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Back Cover Photo - *Agathodes monstralis* (Crambidae), USA, Florida. Photo by Andrei Sourakov.

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Inventory of butterflies of Emerald Valley Nature Reserve, Honduras (Lepidoptera: Papilionoidea)

Robert J. Gallardo

La Unión Suyapa, Las Vegas, Santa Barbara, Honduras, Central America

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Abstract: The diversity of Papilionoidea is still poorly known in much of Central America, especially within families such as Hesperiidae. Honduras remains one of the least studied of all the countries in the region, but efforts are underway to expand on a recent list of species and have already produced noticeable results. This paper discusses an ongoing, long-term assessment that is being conducted at a single site, Emerald Valley Nature Reserve, and provides a list of 704 species recorded to date. Finds of particular significance include the discovery of the recently described *Emesis eleanorae* Gallardo & Grishin, 2021 (Riodinidae) and at least 111 new records for Honduras. This survey demonstrates the importance of conserving species-rich, Premontane Wet Forest formations which remain under constant threat by human encroachment and ensuing anthropogenic practices.

Resumen: El conocimiento sobre la diversidad de Papilionoidea a nivel centroamericano es poco estudiado, especialmente dentro de algunas de las familias como Hesperiidae. Honduras es uno de los países en la región donde se ha realizado poco monitoreo de mariposas. Sin embargo, existen esfuerzos recientes para aumentar la lista oficial del país y se ha tenido buenos resultados. Este manuscrito trata de observaciones continuas a largo plazo que se ha realizado en un solo sitio, Reserva Natural Valle Esmeralda, y que provee una lista de 704 especies registradas hasta la fecha. Hallazgos significativos incluyen el descubrimiento de una especie recién descrita *Emesis eleanorae* (Riodinidae) y 111 especies que representan nuevos registros para Honduras. Este estudio demuestra la importancia de conservar ecosistemas de alta diversidad como los del Bosque Premontano, el cual sigue bajo amenazas y prácticas antrópicos constantes.

Key words: Honduras, Papilionoidea diversity, Emerald Valley Nature Reserve, *Emesis eleanorae*.

INTRODUCTION

Honduras is the second largest country in Central America, encompassing 112,492 km^2 (43,333 mi^2), roughly the size of the USA state of Tennessee. It possesses a wide variety of marine and terrestrial ecosystems and, according to the Holdridge (1967) System, six major forest types exist in the country, which still harbors approximately 46% forest cover (FAO, 2010). Honduras also contains part of the largest swath of lowland rainforest north of the Amazon basin, known as "La Mosquitia," located in the eastern third of the country. Nearly 60% of the country's 4.65 million ha. (11.3 million ac.) of forest is dominated by seven species of native pines (FAO, 2008). The country's geological history has left a complex set of topographical features that make it quite different from remaining countries in southern Central America (Alvarado *et al*., 2007). Mountains comprise 80% of the terrain with cordilleras occurring in east-west or in transverse directions, or as completely isolated massifs above 1500 m. Between the mountains are dry valleys, most of which are arid and some desert-like, supporting various species of cacti (Cactaceae) and a large variety of xerophytic vegetation (Mora *et al.,* 2012).

Published faunistic studies of the butterflies of Honduras remain few, but they include historical documentation by Godman and Salvin (1879-1901) as well as brief mentions in other publications. More recent studies include Monroe *et al*. (1967) and Monroe & Miller (1967), where a total of 480 species were recorded between the two studies. Although Papilionoidea diversity may be well documented in some areas of Central America (DeVries *et al*., 2012), Honduras remains the least studied country in the region. More recent efforts (Lehman, 2016; Van Dort, 2019; Van den Berghe & Vega, 2019) have added small numbers of new records for the country, but most of these surveys have been limited in scope.

Miller *et al.* (2012) reported the most recent list of Papilionoidea for the country, but based on an assessment of butterfly distributions in neighboring countries this figure represents approximately 52% of the potential number of species that could occur in the country (RJG, unpublished data). An ongoing, nation-wide survey being conducted by the author and Olivia Diaz commenced in 2016 and has brought the country list to 1,266 species (RJG, unpublished data). The goal of this paper is to report on the butterfly fauna recorded to date at Emerald Valley Nature Reserve, a private property located at the northwestern corner of Lake Yojoa. I describe the species richness of this small, well defined site and use the results to help to highlight the importance of protecting Premontane Wet Forest formations (hereafter 'premontane forest').

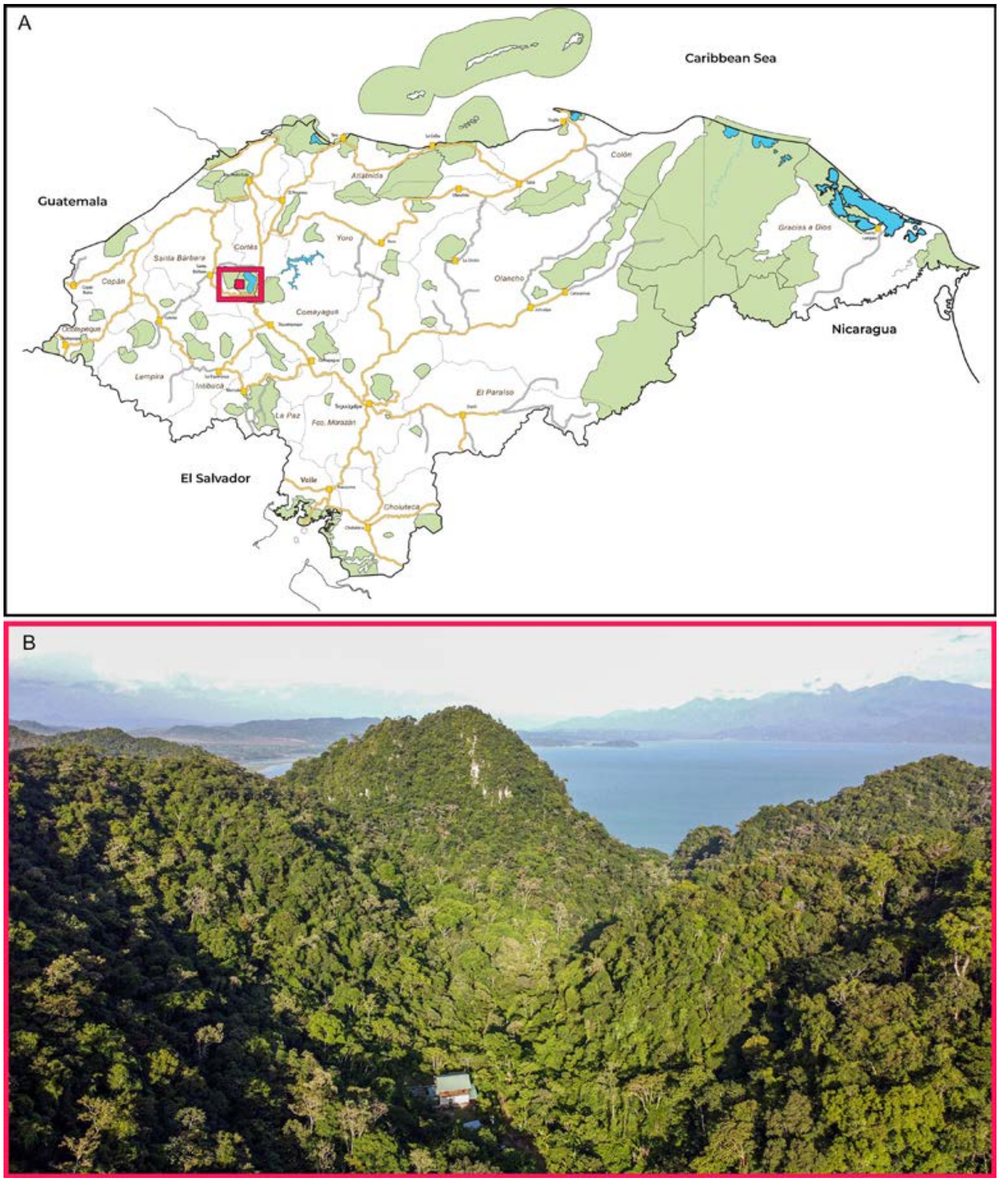

Figure 1. **A.** Map of Honduras showing the location of Lake Yojoa and Emerald Valley (red dot). **B.** Aerial (drone) photo of Emerald Valley facing east toward Lake Yojoa (courtesy of Alejandro Y. Calderón).

A decree issued in 1987 by the Honduran government (Decreto 87-87) and subsequent legislation forming additional national parks and reserves have focused primarily on preserving watersheds above 1800 m. In most cases, premontane forests were ignored and/or were left to be included in "buffer zones" where a certain degree of human activity and settlement is permitted. Within most reserves, premontane forests are non-existent or highly fragmented, and they are often replaced with shade coffee plantations, other agricultural practices, or converted to livestock pastures. Arid thorn scrub forest is the most threatened habitat in Honduras (Anderson *et al.*, 2010), followed by premontane forests. Extensive tracts still exist of both montane and lowland evergreen forests as well as pine-oak associations.

Although the country's overall butterfly fauna and distribution is still poorly known, it is becoming evident that general distribution patterns are similar to those of its birds (Gallardo, 2015), with distributions limited, in many cases, by the Honduran Depression, a major physiographic feature (Monroe, 1965). Honduras appears to act as an important biological bridge in northern Mesoamerica, similar to that of the Darién Gap between Panama and Colombia (Girot, 2002). Honduras possesses a strong combination of faunal elements that occur to the north in Mexico, Guatemala and El Salvador, and those from all countries to its south. In the case of its avifauna, approximately 120 species end their typical southern or northern range limits in Honduras (Gallardo, 2015). To date, 210 species of butterflies have been documented in Honduras which have their northern and southern range limits in the country (RJG, unpublished data).

MATERIALS AND METHODS

Study site: The country's largest body of freshwater, Lake Yojoa, is located in the central-western part of Honduras and lies 84 km south of the Caribbean Sea. The study site falls within

Figure 2. Google Earth image showing the property limits of Emerald Valley Nature Reserve (blue line), the total area surveyed (yellow line), and various points of interest (A-F).

the greater Lake Yojoa basin and pertains to the physiographic region termed 'Northern Cordillera of Serranía' by McCranie & Wilson (2002). Its weather patterns are partially influenced by the Caribbean Sea and, at least historically, the area held one of the highest levels of rainfall in the country with 3000 mm/year. Major ecosystems occurring in the area include pine-oak forest, broadleaf evergreen forest (premontane to montane), tropical dry forest and wetlands. Biodiversity in some faunal elements has proven to be high, and in the case of birds over 500 species have been recorded there, which represents 64% of the country's total (Gallardo, 2015). Although very few sites have been surveyed in detail, overall butterfly diversity in the area is also proving to be high.

Emerald Valley Nature Reserve (14°55'31.37"N, 88°02'57.64"W) is situated at the juncture between the Departments of Santa Bárbara and Cortés (Fig. 1A). The property measures 16.7 ha and has a mean elevation of 815 m, with surrounding land rising 100 m higher (delineated by a blue line on Fig. 2). Located to the west of the property is Santa Bárbara National Park, which reaches a maximum elevation of 2744 m, and along the eastern flank of the lake is Cerro Azul Meambar National Park, with a maximum elevation of 2080 m. The geology of the property and immediate surroundings is primarily karstic in origin, and as a result there are relatively few creeks or rivers in the area and the property itself contains no surface water except for a small vernal pool that often forms during the rainy season. The lower slopes and ridgeline of Emerald Valley are covered with outcroppings of large limestone boulders. Approximately 75% of the property contains a gradient of 40° or more.

Most of the property is covered with broadleaf evergreen forest, 90% of which is mature second growth and the remainder is young second growth. A small, flat area and adjacent lower slope contains an abandoned shade coffee plantation (Area D on Fig. 2). Some of the more common tree species include Spanish Cedar (*Cedrela odorata*, Meliaceae), "Mozote" (*Heliocarpus appendiculatus*, Malvaceae), *Cecropia peltata* (Urticaceae), *Alchornea* sp. (Euphorbiaceae) and Gumbo Limbo (*Bursera simaruba*, Burseraceae). Shrubs include numerous species of Piperaceae, Rubiaceae and Melastomataceae. The mature second growth forest is comprised of a large diversity of tree species, many reaching 25 m or higher. The understory is dense and dark and contains plants such as *Dieffenbachia* (Araceae), *Heliconia* spp. (Heliconiaceae) and numerous plants in Marantaceae. A prominent understory palm occurring there is "Pacaya" (*Chamaedorea tepejilote*, Arecaceae), whose developing inflorescences are consumed by locals as a delicacy. A noticeable plant that occurs in forest interior and ridgeline is a native, fine-leaved bamboo (*Rhipidocladum racemiflorum*, Poaceae), the host plant for *Dalla ramirezi* (Hesperiidae) and also likely for *Splendeuptychia salvini* (Nymphalidae) (RJG, unpublished data).

Sampling: The survey began in September 2016 and data were compiled up to September 2022. All voucher specimens are currently being stored at Emerald Valley within the authors' residence, within standard Cornell University Drawers. This survey, along with an ongoing national study, is being carried out with written authorization from the Instituto de Conservación Forestal (ICF), Gobierno de la República, Honduras.

Sampling methods included the following techniques: 1. intermittent collecting forays and general observations (entire area within the yellow outline in Fig. 2); 2. placing of ripened fruit on the ground, hung near eye level (in used socks) or placed in one or two portable bait traps (Austin & Riley, 1995) (Areas A & B, Fig. 2); 3. utilizing a modified version of the Ahrenholz technique (Lamas *et al*., 1993) to survey primarily for hesperiids (Areas E, B & F in Fig. 2); 4. utilization of a 9-foot high artificial platform in a light gap along the upper ridge (Area E in Fig. 2); 5. occasional use of a mercury vapor light to search for crepuscular species (Area A in Fig. 2); and 6. utilizing urine-cement slabs and mud puddles (Area A in Fig. 2). Net handle extension poles enabled capture of butterflies at a height of 5 m. Surveys were conducted by R. Gallardo and O. Diaz for an average of several hours once a week.

The annual blooming of Blue Mistflower (*Chromolaena odorata*, Asteraceae) is the only plant noted on the property that attracts: 1. species from all six families of Papilionoidea recorded in this study; 2. forest interior species; and 3. species that primarily inhabit the canopy. Concerted efforts were undertaken to propagate this plant around the authors' residence (Area A, Fig. 2). Another plant, *Calathea macrosepala* (Marantaceae), also attracts an assortment of hesperiids. Recent tree thinning (due to threats to power lines) in late 2020 allowed Bitter Vine (*Mikania micrantha*, Asteraceae) to become established along parts of the entrance road, whose short-lived but prolific blooms attract a suite of butterflies. The flowers of a fourth native plant, Black Sage (*Varronia curassavica*, Boraginaceae), were also noted to attract numerous species not observed on other flowering plants. A cultivar form of Porterweed (*Stachytarpheta*, Verbenaceae) attracts species year round and has also been propagated extensively.

Surveys were also carried out along part of a steep ridgeline above the house and an adjacent rocky crag ('Enchanted Peak'-Area F, Fig. 2) to record potentially hilltopping species (Pinheiro, 1990). Muddy areas and fresh cement (during construction of projects) were also inspected. Due to the steep topography, only a moderate proportion (0.052 km²) of the property and adjacent access were surveyed (delineated in yellow on Fig. 2). Surveyed areas include: maturing broadleaf forest, young secondary forest, gardens, and a shade coffee plantation. Another small area utilized to grow corn and beans adjacent the property was also occasionally surveyed (Area C, Fig. 2), where additional species were detected.

The majority of the specimens collected (except for Hesperiidae) (Table 1) were identified to species-level following Warren *et al.* (2017); some changes to Hesperiidae generic classification proposed in the last couple of years are not reflected in the taxonomic list. Authors and dates of butterfly species names are provided in the Appendix and are therefore not included in the main text. *Calephelis* (Riodinidae) that were identified to species-level were first photographed alive and then collected for comparison with images of that genus in Warren *et al*. (2017) and other references. Other groups of Riodinidae (*Emesis* and *Theope*) were identified with the assistance of C. Callaghan. Identification of the majority of specimens and/or photographs of Hesperiidae were made with the assistance of B. Hermier. Identification of *Narcosius* spp., *Cyclosma glamis*, *Amblyscirtes patriciae*, *Oxynetra aureopecta* (Hesperiidae) and *Emesis eleanorae* (Riodinidae) were carried out by N. Grishin and colleagues. Assistance with identification of many Theclinae was provided by R. K. Robbins. Other sources utilized to identify species include: DeVries (1987, 1997), Glassberg (2007) and Garwood & Lehman (2011, 2012, 2013). More than 98% of the species recorded were either collected and/or photographed. The remainder (e.g., *Morpho* spp., *Danaus plexippus*) were readily identified to species in flight due to easily discernible field characteristics.

RESULTS AND DISCUSSION

Over the course of 72 months, 704 species of butterflies were recorded at Emerald Valley (Table 2, Appendix, Figs. 3-11). The data demonstrate that Emerald Valley contains, on average, more than half of all species for each family recorded in Honduras. Concerted efforts for surveying hesperiids led to documenting 76 species previously unrecorded for the country and this family comprises 68% of all previously unrecorded species documented at Emerald Valley.

A total of 111 species that were previously unrecorded for the country was found, including the recently described *Emesis eleanorae*. The proximity to Santa Barbara National Park also likely influenced overall numbers, since certain species that normally inhabit montane habitats occasionally appeared at Emerald Valley. These include *Dione moneta*, *Diaethria anna*, *Marpesia zerynthia*, *Hypanartia godmani*, *H. trimaculata*, *Celastrina* (*echo*) *gozora*, and *Tegosa nigrella*.

The use of artificial lures in the forest interior, especially during crepuscular (p.m.) hours, proved to be quite effective at Emerald Valley and has revealed a whole suite of hesperiids that were previously unknown for the property and/or Honduras. Many of these species would otherwise likely have gone undetected, similar to other studies (e.g., DeVries *et al.*, 2009). This method has been consistently productive along a 50 m stretch of trail appropriately called "Skipper Pass" (Area B, Fig. 2) where the majority of the noteworthy species were detected. This method was utilized primarily during the months of June-November (most of the rainy season) and was ineffective during the months of January-May (dry season). More notable species detected utilizing this method include: four species of *Carystoides* Godman, 1901, *Bungalotis midas*, *B. astylos*, *B. erythus*, *B. milleri*, *B. quadratum*, *Dyscophellus ramon*, *Nicephellus nicephorus*, *Porphyrogenes sula*, *Cephise nuspesez*, *C. aelius*, *Calliades zeutus*, *Venada lamella*,

Table 1. Summary of specimens and photographs originating from Emerald Valley.

	Papilionidae	**Pieridae**	**Lycaenidae**	**Riodinidae**	**Nymphalidae**	**Hesperiidae**	**Totals**
Photos	58	121	192	269	573	1,631	2,844
Specimens	31	65	138	140	302	759	1,435
TOTAL	89	186	330	409	875	2,390	**4,279**

Table 2. Number of species within each family of Lepidoptera sampled at Emerald Valley and the total number of butterfly species recorded in Honduras (latter from R. Gallardo, unpublished data).

Family	**Subfamily**	**Emerald Valley**	**Country Total**	**% of country total that occu at Emerald Valley**
Papilionidae				
	Papilioninae	24	37	59
Pieridae				
	Dismorphiinae	6	9	
	Coliadinae	16	26	
	Pierinae	14	20	
Subtotal		36	55	63
Lycaenidae				
	Lycaeninae	0	1	
	Theclinae	77	181	
	Polyommatinae	4	7	
Subtotal		81	189	43
Riodinidae				
	Euselasiinae	9	14	
	Riodininae	66	141	
Subtotal		75	155	48
Nymphalidae				
	Libytheinae	1	1	
	Danainae	25	44	
	Heliconiinae	23	26	
	Limenitidinae	14	32	
	Apaturinae	4	6	
	Biblidinae	32	54	
	Cyrestinae	5	7	
	Nyphalinae	38	59	
	Charaxinae	18	39	
	Satyrinae	31	82	
Subtotal		191	350	54
Hesperiidae				
	Eudaminae	92	142	
	Pyrginae	86	137	
	Heteropterinae	1	2	

Perichares deceptus, *Synale cynaxa*, *Talides alternata*, *Vertica verticalis*, *Nascus solon*, *N. phocus*, *N. broteas* and *Anthoptus inculta*. The discovery of *Porphyrogenes peterwegei* was particularly notable as it was previously known only from northwestern Costa Rica and Belize (J. Shuey, pers. comm.).

Variations in overall butterfly numbers and composition were observed, which often coincided with changes in climate patterns (Checa *et al*., 2009). Numerous species recorded at Emerald Valley have been detected only once or twice during the entire study period. Some of these are classified as ‘vagrants’ as their typical breeding habitat lies well outside of the study area. The detection of species such as *Zerene cesonia*, *Itaballia demophile* and *Asterocampa idyja* are a few examples of ‘vagrants’. Species listed as ‘rare’ may have low reproductive rates, have limited hostplant availability, primarily occupy the canopy, and/or have population dynamics that are influenced by factors that are so far unknown.

Numerous species were recorded in light gaps (both natural and caused by anthropogenic activities) along a nearby ridgeline and inside an abandoned coffee plantation. Light gaps tend to harbor a higher diversity of species than closed-canopy sites (Hill *et al*., 2001) and a number of species otherwise would have likely gone unnoticed.

Five blooming cycles (2018-2022) of *Chromolaena odorata* were surveyed extensively which usually included examining flowering plants at half hour intervals. Notable species detected included *Neographium agesilaus*, *Charonias eurytele*, *Melete polyhymnia*, *Hesperocharis costaricensis*, *Lieinix nemesis*, *Catasticta nimbice*, *Pereute charops*, *Emesis brimo*, *Emesis eleanorae*, *Apodemia hypoglauca*, *Calicosama lilina*, *Dicya iambe*, *Chlorostrymon telea*, *Calycopis clarina*, *Strymon gabatha*, *Tmolus crolinus*, *Lycorea ilione*, *Eueides vibilia*, *Hypanartia trimaculata*, *Siproeta superba*, *Phanus ecitonorum*, *Cyclosma glamis*, *Mictris crispus*, *Aguna panama*, *A. claxon*, *Astraptes megalurus*, *A. phalaceus*, *Myscelus belti*, *M. amystis*, *Oxynetra aureopecta*, *Melanopyge erythrosticta*, *Arteurotia tractipennis*, *Nisoniades castolus*, *Anastrus tolimus*, *Ebrietas osyris*, *Telemiades choricus*, *Thracides arcalaus*, *Typhedanus ampyx*, *Onophas columbaria*, *Rhinthon molion*, *Quasimellana mexicana*, *Vacerra litana*, *V. gayra*, and *Udranomia orcinus*. Many species that occur at Emerald Valley are only observed when these plants are in bloom from mid-December to late January.

The annual blooming of *Calathea macrosepala* attracts species such as *Tisias myna* and seven species of *Calpodes* Evans, 1955. On the same plant a larva of *Calpodes fusta*, a new record for the country, was found and reared to adult. Male flowers of Papaya (*Carica papaya*) attract *Nascus phocus*, *Carystoides abrahami*, and *C. mexicana*.

Large Porterweed shrubs (*Stachytarpheta* cultivar) attract a diverse suite of Papilionidae, Pieridae and Hesperiidae, with notable species including *Parides montezuma*, *P. childrenae*, *Tithorea harmonia*, *Phocides thermus*, *Codatractus bryaxis*, *Nascus phocus*, *Pseudonascus paulliniae*, *Astraptes chiriquensis*, *A. tucuti*, *Chalypyge chalybea*, *Microceris scylla*, *Perichares adela*, *Orses cynisca*, *Carystoides lila*, *Carystoides escalantei*, *Carystoides abrahami*, *Carystoides floresi*, *Neoxeniades luda*, *Mielkeus tertianus*, *Anatrytone potosiensis*, *Orthos lycortas*, and *O. gabina*.

Notable species recorded on *Mikania micrantha* include *Brangas carthaea*, *Evenus regalis*, *Arcas cypria*, *Denivia lisus*, *D. hemon*, *Ipidecla schausi*, *Kolana ligurina*, *Panthiades ochus*, *Parrhasius polibetes*, *Rhetus arcius*, *Chimastrum argentea*, *Emesis vulpina*, *E. eleanorae*, *Adelpha paraena*, *Doxocopa pavon*, and *D. laurentia*. The documenting of a male *Ipidecla* was significant as it constituted only the second site record for this species in Honduras.

Notable species detected on *Varronia curassavica* include *Thaeides theia*, *Ocaria thales*, *Lathecla latagus*, *Camissecla vespasianus*, *Ziegleria hoffmani*, *Strephonota ericeta*, *Oenomaus ortygnus*, *Michaelus jebus*, *Erora gabina*, *Chalodeta chaonitis*, *Mesene croceella*, *Symmachia accusatrix*, *S. probetor*, *Sarota chrysus*, and *Anteros roratus*.

The use of canopy traps with a fermented banana mixture allowed for the capture of species such as *Fountainea eurypyle*, *Memphis moruus*, *M. oenomais*, *M. mora*, *Archaeoprepona demophon*, *A. demophoon*, *Prepona laertes*, *P. pylene*, and *Morpho theseus*.

