region.

Results

A total of 5556 individuals were recorded to the abundance (Table II), with 934 captured-collected individuals and none of the captured-marked-released individuals were recaptured; distributed in increasing representability to 3266 individuals of Pieridae (58.8%), 1329 of Nymphalidae (23.9%), 517 of Hesperiidae (9.3%), 390 of Lycaenidae (7%), 44 of Riodinidae (0.8%) and 10 individuals of Papilionidae (0.2%) (Table III, Figure 3).

Initially 82 Lepidoptera species were recorded in FATA during the sampling period to the richness (Table II); distributed in 28 species of Hesperiidae (34%), 25 species of Nymphalidae (31%), 12 species of Lycaenidae (15%), 11 species of Pieridae (13%), four species of Riodinidae (5%) and two species of Papilionidae (2%) (Table III, Figure 3).

Table II. List of the species of Papilionoidea in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012. **N** (f_i) = abundance (absolute frequency); **%** (fp_i) = percentage (percent relative frequency); **D** = dominance, EU = eudominant, DO = dominant, SU = subdominant, RE = recessive, RA = rare, UL = ultrarare; **C** = constancy, CON = constant, ACE = accessory, ACI = accidental; **CAA** = species and abundances recorded in the shrubby-arboreal caatinga, **CIL** = species and abundances recorded in the ciliary forest; **RAI** = species and abundances recorded in rainy period (May-June 2011 and January-April 2012), **DRY** = species and abundances recorded in dry period (July-December 2011); species that were recorded at minimum in one of the works for the biomes and the presence or absence of apostrophe (') means records of different subspecies (with apostrophe) or the same subspecies (without apostrophe) in cases or just the same species (without apostrophe) for 1 = Caatinga (Nobre et al. 2008, Paluch et al. 2011, Zacca and Bravo 2012, Lima and Zacca 2014, Kerpel et al. 2014, Câmara et al. 2017, Ferreira-Júnior 2021, Dantas et al. 2021), 2 = Atlantic Forest (Cardoso 1949, Kesselring and Ebert 1979, Zacca et al. 2011, Paluch et al. 2016, Melo et al. 2019, Vila-Verde and Paluch 2020, Vila-Verde et al. 2020, Dantas et al. 2021, Medeiros et al. 2021, Gonçalves et al. 2021), 3 = Cerrado (Emery et al. 2006, Pinheiro and Emery 2006, Mielke et al. 2008, Martins et al. 2017, Silva et al. 2022b, Pinheiro and

Ribeiro 2022), 4 = Amazon (Emmel and Austin 1990, Mielke et al. 2010, Casagrande et al. 2012, Mielke et al. 2012, Martins et al. 2017, Pereira et al. 2018, Mota et al. 2022); [1] = Lepidoptera species outside of the sampling period and of the sample, [2] = Lepidoptera species outside of the sample, [3] = unprecedented record in the Northeast region of Brazil, [4] = unpublished records for Semiarid-Caatinga, [5] = unpublished records in Paraíba state, [6] = unpublished records in the Septentrional Sertaneja Depression ecoregion, [7] = singletons, [8] = doubletons, [9] = uniques, [10] = duplicates; x = presence in the environment or in period.

Taxon	N (f_i)	% (fp_i)	D	C	Environment		Period		Biomes
					CAA	CIL	RAI	DRY	
PAPILIONOIDEA (93)									
PAPILIONIDAE (2)									
Papilioninae (2)									
Troidini									
Battus polydamas (Linnaeus, 1758) [10]	9	0.16	UL	ACI	4	5	9		1', 2', 3', 4'
Papilionini									
Heraclides thoas brasiliensis (Rothschild & Jordan, 1906) [7, 9]	1	0.02	UL	ACI	1			1	1, 2, 3, 4'
PIERIDAE (11)									
Coliadinae (8)									
Abaeis albula (Cramer, 1775)	81	1.46	RE	ACE	15	66	12	69	1', 2', 3', 4'
Anteos clorinde (Godart, [1824]) [10]	3	0.05	UL	ACI		3	3		1, 2, 3
Aphrissa statira (Cramer, 1777) [6]	8	0.14	UL	ACE	7	1	6	2	1, 2, 3, 4
Eurema flavescens (Chavannes, 1850)	1822	32.79	EU	CON	509	1313	936	886	1, 2, 3', 4'
Eurema phiale paula (Röber, 1909) [6]	5	0.09	UL	ACE	4	1	4	1	1, 2, 3
Phoebis marcellina (Cramer, 1777)	300	5.4	DO	CON	183	117	155	145	1, 2, 3', 4
Pyrisitia leuce (Boisduval, 1836)	49	0.88	RA	CON	14	35	37	12	1', 2', 3', 4'
Pyrisitia nise tenella (Boisduval, 1836)	115	2.07	SU	CON	33	82	72	43	1, 2, 3, 4'
Pierinae (3)									
Pierini									
Ascia monuste orseis (Godart, 1819)	824	14.83	EU	CON	176	648	421	403	1, 2, 3, 4'
Ganyra phaloe endeis (Godart, 1819)	46	0.83	RA	ACE		46	10	36	1, 2', 4'
Glutophrissa drusilla (Cramer, 1777)	13	0.23	RA	ACE		13	7	6	1, 2', 3', 4'
LYCAENIDAE (14)									
Theclinae (12)									
Eumaeini									
Allosmaitia strophius (Godart, [1824]) [1]						x	x		1, 2, 3
Chlorostrymon simaethis (Drury, 1773) [7, 9]	1	0.02	UL	ACI		1	1		1
Electrostrymon endymion (Fabricius, 1775) [9]	3	0.05	UL	ACI		3	3		1, 2', 3
Kisutam syllis (Godman & Salvin, 1887) [1]						x	x		1, 2, 3, 4
Ministrymon azia (Hewitson, 1873) [6, 7, 9]	1	0.02	UL	ACI		1	1		1, 3, 4
Pseudolycaena marsyas (Linnaeus, 1758) [8, 9]	2	0.04	UL	ACI		2		2	1, 2, 3, 4
Strephonota sp. [5, 6]	8	0.14	UL	ACE		8	3	5	
Strymon astiocha (Prittwitz, 1865)	21	0.38	RA	CON	7	14	13	8	1, 2, 3, 4
Strymon bubastus (Stoll, 1780) [10]	5	0.09	UL	ACI	2	3	5		1, 2, 3
Strymon crambusa (Hewitson, 1874) [7, 9]	1	0.02	UL	ACI	1		1		1, 3
Strymon rufofusca (Hewitson, 1877)	17	0.31	RA	CON	9	8	3	14	1, 2, 3
Tmolus echion (Linnaeus, 1767) [6, 9]	12	0.22	RA	ACI		12		12	1, 2, 3, 4
Polyommatinae (2)									
Polyommatini									
Hemiargus hanno (Stoll, 1790)	311	5.6	DO	CON	161	150	78	233	1', 2', 3, 4'
Leptotes cassius (Cramer, 1775)	8	0.14	UL	ACE	3	5	5	3	1', 2', 3', 4

RIODINIDAE (4)									
Riodininae (4)									
Nymphidiini									
Aricoris campestris (H. Bates, 1868)	15	0.27	RA	CON	6	9	9	6	1, 2, 3, 4
Aricoris sp. [5, 6]	24	0.43	RA	CON	7	17	5	19	
Synargis calyce (C. Felder & R. Felder, 1862) [6, 10]	3	0.05	UL	ACI		3		3	1, 2, 3, 4
Riodinini									
Lasaia sp. [3, 4, 5, 6, 8, 10]	2	0.04	UL	ACI		2	1	1	
NYMPHALIDAE (27)									
Danainae (5)									
Danaini									
Danaus eresimus plexaure (Godart, 1819)	30	0.54	RA	ACE		30	23	7	1, 2, 3, 4’
Danaus erippus (Cramer, 1775)	31	0.56	RA	ACE	1	30	17	14	1, 2, 3
Danaus gilippus (Cramer, 1775)	138	2.48	SU	CON	11	127	107	31	1’, 2’, 3’, 4
Lycorea halia discreta Haensch, 1909 [7, 9]	1	0.02	UL	ACI		1	1		1, 2, 3, 4’
Ithomiini									
Mechanitis lysimnia nesaea Hübner, [1820][7, 9]	1	0.02	UL	ACI		1		1	1, 2, 3’, 4’
Heliconiinae (4)									
Argynnini									
Euptoieta hegesia meridiania Stichel, 1938	320	5.76	DO	CON	55	265	230	90	1, 2, 3, 4’
Heliconiini									
Dione maculosa Stichel, [1908]	127	2.29	SU	CON	89	38	64	63	1, 2, 3, 4’
Eueides isabella dianasa (Hübner, [1806])[8, 10]	2	0.04	UL	ACI		2	1	1	1, 2, 3, 4’
Heliconius erato phyllis (Fabricius, 1775)	45	0.81	RA	CON	1	44	18	27	1, 2, 3, 4’
Biblidinae (8)									
Biblidini									
Biblis hyperia nectanabis (Fruhstorfer, 1909)	11	0.2	RA	ACE	1	10	2	9	1, 2, 3, 4’
Mestra hersilia hypermestra Hübner, [1825] [6]	111	2	RE	CON	35	76	96	15	1, 2, 3’
Catonephelini									
Eunica tatila bellaria Fruhstorfer, 1908	22	0.4	RA	ACE	7	15	2	20	1, 2, 3, 4
Ageroniini									
Hamadryas februa (Hübner, [1823])	88	1.58	RE	CON	8	80	18	70	1’, 2’, 3, 4
Hamadryas feronia (Linnaeus, 1758) [10]	3	0.05	UL	ACI		3		3	1’, 2’, 3’, 4
Eubagini									
Dynamine arene Hübner, [1823] [6]						x			1, 2, 4
Dynamine postverta (Cramer, 1779) [6, 10]	3	0.05	UL	ACI		3	3		1, 2, 3, 4
Callicorini									
Callicore sorana (Godart, [1824])	23	0.41	RA	CON		23	4	19	1’, 2’, 3’
Nymphalinae (5)									
Victorinini									
Anartia jatrophae jatrophae (Linnaeus, 1763)	195	3.51	SU	CON	17	178	92	103	1’, 2’, 3’, 4’
Siproeta stelenes meridionalis (Fruhstorfer, 1909) [6]	3	0.05	UL	ACE		3	1	2	1, 2, 3’, 4’
Junoniini									
Junonia evarete (Cramer, 1779)	48	0.86	RA	CON	12	36	41	7	1, 3, 4’
Melitaeini									
Anthanassa hermas (Hewitson, 1864)	13	0.23	RA	ACE		13	8	5	1, 2, 3, 4’
Ithra ithra (W. F. Kirby, 1900)	23	0.41	RA	ACE	2	21	7	16	1, 2, 3, 4

Charaxinae (4)									
Anaeini									
Fountainea glycerium cratais (Hewitson, 1874) [6]	19	0.34	RA	ACE	8	11	7	12	1, 2, 3
Fountainea halice moretta (H. Druce, 1877)	58	1.04	RE	CON	33	25	19	39	1, 4’
Hypna clytemnestra forbesi Godman & Salvin, 1884	6	0.11	UL	ACE	3	3	5	1	1, 2, 3’, 4’
Preponini									
Prepona laertes (Hübner, [1811]) [6]					x		x		1, 2, 3, 4
Satyrinae (1)									
Satyrini									
Pharneuptychia phares (Godart, [1824])	8	0.14	UL	ACE	4	4	4	4	1, 2, 3, 4
HESPERIIDAE (35)									
Eudaminae (10)									
Eudamini									
Aguna asander (Hewitson, 1867) [6, 10]	4	0.07	UL	ACI		4	4		1, 2, 3, 4
Cecropterus dorantes (Stoll, 1790)	127	2.29	SU	CON	12	115	123	4	1’, 2’, 3’, 4’
Chioides catillus (Cramer, 1779)	10	0.18	UL	ACE	1	9	4	6	1’, 2’, 3’, 4’
Epargyreus exadeus (Cramer, 1779) [10]	6	0.11	UL	ACI	3	3	6		1, 2’, 3’, 4
Spicauda procne (Plötz, 1881) [8, 9]	2	0.04	UL	ACI		2		2	1, 2, 3, 4
Spicauda teleus (Hübner, 1821) [1, 6]						x	x		1, 2, 3, 4
Telegonus anaphus (Cramer, 1777) [9]	3	0.05	UL	ACI		3		3	1, 2’, 3’, 4’
Urbanus proteus (Linnaeus, 1758) [9]	6	0.11	UL	ACI		6	6		1’, 2’, 3’, 4’
Oileidini									
Cogia calchas (Herrich-Schäffer, 1869)	51	0.92	RA	CON	41	10	43	8	1, 2, 3, 4
Cogia undulatus (Hewitson, 1867)	3	0.05	UL	ACE	1	2	2	1	1, 2, 3, 4
Tagiadinae (1)									
Celaenorrhinini									
Celaenorrhinus sp. [6]	4	0.07	UL	ACE		4	1	3	
Pyrginae (12)									
Carcharodini									
Nisoniades macarius (Herrich-Schäffer, 1870)	4	0.07	UL	ACE	2	2	3	1	1, 2, 3, 4
Erynnini									
Chiothion asychis autander (Mabille, 1891) [6]	15	0.27	RA	ACE	4	11	14	1	1, 2, 3
Clito sompa Evans, 1953	6	0.11	UL	ACE		6	2	4	1, 3
Gesta gesta (Herrich-Schäffer, 1863)	21	0.38	RA	CON	2	19	14	7	1, 2, 3, 4
Hoodus cristata (Austin, 2000)	7	0.13	UL	ACE	4	3	7		1, 2, 3, 4
Pyrgini									
Burnsius orcus (Stoll, 1780)	68	1.22	RE	CON	25	43	52	16	1, 2, 3, 4
Chirgus veturius (Plötz, 1884) [10]	3	0.05	UL	ACI		3	3		1, 2, 4
Heliopetes arsalte (Linnaeus, 1758) [8, 9]	2	0.04	UL	ACI		2	2		1, 2, 3, 4
Heliopetes orbigera (Mabille, 1888) [7, 9]	1	0.02	UL	ACI		1	1		1, 2, 3, 4
Heliopetes willi (Plötz, 1884)	74	1.33	RE	CON	45	29	56	18	1, 3
Trina geometrina (C. Felder & R. Felder, 1867) [6, 7, 9]	1	0.02	UL	ACI		1	1		1, 2, 3, 4
Zopyrion evenor thania Evans, 1953	16	0.29	RA	ACE	11	5	15	1	1, 2, 3’, 4’
Hesperiinae (12)									
Hesperiini									
Callimormus saturnus (Herrich-Schäffer, 1869) [10]	11	0.2	RA	ACI		11	11		1, 3, 4

Cymaenes lepta (Hayward, 1939) [2, 4, 5, 6]						x	x		2, 3
Cymaenes tripunctus theogenis (Capronnier, 1874)	34	0.61	RA	CON		34	27	7	1, 2, 3, 4
Hylephila phyleus (Drury, 1773)	7	0.13	UL	ACE	6	1	2	5	1', 2', 3', 4'
Lerema ancillaris (A. Butler, 1877) [2]						x	x		1, 2, 4'
Lerodea erythrostictus (Prittwitz, 1868) [2]						x		x	1, 2, 3
Lerodea eufala (W. H. Edwards, 1869) [2, 5, 6]						x	x	x	3'
Nyctelius nyctelius (Latreille, [1824]) [1, 6]						x	x		1, 2, 3, 4
Panoquina hecebolus (Scudder, 1872) [2, 6]						x	x		1, 2, 3, 4
Panoquina lucas (Fabricius, 1793) [9]	27	0.49	RA	ACI		27	27		1, 2', 3', 4'
Pompeius pompeius (Latreille, [1824]) [6, 8, 10]	2	0.04	UL	ACI		2	1	1	1, 2, 3, 4
Synapte malitiosa equa Evans, 1955 [8, 10]	2	0.04	UL	ACI		2	1	1	1, 2, 4'
Total	**5556**	**100**	**82**	**82**	**47 1586**	**80 3970**	**74 2998**	**63 2558**	**87, 80, 82, 71 14', 20', 24', 33'**

The richness estimators Jackknife 1 and 2 extrapolated 96.7 and 99.4 species, respectively, Bootstrap obtained 89.6, Chao 2 predicted 89.3, ICE expressed 93.4, results obtained equally through the distribution matrices by data of presence-absence and abundance, while Chao 1 and ACE obtained 85.5 and 86.2 species, with these last two estimators being exclusive to the abundance matrix and inoperative for the binary incidence matrix (Table IV). Values derived from eight singletons, one Papilionidae, three Lycaenidae, two Nymphalidae and two Hesperiidae, seven doubletons, one Lycaenidae, one Riodinidae, one Nymphalidae and four Hesperiidae, 16 uniques, one Papilionidae, six Lycaenidae, two Nymphalidae and seven Hesperiidae, 14 duplicates, one Papilionidae, one Pieridae, one Lycaenidae, two Riodinidae, three Nymphalidae and six Hesperiidae (Table II). With these parameters that quantify rarities the highest expressions were for Hesperiidae (19 species), Lycaenidae (11 species), Nymphalidae (eight species), Papilionidae and Riodinidae (three species each), Pieridae (one species).

Table IV. Richness, abundance and estimates of richness by abundance or incidence of the Lepidoptera species in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through EstimateS software. S = richness; N = abundance; FATA = Tamanduá Farm, DRY = dry period, RAI = rainy period, CAA = shrubby-arboreal caatinga environment, CIL = ciliary forest environment.

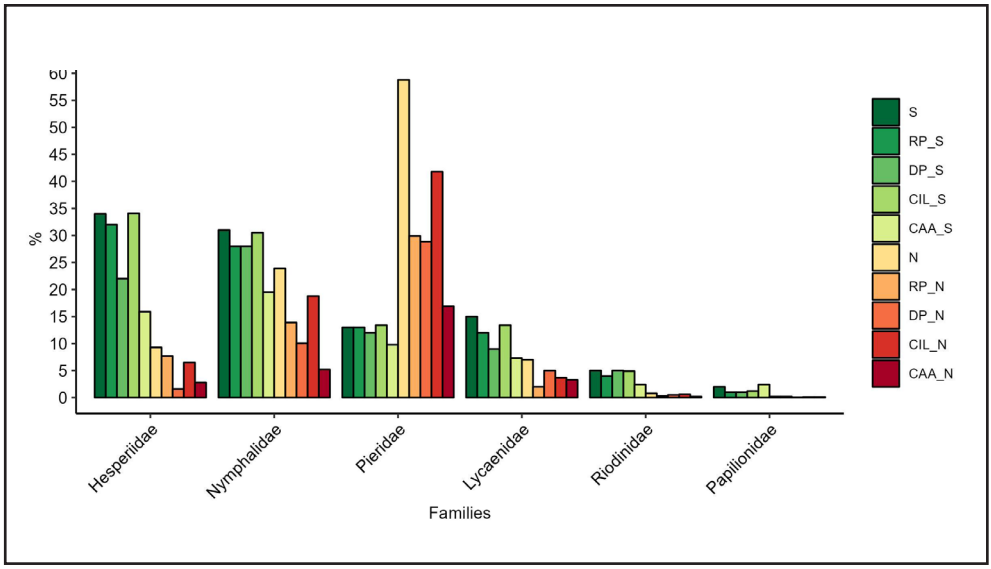
	S	N	Jackknife 1/ 2	Bootstrap	Chao 1/ 2	ICE	ACE
FATA	82	5556	96.7/ 99.4	89.6	85.5/ 89.3	93.4	86.2
DRY	63	2558	78/ 84.1	70.2	76.2/ 73.6	76.9	71.8
RAI	74	2998	90.7/ 90.7	82.9	83.4/ 80.1	90.5	80.7
CAA	47	1586	56.2/ 59.2	51.6	51.2/ 52.2	53.6	50.9
CIL	80	3970	96.5/ 97.1	88.7	83.6/ 87	94.6	85.7

Were added cumulatively to the richness and listing five species involved in cryptic pattern of Hesperiidae (Hesperiinae), *Cymaenes lepta* (Hayward, 1939), *Lerema ancillaris* (A. Butler, 1877), *Lerodea erythrostictus* (Prittwitz, 1868), *Lerodea eufala* (W. H. Edwards, 1869), *Panoquina hecebolus* (Scudder, 1872) (Table II), outside the sample; in addition to six species of Papilionoidea recorded by different collection methods outside of the sampling period and outside of the sample, four species via entomological net with *Nyctelius nyctelius* (Latreille, [1824]) and *Spicauda teleus* (Hübner, 1821), Hesperiidae, *Allosmaitia strophius* (Godart, [1824]) and *Kisutam syllis* (Godman & Salvin, 1887), Lycaenidae (Table II), plus two species of Nymphalidae by *Dynamine arene* Hübner, [1823] with one individual collected via Malaise trap in the ciliary forest and *Prepona laertes* (Hübner, [1811]) recorded in Oliveira et al. (2024) with one individual collected via Van Someren-Rydon trap of fruit-feeding Papilionoixdea in rainy season in the ecological stage of late succession of the caatinga. Species that were not considered in the sample for the calculations of richness or diversity estimators.

Table III. Richness and abundance in absolute numbers and relative proportions in percentages (**%**) of families and subfamilies by periods and environments in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012. **S** = richness; **N** = abundance; **RAI** = months in the rainy period (May-June 2011 and January-April 2012), **DRY** = months in the dry period (July-December 2011); **CAA** = shrubby-arboreal caatinga, **CIL** = ciliary forest.

Families	**S**	**%**	**Periods (S)**				**Environments (S)**				**N**	**%**	**Periods (N)**				**Environments (N)**			
Subfamilies			**RAI**	**%**	**DRY**	**%**	**CAA**	**%**	**CIL**	**%**			**RAI**	**%**	**DRY**	**%**	**CAA**	**%**	**CIL**	**%**
Papilionidae	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2.4**	**1**	**1.2**	**10**	**0.2**	**9**	**0.2**	**1**	**0.02**	**5**	**0.1**	**5**	**0.1**
Papilioninae	2	2	1	1	1	1	2	2	1	1	10	0.2	9	0.16	1	0.02	5	0.09	5	0.09
Pieridae	**11**	**13**	**11**	**13**	**10**	**12**	**8**	**9.8**	**11**	**13.4**	**3266**	**58.8**	**1663**	**29.9**	**1603**	**28.85**	**941**	**16.9**	**2325**	**41.8**
Coliadinae	8	10	8	10	7	9	7	9	8	10	2383	42.9	1225	22.05	1158	20.84	765	13.77	1618	29.12
Pierinae	3	4	3	4	3	4	1	1	3	4	883	15.9	438	7.88	445	8.01	176	3.17	707	12.72
Lycaenidae	**12**	**15**	**10**	**12**	**7**	**9**	**6**	**7.3**	**11**	**13.4**	**390**	**7**	**113**	**2**	**277**	**4.99**	**183**	**3.3**	**207**	**3.7**
Theclinae	10	12	8	10	5	6	4	5	9	11	71	1.3	30	0.54	41	0.74	19	0.34	52	0.94
Polyommatinae	2	2	2	2	2	2	2	2	2	2	319	5.7	83	1.49	236	4.25	164	2.95	155	2.79
Riodinidae	**4**	**5**	**3**	**4**	**4**	**5**	**2**	**2.4**	**4**	**4.9**	**44**	**0.8**	**15**	**0.3**	**29**	**0.52**	**13**	**0.2**	**31**	**0.6**
Riodininae	4	5	3	4	4	5	2	2	4	5	44	0.8	15	0.27	29	0.52	13	0.23	31	0.56
Nymphalidae	**25**	**31**	**23**	**28**	**23**	**28**	**16**	**19.5**	**25**	**30.5**	**1329**	**23.9**	**770**	**13.9**	**559**	**10.06**	**287**	**5.2**	**1042**	**18.8**
Danainae	5	6	4	5	4	5	2	2	5	6	201	3.6	148	2.66	53	0.95	12	0.22	189	3.4
Heliconiinae	4	5	4	5	4	5	3	4	4	5	494	8.9	313	5.63	181	3.26	145	2.61	349	6.28
Biblidinae	7	9	6	7	6	7	4	5	7	9	261	4.7	125	2.25	136	2.45	51	0.92	210	3.78
Nymphalinae	5	6	5	6	5	6	3	4	5	6	282	5.1	149	2.68	133	2.39	31	0.56	251	4.52
Charaxinae	3	4	3	4	3	4	3	4	3	4	83	1.5	31	0.56	52	0.94	44	0.79	39	0.7
Satyrinae	1	1	1	1	1	1	1	1	1	1	8	0.1	4	0.07	4	0.07	4	0.07	4	0.07
Hesperiidae	**28**	**34**	**26**	**32**	**18**	**22**	**13**	**15.9**	**28**	**34.1**	**517**	**9.3**	**428**	**7.7**	**89**	**1.6**	**157**	**2.8**	**360**	**6.5**
Eudaminae	8	10	6	7	5	6	5	6	8	10	208	3.7	187	3.37	21	0.38	58	1.04	150	2.7
Tagiadinae	1	1	1	1	1	1	0	0	1	1	4	0.1	1	0.02	3	0.05	0	0	4	0.07
Pyrginae	13	16	13	16	8	10	7	9	13	16	222	4	171	3.08	51	0.92	93	1.67	129	2.32
Hesperiinae	6	7	6	7	4	5	1	1	6	7	83	1.5	69	1.24	14	0.25	6	0.11	77	1.39
Total	**82**	**100**	**74**	**90**	**63**	**77**	**47**	**57**	**80**	**98**	**5556**	**100**	**2998**	**54**	**2558**	**46**	**1586**	**28.5**	**3970**	**71.5**

Figure 3. Percentage relative frequencies of richness and abundance of the Lepidoptera families by general metric, periods and environments, in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012. S = richness; RP_S = rainy period richness, DP_S = dry period richness; CIL_S = ciliary forest richness, CAA_S = arboreal shrubby caatinga richness; N = abundance; RP_N = rainy period abundance, DP_N = dry period abundance; CIL_N = ciliary forest abundance, CAA_N = arboreal shrubby caatinga abundance.



With the additional records of 11 species outside the sample, 93 Papilionoidea species in the FATA were totalized and equal to the prediction of 93 species by the ICE richness estimator for horizontal asymptote (Table IV). Presenting the following proportions in ascending order of families for Hesperiidae with 35 species and 38%, Nymphalidae with 27 species and 29%, Lycaenidae with 14 species and 15%, Pieridae with 11 species and 12%, Riodinidae with four species and 4%, Papilionidae with two species and 2%.

The most representative subfamilies in abundance were Coliadinae (2383 individuals, 42.9%), Pierinae (883 individuals, 15.9%), Heliconiinae (494 individuals, 8.9%), Polyommatinae (319 individuals, 5.7%), Nymphalinae (282 individuals, 5.1%), Biblidinae (261 individuals, 4.7%), Pyrginae (222 individuals, 4%), Eudaminae (208 individuals, 3.7%), Danainae (201 individuals, 3.6%), among others with smaller representations (Table III, Figure 4).

The most representative subfamilies in richness were Pyrginae (13 species, 16%), Theclinae (10 species, 12%), Eudaminae and Coliadinae (eight species, each, 10%), Biblidinae (seven species, 9%), Hesperiinae (six species, 7%), Danainae and Nymphalinae (five species, each, 6%), among the others (Table III, Figure 4). With 11 additional species the most representative subfamilies became Pyrginae (13 species, 13.98%), Hesperiinae and Theclinae (12 species, each, 12.9%), Eudaminae (nine species, 9.68%), Coliadinae and Biblidinae (eight species, each, 8.6%), Danainae and Nymphalinae (five species, each, 5.38%), Riodininae, Heliconiinae and Charaxinae (four species, each, 4.3%), Pierinae (three species, 3.23%), Papilioninae and Polyommatinae (two species, each, 2.15%), Satyrinae and Tagiadinae (one species each, 1.08%).