Surveys on Enchanted Peak and the adjacent ridge revealed species that have never been detected along the valley floor. Some of these species may well represent individuals that exhibited

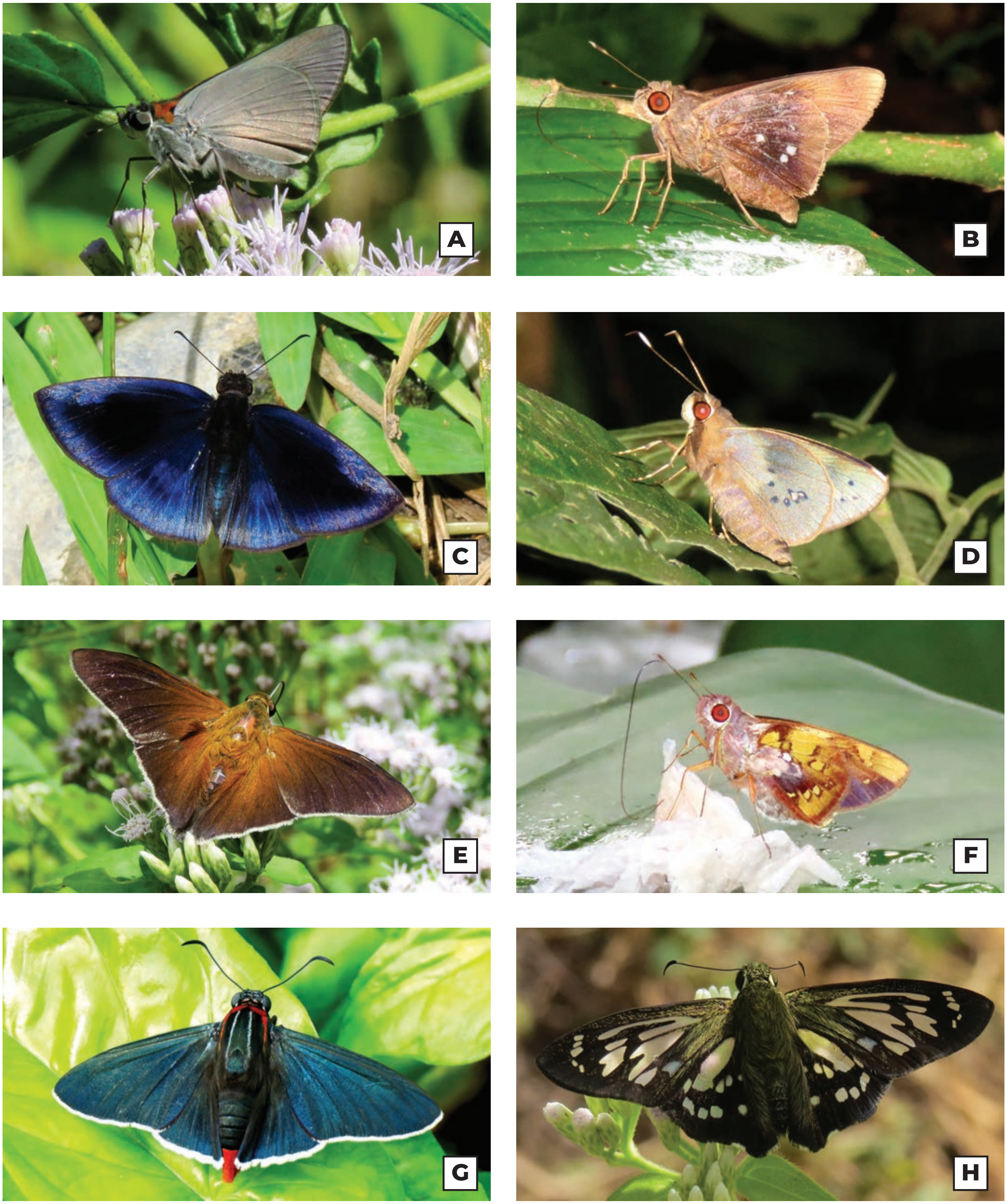

Figure 3. Examples of Hesperiidae recorded at Emerald Valley, Honduras. A. *Cyclosma glamis*. B. *Tisias myna*. C. *Anastrus meliboea*. D. *Carystoides abrahami*. E. *Porphyrogenes peterwegei*. F. *Thracides arcalaus*. G. *Microceris scylla*. H. *Phanus confusis*. A, E, and H feeding on *Chromolaena odorata*.

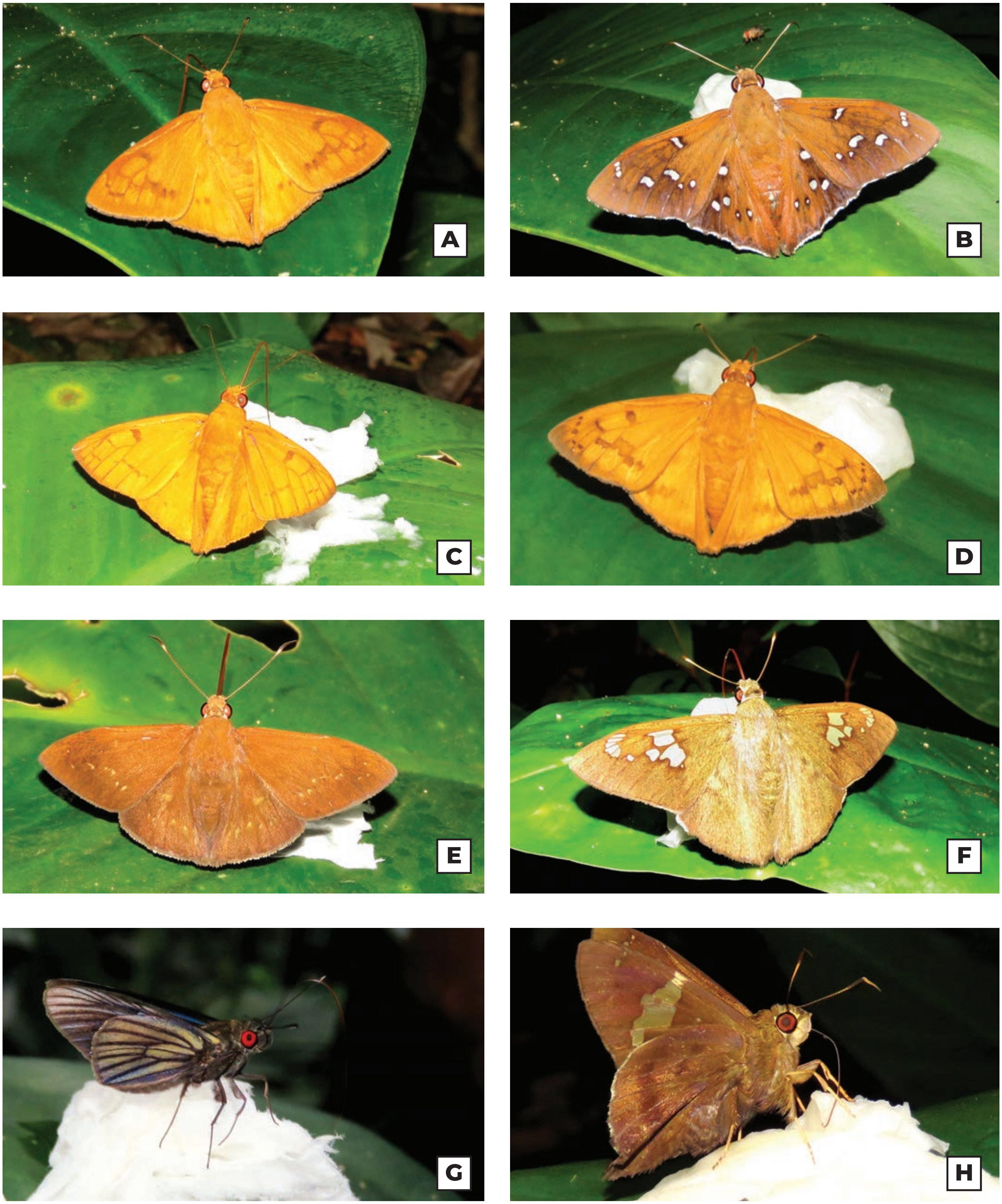

Figure 4. Examples of Hesperiidae attracted to paper lures at Skipper Pass recorded at Emerald Valley, Honduras. A. *Bungalotis astylos*. B. *B. erythus*. C. *B. midas*. D. *B. quadratum*. E. *Nicephellus nicephorus*. F. *Nascus broteas*. G. *Synale cynaxa*. H. *Cephise nuspesez*.

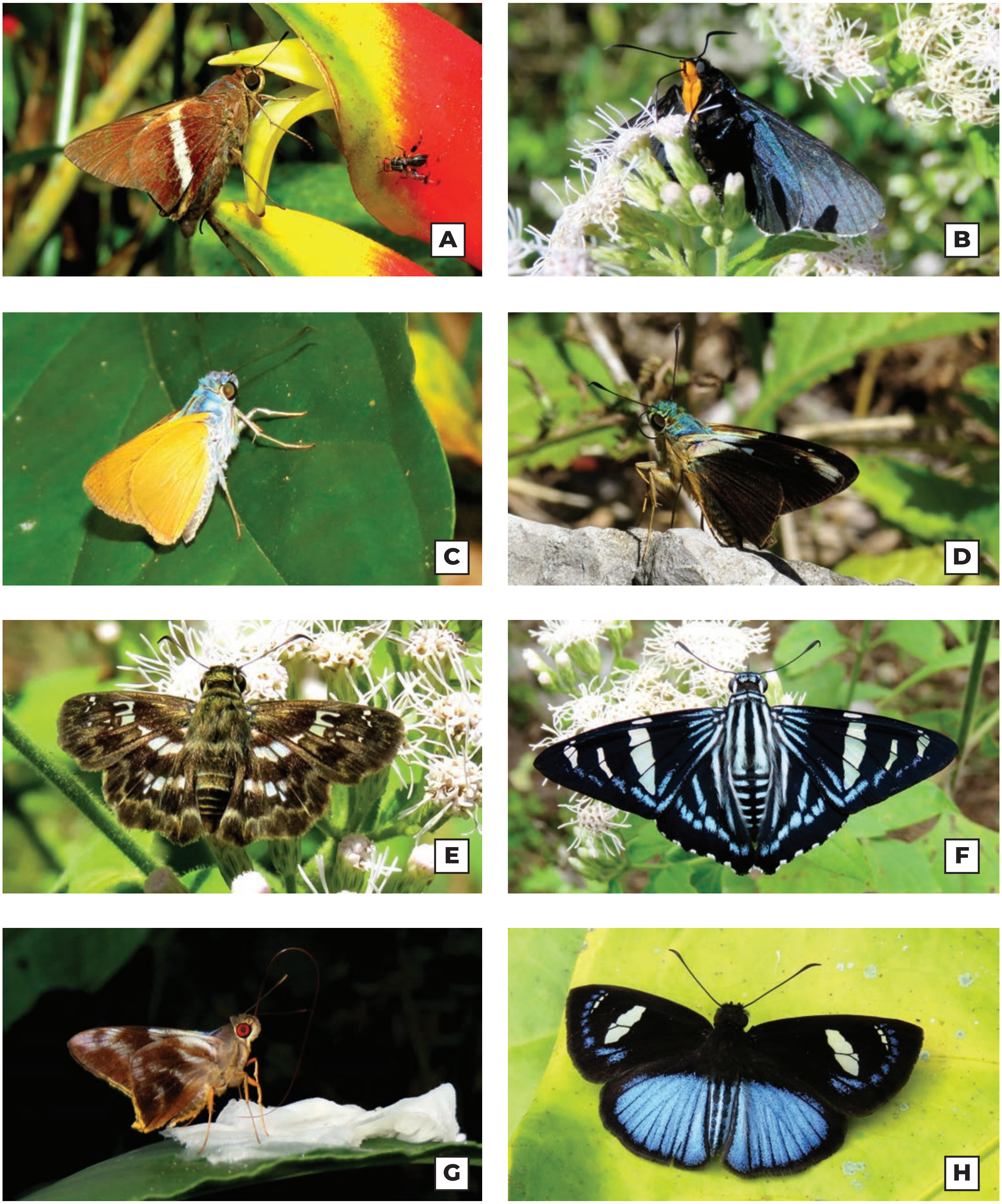

Figure 5. Examples of Hesperiidae recorded at Emerald Valley, Honduras. A. *Xeniades chalestra*. B. *Oxynetra aureopecta*. C. *Onophas columbaria*. D. *Rhinthon molion*. E. *Udranomia orcinus*. F. *Phocides thermus*. G. *Perichares deceptus*. H. *Pythonides jovianus*. B, E, and F feeding on *Chromolaena odorata*.

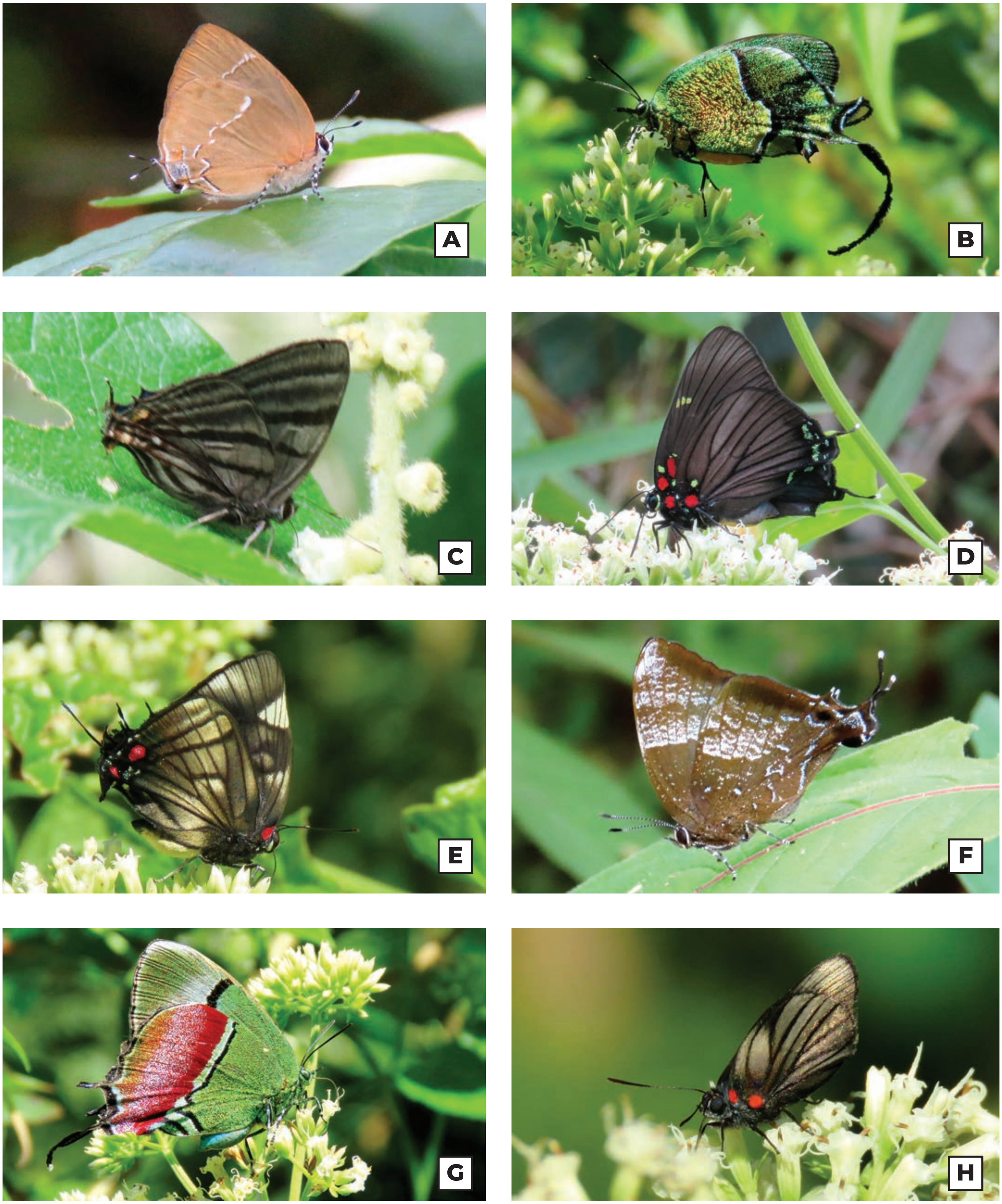

Figure 6. Examples of Lycaenidae recorded at Emerald Valley, Honduras. A. *Theclopsis leos*. B. *Arcas cypria*. C. *Thaeides theia* (feeding on *Varronia curassavica*). D. *Brangas carthaea*. E. *Panthiades ochus*. F. *Brevianta busa*. G. *Evenus regalis*. H. *Ipidecla schausi*. B, D, E, G, and H feeding on *Mikania micrantha*.

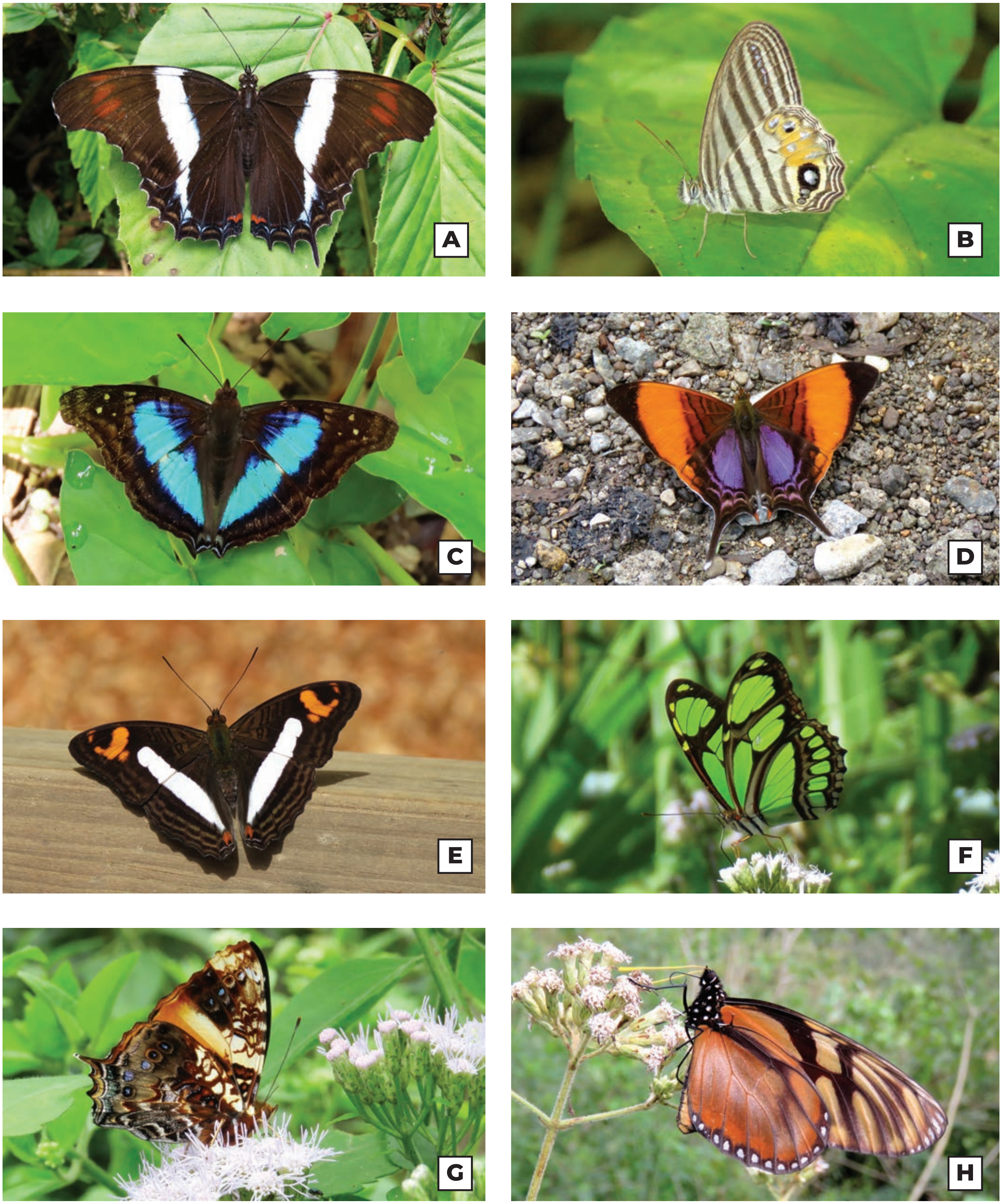

Figure 7. Examples of Nymphalidae recorded at Emerald Valley, Honduras. A. *Siproeta superba*. B. *Splendeuptychia salvini*. C. *Doxocopa laurentia*. D. *Marpesia corita*. E. *Adelpha barnesia*. F. *Philaethria diatonica*. G. *Hypanartia godmani*. H. *Lycorea ilione*. F, G, and H feeding on *Chromolaena odorata*.

Figure 8. Examples of Papilionidae recorded at Emerald Valley, Honduras. A. *Neographium agesilaus* (feeding on *Chromolaena odorata*). B. *N. thyastes*. C. *Protesilaus macrosilaus*. D. *Mimoides phaon*. E. *Pterourus victorinus*. F. *Papilio polyxenes*. G. *Parides montezuma*. H. *Heraclides anchisiades*.

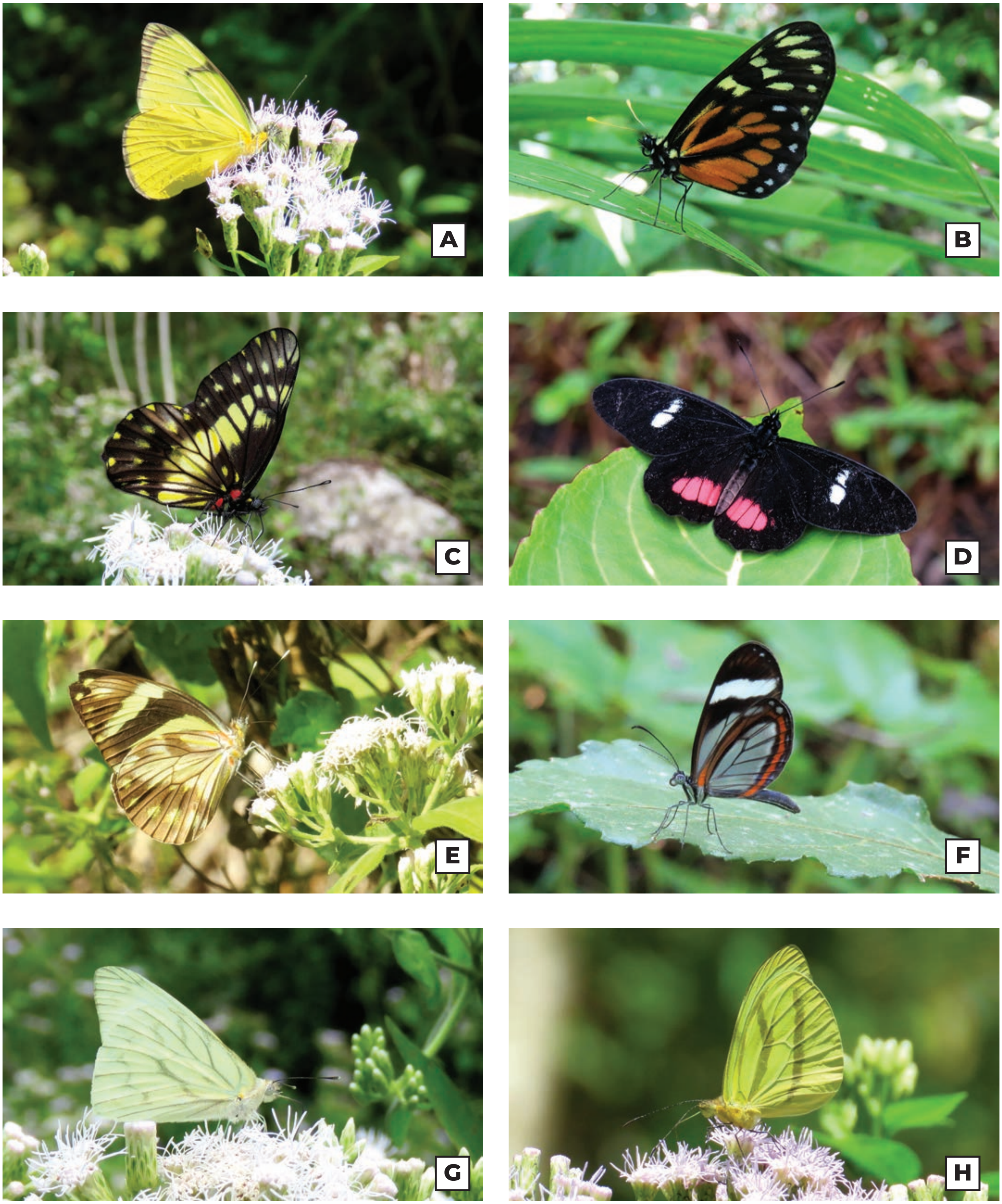

Figure 9. Examples of Pieridae recorded at Emerald Valley, Honduras. A. *Melete polyhymnia*. B. *Charonias eurytele*. C. *Catasticta nimbice*. D. *Archonias brassolis*. E. *Pieriballia viardi*. F. *Dismorphia theucharila*. G. *Hesperocharis costaricensis*. H. *Enantia lina*. A, C, E, G, and H feeding on *Chromolaena odorata*.

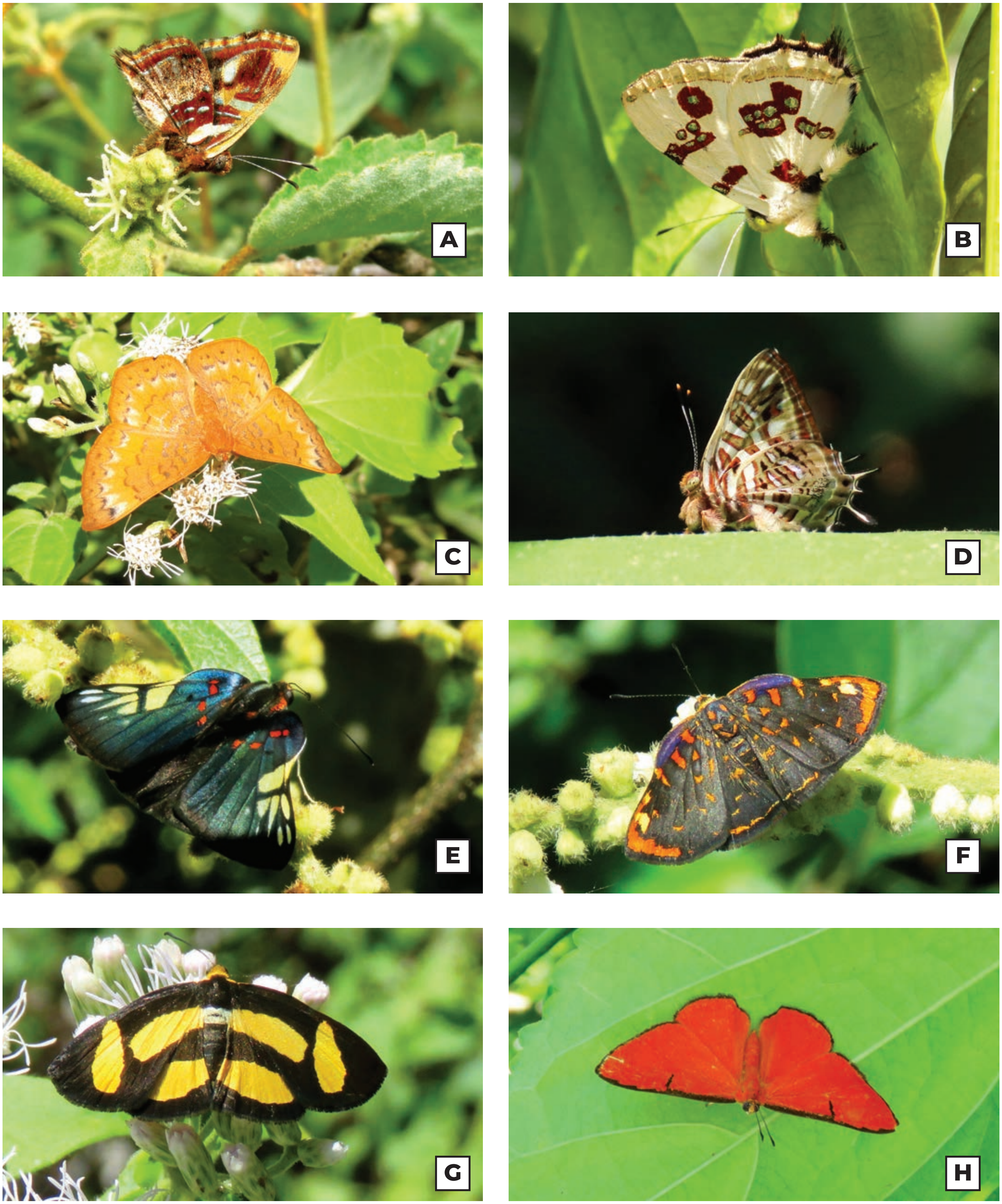

Figure 10. Examples of Riodinidae recorded at Emerald Valley, Honduras. A. *Anteros carausius*. B. *A. micon*. C. *Emesis eleanorae*. D. *Sarota chrysus*. E. *Symmachia accusatrix*. F. *S. probetor*. G. *S. tricolor*. H. *Mesene phareus*. C and G feeding on *Chromolaena odorata*. E and F feeding on *Varronia curassavica*.

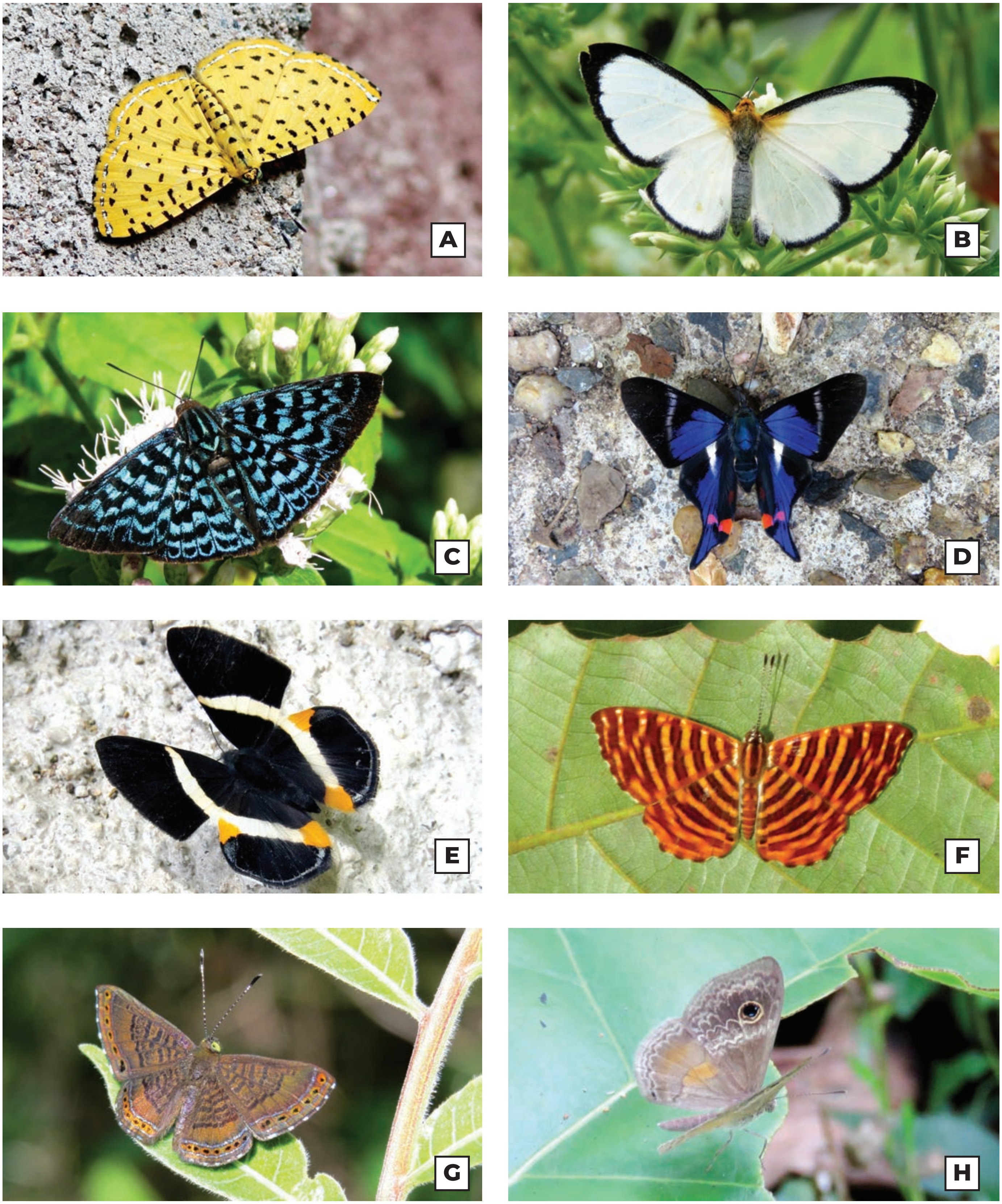

Figure 11. Examples of Riodinidae recorded at Emerald Valley, Honduras. A. *Argyrogrammana stilbe*. B. *Chimastrum argentea* (feeding on *Mikania micrantha*). C. *Menander pretus* (feeding on *Chromolaena odorata*). D. *Rhetus periander*. E. *Notheme erota*. F. *Hyphilaria thasus*. G. *Detritivora barnesi*. H. *Perophthalma tullius*.

hilltopping behavior (Pinheiro, 1990), especially members within Papilionidae. Notable species include *Neographium epidaus*, *N. philolaus*, *Heraclides pallas*, *H. astyalus*, *Adelpha godmani*, *Cyllopsis hedemanni*, *Epiphile iblis*, *Heliconius hortense Oxeoschistus tauropolis Asterocampa idyja*, *Emesis aurimna*, *Euselasia aurantiaca*, *Hades noctula*, *Symmachia rubina*, *Arcas imperialis*, *Electrostrymon denarius*, *Gindanes brontinus*, *Mnasitheus chrysophrys*, *Zera host*, *Parphorus decora* and *Chalybs cecina*.

Notable species detected at the cement slabs and mud puddles include *Protesilaus macrosilaus*, *Neographium thyastes*, *Notheme erota*, *Lasaia sessilis*, *Callicore texa*, *Chlosyne rosita*, *Tegosa nigrella*, *Fountainea glycerium*, *Memphis arginussa*, *Zaretis ellops*, *Anastrus meliboea*, *Codatractus hyster*, *Ocyba calathana*, *Mylon pelopidas*, *Theagenes aegides*, and *Thespieus aspernatus*.

Regional or local endemism in Papilionoidea has only begun to be assessed, but the discovery of two recently described taxa, *Jonaspyge elizabethae* (Hesperiidae) from the southwestern highlands, and *Emesis eleanorae* from Emerald Valley, suggest at least some level of endemism.

The butterfly survey at Emerald Valley has yielded significant contributions to the most recent list compiled for the country (Miller *et al.*, 2012). The results from this study demonstrate the importance of conserving premontane forests, which is one of the most threatened ecosystems in the country. This ongoing inventory represents the first survey of its kind in Honduras and will no doubt serve as an important baseline for future studies. The presence of numerous new records in Honduras demonstrate how much there is yet to learn about local and regional butterfly distribution. One *Oxynetra aureopecta* female was encountered on the inside of a garage door, and another was found feeding on *Chromolaena odorata*; this species was previously known only from males in two states in Mexico (Warren & Grishin 2017). *Tisias myna* was previously known only from Costa Rica and Panama (Warren *et al.*, 2017), but occurs as a fairly common species at Emerald Valley where it has been observed feeding at flowers and is attracted to paper lures. *Carystoides abrahami* was previously known from Mexico (Glassberg, 2017) and is commonly recorded at paper lures. *Cyclosma glamis* is known only from a few historical records in Panama (Grishin, pers. comm.) then reappears in Peru (Warren *et al*., 2017), but is frequently observed at Emerald Valley on *Chromolaena odorata* flowers and occasionally on paper lures. In Central America, *Splendeuptychia salvini* was previously known from a handful of specimens from Panama, but occurs regularly at Emerald Valley. *Emesis brimo* was previously known to occur from Panama to Colombia (Warren *et al.*, 2017), but one male was photographed on 31 December 2017 while feeding on *Chromolaena odorata*.

Residing at Emerald Valley has permitted permanent and unhindered access to the surrounding forest, which has been invaluable in gathering long term data and detecting many species that would likely go unnoticed during shorter survey periods. Intensive surveys such as this are costly and not common in the Neotropics, and researchers thus often utilize various statistical analyses and models to predict species richness (Beccaloni & Gaston, 1995; Robbins *et al.*, 1996; Nally & Fleishman, 2004). In general, these models may help in predicting overall numbers, but they do not predict species composition and tend to be weak at predicting numbers of rarer species (Thomsan *et al.*, 2007). In the case of countries like Honduras, where very few studies have been undertaken, on-the-ground surveys are an utmost necessity. Many species continue to be documented at Emerald Valley, and across much of Honduras, which have not yet been detected in neighboring Nicaragua, attributing to the relevance of this study.

Intensive field studies allow for the opportunity to detect previously undescribed, and especially cryptic, species that have very low reproductive rates, occupy small niches, or have very limited range distributions. This is apparently the case for the recently described *Emesis eleanorae* which has been recorded seven times at Emerald Valley and is known only from that locality. At Emerald Valley, 123 species (17% of survey total) have been detected only once and an additional 64 species (9% of survey total) were detected only twice.

Very few in-depth biodiversity studies have been undertaken in Honduras at sites that harbor premontane forests. However, high species richness in reptiles and amphibians has been documented at a site in northern Honduras that does harbor premontane forest, which reinforces the importance of protecting this threatened ecosystem (Townsend *et al.*, 2012). It is hoped that the Papilionoidea survey at Emerald Valley will stimulate further biodiversity studies at other sites containing this threatened forest type.

Acting upon some of the more significant finds at Emerald Valley, the Pro Nature Honduras Foundation (www.prohn.org) is currently soliciting the placement of *E. eleanorae* on the IUCN Red List. This will be followed up by requesting a formal classification of Emerald Valley as an official Alliance for Zero Extinction (AZE) site. It is hoped that achieving this status and classification will allow Pro-HN to have the opportunity to apply for grants in order to acquire additional acreage of adjacent rainforest, thereby safeguarding critical habitat for the long term. In the interim, Gallardo and Diaz continue to survey Papilionoidea across the country to facilitate publication of a photographic guide to butterfly fauna of Honduras.

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Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras.

Key to frequency estimates:
A-Abundant. Species that often undergo explosive "hatches" and great numbers can be observed for a brief period of time; e.g. *Eunica monima*.
C-Common. Numerous individuals observed daily; e.g. *Anartia fatima*.
FC-Fairly Common. Observed only once or twice a week; e.g. *Mechanitis lysimnia*.
U-Uncommon. Observed infrequently, only once a month; e.g. *Melinaea lilis*.
R-Rare. Observed only once a year or less; e.g. *Notheme erota*.
V-Vagrant. Does not occur regularly at Emerald Valley; e.g. *Itaballia demophile*.

* denotes a species previously unrecorded for Honduras based on Miller *et al.* (2012) or based on conversations with curators at the USNM and FLMNH regarding specimens housed in those collections.

Papilionidae
Papilioninae
Protesilaus macrosilaus (Gray, [1853]) R
Neographium epidaus (Doubleday, 1846) U
Neographium agesilaus (Guérin-Méneville & Percheron, 1835) V
Neographium philolaus (Boisduval, 1836) V
Neographium thyastes (Drury 1782) V
Mimoides phaon (Boisduval, 1836) FC
Mimoides ilus (Fabricius, 1793) FC
Battus polydamas (Linnaeus, 1758) C
Battus laodamas (Felder & Felder, 1859) R
Battus ingenuus (Dyar, 1907) U
Parides montezuma (Westwood, 1842) V
Parides photinus (Doubleday, 1844) U-FC
Parides eurimedes (Stoll, 1782) FC
Parides childrenae (Gray, 1832) R
Parides panares (Gray, [1853]) FC
Parides iphidamas (Fabricius, 1793) C
Parides erithalion (Boisduval, 1836) C
Heraclides anchisiades (Esper, 1788) FC
Heraclides androgeus (Cramer, 1775) R
Heraclides pallas (Gray, [1853]) V
Heraclides thoas (Linnaeus, 1771) C
Heraclides rumiko Shiraiwa & Grishin, 2014 FC
Pterourus victorinus (Doubleday, 1844) U
Papilio polyxenes Fabricius, 1775 C

Pieridae
Dismorphiinae
Lieinix nemesis (Latreille, [1813]) V
Dismorphia amphione (Cramer, 1779) U-FC
Dismorphia theucharila (Doubleday, 1848) U-FC
Enantia lina (Herbst, 1792) U-FC
Enantia albania (Bates, 1864) U
Enantia jethys (Boisduval, 1836) U-FC

Coliadinae
Eurema daira (Godart, 1819) C
Eurema albula (Cramer, 1775) C
Eurema salome (Felder & Felder, 1861) FC
Eurema mexicana (Boisduval, 1836) C
Pyrisitia proterpia (Fabricius, 1775) C
Pyrisitia dina (Poey, 1832) C
Pyrisitia nise (Cramer, 1775) FC
Pyrisitia lisa (Boisduval & Le Conte, [1830]) C
Zerene cesonia (Stoll, 1790) V
Anteos maerula (Fabricius, 1775) FC
Anteos clorinde (Godart, [1824]) FC
Phoebis sennae (Linnaeus, 1758) FC-U
Phoebis philea (Linnaeus, 1763) FC-U
Phoebis neocypris (Hübner, [1823]) FC-U
Phoebis argante (Fabricius, 1775) C

Pierinae
Hesperocharis costaricensis Bates, 1866 * R
Ascia monuste (Linnaeus, 1764) C
Ganyra josephina (Godart, 1819) V
Leptophobia aripa (Boisduval, 1836) C
Itaballia demophile (Linnaeus, 1763) V
Itaballia pandosia (Hewitson, 1853) V
Pieriballia viardi (Boisduval, 1836) FC
Charonias eurytele (Hewitson, [1853]) * U
Archonias brassolis (Fabricius, 1776) C
Catasticta nimbice (Boisduval, 1836) U
Melete lycimnia (Cramer, 1777) U
Melete polyhymnia (Felder & Felder, 1865) * R
Pereute charops (Boisduval, 1836) R
Glutophrissa drusilla (Cramer, 1777) C

Lycaenidae
Theclinae
Brangas carthaea (Hewitson, 1868) R
Thaeides theia (Hewitson, 1870) * R
Evenus regalis (Cramer, 1775) R
Arcas imperialis (Cramer, 1775) U
Arcas cypria (Geyer, 1837) R
Pseudolycaena damo (Druce, 1875) FC
Denivia mavors (Hübner, 1818) FC
Denivia theocritus (Fabricius, 1793) FC
Denivia hemon (Cramer, 1775) U
Denivia lisus (Stoll, 1790) FC
Brevianta busa (Godman & Salvin, 1887) R
Ipidecla schausi (Godman & Salvin, 1887) R
Rekoa meton (Cramer, 1779) FC-C
Rekoa palegon (Cramer, 1780) FC-U
Rekoa zebina (Hewitson, 1869) R
Rekoa marius (Lucas, 1857) U
Arawacus togarna (Hewitson, 1867) C
Arawacus sito (Boisduval, 1836) U
Contrafacia imma (Prittwitz, 1865) U
Kolana ligurina (Hewitson, 1874) U
Ocaria ocrisia (Hewitson, 1868) U
Ocaria thales (Fabricius, 1793) R
Chlorostrymon simaethis (Drury, 1773) U
Chlorostrymon telea (Hewitson, 1868) R
Cyanophrys goodsoni (Clench, 1946) U
Cyanophrys amyntor (Cramer, 1775) U
Cyanophrys fusius (Godman & Salvin, 1887) U
Cyanophrys herodotus (Fabricius, 1793) U
Lathecla latagus (Godman & Salvin, 1887) * R
Allosmaitia strophius (Godart, [1824]) R
Laothus barajo (Reakirt, [1867]) FC
Lamprospilus collucia (Hewitson, 1877) U
Camissecla vespasianus (Butler & Druce, 1872) R
Electrostrymon denarius (Butler & Druce, 1872) U

Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras, continued.

Ziegleria hoffmani Johnson, 1993 U
Ziegleria ceromia (Hewitson, 1877) U
Kisutam syllis (Godman & Salvin, 1887) U
Calycopis calus (Godart, [1824]) R
Calycopis clarina (Hewitson, 1874) R
Calycopis isobeon (Butler & Druce, 1872) FC
Calycopis drusilla Field, 1967 FC
Calycopis trebula (Hewitson, 1868) FC-C
Calycopis sp. U
Strymon melinus (Hübner, [1813]) U
Strymon albata (Felder & Felder, 1865) U
Strymon yojoa (Reakirt, [1867]) C
Strymon mulucha (Hewitson, 1867) * U
Strymon bazochii (Godart, [1824]) R
Strymon istapa (Reakirt, [1867]) * U
Strymon gabatha (Hewitson, 1870) * R
Strymon ziba (Hewitson, 1868) FC
Tmolus crolinus Butler & Druce, 1872 R
Tmolus echion (Linnaeus, 1767) U
Ministrymon clytie (Edwards, 1877) U
Ministrymon arola (Hewitson, 1868) U
Ministrymon azia (Hewitson, 1873) R
Theclopsis leos (Schaus, 1913) U
Theclopsis mycon (Godman & Salvin, 1887) FC
Ostrinotes halciones (Butler & Druce, 1872) R
Ostrinotes keila (Hewitson, 1869) R
Strephonota tephraeus (Geyer, 1837) U
Strephonota ambrax (Westwood, 1852) * U
Strephonota ericeta (Hewitson, 1867) U-FC
Panthiades bitias (Cramer, 1777) FC-C
Panthiades ochus (Godman & Salvin, 1887) * FC
Panthiades bathildis (Felder & Felder, 1865) C
Oenomaus ortygnus (Cramer, 1779) U
Parrhasius polibetes (Stoll, 1781) U
Michaelus phoenissa (Hewitson, 1867) * R
Michaelus jebus (Godart, [1824]) * R
Ignata caldas Robbins, 2010 * R
Dicya iambe (Godman & Salvin, 1887) * R
Erora gabina (Godman & Salvin, 1887) R
Chalybs cecina (Cramer, 1779) C
Chalybs hassan (Stoll, 1790) U-R

Polyommatinae
Celastrina echo gozora (Edwards, 1864) R
Leptotes cassius (Cramer, 1775) FC
Cupido comyntas (Godart, [1824]) C
Hemiargus ceraunus (Fabricius, 1793) FC

Riodinidae
Euselasiinae
Euselasia sergia (Godman & Salvin, 1885) * R
Euselasia mystica (Schaus, 1913) FC
Euselasia procula (Godman & Salvin, 1885) * R
Euselasia amphidecta (Godman & Salvin, 1878) R
Euselasia hieronymi (Salvin & Godman, 1868) FC-C
Euselasia pusilla (Felder, 1869) R
Euselasia eubule (Felder, 1869) U
Euselasia aurantiaca (Salvin & Godman, 1868) C
Hades noctula Westwood, 1851 C

Riodininae
Mesosemia lamachus Hewitson, 1857 FC
Leucochimona lagora (Herrich-Schäffer, [1853]) C
Perophthalma lasus Westwood, 1851 U
Perophthalma tullius (Fabricius, 1787) C
Hyphilaria thasus (Stoll, 1780) U
Napaea eucharila (Bates, 1867) U
Voltinia umbra (Boisduval, 1870) C-FC
Eurybia lycisca Westwood, 1851 C
Eurybia elvina Stichel, 1910 C
Ancyluris jurgensenii (Saunders, 1850) R
Ancyluris inca (Saunders, 1850) C
Rhetus arcius (Linnaeus, 1763) R
Rhetus periander (Cramer, 1777) C
Notheme erota (Cramer, 1780) R
Chalodeta chaonitis (Hewitson, 1866) R
Cariomothis poeciloptera (Godman & Salvin, 1878) * R
Detritivora barnesi (Hall & Harvey, 2001) C
Calephelis mexicana McAlpine, 1971 FC
Calephelis sixola McAlpine, 1971 U
Calephelis fulmen Stichel, 1910 U
Calephelis wellingi McAlpine, 1971 FC
Calephelis browni McAlpine, 1971 FC
Calephelis velutina (Godman & Salvin, 1878) C
Lasaia sula Staudinger, 1888 R
Lasaia agesilas (Latreille, [1809]) C
Lasaia sessilis Schaus, 1890 * FC
Melanis pixe (Boisduval, 1836) U
Mesene croceella Bates, 1865 R
Mesene phareus (Cramer, 1777) U
Mesene margaretta (White, 1843) R
Chimastrum argentea (Bates, 1866) FC
Symmachia probetor (Stoll, 1782) U-R
Symmachia rubina Bates, 1866 U
Symmachia accusatrix Westwood, 1851 U
Symmachia tricolor Hewitson, 1867 U
Sarota chrysus (Stoll, 1781) R
Anteros roratus Godman & Salvin, 1886 R*
Anteros micon Druce, 1875 FC
Anteros carausius Westwood, 1851 U
Emesis aurimna (Boisduval, 1870) U
Emesis furor Butler & Druce, 1872 R
Emesis tegula Godman & Salvin, 1886 FC
Emesis vulpina Godman & Salvin, 1886 U
Emesis tenedia Felder & Felder, 1861 U
Emesis lupina Godman & Salvin, 1886 U
Emesis tristis Stichel, 1929 FC
Emesis ocypore (Geyer, 1837) FC
Emesis brimo Godman & Salvin, 1889 * R
Emesis eleanorae Gallardo & Grishin, 2021 * U
Pachythone gigas Godman & Salvin, 1878 R
Argyrogrammana stilbe (Godart, [1824]) * C
Apodemia hypoglauca (Godman & Salvin, 1878) R
Thisbe irenea (Stoll, 1780) R
Thisbe lycorias (Hewitson, [1853]) R
Juditha caucana (Stichel, 1911) C
Synargis mycone (Hewitson, 1865) U
Synargis nymphidioides (Butler, 1872) U
Menander menander (Stoll, 1780) U
Menander pretus (Cramer, 1777) FC
Calospila cilissa (Hewitson, 1863) U
Hypophylla sudias (Hewitson, [1858]) U
Calicosama lilina (Butler, 1870) R
Theope pedias Herrich-Schäffer, [1853] U
Theope devriesi Hall & Willmott, 1996 U
Theope virgilius (Fabricius, 1793) U
Theope bacenis Schaus, 1890 * U

Nymphalidae
Libytheinae
Libytheana carinenta (Cramer, 1777) R

Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras, continued.

Danainae
Lycorea halia (Hübner, 1816) C
Lycorea ilione (Cramer, 1775) R
Danaus eresimus (Cramer, 1777) R
Danaus gilippus (Cramer, 1775) C
Danaus plexippus (Linnaeus, 1758) C
Tithorea harmonia (Cramer, 1777) V
Tithorea tarricina Hewitson, [1858] V
Melinaea lilis (Doubleday, 1847) FC
Mechanitis lysimnia (Fabricius, 1793) FC
Mechanitis menapis Hewitson, [1856] R
Mechanitis polymnia (Linnaeus, 1758) C
Napeogenes tolosa (Hewitson, 1855) U
Hypothyris euclea (Godart, 1819) U
Hypothyris lycaste (Fabricius, 1793) U
Ithomia patilla Hewitson, 1852 C
Hyposcada virginiana (Hewitson, [1855]) C
Oleria paula (Weymer, 1883) U
Ceratinia tutia (Hewitson, 1852) R
Dircenna dero (Hübner, 1823) C
Dircenna klugii (Geyer, 1837) FC
Episcada salvinia (Bates, 1864) U
Pteronymia alcmena (Godman & Salvin, 1877) U
Pteronymia cotytto (Guérin-Méneville, [1844]) U
Godyris nero (Hewitson, [1855]) FC
Greta morgane (Geyer, 1837) oto C

Heliconiinae
Altinote ozomene (Godart, 1819) FC
Actinote anteas (Doubleday, [1847]) C
Actinote guatemalena (Bates, 1864) C
Agraulis vanillae (Linnaeus, 1758) FC
Dione moneta Hübner, [1825] V
Dione juno (Cramer, 1779) FC
Dryadula phaetusa (Linnaeus, 1758) FC
Dryas iulia (Fabricius, 1775) C
Philaethria diatonica (Fruhstorfer, 1912) U
Eueides aliphera (Godart, 1819) U-FC
Eueides isabella (Stoll, 1781) C
Eueides lineata Salvin & Godman, 1868 R
Eueides procula Doubleday, [1847] FC-C
Eueides vibilia (Godart, 1819) R
Heliconius charithonia (Linnaeus, 1767) C
Heliconius doris (Linnaeus, 1771) U
Heliconius erato (Linnaeus, 1758) C
Heliconius hecale (Fabricius, 1776) C
Heliconius hecalesia (Hewitson, [1854]) FC
Heliconius hortense (Guérin-Méneville, [1844]) V
Heliconius ismenius Latreille, [1817] C
Heliconius sara (Fabricius, 1793) U
Euptoieta hegesia (Cramer, 1779) C

Limenitidinae
Adelpha paraena (Bates, 1865) R
Adelpha serpa (Boisduval, 1836) U
Adelpha godmani Fruhstorfer, 1913 * U
Adelpha barnesia Schaus, 1902 R
Adelpha boeotia (Felder & Felder, 1867) FC
Adelpha cocala (Cramer, 1779) C
Adelpha delinita Fruhstorfer, 1913 U
Adelpha heraclea (C. Felder & R. Felder, 1867) * U
Adelpha iphicleola (Bates, 1864) FC
Adelpha iphiclus (Linnaeus, 1758) FC
Adelpha leuceria (Druce, 1874) U
Adelpha melanthe (Bates, 1864) C
Adelpha phylaca (Bates, 1866) FC
Adelpha salus Hall, 1935 * R

Apaturinae
Asterocampa idyja (Geyer, [1828]) R
Doxocopa laurentia (Godart, [1824]) R
Doxocopa laure (Drury, 1773) U
Doxocopa pavon (Latreille, [1809]) U

Biblidinae
Biblis hyperia (Cramer, 1779) C
Mestra amymone (Ménétriés, 1857) FC
Catonephele mexicana Jenkins & Maza, 1985 U
Catonephele numilia (Cramer, 1775) C
Eunica alpais (Godart, [1824]) R
Eunica alcmena (Doubleday, [1847]) R
Eunica monima (Stoll, 1782) A
Myscelia cyaniris Doubleday, [1848] R
Myscelia ethusa (Doyère, [1840]) U-R
Nessaea aglaura (Doubleday, [1848]) FC
Hamadryas amphinome (Linnaeus, 1767) FC
Hamadryas februa (Hübner, [1823]) FC
Hamadryas feronia (Linnaeus, 1758) C
Hamadryas fornax (Hübner, [1823]) U
Hamadryas iphthime (Bates, 1864) C
Hamadryas laodamia (Cramer, 1777) FC-U
Epiphile adrasta Hewitson, 1861 U-FC
Epiphile iblis Felder & Felder, 1861 * R
Nica flavilla (Godart, [1824]) C
Pyrrhogyra edocla (Doubleday, [1848]) U
Pyrrhogyra otolais Bates, 1864 C
Pyrrhogyra neaerea (Linnaeus, 1758) R
Temenis laothoe (Cramer, 1777) C
Dynamine artemisia (Fabricius, 1793) FC
Dynamine dyonis Geyer, 1837 U
Dynamine postverta (Cramer, 1779) C
Dynamine theseus (Felder & Felder, 1861) C
Callicore texa (Hewitson, [1855]) FC-U
Callicore lyca (Doubleday, [1847]) R
Catagramma tolima Hewitson, 1852 C
Diaethria anna (Guérin-Méneville, [1844]) V
Diaethria astala (Guérin-Méneville, [1844]) FC

Cyrestinae
Marpesia berania (Hewitson, 1852) C
Marpesia chiron (Fabricius, 1775) C
Marpesia corita (Westwood, 1850) U
Marpesia petreus (Cramer, 1776) C
Marpesia zerynthia Hübner, [1823] V

Nymphalinae
Historis acheronta (Fabricius, 1775) U-FC
Historis odius (Fabricius, 1775) C
Colobura dirce (Linnaeus, 1758) C
Tigridia acesta (Linnaeus, 1758) FC
Smyrna blomfildia (Fabricius, 1781) C
Smyrna karwinskii Geyer, [1833] U
Hypanartia godmanii (Bates, 1864) V
Hypanartia lethe (Fabricius, 1793) C
Hypanartia trimaculata Willmott, Hall & Lamas, 2001 * V
Vanessa virginiensis (Drury, 1773) R
Anartia fatima (Fabricius, 1793) C
Anartia jatrophae (Linnaeus, 1763) C
Siproeta epaphus (Latreille, [1813]) FC-C
Siproeta stelenes (Linnaeus, 1758) C
Siproeta superba (Bates, 1864) U
Junonia evarete (Cramer, 1779) U

Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras, continued.