Among the months were registered 37 species and 173 individuals in May, 48 species and 419 individuals in June (addition of 18 different species), 38 species and 491 individuals in July (addition of two different species), 42 species and 425 individuals in August (addition of nine different species), 36 species and 493 individuals in September (addition of four different species), 22 species and 250 individuals in October (without addition of different species), 31 species and 581 individuals in November (addition of two different species), 26 species and 318 individuals in December (without addition of different species), for the year 2011, 26 species and 292 individuals in January (addition of one different species), 20 species and 164 individuals in February

(addition of one different species), 39 species and 711 individuals in March (addition of four different species), 44 species and 1239 individuals in April (addition of four different species), for the year 2012. With relative percentage of abundance and richness of families and subfamilies by months presented in Figure 5 and Figure 6, Figure 7 and Figure 8.

Figure 4. Percentage relative frequencies of richness and abundance of the Lepidoptera subfamilies by general metric, periods and environments, in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012. S = richness; RP_S = rainy period richness, DP_S = dry period richness; CIL_S = ciliary forest richness, CAA_S = arboreal shrubby caatinga richness; N = abundance; RP_N = rainy period abundance, DP_N = dry period abundance; CIL_N = ciliary forest abundance, CAA_N = arboreal shrubby caatinga abundance.

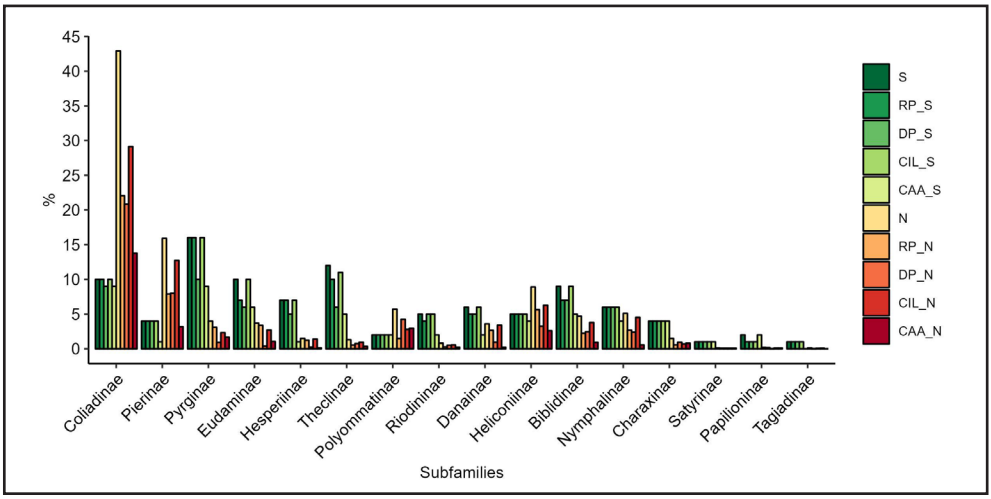
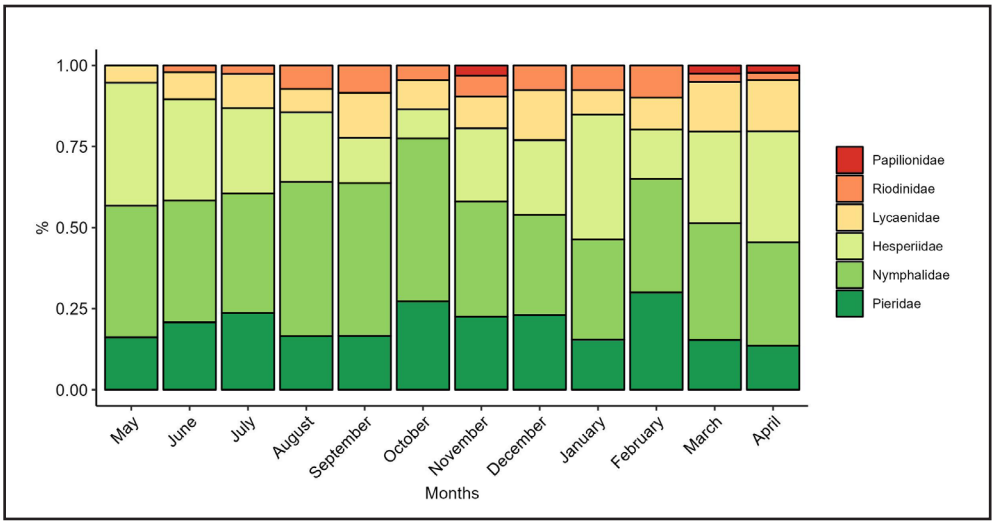


Figure 5. Relative frequencies in percentages of the abundance of Lepidoptera families by months in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012.



In total abundance there was a division of 2998 individuals (54%) for the rainy period (RAI) and 2558 individuals (46%) for the dry period (DRY), while the distribution of 1586 individuals (28.5%) in shrubby-ar-

boreal caatinga (CAA) and 3970 individuals (71.5%) in ciliary forest (CIL) (Table III). When examining the environments (CAA and CIL) in rainy period (RAI) and dry period (DRY), it was evidenced shrubby-arboreal caatinga environment with 837 individuals in rainy period (52.8%) and 749 individuals in dry period (47.2%), while it was demonstrated to ciliary forest environment with 2161 individuals in rainy period (54.4%) and 1809 individuals in dry period (45.6%).

Figure 6. Relative frequencies in percentages of the abundance of Lepidoptera subfamilies by months in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012.

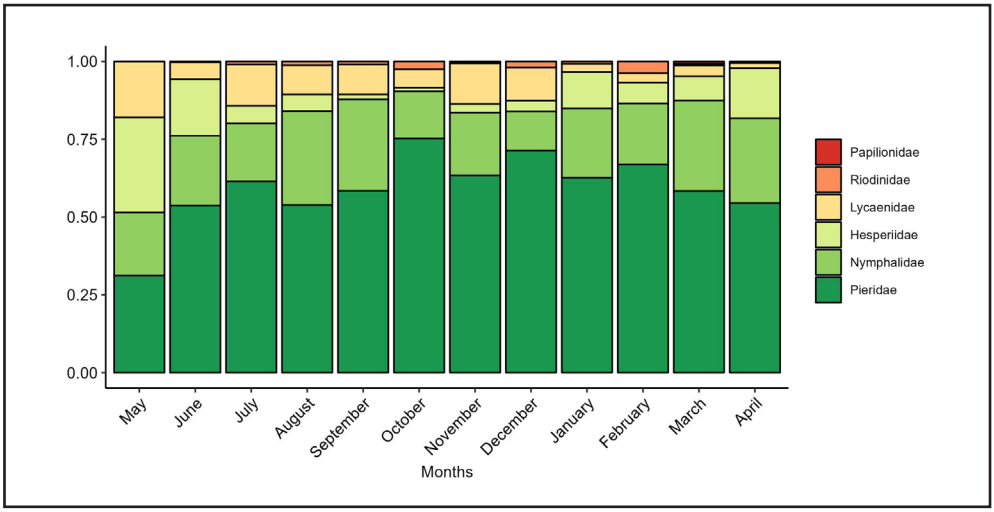


Figure 7. Relative frequencies in percentages of the richness of Lepidoptera families by months in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012.

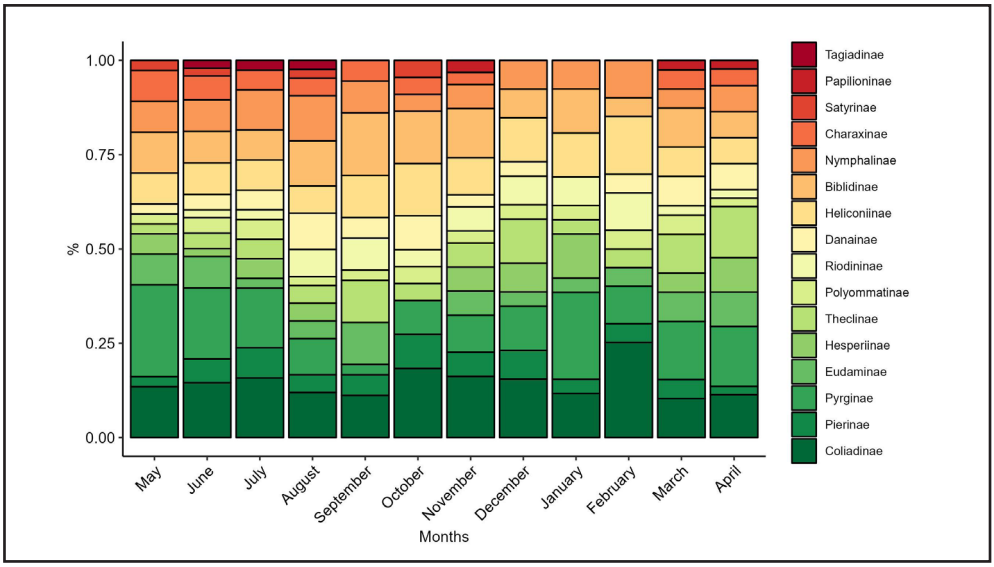
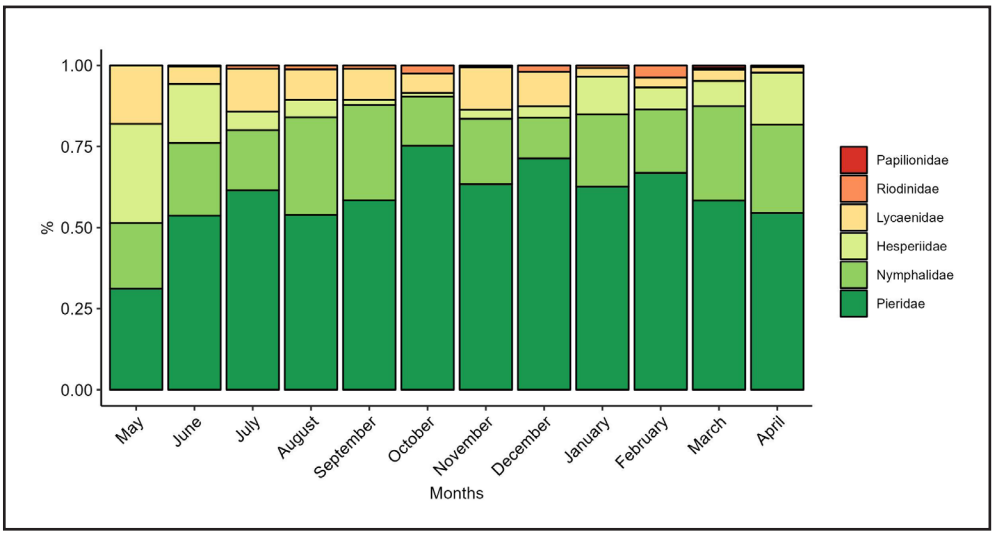


Figure 8. Relative frequencies in percentages of the richness of Lepidoptera subfamilies by months in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012.



Considering the sample, 74 species (90%) were recorded in rainy period (RAI) and 63 species (77%) in dry period (DRY) (Table III), with 19 exclusive species for the rainy period (23%) and eight exclusive species for the dry period (10%), a total of 55 species shared for both periods or more than half (67%).

The similarity and distance indexes resulted in 0.76 (76%) and 0.24 (24%) of the total of one (100%) with Bray-Curtis, very significant probability through bifactorial ANOSIM test for the factor of periods ($p = 0.0039$) and for expressing a difference between rainy period (RAI) and dry period (DRY) assemblies, meanwhile 0.67 (67%) and 0.33 (33%) for Jaccard, non-significant probabilities by the monofactorial and bifactorial ANOSIM tests ($p > 0.05$), via PAST. Richness extrapolations follow for the dry period (DRY) in Bootstrap with 70.2 species, Chao 1 and 2 with 76.2 and 73.6 species, Jackknife 1 and 2 with 78 and 84.1 species, ICE and ACE with 76.9 and 71.8 species; while estimates for the rainy period (RAI) in Bootstrap with 82.9 species, Chao 1 and 2 with 83.4 and 80.1 species, Jackknife 1 and 2 with 90.7 species for both estimators, ICE and ACE with 90.5 and 80.7 species, via EstimateS (Table IV).

About the differences and similarities between the environments (CAA and CIL) it was recorded 47 species (57%) in shrubby-arboreal caatinga (CAA) and two exclusive species (2%), 80 species (98%) in ciliary forest (FCI) and 35 exclusive species (43%) (Table III), with a total of 45 shared species in both environments and by just over half (55%). According to the indexes of similarity and distance that resulted in 0.5 (50%) for Bray-Curtis, very significant probability through monofactorial ANOSIM test ($p = 0.0017$) and highly significant by the bifactorial ($p < 0.001$), then in 0.55 (55%) and 0.45 (45%) for Jaccard, extremely significant probability by monofactorial ANOSIM ($p < 0.001$) and very significant by the bifactorial ($p = 0.0014$), confirming difference between these taxocenoses (CAA and CIL), via PAST. Richness estimates for the shrubby-arboreal caatinga environment (CAA) follow in Bootstrap with 51.6, Chao 1 and 2 with 51.2 and 52.2, Jackknife 1 and 2 with 56.2 and 59.2, ICE and ACE with 53.6 and 50.9, while for the ciliary forest environment (CIL) in Bootstrap with 88.7, Chao 1 and 2 with 83.6 and 87, Jackknife 1 and 2 with 96.5 and 97.1, ICE and ACE with 94.6 and 85.7, via EstimateS (Table IV).

Table V. Diversity indexes in two localities in Brazil, Semiarid, Caatinga, Septentrional Sertaneja Depression, Paraíba, through PAST software. CSTR = Health Center and Rural Technology ("Centro de Saúde e Tecnologia Rural"), Patos, sampling effort of 80 hours/one collector plus assistant in 10 months; FATA = Tamanduá Farm ("Fazenda Tamanduá"), Santa Teresinha, sampling effort of 96 hours/one collector plus assistant in 12 months, DRY = dry period, RAI = rainy period, CAA = shrubby-arbo-

real caatinga environment, CIL = ciliary forest environment; **S** = richness; **N** = abundance; **DO** = Dominance; **J** = Equitability; **H'** = Shannon; **1-D** = Gini-Simpson; **D** = Simpson; **TPD*p*** = probabilities of the diversity permutation test; **T*p*** = probabilities of the diversity *t* test.

	S	N	DO	J	H'	1-D	TPD*p*	T*p*
CSTR	81	2531	0.06	0.76	3.33	0.94	< 0.001 (DO) < 0.001 (J)	< 0.001 (H') < 0.001 (D)
FATA	82	5556	0.14	0.63	2.77	0.86		
DRY	63	2558	0.16	0.62	2.57	0.84	< 0.001 (DO) = 0.01 (J)	< 0.001 (H') < 0.001 (D)
RAI	74	2998	0.13	0.65	2.79	0.87		
CAA	47	1586	0.147	0.66	2.55	0.853	> 0.05 (DO) > 0.05 (J)	< 0.001 (H') > 0.05 (D)
CIL	80	3970	0.149	0.63	2.74	0.851		

Table VI. Diversity estimators q0 (Richness), q1 (Shannon) and q2 (Simpson) by rarefaction and extrapolation of the Lepidoptera species in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through R software and iNEXT package in 99% confidence limits. FATA = Tamanduá Farm, CAA = shrubby-arboreal caatinga environment, CIL = ciliary forest environment; SC = sample coverage estimate, CI = confidence interval; **N/ NSU** = Abundance/ Number of sampling units; **O** = Observed; **E** = Estimator; **L/ U** = Lower and Upper confidence limits through functions ChaoRichness(), ChaoShannon() and ChaoSimpson(); * = by applications see Hsieh et al. (2022b) for explanations of the standardization and of the possibility of variations, to the numbers obtained by the bootstrap method in randomly regenerated samples and by replications with the same data, probable differences via distinct versions or configurations in activations or not of determinate functions and parameters with arguments (syntax).

Site	N/ NSU	*Diversity	Abundance			Incidence		
			O	E	L/ U	O	E	L/ U
FATA	5556/ 12	Richness	82	86.57	82.6/ 116.82	82	90.38	83.77/ 121.75
		Shannon	15.89	16.02	15.89/ 16.89	62.04	67.15	62.04/ 72.78
		Simpson	6.93	6.94	6.93/ 7.41	52.26	54.87	52.26/ 59.49
			SC = 0.9986		CI = 0.99	SC = 0.9662		CI = 0.99
CAA	1586/ 12	Richness	47	53.12	47.73/ 98.65	47	53.55	48.01/ 89.56
		Shannon	12.81	13.03	12.81/ 14.24	36.08	39.92	36.08/ 44.66
		Simpson	6.80	6.82	6.80/ 7.53	30.01	32.13	30.01/ 35.95
			SC = 0.9956		CI = 0.99	SC = 0.9569		CI = 0.99
CIL	3970/ 12	Richness	80	84.50	80.64/ 111.74	80	87.82	81.75/ 114.98
		Shannon	15.47	15.64	15.47/ 16.65	59.27	65.14	59.43/ 70.85
		Simpson	6.70	6.71	6.70/ 7.21	48.78	51.76	48.78/ 56.82
			SC = 0.9977		CI = 0.99	SC = 0.9576		CI = 0.99

The diversity of the Papilionoidea community in the FATA, with assemblages or taxocenoses on temporal or spatial scales, in different periods or environments, evidenced greater abundance and richness for the rainy period and ciliary forest environment, detainers of diversities (relationship between richness and equitability or evenness) more expressive, mainly by the Shannon index (H') with individuals more evenly distributed among the species in rainy period (H' = 2.79) and in the ciliary forest environment (H' = 2.74), followed by a bigger accumulation of individuals belonging to few species in dry period (H' = 2.57) and in the shrubby-arboreal caatinga environment (H' = 2.55), in convergence by relationship with the greater equitability of Pielou (J) as greater homogeneity for the rainy period (J = 0.65) than to the dry period (J = 0.62) and lower dominance (DO) in rainy period (DO = 0.13) than in dry period (DO = 0.16), while the relative confluence for results of the Gini-Simpson index (1-D) by higher in rainy period (1-D = 0.87) and lower in

dry period (1-D = 0.84) due to having more dominant species with greater average relative abundance or smaller equitability in dry period (Table V). Results were reinforced by the observation of highly significant probabilities ($p < 0.001$) for the indexes between the different periods and environments through the diversity tests, especially Shannon, in addition to the very significant index of J ($p = 0.01$) between the dry and rainy periods; except with the non-significant indexes (> 0.05) of D, J and 1-D for the shrubby-arboreal caatinga and ciliary forest environments (Table VI).

The dominance expressed two species of Pieridae as eudominants (2.4% of the total richness), *Eurema flavescens* (Chavannes, 1850) with 1822 individuals (32.79%) and *Ascia monuste orseis* (Godart, 1819) with 824 individuals (14.83%), accounted in 2646 individuals (47.62%) of the total abundance of 5556 registered individuals (Table II); reflected in population explosions of some Pieridae species involved in migrations and recorded for the months with the highest precipitations during the rainy period (Table III); following in the dominant category with three species (3.7%) and encompassing 931 individuals (16.76% of the total abundance), *Phoebis marcellina* (Cramer, 1777) with 300 individuals (5.4%), *Hemiargus hanno* (Stoll, 1790) with 311 individuals (5.6%) and *Euptoieta hegesia meridiania* Stichel, 1938 with 320 individuals (5.76%) (Table II); subdominant with five species (6.1%) and 702 individuals (12.64%) (Table II); recessive with six species (7.3%) and 480 individuals (8.63%) (Table II); rare with 25 species (30.5%) and 637 individuals (11.47%), most Nymphalidae (10 species) and Hesperiidae (seven species), followed by Pieridae and Lycaenidae (three species each), Riodinidae (two species) (Table II); ultrarare with 41 species (50% of the total richness) and 160 individuals (2.88% of the total abundance), most Hesperiidae (18 species), Nymphalidae and Lycaenidae (eight species each), followed by Pieridae (three species), Papilionidae and Riodinidae (two species each) (Table II).

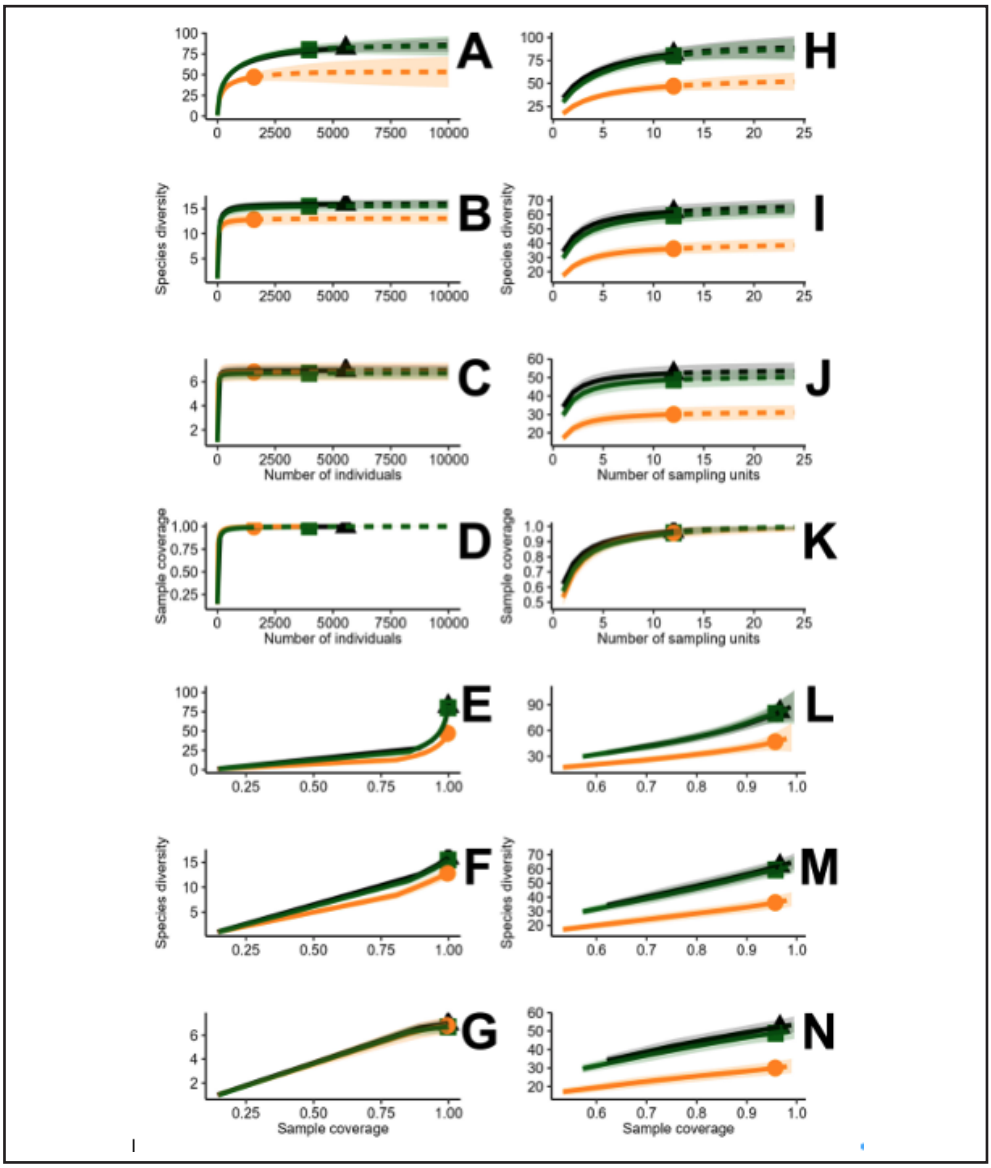
The constancy resulted in 26 constant species (32%), most Nymphalidae (10 spp.), Hesperiidae (six spp.), Pieridae (five spp.), followed by Lycaenidae (three spp.) and Riodinidae (two spp.) (Table II), with 10 species present throughout the entire sampling period of 12 months, *E. flavescens*, *P. marcellina*, *Pyrisitia nise tenella* (Boisduval, 1836), *A. monuste orseis*, *H. hanno*, *E. hegesia meridiania*, *Dione maculosa* Stichel, [1908], *Heliconius erato phyllis* (Fabricius, 1775), *Hamadryas februa* (Hübner, [1823]), *Anartia jatrophae jatrophae* (Linnaeus, 1763); 26 accessory species (32%), most Nymphalidae (10 spp.), Hesperiidae (nine spp.), followed by Pieridae (five spp.) and Lycaenidae (two spp.) (Table II); 30 accidental species (36%), most Hesperiidae (13 spp.), Lycaenidae (seven spp.) and Nymphalidae (five spp.), followed by Papilionidae and Riodinidae (two spp. each), Pieridae (one sp.) (Table II). Only three constant species were present in both shrubby-arboreal caatinga and ciliary forest environments throughout the entire sampling period, *E. flavescens*, *P. marcellina* and *H. hanno*.

Interpolation and extrapolation analyses for species diversity by Hill numbers through iNEXT showed promising results (Table VI, Figure 9), with relative comparative correspondence to the results contained in Table IV and Table V, as well as transposing some limitations of given tools or other statistical resources, for example, by increasing estimate intervals or giving others for important differences. Due to probabilities involved in the dynamics of fluctuations of populations and communities to the possible human records as representations for formal documentation, with potentialities for approximate or exact validations of computational simulations (evidence, proof). See, for instance, estimates of richness order (q0) to FATA at 116.82 species (upper confidence limit) by abundance and 121.75 species (upper confidence limit) by incidence (Table VI); with replications by functions in specific configurations, as other examples, to the result for past and recent versions of iNEXT in the R return with q0 orders by 103.43 species in abundance (UCL 95% and 95% Upper in ChaoRichness) or for the recent version by 103.03 species in incidence (UCL 99%), even by the recent version of iNEXT Online (http://chao.stat.nthu.edu.tw/wordpress and https://chao.shinyapps.io/iNEXTOnline) with q0 orders in extrapolations by 102.77 species in abundance (qD.UCL 99% Level of confidence interval) or by 103.06 species in incidence (qD.UCL 99% Level of confidence interval), as some of the intervals.

Other analyses, through the R software with vegan package and auxiliaries, such as those that can precede the NMDS ordination or after for the provenance, by ANOSIM function resulted in a significant difference ($p < 0.05$) between the rainy period (RAI) and dry period (DRY) in the FATA; followed by the dissimilarity level in configuration of the SIMPER function with 0.45 (45%) of the total of one (100%) and in another configuration with contributions to the significance levels for some of the species by *Junonia evarete* (Cramer, 1779), *Heliopetes willi* (Plötz, 1884), *Burnsius orcus* (Stoll, 1780), *Zopyrion evenor thania* Evans, 1953, *H. hanno*, *Strymon rufofusca* (Hewitson, 1877) and *Aricoris* sp. Then, by the dimensioning via NMDS in a stress of 0.072, by random departures to the dissimilarity calculations, for ordination with the formation in significance of two

different groups by the lines of distinct polygons at different points and overlapping parts or not for the set of the months of rainy period or the set of the months of dry period, with adjustment qualities by sequences in centroids for approximations and distances between points (Figure 10).

Figure 9. Interpolation and extrapolation curves of the abundance (A-G) and incidence (H-N) of Papilionoidea in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through R software and iNEXT package in 99% Lower and Upper Confidence Limits (LCL and UCL). Continuous line = Rarefaction; Dashed line = Extrapolation; Triangle and black color = Tamanduá Farm; Circle and orange color = Shrubby-arboreal caatinga; Square and green color = Ciliary forest; A, E and H, L = order q0 (Richness); B, F and I, M = order q1 (Shannon); C, G and J, N = order q2 (Simpson); A, B, C and H, I, J = Sample-size-based R/E curves; D and K = Sample completeness curves in orders q0, q1, q2; E, F, G and L, M, N = Coverage-based R/E curves.



The NMDS data of the FATA for rainy (RAI) and dry (DRY) periods, through envfit function for dissimilarity of the communities in periods and other variables that could or could not drive the distribution pattern, resulted in contributions by significance levels for species *E. flavescens*, *A. monuste orseis*, *P. nise tenella*, *Pyrisitia leuce* (Boisduval, 1836), *Eurema phiale paula* (Röber, 1909), *Cogia calchas* (Herrich-Schäffer, 1869), *Epargyreus exadeus* (Cramer, 1779), *Nisoniades macarius* (Herrich-Schäffer, 1870), *H. willi*, *E. hegesia meridiania*, *Danaus gilippus* (Cramer, 1775), *Danaus eresimus plexaure* (Godart, 1819), *Danaus erippus* (Cramer, 1775), *D. maculosa*, *Mestra hersilia hypermestra* Hübner, [1825], *Dynamine postverta* (Cramer, 1779), *Anthanassa hermas* (Hewitson, 1864), *Hypna clytemnestra forbesi* Godman & Salvin, 1884 and with little variation, continuing by envfit in another configuration with output of the relative contribution of isolated environmental variables and only for temperature as significant ($p < 0.05$); along with the possibility of using different functions and distinct configurations or other tests, for correlations or not with ordination axes, also to evaluate the influence of variables separately or jointly to verify the conduction or not of observed differences in distributions, perhaps to reinforce or not, such as a different function in a configuration that returned significance for correlation with the variable set of precipitation plus temperature in the FATA and for disposition in periods (RAI and DRY) by species.

Data arrangement for the environments of shrubby-arboreal caatinga (CAA) and ciliary forest (CIL), in the FATA, resulted in relationships by environments (CAA and CIL) and periods (RAI and DRY) to the dimensioning. The disposition of environments by periods showed ANOSIM result in non-significance, with another result in distinction for significance due to a different function and configuration; then by SIMPER in a configuration between the periods with 0.54 (54%) and significance levels for few species compared to the results of the anterior and posterior SIMPER. In an analytical disposition only by environments (CAA and CIL) resulted in ANOSIM as very significant ($p = 0.001$); followed by SIMPER in configurations between the environments with 0.57 (57%) and significance levels for slightly more than half of the species registered in the FATA. The data of the NMDS from FATA by environments of shrubby-arboreal caatinga (CAA) and ciliary forest (CIL), with general stress of 0.096, resulted in directional points with lines to the formation of polygons with overlapping parts or not by degrees of differentiation for the months by periods (DRY and RAI) in distribution (Figure 11) and for the months by environments (CAA and CIL) in approximation or distancing (Figure 12).

Figure 10. NMDS of the abundance of Lepidoptera species by rainy period (RAI) and dry period (DRY) in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through R software and vegan package, 0.072 stress. Square and green color = rainy period (May-June 2011 and January-April 2012); Triangle and orange color = dry period (July-December 2011).

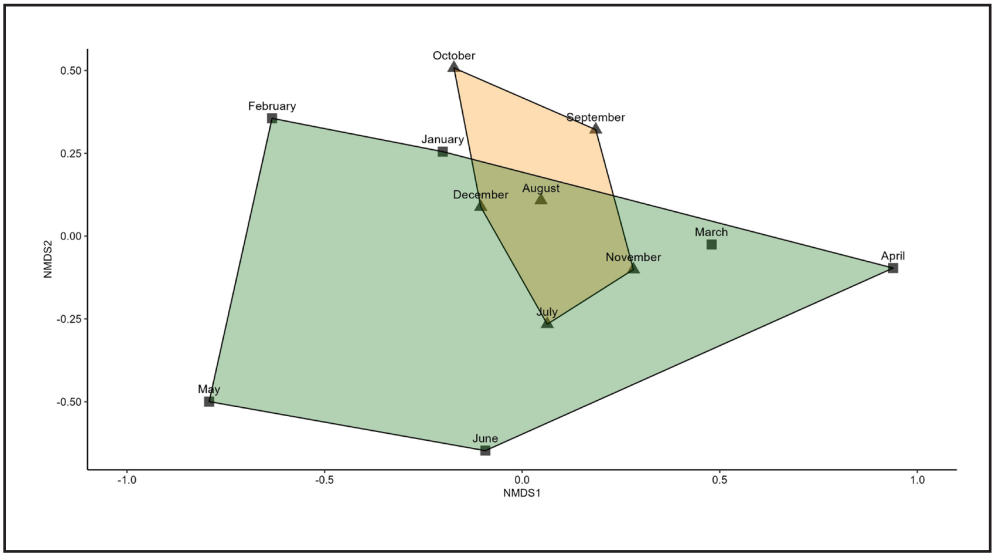


Figure 11. NMDS of the abundance of Lepidoptera species by environments of shrubby-arboreal caatinga (_Caa) and ciliary forest (_Cil) in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through R software and vegan package, 0.096 stress, for the environments in months by periods. Square and green color = rainy period (May-June 2011 and January-April 2012); Triangle and orange color = dry period (July-December 2011).

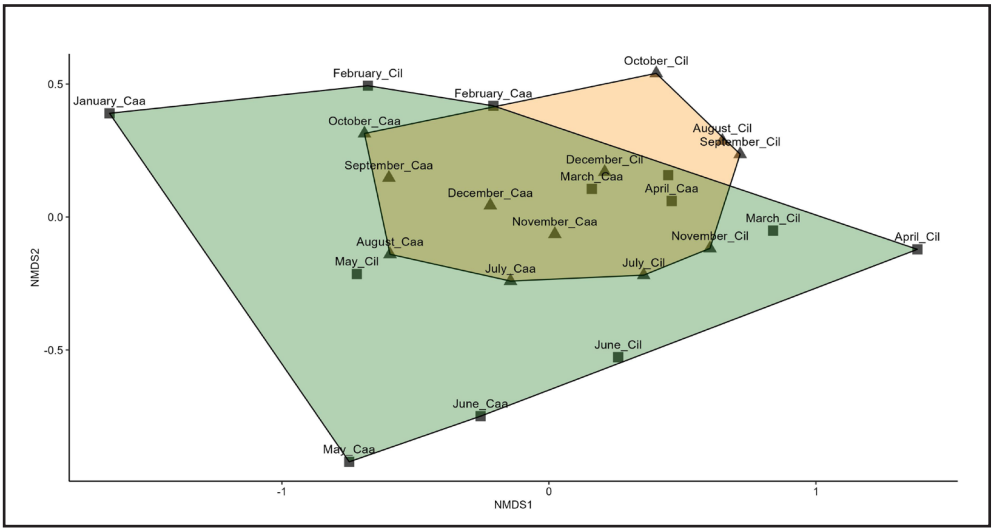
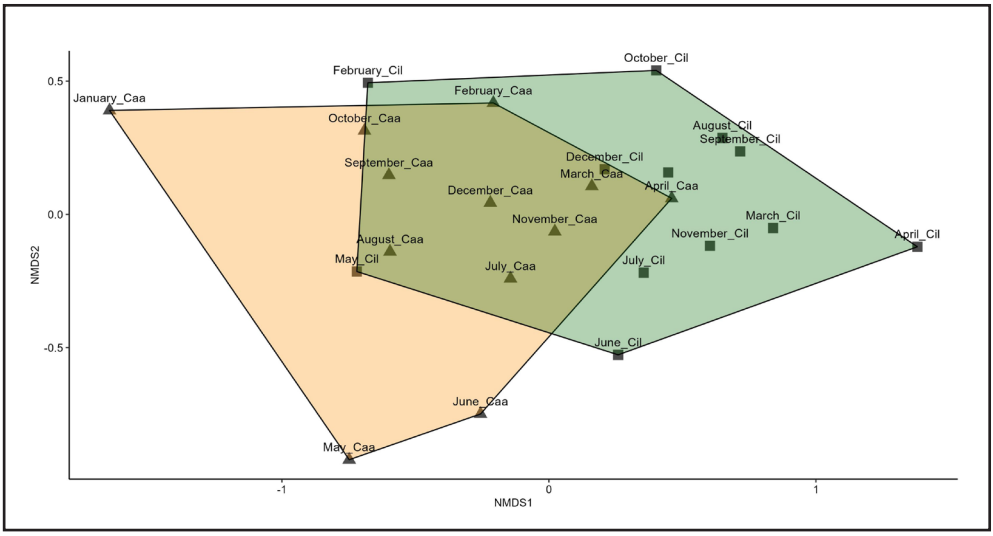


Figure 12. NMDS of the abundance of Lepidoptera species by environments of shrubby-arboreal caatinga (_Caa) and ciliary forest (_Cil) in the Tamanduá Farm (FATA), Santa Teresinha, Paraíba, Brazil, with sampling effort of 96 hours/one collector plus assistant in 12 months, between May 2011 to April 2012, through R software and vegan package, 0.096 stress, for the months by environments. Square and green color = ciliary forest (_Cil); Triangle and orange color = shrubby-arboreal caatinga (_Caa).



The envfit function via the NMDS result, through the dissimilarity of communities to spaces and species as driving variables of the distribution pattern, resulted in contributions by significance levels for *E. flavescens*,

E. phiale paula, *P. leuce*, *P. nise tenella*, *A. monuste orseis*, *Strephonota* sp., *Leptotes cassius* (Cramer, 1775), *D. eresimus plexaure*, *D. erippus*, *D. gilippus*, *E. hegesia meridiania*, *H. erato phyllis*, *M. hersilia hypermestra*, *Callicore sorana* (Godart, [1824]), *A. jatrophae*, *Siproeta stelenes meridionalis* (Fruhstorfer, 1909), *C. calchas*, *E. exadeus*, *N. macarius*, *Hoodus cristata* (Austin, 2000), *H. willi* and with little variation, species in the multidimensional space with center and greater proximities to the centroids; followed by envfit in another configuration to return relative contribution of isolated variables and only to the environment (CAA and CIL) as very significant ($p = 0.003$), with reinforcement for previous correlation by different functions and distinct configurations or different tests.

Discussion

The majority of species at FATA are common in forest edges, open or ruderal areas; generalists by polyphagy with approximately 41 species, among 71 recognized species that also include specialists by monophagy with 12 species and by oligophagy with 18 species, via connected information or cross-data (Trigo et al. 2000; Beccaloni et al. 2008; Guedes et al. 2012; Silva et al. 2012; Cabral et al. 2013; Laine et al. 2017); extensively distributed in Brazil because many are shared in different environments of Caatinga (87 species), Cerrado (82 species), Atlantic Forest (80 species) and Amazon (71 species), as observed in comparison described for these biomes (Table II), while sharing more than half of their species (84 species) with the largest inventory in the northeastern Semiarid region (Kerpel et al. 2014) and representation around 21.6% (Table VII). Descriptions of possible new species included in the FATA are still in development, such as *Aricoris* sp. (Riodinidae) and *Celaenorrhinus* sp., in addition to the probable definitions of endemism's for the Caatinga biome or Semiarid region which are under evaluation.

Table VII. Synthesis of the Lepidoptera inventories developed in the Caatinga biome and published, including the present study in the Tamanduá Farm (FATA) in Santa Teresinha municipality and Paraíba state. DSS = Septentrional Sertaneja Depression ("Depressão Sertaneja Setentrional"), DSM = Meridional Sertaneja Depression ("Depressão Sertaneja Meridional"), PBO = Borborema Plateau ("Planalto da Borborema"), CCD = Chapada Diamantina Complex ("Complexo da Chapada Diamantina"), CCM = Campo Maior Complex ("Complexo de Campo Maior"), CIA = Ibiapaba/Araripe Complex ("Complexo Ibiapaba/Araripe"); N = Entomological net, T = Van Someren-Rydon trap.

Work	Locality	State	Caatinga Ecoregion	Sampling effort	Richness	Shared species
Present study FATA	Fazenda Tamanduá	PB	DSS	96 h/ one collector N	82 (93)	–
Nobre et al. (2008)	PARNA do Catimbau	PE	PBO, DSM	360 h/ one collector N(T)	121	66
Paluch et al. (2011)	Parque Municipal João V. Sobrinho	PE	PBO	216 h/ two collectors N(T)	197	57
Zacca & Bravo (2012)	Chapada Diamantina	BA	CCD	392 h/ one collector N(T)	169	60
Lima & Zacca (2014)	Serra da Fumaça	BA	CCD	97 h/ one collector N(T)	121	47
Kerpel et al. (2014)	11 localities	PI, CE, PB, PE, BA	DSM, PBO, CCD, CIA	N(T)	389	84
Kerpel et al. (2014)	Milagres	BA	DSM	32 h/ two collectors N(T)	65	43
Kerpel et al. (2014)	Maracás	BA	DSM	32 h/ two collectors N(T)	84	40
Câmara et al. (2017)	PARNA de Sete Cidades and Ubajara	CE	CCM, CIA	98 h/ one collector N(T)	150	45

Ferreira-Júnior (2021)	UFCG-CSTR, Patos	PB	DSS	80 h/ one collector N	81 (92)	60 (69)
Dantas et al. (2021)	UEFS, Feira de Santana	BA	DSM	180 h/ one collector N(T)	96 (114)	61

The richness found in the FATA is considerably lower compared to five studies described for areas in Caatinga ecoregions (Nobre et al. 2008; Paluch et al. 2011; Zacca & Bravo, 2012; Lima & Zacca, 2014; Câmara et al. 2017), while the richness is close to two localities with Maracás in Bahia (Kerpel et al. 2014) or Patos in Paraíba (Ferreira-Júnior, 2021) and having greater richness than that recorded for Milagres in Bahia (Kerpel et al. 2014), considering distinct phytophysiognomies, environmental heterogeneities, collection methods and different sampling efforts, in contrast to the difference of species composition between the cited works (Table VII). The richness of the FATA is also considered low when compared with the richness in areas of Atlantic Forest, Cerrado and Amazon in the Northeast region, except for the works of Duarte-Júnior et al. (2001), Vasconcelos et al. (2009), Pereira et al. (2018) and Medeiros et al. (2021) (Table I). The relatively low richness is expected for a hyperxerophilous region that is under strong influence of seasonality, has a very irregular rainfall regime and high levels of insolation, with relatively scarce forest and litter cover, where most of the trees are deciduous (Nobre et al. 2008). So far, the richness in the FATA represents 21.78% of the Lepidoptera richness in Paraíba, with the possibility of changes in conformity to future studies.

The greater abundance for the rainy period in the FATA is in agreement with the baseline result by Malaise trap for Lepidoptera in "RPPN Fazenda Almas" in the semiarid of the Paraíba with preserved caatinga vegetation and approximately 108 km of distance, defining the rainy period from February to July and dry period from August to January (Vasconcellos et al. 2010); as findings of relative accuracy or precision of the standards; then also by abundance and richness of fruit-feeding Papilionoidea collected with Van Someren-Rydon traps in the semiarid or caatinga of Pernambuco as more expressive during the rainy period in "PARNA Catimbau" with approximately 255 km away from FATA, defining the rainy period from March to August and dry period from September to February (Nobre et al. 2012).

A new record of Lepidoptera for the Northeast region is cited, *Lasaia* sp. (Riodininae, Riodinidae), with a single individual collected during the rainy period while ingesting mineral salts in a seasonal water body in the stream or another recorded by sighting during the dry period and both in the ciliary forest (Table I, Table II); meanwhile *Lasaia* sp. and *C. lepta* represent two previously unrecorded for the Semiarid-Caatinga; including when added with *Strephonota* sp. (Lycaenidae, Theclinae), *Aricoris* sp. (Riodinidae, Riodininae) and *L. eufala* (Hesperiidae, Hesperiinae) to form five unpublished records to the Paraíba state (Table I, Table II). For the ecoregion of the Septentrional Sertaneja Depression 24 unprecedented records were included, which is equivalent to the number of exclusive species of the FATA by comparison with the Health Center and Rural Technology (CSTR in Portuguese for "Centro de Saúde e Tecnologia Rural") in Patos (Ferreira-Júnior, 2021), also adding the Papilionoidea *D. arene* and *P. laertes* (Table I, Table II, Table VII). It is noteworthy that *L. eufala* was not recorded through works contained in Table I and this species was documented via specimen collected in Pernambuco state as reported by Evans (1955). To date and through the free or open platform of the citizen science iNaturalist (https://www.inaturalist.org) no unprecedented Lepidoptera records have been observed in the intermediations of the Santa Teresinha municipality (https://www.inaturalist.org/observations?place_id=22813) or when covering the area of the Tamanduá Farm (iNaturalist 2023).

It is emphasized that most species of Nymphalidae, Pieridae and Papilionidae, are relatively easier to record; while many species of Riodinidae and especially Hesperiidae or Lycaenidae often small in size, exhibit fast or erratic flight, may present slight coloration on two sides or one, may occur spatiotemporally of mode more punctual and with few individuals of transient or infrequent species, most of the time (Iserhard et al. 2013), requiring greater collection effort to be adequately sampled; as well as evidenced by relationships with the FATA through expressions of rarities, like via singletons or doubletons and uniques or duplicates, in dominance or constancy and species recorded outside the sampling period or sample, belonging more to Hesperiidae and Lycaenidae (Table II). Moreover, samples can have cryptic species complexes that make identification difficult. It is noteworthy that given identifications may vary by synonymies or change by non-synonymies (redetermination or not) and depending on who observed or how it was observed, relatively, due to limitations involved in the field or laboratory, lack or scarcity of resources, level of knowledge or experience, new studies or systematic-

taxonomic reviews, for the observer effect applied in this scope which can be mitigated by the integration with other methods or more analyzes to deepen and such as genetic analyzes in objectivity to reinforce hypotheses/ results or not.

Only one (sub)species of Ithomiini, *Mechanitis lysimnia nesaea* Hübner, [1820], was registered in the FATA and in ciliary forest, a Lepidoptera indicative of more disturbed environments in the Atlantic Forest (Brown-Junior, 1992) and without record for its host plants of Solanaceae (Beccaloni et al. 2008) in the area (Guedes et al. 2012; Silva et al. 2012; Cabral et al. 2013; Laine et al. 2017), besides Satyrini also with a single species recorded for *Pharneuptychia phares* (Godart, [1824]) in the FATA. The low representation of Ithomiini or Satyrini found in the FATA and for a semi-urban environment surrounding the city of Patos, at 250 m of average altitude and approximately 20 km away (Ferreira-Júnior, 2021), demonstrates in agreement with the works of Nobre et al. (2008, 2012) and Melo et al. (2023) that the richness of these specialized groups is considered low in typical areas of xerophilic caatinga of low altitude or due to environmental filters, with the possibility to extending in localities at (Septentrional) Sertaneja Depression and see works in Table VII. Limiting factors include climatic conditions, lack of suitable habitats, level of preservation or conservation, absence or scarcity of resources for larvae or adults, which are ideal for the survival and distribution of other representatives of these groups.

Among the species that showed potentiality for future studies of natural history, bionomy, migration, clinal variation (cline), polyphenism and others, highlighted *E. flavescens flavescens* by the evident observations of the difference in size between individuals in rainy and dry periods, with possible overlap of forms in variation, changes to the dimorphism or dichromatism, probably due to differences that involve seasonal conditions or food resources (Vanini et al. 1999; Ruszczyk et al. 2004).

Through samples of the 82 species registered in the FATA and 81 species recorded in the CSTR, 103 species of a total were obtained, by the intersection of 60 shared species (58%) between these localities (Table VII), with 22 exclusive species to FATA and 21 exclusive species to CSTR, correction of part in Ferreira-Júnior (2021); these or some of these exclusive species can occur, be registered or not, eventually for each locality in which were not recorded or collected. In general, when including species from the samples and outside them, there are a total of 116 species for the FATA set (93 spp.) plus the CSTR set (92 spp.) and in intersection with 69 shared species (59%) between these areas (Table VII). With probable species to the turnover (rotativity), establishment or not through colonization, in conformity with the habitat preferences and by conditions or resources, totaling 47 exclusive species between the localities of the FATA (24 spp.) and CSTR (23 spp.), then, by expressions of Hesperiidae (19 spp.), Nymphalidae (12 spp.), Pieridae (seven spp.), Riodinidae (five spp.), Lycaenidae (three spp.) and Papilionidae (one sp.), via flows in cycles of fluctuations due to dispersions by the emigrations or immigrations in (meta)populations or (meta)communities.

The Shannon (H') and Gini-Simpson (1-D) diversity indexes, with emphasis on rare species or intermediary relative abundances (H') and more common or dominant species (1-D), revealed that the Lepidoptera community in the less anthropogenic environment of the FATA (H' = 2.77 and 1-D = 0.85) is less diverse and more heterogeneous than in the more anthropogenic environment of the CSTR (H' = 3.33 and 1-D = 0.94), proportionally due to decreased uniformity in the FATA and not necessarily by a difference of richness for just one species, in convergence with the greater equitability of Pielou (J) in the CSTR and with the greater dominance (DO) in the FATA, reinforced by the extremely significant probabilities ($p < 0.001$) in diversity tests (Table V). Dispositions are possibly influenced by the contribution of the edge effect and not exclusively. Along with the evidence of greater abundance in the FATA (5556 individuals) in distribution among species to the example by rarities with 80.5% which corresponds to only 14.35% of the total abundance and comparison with the smaller abundance in the CSTR (2531 individuals) in distribution of species by rarities with 72% which corresponds to only 13% of the total abundance.

It is necessary to emphasize that there was the prediction of a greater number of species in the CSTR, Chao 1 equal to 105 species (Ferreira-Júnior, 2021), than in the FATA, Jackknife 2 equal to 99 species (Table IV), considered the highest value obtained through richness estimators in both localities, with proximity to the evidential cumulative computation of 103 or 117 registered species, for probable fluctuations, while assessment of interval by the iNEXT in order of the richness q0 by abundance with 103.43 species (UCL 95% and 95% Upper in ChaoRichness) or 116.82 species (99% Upper in ChaoRichness) and other details in Table VI.

It is noted through the set in evidence of the current record of 116 species, resulting from the combination FATA plus CSTR, that in the FATA over time can approach (for less or more) or exactly reach (equality) the

116.82 species by estimate of abundance q0 (Table VI), for a given space of time (period) and cumulatively; even exceed and observe the extrapolation of 121.75 species by the q0 incidence estimate (Table VI) or by comparison if species are considered as elements inside and outside of the intersection between sets of recorded Papilionoidea in the interconnected spaces by levels of natural to artificial gradients between the FATA with CSTR at an approximate distance of 20 km (Ferreira-Júnior, 2021) and the former State Park Peak of Jabre (PEPJ in Portuguese for "Parque Estadual Pico do Jabre") at an approximate distance of 65 km from the FATA, in landscapes with characteristics and aiming the indispensable ecological corridors. Situations that are plausible or reasonable, for possibilities, probable by variables to the future in comparison with the documented past and through the present.

The populations of species in communities for a given space and time may or may not exhibit the same concentration of abundance or richness, due to environmental differences, distinct natural histories, methodological variations, besides compositions that can be the same or different, presenting population dynamics through (bio)ecological phenomena in biocenosis or biota of the biotope or ecotope in the ecosystem. In an analysis of the natural regeneration of tropical dry forests (TDFs), which includes Tamanduá Farm, fruit-feeding Papilionoidea had higher Hill-Simpson diversity in the early succession phase than in the late growth phase and varied widely in the intermediate stages; with evidence that Hill-Simpson diversity and changes in species composition, provided by β^2-diversity, are better indicators of forest natural regeneration than raw species richness (Oliveira et al. 2024).

It is important to highlight that in years 2011 and 2012 were recorded with the occurrence of La Niña phenomenon (National Oceanic and Atmospheric Administration, 2023), moderate La Niña between 2010-2011 (Centro de Previsão de Tempo e Estudos Climáticos, 2016), in 2011 that there were flash floods in Brazil (National Oceanic and Atmospheric Administration, 2012) and in 2012 was one of the warmest La Niña years (Osborne & Blunden, 2013), with drought in first semester in the Northeast region of Brazil (National Oceanic and Atmospheric Administration, 2013) and permanence for years, with further elucidations of the phenomena involved in Marengo et al. (2018), Pontes-Filho et al. (2020) and Barbosa (2023). Historically in area that covers the FATA was recorded rainiest quarter for November-December-January (Empresa Brasileira de Pesquisa Agropecuária, 2016).

Probably, due to habitat specificities or seasonality, some of the species found only in the ciliary forest are less tolerant to the microclimatic conditions of temperature or humidity in the shrubby-arboreal caatinga environment. See findings in statistical significance to the differences and distributive directions. Possibly, the milder environment and the greater availability of resources throughout the year in the ciliary forest favor these incidences, also functioning as a mesic refuge for these Papilionoidea and others in periods of greater adversity (Anselmo et al. 2014). It was observed that of the 35 exclusive species of the ciliary forest, which were not recorded in the transects of shrubby-arboreal caatinga in the FATA, 24 were recorded in the herbaceous-shrubby or shrubby-arboreal caatinga in the CSTR, three Pieridae, three Lycaenidae, seven Nymphalidae and 11 Hesperiidae (Ferreira-Júnior, 2021), filtering 11 remaining species in exclusivity in the ciliary forest for *Ministrymon azia* (Hewitson, 1873), *Strephonota* sp. and *Tmolus echion* (Linnaeus, 1767) (Lycaenidae), *Lasaia* sp. and *Synargis calyce* (C. Felder & R. Felder, 1862) (Riodinidae), *D. postverta postverta* and *S. stelenes meridionalis* (Nymphalidae), *Aguna asander* (Hewitson, 1867), *Celaenorrhinus* sp., *Trina geometrina* (C. Felder & R. Felder, 1867) and *Pompeius pompeius* (Latreille, [1824]) (Hesperiidae).

Some measures of biological or ecological diversity with attributes by characteristics, qualifications for quantifications or quantifications for qualifications, can be indifferent to certain qualitative particularities of compositions, thus still with preponderance of abundances to the definitions of balances/imbalances or environmental health level and risks of extirpation or extinction of species. Such as possible incidences of certain species or groups of Papilionoidea, indicator species (Freitas et al. 2003, 2006), endangered species, endemic species, and new species, with value by the conservation biology or conservation ecology. For example, some of the species that were recorded exclusively in the FATA in comparison with the CSTR stand out or some of the 11 species that by the filter represented exclusive records in the ciliary forest as probable indicators of this environment, probably, also by constituting bioindicator Papilionoidea of the environmental quality or of the conservation in levels in the Tamanduá Farm with parts mainly via fruit-feeding Papilionoidea for *D. arene* and *P. laertes* (Nymphalidae), *M. azia*, *Strephonota* sp. and *T. echion* (Lycaenidae), *Aricoris* sp., *Lasaia* sp. and *S. calyce* (Riodinidae), *Celaenorrhinus* sp. (Hesperiidae), or even other species, which can or cannot continue in these conditions in the Septentrional Sertaneja Depression and Caatinga or Semiarid with localities.

With the probable interchangeabilities or turnover of Lepidoptera species in spaces and times, time spaces (intervals), which can be segmented to evaluate differences, conditionalities, via qualifications or quantifications, specifications or generalizations, biogeographical or environmental details, up to geographical or political characteristics with social and human practices can influence in ambits through actions that contribute to the involvement of protections through fields of sociopolitical, socioenvironmental, sociobiodiversity, bioeconomy, biosocioeconomic or sociobioeconomic, ecosocioeconomic, ecodevelopment, and sustainable development (Agenda 2030 para o Desenvolvimento Sustentável, 2015), besides other scopes.

The continuity of the monitoring and development of other studies, such as the description of the survival strategies of Papilionoidea in the FATA, are necessary to better understand the natural history of many species or groups in the Caatinga or Semiarid, as well as, given the spatial or temporal heterogeneity and by the interperiod variability tendency, in order to evaluate possible alterations due to environmental or climatic changes, by being able to designate or corroborate patterns or parameters, reinforcing the importance of conservation of the ciliary forests and which provide resources for Papilionoidea not exclusively in periods with unfavorable conditions.

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Conflict of Interest

The authors declare that there is known financial interest or personal relationship that could have influence the work presented in this article.