Chlosyne gaudialis (Bates, 1864) U
Chlosyne janais (Drury, 1782) C
Chlosyne erodyle (Bates, 1864) FC-C
Chlosyne melanarge (Bates, 1864) R
Chlosyne hippodrome (Geyer, 1837) U
Chlosyne rosita Hall, 1924 R
Chlosyne theona (Ménétriés, 1855) FC
Chlosyne lacinia (Geyer, 1837) C
Anthanassa ardys (Hewitson, 1864) U
Anthanassa subota (Godman & Salvin, 1878) * U-FC
Anthanassa argentea (Godman & Salvin, 1882) V
Anthanassa drusilla (C. Felder & R. Felder, 1861) FC
Anthanassa tulcis (Bates, 1864) C
Anthanassa ptolyca (Bates, 1864) U
Castilia eranites (Hewitson, 1857) * R
Castilia griseobasalis (Röber, 1913) U
Castilia ofella (Hewitson, [1864]) * FC-C
Eresia clio (Linnaeus, 1758) FC
Eresia phillyra Hewitson, 1852 C
Tegosa anieta (Hewitson, 1864) C
Tegosa guatemalena (Bates, 1864) U
Tegosa nigrella (Bates, 1866) V

Charaxinae
Consul electra (Westwood, 1850) C
Consul fabius (Cramer, 1776) FC-C
Siderone galanthis (Cramer, 1775) U-FC
Zaretis callidryas (R. Felder, 1869) C
Zaretis ellops (Ménétriés, 1855) R
Fountainea eurypyle (Felder & Felder, 1862) U
Fountainea glycerium (Doubleday, [1849]) * R
Memphis arginussa (Geyer, 1832) FC
Memphis aureola (Bates, 1866) R
Memphis mora (Druce, 1874) U
Memphis moruus (Fabricius, 1775) U
Memphis oenomais (Boisduval, 1870) FC
Memphis philumena (Doubleday, [1849]) U
Archaeoprepona amphimachus (Fabricius, 1775) C
Archaeoprepona demophon (Linnaeus, 1758) C
Archaeoprepona demophoon (Hübner, [1814]) U
Prepona laertes (Hübner, [1811]) U
Prepona pylene Hewitson, [1854] U-FC

Satyrinae
Morpho helenor (Cramer, 1776) C
Morpho polyphemus Westwood, [1850] U
Morpho theseus Deyrolle, 1860 FC-C
Caligo telamonius (Felder & Felder, 1862) C
Caligo uranus Herrich-Schäffer, 1850 U
Eryphanis aesacus (Herrich-Schäffer, 1850) C
Opsiphanes boisduvalii Doubleday, [1849] R
Opsiphanes cassina (Boisduval, 1870) C
Opsiphanes quiteria (Stoll, 1780) C
Opsiphanes tamarindi Felder & Felder, 1861 FC
Pierella luna (Fabricius, 1793) C
Manataria maculata (Hopffer, 1874) U
Oxeoschistus tauropolis (Westwood, [1850]) C
Cepheuptychia glaucina (Bates, 1864) FC
Vanima labe (Butler, 1870) FC
Cissia pseudoconfusa Singer, DeVries & P. Ehrlich, 1983 U
Cissia pompilia (Felder & Felder, 1867) C
Cyllopsis hedemanni Felder, 1869 U-R
Cyllopsis pallens Miller, 1974 * FC
Euptychia westwoodi Butler, 1867 U
Hermeuptychia intricata Grishin, 2014 C
Malaveria alcinoe (C. Felder & R. Felder, 1867) * U
Magneuptychia libye (Linnaeus, 1767) C
Pareuptychia metaleuca (Boisduval, 1870) C
Pareuptychia ocirrhoe (Fabricius, [1777]) C
*Splendeuptychia salvini** (A. Butler, 1867) C
Taygetina kerea (Butler, 1869) * C
Taygetis leuctra Butler, 1870 * C
Taygetis rufomarginata Staudinger, 1888 C
Taygetis thamyra (Cramer, 1779) C
Yphthimoides renata (Stoll, 1780) U

Hesperiidae
Eudaminae
Phocides polybius (Fabricius, 1793) FC
Phocides thermus (Mabille, 1883) U
Phanus confusis Austin, 1993 * FC
Phanus ecitonorum Austin, 1993 * FC
Phanus marshallii (Kirby, 1880) R
Udranomia orcinus (Felder & Felder, 1867) * U
Proteides mercurius (Fabricius, 1787) FC-U
Epargyreus cruza Evans, 1952 U
Epargyreus aspina Evans, 1952 U
Epargyreus spina Evans, 1952 C
Epargyreus clavicornis (Herrich-Schäffer, 1869) U
Polygonus savigny (Latreille, [1824]) C
Chioides albofasciatus (Hewitson, 1867) U
Chioides zilpa (Butler, 1872) U
Aguna asander (Hewitson, 1867) C
Aguna claxon Evans, 1952 R
Aguna aurunce (Hewitson, 1867) U
Aguna panama Austin & Mielke, 1998 R
Typhedanus undulatus (Hewitson, 1867) U
Typhedanus ampyx (Godman & Salvin, 1893) R
Polythrix octomaculata (Sepp, [1844]) U
Polythrix mexicanus Freeman, 1969 * R
Polythrix asine (Hewitson, 1867) C
Polythrix caunus (Herrich-Schäffer, 1869) * R
Polythrix auginus (Hewitson, 1867) * C
Cephise nuspesez Burns, 1996 * U
Cephise aelius (Plötz, 1880) R
Venada lamella Burns, 2013 * U
Codatractus carlos Evans, 1952 FC
Codatractus alcaeus (Hewitson, 1867) U
Codatractus bryaxis (Hewitson, 1867) R
Codatractus hyster (Dyar, 1916) * U
Urbanus viterboana (Ehrmann, 1907) U
Urbanus belli (Hayward, 1935) C
Urbanus pronta Evans, 1952 FC
Urbanus pronus Evans, 1952 U
Urbanus esmeraldus (Butler, 1877) C
Urbanus pronus Evans, 1952 U
Urbanus esmeraldus (Butler, 1877) C
Urbanus evona Evans, 1952 * R
Urbanus dorantes (Stoll, 1790) C
Urbanus teleus (Hübner, 1821) FC-U
Urbanus tanna Evans, 1952 FC
Urbanus simplicius (Stoll, 1790) FC
Urbanus procne (Plötz, 1880) U
Urbanus doryssus (Swainson, 1831) U
Urbanus albimargo (Mabille, 1876) U
Astraptes talus (Cramer, 1777) C
Astraptes fulgerator (Walch, 1775) C
Astraptes megalurus (Mabille, 1877) * R
Astraptes tucuti (Williams, 1927) R
Astraptes brevicauda (Plötz, 1886) U
Astraptes phalaceus (Godman & Salvin, 1893) U

Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras, continued.

Astraptes egregius (Butler, 1870) FC
Astraptes enotrus (Stoll, 1781) FC
Astraptes janeira (Schaus, 1902) FC
Astraptes alardus (Stoll, 1790) U-FC
Astraptes alector (Felder & Felder, 1867) U-FC
Astraptes chiriquensis (Staudinger, 1876) R
Astraptes weymeri (Plötz, 1882) FC
Astraptes anaphus (Cramer, 1777) C
Narcosius colossus (Herrich-Schäffer, 1869) FC
Narcosius helen (Evans, 1952) FC
Narcosius nazaraeus Steinhauser, 1986 U
Calliades zeutus (Möschler, 1879) * R
Autochton neis (Geyer, 1832) FC
Autochton longipennis (Plötz, 1882) FC
Autochton zarex (Hübner, 1818) FC
Autochton bipunctatus (Gmelin, [1790]) U
Achalarus albociliatus (Mabille, 1877) U
Cabares potrillo (Lucas, 1857) C
Spathilepia clonius (Cramer, 1775) C
Cogia cajeta (Herrich-Schäffer, 1869) R
Cogia hippalus (Edwards, 1882) * U
Cogia calchas (Herrich-Schäffer, 1869) FC
Telemiades meris (Plötz, 1886) * U
Telemiades choricus (Schaus, 1902) * R
Telemiades austini Siewert, Mielke & Casagrande, 2020 FC
Telemiades antiope (Plötz, 1882) * R
Telemiades fides Bell, 1949 FC
Bungalotis erythus (Cramer, 1775) U
Bungalotis midas (Cramer, 1775) FC-C
Bungalotis astylos (Cramer, 1780) C
Bungalotis milleri Freeman, 1977 R
Bungalotis quadratum (Sepp, [1845]) U-FC
Nicephellus nicephorus (Hewitson, 1876) FC
Dyscophellus ramon Evans, 1952 FC
Nascus phocus (Cramer, 1777) U
Nascus solon (Plötz, 1882) U
Nascus broteas (Cramer, 1780) * R
Pseudonascus paulliniae (Sepp, [1842]) FC
Porphyrogenes peterwegei Burns, 2010 * R
Porphyrogenes sula (Williams & Bell, 1940) R
Ocyba calathana (Hewitson, 1868) FC

Pyrginae

Myscelus amystis (Hewitson, 1867) R
Myscelus belti Godman & Salvin, 1879 R
Myscelus perissodora Dyar, 1914 * R
Chalypyge chalybea (Scudder, 1872) R
*Oxynetra aureopecta** Warren & Grishin, 2017 R
Melanopyge erythrosticta (Godman & Salvin, 1879) U
Melanopyge sp. MS U
Microceris scylla (Ménétriés, 1855) R
Elbella patrobas (Hewitson, 1857) R
Mysoria ambigua (Mabille & Boullet, 1908) R
Celaenorrhinus stallingsi Freeman, 1946 U
Celaenorrhinus eligius (Stoll, 1781) * U
Arteurotia tractipennis Butler & Druce, 1872 R
Mictris crispus (Herrich-Schäffer, 1870) * R
Polyctor cleta Evans, 1953 V
Polyctor enops (Godman & Salvin, 1894) C
Nisoniades godma Evans, 1953 FC
Nisoniades rubescens (Möschler, 1877) U-FC
Nisoniades ephora (Herrich-Schäffer, 1870) U
Nisoniades macarius (Herrich-Schäffer, 1870) R
Nisoniades castolus (Hewitson, 1878) R
Pachyneuria licisca (Plötz, 1882) U
Pellicia arina Evans, 1953 U
Pellicia costimacula Herrich-Schäffer, 1870 * U
Pellicia angra Evans, 1953 * U
Pellicia dimidiata Herrich-Schäffer, 1870 FC
Noctuana lactifera (Butler & Druce, 1872) FC
Noctuana stator (Godman, 1899) U
Cyclosemia anastomosis Mabille, 1878 U
Bolla cupreiceps (Mabille, 1891) FC
Bolla subapicatus (Schaus, 1902) * U
Bolla evippe (Godman & Salvin, 1896) * FC-C
Bolla imbras (Godman & Salvin, 1896) U
Bolla boliviensis (Bell, 1937) * R
Staphylus vulgata (Möschler, 1879) U
Staphylus ascaphalus (Staudinger, 1876) FC
Staphylus lenis Steinhauser, 1989 * U
Staphylus azteca (Scudder, 1872) U
Staphylus cartagoa (Williams & Bell, 1940) * R
Gorgythion vox Evans, 1953 C
Sostrata nordica Evans, 1953 U
Mylon lassia (Hewitson, 1868) C
Mylon maimon (Fabricius, 1775) C
Hoodus pelopidas (Fabricius, 1793) R
Timochares trifasciata (Hewitson, 1868) U-FC
Anastrus sempiternus (Butler & Druce, 1872) U
Anastrus tolimus (Plötz, 1884) U
Anastrus meliboea (Godman & Salvin, 1894) * U
Ebrietas osyris (Staudinger, 1876) * R
Ebrietas anaceron (Staudinger, 1876) FC-C
Ebrietas sappho Steinhauser, 1974 R
Ebrietas evanidus Mabille, 1898 R
Ebrietas elaudia (Plötz, 1884) * R
Helias cama Evans, 1953 C
Camptopleura auxo (Möschler, 1879) * U
Cycloglypha thrasibulus (Fabricius, 1793) U
Theagenes aegides (Herrich-Schäffer, 1869) R
Chiomara georgina (Reakirt, 1868) U
Gesta invisus (Butler & Druce, 1872) R
Erynnis funeralis (Scudder & Burgess, 1870) U
Aethilla lavochrea Butler, 1872 FC
Aethilla echina Hewitson, 1870 R
Tosta thraso (Hübner, [1807]) C
Achlyodes busirus (Cramer, 1779) FC
Achlyodes pallida (Felder, 1869) V
Ouleus salvina Evans, 1953 U
Ouleus dilla Evans, 1953 * R
Zera hosta Evans, 1953 * FC
Zera hyacinthinus (Mabille, 1877) U
Quadrus cerialis (Stoll, 1782) U
Quadrus contubernalis (Mabille, 1883) FC
Quadrus lugubris (Felder, 1869) U
Gindanes brontinus Godman & Salvin, 1895 * U
Pythonides jovianus (Stoll, 1782) C
Atarnes sallei (Felder & Felder, 1867) U
Carrhenes calidius Godman & Salvin, 1895 FC
Carrhenes canescens (Felder, 1869) U
Xenophanes tryxus (Stoll, 1780) FC
Antigonus nearchus (Latreille, [1817]) U
Antigonus erosus (Hübner, [1812]) FC
Antigonus corrosus Mabille, 1878 C
Burnsius adepta (Plötz, 1884) U
Burnsius oileus (Linnaeus, 1767) C
Heliopetes macaira (Reakirt, [1867]) U
Heliopetes arsalte (Linnaeus, 1758) C
Heliopetes alana (Reakirt, 1868) FC

Heteropterinae

Dalla ramirezi Freeman, 1969 FC

Appendix. List of butterfly species recorded at Emerald Valley Nature Reserve, Honduras, continued.

Hesperiinae
Perichares adela (Hewitson, 1867) C
Perichares deceptus (Butler & Druce, 1872) * R
Orses cynisca (Swainson, 1821) U
Ancyloxypha arene (Edwards, 1871)
Copaeodes minima (Edwards, 1870)
Talides cantra Evans, 1955 C
Talides alternata Bell, 1941 * FC
Synale cynaxa (Hewitson, 1867) U
Tisias myna (Mabille, 1889) * FC-C
Carystoides abrahami Freeman, 1969 * C
Carystoides escalantei Freeman, 1969 * U
Carystoides floresi Freeman, 1969 * FC
Carystoides lila Evans, 1955 U
Carystoides mexicana Freeman, 1969 * U
Calpodes ethlius (Stoll, 1782) U
Calpodes antoninus (Latreille, [1824])FC
Calpodes esperi Evans, 1955 U-FC
Calpodes fusta Evans, 1955 * U
Calpodes longirostris (Sepp, [1840]) C
Calpodes saladin Evans, 1955 U
Calpodes salius (Cramer, 1775) * U
Calpodes triangularis (Kaye, 1914) C
Panoquina ocola (Edwards, 1863) FC
Panoquina hecebolus (Scudder, 1872) U
Panoquina lucas (Fabricius, 1793) U
Panoquina evansi (Freeman, 1946) * U
Panoquina pauper (Mabille, 1878) R
Panoquina evadnes (Stoll, 1781) U
Zenis jebus (Plötz, 1882) FC *
Thracides phidon (Cramer, 1779) U
Thracides arcalaus (Stoll, 1782) R
Neoxeniades luda (Hewitson, 1877) R
Synapte salenus (Mabille, 1883) FC
Synapte silius (Latreille, [1824]) * FC
Anthoptus epictetus (Fabricius, 1793) FC-C
Anthoptus inculta (Dyar, 1918) * U-FC
Corticea corticea (Plötz, 1882) FC
Corticea lysias (Plötz, 1883) U
Lento xanthina (Mabille, 1891) * FC
Zeriaspes mys (Hübner, [1808]) C
Cantha roraimae (Bell, 1932) * U
Callimormus juventus Scudder, 1872 C
Callimormus radiola (Mabille, 1878) C
Callimormus saturnus (Herrich-Schäffer, 1869) FC
Mnasicles geta Godman, 1901 FC
Remella remus (Fabricius, 1798) U
Remella rita (Evans, 1955) V
Remella vopiscus (Herrich-Schäffer, 1869) C
Amblyscirtes patriciae (Bell, 1959) * U
Methionopsis ina (Plötz, 1882) U
Repens florus (Godman, 1900) * FC
Phanes aletes (Geyer, 1832) U
Monca crispinus (Plötz, 1882) FC
Cymaenes trebius (Mabille, 1891) FC
Vehilius stictomenes (Butler, 1877) FC
Lerodea eufala (Edwards, 1869) * U
Mnasitheus chrysophrys (Mabille, 1891) U
Moeris striga (Geyer, 1832) * FC
Parphorus decora (Herrich-Schäffer, 1869) * R
Parphorus storax (Mabille, 1891) R
Papias phainis Godman, 1900 * U
Papias subcostulata (Herrich-Schäffer, 1870) FC
Cobalopsis autumna (Plötz, 1882) * FC
Cobalopsis nero (Herrich-Schäffer, 1869) FC-C
Lerema lochius (Plötz, 1882) * U
Lerema liris Evans, 1955 U
Morys micythus (Godman, 1900) U
Morys lyde (Godman, 1900) FC
Tigasis simplex (Bell, 1930) * U
Tigasis zalates Godman, 1900 R
Niconiades incomptus Austin, 1997 U
Troyus onaca Evans, 1955 C
Mielkeus tertianus (Herrich-Schäffer, 1869) FC
Eutychide complana (Herrich-Schäffer, 1869) FC
Eutychide paria (Plötz, 1882) U
Eutychide subcordata (Herrich-Schäffer, 1869) * U
Onophas columbaria (Herrich-Schäffer, 1870) R
Styriodes dedecora (Plötz, 1882) * R
Vertica verticalis (Plötz, 1882) U
Saturnus reticulata (Plötz, 1883) * R
Rhinthon osca (Plötz, 1882) U
Rhinthon molion (Godman, 1901) R
Hylephila phyleus (Drury, 1773) C
Polites vibex (Geyer, 1832) FC
Pompeius pompeius (Latreille, [1824]) C
Anatrytone mella (Godman, 1900) FC
Anatrytone potosiensis (Freeman, 1969) R
Quasimellana mexicana (Bell, 1942) * R
Quasimellana eulogius (Plötz, 1882) C
Euphyes antra Evans, 1955 * U
Euphyes peneia (Godman, 1900) U
Metron chrysogastra (Butler, 1870) * C
Quinta cannae (Herrich-Schäffer, 1869) FC
Cynea anthracinus (Mabille, 1877) U
Cynea irma (Möschler, 1879) FC
Cynea corisana (Plötz, 1882) * U
Cynea megalops (Godman, 1900) R
Cynea bistrigula (Herrich-Schäffer, 1869) * R
Cynea diluta (Herrich-Schäffer, 1869) U
Cynea cynea (Hewitson, 1876) FC
Cyclosma glamis Evans, 1955 * FC
Orthos lycortas (Godman, 1900) U
Orthos gabina (Godman, 1900) FC
Conga chydaea (Butler, 1877) FC
Decinea decinea (Hewitson, 1876) U-R
Decinea percosius (Godman, 1900) * R
Decinea lucifer (Hübner, [1831]) * U
Nyctelius nyctelius (Latreille, [1824]) C
Thespieus dalman (Latreille, [1824]) U
Thespieus macareus (Herrich-Schäffer, 1869) R
Thespieus aspernatus Draudt, 1923 * R
Vacerra gayra (Dyar, 1918) R
Vacerra caniola (Herrich-Schäffer, 1869) * C
Vacerra litana (Hewitson, 1866) R
Oxynthes corusca (Herrich-Schäffer, 1869) * U
Xeniades chalestra (Hewitson, 1866) * U

A new species of *Caeruleuptychia* Forster, 1964 from the Amazon basin (Lepidoptera: Nymphalidae: Satyrinae: Satyrini)

Shinichi Nakahara[1*], Mônica Piovesan[2], Quinlyn Baine[3], Emma C. MacKenzie[1], Geoffrey Gallice[4], Eduardo P. Barbosa[5] and Kaylin Kleckner[6*]

1.Department of Organismic and Evolutionary Biology, Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138 USA; 2. Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil; 3. Department of Biology, University of New Mexico, MSC03-2020, Albuquerque, NM 87131 USA; 4. Alliance for a Sustainable Amazon, 923 Willowleaf Way, Potomac, MD 20854 USA; 5. Departamento de Biologia Animal, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil; 6. Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611 USA; *Corresponding authors: snakahara@fas.harvard.edu; kaylin.kleckner@ufl.edu

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Abstract: Here, we describe and name a new nymphalid butterfly species in the subtribe Euptychiina. *Caeruleuptychia thaliana* Nakahara & Piovesan, **n. sp.** is proposed by incorporating three independent sources of evidence: adult external morphology, DNA sequence data, and early stage biology. *Caeruleuptychia thaliana* **n. sp.** is known from two sites in the Amazon basin, in the state of Mato Grosso, Brazil, and another site situated in Madre de Dios department, Peru. A single egg of *C. thaliana* **n. sp.** was obtained while conducting field work at the latter locality, and subsequently observations were made of the larva passing through four larval stages until reaching the adult stage. The natural host plant for *C. thaliana* **n. sp.** was identified as a species of grass, *Lasiacis ligulata* Hitchcock & Chase (Poaceae: Panicoideae: Paniceae).

Key words: Brazil, *Caeruleuptychia thaliana* **n. sp.**, Euptychiina, host plant, Peru, Poaceae, taxonomy.

Resumen: Aquí, describimos y nombramos una nueva especie de mariposa ninfálida de la subtribu Euptychiina. *Caeruleuptychia thaliana* Nakahara & Piovesan, **n. sp.** es propuesta con base en tres fuentes independientes de evidencia: morfología externa del adulto, datos de secuencia de ADN e información de la biología de los estados inmaduros. *Caeruleuptychia thaliana* **n. sp.** se conoce de dos sitios en la cuenca del Amazonas, la localidad tipo se encuentra en el estado de Mato Grosso, Brasil, y el otro sitio está ubicado en el departamento de Madre de Dios, Perú. Un solo huevo de *C. thaliana* **n. sp.** se obtuvo durante el trabajo de campo en esta última localidad, y posteriormente se observó el desarrollo larval de cuatro estadios hasta llegar al estadio adulto. La planta hospedera natural de *C. thaliana* **n. sp.** se identificó como una especie de hierba, *Lasiacis ligulata* Hitchcock & Chase (Poaceae: Panicoideae: Paniceae).

Palabras clave: Brasil, *Caeruleuptychia thaliana* **n. sp.**, Euptychiina, planta hospedera, Perú, Poaceae, taxonomía.

Resumo: Aqui, descrevemos e nomeamos uma nova espécie de ninfalídeo na subtribo Euptychiina. *Caeruleuptychia thaliana* Nakahara & Piovesan, **n. sp.** é proposta, incorporando três fontes independentes de evidência: morfologia externa do adulto, sequências de DNA e biologia dos estágios imaturos. *Caeruleuptychia thaliana* **n. sp.** é conhecida de dois locais da bacia Amazônica, no estado de Mato Grosso, Brasil, e o outro local está situado no departamento de Madre de Dios, Peru. Um único ovo de *C. thaliana* **n. sp.** foi obtido durante o trabalho de campo nesta última localidade, e posteriormente foram feitas observações da larva passando por quatro ínstares larvais até atingir o estágio adulto. A planta hospedeira natural de *C. thaliana* **n. sp.** foi identificada como uma espécie de gramínea, *Lasiacis ligulata* Hitchcock & Chase (Poaceae: Panicoideae: Paniceae).

Palavras chave: Brasil, *Caeruleuptychia thaliana* **n. sp.**, Euptychiina, planta hospedeira, Peru, Poaceae, taxonomia

INTRODUCTION

It's just a name, but it's still a name. Taxonomists help fulfill our irresistible desire to produce order from the immensely chaotic diversity of life surrounding us through (imaginative) invention of new scientific names for nomenclatural purposes. These arbitrary combination of letters may seem as if they are meaningless symbols, but each one of them has its own story, receiving nonscientific influences, as well as invariably reflecting a taxonomist's state of mind and emotional stakes. This subjective aspect of taxonomy has perhaps contributed to its reputation as a frivolous branch of science. Ironically, on the contrary, naming new taxa can be an enriching scientific practice for the same reason, and these names will persist, as long as we care and communicate about the natural world. Taxonomy, indeed, is a worthwhile scientific endeavor which we greatly benefit from hereunder.

Although diverse and common in the Neotropics, the nymphalid butterfly subtribe Euptychiina received little attention from Lepidoptera researchers until recently (see https://www.floridamuseum.ufl.edu/neotropica/research/euptychiina/ for recent advancements on euptychiine systematics), perhaps partly due to their drab and unassuming adult appearance. Consequently, euptychiine classification remained chaotic for decades, with an overwhelmingly high proportion of paraphyletic and polyphyletic genera revealed through phylogenetic studies (e.g., Murray & Prowell, 2005; Peña *et al*., 2010; Matos-Maraví *et al*., 2013; Espeland *et al.*, 2019). Additionally, a high number of unresolved species-level taxonomic issues exist because morphological homogeneity makes it difficult to find diagnostic characters. This cryptic nature of euptychiine species is further apparent in recent studies incorporating molecular data to uncover the subtribe's hidden diversity (e.g., Cong & Grishin, 2014; Barbosa *et al.*, 2015; Nakahara *et al*., 2018b). Commonly, documentation of new euptychiine species is often based solely on the adult stage without incorporating any information on their early stage biology; as a result, approximately 80% of the species in the subtribe lack relevant life history information (Corahua-Espinoza *et al*., 2022a). However, these gaps in knowledge regarding euptychiine immature biology have steadily been filled in over the past year by a series of studies conducted at the heart of euptychiine diversity, in southeastern Peru (Corahua-Espinoza *et al*., 2022a, b, in press, in prep.), building upon earlier pioneering efforts aimed at revealing euptychiine life history (e.g., Müller, 1878, 1886; Biezanko *et al*., 1974; DeVries, 1986, 1987).