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Lista de socios altas y bajas
List of membership join and cease

La Sociedad da la bienvenida a las siguientes personas que han sido elegidas como nuevos socios recientemente. Deseamos que sea por mucho tiempo y que realicen una productiva actividad científica con la Sociedad / *The Society extends a warm welcome to the following persons who have been elected to the membership recently. We wish them all along, happy and productive association with the Society*:

D. Diego Aguado Garrido (España / *Spain*)
Dr. JiÍí Binter (Repúbica Checa / *Czech Republic*)
Mr. Laluque Olivier (Francia / *France*)
Ing. Petz Reinhold (Austria / *Austria*)
Mr. Dirk Lindner (Alemania / *Germany*)
D. Rafael Centenera Ulecia (España / *Spain*)
D. Miguel Ángel Engra Parra (España / *Spain*) (Reingreso / *Rejoin*)
Prof. Dr. Jorge Llorente Bousquets (México / *Mexico*)

La Sociedad ha recibido comunicación formal, de darse de baja como socio de / *The Society has received formal notice of the resignation from the membership of the following:*

Dr. José Luis Yela García (España / *Spain*)
Mr. Angelo Sacchi (Italia / *Italy*)
Mr. Morten Top-Jensen (Dinamarca / *Denmark*)
Mtr. Dieter Fritsch (Alemania / *Germany*)
Mr. Jan Socha (Republica Checa / *Czech Republic*)
Mr. Joachim Asal (Alemania / *Germany*)
Mr. Kund Bech (Dinamarca / *Denmark*)
Mr. Francesco Fantoni (Italia / *Italy*)
DIRPUBLI (España / *Spain*)
D. Alejandro A. Lázaro Camafreita (España / *Spain*)
D. Enrique Murria Beltrán (España / *Spain*)
Dra. Tania Olivares Zenteno (Chile / *Chile*)
Mr. Jukka Hyttinen (Finlandia / *Finland*)

La Sociedad da de baja, por no pagar la Cuota Anual en el tiempo fijado por la Junta Directiva, a los siguientes socios / *The Society ceases the following membership, due to unpaid Annual Fee in the time allocated by the Governing Body:*

Dr. Christoph L. Häuser (Alemania / *Germany*)

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A review of the Neotropical Apatelodidae genus *Prothysana* Walker, 1855 (Lepidoptera: Bombycoidea)

Vitor O. Becker & Elton Orlandin

Abstract

Three species of *Prothysana* Walker, 1855, are recognized, one of them, from Brazil, described as new: *P. felderi* (Druce, 1887); *P. magna* Becker & Orlandin, sp. nov., and *P. terminalis* Walker, 1855. Diagnosis, key, and illustrations of both the adults and the genitalia are presented to enable their recognition.
Keywords: Lepidoptera, Bombycoidea, Apatelodinae, *Prothysana,* new species, distribution, Neptropical.

Revisión del género Neotropical de Apatelodidae *Prothysana* Walker, 1855 (Lepidoptera: Bombycoidea)

Resumen

Se reconocen tres especies de *Prothysana* Walker, 1855, una de ellas, de Brasil, descrita como nueva: *P. felderi* (Druce, 1887), *P. magna* Becker & Orlandin, sp. nov. y *P. terminalis* Walker, 1855. Se presentan diagnosis, clave e imágenes de los adultos y genitalia para permitir su identificación.
Palabras clave: Lepidoptera, Bombycoidea, Apatelodidae, *Prothysana,* especie nueva, distribución, Neotropical.

Revisão do gênero Neotropical Apatelodidae *Prothysana* Walker, 1855 (Lepidoptera: Bombycoidea)

Resumo

Três espécies de *Prothysana* Walker, 1855 são reconhecidas, uma delas, do Brasil, descrita como nova: *P. felderi* (Druce, 1887); *P. magna* Becker & Orlandin, sp. nov. e, *P. terminalis* Walker, 1855. Diagnose, chave e ilustração de ambos adultos e genitália são apresentados para permitir seu reconhecimento.
Palavras-chave: Lepidoptera, Apatelodidae, *Prothysana,* espécie nova, distribuição, Neotropical.

Introduction

Protysana Walker, 1855, described, as a monotypic genus, in the Drepanulidae [Drepanidae], included two species (Draudt, 1929; Becker, 2001). It was transferred to the Bombycidae by Kirby (1892, p. 932) and to the Apatelodidae by Fletcher & Nye (1982, p.133). Examination of the material in the Brazilian collections revealed that the genus includes three species, one of them, from Brazil, undescribed. The genus is here reviewed for the first time. Diagnosis, illustrations of both the adult and genitalia, as well as a key do species, are provided to enable their identifications.

Material and methods

This work is based on 19 specimens deposited in the first author (VOB), three in the Diego R. Dolibaina (DDC), on 19 specimens in the University Federal of Paraná (UFPR), and 108 specimens in the (USNM) collections, as well as on the pertinent literature. A synoptic collection was taken by the first author to the NHMUK and to USNM and compared with material deposited there. Genitalia dissections follow Robinson (1976) and terms for morphological characters, Hodges (1971). The type-material will provisionally be deposited in the first author´s collection and will be transferred, along with the rest of the collection, to a Brazilian institution.

Abbreviations

ACG = Area de Conservación Guanacaste, Costa Rica.
AL = Alagoas State, Brazil.
BA = Bahia State, Brazil.
DDC = Diego R. Dolibaina Collection.
ES = Espirito Santo State, Brazil.
FW = Forewing.
HW = Hind wing.
MG = Minas Gerais State, Brazil.
NHMUK = Natural History Museum, London, United Kingdom.
PR =Paraná State, Brazil.
RJ = Rio de Janeiro State, Brazil.
SC = Santa Catarina State, Brazil.
SP = São Paulo State, Brazil.
UFPR = Universidade Federal do Paraná.
USNM = Smithsonian National Museum of Natural History, Washington, DC, USA.
VOB = Vitor O. Becker collection, Serra Bonita Reserve, Camacan, Bahia, Brazil.

Results and discussions

Prothysana Walker, 1855
Prothysana Walker, 1855. *List specimens lepid. Insects Colln Br. Mus., 5*, 1175
TS: *P. terminalis* Walker, 1855. *List specimens lepid. Insects Colln Br. Mus., 5,* 1175, by monotypy
= *Compsa* Walker, 1862. *Trans. Ent. Soc. Lond.,* (3) *1*, 254
TS: *C. saturata* Walker, 1862. *Trans. Ent. Soc. Lond.,* (3) *1,* 254, by monotypy. Junior homonym of *Compsa* Perty, 1832, in Spix, *Delectus animalia articulatorum Bras,* (2), *92* (Coleoptera). [Synonymized by Becker, 2001, p. 156].
= *Mesotages* Felder, 1874. *Reise ost. Fregatte Novara (Zool.), 2*(Abt. 2), pl. 95
TS: *Mimallo trilunula* Herrich-Schäffer, [1856]. *Samm. neuer oder venig bekannter aussereur. Schmett., 1*(1), pl. 81, fig. 485, by monotypy. Junior homonym of *Mesotages* Foerster, 1862, *Verh. natur. Ver. preuss. Rheinl., 19*, 258 (Hymenoptera). [Synonymized by Becker, 2001, p. 156].
= *Tarchon* Druce, 1887. *Biol. Cent.-am. (Zool.) Lepid. Heterocera*, *1*, 222.
TS: *Mimallo trilunula* Herrich-Schäffer, [1856], *Samm. neuer oder venig bekannter aussereur. Schmett., 1*(1), pl. 81, fig. 485, by monotypy.). [Synonymized by Becker, 2001, p. 156].
= *Zolessia* Biezanko & Monné, 1968, *Revta. soc. Urug. Ent., 7*, 101, repl. n.
TS: *Compsa saturata* Walker, 1862. *Trans. Ent. Soc. Lond.,* (3) *1*, 254, by monotypy. [Synonymized by Becker, 2001, p. 156].

Diagnosis: Medium size (FW length 15 to 25 mm; 34-55 mm wingspan). Dark reddish brown or light reddish brown. Antenna long ciliated in males, shorter ciliated in females, approximately 1/3 the length of the costal margin of the FW in males,1/4 in females. Labial palpus upcurved, covered by large scales, reaching 1/2 of eye height, 2nd segment twice as long as the 1st, 3rd absent. Proboscis absent. FW basal and apical area

light brown. HW ventrally lighter than dorsally, with a pronounced discal spot. FW and HW venation as illustrated by Lima (1950, p. 280). Abdomen slender in males, more robust in females. Male genitalia: Uncus simple, flat at the tip with slightly concave apex, socii absent, gnathos fused. Aedeagus curved. Vesica with numerous small cornuti.

Distribution: From Southern Mexico to Southern Brazil, absent in the Antilles.

Remarks: In Apatelodidae, *Prothysana* is the only genus in which the known immatures build cocoons and do not pupate underground.

Key to species

1.Mexico, Central America, Andes (Venezuela to Peru) ..... *felderi*
Brazil 2

2. FW length <17 mm ..... *terminal*
FW length >20 mm ..... *magna*

Prothysana terminalis Walker, 1855 (Figures 1-5, 12-14, 19-21)
Prothysana terminalis Walker, 1855. *List specimens lepid. Insects Colln Br. Mus., 5*, 1175
Holotype ♂, [BRAZIL]: Rio de Janeiro (ex Fry col.) [presumably lost].
= *Mimallo trilunula* Herrich-Schäffer, [1856], *Samm. neuer oder venig bekannter aussereur. Schmett., 1*(1), pl. 81, fig. 485.
Type ♂, BRAZIL: [RJ, Rio de Janeiro] [plate examined]. [Synonymized by Becker, 2001, p. 156].
= *Compsa saturata* Walker, 1862. *Trans. Ent. Soc. Lond.,* (3)*1*, 254.
Holotype ♂, [BRAZIL: RJ], Rio de Janeiro (ex Fry col.) [image examined]. [Synonymized by Becker, 2001, p. 156].

Material examined (37 ♂, 4 ♀, 3 g. s.): BRAZIL: AL, 2 ♂, Maceió, 26-IX-1949, 21-VII-1973 (Cardoso) (UFPR 45512, 52970); BA, 2 ♂, Camacã, Reserva Serra Bonita, 15º23'S - 39º33'W, 800 m, VIII-2009, 3-VIII-2018 (Becker 144423, 157029) (VOB); ES, 3 ♂ [no further data] (Johnson) (USNM); 7 ♂, Linhares, Reserva Florestal Vale do Rio Doce, 40 m, 4, 1-IV-1987, 5-9-IV-1992, g. s. 1773, 2694; 25-30-I-1998 (Santos) (VOB 74489), (Becker 82008, 113456) (VOB, USNM); 1 ♂, Marechal Floriano, 2 km E Araguaia, 20º29'56.77"S - 40º45'36.84"W, 800 m, 21-24-VII-2020 (Dolibaina) (DDC 718); MG, 1 ♂, Caldas, 9-2-[19]07, (Arp) (USNM); 1 ♂, Caraça, 1300 m,10-V-1996 (Becker 107898) (VOB); 2 ♂, Espera Feliz, Sítio Sereno, 20º31'27.78"S - 41º51'3.93"W, 1200 m, 11-14-I-2021 (Dolibaina) (DD 719, DD 720); 1 ♂, São Roque de Minas, Pousada Dois Irmãos, 20º18'38.99"S - 46º32'9.58"W, 870 m, 6-8-II-2020 (Vasconcellos) (UFPR 52. 816); PR, 1 ♀, Castro (USNM); 1 ♂, Cornélio Procópio, Pq. Est. Mata São Francisco, 23º08'59"S - 50º34'19"W, 3-5-V-2016, (Santos, Silva ♀ Queiroz Santos) (UFPR 45508); RJ, 1 ♂ (Zikan) (USNM); 1 ♂, Angra [dos Reis], Jussaral, 22-II-1936, (Almeida, Oiticica ♀ Costa) (UFPR 45608), 1 ♂, Cachoeiras de Macacu, Valério, 25-IX-2012 (Tangerini) (UFPR 52971), 1 ♂, Mangaratiba, 150 m, 20-I-1993 (Becker 85413) (VOB); 1 ♂, Sahy, Ramal de Mangarat[iba], 27-VIII-1932 (Almeida) (UFPR 52965); 1 ♂ Paineiras, 12-II-1956 (Gagarin) (UFPR 45470); 6 ♂, Petrópolis, 5-IX-1959, 23-IX-1959, 19-10-1959, 18-VI-1960, 13-VIII-1963 (Gagarin) (UFPR 45551, 45600, 45622, 51538, 52967, 52969); 1 ♂, Petrópolis, Independência, 900 m, 20-III-1939, Gagarin (UFP 52966); 1 ♂, Teresópolis, Barreira, 11-XI-1955 (Gagarin) (UFPR 52968); SC, 2 ♂ [no further data] (Johnson) (USNM); 1 ♀, Joaçaba, Nova Petrópolis, 27º06'08.3"S - 51º36'25.2"W, 780 m, 16-III-2022 (Orlandin ♀ Piovesan), ex larvae (UPR 54349); SP; 1 ♂, Capão Bonito, Intervales, 24º16'S - 48º24'W, 900 m, 5-7-XII-2001, g. s. 6010 (Becker 134145), 1 ♀, Termas de Lindoia, 2-II-1950, g. s. 45588 (Almeida) (UFPR 45588), 1 ♀, Umuarama, 1800 m, 8-15-IV-1937 (Gagarin) (UFPR 45592); 1 ♂, São Luis do Paraitinga, 23º20'S - 45º06'W, 900 m, 12-17-XI-2001 (Becker 133835) (VOB).

Diagnosis: Male (Figures 2-3) FW length 15-17 mm (32-35 mm wingspan). Dark reddish-brown, FW apical area with three ochreous lunular dots. Similar to *P. magna* sp. n. but smaller and with basal and apical areas lighter.

Description: FW dorsally dark reddish brown, basal area light brown, post discal area, from costal to dorsum with a blurry band; apical area with three ochreous lunular spots on R_4-M_2; ventrally dark reddish

brown, anal area light brown, apical area with a light brown semicircular spot from R_4-M_3. HW dorsally dark reddish brown, ventrally light brown, postdiscal area dark reddish brown. Abdomen dorsally dark reddish brown, ventrally light brown with 6 or 7 pairs of dark reddish-brown spots. Female (Figures 4-5) FW length 17-22 mm (40-44 mm wingspan) wings lighter than male.

Male genitalia (Figures 12-13): Valva 2,5 times as long as wide, margins curved, apex round; sacculus more sclerotized than the valva, rectangular, 1/3 of the valva length.

Female genitalia (Figure 14): Eighth tergum a rectangular plate; lamella antevaginalis less sclerotized than tergum; lamella postvaginalis weakly sclerotized; anterior apophysis about the same length as posterior apophysis both as long as ductus bursae; ostium bursae and antrum weakly sclerotized; ductus bursae membranous, short, of the same length as of corpus bursae; corpus bursae ovoid, membranous, signum small, somewhat rounded bearing inward-pointing spines; ductus seminalis membranous, located near the antrum; papillae analis elongated dorsoventrally.

Immature stages (Figures 19-21): A caterpillar of the penultimate instar was collected and reared by the second author. The body is slightly flattened dorsoventrally, covered with long and short straw-yellow setae. The dorsal region is covered by straw-yellow spatulate setae, except on A1 and A2 where these setae are black. In the last larval instar, the larva builds the cocoon by joining the setae of its own body with silk and attaching the cocoon to the host plant. Pupa brown, smooth, without ornamentation and cremaster.

Host-plant: *Saccharum villosum* Steud. and others Poaceae not identified.

Distribution (Figure 1): Brazil, eastern, from Alagoas to Santa Catarina.

Remarks: In the USNM series there is one female bearing a label in Schaus´ handwriting: “Comp. type Oxf.”. It was not possible to examine the type-material of *M. trilunula,* however the original illustration leaves no doubt about its identity. Males come ready to light.

Prothysana felderi (Druce, 1887) (Figures 1, 6-9, 15, 16)
Tarchon felderi Druce, 1887. *Biol. Cent.-am. (Zool.) Lepid. Heterocera, 1*, 222
Holotype ♂, PANAMA: Volcán de Chiriqui (NHMUK) [image examined].

Material examined (Type, 37 ♂, 71 ♀, 1 g. s.): ECUADOR: 1 ♀, Cañar, 20 km SE La Troncal, 2200ft [670 m], VII-1984 (Weller & Jacobson) (USNM). GUATEMALA: 1 ♂, B.[aja] Ver.[apaz], Purulha, 1620 m, 1-4-IX-1999, g. s. 6011 (Becker 123087 (VOB); 2 ♂ [Verapaz], Purulha, VII (Schaus and Barnes) (USNM); 1♀, [Izabal], Cayuga, V (Schaus and Barnes) (USNM); 1 ♂, COSTA RICA: Cartago, Turrialba, 600 m, 20-XII-1971 (Becker 21416); 1 ♂, Puntarenas, Monte Verde, 1500 m, 1-4-IX-1999 (Becker 119277); 30 ♂ 62♀, Guanacaste/Alajuela, Área de Conservación Guanacaste (Janzen ♀ Hallwach). MEXICO: [Veracruz], 1 ♀ Jalapa (Schaus) (USNM); 2 ♂, 1♀ Misantla, VII, X, XI-[19]11 (Gugelmam, R Muller) (USNM); 1 ♀, Jalapa (USNM). PANAMA:1♀, cocoon, pupal skin, Pipeline rd, near Gamboa, 4-I-1990, ex larva on *Flemingia strobilifera* (L.) W. T. Aiton (Fabaceae) (A. Aiello) (VOB), 1 ♀, Lino, 800 m (Fassl) (USNM); PERU: Loreto, Explorama Inn, 40 Km NE Iquitos on Amazon Riv., 24-VI-20-VII-1990 (Menke ♀ Awertschenko) (USNM). VENEZUELA: 2 ♀, Aragua, 1100 m, 8-14-VIII-1967, 22-23-I-1978 (Heppner, Poole) (USNM).

Diagnosis: Male (Figures 6, 7) FW length 18-21 mm (40-45 mm wingspan). Similar to *P. terminalis,* but with a contrasting dot at the end of discal cell and with white dots on postdiscal area near inner margin.

Description: Male dorsally dark reddish brown; a contrasting dot at the end of discal cell; postdiscal area, near the inner margin with white dots; outer margin pale brown; ventrally paler and without white dots. HW dorsally dark reddish brown; underside paler. Female (Figures 8-9) FW length 26 mm (56 mm wingspan). Wings light reddish brown; FW postdiscal area with white spots more pronounced.

Male genitalia (Figures 15-16): As in *P. terminalis*, but valva with reduced sacculus and aedeagus more robust and less curved.

Immature stages: In ACG (Janzen & Hallwachs, 2009) there are images of several immatures of *P. felderi*. The caterpillar of *P. felderi* is similar to the *P. terminalis* caterpillar but with two variants of coloration. Apparently, the male of *P. felderi* shows similar color to the immature of *P. terminalis*, while the female is covered with long and short red setae with white and black spatulate dorsal setae.

Hostplant: In ACG (Janzen & Hallwachs, 2009) there are records for numerous host plants families: ferns (Dennstaedtiaceae), monocots (e. g. Araceae, Heliconiaceae, Musaceae), and dicots (e. g. Asteraceae, Euphorbiaceae, Fabaceae, Lauraceae, Malvaceae, Myrtaceae Rubiaceae, Solanaceae, Urticaceae).

Distribution (Figure 1): Mexico through Central America, along the Andes, from Venezuela to Peru.

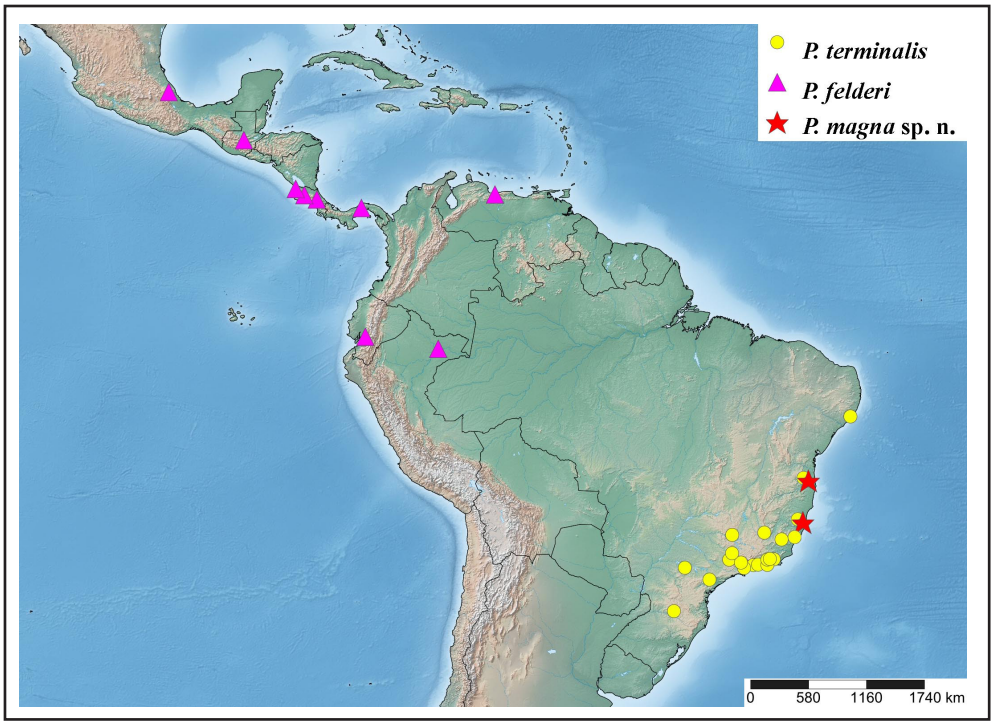
Remarks: What draws attention is the range of host plant strains that can be used by this species. In other known species of Apatelodidae, feeding is restricted to a few families of host plants, all of which are dicots. At Bold Systems platform, there is a series of about 100 specimens of *P. felderi* with sequenced COI, all from ACG. This series forms two clusters with a distance greater than 2% between them. Studies should be carried out in order to elucidate whether *P. felderi* forms a complex of cryptic species or whether this result is just an intraspecific variation.

***Prothysana magna* Becker & Orlandin, sp. nov.** (Figures 1, 10-11, 17-18)
https://zoobank.org/132A99C3-FB51-4989-BA93-D508B36C4096

Holotype ♂, BRAZIL: BA, Camacã, Reserva Serra Bonita, 15º23'S - 39º33'W, 800 m, IV-2012 (Becker 149596) (VOB). Paratypes: 2 ♂, same locality as holotype, IV-2019, V-2021, g. s. 6012 (Becker 158587, 163691) (VOB); 1 ♂, ES, Linhares, Reserva Florestal Vale do Rio Doce, 28-IV-1989, g. s. 6013 (J. Santos) (VOB 74488).

Diagnosis: Male (Figures 10, 11) FW length 20-25 mm (45-54 mm wingspan). Similar to *P. terminalis* but larger and with basal and apical areas darker. Male genitalia similar to those of *P. terminalis* but larger; sacculus larger and rounded, almost reaching the dorsal region of the valva.

Figure 1. *Prothysana*, distribution. Mexico through Central America, along the Andes, from Venezuela to Peru, south to Southeastern Brazil.



Description: Head, dark reddish brown. Antenna long ciliated, approximately 1/3 the length of the costal margin of the FW. FW dorsally dark reddish brown, basal area light brown, postdiscal area, from costa to inner margin with a blurry band; apical area with three light brown lunular dots on R_4-M_2; ventrally dark reddish brown, anal area light brown, apical area with a light brown semicircular dot from R_4-M_3. HW dorsally dark reddish brown, ventrally light brown, postdiscal area dark reddish brown. Abdomen dorsally dark reddish brown, ventrally light brown with 6 or 7 pairs of dark reddish-brown dots. Female unknown.

Male genitalia (Figures 17-18): Uncus simple, flat at the tip with slightly concave apex, socii absent, gnathos fused; valva long, like a tongue; sacculus more sclerotized than the valva, rounded, almost reaching the dorsal region of the valva. Aedeagus curved. Vesica with numerous small cornuti.

Immature stages and hostplant: Unknown.

Distribution (Figure 1): Brazil, Southeastern.

Etymology: From the Latin *magnus, -a, -um* = large, great; feminine.

Remarks: The largest species in the genus. The male from Espirito Santo is lighter, reddish brown, not as dark as the specimens from Bahia, however, their genitalia are identical. It is a crepuscular species. No specimens ever came to the sheet, arriving to the windows just when it was getting dark, never resting, banging against the glass.

Acknowledgements

Dr. Scott E. Miller (USNM) reviewed the manuscript, made several corrections and suggestion that improved it. Annette Aiello (USNM, Panama), kindly donated the female specimen of *P. felderi,* reared by her from a caterpillar. Dr. Talitta Simões (USNM) took the photos of the specimens deposited at the USNM. To Dr. Cassiano A. D. Welker for the identification of the hostplant of *P. terminalis*. E. O. (140599/2017-7) thanks Conselho Nacional de Desenvolvimento Tecnológico (CNPq). Dr. Antonio Vives, the editor of *SHILAP Revta. lepid*., did an excellent job to keep the high quality of the publication.

Conflict of Interest

The authors declare that there is no known financial interest or personal relationship that could have influenced the work presented in this article.

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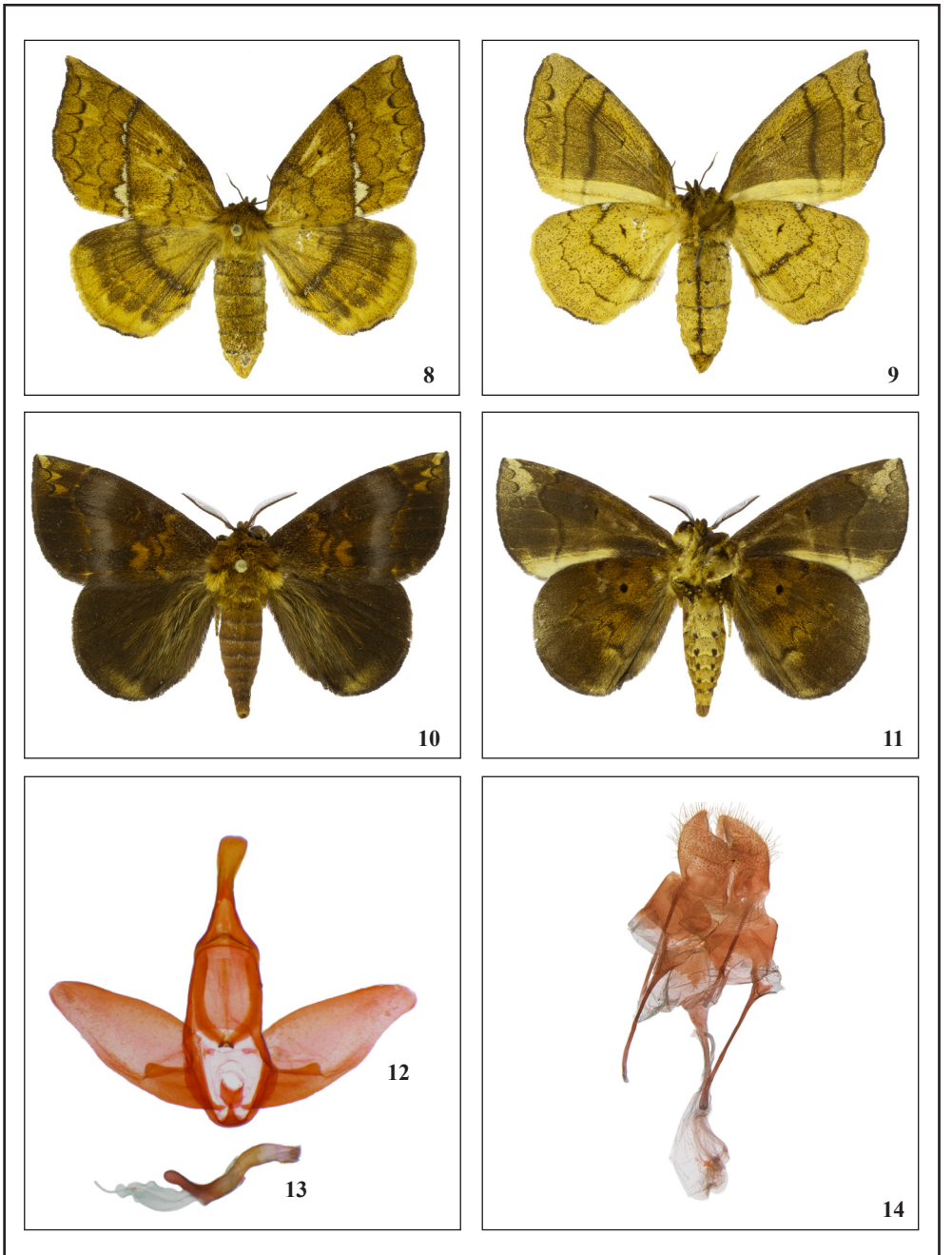
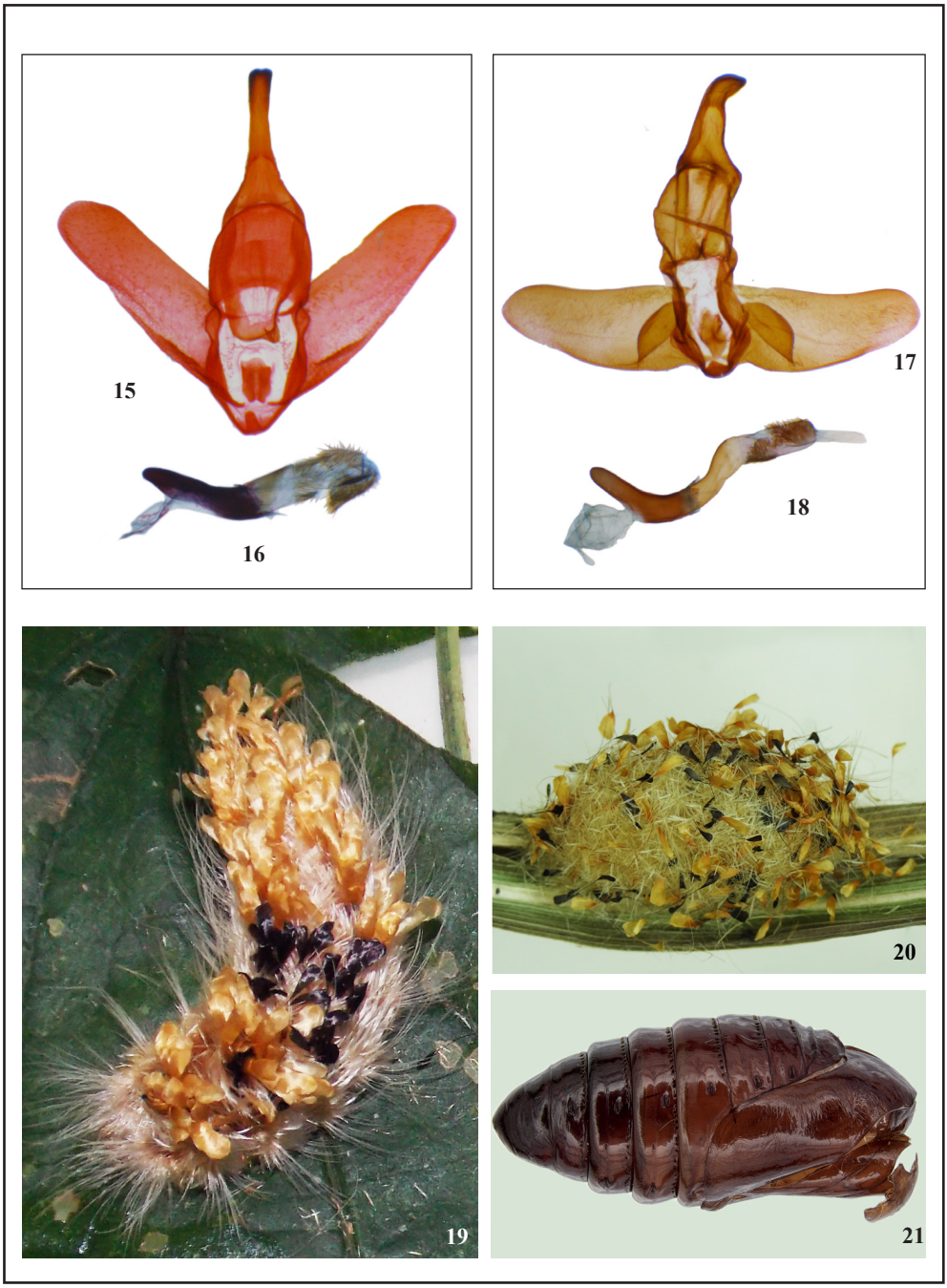
Figures 2-7. *Prothysana* adults, dorsal and ventgral views. **2-5.** *P. terminalis*, Brazil: **2-3.** Male, dorsal, ventral view. **4-5.** Female, dorsal, ventral view. **6-9.** *P. felderi*: **6-7.** Male, Costa Rica, dorsal, ventral view.

Figures 8-14. Female, ventral view. **8-9.** *P. felderi*: Female, Panama, dorsal, ventral view. **10-11.** *P. magna*, male holotype, Brazil, dorsal, ventral view. **12-14.** *P. terminalis*, Brazil: **12.** Male, ventral view. **13.** Aedeagus, lateral view. **14**. Female, ventral view.



Figures 15-21. 15. Male, ventral view. **16.** Aedeagus, lateral view. **17.** *P. magna*, paratype, Brazil: **18.** Aedeagus, lateral view. *P. terminalis* Brazil: **19.** Larva, last instar. **20.** Cocoon. **21.** Pupal skin.



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New and interesting Portuguese Lepidoptera records from 2024 (Insecta: Lepidoptera)

João Nunes, Martin F. V. Corley, José L. Fabião, Paulo Lemos & Jorge Rosete

Abstract

This paper is the nineteenth in the series of annual summaries presenting new information on Portuguese Lepidoptera. Based on fieldwork and studies carried out by the authors and others during 2024, ten species are added to the Portuguese Lepidoptera fauna, including one species new to the Iberian Peninsula, while one species is removed. In addition, several new province and other noteworthy records are reported. A summary of recent publications affecting the Portuguese fauna is also provided. The revised total number of Lepidoptera species recorded from Portugal, considering also the taxonomic updates discussed in recent publications, now stands at 2816.
Keywords: Insecta, Lepidoptera, distribution, faunistics, Portugal.

Novos e interessantes registos portugueses de Lepidoptera em 2024 (Insecta: Lepidoptera)

Resumo

Este artigo é o décimo nono da série de resumos anuais que apresentam nova informação sobre Lepidoptera de Portugal. Com base em trabalho de campo e estudos realizados pelos autores e por outros durante o ano de 2024, dez espécies são adicionadas à fauna de Lepidoptera de Portugal, incluindo uma espécie nova para a Península Ibérica, enquanto uma espécie é removida. Além disso, são apresentados vários novos registos de província e outros registos relevantes. É também incluído um resumo das publicações recentes com impacto na fauna portuguesa. O número total revisto de espécies de Lepidoptera registadas em Portugal, considerando também as atualizações taxonómicas discutidas em publicações recentes, é agora de 2816 espécies.
Palavras-chave: Insecta, Lepidoptera, distribuição geográfica, faunística, Portugal.

Nuevas e interesantes citas portuguesas de Lepidoptera en 2024 (Insecta: Lepidoptera)

Resumen

Este trabajo es el decimonoveno da serie de resúmenes anuales que presentan nueva información sobre Lepidoptera de Portugal. Basado en el trabajo de campo y en los estudios realizados por los autores y otros colaboradores durante el año 2024, se añaden diez especies a la fauna de Lepidoptera de Portugal, incluyendo una especie nueva para la península ibérica, mientras que una especie es eliminada. Además, se presentan varios nuevos registros provinciales y otros registros de interés. También se incluye un resumen de las publicaciones recientes que afectan a la fauna portuguesa. El número total revisado de especies de Lepidoptera

registradas en Portugal, considerando también las actualizaciones taxonómicas discutidas en publicaciones recientes, asciende ahora a 2.816 especies.
Palabras clave: Insecta, Lepidoptera, distribución geográfica, faunística, Portugal.

Introduction

This paper is the nineteenth in the series of annual summaries presenting new knowledge on Portuguese Lepidoptera. It includes records of species added to the Portuguese fauna in 2024, as well as some previously unpublished records, new province records not listed in the national checklist (Corley, 2015), and other noteworthy data. Corrections to earlier records, based on newly available information, are also provided. Recent publications relevant to the Portuguese Lepidoptera fauna are listed and briefly summarised.

The Portuguese moth recording scheme, Rede de Estações de Borboletas Noturnas, launched in 2021, has made a significant contribution to the knowledge of moth species distribution in Portugal (Nunes et al. 2025a). First national and province records arising from this project during 2024, i.e., records submitted to the eBMS platform via butterfly-monitoring.net or the ButterflyCount mobile application, are included in this paper.

Ten species new to Portugal are reported here, including one new to the Iberian Peninsula, while one species is removed from the Portuguese list. In Corley et al. (2024), the number of Lepidoptera species known from mainland Portugal was 2794. Considering the records presented in this paper and the taxonomic updates discussed in recent publications, the revised total now stands at 2816 species.

Material and Methods

All moth records reported in this paper were obtained through light trapping, unless otherwise stated. Larval records were obtained through direct searches, and identifications were made only after ex situ rearing with the hostplant on which the larvae were found. Specimens of species newly recorded for Portugal are retained in the collections of the original recorders, unless otherwise indicated. For records supported by preserved specimens and genitalia preparations, the corresponding specimen and slide codes are provided. Original photographs of several species newly recorded for Portugal are included. Finally, an Appendix details the position of species newly recorded for Portugal in the checklist, along with all nomenclatural changes resulting from recent literature

The order and nomenclature of families and species follow the Portuguese checklist (Corley, 2015) and subsequent updates in this series (Corley et al. 2016, 2018a, 2018b, 2019, 2020, 2021, 2022, 2023, 2024). Plant nomenclature follows the World Checklist of Vascular Plants database (Govaerts, 2024).

Entries for species new for Portugal conclude with a summary of their known European distribution, based on relevant cited works, as well as available information on larval host-plants.

Localities (municipality in brackets) with UTM squares and altitude (Figure 1)

Abiúl (Pombal)	29S NE3940	150 m
Aguiar de Sousa (Paredes)	29T NF4752	60 m
Alcáçovas (Viana do Alentejo)	29S NC7348	205 m
Aljezur (Aljezur)	29S NB1623	70 m
Ansião, 2 km E. of, (Ansião)	29S NE5011	250 m
Arganil (Arganil)	29T NE8052	160 m
Arrochela (Silves)	29S NB4814	60 m
Aveção do Cabo, Campeã (Vila Real)	29T NF9372	755 m
Bairro dos Formarigos (Bragança)	29T PG8429	675 m
Bajouca, Gemunde (Maia)	29T NF3069	90 m
Bensafrim (Lagos)	29S NB2512	20 m
Bertiandos (Ponte de Lima)	29T NG2923	5 m
Bouro, Salir do Porto (Caldas da Rainha)	29S MD8669	17 m
Braço da Barrosa, Lagoa de Óbidos (Óbidos)	29S MD8461	1 m
Bragança (Bragança)	29T PG8731	610 m

Campo (Caldas da Rainha)	29S MD8764	14 m
Casais do Porto, Louriçal (Pombal)	29T NE2329	5 m
Casal do Seixal, Salir do Porto (Caldas da Rainha)	29S MD8670	55 m
Casalinho (Alpiarça)	29S ND3842	35 m
Casas Baixas, Cachopo (Tavira)	29S PB0733	360 m
Casfreires (Sátão)	29T PF0919	700 m
Castro Laboreiro (Melgaço)	29T NG6952	980 m
Cesaredas, Reguengo Grande (Lourinhã)	29S MD8050	145 m
Chão da Parada, Tornada (Caldas da Rainha)	29S MD8769	0 m
Chão do Ulmeiro (Pombal)	29S NE3830	330 m
Concavada (Abrantes)	29S ND8067	110 m
Entrecampos (Lisboa)	29S MC8696	77 m
Entroncamento (Entroncamento)	29S ND4568	35 m
Fão (Esposende)	29T NF1994	10 m
Fonte Boa (Esposende)	29T NF2094	10 m
Fonte da Pedra, Louriçal (Pombal)	29S NE1951	40 m
Gâmbia (Setúbal)	29S NC2066	10 m
Gens (Gondomar)	29T NF4352	85 m
Guerreiros do Rio (Alcoutim)	29S PB3740	2 m
Herdade da Mitra, Valverde (Évora)	29S NC8565	215 m
Ilha da Culatra (Faro)	29S PA0395	4 m
Ilha da Morraceira (Figueira-da-Foz)	29T NE1528	3 m
Lagoa da Ervedeira, Coimbrão (Leiria)	29S NE0819	50 m
Lagoa da Nave (Loulé)	29S NB8419	155 m
Lagoa das Correntes, Carriço (Pombal)	29T NE1133	30 m
Lagoa de São José, Mata do Urso, Carriço (Pombal)	29T NE1028	45 m
Lagoa Pequena (Sesimbra)	29S MC8763	5 m
Macarca, Alfeizerão (Alcobaça)	29S MD9274	40 m
Malhada do Falcato (Vidigueira)	29S PC1032	320 m
Mata da Margaraça (Arganil)	29T NE9260	500 m
Mata do Vimeiro (Alcobaça)	29S MD9771	85 m
Mirandela (Mirandela)	29T PF5295	220 m
Nazaré, 2 km N. of (Nazaré)	29S MD9488	85 m
Óbidos (Óbidos)	29S MD8656	70 m
Oliveira do Douro (Vila Nova de Gaia)	29T NF3451	155 m
Ota (Alenquer)	29S MD9928	185 m
Outeiro de São Miguel (Guarda)	29T PE4992	890 m
Panchorra (Resende)	29T NF8640	1060 m
Paul de Tornada (Caldas da Rainha)	29S MD8866	10 m
Paúl do Boquilobo (Torres Novas)	29S ND4062	20 m
Pedra Amarela, Alcabideche (Cascais)	29S MC6290	225 m
Pó (Bombarral)	29S MD8051	55 m
Poça do Vau (Óbidos)	29S MD8159	5 m
Ponta da Piedade (Lagos)	29S NB2804	45 m
Ponte de Serpa (Beja)	29S PC1804	50 m
Portas do Mouchão da Cabra (Vila Franca de Xira)	29S ND0200	0 m
Portinho da Arrábida (Setúbal)	29S NC0158	10 m
Posto de vigia da Serra de Alvaiázere (Alvaiázere)	29S NE5041	310 m
Póvoa do Conde (Santarém)	29S ND1849	60 m
Praia das Pedras Negras (Marinha Grande)	29S ME9804	0 m
Praia do Cabedelo (Viana do Castelo)	29T NG1314	0 m
Praia do Guincho (Cascais)	29S MC5988	18 m
Praia do Samouco (Marinha Grande)	29S NE0007	5 m
Quinta da Suratesta (Beja)	29S NC9911	200 m
Quinta de Marim (Olhão)	29S PA0599	15 m
Rio Caldo (Terras de Bouro)	29T NG6714	230 m

Rio Este, Espinheira (Vila do Conde)	29T NF2580	15 m
Santa Margarida da Coutada (Constância)	29S ND5866	145 m
Santa Maria da Feira (Santa Maria da Feira)	29T NF3829	110 m
Santa Maria de Marvão (Marvão)	29S PD3863	490 m
São Gonçalo de Lagos (Lagos)	29S NB2710	20 m
São Martinho do Porto (Caldas da Rainha)	29S MD8772	4 m
São Miguel (Guarda)	29T PE4890	820 m
São Vicente de Penso, Carcavelos (Braga)	29T NF4693	185 m
Trafaria (Almada)	29S MC7979	70 m
Verdizela (Seixal)	29S MC8769	70 m
Vila Verde de Ficalho (Serpa)	29S PB4597	205 m
Zavial (Vila do Bispo)	29S NB1100	30 m

Recorders

Paulo Alves
Hélio Batista
Helder Cardoso
João Pedro Cardoso
Fernando Carvalho
Nelson Conceição
Ângela Cordeiro
Martin Corley
Anton Cox
John Dapling
José Luís Fabião
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Carlos Silva and Fernanda Lameira
Diogo Silva
Luís Silva
Isabel Cunha Soares
Joaquim Teixeira
Ana Valadares
Thijs Valkenburg

Abbreviations and symbols

*	New for Portugal	f	female
**	New for the Iberian Peninsula	gen. det.	determined by analysis of genitalia
coll.	in collection of	gen. prep.	genitalia preparation by
conf.	confirmed by	m	male
det.	determined by	REBN	Record obtained under the Portuguese moth recording scheme

Provinces

AAL	Alto Alentejo
ALG	Algarve
BA	Beira Alta
BAL	Baixo Alentejo
BB	Beira Baixa
BL	Beira Litoral
DL	Douro Litoral
E	Estremadura
M	Minho
R	Ribatejo
TM	Trás-os-Montes

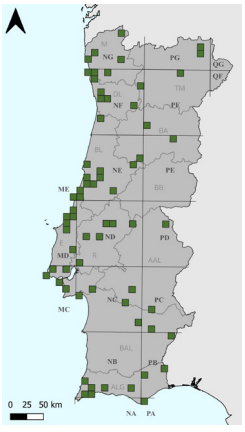

Figure 1. Distribution of records across Portugal shown in UTM 10×10 km grid squares. Provinces are outlined and labelled with their respective abbreviations.

List of records

MICROPTERIGIDAE

Micropterix granatensis Heath, 1981
E: Ota, 9-IV-2024, H. Cardoso, conf. Corley.

NEPTICULIDAE

Trifurcula ortneri (Klimesch, 1951)
E: Trafaria, 16-VIII-2024, Fabião, gen. det. Fabião (100-8626 m), (REBN).

OPOSTEGIDAE

Opostegoides menthinella (Mann, 1855)
DL: Panchorra, 4-VIII-2024, Rosete, gen. det. Rosete (JR822 f).

HELIOZELIDAE

Heliozela resplendella (Stainton, 1851)
DL: Aguiar de Sousa, 5-IX-2024, Nunes, leafmines on *Alnus glutinosa* (L.) Gaertn.

ADELIDAE

Nematopogon schwarziellus Zeller, 1839
BL: Mata da Margaraça, Arganil, 15-V-2016, Rosete, gen. det. Corley (GP4937 m).

PSYCHIDAE

Dissoctena granigerella Staudinger, 1859
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete.

Luffia lapidella (Goeze, 1783)
BL: Alvaiázere, ex pupa, 9-VIII-2021, Rosete.

Oiketicoides eganai (Agenjo, 1962)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR873 m), conf. W. Arnscheid.

TINEIDAE

Infurcitinea atrifasciella (Staudinger, 1871)
E: Verdizela, Seixal, 6-VI-2024, Hilário (REBN).

Dryadaula heindeli Gaedike & Scholz, 1998
Second Portuguese record. BL: Fonte da Pedra, Louriçal, 18-V-2024, to pheromone lure, Corley and Rosete.

Nemapogon agenjoi Petersen, 1959
E: Trafaria, 31-V-2024, Fabião, gen. det. Fabião (100-7152 m), (REBN).

Tinea basifasciella Ragonot, 1895
E: Trafaria, 1-VI-2024, Fabião, gen. det. Fabião (100-7281 m), (REBN).

Tinea columbariella Wocke, 1877
E: Trafaria, 26-VII-2024, Fabião, gen. det. Fabião (100-8179 f), (REBN).

BUCCULATRICIDAE

Bucculatrix helichrysella Constant, 1889
E: Praia do Samouco, Marinha Grande, 20-IV-2024, Rosete, gen. prep. Rosete (JR773 m), conf. Z. Tokár.

Delete *Bucculatrix basifuscella* (Staudinger, 1880). Record reported in Passos de Carvalho & Corley (1995) and Corley (2015) belongs to the next species.

****Bucculatrix pyrenaica*** Nel & Varenne, 2004
ALG: Lagoa da Nave, 22-IV-1992, Corley, previously identified as *B. basifuscella* (Staudinger, 1880); Zavial, 7-X-2024, Fabião, gen. det. Fabião (100-9967 m), conf. Nel (Figure 2). France (Nel & Varenne, 2004). Host-plant unknown.

GRACILLARIIDAE

Caloptilia falconipennella (Hübner, 1813)
BL: Casais do Porto, Louriçal, 3-VII-2024, Rosete, gen. det. Rosete (JR783 m).

Phyllonorycter oxyacanthae (Frey, 1855)
BL: Chão do Ulmeiro, Pombal, 30-VI-2024, Rosete, gen. det. Rosete (JR776 m).

Phyllonorycter millierella (Staudinger, 1871)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR845 m).

YPONOMEUTIDAE

Zelleria oleastrella (Millière, 1864)
R: Casalinho, Alpiarça, 12-VII-2024, C. Silva and F. Lameira (REBN).

PRAYDIDAE

Prays oleae (Bernard, 1788)
DL: Oliveira do Douro, 14-X-2024, R. Ferreira, det. Fabião (REBN).

Prays peregrina Agassiz, 2007
E: Pó, Bombarral, 29-VII-2024, H. Cardoso (REBN).

GLYPHIPTERIGIDAE

Orthotelia sparganella (Thunberg, 1788)
E: Chão da Parada, Tornada, 12-IX-2023, Lemos, by torchlight.

Glyphipterix schoenicolella Boyd, 1858
BL: Lagoa das Correntes, Carriço, 18-V-2024, Corley and Rosete, by day on *Schoenus nigricans* L (Figure 3). Recorded from Southern to Northern Europe as far as Russia. Larva known to feed on *Schoenus nigricans* L., *Cyperus longus* L. and *Cladium mariscus* (L.) Pohl (Ernst, 2009; Ernst & Niederbichler, 2014).

AUTOSTICHIDAE

Symmoca nigromaculella Ragonot, 1875
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. prep. Rosete (JR841 m), gen. det. Corley.

OECOPHORIDAE

Goidanichiana jourdheuillella (Ragonot, 1875)
R: Casalinho, Alpiarça, 7-V-2024, C. Silva and F. Lameira (REBN).

DEPRESSARIIDAE

Agonopterix assimilella (Treitschke, 1832)
DL: Panchorra, 04-VIII-2024, Rosete, gen. det. Rosete (JR812 m).

Agonopterix olusatri Corley & Buchner, 2019
E: Trafaria, 10-II-2024, Fabião, gen. det. Fabião (100-5633 m), (REBN).

Depressaria badiella (Hübner, 1796)
E: Trafaria, 9-VI-2024, Fabião, gen. det. Fabião (100-7402 f), (REBN).

COSMOPTERIGIDAE

Coccidiphila gerasimovi Danilevsky, 1950
E: Trafaria, 23-III-2024, Fabião, gen. det. Fabião (100-5461 f), (REBN).

Vulcaniella grabowiella (Staudinger, 1859)
BAL: Malhada do Falcato, 22-V-2024, Corley and S. Ferreira.

GELECHIIDAE

Syncopacma albipalpella (Herrich-Schäffer, 1854)
DL: Gens, 19-V-2024, Nunes (JN0455), reared on *Genista triacanthos* Brot., gen. det. Nunes (GP0032).

Syncopacma polychromella (Rebel, 1902)
E: Trafaria, 23-XI-2024, Fabião (REBN).

Anarsia lineatella Zeller, 1839
E: Trafaria, 18-V-2024, Fabião, gen. det. Fabião (100-6889 m), (REBN).

Epidola stigma Staudinger, 1859
R: Casalinho, Alpiarça, 21-VII-2024, C. Silva and F. Lameira, det. Nunes (REBN).

Pragmatodes melagonella (Constant, 1895)
E: Trafaria, 24-VIII-2024, Fabião, gen. det. Fabião (100-8891 m), (REBN).

Oxypteryx immaculatella (Douglas, 1850)
E: Trafaria, 30-VIII-2024, Fabião, gen. det. Fabião (100-8985 m), (REBN).

**Scrobipalpa nitentella* (Fuchs, 1902)
E: Trafaria, 16-VIII-2024, Fabião, gen. det. Fabião (100-8733 f) (REBN) (Figure 4). Known from coasts of southern and western Europe. Larva on Amaranthaceae, such as *Atriplex* L., *Suaeda* Forssk. ex J. F. Gmel. and *Salicornia* L. (Huemer & Karsholt, 2010).

Scrobipalpa ergasima (Meyrick, 1916)
E: Trafaria, 16-VIII-2024, Fabião, gen. det. Fabião (100-8621 m), (REBN).

Neotelphusa cisti (Stainton, 1869)
E: Praia do Samouco, Marinha Grande, 10-VIII-2024, Rosete, gen. det. Corley (JR859 m).

**Istrianis myricariella* (Frey, 1870)
ALG: Bensafrim, 7-VI-2024, Valadares, reared on *Tamarix* L., gen. det. Fabião (AV240927D) (Figure 5). Corley et al. (2000) reported this species from Portugal, also from Bensafrim, but the material supporting that record was later re-examined and identified as *Istrianis arenicolella* (Caradja, 1920), following the discovery of the latter species in Portugal (see Corley et al. (2023)). *I. myricariella* is known from North Africa, Turkey and Southern Europe, northwards to Germany (Bidzilya & Karsholt, 2015).

Xenolechia aethiops (Humphreys & Westwood, 1845)
E: Trafaria, 6-IX-2024, Fabião, gen. det. Fabião (100-9076 f), (REBN).

ELACHISTIDAE

Elachista nuraghella Amsel, 1951
E: Trafaria, 21-IV-2024, Fabião, gen. det. Fabião (100-6484 m), (REBN).

Elachista canapennella (Hübner, 1813)
DL: Panchorra, 04-VIII-2024, Rosete, gen. det. Rosete (JR828 m).

**Elachista anserinelloides* Nel, 2003
M: Castro Laboreiro, 2-VII-2021, Nunes, coll. Corley, det. by barcode (INV10158) (Figure 6). Recorded from France and Spain. Host-plant unknown (Kaila, 2019).

COLEOPHORIDAE

Coleophora perplexella Toll, 1960
BL: Abiúl, Pombal, 4-IV-2024, Rosete, gen. det. Rosete (JR762 m).

Coleophora bilineella Herrich-Schäffer, 1855
E: Praia do Samouco, Marinha Grande, 10-VIII-2024, Rosete, gen. det. Rosete (JR836 f).

**Coleophora medelichensis* Krone, 1908
BA: Casfreires, Sátão (7-10)-VI-2011, Cox, gen. prep. Van der Wolf (Wf.10858 m), deposited in Natuurmuseum Brabant, Tilburg, Netherlands. Known from Southern Europe from Spain to Greece, northwards to Czechia. Larva on *Lotus dorycnium* L. (Baldizzone, 2019).

Coleophora versurella Zeller, 1849
E: Trafaria, 20-VII-2024, Fabião, gen. det. Fabião (100-7156 f), (REBN).

Coleophora luteolella Staudinger, 1880
E: Trafaria, 18-V-2024, Fabião, gen. det. Fabião (100-6917 f), (REBN).

**Coleophora texanella* Chambers, 1878
E: Trafaria, 31-VIII-2024, Fabião, gen. det. Fabião (100-9044 m) (REBN) (Figure 7). A North American species introduced into Europe, first recorded in Greece in 2003, now known from much of southern Europe, where it is known to feed on *Portulaca oleracea* L. (Baldizzone, 2019).

SCYTHRIDIDAE

Scythris terrenella (Zeller, 1847)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR848 m).

Episcythris triangulella (Ragonot, 1874)
E: Trafaria, 21-VI-2024, Fabião (REBN).

Eretmocera medinella (Staudinger, 1859)
Second Portuguese record. ALG: Ponta da Piedade, 13-VII-2024, Soares, det. Nunes.

PTEROPHORIDAE

Agdistis heydeni (Zeller, 1852)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR846 f).

Stenoptilodes taprobanes (Felder & Rogenhofer, 1875)
BL: Ilha da Morraceira, Figueira-da-Foz, 1-VIII-2024, Rosete.

Stangeia siceliota (Zeller, 1847)
M: Fão, 9-VIII-2024, Gaifém, det. Nunes (REBN).

EPERMENIIDAE

Epermenia chaerophyllella (Goeze, 1783)
DL: Panchorra, 04-VIII-2024, Rosete, gen. det. Rosete (JR821 m).