The euptychiine genus *Caeruleuptychia* Forster, 1964 was established by Walter Forster to circumscribe a group of species marked unusually with iridescent blue scales on their wings (Forster, 1964). Forster (1964) recognized three species groups within *Caeruleuptychia*: species without an androconial patch on the male dorsal wings: *C. caerulea* (Butler, 1869), *C. coelestis* (Butler, 1867), *C. divina* (Weymer, 1911), *C. coelica* (Hewitson, 1869), *C. lobelia* (Butler, 1870), *C. urania* (Butler, 1867), and *C. ziza* (Butler, 1869); species with an androconial patch close to the inner margin of the dorsal hindwing: *C. glauca* (Weymer, 1911), *C. cyanites* (Butler, 1871), *C. pilata* (Butler, 1867), *C. tenera* (Weymer, 1911), *C. penicillata* (Godman, 1905), and *C. scopulata* (Godman, 1905); and species with a circular, black androconial patch at the dorsal hindwing tornus: *C. helios* (Weymer, 1911), *C. aegrota* (Butler, 1867), and *C. aetherialis* (Butler, 1877). Simultaneously, Forster (1964) erected *Weymerana* Forster, 1964 to accommodate a single species, *Euptychia viridicans* Weymer, 1911, which is currently considered as a junior subjective synonym of *Euptychia umbrosa* Butler, 1870 (Lamas, 2004). Owing to recent contributions towards *Caeruleuptychia* taxonomy (Brévignon & Benmesbah, 2012; Nakahara *et al*., 2018b; Ríos-Málaver 2019), coupled with an ongoing molecular phylogenetic study, our understanding of *Caeruleuptychia* diversity and systematics are reaching some degree of stability. An emerging consensus is that *Caeruleuptychia* itself is monophyletic, which can be divided into three somewhat morphologically compact clades: 1) a group including species with males displaying an androconial patch on the dorsal hindwing ("*aegrota* clade"); 2) a group including mainly species with lilac-blue wings ("*caerulea* clade"); 3) a group including mainly species with brown wings, with males accompanied by secondary sexual traits ("*umbrosa* clade"). Greater understanding of *Caeruleuptychia* species diversity will undoubtedly require descriptions of a number of undescribed species concentrated mainly in the "*umbrosa* clade", and an ongoing morphological and molecular study suggests the species-richness of the genus will exceed 50 species. Members of *Caeruleuptychia* are found almost exclusively east of the Andes, including some species known from the cloud forests of the Andes and two records known from Central America (Dyar, 1914; unpublished data). In particular, the vast majority of *Caeruleuptychia* species are strictly Amazonian, with the peak of diversity found in the southwestern Amazon basin, including some taxa known only from this region. Adults of *Caeruleuptychia* species are often found in close association with bamboo stands, with males of some species exhibiting perching behavior (Nakahara *et al*., 2018b; see below). On the other hand, our understanding of immature stages and host plant records for many *Caeruleuptychia* taxa remain in infancy, with information on their natural history available for a mere four species to date (Murray, 2001; Beccaloni *et al*., 2008; Nakahara *et al*., 2018b; Corahua-Espinoza *et al.*, in prep.).

Given this background, the objective of this study is to document an undescribed Amazonian species of *Caeruleuptychia* with its immature stages and natural host plant, in order to improve our understanding of *Caeruleuptychia* species diversity as well as euptychiine early stage biology. We here incorporate three independent sources of evidence to support our taxonomic hypothesis of species designation: adult external morphology, DNA sequence data, and life history. The present study also aims to recognize a seemingly endless effort and enthusiasm devoted towards discovering novel butterfly life history information by dedicating the species-group name of this new taxon to Thalia Corahua-Espinoza. Introducing this patronym will remind us in perpetuity of her contributions towards understanding the immature biology of Neotropical butterflies, including over a dozen euptychiine species, based on her studies in the Peruvian Amazon (Ccahuana *et al*., 2022; Corahua-Espinoza *et al*., 2022a, b, in press, in prep.; Duerr *et al.*, in press; Nakahara *et al.,* 2022; Tejeira *et al.,* 2021).

MATERIALS AND METHODS

Specimens and sequences relevant to this study are based on data compiled for taxonomic revision of the genus, including study of >1,000 specimens from >20 public/private collections (see Nakahara *et al*. (2022) as an example of the repositories examined for these materials).

Acronyms and terminology. The following collection acronyms are used throughout the text: **ASA:** Alliance for a

Sustainable Amazon collection, Puerto Maldonado, Peru; **DZUP:** Coleção Entomológica Padre Jesus Santiago Moure, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba, Brazil; **MCZ:** Museum of Comparative Zoology, Harvard University, Cambridge, USA; **STD:** Senckenberg Museum für Tierkunde, Dresden, Germany; **NHMUK:** Natural History Museum, London, UK. The terminology associated with wings and genitalia follows Nakahara *et al.* (2018a, b). We follow Hinton (1946), Murray (2001) and Corahua-Espinoza *et al.* (2022a) for terminology related to immature stages.

Morphological work. We studied adult external morphology using a Zeiss Stemi SV6 stereomicroscope at the DZUP, and a Zeiss SteREO Discovery V.20 stereomicroscope at Laboratory of Ecology and Systematic of Butterflies, Biology Department, State University of Campinas (Brazil). The genitalia were examined by separating the abdomen from the body, soaking in hot (55-60°C) 10% potassium hydroxide solution (KOH) for approximately two minutes, and rinsing in water before examination. Information on dissected individuals with associated DNA data are provided in Table 1. Subsequently, the genitalia were photographed using an optical stereomicroscope adapted with focus stacking (Leica Application Suite Version 4.12.0 [Build 86]), and images of the holotype (deposited at the DZUP) were recorded with a Sony DSC-HX100V digital camera. The head capsules were examined and photographed using Leica DFC450 attached to a Leica M205 C stereomicroscope and stacked using Leica Application Suite X (LAS X v.5.02) at the MCZ.

Molecular work. The mitochondrial gene *cytochrome oxidase I* (COI) barcoding region (*sensu* Hebert *et al.,* 2003) was sequenced for relevant individuals of *Caeruleuptychia* taxa to inform our taxonomic hypothesis. Genomic DNA extraction, PCR, primer design, and Sanger sequencing procedures for molecular samples used in the present study largely follow Corahua-Espinoza *et al.* (2022b) and Nakahara *et al.* (2020). GenBank accession numbers for *Caeruleuptychia* sequences repeatedly discussed herein are listed in Table 1. These sequences were incorporated into the matrix based on 633 base pairs, consisting in total of 63 individuals of selected *Caeruleuptychia* sequences, in addition to 14 outgroup taxa. We edited raw sequences using various versions of Geneious (Biomatters Ltd.; Kearse *et al.*, 2012) and calculated patristic distance by reconstructing a Neighbour-Joining tree using the Jukes-Cantor model with 500 bootstrap replicates. To graphically illustrate and test our taxonomic hypothesis, we performed phylogenetic analysis based on the above dataset with maximum likelihood (ML) as an optimality criterion. Sequences were aligned using MUSCLE 3.8 (Edgar, 2004). We used IQ-TREE v.2.1.3 (Minh *et al.,* 2020) and ModelFinder by employing Akaike Information Criterion (AIC) to select the nucleotide substitution model TIM2+F+I+G4 (Kalyaanamoorthy *et al.*, 2017), and performed 10 independent analyses under this model. The run which produced the highest log-likelihood (LnL) was chosen and we rooted the tree manually with *Cisandina lea* (Cramer, 1777). Confidence in the phylogenetic hypothesis was assessed through 1,000 replicates of ultrafast bootstrap (UFBoot; Hoang *et al.*, 2018) with optimization by nearest-neighbor interchange, 1,000 replicates of the SH-like approximate Likelihood Ratio Test (SH-aLRT; Guindon *et al*., 2010), and approximate Bayes branch test (aBayes; Anisimova *et al*., 2011). IQ-TREE analysis was performed using supercomputer and cluster resources provided by the University of New Mexico Center for Advanced Research Computing (New Mexico, USA).

Rearing. The life cycle and natural host plant of *C. thaliana* **n. sp.** were documented at Finca Las Piedras (FLP), a research station situated approximately 50 km north of Puerto Maldonado (Madre de Dios department, Peru; -12.22789, -69.11119; elevation, approximately 240 m). Materials and methods related to the study of life history of *C. thaliana* **n. sp.** are largely in accordance with those described in Corahua-Espinoza *et al*. (2022a). A single egg was obtained from *Lasiacis ligulata* Hitchcock & Chase within the FLP property on 10 May 2021, subsequently vouchered as 2021-FLP-IMM-0371, and it developed by feeding on *L. ligulata* in captivity throughout all larval stages (see below for duration and molt dates).

SPECIES DESCRIPTION

Caeruleuptychia thaliana Nakahara & Piovesan, **new species**

ZooBank registered: urn:lsid:zoobank.org:act:83D21E6B-85DB-4E5F-9CAE-5273D15DEFBB
(Figs. 1-5)

Systematic placement. The genus *Caeruleuptychia* is recovered as a member of the so-called "*Splendeuptychia* clade" (*sensu* Murray & Prowell, 2005) based on hybrid enrichment data (Espeland *et al.*, 2019). In the present study, *C. thaliana* **n. sp.** is strongly supported as a sister to *C. umbrosa*

Table 1. GenBank vouchers of sequences for *C. thaliana* **n. sp.** and *C. umbrosa* used in the present study (names in bold denote dissected specimens).

Species	sex	DNA Voucher code	GenBank Acc. No.	Country	State/Prov./Dept.	Specific locality
Caeruleuptychia umbrosa	female	MGCL-LOAN-513	OP207987	Brazil	Bahía	Reserva Biológica de Una
Caeruleuptychia umbrosa	male	LEP-08903	OP207988	Ecuador	Pastaza	Kapawi village
Caeruleuptychia umbrosa	male	NVG-2639	OP207989	Bolivia	Beni	5 km N Rurrenambaque
Caeruleuptychia umbrosa	male	LEP-10074	MF192698	Ecuador	Morona-Santiago	Chupianza Grande
Caeruleuptychia umbrosa	female	YPH-0586	KU340888	Brazil	Minas Gerais	PE do Rio Doce, Marliéria
Caeruleuptychia umbrosa	unknown	LEPAR448	MF546867	Argentina	Misiones	Parque Nacional Iguazu
Caeruleuptychia umbrosa	male	CP01-09	GU205824	Peru	Madre de Dios	Z.R. Tambopata - Candamo
Caeruleuptychia umbrosa	unknown	DNA00-016	AY508523	Ecuador	Napo	Jatun Sacha
Caeruleuptychia thaliana	male	BC-DZ-025	ON932574	Brazil	Mato Grosso	Barra do Bugres
Caeruleuptychia thaliana	female	2021-FLP-IMM-0371	ON931448	Peru	Madre de Dios	Finca Las Piedras

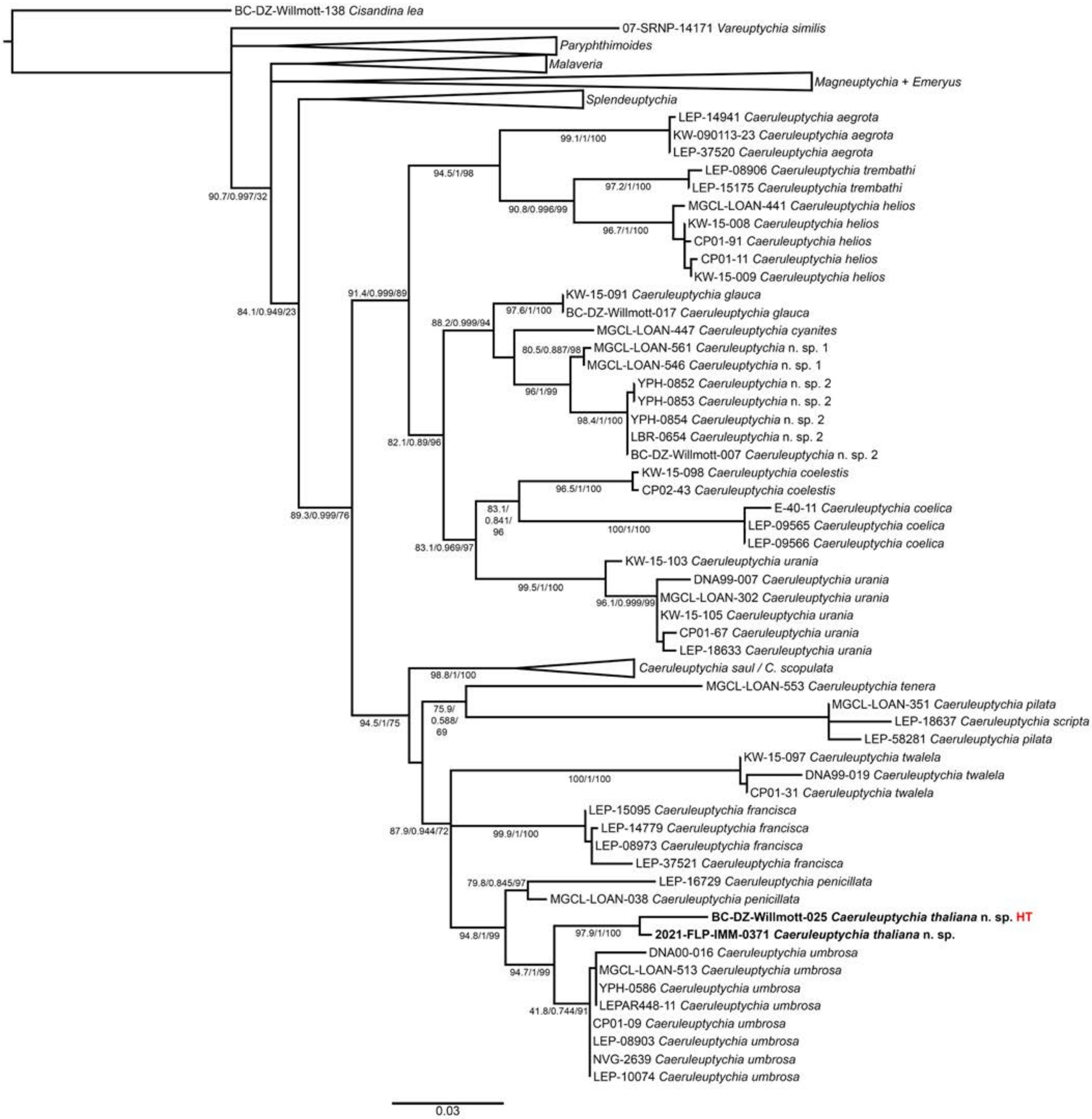

Figure 1. Maximum likelihood tree (LnL = -4894.872) showing the phylogenetic position of *C. thaliana* **n. sp.** and other *Caeruleuptychia* taxa selected for this study. Values beside branches represent UFBoot/aBayes/SH-aLRT support. HT denotes the holotype of *C. thaliana* **n. sp.**

according to the ML phylogenetic hypothesis based on COI barcode data (Fig. 1; UFBoot/aBayes/SH-aLRT = 94.7/1/99). *Caeruleuptychia penicillata* is found to be sister to this species pair (*C. thaliana* **n. sp.** + *C. umbrosa*) with high support (Fig. 1; UFBoot/aBayes/SH-aLRT = 94.8/1/99). The clade with these three taxa (*C. penicillata* + (*C. thaliana* **n. sp.** + *C. umbrosa*)) is found within the "*umbrosa* clade", with *C. twalela* and *C. francisca* (Butler, 1870) as members of the same clade.

Diagnosis. The male of *C. thaliana* **n. sp.** is readily distinguishable from *C. umbrosa* by the lack of a hair-pencil (androconial brush) on the dorsal forewing in cell Cu_2, whereas there is a hair-pencil lying near the origin of Cu_2 in this cell in *C. umbrosa* (see Fig. 2E). Nevertheless, this structure may become loose over time and it is not fully discernible in some old museum specimens. This fact, coupled with the limited number of known specimens for *C. thaliana* **n. sp.**, including one reared specimen, and its resemblance to *C. umbrosa* as well as the intraspecific variation of this latter taxon overlapping with that of the former, these following diagnostic characters should be used in combination. The male of *Caeruleuptychia thaliana* **n. sp.** is further distinguished from that of *C. umbrosa*

Figure 2. Adults of *Caeruleuptychia thaliana* **n. sp.**: A) male holotype, dorsal surface; B) male holotype, ventral surface; C) female paratype (2021-FLP-IMM-0371), dorsal surface; D) female paratype (2021-FLP-IMM-0371), ventral surface. Male specimen of *Caeruleuptychia umbrosa* (LEP-08903): E) dorsal surface, with arrow indicating the hair-pencil; F) ventral surface.

by its brown wing surface lacking an olive-grayish sheen on the dorsal and ventral surface, as well as the paler ventral surface. As a result of the ventral surface possessing an olive-grayish sheen, the ventral surface of *C. umbrosa* appears scalier due to contrasting whitish scales, especially at the distal sides of the wings. The ventral submarginal ocelli are generally larger in *C. umbrosa*. In particular, the ocellus in the ventral hindwing cells M_1 and Cu_1 may occasionally reach the intervening veins and/or the submarginal band in *C. umbrosa*. The ocellus in the ventral hindwing cell Cu_1 is also more elongated in *C. thaliana* **n. sp.** compared to the rounded corresponding ocellus of *C. umbrosa*. The submarginal bands on both the ventral forewing and hindwing appear broader in *C. umbrosa*. Furthermore, the ventral hindwing submarginal band gradually broadens in *C. thaliana* **n. sp.**, whereas this band appears rather evenly broad in *C. umbrosa*. The apical process of the valva in *C. thaliana* **n. sp.** possesses a straight dorsal margin in the lateral view, terminating in a slightly hooked, angular, and blunt point, whereas the dorsal margin of valva in *C. umbrosa* typically exhibits a concavity and the apical point is not skewed distally. The female of *C. thaliana* **n. sp.** is distinguished from that of *C. umbrosa* by the ventral forewing post-discal band fading in cell Cu_2 and failing to reach 2A, whilst this band reaches 2A in *C. umbrosa*. In accordance with the males, the ventral hindwing submarginal band of females also gradually broadens in *C. thaliana* **n. sp.**, although this character is not pronounced

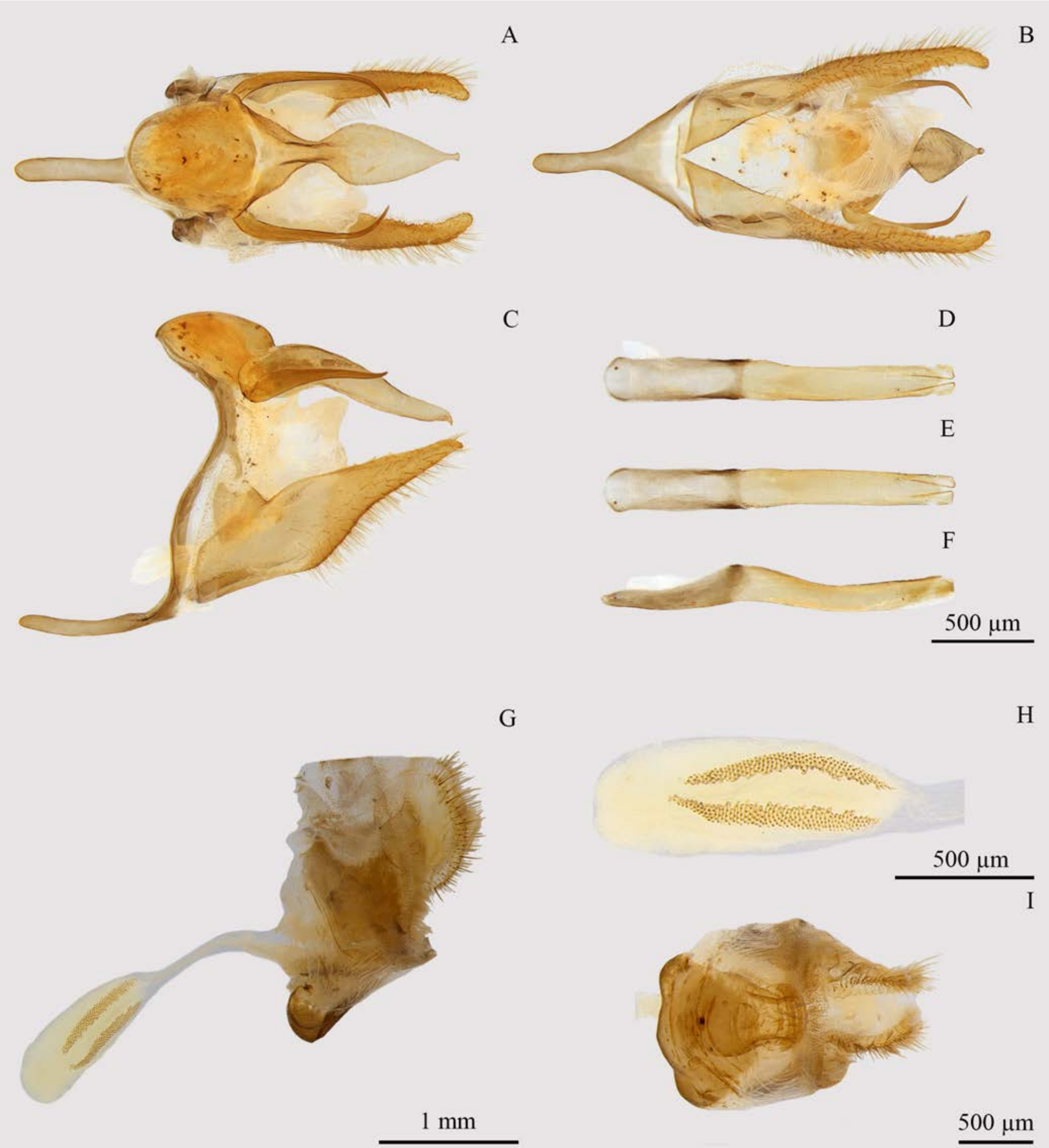

Figure 3. Genitalia of the male holotype (DZ 42. 559) and female paratype (DZ 42. 546) of *C. thaliana* **n. sp.**: A) male genitalia in dorsal view; B) male genitalia in ventral view; C) male genitalia in lateral view; D) phallus in dorsal view; E) phallus in ventral view; F) phallus in lateral view; G) female genitalia in lateral view; H) signa; I) lamella antevaginalis in ventral view.

in the reared female from Madre de Dios, Peru. Furthermore, *C. thaliana* **n. sp.** is separated from *C. umbrosa* by having more grooves along the distal side of lamella antevaginalis in ventral view, as well as having broader and longer signa. Additionally, *C. thaliana* **n. sp.** somewhat resembles species in the genus *Hermeuptychia* Forster, 1964, but *C. thaliana* **n. sp.** is readily distinguished from *Hermeuptychia* species by lacking dark scaling along the disco-cellular vein on the ventral forewing and below the origin of M_2 on the ventral hindwing, as well as lacking an indentation along the ventral margin of the valva in lateral view.

Description. MALE: Forewing length 19.7 mm (n=1; holotype).

Head: Eyes covered with dark brown hair-like setae, white scales at base; frons dark brown, with grayish and brownish scales, as well as concolourous elongated hair-like scales; first segment of labial palpi short, with dark brownish and whitish scales and concolourous long setiform scales, ventrally directed, second segment of labial palpi slightly longer than longitudinal eye depth, dorsally with dark brownish setiform scales mixed with whitish scales, laterally with whitish scales, ventrally with long dark brownish and whitish hair-like scales, longer than third segment of labial palpi, third segment of labial palpi porrect, dorsally with dark brownish and whitish scales, laterally with whitish scales and ventrally with dark brownish scales; antennae approximately two-fifths of forewing length (i.e., from wing base to R$_5$), shorter than discal cell length (i.e., from base to inferior disco-cellular vein), composed of 29 flagellomeres (scape and pedicel not examined), four distal flagellomeres appearing darker than others, club rather insignificant but discernible, grayish and brownish scales along antennae. **Thorax:** Dorsally and laterally with brownish scales and long hair-like scales; ventrally with light brownish hair-like scales and yellow ocher scales; prothoracic leg reduced, with grayish or brownish setiform scales; mesothoracic leg brownish, dorsally darker than ventrally (metathoracic leg not located on holotype), pair of tibial spurs, equal in length, visible at distal end of tibia, both tibia and tarsus adorned with longtitudinal rows of spines ventrally, in addition to several spines noticeable on lateral side of tibia. **Abdomen:** Eighth tergite appearing as membranous, visible as narrow band at base of eighth abdominal segment, as well as somewhat broad weakly sclerotized posterior region noticeable. **Wing venation:** Basal half of subcostal vein inflated, as well as base of cubitus; recurrent vein apparently absent in forewing discal cell; hindwing humeral vein developed. **Wing shape:** Forewing subtriangular, overall appearing rounded and broad rather than elongate, apex rounded, costal margin slightly convex, outer margin straight from M$_2$ to Cu$_2$, curved above and below these veins respectively, inner margin straight; hindwing overall slightly elongate and rounded, costal margin convex above Sc + R$_1$, outer margin slightly sinuate, inner margin slightly concave near tornus, anal lobe convex. **Dorsal forewing:** Ground color brown, slightly darker distally; no visible secondary sexual traits on wings; olive-greyish sheen apparently not present. **Dorsal hindwing:** Ground color brown; marginal band around Cu$_1$ and below; no visible secondary sexual traits on wings; olive-greyish sheen apparently not present. **Ventral forewing:** Ground color chestnut brown; brownish discal band crossing discal cell, passing area near origin of Cu$_2$ distally, fading in cell Cu$_2$; concolourous postdiscal band, broader than discal band, traversing from R$_5$ to 2A, anteriorly narrow and somewhat sinuate, slightly broadening posteriorly and fading in cell Cu$_2$; small submarginal ocellus in cell M$_1$, appearing as black spot with orangish-yellow ring, with two silver-ish pupils; submarginal band grayish brown, extending from apical area to 2A by gradually broadening, and jagged; concolorous marginal band traversing from apex to 2A; fringe dark ocher. **Ventral hindwing:** Ground color chestnut brown; narrow band absent at base of wing; discal band traversing from costal margin to inner margin, roughly straight and evenly broad throughout, passing area near origin of Rs basally; concolorous postdiscal band, parallel to discal band and similar in width, roughly straight but indented at origin of Cu$_1$; five submarginal ocelli, those in cells Rs, M$_1$ and Cu$_2$, appearing as black spot with orangish-yellow ring, ocellus in cell Rs with single large silver-ish pupil encompassing much of ocellus, ocellus in cell M$_1$ with single small pupil in middle, ocellus in cell Cu$_2$ with two small pupils and ocellus elongated vertically, ocellus in cells M$_2$ and M$_3$ appearing as creamy-yellowish smudge accompanied with barely noticeable pupil; submarginal band grayish brown, extending from cell Rs towards inner margin and apparently fused with postdiscal band at its posterior end, appearing jagged and gradually broadening; marginal band appearing slightly darker than submarginal band and slightly undulating, traversing from apex to tornus; fringe dark ocher. **Genitalia** (Figs. 3A-F): Tegumen approximately hemisphere in lateral view, dorsally convex with anterior end appearing slightly hooked in lateral view, ventral margin roughly straight; uncus approximately twice as long as tegumen in lateral view, hair-like setae not visible along uncus, base broadening in both lateral and dorsal view, dorsal margin slightly curving posteriorly in lateral view, tapering posteriorly and terminating in hooked single point in lateral view, terminating in spatula-like end in dorsal view; brachium tapering towards apex, apical point positioned above uncus in lateral view, roughly parallel to uncus with apical edge curving inwards in dorsal view; combination of ventral arms from tegumen and dorsal arms from saccus sinuate; appendices angulares present, developed and curving inwards; saccus slightly curved, shorter than uncus in length but longer than tegumen; weakly sclerotized region visible on ventral surface of anal tube; juxta present as “V-shaped” weakly sclerotized plate with acute apex; valva distally setose, valva appearing approximately parallelogram in lateral view, ventral margin convex at middle, dorsal margin of costa with concavity, apical process of valva with straight dorsal and ventral margin in lateral view, terminating in slightly hooked, angular, and blunt point; inner margin of apical process of valva serrated; phallus roughly straight, phallobase shorter than aedeagus; cornuti apparently absent.

COI barcode sequence (molecular voucher: BC-DZ-025; GenBank voucher: ON932574):

```
TTTTTGGTATTTGAGCAGGAATATTGGGCACATCTCTTAGCTTAATCATTCG
AATAGAATTAGGTAACCCAGGATTTTTAATTGGAAATGACCAAATTTATAAT
ACAATTGTAACAGCCCATGCTTTTATTATAATTTTTTTTATAGTAATACCCA
TTATGATTGGAGGATTTGGTAATTGATTAGTTCCTTTAATATTAGGAGCTCC
TGATATAGCTTTTCCTCGTATAAATAATATAAGATTTTGGCTACTCCCCCCT
TCTTTAATTTTATTAATTTCGAGAAGTATTGTAGAAAATGGAGCTGGTACTG
GATGAACAGTTTACCCCCCCCCTTTCTCTAATATTGCTCATAGAGGCTCCTC
AGTTGATTTAGCTATTTTTTCCCTTCATTTAGCTGGAATTTCCTCAATTTTA
GGAGCTATTAATTTTATTACTACAATACTNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
NNNNNNNNNNTTCTTACCTGTTTTAGCAGGAGCTATCACAATACTTTTAACT
GATCGAAATTTAAACACATCTTTTTTTGATCCTGCAGGAGGAGGTGATCCTA
TTTTATACCAACATTTATTTTGATTTTTTGGTCACCCTGAAGTT
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FEMALE: Forewing length 18.3-19.4 mm (n=2). **Similar to male except as follows:** Foretarsus divided into five segments; wing overall appearing broad and rounded, as well as paler, ventral hindwing submarginal band broader. **Abdomen and genitalia** (Figs. 3G-I): Eighth tergite fully developed; intersegmental membrane of seventh and eighth abdominal segment pleated and expandable, folded over lamella antevaginalis, with moderately sclerotized region present; lateral plate of eighth abdominal segment not fused with lamella antevaginalis; lamella antevaginalis appearing as somewhat winkled and trapezoidal sclerotized plate broadening anteriorly; ductus seminalis exiting at one-third distance from ostium bursae to corpus bursae, pair of rather broad and long signa located ventrally on corpus bursae; papilla analis elongated vertically than horizontally, with numerous setae, posterior apophysis as rounded point. **COI barcode sequence** (2021-FLP-IMM-0371; GenBank voucher: ON931448)**:** differing from holotype by 14 base pairs.

Immature stages (based on 2021-FLP-IMM-0371 throughout).

Egg (Figs. 4A, B)**:** Spherical, appearing yellowish and semi-transparent, with apparently somewhat irregular polygonal markings covering surface. Stemmata and mouth parts visible day prior to hatching. Diameter: 1.0 mm. Duration: Unknown, collected on 10 May 2021 and hatched on 11 May 2021.

First instar (Figs. 4C, D; 5A)**:** Head capsule width: 0.8 mm. Head capsule appearing black, vertex rounded and epicranial notch insignificant, with semi-rectangular scolus adorned with delated setae (scolus length 0.1 mm); five noticeable chalazae visible, M1, M2, M3 and P4, as well as one by stemma 3; four setae visible on one side of labrum; six stemmata visible, stemma 3 largest, closer to stemma 2 than 4. Body integument yellowish and semi-transparent, overall body color chartreuse due to greenish intestinal content revealed through semi-translucence; pair of white insignificant dorsal lines present, delineating reddish brown mid-dorsal region; three concolourous sub-dorsal to lateral lines present, parallel to two dorsal lines; spiracles and tracheal system noticeable along spiracles; chaetotaxy not fully discernible based on photographs but primary setae thread-like and slightly dilated at apex (described as “weakly bulbed” *sensu* Murray (2001: Fig 3.13C)), XD1 and XD2 visible on T1 and similar in length, D1, D2, SD1 and L1 apparently present from T1 to A10, D1 and D2 rather short but noticeably longer on terminal abdominal segments (length of D2 about half of D1, on A8 and A9), SV1, SV2, SV3, L2 and PP1 noticeable on A10 (but not fully discernible on A9); slightly pinkish bifid caudal filaments, appearing similar or shorter than A8 in dorsal view. Body length: 5.9 mm based on larva photographed on 17 May 2021. Duration: 8 days (11-19 May 2021).

Second instar (Figs. 4E, F; 5B)**:** Head capsule width: 0.9 mm. Head capsule appearing dark brown, epicranial notch and vertex as in previous instar, with numerous secondary setae and two developed horn-like scolus, inner margin appearing darker (darker area extends to vertex), with seta on both tips (scolus length 0.3 mm); chalazae reduced; five setae discernable on one side of labrum; six stemmata visible, arrangement similar to previous instar. Body overall appearing dark, fleshy, and granular; five creamy-whitish mid-dorsal to lateral lines present as in previous instar, appearing darker between two dorsal lines; setae thread-like and shorter; spiracles rather insignificant but noticeable on T1 and A8, tracheal system not discernable; bifid caudal filaments, appearing longer than A8 in dorsal view, inner-margin slightly pink-ish. Body length: 7.0 mm based on larva photographed on 22 May 2021. Duration: 10 days (19-29 May 2021).

Third instar (Figs. 4G, H; 5C)**:** Head capsule width: 1.5 mm; scolus length 0.5 mm. Head and body similar to immediately preceding instar except for head scolus lighter distally and labrum appearing reduced. Body length: 16.0 mm based on larva photographed on 2 June 2021. Duration: 8 days (29 May-6 June 2021).

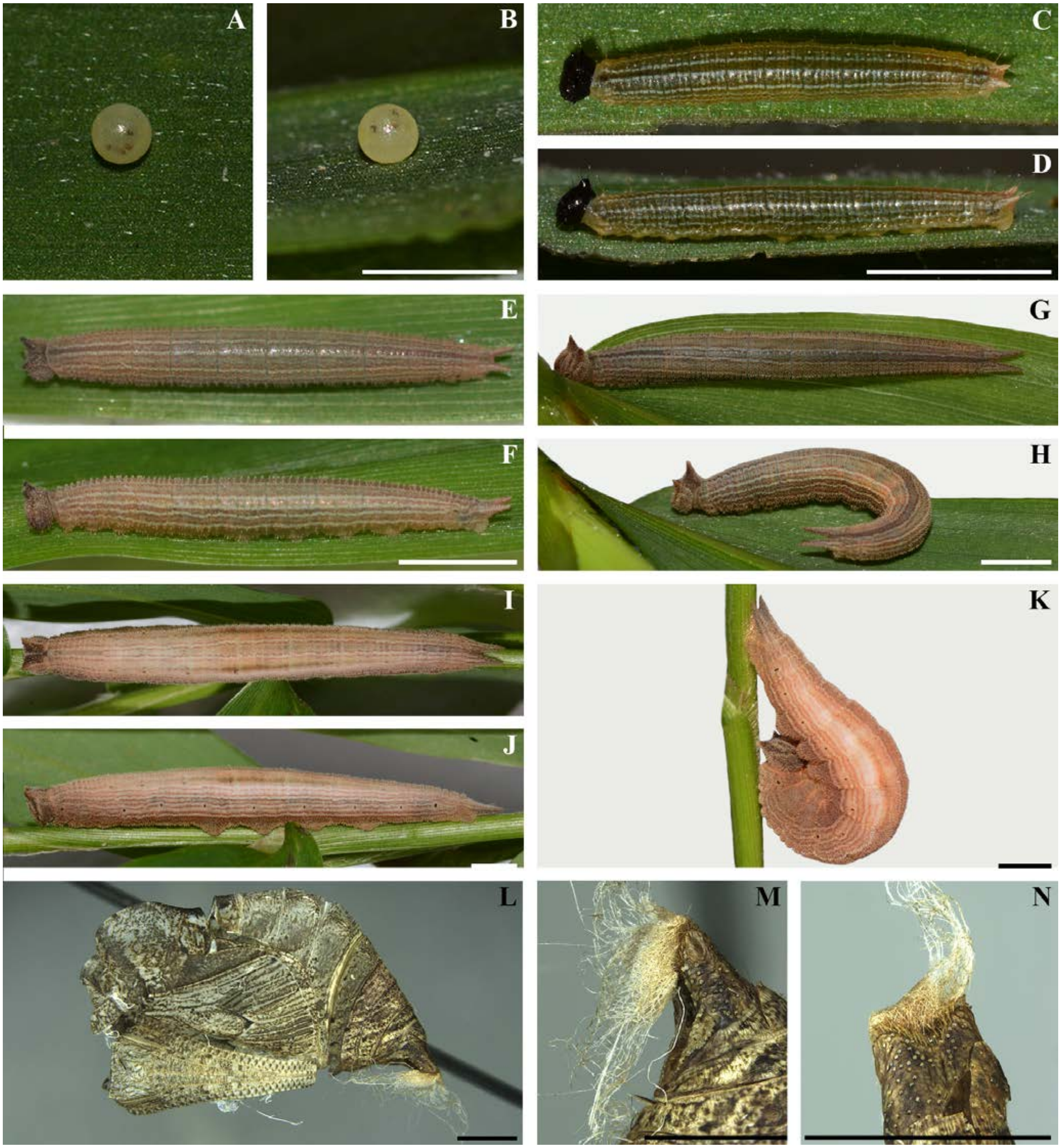

Figure 4. Immature stages of *C. thaliana* **n. sp.** based on 2021-FLP-IMM-0371: A, B) egg, with mouthparts and stemmata showing through semi-translucent; C) first larval instar in dorsal view; D) first larval instar in lateral view; E) second larval instar in dorsal view; F) second larval instar in lateral view; G, H) third larval instar in dorsal-lateral view; I) fourth (ultimate) larval instar in dorsal view; J) fourth (ultimate) larval instar in lateral view; K) prepupa; L) pupal case in lateral view; M) cremaster in lateral view; N) cremaster in dorsal view. All scale bars = 2 mm.

Fourth (ultimate) instar (Figs. 4I, J; 5D)**:** Head capsule width: 2.2 mm; scolus length 0.7 mm. Head and body similar to immediately preceding instar except base of head scolus broader, labrum appearing reduced, and body overall appearing lighter with spiracles more prominent. Body length: 26.4 mm based on larva photographed on 17 June 2021. Duration: 15 days (6-21 June 2021).

Pupa (Figs. 4L-N)**:** Pupal case as illustrated; cremaster broad, somewhat wrinkled and dark with numerous setae discernable ventrally as well as posteriorly, terminating rather broadly with concavity observed in dorsal view. Body length: not measured. Duration: 16 days (21 June-7 July 2021).

Host plant (recorded by Thalia Corahua-Espinoza). *Lasiacis ligulata* Hitchcock & Chase (Poaceae: Panicoideae: Paniceae) (Figs. 6A-C).

The natural host plant for *Caeruleuptychia thaliana* **n. sp.** was identified as a grass species in the plant family Poaceae, *Lasiacis ligulata* Hitchcock & Chase, at FLP. At FLP, this plant species is a common component of the plant community along forest edges, and it is occasionally found inside the forest,

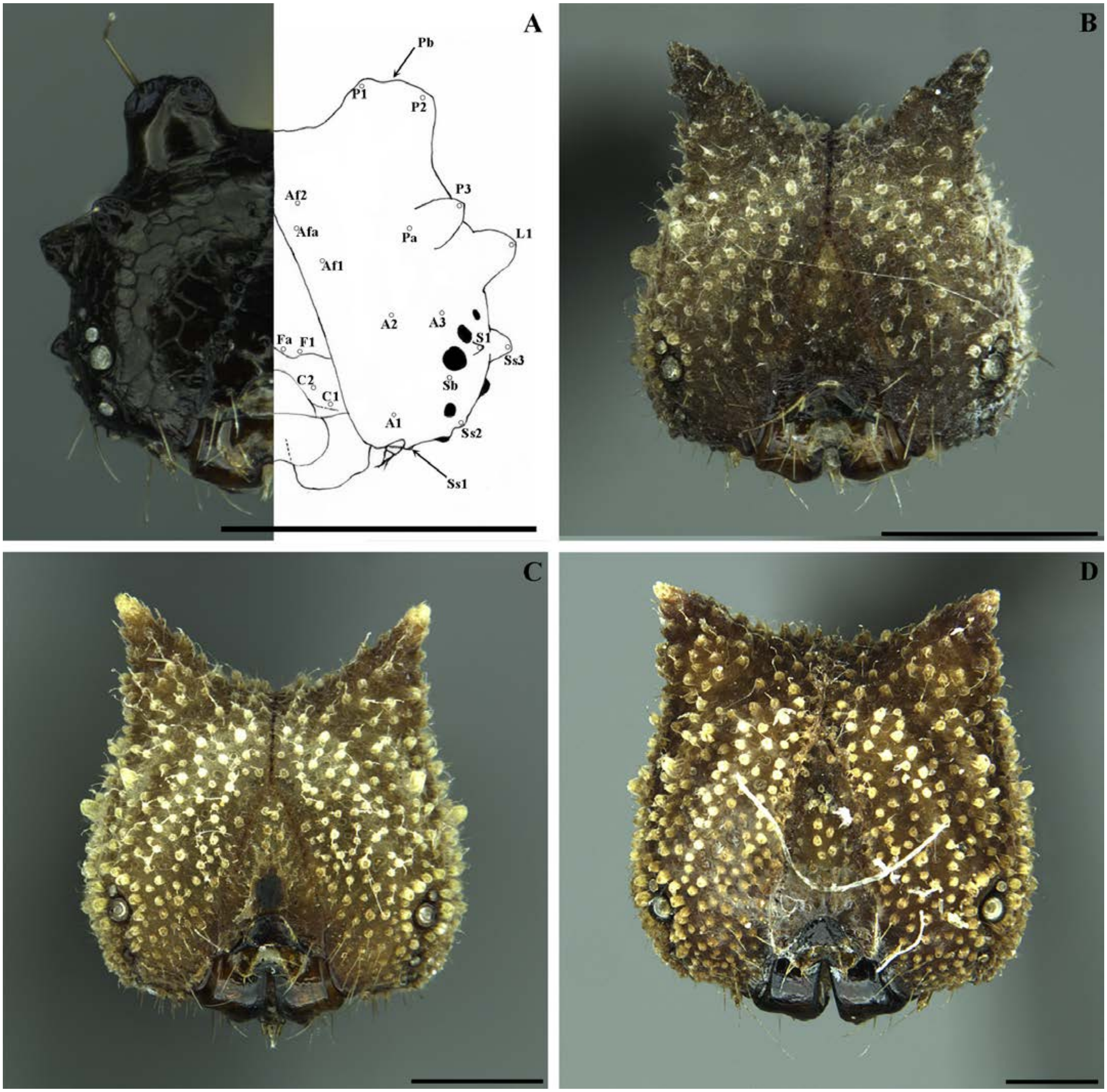

Figure 5. Head capsules of *C. thaliana* **n. sp.** based on 2021-FLP-IMM-0371: A) first instar in frontal view; B) second instar in frontal view; C) third instar in frontal view; D) fourth (ultimate) instar in frontal view. All scale bars = 0.5 mm.

especially along large forest trails. A single egg of *C. thaliana* **n. sp.** reared for the present study (2021-FLP-IMM-0371) was found at the entrance to a forest trail. At the time of sampling on 10 May 2021, the height of the plant was 2.5 m. The egg was found at a distance of 1.3 m from the ground, located on the abaxial surface, on the proximal part of the leaf blade, between the midrib and leaf margin.

Types. HOLOTYPE: male, with following labels written verbatim: //31 a 35 km NO de Barra do Bugres, Barra do Bugres, MT, 28-VI-1972 200 m, Mielke & Brown//BC-DZ-Willmott 25//DZ 42. 559//GEN. PREP. M. M. Casagrande 2021//HOLOTYPUS//HOLOTYPUS CAERULEUPTYCHIA THALIANA NAKAHARA & PIOVESAN DET. 2022// (DZUP).

PARATYPES: two females, with following labels written verbatim: //31 a 35 km NO de Barra do Bugres, Barra do Bugres, MT, 28-VI-1972 200 m, Mielke & Brown// DZ 42. 546//GEN. PREP. M. Piovesan 2022// (DZUP); //PERU: Madre de Dios Dept. Finca Las Piedras, ca. 270 m asl -12.226616°, -69.112392° approx. Reared from immature stage Adult eclosion: 07 Jul 2021 T. Corahua *leg*.// 2021-FLP-IMM-0371// (ASA).

Etymology (by Shinichi Nakahara). *Caeruleuptychia thaliana* **n. sp.** is named in recognition of Thalia Corahua-Espinoza, from Puerto Maldonado, Peru, whose study at FLP in 2021 brought numerous novel host plant records to science and significantly advanced our knowledge of Neotropical butterfly immature stages. As indicated above, her discoveries served as the basis

Figure 6. Habitat and host plant (*L. ligulata*) of *C. thaliana* **n. sp.**: A) Habitat at FLP where the host plant was found (photo credit: Zunilda Escalante); B) host plant *in situ*; C) close-up view of leaves and nodes.

for generating a number of life history articles (Ccahuana *et al*., 2021; Corahua-Espinoza *et al*., 2022a, b, in press, in prep.; Duerr *et al*., in press; Nakahara *et al*., 2022; Tejeira *et al*., 2021), including the present study, and these accomplishments in a given short time-frame are remarkable and unmatched. Her seemingly unlimited intrinsic motivation to revamp our understanding of Amazonian biodiversity was truly inspirational and anchored myself to Neotropical Lepidopterology by instilling me with revived interest, continuing to document butterfly diversity as a taxonomist. This patronym is also coined in appreciation for her fine company, hospitality, and tolerance throughout the course of traveling to various sites around Puerto Maldonado in June 2022. Thalia's solicitude, thoughtfulness, selflessness, and dry sense of humor coupled with her honesty, modesty, infinite patience, and (sometimes) meticulousness are all acquainted to everyone who has had the pleasure and fortune to know her in person. The specific epithet is an indeclinable Latinized noun standing in apposition with the feminine generic name.

Distribution. *Caeruleuptychia thaliana* **n. sp.** is known from two sites which are over 1,300 km apart in the Amazon basin, namely Barra do Bugres (Mato Grosso, Brazil) (type locality) and Finca Las Piedras (Madre de Dios, Peru).

DISCUSSION

The decision to place *C. thaliana* **n. sp.** in *Caeruleuptychia* is primarily influenced by the fact that the type species of the genus, *Euptychia caerulea* Butler, 1869 (i.e., junior subjective synonym of *E. urania* Butler, 1867; Ríos-Málaver (2019)), is recovered as part of a monophyletic *Caeruleuptychia* based on the ML tree (Fig. 1). However, support for the monophyly of *Caeruleuptychia* in the current study is not strong (UFBoot/aBayes/SH-aLRT = 89.3/0.999/76); therefore, we consider the fact that *C. thaliana* **n. sp.** was found as being the sister species of *C. umbrosa* to be another piece of evidence to justify this generic classification.

We here discuss two available species-group names associated with *Caeruleuptychia*, both of which have arguable applications to the concept represented by the name *C. thaliana* **n. sp.**, in order to justify our taxonomic hypothesis by excluding these possibilities. *Euptychia umbrosa* Butler, 1870 was described by Arthur G. Butler based on an unspecified number of specimen(s) collected by [Clarence] Buckley in Ecuador, owned by [William Chapman] Hewitson (Butler, 1870). Although the description predominantly reflects a typical brown euptychiine species, a certain portion of the wing description of *E. umbrosa* provided by Butler enables us to narrow down its identity: dorsal surface of the wing grayish-green (*Alae supra cinereo-virides*); ventral surface paler with white scales (*Alae subtus pallidiores albido squamosae*). The former grayish-green dorsal surface is also depicted in the illustration of its dorsal surface (on pl. XVIII [18], fig.8) accompanying the original description of *E. umbrosa*. These two features are visible in the male syntype housed in NHMUK (images available through Warren *et al.,* 2017), albeit the grayish-green sheen of the dorsal surface is apparently faded in this syntype. For an unknown reason, Forster (1964) did not classify *E. umbrosa* in any of the genera he erected in his ground-breaking work regarding euptychiine classification, and it was not until Lamas (2004) where this taxon was placed in *Caeruleuptychia*.

Euptychia viridicans Weymer, 1911 was described based on an unspecified number of specimen(s) from Peru, by Gustav Weymer (Weymer, 1911: 199, fig. 47b). The sex of the syntype was not explicitly stated in the original description, although the syntype housed at STD is a male specimen, judging from the genitalia visible at the posterior tip of the abdomen (images available through: Warren *et al.,* 2017). Subsequently, Forster (1964) established a monospecific genus *Weymerana* Forster, 1964 to accommodate *E. viridicans* and provided a somewhat ambiguous feature of the phallus/aedeagus as apparently the sole diagnostic character for *Weymerana*. Lamas (2004) considered *Euptychia viridicans* as a junior subjective synonym of *E. umbrosa* without providing rationale for this taxonomic proposal.

Despite the fact that these two authors did not depict the hair-pencil on the dorsal forewing in their description of these two taxa, the two syntypes discussed above possess all the wing pattern features mentioned above to distinguish *C. umbrosa* from *C. thaliana* **n. sp.**, except for the male syntype of *E. viridicans* apparently lacking an olive-grayish sheen on the dorsal surface (the hair-pencil on the dorsal forewing is somewhat visible in these two syntypes). This fading phenomenon of the olive-grayish sheen is also noticeable in one sequenced male of *C. umbrosa* (CP01-09; MUSM-LEP-100245), although the trace of a sheen is discernible at the base of wings in this male specimen. Nonetheless, other phenotypic features, as well those genital characters (#CP-191, MUSM), discussed as diagnostic above are clearly visible in this sequenced specimen from Madre de Dios, Peru. Thus, it seems plausible to apply the specific epithet *umbrosa* to the clade consisting of eight specimens spanning its range in the Amazon basin and beyond (see Table 1 for locality data), as well as to any individuals which can fall within the concept represented by the species-group name *umbrosa* based on these characters discussed herein. Due to the lack of genetic data from relevant types, we refrain from designating lectotypes of these two names in the current work, but it does seem reasonable to retain *E. umbrosa* as a senior subjective synonym of *E. viridicans*.

The COI barcode patristic distance between eight sequenced *C. umbrosa* and the holotype of *C. thaliana* **n. sp.** ranged from 4.1%-5.1% (mean: 4.21%), while genetic divergence among these eight *C. umbrosa* ranged from 0.1%-1.7% (mean: 0.67%). *Caeruleuptychia thaliana* **n. sp.** and *C. umbrosa* are broadly sympatric in the Amazon basin, supporting the proposed species-level status of *C. thaliana* **n. sp.** in conjunction with the presence/absence of the dorsal forewing hair-pencil. For example, 2021-FLP-IMM-0371 (*C. thaliana* **n. sp.** from FLP, Madre de Dios) and CP01-09 (*C. umbrosa* from Tambopata Research Center, Madre de Dios) originate from sites which are approximately 100 km apart and exhibited genetic distance of >3.0%. Conversely, two sequenced individuals of *C. thaliana* **n. sp.** were sampled from localities which >1,300 km apart and showed genetic divergence of <2.0%. Notwithstanding this result, one might argue that our decision to consider BC-DZ-25 conspecific with 2021-FLP-IMM-0371 can be falsified since the COI barcode sequence from the latter individual shows a somewhat high patristic distance (1.9%) from the holotype. Additionally, the patristic distance of 2021-FLP-IMM-0371 and the holotype of *C. thaliana* **n. sp.** against eight sequenced individuals of *C. umbrosa* is 3.0%-5.1% (mean: 3.74%), resulting in a rather trivial barcoding gap. Despite this situation, we observed a nonsynonymous substitution between sequences of *C. thaliana* **n. sp.** (n=2) and *C. umbrosa* (n=8): sites 148-150 are ATT in *C. thaliana* **n. sp.**, whereas GTT in *C. umbrosa*, translating to Isolucine and Valine, respectively. This amino-acid-altering substitution, which is not detected among eight sequences of *C. umbrosa*, will influence the LnL of the sequence data at this codon position 148 during the topology and branch length proposals during the maximum likelihood analysis (Felsenstein, 1981). However, when we partitioned the data into codon positions, the placement of *C. thaliana* **n. sp.** in the ML tree resulted in a paraphyletic *C. umbrosa* (data not shown). Although modeling DNA sequence data is more reasonable this way, any given gene-tree will likely illustrate some discrepancies from a species-tree (e.g., Maddison, 1997). Since *C. thaliana* **n. sp.** and *C. umbrosa* both form a clade and are recovered as sister to each other in the ML tree under a single substitution model (Fig. 1), we consider our taxonomic hypothesis is supported by showing this ML tree. *Caeruleuptychia thaliana* **n. sp.** is therefore a taxon that warrants a specific name, and application of a subspecific epithet is inappropriate.

As set forth above, our taxonomic hypothesis is supported based on adult external morphology and molecular data, as well as evidence illustrating that no available species-group names are in existence. Here, we discuss an additional potential layer of evidence which may support taxonomic status of *C. thaliana* **n. sp.** by extracting and interpreting relevant life history information presented in an unpublished portion of Murray's (2001) dissertation.

The identity of *C. scopulata*, reported to feed on species of *Guadua* Kunth (Poaceae: Bambusoideae: Bambuseae) in eastern Ecuador, in Murray's (2001) dissertation may well represent *C. umbrosa*. This assumption is supported by the fact that sequenced material from Napo province, Ecuador included in the present study (DNA00-016; see Table 1) is a molecular sample originally identified as *C. scopulata* and was generated during the course of preparing Murray (2001: Table 4.1). As discussed above, eight sequences identified as *C. umbrosa* herein, including DNA00-016, illustrated a rather low intraspecific genetic divergence and their conspecificy is graphically informed in Fig. 1. In fact, DNA00-016 was identified as *C. umbrosa* in Murray & Prowell (2005). Murray (2001: Table 4.1) indicates that DNA from this specimen was extracted from dried material. However, it is unclear whether DNA00-016 was one of the samples used to study life stages in Murray (2001), or an adult collected in the field with no associated immature stages data. If the concept of *C. scopulata* was applied uniformly to all individuals identified as this taxon studied in Murray (2001), it would be reasonable to accept that this specific epithet was misapplied to samples used to examine immature morphology and biology. Given this, the natural host plant of *C. umbrosa* recorded in Jatun Sacha (Napo, Ecuador) is an unidentified species of *Guadua* according to Murray (2001: Table 5.1). *Guadua* is a genus of Neotropical woody bamboo in the subtribe Guaduinae (Bambuseae). With over 30 species recognized, *Guadua* is the third species-rich genus of the Neotropical bamboos (i.e., Bambuseae + Olyreae) after two diverse Andean bamboo genera, *Chusquea* Kunth and *Aulonemia* Goudot (Clark & Oliveira, 2018). Unlike *Chusquea* and *Aulonemia*, *Guadua* is known for its representation in the lowlands (Clark, 1990), and among *ca*. 150 euptychiine species with some kind of associated host plant records, at least 17 species are recorded to have species of *Guadua* as a host plant (Corahua-Espinoza & Nakahara, unpublished data). It must be noted that these numbers do not include species with host plants recorded as "many grass species", "probably many grass species" and "probably *Guadua*" in Murray (2001: Table 5.1) due to ambiguity. Among these 17 euptychiine species recorded to utilize species of *Guadua*, host plant records for 10 species are represented to date only by *Guadua* species. In fact, existing evidence suggests some euptychiine species may feed exclusively on *Guadua* (e.g., *Pseudodebis valentina* (Cramer, 1779), *Posttaygetis penelea* (Cramer, 1777), *Splendeuptychia itonis* (Hewitson, 1862); Corahua-Espinoza *et al*., in press; Murray, 2001, 2003). Based on the feeding experiments conducted by Murray (2001), *Pseudodebis valentina* and *S. itonis* consumed and pupated only by feeding on *Guadua* sp., and rejected or died shortly after consuming the following Poaceae species: *Olyra* sp., *Pariana* sp. (both Olyreae), *Orthoclada* sp. (Zeugiteae), *Lasiacis* sp. (Paniceae) (for *S. itonis* only) and *Panicum* sp. (Paniceae) (for *P. valentina* only). Murray (2003) reported a similar observation for *Posttaygetis penelea*, namely mature larvae rejecting two herbaceous bamboo species and one grass species, consuming only *Guadua* bamboo. This specialization of *P. penelea* is corroborated by recent field work at FLP, where immature stages of this taxon were found exclusively on *Guadua weberbaueri* Pilg. in nature (n=5; Zunilda Escalante, pers. comm.). Nevertheless, *C. umbrosa* is found at sites in Ecuador where *Guadua* bamboos apparently do not occur (Keith Willmott, pers. comm.), and caution must be exercised when interpreting the field experiment results of Murray (2001), thus increasing the likelihood of *C. umbrosa* utilizing non-*Guadua* plants in nature. On the other hand, Janzen & Hallwachs (2018) reported a single record of *Guadua* bamboo for *Taygetis laches* (Fabricius, 1793) in southwestern Costa Rica, whereas > 500 other records are known from various other grass species and herbaceous bamboos, including > 300 records from *Olyra latifolia*, as well as 13 records based on Cyperaceae. Thus, *Guadua* bamboo is likely not the preferred host plant for *T. laches* at Janzen & Hallwachs' (2018) study site in Costa Rica and this record may be best considered as an irregular host plant record. We see a similar case with two other *Taygetis* species according to Janzen & Hallwachs' (2018) database, where the host plant record of *Guadua* is represented as a single record along with various other Poaceae species with records for multiple individuals associated. Corahua-Espinoza *et al.* (in press) discussed that this ability to feed on various Poaceae species, as well as other plant families, might have contributed to the species diversity of *Taygetis* Hübner, [1819], although such debate is only possible through accumulation of host plant records. Unfortunately, Janzen & Hallwachs' (2018) study is based in Costa Rica, where representation of *Caeruleuptychia* is almost non-existent. *Caeruleuptychia* rivals *Taygetis* in terms of species diversity, and it would be most interesting to assess the diet breadth of the members of *Caeruleuptychia* in order to provide insights into its diversity in the Amazon basin.