TORTRICIDAE

Platynota stultana Walsingham, 1884
Second and third Portuguese records. ALG: Quinta de Marim, 1-VI-2024, Valkenburg; DL: Bajouca, Gemunde, 14-X-2024, C. Silva.

Clepsis dumicolana (Zeller, 1847)
Second Portuguese record. DL: Santa Maria da Feira, 15-IV-2024, Marques.

Clepsis coriacanus (Rebel, 1894)
R: Casalinho, Alpiarça, 11-VI-2024, Nascimento (REBN).

Clepsis peritana (Clemens, 1860)
AAL: Alcáçovas, 9-VIII-2024, R. Ferreira, det. Nunes (REBN); TM: Mirandela, 23-III-2024, Gonzalez (REBN).

Cnephasia conspersana Douglas, 1846
E: Trafaria, 13-VI-2024, Fabião, gen. det. Fabião (100-6773 f), (REBN).

Cochylimorpha elongana (Fischer von Röslerstamm, 1839)
E: Praia do Samouco, Marinha Grande, 20-IV-2024, Rosete.

Cochylimorpha decolorella (Zeller, 1839)
R: Casalinho, Alpiarça, 20-III-2024, C. Silva and F. Lameira, det. Nunes (REBN).

**Diceratura ostrinana* (Guenée, 1845)
TM: Bairro dos Formarigos, Bragança, 3-VIII-2024, Nunes (JN0499), gen. det. Nunes (GP0035 f) (Figure 8). Southern Europe from Spain to Hungary and Ukraine. Larva on flowers of *Chondrilla juncea* L. and *Dipsacus* L. (Razowski, 2002).

Hedya atropunctana (Zetterstedt, 1839)
TM: Aveção do Cabo, Campeã, 11-V-2024, Nunes (REBN).

Celypha lacunana (Denis & Schiffermüller, 1775)
E: Campo, Caldas da Rainha, 2-V-2022, Lemos, by day.

Enarmonia formosana (Scopoli, 1763)
Second Portuguese record. M: Bertiandos, 4-V-2024, Gonçalves.

Epinotia thapsiana (Zeller, 1847)
R: Paúl do Boquilobo, 13-VIII-2024, Alves (REBN).

Pelochrista infidana (Hübner, 1824)
E: Praia do Samouco, Marinha Grande, 25-VII-2014, Rosete.

Pseudococcyx friedmariana Larsen, 2020
E: Verdizela, Seixal, 17-III-2024, Hilário, det. Nunes (REBN).

Rhyacionia duplana (Hübner, 1813)
E: Trafaria, 27-I-2024, Fabião (REBN); M: Fão, 10-II-2024, Gaifém (REBN); TM: Bragança, 13-II-2024, Cordeiro, det. Nunes (REBN).

Dichrorampha letarfensis Gibeaux, 1983
DL: Rio Este, Espinheira,14-V-2024, larva in flowerhead of *Coleostephus myconis* (L.) Rchb.f., Corley, gen.prep. M. Dale.

Cydia strigulatana (Kennel, 1899)
R: Entroncamento, 23-III-2024, Martins, det. Nunes (REBN).

Cydia interscindana (Möschler, 1866)
ALG: Arrochela, Silves, 21-VI-2024, Valkenburg.

SESIIDAE

Tinthia tineiformis (Esper, 1789)
BAL: Quinta da Suratesta, 22-V-2024, to pheromone lure, Corley and S. Ferreira.

Pyropteron koschwitzi (Špatenka, 1992)
E: Praia do Guincho, 15-V-2024, to pheromone lure, Corley and L. Silva.

Pyropteron doryliformis (Ochsenheimer, 1808)
BAL: Quinta da Suratesta, 22-V-2024, to pheromone lure, Corley and S. Ferreira. Second inland Portuguese record.

PYRALIDAE

Hypsopygia incarnatalis (Zeller, 1847)
E: Lagoa Pequena, Sesimbra, 24-VIII-2024, Batista (REBN).

Pyralis lienigialis (Zeller, 1843)
R: Casalinho, Alpiarça, 1-VI-2024, C. Silva and F. Lameira, det. Nunes (REBN).

Stemmatophora vulpecalis (Ragonot, 1891)
DL: Aguiar de Sousa, 13-VII-2024, Nunes (REBN); E: Mata do Vimeiro, 1-VIII-2023, Lemos; R: Santa Margarida da Coutada, 12-VII-2024, Mendes, det. Nunes (REBN).

Stemmatophora combustalis (Fischer von Röslerstamm, 1842)
BA: Outeiro de São Miguel, Guarda, 13-VII-2024, E. Flor (REBN).

Stemmatophora rungsi (Leraut, 2000)
E: Verdizela, Seixal, 24-VIII-2024, Hilário, det. Nunes (REBN).

Aglossa caprealis (Hübner, 1809)
BA: São Miguel, Guarda, 19-VIII-2024, E. Flor (REBN); R: Concavada, 10-VII-2024, Alves (REBN).

Cryptoblabes gnidiella (Millière, 1867)
R: Entroncamento, 21-IX-2024, Martins, det. Nunes (REBN).

Alophia combustella (Herrich-Schäffer, 1855)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR710 m).

Amphithrix sublineatella (Staudinger, 1859)
BL: Lagoa de São José, Mata do Urso, Carriço, 11-VIII-2018, Rosete.

Phycita diaphana (Staudinger, 1870)
E: Trafaria, 20-IX-2024, Fabião, gen. det. Fabião (100-9422 f), (REBN).

Pima boisduvaliella (Guenée, 1845). The records reported in Passos de Carvalho & Corley (1995) and Corley et al. (2020) refer to a different species, which may correspond to one of the North African taxa described by Slamka (2019) or possibly an undescribed species. Only males are available to the authors. Until this issue is resolved, the Portuguese records of "*Pima boisduvaliella*" should be treated as *Pima* sp.

Acrobasis fallouella (Ragonot, 1871)
BL: Ansião, 2 km E. of, 10-VIII-2011, Rosete; E: Trafaria, 1-VI-2024, Fabião, gen. det. Fabião (100-7244 m), (REBN); AAL: Herdade da Mitra, Valverde, 14-IX-2024, Rosete, gen. det. Rosete (JR707 m).

Apomyelois ceratoniae (Zeller, 1839)
M: Fonte Boa, Esposende, 14-IX-2024, Gaifém (REBN).

Assara conicolella (Constant, 1884)
M: Fão, 21-VII-2023, Nunes (JN0003).

Euzophera fuliginosella (Heinemann, 1865)
E: Praia do Samouco, Marinha Grande, 10-VIII-2024, Rosete, det. Nunes (REBN).

Phycitodes albatella (Ragonot, 1887)
BL: Casais do Porto, Louriçal, 3-VII-2024, Rosete, gen. det. Rosete (JR674 m), (REBN).

Ephestia kuehniella Zeller, 1879
E: Trafaria, 30-IV-2024, Fabião, gen. det. Fabião (100-6586 m), (REBN).

CRAMBIDAE

Paracorsia repandalis (Denis & Schiffermüller, 1775)
E: Lagoa Pequena, Sesimbra, 24-VIII-2024, Batista (REBN).

Loxostege sticticalis (Linnaeus, 1761)
BA: São Miguel, Guarda, 25-VI-2024, E. Flor (REBN).

Achyra nudalis (Hübner, 1796)
AAL: Alcáçovas, 5-VIII-2024, R. Ferreira (REBN).

Sitochroa palealis (Denis & Schiffermüller, 1775)
R: Casalinho, Alpiarça, 1-VII-2024, C. Silva and F. Lameira (REBN).

Anania verbascalis (Denis & Schiffermüller, 1775)
ALG: Aljezur, 10-VIII-2024, Valadares (REBN); E: Poça do Vau, 8-VI-2024, Lemos.

Patania ruralis (Scopoli, 1763)
BL: Casais do Porto, Louriçal, 3-VII-2024, Rosete (REBN).

Diplopseustis perieresalis (Walker, 1859)
R: Casalinho, Alpiarça, 2-I-2024, C. Silva and F. Lameira (REBN).

Duponchelia fovealis Zeller, 1847
AAL: Alcáçovas, 5-VIII-2024, R. Ferreira (REBN).

Hodebertia testalis (Fabricius, 1794)
E: Gâmbia, 13-IX-2024, Santos, det. Nunes (REBN).

Metasia suppandalis (Hübner, 1823)
AAL: Alcáçovas, 5-VIII-2024, R. Ferreira (REBN).

Metasia ibericalis Ragonot, 1894
R: Póvoa do Conde, Santarém, 5-VII-2024, Lemos.

Euchromius ocellea (Haworth, 1811)
M: Fão, 10-II-2024, Gaifém (REBN).

**Euchromius bella* (Hübner, 1796)
ALG: Ilha da Culatra, 27-VIII-2005, J. P. Cardoso, det. Corley (GP 2703 f). Southern half of Europe, north to Slovakia. Larva on dry leaves and flowers of *Picris* L., *Hieracium* L. and *Scabiosa* L. (Slamka, 2008).

Euchromius ramburiellus (Duponchel, 1836)
E: Trafaria, 18-III-2024, Fabião, gen. det. Fabião (100-5865 f), (REBN).

Euchromius cambridgei (Zeller, 1867)
BAL: Ponte de Serpa, 21-V-2024, Corley and S. Ferreira.

Chilo phragmitella (Hübner, 1805)
R: Portas do Mouchão da Cabra, 14-IX-2024, J. Flor (REBN).

Chilo suppressalis Błeszyński, 1965
E: Nazaré, 2 km N. of, 14-V-2014, Lemos.

**Chilo luteellus* (Motschulsky, 1866)
ALG: Guerreiros do Rio, 12-V-2024, Conceição, coll. Nunes (JN0523), gen. det. Nunes (GP0030 m) (Figure 9). Southern half of Europe. Host-plant unknown (Slamka, 2008).

Mesocrambus pallidellus (Duponchel, 1836)
BL: Lagoa da Ervedeira, Coimbrão, 1-VIII-2013, Rosete.

Parapoynx stratiotata (Linnaeus, 1758)
BL: Lagoa da Ervedeira, Coimbrão, 1-VIII-2013, Rosete.

DREPANIDAE

Cilix hispanica De-Gregorio, Torruella, Miret, Casas & Figueras, 2002
BAL: Ponta de Serpa, 21-V-2024, Corley and S. Ferreira.

Watsonalla binaria (Hufnagel, 1767)
BA: Outeiro de São Miguel, Guarda, 7-V-2024, E. Flor (REBN).

Polyploca ridens (Fabricius, 1787)
BA: Outeiro de São Miguel, Guarda, 11-IV-2024, E. Flor (REBN).

SPHINGIDAE

Laothoe populi (Linnaeus, 1758)
AAL: Santa Maria de Marvão, 13-IX-2024, Valadares (REBN).

Sphinx ligustri Linnaeus, 1758
E: Nazaré, 2 km N. of, 25-IV-2014, Lemos.

Proserpinus proserpina (Pallas, 1772)
E: Paul de Tornada, 16-V-2024, Lemos.

GEOMETRIDAE

Idaea alicantaria (Reisser, 1963)
E: Trafaria, 31-V-2024, Fabião, gen. det. Fabião (100-7146 f), (REBN).

Brachyglossina hispanaria (Püngeler, 1913)
R: Santa Margarida da Coutada, 4-VII-2024, Mendes, det. Nunes (REBN).

Scopula decorata (Denis & Schiffermüller, 1775)
E: Verdizela, Seixal, 6-IV-2024, Hilário (REBN).

Cyclophora punctaria (Linnaeus, 1758)
E: Praia do Samouco, Marinha Grande, 10-VIII-2024, Rosete, gen. det. Rosete (JR668 m), (REBN).

Xanthorhoe iberica (Staudinger, 1901)
DL: Panchorra, 24-VII-2012, Rosete.

Catarhoe basochesiata (Duponchel, 1831)
AAL: Santa Maria de Marvão, 15-III-2024, Valadares (REBN).

Hydriomena furcata (Thunberg, 1784)
DL: Panchorra, 4-VIII-2024, Rosete (REBN).

Perizoma hydrata (Treitschke, 1829)
BL: Arganil, 11-V-2024, by torchlight, Lemos.

Eupithecia cocciferata Millière, 1864
R: Casalinho, Alpiarça, 20-III-2024, C. Silva and F. Lameira, det. Nunes (REBN).

Eupithecia extremata (Fabricius, 1787)
BAL: Vila Verde de Ficalho, 2-IV-2024, Valadares (REBN).

Eupithecia oxycedrata (Rambur, 1833)
DL: Oliveira do Douro, 12-IV-2024, R. Ferreira (REBN).

Eupithecia icterata (de Villers, 1789)
DL: Panchorra, 4-VIII-2024, Rosete, gen. det. Rosete (JR687 m), (REBN).

Isturgia deerraria (Walker, 1861)
AAL: Santa Maria de Marvão, 11-IX-2024, Valadares (REBN); DL: Oliveira do Douro, 14-X-2024, R. Ferreira, det. Nunes (REBN).

Epione repandaria (Hufnagel, 1767)
E: Paul de Tornada, 16-VI-2023, Lemos, by torchlight.

Ennomos erosaria (Denis & Schiffermüller, 1775)
Delete record from ALG. *Ennomos fuscantaria* (Haworth, 1809) from southern Portugal almost completely lack the characteristic grey shading in the outer area of the wing (vide *E. fuscantaria algeriensis* Prout, 1929 in Müller et al. (2019)). As there are no confirmed records of *E. erosaria* from southern Portugal, it is therefore likely that the record from Fonte de Benémola published in Corley et al. (2019) represents a misidentification of *E. fuscantaria*. No specimen is available for verification.

Ennomos quercaria (Hübner, 1813)
AAL: Santa Maria de Marvão, 11-IX-2024, Valadares (REBN).

Colotois pennaria (Linnaeus, 1761)
R: Santa Margarida da Coutada, 6-XII-2024, Mendes (REBN).

Phigalia pilosaria (Denis & Schiffermüller, 1775)
AAL: Santa Maria de Marvão, 15-III-2024, Valadares (REBN).

Lycia hirtaria (Clerck, 1759)
TM: Aveção do Cabo, Campeã, 5-IV-2024, Fernandes (REBN).

Agriopis marginaria (Fabricius, 1776)
R: Paúl do Boquilobo, 6-II-2024, Alves (REBN).

Erannis defoliaria (Clerck, 1759)
E: Pedra Amarela, Alcabideche, 6-II-2024, D. Silva (REBN).

Ekboarmia miniaria Skou, Stüning & Sihvonen, 2016
E: Verdizela, Seixal, 17-III-2024, Hilário (REBN).

Ectropis crepuscularia (Denis & Schiffermüller, 1775)
E: Nazaré, 2 km N. of, 26-V-2023, Lemos.

Charissa crenulata (Staudinger, 1871)
Delete record from AAL. The record published in Corley et al. (2024) belongs to *Charissa predotae* (Schawerda, 1929).

Cleorodes lichenaria (Hufnagel, 1767)
DL: Panchorra, 4-VIII-2024, Rosete (REBN).

Geometra papilionaria (Linnaeus, 1758)
DL: Panchorra, 24-VII-2012, Rosete.

NOTODONTIDAE

Notodonta ziczac (Linnaeus, 1758)
E: Bouro, Salir do Porto, 19-IV-2014, Lemos, by torchlight.

Clostera pigra (Hufnagel, 1766)
E: Casal do Seixal, Salir do Porto, 16-IV-2014, Lemos.

EREBIDAE

Scoliopteryx libatrix (Linnaeus, 1758)
E: Paul de Tornada, 9-IX-2014, Lemos, by day.

Rivula sericealis (Scopoli, 1763)
E: Poça do Vau, 5-IX-2014, Lemos, by torchlight.

Arctia tigrina (de Villers, 1789)
E: Nazaré, 2 km N. of, 4-V-2024, Lemos.

Eilema depressa (Esper, 1787)
ALG: São Gonçalo de Lagos, 4-V-2024, Valadares (REBN).

Eilema uniola (Rambur, 1866)
R: Santa Margarida da Coutada, 17-IX-2024, Mendes, det. Nunes (REBN).

Eilema lurideola (Zincken, 1817)
DL: Panchorra, 4-VIII-2024, Rosete (REBN).

Eilema complana (Linnaeus, 1758)
DL: Panchorra, 4-VIII-2024, Rosete, det. Rosete (REBN).

Eilema pygmaeola (Doubleday, 1847)
DL: Panchorra, 4-VIII-2024, Rosete, gen. det. Rosete (JR701 m), (REBN).

Eilema rungsi Toulgöet, 1960
E: Lagoa Pequena, Sesimbra, 8-IX-2024, Batista (REBN).

Eublemma baccatrix Hacker, 2019
Second Portuguese record. ALG: São Gonçalo de Lagos, 6-XII-2024, Valadares (REBN).

Catocala dilecta (Hübner, 1808)
E: Trafaria, 30-VIII-2024, Fabião (REBN); R: Santa Margarida da Coutada, 12-VII-2024, Mendes, det. Nunes (REBN).

Catocala promissa (Denis & Schiffermüller, 1775)
E: Lagoa Pequena, Sesimbra, 7-VII-2024, Batista (REBN).

Catocala optata (Godart, 1824)
E: Chão da Parada, Tornada, 14-VIII-2024, Lemos, by torchlight.

Ophiusa tirhaca (Cramer, 1773)
AAL: Santa Maria de Marvão, 14-III-2024, Valadares (REBN).

Grammodes bifasciata (Petagna, 1787)
E: Chão da Parada, Tornada, 3-V-2023, Lemos; R: Portas do Mouchão da Cabra, 17-VII-2024, J. Flor (REBN).

NOCTUIDAE

Abrostola tripartita (Hufnagel, 1766)
Delete record from E. The record published in Corley (2015) belongs to *Abrostola triplasia* (Linnaeus, 1758), Entrecampos, Lisboa, 27-IV-2006, Carvalho, deposited in Museu Nacional de História Natural e da Ciência, Lisbon, Portugal (MNHNCENT0058761).

Thysanoplusia daubei (Boisduval, 1840)
R: Casalinho, Alpiarça, 18-I-2024, C. Silva and F. Lameira (REBN); TM: Mirandela, 23-III-2024, Gonzalez, det. Nunes (REBN).

Colocasia coryli (Linnaeus, 1758)
E: Macarca, Alfeizerão, 10-V-2024, Lemos, by torchlight.

Calophasia almoravida Graslin, 1863
AAL: Santa Maria de Marvão, 5-IV-2024, Valadares (REBN); BA: São Miguel, Guarda, 12-IV-2024, E. Flor, det. Nunes (REBN); M: São Vicente de Penso, Carcavelos, 6-IV-2024, Gomes, det. Nunes (REBN).

Bryonycta pineti (Staudinger, 1859)
E: Trafaria, 8-V-2024, Fabião (REBN); R: Santa Margarida da Coutada, 17-IX-2024, Mendes, det. Nunes (REBN).

Condica capensis (Guenée, 1852)
ALG: Aljezur, 7-XII-2024, Valadares (REBN).

Chilodes maritima (Tauscher, 1806)
E: Poça do Vau, 23-VIII-2023, Lemos, on *Phalaris aquatica* L.

Trachea atriplicis (Linnaeus, 1758)
R: Casalinho, Alpiarça, 12-V-2024, C. Silva and F. Lameira (REBN).

Lenisa geminipuncta (Haworth, 1809)
E: Paul de Tornada, 4-VI-2017, Lemos, by day.

Coenobia rufa (Haworth, 1809)
E: Poça do Vau, 26-VIII-2023, Lemos.

Denticucullus pygmina (Haworth, 1809)
AAL: Santa Maria de Marvão, 11-IX-2024, Valadares (REBN); E: Óbidos, 26-IX-2013, Lemos.

Sesamia nonagrioides (Lefèbvre, 1827)
AAL: Herdade da Mitra, Valverde, 14-IX-2024, Valadares (REBN).

Cirrhia icteritia (Hufnagel, 1766)
E: Lagoa Pequena, Sesimbra, 14-X-2024, Batista (REBN).

Agrochola lota (Clerck, 1759)
AAL: Santa Maria de Marvão, 29-XI-2024, Valadares (REBN).

Agrochola haematidea (Duponchel, 1827)
R: Santa Margarida da Coutada, 7-XI-2024, Mendes, det. Nunes (REBN).

Agrochola circellaris (Hufnagel, 1766)
E: Óbidos, 27-XI-2012, Lemos.

Conistra alicia Lajonquière, 1939
E: Ota, 4-XII-2024, H. Cardoso, gen. det. H. Cardoso (REBN).

Lithophane ornitopus (Hufnagel, 1766)
M: Rio Caldo, 15-I-2024, Dapling (REBN).

Ipimorpha subtusa (Denis & Schiffermüller, 1775)
M: São Vicente de Penso, Carcavelos, 25-VI-2024, Gomes, det. Nunes (REBN).

Dryobota labecula (Esper, 1788)
AAL: Santa Maria de Marvão, 29-XI-2024, Valadares (REBN); R: Casalinho, Alpiarça, 27-I-2024, C. Silva and F. Lameira (REBN).

Orthosia cruda (Denis & Schiffermüller, 1775)
E: Portinho da Arrábida, 15-II-2024, Palma, det. Nunes (REBN).

Orthosia gothica (Linnaeus, 1758)
BA: Outeiro de São Miguel, Guarda, 11-IV-2024, E. Flor (REBN).

Anorthoa munda (Denis & Schiffermüller, 1775)
M: Rio Caldo, 4-II-2024, Dapling (REBN).

Anarta sodae (Rambur, 1829)
R: Portas do Mouchão da Cabra, 17-VII-2024, J. Flor (REBN).

Lacanobia blenna (Hübner, 1824)
E: Braço da Barrosa, Lagoa de Óbidos, 2-IX-2017, Lemos, by day.

Hadena silenides (Staudinger, 1895)
ALG: Casas Baixas, Cachopo, 10-II-2024, Valkenburg and Conceição.

Mythimna pallens (Linnaeus, 1758)
E: Poça do Vau, 25-VIII-2023, Lemos, on *Phalaris aquatica* L.

Mythimna impura (Hübner, 1808)
DL: Panchorra, 24-VII-2012, Rosete.

Mythimna litoralis (Curtis, 1827)
E: Praia das Pedras Negras, Marinha Grande, 2-IX-2013, Rosete.

Leucania joannisi Boursin & Rungs, 1952
R: Casalinho, Alpiarça, 7-IV-2024, C. Silva and F. Lameira, det. Nunes (REBN).

Agrotis graslini Rambur, 1848
E: Praia do Samouco, Marinha Grande, 9-IX-2013, Rosete.

Agrotis sabulosa Rambur, 1837
Delete record from BA. The record published in Corley (2015) belongs to *Agrotis trux* (Hübner, 1824), (GP 4032 f).

Agrotis ripae (Hübner, 1823)
M: Praia do Cabedelo, Viana do Castelo, 14-IV-2024, Gomes, det. Nunes (REBN).

Diarsia guadarramensis (Boursin, 1928)
DL: Panchorra, 4-VIII-2024, Rosete, gen. det. Rosete (JR699 m), (REBN).

Noctua interjecta Hübner, 1803
E: Óbidos, 21-VIII-2013, Lemos.

NOLIDAE

Meganola albula (Denis & Schiffermüller, 1775)
E: Cesaredas, Reguengo Grande, 9-VI-2024, H. Cardoso (REBN).

Nola squalida Staudinger, 1871
DL: Aguiar de Sousa, 4-X-2024, Nunes (REBN); E: Chão da Parada, Tornada, 9-IX-2023, Lemos, by torchlight.

Earias albovenosana Oberthür, 1917
R: Casalinho, Alpiarça, 16-VI-2024, C. Silva and F. Lameira, det. Nunes (REBN).

Earias insulana (Boisduval, 1833)
DL: Oliveira do Douro, 14-X-2024, R. Ferreira, det. Nunes (REBN).

Recent literature

Aarvik et al. (2025) note that *Bucculatrix frangutella* (Goeze, 1783) is a misspelling of *B. frangulella*, which is the name that should be used.

Balletto et al. (2024) argue that the changed typification of *Papilio hermione* Linnaeus, 1764 by Russell & Vane-Wright (2022) was not legitimate and that *Hipparchia hermione* (Linnaeus, 1764) remains the correct name for this species, not *H. alcyone* (Denis & Schiffermüller, 1775).

Bidzilya et al. (2025) describe *Sophronia pseudosagittans* Bidzilya, Karsholt & Šumpich, 2025 from Portugal, Spain, and Tunisia. The new species is reported from ALG and TM, while *Sophronia humerella* (Denis & Schiffermüller, 1775) is confirmed from TM. Published records of *S. humerella* from AAL, R, BB, BA, and BL could not be confirmed for either species. Additional material should therefore be collected to clarify the distribution limits of both species in Portugal.

Buchner & Corley (2024) review the family Depressariidae at European level. The modifications in the national checklist are the replacement by synonymisation of *Agonopterix mendesi* Corley, 2002 and *Depressaria adustatella* Turati, 1927 by *Agonopterix straminella* (Staudinger, 1859) and *Depressaria radiosquamella* Walsingham, 1903, respectively and the exclusion of *Depressaria beckmanni* Heinemann, 1870, since all Portuguese records belong to *D. douglasella* Stainton, 1849.

Cardoso (2025) reports a new species for Portugal, *Niphonympha dealbatella* (Zeller, 1847), from BB.

Corley & Ferreira (2025) review the genus *Megacraspedus* Zeller, 1839 in mainland Portugal, adding five species to the national checklist, of which four are described in that work: *Megacraspedus lanceolellus* (Zeller, 1850) from BA, *Megacraspedus dalei* Corley, 2025 from AAL and BL, *Megacraspedus transmontanus* Corley, 2025 from TM, *Megacraspedus dinensis* Corley, 2025 from TM and *Megacraspedus terryae* Corley, 2025 from R and BL. *Megacraspedus trineae* Huemer & Karsholt, 2018 is removed from AAL, E and BL and given for TM. *Megacraspedus ibericus* Huemer & Karsholt, 2018 is removed from DL.

Corley (2025a) lists Lepidoptera recorded in the Tua Valley between 2006 and 2014. Species added to the Portuguese fauna in the course of that fieldwork have already been published in Corley et al. (2007) and later papers.

Corley (2025b) reviews the genus *Gymnancyla* Zeller, 1848 in mainland Portugal, excluding *Gymnancyla hornigii* (Lederer, 1852) from the Portuguese checklist. *Gymnancyla canella* (Denis & Schiffermüller, 1775) record from ALG is attributed to *Gymnancyla ruscinonella* (Ragonot, 1888). *Gymnancyla sfakesella* Chrétien, 1911 is reported for ALG.

Corley (2025c) deletes *Archanara dissoluta* (Treitschke, 1825) and *Epipsilia latens* (Hübner, 1809) from the Portuguese checklist. National records of *E. latens* are attributed to *Epipsilia cervantes* (Reisser, 1935).

Corley (2025d) reviews the genus *Apatema* Walsingham, 1900 in mainland Portugal, excluding *A. apolausticum* Gozmány, 1996 and *A. parodia* Gozmány, 1988 from the Portuguese checklist and adding *A. proteroclina* (Meyrick, 1938) and *A. albifasciella* Nel, Huemer & Varenne, 2024. The distribution of *Apatema* species in Portugal is also reviewed: *A. mediopallidum* Walsingham, 1900 is reported for ALG, AAL, E and BL, *A. albifasciella* from ALG and *A. proteroclina* from E, BL, BA, DL, M and TM.