Apart from *Guadua* bamboo records, to date >40 euptychiine species out of *ca*. 150 species are known to solely utilize species of woody bamboos and/or herbaceous bamboos, whilst at least 6 species are recorded to feed on other grass species as well (Corahua-Espinoza & Nakahara, unpublished data). If euptychiine species feeding on *Guadua* and other bamboo species tend to have a narrow diet breadth, that may strengthen the taxonomic hypothesis proposed herein. *Caeruleuptychia thaliana* **n. sp.** is reported to utilize a grass species, *L. ligulata* in southeastern Peru and *C. umbrosa* is reported to feed on a woody bamboo, *Guadua* sp. in eastern Ecuador, implying some degree of niche partitioning by utilizing plant species in two different subfamilies. Nevertheless, as explained above, some ambiguity regarding information presented in Murray (2001) requires clarification to develop this argument further. Our highly fragmentary knowledge regarding *Caeruleuptychia* immature stages, host plants, and their diet breadth also prevents us from continuing this debate. Apart from the two host plant records discussed and presented herein, records for a mere two species are available to us regarding *Caeruleuptychia* host plants: unidentified *Caeruleuptychia* - unidentified Poaceae in Brazil (Beccaloni *et al.*, 2008); *Caeruleuptychia urania* - study in progress (Corahua-Espinoza *et al.*, in prep.). We also add that both male and female individuals of *C. helios* Weymer, 1911 were only found in association with *Guadua weberbaueri* at FLP (pers. obs.), suggesting that *C. helios* may utilize *G. weberbaueri* in nature. *Caeruleuptychia trembathi* Willmott, Nakahara, Hall & Neild, 2017 is also found in close association with *Guadua* or *Chusquea* bamboo stands, and known females from Ecuador are always found near *Chusquea* bamboo in eastern Ecuador (see Nakahara *et al.*, 2018b). Clearly, these speculations regarding their host plants will need to be clarified by documenting immatures of these *Caeruleuptychia* species in nature. As euptychiine host plant records continue to accumulate, we see some degree of tendency and evidence towards bamboo feeding in euptychiine species to be more concentrated in the so-called "*Taygetis* clade", "*Amphidecta* clade" and "*Cyllopsis* clade". Nevertheless, there exist exceptions, such as the *Splendeuptychia* "*ashna* group" (recovered in the so-called "*Splendeuptychia* clade"), and the aforementioned sparse host plant records for *Caeruleuptychia* will not allow us to draw any conclusions as to its host plant preference and diet breadth. It hardly needs saying that a consensus regarding euptychiine natural history is only beginning to emerge.

Finally, like other species-group names published for the purposes of zoological nomenclature, *Caeruleuptychia thaliana* **n. sp.** is a name inextricably tied to the name-carrier (i.e., holotype). This will enable application of this arbitrary combination of letters to designate a corresponding concept of *C. thaliana* **n. sp.** based on the classification introduced herein. If applied to a concept, *C. thaliana* **n. sp.** becomes a taxonomic hypothesis, which can be falsified if contradicting evidence surfaces. Hence, the specific epithet may be interpreted as a mere reflection of our current understanding of this ancestor-descendant lineage to which the name-bearing type belongs. As mentioned and demonstrated herein, creation of a scientific name involves subjectivity. Additionally, application of this name is an equally subjective process, since species recognition is based on picking strands of evidence to fit a taxonomic hypothesis. These hypotheses (i.e., concepts) are subject to revisions, and consequently, scientific names can be endlessly removed, renamed, or reapplied. It is this advancement of our understanding of the natural world which causes taxonomy, the science of naming and classifying the diversity of life, to hold so much appeal.

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Scientific Note: Caterpillar mimicry across orders: Pine sawfly larvae as a possible model for an Erythrina Leafroller caterpillar, *Agathodes monstralis* (Lepidoptera, Crambidae)

Andrei Sourakov

McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville, FL 32611, USA

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Abstract: While caterpillars are under huge selective pressure from predators and are frequently chemically protected, very few cases of caterpillar mimicry have been formally described in the scientific literature compared to the mimicry complexes found in adult Lepidoptera. Nevertheless, caterpillar mimicry may be common, so possible mimicry complexes should be described and, when possible, investigated. Here, it is proposed that caterpillars of the Redheaded Pine Sawfly, *Neodiprion lecontei* (Hymenoptera, Diprionidae), are chemically defended co-mimics with a crambid caterpillar, *Agathodes monstralis* (Lepidoptera, Crambidae), with which they are found in the same habitat in eastern United States. While both species are chemically defended, based on differences in behavior (open gregarious feeding for the sawfly larvae and concealed solitary feeding in the moth caterpillar), this mimicry complex is likely to be quasi-Batesian (both contribute to aposematic signal, albeit unequally). This mimicry hypothesis is supported by the strong phenotypic similarity between the larvae of the two insect taxa discussed here, and the obvious divergence in *Agathodes monstralis* in comparison with congeners outside the sawfly's range.

First described by Bates over a century ago (Bates, 1862), mimicry in Lepidoptera continues to contribute as a remarkable phenomenon for understanding mechanisms of evolution. For instance, characterization of microhabitat niches during field research (e.g., Willmott *et al.*, 2017) led to understanding of how distinct mimicry complexes and bird predators might partition habitats within a forest. Modern CRISPR work, such as gene silencing, allows researchers to dissect the formation of color patterns in mimetic butterflies, showing that congeneric co-mimics arrive at similar wing patterns using different developmental pathways (Concha *et al*., 2019).

While there are numerous well documented mimicry complexes among adult Lepidoptera, there are less than two dozen caterpillar mimicry complexes that have been described in the scientific literature (Willmott *et al*., 2011 and references therein). This is likely not as much due to the lack of mimicry complexes among caterpillars, but because they are rarely reported. For instance, Janzen *et al.* (2010) described eye-spot bearing caterpillars and pupae of tropical Lepidoptera as a "horde of counterfeit predator eyes."

In their pursuit of understanding the mechanisms of convergent evolution, developmental biologists may want to turn their attention from well-known mimicry systems, such as those found among butterflies (e.g., Beccaloni, 1997), to immature stages, since the latter may provide amazing revelations. For instance, recent work has shown that the integument of a geometrid caterpillar can sense the color of its surrounding and change its color accordingly to fit the background (Eacock *et al*., 2019).

When it comes to mimicry complexes involving caterpillars, they don't have to involve the same developmental stages or even the same orders of insects. For instance, a larva of a species from one family, *Pryeria sinica* Moore, 1877 (Zygaenidae), may mimic a pupa of another species from a different family - *Ivela auripes* Butler, 1877 (Lymantriidae), as was recently described by Yazaki *et al.* (2019). An aposematic caterpillar can also be a co-mimic of the adult stage of the same species with which they co-share habitat, color pattern and defensive compounds, as had been proposed by Scott (2016) and Sourakov (2016) for the geometrids (Geometridae) *Meris alticola* Hulst, 1896 and *Abraxas grossulariata* (Linnaeus, 1758), and for the tiger moths (Erebidae) in the genus *Utetheisa* Hübner, [1819].

Pine Sawfly/Erythrina Leafroller mimicry

Humans frequently confuse Lepidoptera caterpillars with larval sawflies (Hymenoptera, Symphyta), and because sawflies are frequently gregarious and chemically defended, it is quite possible that they serve as models for some Lepidoptera caterpillars, as suggested by Willmott *et al.* (2011) for ithomiine butterflies. Here, I propose that the Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch, 1859) (Hymenoptera, Diprionidae) (Fig. 1B), a species of commercial importance that defends itself by regurgitating substances sequestered from pine needles and feeds gregariously, is a model for caterpillars of *Agathodes monstralis* Guenée, 1854 (Crambidae). The sawfly can become quite prominent, especially during outbreaks (DeBerry, 2014), and has been described as a pest of many pine species, especially while they are less than 5 m tall, including Longleaf Pine, *Pinus palustris* (Pinaceae).

In the understory of these pine trees grows Coral Bean

Figure 1. (A) Caterpillar of Erythrina Leaf-roller (*Agathodes monstralis*), a proposed mimic of the chemically-defended model, Redheaded Pine Sawfly (*Neodiprion lecontei*) larvae **(B)**, which feed openly and frequently gregariously on Longleaf Pine and other pine species in south-eastern United States. Photos from Gainesville, Florida, USA.

Erythrina herbacea L. (Fabaceae), a plant defended from herbivores by a variety of alkaloids, but on which several Lepidoptera species, including *A. monstralis*, are specialists (Sourakov, 2012). The larvae of *A. monstralis* are very similar to those of the sawfly (Fig. 1A). It is very likely that this putative moth mimic of Redheaded Pine Sawfly is also distasteful due to traces of alkaloids, as has been demonstrated by liquid chromatography (Sourakov *et al*., unpublished), and hence this system may be a case of quasi-Batesian mimicry, in which both species contribute to the aposematic signal, though unequally.

In support of the mimicry hypothesis, the caterpillars of other *Agathodes* Guenée, 1854, as well as the closely related crambid genera *Liopasia* Möschler, 1882, and *Terastia* Guenée, 1854, diverge, sometimes sharply, from the pattern displayed by *A. monstralis*, while maintaining their ecological association with *Erythrina*. For instance, the caterpillars of *Agathodes ostentalis* (Geyer, 1837) found in South-East Asia, India and Australia are dark-striped on a pale cream background with a black head, sometimes turning bright red as prepupae (Herbison-Evans & Crossley, 2021) resembling other sawfly larvae, such as, for example, the European Pine Sawfly, *Neodiprion sertifer* (Geoffroy, 1785). The Redheaded Pine Sawfly (*Neodiprion lecontei*) is found in the eastern United States from the Great Lakes to Texas and Florida and, while the *Agathodes monstralis*/*A. designalis* species complex is distributed from southeastern United States to Argentina, *A. monstralis* is its northern member, and the caterpillar morphology in Central and South America begins to diverge, with caterpillar colored cryptically green rather than aposematically (Sourakov *et al*., 2015; Pereira & Da Silva, 2013). Other closely related Erythrina-feeding crambids that would not benefit from aposematism as they feed concealed inside pods or stems, such as *Terastia meticulosalis* (Guenée, 1854) (co-occurring with *A. monstralis*) or the South American *Liopasia ochracealis* (Walker 1865), are drab-colored (Pereira & Da Silva, 2013). These observations, together with the similarity and co-habitation between *A. monstralis* and Redheaded Pine Sawfly, are consistent with the idea that the color pattern of the former has been subject to selection to resemble the latter.

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A world checklist of the genus *Phauda* Walker (Lepidoptera: Phaudidae) with the description of female genitalia of *Phauda flammans* (Walker, 1854)

Shahabab A. Farooqui[1, 4*], Kazi S. Siddiqua[1,5], MD. J. Rayhan[2] and Shameem Ahmad Khan[3]

1. Aligarh Muslim University, Aligarh, Department of Zoology, 202002, Uttar Pradesh, India and Aligarh College of Education (ACE), NH93, Chherat, 202122 Uttar Pradesh, India. 2. Chittagong University, Department of Zoology, Chittagong, Bangladesh. E-mail: jrayhan97@gmail.com. 3. Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, 226025 Uttar Pradesh, India. E-mail: amu.shameemkhan@gmail.com. 4. E -mail: shahababfarooqui@gmail.com; ORCID-http://orcid.org/0000-0001-7289-5331. 5. E-mail: kazishabnam4@gmail.com; ORCID-https://orcid.org/0000-0002-0796-0309.
*Corresponding author.

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Abstract: In the present manuscript, the female genitalia of *Phauda flammans* (Walker, 1854), collected from Uttar Pradesh, India, are described, representing the first record of Phaudidae from the state of Uttar Pradesh as well as from the Gangetic Plain biogeographic zone of India. Additionally, a world checklist of *Phauda* Walker is also provided.

Keywords: female genitalia, Gangetic plains, India, Uttar Pradesh

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INTRODUCTION

The genus *Phauda* Walker, 1854 was established for *Euchromia flammans* Walker from north India. The genus was initially placed in the subfamily Phaudinae by Kirby (1892) and later in the Zygaenidae by Yen *et al.* (2005), who also discussed the uncertainty surrounding the monophyly of Phaudinae. Kristensen *et al.* (2007) kept Phaudinae as a subfamily of Zygaenidae, but molecular analyses support the status of Phaudinae as a family, Phaudidae, and its sister relationship with Zygaenidae (Niehuis *et al.,* 2006; Mutanen *et al.,* 2010, Zheng *et al.,* 2020). Nieukerken *et al.* (2011) mentioned 3 genera and 15 species in Phaudidae. In the present paper, we report Phaudidae for the first time from Uttar Pradesh, and illustrate the female genitalia of *Phauda flammans* (Walker, 1854). A world checklist of *Phauda* Walker is also provided.

MATERIALS AND METHODS

Two female specimens were collected using an insect net in late morning near to a *Ficus religiosa* Linnaeus (Moraceae) tree at Aligarh (27.9284684°N 78.0571125°E; 178 m; Figure 1) outside of Aligarh fort in Aligarh district, Uttar Pradesh, on 17 March 2020. The genitalia was dissected and preserved in a solution of alcohol and glycerin (3:1) in a cryotube. Images of the adult were captured by Nikon D7200 camera and Nikkor 105 mm macro lens, and of the genitalia using a camera attached to a Hund Wetzlar stereo-microscope. The voucher specimens are deposited in the ZDAMU (Zoology Department, Aligarh Muslim University, Aligarh, Uttar Pradesh). Species names follow LepIndex (Beccaloni *et al.*, 2003), and the following abbreviations are used: TL= Type locality; TS= Type species.

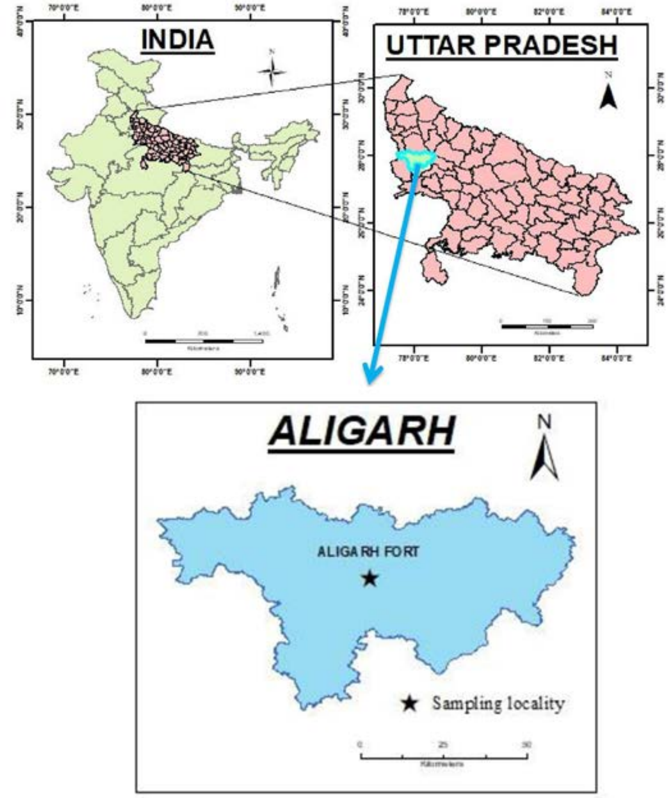

Figure 1. Site of observation of *Phauda flammans* (Walker, 1854).

RESULTS

Taxonomy

Genus ***Phauda*** Walker, 1854
Phauda Walker, 1854; *List Spec. Lepid. Insects Colln. Br. Mus.* 1: 256.
TS: *Euchromia flammans* Walker

Description: Antennae bipectinate in male, simple in female. Wings long and narrow; forewing with rounded apex, outer margin oblique; hindwing with vein M1 from near middle of discocellular. Mid-tibia and hind-tibia with minute terminal pair of spurs. Abdomen with lateral tufts of hairs excluding first two segments, a pair of long anal tufts in male.

Distribution: The genus is distributed in China, India, Indonesia (Java and Sumatra) (Hampson, [1893]); Nepal, Myanmar, China, Hong Kong (Kendrick, 2002; Zheng *et al.*, 2015); Vietnam, Thailand (Zheng *et al.*, 2020).

***Phauda flammans* (Walker, 1854)**
Euchromia flammans Walker, 1854; *List Spec. Lepid. Insects Colln. Br. Mus.*, 1: 257.
TL: N. India.
Material examined: India, Uttar Pradesh, Aligarh, Aligarh fort, 17.iii.2020, 2 ex. ♀, (Coll. SAF).

Description:

***Adult* (Figure 2A,B)**: Wingspan: 41 mm. Body overall bright red with black patterning. Palpi black; antennae serrate, black with whitish tips; head and thorax scarlet or crimson; abdomen black, sparsely covered with thick scarlet lateral tufts. Forewings red, black towards tips, black part with a strongly curved outline, hind margin more than twice as long as fore margin, , fringe black, whitishat tips of wings. Hindwings semi-hyaline, reddish with outer area blackish. Legs black.

***Female genitalia* (Figure 2C)**: Ovipositor short and broad. Papillae analis oval-shaped. Apophyses rudimentary or short, heavily fused to 8th segment. Lamella postvaginalis narrow, slightly sclerotised. Lamella antevaginalis slightly prominent, sclerotized. Ductus bursae almost straight anteriorly; second part highly coiled, fourteen times. Corpus bursae globular, signum absent.

Distribution in India: Himachal Pradesh (Shimla), Sikkim, Pusa, Meghalaya (Cherrapunji) (Fletcher, 1925); South India (Nageshchandra *et al.*, 1972); Uttar Pradesh (Aligarh district) (present study).

Global records: Myanmar (Hampson, [1893]); Pakistan (Lahore), Java (Fletcher, 1925); Nepal, Myanmar, China, Hong Kong (Kendrick, 2002; Zheng *et al.*, 2015); Vietnam, Thailand (Zheng *et al.*, 2020).

Larval Host Plants/ Ecology: The species was recorded by Verma & Dogra (1982) feeding on *Ficus* Linnaeus (Moraceae) in Himachal Pradesh. Caterpillars of *Phauda flammans* feed on *Ficus* spp. plants' leaves and are often considered as important pests of the plants (Zheng *et al.*, 2015). *Ficus microcarpa* (L.) and *F. racemosa* (L.) are often extensively damaged by the defoliating larvae in China (Liu *et al.*, 2014, 2015a, 2015b).

Biological control agent: Several parasitoids: Hymenoptera: *Gotra octocinctus* (Ashmead, 1906), (Ichneumonidae); *Apanteles* Förster, 1862 sp. (Braconidae); *Eurytoma verticilliata* (Fabricius, 1798), (Eurytomidae); and Diptera: *Exorista yunnanica* Chao, 1964 (Tachinidae) have been identified as biological control agents for the caterpillars (Zheng *et al.*, 2015).

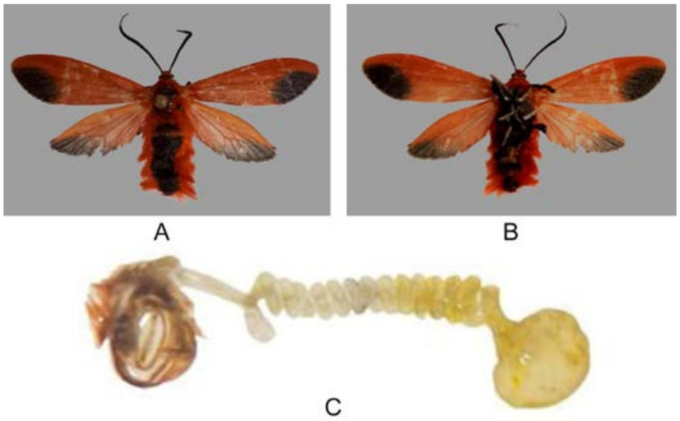

Figure 2. *Phauda flammans* (Walker, 1854). A. Adult female, dorsal view, B. Adult female, ventral view. C. Female genitalia.

A checklist of *Phauda* species

1. *Phauda arikana* Matsumura, 1911
Phauda? arikana Matsumura, 1927; *Journ. Coll. Agricult. Hokkaido,* 19(1): 80.
TL: Taiwan, Koshun.

2. *Phauda bicolor* Fibiger, Larsen & Buchsbaum, 2011
Phauda bicolor Fibiger, Larsen & Buchsbaum, 2011; *Nota lepidopterologica*, 33(2): 263-269.
TL: Indonesia, north Sumatra.

3. *Phauda defluiteri* Roepke, 1943
Phauda defluiteri Roepke, 1943; *Natuurh. Maandbl.*, 32: 50.
TL: Indonesia, Java.

4. *Phauda dichroa* Jordan, 1907
Phauda dichroa Jordan, 1908; *Gross-Schmett. Erde*, 10: 7.
TL: India, Andaman and Nicobar Islands, Port Blair.

5. *Phauda dimidiata* (Snellen, 1879)
Xenares dimidiata Snellen, 1879; *Tijdschr. Ent.*, 22: 69.
TL: Indonesia, Sulawesi (Celebes).

6. *Phauda enigma* Hering, 1925
Phauda enigma Hering, 1925; *Deutsche. Ent. Zeitschr. Iris*, 39: 171.
TL: Bangladesh, Sylhet.

7. *Phauda eos* de Joannis, 1910
Phauda eos de Joannis, 1910; *Bull. Soc. ent. Fr.*, 1910: 246.
TL: Vietnam, Tonkin.

8. *Phauda flammans* (Walker, 1854)
Euchromia (Phauda) flammans Walker, 1854; *List Spec. Lepid. Insects Colln. Br. Mus.*, 1: 257.
TL: N. India.

9. *Phauda fortunii* (Herrich-Schäffer, [1854]
Xenares fortunii Herrich-Schäffer, 1854; *Samml. Aussereurop. Schmett.*, (I)1: 7.
TL: N. China.
Remarks: Treated as a synonym of *Phauda triadum* (Walker, 1854) by Kirby (1892) and Bryk (1936); treated as a species of *Phauda* by Alberti (1954).

10. *Phauda fuscalis* Swinhoe, 1892
Phauda fuscalis Swinhoe, 1892; *Cat. Het. Mus. Oxford,* 1: 60.
TL: India, Assam.

11. *Phauda horishana* Matsumura, 1927
Phauda horishana Matsumura, 1927; *Journ. Coll. Agricult. Hokkaido*, 19: 80.
TL: Taiwan, Horisha.

12. *Phauda kantonensis* Mell, 1922
Phauda kantonensis Mell, 1922; *Ent. Zeitschrift.* : 126.
TL: China, Kanton.

13. *Phauda lanceolata* Jordan, 1907
Phauda lanceolata Jordan, 1907; *Gross-Schmett. Erde,* 2: 5.
TL: China, Yichang.

14. *Phauda limbata* (Wallengren, 1861)
Collestis limbata Wallengren, 1861; *Svenska fregatten Eugenies Resa*: 361.
TL: Singapore, Manilla.

15. *Phauda mahisa* Moore, [1860]
Phauda mahisa Moore, 1860; *Cat. Lep. Ins. Mus. Nat. East India House,* 2: 329.
TL: Indonesia, Java.

16. *Phauda mimica* Strand, 1915
Phauda mimica Strand, 1915; *Archive. f. Naturg.*, 80A(10): 117.
TL: Taiwan.

17. *Phauda pratti* Leech, 1890
Phauda pratti Leech, 1890; *Entomologist*, 23: 81.
TL: China, Yichang.

18. *Phauda rubra* Jordan, 1907
Phauda rubra Jordan, 1907; *Gross-Schmett. Erde.*, 10: 7.
TL: Taiwan.

19. *Phauda similis* Hering, 1925
Phauda similis Hering, 1925; *Deutsche. Ent. Zeitschrift. Iris.,* 39: 172-173.
TL: Taiwan.

20. *Phauda triadum triadum* (Walker, 1854)
Euchromia triadum Walker, 1854; *List Spec. Lepid. Insects Colln. Br. Mus.*, 1: 257.
TL: N. China.

21. *Phauda triadum erythra* Jordan, 1907
Phauda triadum erythra Jordan, 1907; *Gross-Schmett. Erde*, 10: 7.
TL: India, Karnataka, Belgaum.

22. *Phauda triadum sumatrensis* Walker, 1864
Phauda sumatrensis Walker, 1864; *List Spec. Lepid. Insects Colln. Br. Mus.*, 31: 106.
TL: Indonesia, Sumatra.

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The *Urania* (Geometrioidea: Uraniidae: Uraniinae) of Jamaica, West Indies

Thomas Turner[1] and Vaughan A. Turland[2]

1. 12 Kingfishers Cove, Safety Harbor, Florida, 34695. Research Associate, McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, Gainesville, FL 32611. E-mail: cwpublications17@gmail.com. 2. PO Box 774, Santa Cruz, St. Elizabeth, Jamaica, W. I. Research Associate, Windsor Research Centre, Windsor, Trelawny, Jamaica, W.I. E-mail: v.turland@gmail.com

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Abstract: Three species of Uraniinae have been documented from Jamaica. These include the endemic but now extinct *U. sloanus* (Cramer), one doubtful record of the Cuban endemic *U. boisduvalii* (Herrich-Schäffer), and the subspecies *U. fulgens poeyi* (Guérin) which is considered to be an occasional stray to Jamaica from Cuba. This article documents their occurrences on the island and provides a consolidation of the fragmentary information published on Uraniidae found in Jamaica so far. The last year in which living specimens of *Uranus sloanus* were seen has also been in doubt. The last record found of observations of living specimens was in 1897.

Key words: Cuba, extinct, Jamaica, migratory, *Omphalea*.

INTRODUCTION

The family Uraniidae is divided into four subfamilies and 90 genera, and includes some 700 species worldwide (Minet & Scoble, 1999). Two subfamilies are represented in the Greater Antilles, the diurnal Uraniinae with two extant, and one now extinct, species, and the nocturnal Epipleminae. The type species of *Urania* was described as *Papilio leilus* by Linnaeus (1758), who believed that the insect was a butterfly, as did Fabricius (1807) when he described the genus *Urania*.

The genus *Urania* was included in the subfamily Uraniinae by Minet & Scoble (1999). The distribution and relationships among the Neotropical members of *Urania* have recently been resolved by molecular studies (Nazari *et al*., 2016). The *Urania* are black moths marked both dorsally and ventrally with iridescent stripes of blue and green, with *U. sloanus* also displaying coppery red iridescence. Prum *et al*. (2006), investigating iridescence in *U. fulgens,* determined that the colors are structural, originating from refraction of light from "ribbon-like scales" on the wings. Although the patterns reflected on each wing of each species and subspecies are similar in overall appearance, each species displays minor variations in the distribution of markings present on each wing of any given specimen.

Four species and two subspecies of *Urania* have been recognized in the Neotropical region (Nazari *et al*., 2016). *Urania leilus* (Linnaeus, 1758) is present in northern South America primarily east of the Andes, with specimens recorded from Trinidad and St. Vincent in the south eastern Caribbean. Subspecies *U. leilus braziliensis* (Swainson, 1833) is restricted to eastern Brazil. *Urania fulgens* (Walker, 1854) is found in northwestern South America, including Ecuador and Colombia west of the Andes, and north to southern Mexico, with strays to the southern United States. Long isolation of ancestors of *U. fulgens* from Central America apparently resulted in endemic species, *U. boisduvalii* on Cuba, and *U. sloanus* on Jamaica (Nazari *et al*., 2016). A second more recent invasion of *U. fulgens* to Cuba resulted in subspecies *U. fulgens poeyi* (Nazari *et al*., 2016). *Urania boisduvalii* and *U. fulgens poeyi* have been recorded from Jamaica but neither have become permanent residents in the island.