Corley et al. (2024) add 20 species to the Portuguese list: *Dryadaula heindeli* Gaedike & Scholz, 1998, *Glyphipterix forsterella* (Fabricius, 1781), *Acompsia cinerella* (Clerck, 1759), *Klimeschiopsis arnoldfransorum* Huemer & Karsholt, 2023, *Blastobasis lavernella* Walsingham, 1894, *Merrifieldia garrigae* Bigot & Picard, 1989, *Clepsis dumicolana* (Zeller, 1847), *Eana incanana* (Stephens, 1852), *Platynota stultana* Walsingham, 1884, *Eucosma subvittana* (Staudinger 1892), *Notocelia mediterranea* (Obraztsov, 1952), *Dichrorampha vancouverana* MacDunnough, 1935, *Aphomia cephalonica* (Stainton, 1866), *Gymnancyla sfakesella* Chrétien, 1911, *Eurhodope incensella* (Staudinger, 1859), *Scotopteryx mucronata* (Scopoli, 1763), *Selenia tetralunaria* (Hufnagel, 1767), *Condica capensis* (Guenée, 1852), *Chlorothalpa graslini* (Culot, 1913) and *Agrotis ripae* (Hübner, 1823). Four species are deleted: *Merrifieldia malacodactylus* (Zeller, 1847), *Eucosma cana* (Haworth, 1811), *Notocelia incarnatana* (Hübner, 1800) and *Chlorothalpa xanthochloris* (Boisduval, 1840).

Corley et al. (2025) delete *Eilema predotae* (Schawerda, 1927) from the Portuguese checklist, reattributing all records of this species to *Eilema marcida* (Mann, 1859), add *Arctia angelica* (Boisduval, 1828), recorded from ALG, BAL, AAL, E, R, BB, BL and BA, while restricting *A. villica* (Linnaeus, 1758) to BA, BL, DL, M and TM (which was given for all provinces in Corley (2015)) and report the presence of *Coscinia cribraria benderi* Marten, 1957 in Portugal as form *benderi*; subspecies *guidoi* Cruz, 1978 is reinstated as form *guidoi*.

Gastón et al. (2025) review the distribution of *Ancylosis sareptalla* (Herrich-Schäffer, 1861) in the Iberian Peninsula and describe *Ancylosis albaladejoi* Gastón, Huemer & Vives, 2025. The newly described species is reported from Portugal for ALG, BAL, and BL, and represents the correct identification for previously published records of *A. sareptalla* and *Ancylosis albidella* Ragonot, 1888 in the country. *A. sareptalla and A. albidella* are therefore removed from the Portuguese checklist. The distribution map presented by the authors includes a GBIF record of *A. sareptalla* from DL, marked with a question mark. This record originates from iNaturalist, but the associated photograph does not allow confirmation of whether it refers to *A. sareptalla* or *A. albaladejoi*. Considering the revised distributions of both species in the Iberian Peninsula, the latter appears to be the most likely identification. However, specimens are required to confirm the occurrence of the newly described species in DL.

Green (2025) reports two new species for Portugal from ALG, *Eupithecia minusculata* Alphéraky, 1883 and *Reisserita haasi* (Rebel, 1901), and two new species for ALG, *Phereoeca lodli* Vives, 2001 and *Placodoma calpella* Sobczyk, 2013.

Hu et al. (2023) found *Grapholita* Treitschke, 1829 to be polyphyletic, necessitating a split into three genera. Portuguese species are now placed as follows: *Aspila* Stephens, 1834 containing *funebrana* (Treitschke, 1835), *tenebrosana* (Duponchel, 1843), *janthinana* (Duponchel, 1835) and *molesta* (Busck, 1916);

Grapholita Treitschke, 1829 is now restricted to *compositella* (Fabricius, 1775), *internana* (Guenée, 1845) and *lunulana* (Denis & Schiffermüller, 1775); *Ephippiphora* Duponchel, 1834 includes *fissana* (Frölich, 1828) and *gemmiferana* (Treitschke, 1835).

Keegan et al. (2021) returned *Acontia trabealis* (Scopoli, 1763) to genus *Emmelia* Hübner, 1821.

Labonne & Lopez-Vaamonde (2024) show that *Isotrias hybridana* (Hübner, 1817) should be treated as a synonym of *I. rectifasciana* (Haworth, 1811) but that material from Portugal under the name *I. hybridana* belongs to another species. This may represent a new species, or it may be that one of the supposed synonyms of *I. hybridana* is the same as the Portuguese species. For the moment this problem remains unresolved. The Portuguese "*I. hybridana*" should be referred to as *Isotrias* sp.

Marabuto & Fonseca (2025) report the first reliable records of *Thyris fenestrella* (Scopoli, 1763) from Portugal, from ALG.

Murillo-Ramos et al. (2021) synonymised *Ematurga* Lederer, 1853 with *Hypomecis* Hübner, 1821. Although this appears counterintuitive from the external appearance of these species, multi-gene analysis suggests that this is correct and genitalia morphology points to the same conclusion.

Nel et al. (2022) place *Metzneria campicolella* (Mann, 1857) in a new genus, *Huemeria* Nel, Varenne & Bassi, 2022.

Nunes (2025) reports a new adventive species in Portugal, *Earias roseifera* Butler, 1881, from M and DL.

Nunes et al. (2025b) report a preliminary inventory of the moth fauna of Mértola municipality with 438 species, of which 71 are new for BAL, four of these being the first records for Portugal: *Symmoca sultan* Gozmány, 1962, *Eteobalea sumptuosella* (Lederer, 1855), *Coleophora arefactella* Staudinger, 1859 and *Idaea deitanaria* (Reisser & Weisert, 1977).

Ortiz et al. (2023) treat the genera *Atlantarctia* Dubatolov, 1990 and *Hyphoraia* Hübner, 1820 as synonyms of *Arctia* Schrank, 1802.

Õunap et al. (2024) transfer *Macaria artesiaria* (Denis & Schiffermüller, 1775) to genus *Speranza* Curtis, 1828.

Pohl & Landry (2023) point out that *Epicallima* Dyar, 1904 was an unnecessary replacement name for *Callima* Clemens, 1860, introduced on account of an incorrect subsequent spelling of *Kallima* Doubleday, 1849 (Nymphalidae).

Tabell et al. (2025) review part of the genus *Pleurota* Hübner, 1825 in the Iberian Peninsula, describing four new species from peninsular Spain. The single mention of Portugal is under *Pleurota hebetella* Ragonot, 1889, stating that records of this species from Portugal should be re-examined. There are two published records from Portugal, one from ALG (Monteiro & Passos de Carvalho, 1984), which was considered unconfirmed in Corley (2015) due to the absence of material for verification, and another from TM (Corley et al. 2011). The specimen underlying the latter record was not located; however, the male genitalia slide in Corley's collection (GP 3415 m) does not match the illustrations provided by Tabell et al. (2025). Consequently, this species should be removed from the Portuguese checklist. No alternative identification for the specimen is suggested.

Valadares & Cardoso (2025) add two species for Portugal: *Idaea trigeminata* (Haworth, 1809) from TM and *Trisateles emortualis* (Denis & Schiffermüller, 1775) from M.

Wilton (2025) adds one new species for Portugal from ALG, *Eublemma baccatrix* Hacker, 2019, and two new species for ALG, *Eublemma amoena* (Hübner, 1803) and *Eteobalea sumptuosella* (Lederer, 1855).

Appendix: Changes to the Portuguese checklist

0178.1 *Reisserita haasi* (Rebel, 1901)
0209 *Bucculatrix bechsteinella* (Scharfenberg, 1806)
0211 *Bucculatrix frangulella* (Goeze, 1783) (*frangutella* misspelling)
0213 *Bucculatrix pyrenaica* Nel & Varenne, 2004 (*basifuscella auct. nec* Staudinger, 1880)
Niphonympha Meyrick, 1914
0319.1 *Niphonympha dealbatella* (Zeller, 1847)
0334.1 *Glyphipterix schoenicolella* Boyd, 1858
0378.1 *Apatema albifasciella* Nel, Huemer & Varenne, 2024 (*apolausticum sensu* Corley et al., 2020)
0378.2 *Apatema proteroclina* (Meyrick, 1938)

0384.1 *Symmoca sultan* Gozmány, 1962
Callima Clemens, 1860 (*Epicallima* Dyar, 1904, unnecessary replacement name)
0416 *Callima mercedella* (Staudinger, 1859) (*E. mercedella* (Staudinger, 1859))
0417 *Callima formosella* (Denis & Schiffermüller, 1775) (*E. formosella* (Denis & Schiffermüller, 1775))
0417.1 *Callima mikkolai* Lvovsky, 1995 (*E. mikkolai* Lvovsky, 1995)
0444 *Agonopterix straminella* (Staudinger, 1859) (*mendesi* Corley, 2002)
0468 *Depressaria radiosquamella* Walsingham, 1903 (*adustatella* Turati, 1927)
0505.1 *Eteobalea sumptuosella* (Lederer, 1855)
0575.1 *Megacraspedus lanceolellus* (Zeller, 1850)
0575.2 *Megacraspedus dalei* Corley, 2025
0576.2 *Megacraspedus transmontanus* Corley, 2025
0576.3 *Megacraspedus dinensis* Corley, 2025
0576.4 *Megacraspedus terryae* Corley, 2025
Huemeria Nel, Varenne & Bassi, 2022
0609 *Huemeria campicolella* (Mann, 1857)
0633.1 *Sophronia pseudosagittans* Bidzilya, Karsholt & Šumpich, 2025
0665.1 *Scrobipalpa nitentella* (Fuchs, 1902)
0705.1 *Istrianis myricariella* (Frey, 1870)
0733.1 *Elachista anserinelloides* Nel, 2003
0771.3 *Coleophora arefactella* Staudinger, 1859
0776.1 *Coleophora medelichensis* Krone, 1908
0858.1 *Coleophora texanella* Chambers, 1878
0977 *Isotrias* sp. (*hybridana auct. lusit. nec* Hübner, 1815)
1084.1 *Diceratura ostrinana* (Guenée, 1845)
Ephippiphora Duponchel, 1834
1196 *Ephippiphora fissana* (Frölich, 1828) (*Grapholita fissana* (Frölich, 1828))
1199 *Ephippiphora gemmiferana* (Treitschke, 1835) (*Grapholita gemmiferana* (Treitschke, 1835))
Aspila Stephens, 1834
1201 *Aspila funebrana* (Treitschke, 1835) (*Grapholita funebrana* (Treitschke, 1835))
1201.1 *Aspila tenebrosana* (Duponchel, 1843) (*Grapholita tenebrosana* (Duponchel, 1843))
1202 *Aspila janthinana* (Duponchel, 1835) (*Grapholita janthinana* (Duponchel, 1835))
1203 *Aspila molesta* (Busck, 1916) (*Grapholita molesta* (Busck, 1916))
Thyris Laspeyres, 1803
1269.1 *Thyris fenestrella* (Scopoli, 1763)
1328 *Hipparchia hermione* (Linnaeus, 1764) (*alcyone sensu* Russell & Vane-Wright, 2022)
1484 *Pima* sp. (*boisduvaliella auct. lusit. nec* Guenée, 1845)
1526 *Ancylosis albaladejoi* Gastón, Huemer & Vives, 2025 (*sareptalla auct. nec* Herrich-Schäffer, 1861)
1638.1 *Euchromius bella* (Hübner, 1796)
1642.2 *Chilo luteellus* (Motschulsky, 1866)
1784.1 *Idaea deitanaria* (Reisser & Weisert, 1977)
1779.1 *Idaea trigeminata* (Haworth, 1809)
1900.1 *Eupithecia minusculata* Alphéraky, 1883
Speranza Curtis, 1828
1948 *Speranza artesiaria* (Denis & Schiffermüller, 1775) (*Macaria artesiaria* (Denis & Schiffermüller, 1775))
2019 *Hypomecis atomaria* (Linnaeus, 1758) (*Ematurga atomaria* (Linnaeus, 1758))
2122.1 *Arctia angelica* (Boisduval, 1828)
2124 *Arctia tigrina* (de Villers, 1789) (*Atlantarctia tigrina* (de Villers, 1789))
2125 *Arctia dejeani* (Godart, 1822) (*Hyphoraia dejeani* (Godart, 1822))
2131 *Coscinia cribraria* ssp. *cribraria* (Linnaeus, 1758)
form *benderi* (Marten, 1957)
form *guidoi* (Cruz, 1978)
2169.1 *Trisateles emortualis* (Denis & Schiffermüller, 1775)
2180.1 *Eublemma baccatrix* Hacker, 2019

2230 *Emmelia trabealis* (Scopoli, 1763) (*Acontia trabealis* (Scopoli, 1763)
2549 *Epipsilia cervantes* (Reisser, 1935) (*latens auct. lusit. nec* Hübner, 1809)
2589 *Earias roseifera* Butler, 1881

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Conflict of Interest

The authors declare that there is no known financial interest or personal relationship that could have influenced the work presented in this article.

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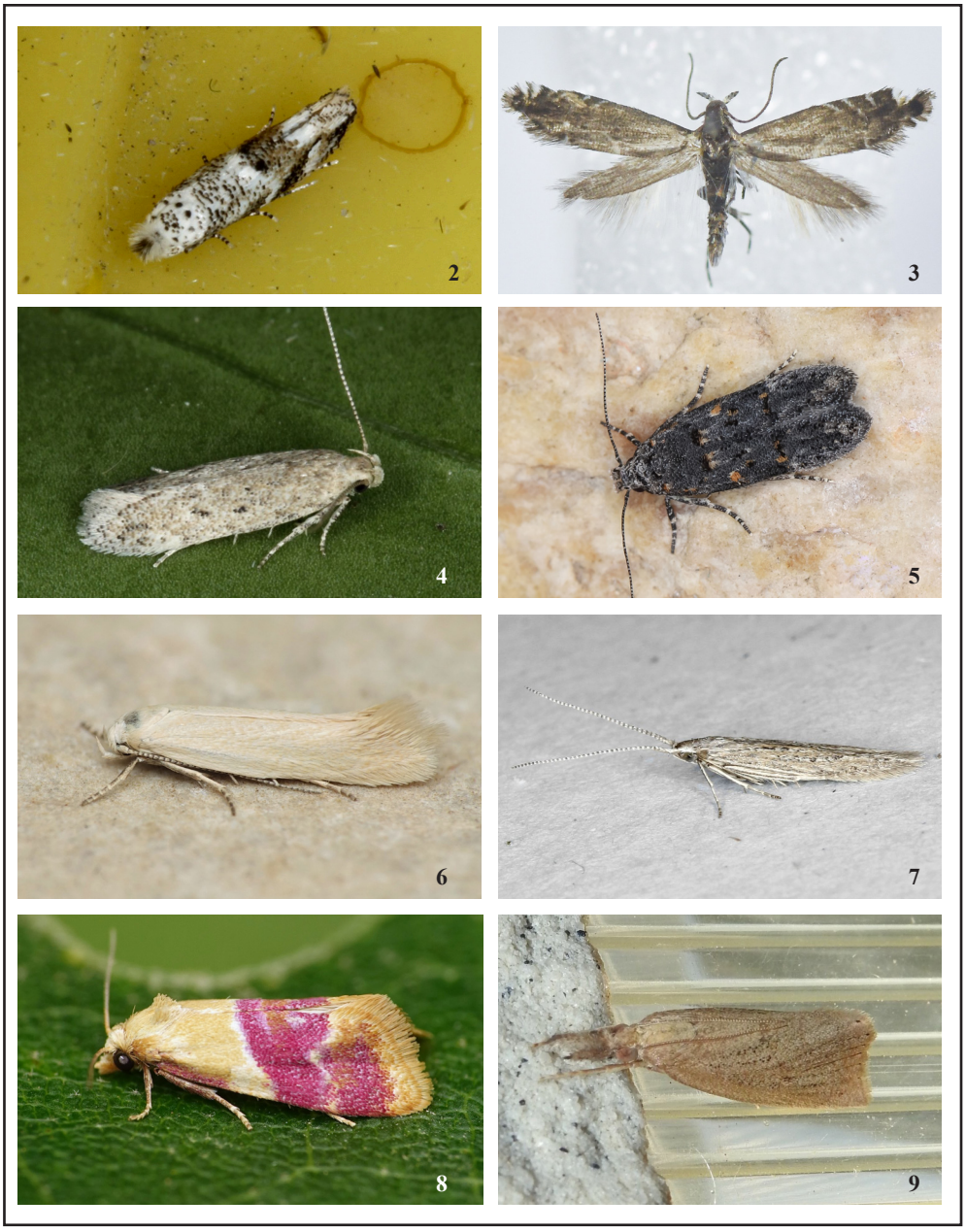
Figures 2-9. 2. *Bucculatrix pyrenaica* Nel & Varenne, 2004, Zavial, 7-X-2024 (J. L. Fabião). **3.** *Glyphipterix schoenicolella* Boyd, 1858, Lagoa das Correntes, Carriço, 18-V-2024 (André Lameirinhas). **4.** *Scrobipalpa nitentella* (Fuchs, 1902), Trafaria, 16-VIII-2024 (J. L. Fabião). **5.** *Istrianis myricariella* (Frey, 1870), Bensafrim, ex larva 7-VI-2024 (A. Valadares). **6.** *Elachista anserinelloides* Nel, 2003, Castro Laboreiro, 2-VII-2021 (J. Nunes). **7.** *Coleophora texanella* Chambers, 1878, Trafaria, 31-VIII-2024 (J. L. Fabião). **8.** *Diceratura ostrinana* (Guenée, 1845), Bairro dos Formarigos, Bragança, 3-VIII-2024 (J. Nunes). **9.** *Chilo luteellus* (Motschulsky, 1866), Guerreiros do Rio, 12-V-2024 (N. Conceição).



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Confirmation of the subspecific status of *Polyommatus huberti arpaensis* Charmeux, 2018 and description of a new subspecies of *Polyommatus pseudactis* (Forster, 1960) from the Sevan region (Gegharkunik, Armenia) based on evidence from DNA barcodes (Lepidoptera: Lycaenidae)

Jean-François Charmeux, Yvan Diringer, Xavier Mérit & Vazrick Nazari

Abstract

Based on evidence from mitochondrial DNA barcodes, the subspecific rank of the taxon *Polyommatus huberti arpaensis* Charmeux, 2018 is confirmed. Even though the populations of this species from Vayots Dzor and Gegharkunik show small morphological differences, they are here considered as local variants of *P. huberti arpaensis* due to lack of differentiation in DNA barcodes. Morphological observations supported by DNA barcode data also revealed a new subspecies, described here as *P. pseudactis sevanensis* subsp. nov. from the Sevan Lake region (Armenia, Gegharkunik Province).
Keywords: Lepidoptera, Lycaenidae, Polyommatinae, Polyommatus, *P. pseudactis sevanensis*, DNA barcode, taxonomic, ranking, Palaearctic region.

Confirmación del estatus subespecífico de *Polyommatus huberti arpaensis* Charmeux, 2018 y descripción de una nueva subespecie de *Polyommatus pseudactis* (Forster, 1960) de la región de Sevan (Gegharkunik, Armenia) basada en pruebas de códigos de barras de ADN (Lepidoptera: Lycaenidae)

Resumen

A partir de las pruebas de los códigos de barras del ADN mitocondrial, se confirma el rango subespecífico del taxón *Polyommatus huberti arpaensis* Charmeux, 2018. Aunque las poblaciones de esta especie de Vayots Dzor y Gegharkunik muestran pequeñas diferencias morfológicas, aquí se consideran variantes locales de *P. huberti arpaensis* debido a la falta de diferenciación en los códigos de barras de ADN. Las observaciones morfológicas respaldadas por los datos del código de barras de ADN también revelaron una nueva subespecie, descrita aquí como *P. pseudactis sevanensis* subsp. nov. de la región del lago Sevan (Armenia, provincia de Gegharkunik).
Palabras clave: Lepidoptera, Lycaenidae, Polyommatinae, *Polyommatus*, *P. pseudactis sevanensis*, código de barras de ADN, taxonómico, clasificación, región Paleártica.

Introduction

With 120 species recognized so far, the members of subgenus *Polyommatus (Agrodiaetus)* are among the most diverse groups of butterflies in the palearctic region (Eckweiler & Bozano, 2016). Beginning in the 1950s, karyological studies led by Hubert de Lesse (1914-1972) and others revealed a wide range of hidden complexity within the members of this group that are often externally indistinguishable (de Lesse, 1960; Lukhtanov, 1989; Vershinina & Lukhtanov, 2017). More recently, DNA barcoding has been shown to be a useful tool for resolving the difficult taxonomic and phylogenetic questions in this group (Lukhtanov et al. 2023). Sources list 32 species for Turkey (Hesselbarth et al. 1995), 23 for the Caucasus and Transcaucasia region (Tshikolovets & Nekrutenko, 2012), and 18 species for Armenia (Aghababyan & Khanamirian, 2025).

The taxon *Polyommatus* (*Agrodiaetus*) *huberti* Carbonell, 1993 was described from Turkey, Ağrı Province. It was differentiated from the sympatric taxon *ninae* Forster, 1956 by various morphological characters such as pattern, antennae and genitalia (Carbonell, 1993). The taxon *Polyommatus arpaensis* Charmeux, 2018 from Vayots Dzor Province, Armenia was originally described as a subspecies of *P. huberti*. Unlike the nominotypical population from Ağrı, this population is mainly characterised by the accented markings on the underside of the wings (Charmeux, 2018).

The areas to the North of the Sevan Lake region were first visited in 2018 by Y. Diringer and later by J. F. Charmeux and X. Mérit in 2022. Many *Polyommatus* species were observed in this region, among them two populations of *P. huberti* and *P. pseudactis* (Figures 2-3) showing different patterns from their counterparts in other regions. Even though some sources have considered *pseudactis* only as a subspecies of *Polyommatus actis* (Herrich-Schäffer, 1851) (e.g. Eckweiler & Bozano, 2016), recent molecular studies list it as a separate species (e.g. Lukhtanov et al. 2023).

We aimed to find answers to these taxonomic uncertainties, and test for the presence of additional undetected taxonomic diversity in this region, by application of DNA barcoding to the material collected in those expeditions as well as samples from populations in neighbouring areas. More specifically, we tested whether sequence data from DNA barcodes can support the observed morphological differences among various populations of *P. pseudactis* and *P. huberti.*

Materials and Methods

Taxon sampling: Fieldwork was conducted in Armenia between 2018-2022. All collected samples are held at the private collections of JFC, YD and XM. Legs from 17 specimens representing 9 *P. huberti* and 8 *P. pseudactis* were sampled from across their range, of which 14 yielded usable barcode sequences (Table 1). In addition, 16 public barcode records from BOLD and GenBank of *Polyommatus* from previous studies were retrieved and added to our dataset. We also included sequences for several closely related species of *Polyommatus (Agrodiaetus)* (i.e. *P. sigberti, P. actis, P. artvinensis, P. ernesti, P. haigi, P. ninae, P. turcicolus,* and *P. elbursicus*) as putative outgroups (Table 1). The voucher data are publicly available through the BOLD dataset "DS-PSDACTIS", accessible at https://doi.org/10.5883/DS-PSDACTIS. We excluded one public sample identified as *A. pseudactis* (AY556845), as it likely represents an undescribed lineage of *P. firdussii*.

Molecular analysis: The extraction of total genomic DNA, amplification and sequencing were performed in the Centre for Biodiversity Genomics (Guelph, Ontario, Canada) using mini-primers (LepF/mLepR and mLepF/LepR) (Hajibabaei et al. 2006). Many samples produced full length barcodes (658 bp). Fourteen new barcode sequences were submitted to GenBank (Accessions PQ884470 - PQ884484), and all sequences are also publicly available in the BOLD dataset "DS-PSDACTIS" (dx. https://doi.org/10.5883/DS-PSDACTIS).

The combined dataset was assembled using MEGA 11.0.8 (Tamura et al. 2021). Alignment of sequences was carried out using MUSCLE modules implemented in AliView 1.28 (Larsson, 2014) and double-checked visually. The final dataset file was analyzed using the IQtree web server (https://iqtree.cibiv.univie.ac.at) (Trifinopoulos et al. 2016) with 1000 Ultrafast bootstrap replicates. The resulting tree was edited using FIGTREE 1.4.4 (Rambaut, 2018). Uncorrected *p*-distances were calculated using MEGA 11.0.8 (Tamura et al. 2021).

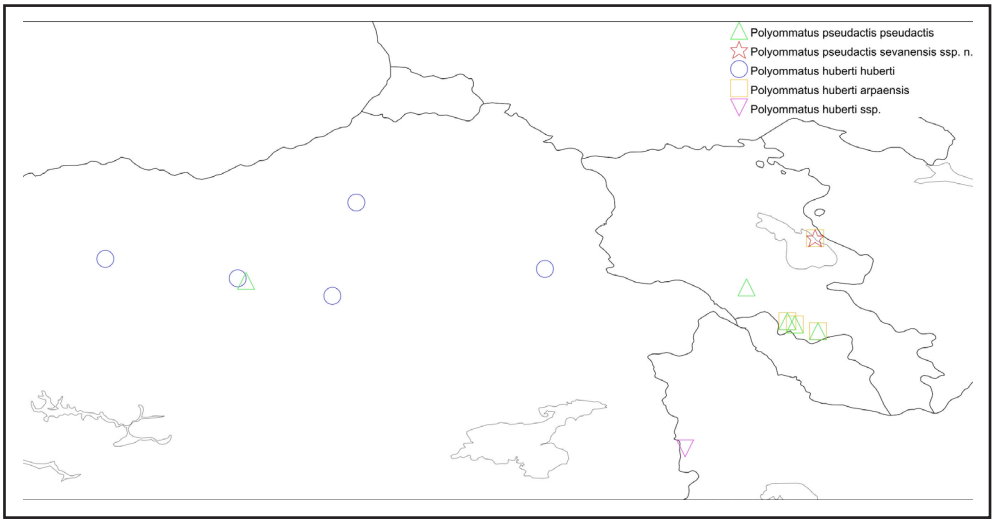
Table 1. Names, sample ID, GenBank accession numbers, locality, and geographic coordinates of the samples used for this study.

Taxon	SampleID	Accession	Locality	Lat.	Long.
Polyommatus sigberti	MW98284	AY557020	Turkey, Kayseri, Ala Daglar	37.916667	35.216667
Polyommatus actis	MW98162	AY556999	Turkey, Sivas, Gokpinar	38.708931	37.336226
Polyommatus artvinensis	MW99058	AY557038	Turkey, Artvin, Kilickaya	40.719749	41.475189
Polyommatus ernesti	MW98097	AY556989	Turkey, Isparta, Dedegol Gecidi	37.667222	31.302778
Polyommatus haigi	VL-01-L340	AY496750	Turkey, Van, Catak	38.027364	43.039766
Polyommatus pseudactis pseudactis	AD-00-P263	AY496777	Armenia, Aiodzor Mts, Gnishyk	39.656828	45.297763
Polyommatus pseudactis pseudactis	JFC23034	PQ884484	Armenia, Vayots Dzor, env. Martiros	39.597673	45.499464
Polyommatus pseudactis pseudactis	JFC23035	PQ884480	Armenia, Vayots Dzor, env. Martiros	39.597673	45.499464
Polyommatus pseudactis sevanensis ssp. nov.	JFC23036	PQ884476	Armenia, Gegharkunik, Sevan region, Tsapatagh	40.409004	45.474675
Polyommatus pseudactis sevanensis ssp. nov.	JFC23037	PQ884477	Armenia, Gegharkunik, Sevan region, Tsapatagh	40.409004	45.474675
Polyommatus pseudactis?	JFC23038	-	Turkey, Erzurum, Kopdagi Gecidi	40.036389	40.513611
Polyommatus pseudactis	JFC24026	PQ884479	Armenia, Vayots Dzor, Noravank	39.684769	45.232724
Polyommatus pseudactis	JFC24027	PQ884473	Armenia, Vayots Dzor, Gnishyk	39.656828	45.297763
Polyommatus pseudactis	JFC24028	-	Armenia, Ararat, Ararat, Vedi river valley	39.980391	44.876892
Polyommatus pseudactis	JFC24032	-	Turkey, Erzurum, Kopdagi Gecidi	40.036389	40.513611
Polyommatus ninae	MW99508	AY557113	Turkey, Agri	39.719074	43.050591
Polyommatus turcicolus	MW99479	AY557110	Turkey, Van, Erek Dagi	38.468611	43.518056
Polyommatus elbursicus	AD02W269	AY953986	Iran, Mazandaran, Veresk	35.907136	52.982781
Polyommatus huberti huberti	VL-01-L123	AY496753	Turkey, Gumushane, Dilekyolu	40.2285	39.286671
Polyommatus huberti huberti	VL-01-L315	AY496754	Turkey, Erzurum	39.905499	41.265824
Polyommatus huberti huberti	MW99053	AY557036	Turkey, Artvin, Kilickaya	40.719749	41.475189
Polyommatus huberti huberti	MW99095	AY557046	Turkey, Kars, Kagizman	40.140648	43.119118
Polyommatus huberti huberti	MW99552	AY557123	Turkey, Bayburt, Kop Gecidi	40.058889	40.440556
Polyommatus huberti arpaensis	JFC23010	PQ884470	Armenia, Gegharkunik, Sevan region, Tsapatagh	40.409004	45.474675
Polyommatus huberti arpaensis	JFC23011	PQ884478	Armenia, Gegharkunik, Sevan region, Tsapatagh	40.409004	45.474675
Polyommatus huberti arpaensis	JFC23012	PQ884483	Armenia, Gegharkunik, Sevan region, Tsapatagh	40.409004	45.474675
Polyommatus huberti arpaensis	JFC23006	PQ884474	Armenia, Vayots Dzor, env. Martiros	39.597673	45.499464
Polyommatus huberti arpaensis	JFC23009	PQ884471	Armenia, Vayots Dzor, Noravank	39.684769	45.232724
Polyommatus huberti arpaensis	AD-00-P260	AY496752	Armenia, Aiodzor Mts, Gnishyk	39.656828	45.297763
Polyommatus huberti arpaensis	AD98024	AY556848	Armenia, Gnyshik	39.656828	45.297763
Polyommatus huberti arpaensis	JFC23007	PQ884475	Armenia, Vayots Dzor, env. Martiros	39.597673	45.499464
Polyommatus huberti arpaensis	JFC23008	PQ884482	Armenia, Vayots Dzor, Noravank	39.684769	45.232724
Polyommatus huberti	ARLY-146b-002	PQ884481	Iran, West Azerbaijan, Khoy, Mohamad Agha Mt	38.577	44.341

Results

The distribution of our barcodes samples are shown in Figure 1. We found an average of 0.6% (0.58±0.22%) difference between populations of *P. huberti* from Armenia (ssp. *arpaensis*, Gnyshik, Vayots Dzor, Gegharkunik, n=9) and those from Turkey (ssp. *huberti*, Bayburt, Erzurum, Gumushane, Kars, n=5). The two subspecies also show clear morphological differences (Figure 2-3), with individuals form ssp. *huberti* often having smaller spots on the underside, obsolete submarginal patterns on the underside of the forewings (brownish lunules in S2 and S3 in ssp. *arpaensis*), and weak submarginal chevrons on the underside of the hindwings. In our phylogenetic reconstruction, these two populations formed two independent clades that always stayed together with moderate support (bootstrap=75) confirming their sister-group relationship at species-level (Figure 4). We noted that individuals of the *P. huberti* population in Sevan were even smaller in size and often showed a stronger reduction of markings on the underside of the hindwings; however, they showed no differentiation in DNA barcodes from other Armenian populations.

Figure 1. Distribution of specimens examined in this study.



We also found an average of 0.3% (0.29±0.03%) distance between populations of *P. pseudactis* from Gegharkunik (n=2) and those from the type locality ("Armenia, mts. Daralagez, pag. Martiros" = Vayots Dzor; Forster, 1960) (n=5). Morphologically they showed a more pointed tip of the forewings, ground-colour of the upperside brighter blue-violet, and all markings strongly reduced on the underside of hindwings. Despite the limited number of barcoded samples in our study, which was largely due to the limited number of available specimens, we consider a lack of genetic differentiation within each of these two groups, and presence of a consistent and notable genetic gap between the two, in addition to clear morphological differences between them, as sufficient evidence to describe the population of *P. pseudactis* from Gegharkunik as a new subspecies.

***Polyommatus pseudactis sevanensis* Charmeux, Diringer, Mérit & Nazari, subsp. nov.**
(Figures 2 D-E, 3B)
https://zoobank.org/A7230E8D-2BD8-4AAE-8148-07CCBEB356AA

Holotype ♂. SampleID JFC23036, GenBank accession PQ884476. Armenia, Gegharkunik, N Sevan Lake, Tsapatagh, 2000 m, 01-VII-2022, J.-F. Charmeux leg., deposited in Muséum National d'Histoire Naturelle (MNHN), Paris, France.

Paratypes: Same data as holotype, 1 ♂, SampleID JFC23037 (MNHN); same locality, 2000 m, 3 ♂,

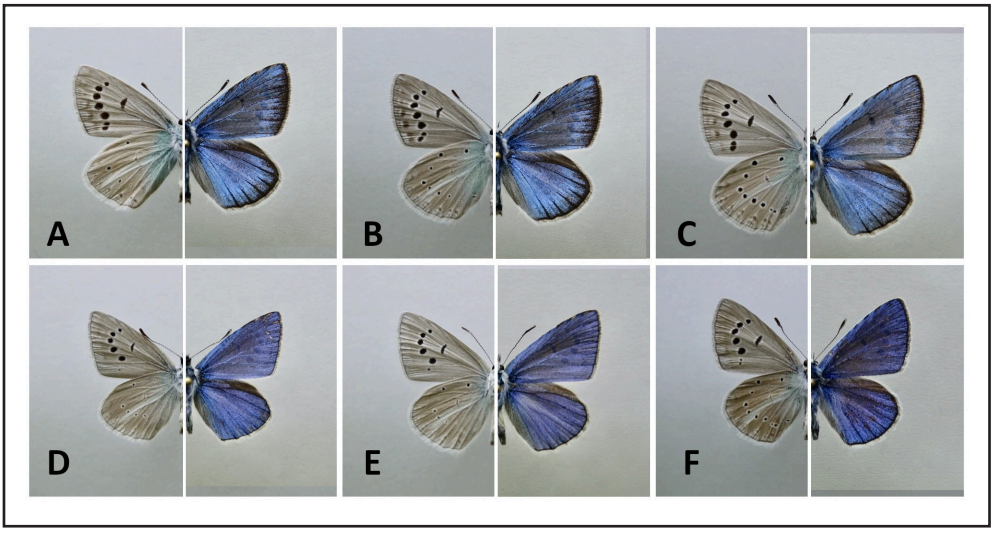
10-11-VII-2018, Y. Diringer leg.; same data as holotype, 1 ♂, J.-F. Charmeux leg. (in coll. Y. Diringer); same locality, 1 ♂, 11-VII-2022, X. Mérit leg. (in coll Mérit); same data as holotype, 1 ♂, J.-F. Charmeux leg. (in coll. X. Mérit).

Description male (Figures 2, D-E): Forewing length in Holotype 15.2 mm, in Paratypes 14.4-17 mm (n=7). Wingspan between apex in Holotype 26.5 mm, in Paratypes 24-27 mm. On the forewings, outer edge practically straight, pointed tip. Upperside. Ground-color luminous violet-blue, veins very slightly lined distally with black. Underside. Ground-color light grey, very thin marginal line. Hindwings with a conspicuous white band along M3, series of white triangular markings, weak greenish blue basal suffusion and all markings strongly reduced: the postdiscal black dots are very small and incomplete, more often obsolete.

Female: unknown

Diagnosis: Compared to the nominotypical subspecies (see Figure 2F), the new subspecies is on average slightly smaller in size (25.5 vs. 26 mm) with a straighter outer edge of the forewings (more rounded in *pseudactis*); the ground-color on the upperside of the wings is luminous violet-blue (dark purple in ssp. *pseudactis*) and on the underside it is lighter gray (dark grey in *pseudactis*); postdiscal black markings small and incomplete (larger and present in complete series in *pseudactis*) and marginal line is very thin (nearly double the width in *pseudactis*).

Figure 2. Adults of *Polyommatus*. Left: Underside, Right: Upperside of the wings. **A-C** *P. huberti arpaensis* **A.** Armenia, Gegharkunik, N Sevan Lake, Tsapatagh, 2000 m, 18-VII-2018, J.-F. Charmeux leg. & coll. **B.** Armenia, Gegharkunik, N Sevan Lake, Tsapatagh, 2000 m, 01-VII-2022, J.-F. Charmeux leg. & coll. **C.** Armenia, Vayots Dzor, Noravank, 1550 m, 23-VI-2015, J.-F. Charmeux leg. & coll. **D-E** *P. pseudactis sevanensis* **subsp. nov. D.** Paratype, Armenia, Gegharkunik, N Sevan Lake, Tsapatagh, 2000 m, 01-VII-2022, J.-F. Charmeux leg., MNHN. **E.** Holotype, Armenia, Gegharkunik, N Sevan Lake, Tsapatagh, 2000 m, 01-VII-2022, J.-F. Charmeux leg. & coll. **F.** *P. pseudactis pseudactis,* Armenia, Vayots Dzor, env. Martiros, 2000 m, 15-VI-2019, J.-F. Charmeux leg. & coll. (Photos: JFC).



Etymology: Toponymic, from the Sevan region in Central-Eastern Armenia.

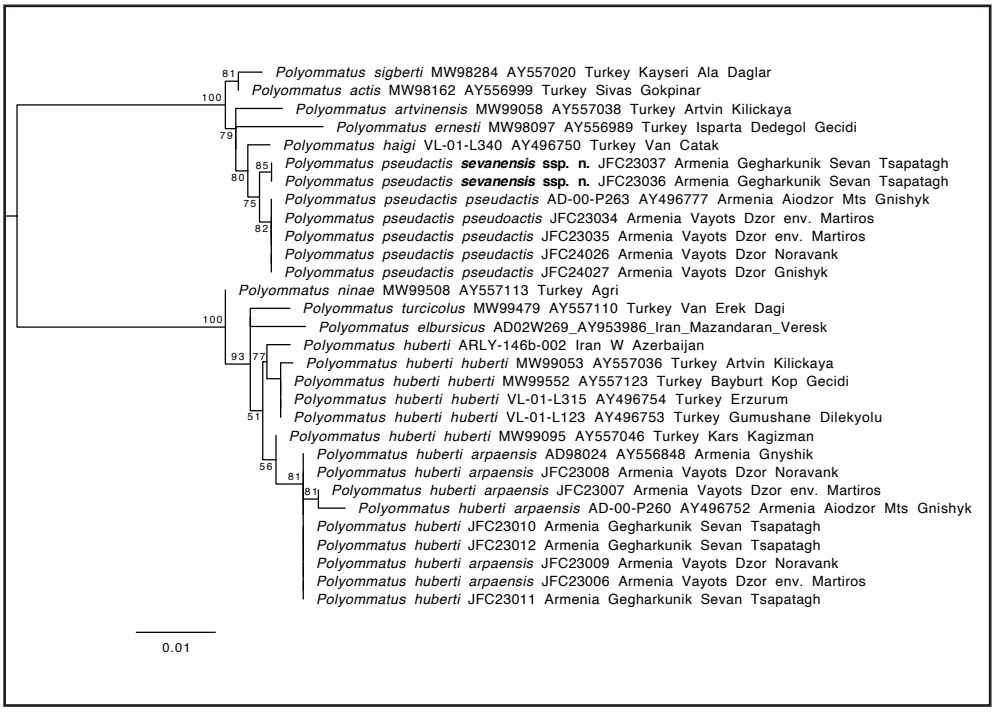
Distribution: Valleys to the north of Sevan Lake area. The new subspecies can be observed flying together with numerous other blue and brown Polyommatinae (e.g. *P. huberti arpaensis* Charmeux, 2018; *P. damon kotshubeji* Sovinsky, 1915; *P. ninae* Forster, 1956; *P. vanensis sheljuzhkoi* Forster, 1960; *P. emmeli* Lukhtanov & Dantchenko, 2024; and *P. demavendi antonius* Lukhtanov & Dantchenko, 2024. Other species that occur in the area include *P. amandus* (Schneider, [1792]); *P. daphnis dugijani* Schurian & Häuser, 1981; *Plebejus idas altarmena* (Forster, 1936); *Plebejus argus aegidion* (Meisner, 1818); *Pyrgus sidae* (Esper, [1784]); *Pyrgus cinarae* (Rambur, [1839]), and *Pieris napi meridionalis* Heyne, 1895.

Figure 3. Adults specimens and habitat. **A.** *P. huberti arpaensis***,** Vayots Dzor, Noravank, 06-VII-2014. **B.** *P. pseudactis sevanensis* subsp. nov. Gegharkunik, Tsapatagh, 06-VII-2024. **C.** *P. pseudactis pseudactis*, Vayots Dzor, Sers, 26-VI-2024. **D.** habitat of *P. pseudactis sevanensis* subsp. nov. and *P. huberti* in the Sevan region. **E.** habitat of *P. pseudactis pseudactis* and *P. huberti arpaensis* in the Vayots Dzor region. **F.** Lycaenidae mud puddling at Gegharkunik, Tsapatagh, 18-07-2018. In the center of the picture a specimen of *P. huberti arpaensis* can be seen, next to *Plebejus idas* and *Polyommatus emmeli* (Photos: JFC).

Ecology: The habitat of *P. pseudactis sevanensis* consists of narrow river valleys on the southern face of the Sevan Mountains, at an altitude between 2,000 and 2,450 m. These valleys extend over a mountainous area that spreads out over a pocket of Mesozoic and Cenozoic sedimentary rocks characterized by outcrops of ophiolitic sequences composed of basaltic rocks and limestone zones. Wedged between the Lesser Caucasus and Lake Sevan, this area is subject to the micro-climate of Lake Sevan, whose temperatures are cooler than those of the surrounding regions. The north-facing slopes of these valleys are covered by relict oak forests (*Quercus* spp.) and century-old junipers (*Juniperus polycarpos* K. Koch. and *J. oblonga* M. Bieb.), while the bottoms of the valleys host retracted riparian vegetation and small semi-humid meadows. The dry slopes and summits are dominated by typical high-altitude Mediterranean plants such as *Onobrychis cornuta* (L.) Desv., *Acantholimon* spp., *Androsace villosa* L., *Alyssum tortuosum* Waldst. & Kit. ex Willd., *Astragalus cornutus* Pall., *Sedum caucasicum, sempervirum* ssp. and *Spiraea* ssp., and endemism's such as *Astragalus schuschaensis* Grossh., and *Acantholimon gabrieljaniae* Mizoeva.

We noted in these meadows the presence of several species of Leguminosae (*Onobrychis, Medicago*, *Astragalus*) which are hostplants for numerous blue Lycaenidae elsewhere in Armenia (e.g. *Onobrychis transcaucasica* Grossh., *O. altissima* Grossh. and *O. hajastana* Gross., hosts of *Polyommatus turcicus, P. damon* and *P. iphigenia*). It is highly likely that *P. pseudactis sevanensis* larvae use *Onobrychis cornuta* as their host plant, as in the case of the nominotypical populations of the Vayots Dzor Province mountains where we were able to observe oviposition in situ on this plant. However, we were unable to identify the host plant of *P. huberti*. Similarly, the data available to us are still too fragmentary to provide a clear picture of the phenology of the new subspecies. However, it appears that the adults emerge in July, somewhat later than the nominotypical populations in Vayots Dzor.

Figure 4. Maximum Likelihood tree of *Polyommatus pseudactis* and *P. huberti* COI barcodes inferred using IQTree. Other *Polyommatus* species are included as outgroups. Values on the nodes represent bootstrap support for 1000 replicates for supported nodes (Scale bar = 1%).



Discussion

The advent of DNA barcoding in the past two decades has provided the researchers an additional tool that has allowed the discovery of previously undetected diversity in many groups of Lycaenidae, particularly in *Polyommatus* (e.g. Lukhtanov et al. 2020, 2021, 2023; Naderi et al. 2024, Karbalaye & Lukhtanov, 2024). Our findings demonstrate that even in relatively well-studied regions such as Armenia, cryptic diversity may persist in Lepidoptera that need further investigation. Compilation of comprehensive regional barcode libraries can further elucidate taxonomic diversity in those regions and help clarify the true extent of variation and diversity in taxonomically difficult groups such as *Polyommatus* species.

Compared to the nominotypical *P. huberti*, the Armenian population from Vayots Dzor (ssp. *arpaensis*) has larger spots on the underside of the wings, well-developed submarginal patterns on the forewings with brownish lunules in spaces 2 and 3, as well as well-developed submarginal chevrons on the hindwings. The *P. huberti* population from Sevan differs from the nominotypical *P. huberti* as well as *P. huberti arpaensis* by its smaller size and the obsolescence of the postdiscal markings underside of hindwings. Initially we thought that this population potentially represented a separate subspecies, however since they showed no differentiation in their DNA barcodes from other Armenian populations, for now we consider them a local variant of *P. huberti arpaensis* until further evidence proves otherwise. Noteworthy are also specimens of *P. huberti* from Kars (AY557046) and NW Iran (PQ884481), both of which are notably divergent in their DNA barcodes from other populations and may signal additional undetected diversity.

The low but consistent sequence divergence between the populations of *P. pseudactis* from Gegharkunik and those in Vayots Dzor (0.3%) falls well within the spectrum of intra-specific variation in *Polyommatus*. Considering the morphological differentiation between them, we determined that the Gegharkunik population merited a new subspecific name, here described as ssp. *P. pseudactis sevanensis* ssp. nov**.** The molecular characteristics of the Iranian populations of *P. pseudactis* distributed in Western Iran and south to Esfahan (Rajaei et al. 2023) remain unstudied, and indeed they may represent yet another undescribed subspecies. A focused phylogeographic study on the whole complex is needed to further delineate species and subspecies in this complex.

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Conflict of interest

The authors declare that there is no known financial interest or personal relationships that could have influenced the work presented in this article.

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A new species of the genus *Epiplema* Herrich-Schäffer, [1855] from China (Lepidoptera: Uraniidae, Epipleminae)

Ming-Xu Han & Hui-Lin Han

Abstract

A new species *Epiplema sinica* Han & Han, sp. nov. is described from Guangxi Zhuang Autonomous Region and Guangdong, Fujian, Jiangxi, Sichaun, Yunnan Provinces, China. The images of the adults and the genitalia of both sexes are illustrated and compared with the related species *E. albida* (Hampson, 1891).
Keywords: Lepidoptera, Uraniidae, Epipleminae, *Epiplema*, new species, China.

Una nueva especie del género *Epiplema* Herrich-Schäffer, [1855] de China (Lepidoptera: Uraniidae, Epipleminae)

Resumen

Se describe una nueva especie, *Epiplema sinica* Han & Han, sp. nov., procedente de la región autónoma de Guangxi Zhuang y las provincias de Guangdong, Fujian, Jiangxi, Sichuan y Yunnan, en China. Se ilustran las imágenes de los adultos y la genitalia de ambos sexos y se comparan con los de la especie relacionada *E. albida* (Hampson, 1891).
Palabras clave: Lepidoptera, Uraniidae, Epipleminae, *Epiplema*, nueva especie, China.

Introduction

The genus *Epiplema* Herrich-Schäffer, [1855] with type species *E. acutangularia* Herrich-Schäffer, [1855] from Brazil. To date, this genus includes more than one hundred species, among them, many species had been misplaced, and the Southeast Asia species were transferred to other genera: *Chaetoceras* Warren, 1896, *Chionoplema* Holloway, 1998, *Dysaethria* Turner, 1911, *Europlema* Holloway, 1998, *Leucoplema* Janse, 1932, *Oroplema* Holloway, 1998, *Pseudodirades* Janse, 1932 and *Rhombophylla* Turner, 1911 (Holloway, 1998). The species of *Epiplema* are mainly distributed in the tropical and subtropical regions, only a few species extend into the Palaearctic region, and one species: *E. styx* (Butler, 1881) was recorded in Japan and South Korea (Sohn et al. 2005; Kishida et al. 2011). Up to now, this genus with 5 species is recorded in China: *Epiplema arizana* Matsumura, 1931, *E. arcuata* Warren, 1896, *E. columbaris* (Butler, 1889), *E. himala* (Butler, 1880) and *E. strigulicosta* (Strand, 1916) (Chu et al. 2004; Fu et al. 2020).

Materials and methods

The materials were collected in Guangxi Zhuang Autonomous Region and Guangdong, Fujian, Jiangxi, Sichuan, Yunnan Provinces, China, using 220V/450W mercury lamp and DC black light. Standard methods for dissection and preparation of genitalia slides were used (Kononenko & Han, 2007). The specimens were photographed using a Nikon Z6II camera; the genitalia slides were photographed using an Olympus

photomicroscope and were stacked using Helicon Focus 7.6, and further processed in Adobe Photoshop CC2019. The holotype of the new species is deposited in the collection of Northeast Forestry University, Harbin, China, and the paratypes are deposited in the collection of Northeast Forestry University (NEFU), Harbin, China, and Sun Yat-sen University (SYSU), Guangzhou, China.

Taxonomic account

Genus *Epiplema* Herrich-Schäffer, [1855] 1850-1858
Epiplema Herrich-Schäffer, [1853] 1850-1858. *Samml. aussereurop. Schmett.* (I) *1* (13-17), p. 25, 38, 62
Type species: *Epiplema acutangularia* Herrich-Schäffer, [1855] 1850-1858. *Samml. aussereurop. Schmett.* (I) *1* (13-17), pl. 58, fig. 324
Type locality: BRAZIL

Descriptions of new species

***Epiplema sinica* Han & Han, sp. nov.** (Figures 1, 2, 3, 7, 10, 13, 14)
https://zoobank.org/06961C4F-DEA5-47A8-A485-AD6A9DDE4F0D

Material: Holotype ♂, China, Guangxi Zhuang Autonomous Region, Yinzhulaoshan National Nature Reserve, Hengjiang Station, 15-16-VII-2021, JJ. Fan, B. Gao leg., genitalia No. hmx-120-1, coll. NEFU. Paratypes: 1 ♂, China, Guangdong Province, Maoming City, Xianrendong Nature Scenic Area, 10-VI-2020, FL. Jia, ZY. Jiang leg., genitalia No. hmx-80-1, coll. SYSU; 1 ♀, Guangdong Province, Shaoguan City, Chebaling National Nature Reserve, 29-V-3-VI-2019, HL. Han, J. Wu, WJ. Li leg., genitalia No. hmx-126-2, coll. NEFU; 1 ♀, Fujian Province, Nanping City, Mangdangshan National Nature Reserve, 1-V-2024, Z. Peng leg., genitalia No. hmx-192-2, coll. NEFU; 1 ♀, Jiangxi Province, Jinggangshan City, Jinggangshan National Nature Reserve, Fire command center, 1-VIII-2024, HL. Han, LY. Ha leg., coll. NEFU; 1 ♂, Sichuan Province, Guangyuan City, Tangjiahe National Nature Reserve, 14-X-2024, J. Wu, TT. Zhao, WH. Xu leg., coll. NEFU; 1 ♂, Yunnan Province, Pu'er City, Jiangcheng County, 1-2-VIII-2018, HL. Han, MR. Li, J. Wu leg., genitalia No. hmx-240-1, coll. NEFU.

Description: Wingspan 16-18 mm in male, 21mm in female. Head pale grey; labial palpus short; antenna filiform, light taupe. Thorax and tegula pale grayish brown; legs with pale grey scales. Abdomen grayish brown to yellowish-brown. Forewing light grey; antemedial line very slender, with curved outward on costal margin region, then extend inwardly curved to the inner margin, and connect with the reddish-brown patch; medium line reddish-brown, outward curved on Cu vein, and closed to reniform spot; postmedial line reddish-brown, broadest accompanied by pale white and slender line on the outside, and outward curved at front of M_3 then inward curved to inner margin; subterminal line very slender, wave and indistinct; terminal line area with reddish-brown inverted triangle on M vein; reniform spot reddish-brown and narrow eye shaped; tornus with blackish-brown and short tuft; postmedial and median line regions appear a reddish-brown patch on inner margin area; inner margin with gently arc concave at outer half. Hindwing colour same as forewing; antemedial line reddish-brown, broadest, and curved at Cu vein; postmedial line reddish-brown, mixed yellow appear a dot, and parallel to antemedial line; outer margin with short extension at R_s and M_3 veins.

Male genitalia: Uncus long, slender, slightly hook shaped, strongly sclerotized. Tegumen triangular narrow ca 1.5× the length of uncus. Valva board bar shaped, covered with densely hair; cucullus smooth arc shaped; thick and narrow, extend to cucullus; sacculus rather thick and sclerotized at basal part; sacculus process very board and covered valva; basal of sacculus small and half-moon shaped; peniculus narrow. Saccus "U" shaped. Juxta membranous, slender water chestnut shaped. Aedeagus long cylinder-shaped, slightly wave, carina slender; caecum short, as 1/6 long as aedeagus. Vesica membranous, with densely small grain, without cornutus.

Female genitalia: Papillae anales sclerotized conical shaped, covered with short setose. Apophysis posterioris same as apophysis anterioris. Ostium bursae funnel shaped, slightly sclerotized. Ductus bursae membranous, long, common and straight, ca 1.5× the length of corpus bursae. Corpus bursae membranous, olive shaped, densely covered with small grain; signum absent.

Diagnosis: Superficially this new species is similar to *E. albida* (Hampson, 1891) (Figures 4, 5, 8, 11)

and *Oroplema oyamana* (Matsumura, 1931) (Figures 6, 9, 12), but has several distinguishing features as follows: in adult, the postmedial line accompanied with grayish-white slender line on the outside (in *E. albida* and *O. oyamana* absent); terminal line area curved into inverted triangle shaped on M vein (in *E. albida* and *O. oyamana* doesn't curved into inverted triangle shaped); antemedial line connect with the bar shaped patch on the back of postmedial and median line regions at inner margin (in *E. albida* and *O. oyamana* far from). In the male genitalia, the aedeagus is long, thin and weakly wave (in *E. albida* short and broad; in *O. oyamana* long and curved); cornuti (in *E. albida* absent; in *O. oyamana* short hook shaped); basal of sacculus small and half-moon shaped (in *E. albida* large circular shaped; in *O. oyamana* common). In the female genitalia, ductus bursae straight and common (in *E. albida* curved and broad; in *O. oyamana* wave and slender); corpus bursae olive shaped (in *E. albida* irregular gourd shaped; in *O. oyamana* oval shaped).

Distribution: China (Guangxi: Ziyuan; Guangdong: Maoming, Shaoguan; Fujian: Nanping; Jiangxi: Jinggangshan; Sichuan: Guangyuan; Yunan: Pu'er) (Figure 14).

Etymology: The species name *sinica* is named after the distribution region of this new species.

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Conflict of Interest

The authors declare that there are no known financial interest or personal relationship that could have influenced the work presented in this article.

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Figures 1-6. Adults of *Epiplema* and *Oroplema* spp. **1.** *Epiplema sinica* Han & Han, sp. nov., male, holotype, Guangxi, China **2.** Ditto, male, paratype, Guangdong, China **3.** Ditto, female, paratype, Guangdong, China **4.** *E. albida* (Hampson, 1891), male, Sri Lanka, (after Cock & Shaw, 2017) **5.** Ditto, female, Sri Lanka, (after Cock & Shaw, 2017) **6.** *Oroplema oyamana* (Matsumura, 1931), male, Fujian, China. Scale bar: 1 cm.

Figures 7-12. Genitalia of *Epiplema* and *Oroplema* spp. **7.** *E. sinica* Han & Han, sp. nov., male, holotype, genit. prep. hmx-120-1 (in NEFU) **8.** *E. albida* (Hampson, 1891), male, (after Cock & Shaw, 2017) **9.** *Oroplema oyamana* (Matsumura, 1931), male, genit. prep. hmx-43-1 (in NEFU) **10.** *E. sinica* Han & Han, sp. nov., female, paratype, genit. prep. hmx-126-2 (in NEFU) **11.** *E. albida* (Hampson, 1891), female, (after Cock & Shaw, 2017) **12.** *Oroplema oyamana* (Matsumura, 1931), female, genit. prep. hmx-132-2 (in NEFU)

Figure 13. Living male adult, Sichaun Provinve, Guanyuan City, Tangjahe National Nature Reserve, Photograph by Dr. Jun Wu.

Figure 14. Collecting site of *Epiplema sinica* Han & Han, sp. nov.

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Apatelodidae

Argyresthiidae

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