Cramer (1779) correctly recognized *Urania* as a genus of day-flying moths when he described *Urania sloanus,* so named in recognition of Sir Hans Sloane who first illustrated this insect in 1725 nearly three hundred years ago. Only Gosse (1851, 1880, 1881) has provided detailed observations of adult and immature stages of *U. sloanus*. The present article reviews Gosse's information and consolidates the fragmentary notes on the presence of *U. sloanus, U. boisduvalli* and *U. fulgens poeyi* in Jamaica since 1881.

MATERIALS AND METHODS

Urania specimens were examined from Jamaica and elsewhere in the Neotropics. We examined 131 specimens of *U. leilus* from southern Brazil, north to Trinidad and St. Vincent in the eastern Caribbean, through western Brazil, to Peru, Ecuador, Bolivia, and southern Colombia. A total of 207 specimens of *U. fulgens* were examined from across the range of this species from northern Ecuador, northwestern Brazil, and Colombia west of the Andes, north to southern Mexico. We also examined 12 *U. boisduvalii* and five *U. fulgens poeyi* from Cuba, and 48 *U. sloanus*, six *U. fulgens poeyi* and one *U. boisduvalii* from Jamaica.

These investigations were made possible with the issuance of Permit 18/27 from the National Environment

Figure 1. *Urania sloanus*: ♂ dorsal (left), ♂ ventral (right). Right tail digitally restored. Photos courtesy CMNH.

Protection Agency, Kingston, which allowed for the collection and examination of species of Jamaican moths in the family Uraniidae. However, no members of the genus *Urania* were collected during this study. Collections of relevant Jamaican specimens and related species were examined at the American Museum of Natural History, New York (AMNH), the Carnegie Museum, Pittsburg (CMNH), The Natural History Museum, London (NHM, UK), the Life Sciences Department at University of the West Indies, Mona, and the Natural History Museum Jamaica, Institute of Jamaica, Kingston (NHMJ, IJ).

Pinned specimens were photographed using a Canon EOS 5DsR camera with Tamron 90 mm F/2.8 lens or Sony Cyber-shot 20.4 megapixels with 30X optical zoom.

Family Uraniidae Leach, 1815
Subfamily Uraniinae Leach, 1815, American Swallowtail Moths
Genus: *Urania* Fabricius, 1807

***Urania sloanus* (Cramer, 1779)** TL: Jamaica

Forty-eight specimens of *U. sloanus* were examined: four males, four females from the AMNH; four males and females from the CMNH, and seventeen males and ten females in the collection in NHMJ, IJ. A previously undescribed blue color variant from the NHMJ, IJ collection is also described. We also examined photographs of three females and two male specimens in the collection of the Muséum national d'Histoire Naturelle, Paris.

Although *U. sloanus* is now extinct and information for this species is limited, some recorded behaviors appear similar to those of the extant *U. fulgens* of Central America. In addition, considerable pink suffusion, as found in *U. sloanus*, was found in just under 3% of the forty-nine Colombian specimens of *U. fulgens* examined.

Brief description of the adult

Male wingspans vary between 62 mm and 66 mm, with forewing lengths between 28 mm and 40 mm (n=24). Female wingspan varies from 64 mm to 76 mm, with forewing lengths between 28 mm and 58 mm (39.75) (n=17); the tail on hindwing varies between 11 and 16 mm in length in both sexes.

Apart from a somewhat enlarged abdomen and slightly more elongated wings in the female, there are no significant differences in appearances between the sexes. The outermost green stripe on the upper dorsal forewing, characteristic of *U. sloanus*, appears slightly bolder in the female than in the male. The wing markings are otherwise similar in both sexes.

Female: Upper forewing marked with four to five thin transverse green-gold stripes; fifth stripe often joined at posterior part of wing to a broad, almost straight bar which crosses wing beyond end of discal cell; anterior margin of this iridescent bar often bifid, with posterior end of bar meeting hind margin just basad of tornus close to vein Cu$_1$. This arrangement of stripes does not differ greatly from that of *U. fulgens*, but the stripes on that species are predominantly green and much narrower. There may occasionally be the trace of green scales forming a partial stripe between outer bar and wing apex.

Outer margin of upper hindwing elongated, marked with three indentations, each edged with off-white scales, with black 'dart-shaped' markings extending from these across the first third of wing. Surrounding these darts are semicontinuous transverse bands of iridescent scales. A blue patch present near the middle of the anterior margin, followed by a yellow patch of similar size. Remainder of outer wing flushed with pinkish-red iridescence, trending to blue along part of anal margin, and toward green at base of tail. All iridescent markings display some degree of black speckling. Tails mostly black, or with basal green iridescent patches, and tipped with off-white scales.

Antennae thin, not thickened toward end; palpi with

Figure 2. *Urania sloanus*: blue form, head and antennae missing. ♂ dorsal (left), ♂ ventral (right). Photos courtesy NHMJ, IJ.

reddish iridescent scales, meeting with a red iridescent transverse bar between antennae; thorax with median and lateral golden iridescent stripes with a discontinuous median stripe extending onto anterior segments of abdomen. Ventral thorax and abdomen with long, off-white scales except for terminal segment of abdomen which is gray-black.

Lower forewing black, suffused with pale blue-green stripes and flecked markings located as on dorsum but much broader; wing predominantly iridescent gold toward anterior part, fading to pale blue-green toward hind margin.

When compared, in *U. fulgens*, the ventral stripes of the forewing are narrower and iridescent green as on the dorsum.

Male: Blue form: Wingspan 65 mm; forewing length 36 mm. In the collection at the NHMJ, IJ is a male in which the iridescent stripes and markings both dorsally and ventrally are of the same pattern as in the female described above but all the iridescent stripes are violet-blue. Both the dorsum of the left forewing and hindwing show a sparse partial dusting of iridescent green over the blue markings, but the right side shows no evidence of green or any color other than blue. The head and antennae are missing. There is no collection data attached.

In The Seymour Legacy (Vane-Wright & Hughes, 2005) Plate 20 (#25), Fig. 2, there is a painting of an unidentified "butterfly or moth, the most likely provenance, Jamaica?" along with the comment "This is quite the most puzzling image in the entire Seymour *oeuvre*". The forewing markings of this blue and black specimen clearly represent the ventral wing-markings of an Uraniidae. The left wing has a single outermost partial stripe, and the right wing has two outermost stripes that are perhaps better defined than is usual. The antennae are shown as being clubbed, but these may have been absent on the specimen being painted. The ventral hindwings are of a general uraniid shape complete with tails, but there is a pair of small, dull red tornal markings that are reminiscent of such markings on the dorsal hindwings of the Papilionidae butterfly *Protographium marcellinus* (Doubleday, [1845]). However, the distribution of the blue markings on what would be the ventral hindwings in the painting match neither this species nor those of *U. sloanus*.

Immature stages

Larvae of the Uraniinae are believed to sequester toxic polyhydroxy alkaloids from their larval food plants which are species of *Omphalea* (Euphorbiaceae) (Lees & Smith, 1991). Analysis of *Omphalea* seed oil (Freise, 1935) determined the presence of terpenes and sesquiterpenes, which, after sequestration during the development of the immature stages, may confer some protection from predators for both the immature stages and adults.

The documented larval food plants of this species in Jamaica are *Omphalea diandra* L. (Adams, 1968 pers. comm.), and *O. triandra* L. (Euphorbiaceae). (Gosse, 1880). *Omphalea diandra*, is a "trailing and climbing shrub reaching heights of 15 m" (Adams, 1972), and this is also the primary larval foodplant for *U. fulgens* in Central America where this plant can climb to 30 m (Smith, 1973, pers. comm.). The former records for this plant in Jamaica are only from Portland Gap just south of the Portland-St. Thomas parish boundaries at an elevation of 1,795 m below Blue Mountain Peak with an elevation of 2,256 m. (Adams, 1968, pers. comm.)

Gosse (1851) noted that abdomens of female *U. sloanus* were "quite globose" and described the eggs as yellowish-white, slightly marked with numerous perpendicular ridges, flattened at the poles. Gosse estimated the life cycle to take approximately two months, although Smith (1983a) indicated the life cycle in *Urania fulgens* in Central America to be completed in approximately thirty days.

Smith (1992, 2005) noted that the related *U. fulgens* lays one or two eggs on a single young *Omphalea* leaf which the larvae strip, or adults may lay eggs in groups of up to 20 or more at once, each female being capable of laying as many as 450 eggs during its life. Occasionally, however, females cluster on a single plant, laying up to 2,000 eggs in combined masses with the resulting adults migrating in large numbers (Smith, 2005). It may have been a mass laying of eggs before the commencement of a migratory phase within Jamaica that Townsend (1893) referred to, as reported by Mr. Capper, the owner of a small coffee plantation at Portland Gap, St. Thomas Parish. Capper had observed adults crowded on vines, presumed by Adams (1968, pers. comm.) to be *Omphalea diandra* in July and August of 1891.

In July 1880, as reported by Gosse (1880, 1881), the Reverend J. L. Mais found larvae of *U. sloanus* on *Omphalea triandra* L. (Euphorbiaceae) on the north coast at Bogue Bay near Ocho Rios in St. Ann Parish. Locally known as Pop Nut, this is an upright tree growing to some 15 m, which is found in mesic limestone forest from sea level to elevations of at least 610 m, with some trees growing on shale up to 1,220 m (Adams, 1972).

Gosse related how he found the adults in June in perfect wing condition as if just emerged from the pupae at Beeston Springs, elevation 283 m, southeast of Bluefields and speculated that these were progeny from those adults seen in April. Gosse stated the fully grown larva had a fulvous-red head. The remaining segments were black with a blue-black mid-dorsal line and white latero-dorsal and dorsolateral lines interrupted by white transverse intersegmental bands. The lateral line was described as thin, interrupted by the spiracles, and the ventrum was black edged with cream lines. The final stage larva reached a length of approximately 44 mm and, as in other *Urania* larvae (Lees & Smith, 1991), possessed segmental whorls of long black, white-tipped, fusiform setae.

The pupa was described as reddish-brown, with a bluntly rounded head and tapered abdomen attached by the cremaster to a silken pad. Although not mentioned by Gosse in his description of *U. sloanus*, *U. fulgens* pupates within a yellow silken mesh cocoon (Smith, 1983b).

Adult behavior

While living at Bluefields House, Bluefields, Westmoreland Parish, at an elevation of approximately 77 m above sea level in southwestern Jamaica, Gosse (1851) described *U. sloanus* as “one of the most brilliantly lovely of animal forms”, entitling “this insect to take its place in the very foremost rank of the most lovely class of animated beings”. Gosse observed single specimens during the winter months but began seeing the insect in numbers in March, with groups of six or more feeding on the blossoms of several introduced avocado trees (*Persea americana* Mill.) (Lauraceae) at the top of Bluefields Mountain, elevation 780 m, soon after sunrise with others dashing between and over lofty trees. In the first week of April, they appeared “in scores” at lower elevations feeding on blossoms of avocado and mango trees (*Mangifera indica* L.) (Anacardiaceae) at Bluefields Great House. Gosse estimated that some specimens flew at heights of up to 150 m and mentioned their head-down pose when settled on leaves with wings open. When the temperature increased between 0800 h and 0900 h they disappeared, only to appear once more after afternoon rains to feed on the avocado flowers, with this behavior continuing for about two weeks.

Distribution

Most examined specimens of *U. sloanus* have no collection data. One male specimen in the NHMJ, IJ is dated, “31st August 1885”, and another notes “St. Andrew [Parish], Newcastle, 6th July 1891”, while other labels, when present, indicate “Jamaica”. Scoble (1986, pers. comm.) notes one of thirty specimens of *U. sloanus* at the NHM has a label stating, “Road to Blue Mountain Peak”, and a second was collected at Bath, St. Thomas Parish in southeastern Jamaica.

Early accounts by Gosse (1851), Townsend (1893), Walter (1943), Lewis (1944), and Perkins (1945) also mention additional localities where the insect was observed, but this fast-flying species was undoubtedly present island-wide in those years when it was common. Studies of *U. fulgens* (Smith, 1983b) document periods when the insect was sedentary, followed by migratory phases with an approximately six to eight-year periodicity. Unfortunately, there are only sparse records from Jamaica extending from Sloane in 1725 to Fawcett in 1897 (Fawcett, 1898) which are insufficient to determine if such behavior also applied to *U. sloanus*. The insect appeared to be abundant between 1881 and 1885 in western Jamaica, and in the Blue Mountains of eastern Jamaica the insect was common in 1891, declining again by 1893 (Townsend, 1893). Townsend (1893) also noted that at Portland Gap the insect was known locally as the “Christmas Fly” because adults appeared during the Christmas season, appearing again between July and August suggesting a bivoltine life history (Fawcett & Rendle, 1926).

Another observation of what must have been *U. sloanus* appears in *Reminisces of the Blue Mountains* written by Margaret Walter (1943). In her account, Walter recalled staying with the Cappers in a “four-roomed hut in the remoteness of Portland Gap”. Walter related, “Not far from the hut was a fine tree of the Solanum family” (*Solanum punctulatum* Dunal, Solanaceae) (Adams 1994, pers. comm.). “Once when we arrived from the plain we found it strung with beautiful swallowtail butterflies, hanging head downwards in all parts of the tree. The tree was covered in pale purple sweet-scented flowers and we supposed these beautiful creatures had been intoxicated and poisoned by their juice. We never saw these butterflies up there again”.

The head-down position is a favored pose of *Urania* and no Jamaican swallowtail butterflies exhibit the behaviors described. There is no indication of the month these sightings were made. The account was written in 1942 and published in January 1943 and Walker noted that this sighting was “some fifty years ago”, or possibly in 1893.

Another account in *Natural History Notes of the Institute of Jamaica* written by naturalist Lilly Perkins (1945) records that, in 1894 or 1895, a specimen of *U. sloanus* was collected at York Castle School on the hill east of the school buildings where *Eupatorium odoratum* L. (Asteraceae), was growing, and that the insect was common for the next few years. Other localities mentioned by Perkins (pers. comm. in Lewis, 1944) were Walton and Claremont, where the high-flying insects visited mango blossoms. Perkins also noted that early collectors referred to the insect as the “Jamaican Emperor” (Lewis, 1944).

Lees & Smith (1991) noted that the last documented living specimen of *Urania sloanus* was supposedly between 1894 and 1895. However, Fawcett (1898) documented sightings of individuals in flight at Cinchona in 1897. This is the last reference to the existence of living specimens so far found. William Fawcett was Director of Public Gardens and Plantations between 1887 and 1908, including Cinchona Gardens, located west northwest of Portland Gap in St. Andrew Parish at elevations between 1,372 m and 1,676 m in the Blue Mountains. Domagala *et al*. (2015) note that some museum specimens have been found with labels dated years later, as also noted by Vinciguerra (2009), but there are no records from Jamaica that would indicate the insect was still present after 1897.

Fawcett, in *Flora of Jamaica* by Fawcett & Rendle (1926), noted that the insect nectared on the white flowers of *Miconia theaezans* (Bonpl.) (Melastomataceae) at Cinchona. The flowering periods of this plant between December and February and again between June and August happen to coincide with the two known flight periods for this insect in the Blue Mountains. Adams (1968, pers. comm.) speculated that the *O. diandra* vines at Portland Gap were cut down, noting that since 1926 there have been no records for the presence of this plant in Jamaica.

The clearing and fragmentation of the once contiguous mesic broadleaf forest across Jamaica for lumber, agriculture, and settlements by the Spanish, expanded by British settlement beginning in 1655 and especially up to the mid 1850s, also resulted in losses of *Omphalea triandra*, which is now restricted to scattered localities within the interior forests. The simultaneous loss of the larval food plant *O. diandra*, together with significant reduction of *O. triandra* in the late 1800s, presumably contributed to the extinction of this species (Turner, 1986). There is one unverified record of a stray *U. sloanus* collected in Cuba (Sagra, 1857).

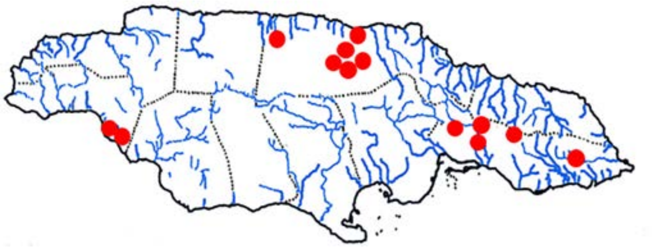

Figure 3. Historical distribution map of *Uranus sloanus*.

***Urania boisduvalii* (Guérin, 1829)** TL: Cuba

There is one specimen of this species reportedly from Jamaica in the NHM, UK. The specimen data label just states “Urania boisduvalii Jamaique”, but without further proof of provenance (Lees, 1987, pers. comm.). This strong-flying species occurs across Cuba but appears to be most abundant in eastern Cuba, and it is not unreasonable to suppose this specimen could have been a stray visitor to the island. A male from the Institute of Jamaica collection collected at Sabanilla, Matanzas Province, Cuba, in November 1960 is illustrated in figure 4.

Brief description of the adult

Male wingspan 70 mm; forewing length 40 mm. Female wingspan 80 mm; forewing length 42 mm.

Male: wings and body black; forewing black with five bold transverse basal bands; fifth band sometimes joining slightly broader sixth band at hind margin. Three additional finer transverse bands distad of broadest band, with short green markings between each longer band along costal margin. Outer margin finely edged with off-white scales between major vein endings.

Figure 4. *Urania boisduvalii*. ♂ dorsal (left), ♂ ventral (right). Sabanilla, Matanzas Prov., Cuba. Photos courtesy NHMJ, IJ.

Figure 5. *Urania fulgens poeyi*: ♀ dorsal (left), ♀ ventral (right), Grange Hill, Westmoreland, Jamaica. 19 September, 1955, G. B. Whitelocke.

Dorsal hindwings with iridescent green markings positioned not greatly dissimilar to that of *U. fulgens* but with finer submarginal markings extending to base of 17 mm long tail, and with a broad green median longitudinal stripe. Hind margin marked with another less well-defined elongate stripe.

Head with an iridescent green transverse band between base of filiform antennae. Antennae slightly thickened before curved apical tip; thorax with a bold iridescent green-gold median and lateral iridescent stripes marked with blue scales on thorax, all extending to end of abdomen. Ventral head and thorax with long gray-black hair-like scales but anterior edges of all appendages edged with blue gold scaling and abdomen covered in short green-gold scales.

Ventral forewing with nine green transverse stripes of approximately equal width, the ninth bifid toward anterior margin. Distad of this, three narrow transverse stripes not fully crossing wing, alternating with three short marginal markings; green stripes toward base of wing suffused with iridescent blue.

Ventral hindwing with dorsal markings repeated but without bold median stripe. Basal and median area suffused with golden-green scales; more blue-green marginally.

Female: Dorsal markings essentially similar to those of male but transverse bars slightly bolder and all stripes suffused with golden-green iridescence. Abdomen larger with narrower mid-dorsal iridescent line.

Distribution

This Cuban endemic species is frequently encountered in eastern Cuba where it can be seen patrolling back and forth in a linear fashion over distances of approximately 700 m at a height of approximately 5 m in localities such as the Minas Amores Road near Baracoa in Guantanamo Province (Turner, pers. obs.) or near the coast at Sabanilla further west in Matanzas Province. The species is also found commonly in far western Cuba (Nuñez-Penichet *et al*., 2019).

Urania fulgens poeyi (Herrich-Schäffer, 1866)

This insect was originally described from Cuba by Herrich-Schäffer (1866) (as the species *Cydimon poeyi*), but recent DNA studies of Caribbean *Urania* have determined that this taxon should be recognized as a subspecies of the Central American *U. fulgens* (Nazari *et al*., 2016). In Cuba, *U. fulgens poeyi* is found primarily in eastern localities where the immature stages have been observed on *Omphalea triandra* L. *Urania fulgens* is well-documented as a strongly migratory species in certain years (Smith, 1972), so it is no surprise to find strays of the Cuban subspecies at intervals in Jamaica. This may also be the subspecies documented from Okaloosa County, Florida by a single worn individual reported by V. J. Farkas in September 1973 (Emmel & Farkas, 1974), and on October 19, 2011, in both South Pasadena, Pinellas County, and Cedar Key, Levy County, Florida, as reported by John Calhoun and Miklos Loranet at Texas Entomology https://texasento.net/Urania.html (Quinn, 2017, compiler).

Brief description of the adult

Male average wingspan 71 mm; forewing length 37.5 mm (n=2). Female larger, with a wingspan of 80 mm; forewing length 43 mm (n=1). Most Jamaican specimens exhibit extensive hindwing damage. The sexes are similar in appearance.

Male: Upper forewing black, elongate, with a basal green iridescent marking followed by four additional narrow green transverse stripes basad of a bolder iridescent green bar that crosses wing; somewhat variable from wing to wing on same specimen; bar may or may not be divided at anterior wing margin.

Dorsal hindwing, black. Two narrow green iridescent parallel lines extend from near wing-base toward tail terminating in a series of two irregular transverse iridescent green bars above tail. Outer submargin with an irregular series of five short, bold yellowish-green, iridescent markings; last marking terminating at base of tail; anal margin with two additional series of blue-green iridescent scales above tail; tail black, tapered tail 18-20 mm in length, with or without short iridescent green basal bars. Outer margin with three well defined indentations above tail, all edged with off-white scales except where black vein endings reach outer margin.

Dorsal thorax and abdomen, black, with fine longitudinal median and lateral iridescent green to rosaceous longitudinal stripes, though muted in female Ventrally, dull gray-brown, but with bright turquoise color laterally on palps, base of head, on dorsal edges of legs and with segmental banding ventrally on abdomen.

Ventral forewing black with seven to eight fine iridescent green transverse lines followed by a bold broad iridescent bar which is usually but not always bifid where it joins costa. Lower hindwing black with six fine iridescent basal lines curving across wing. Distad and ventrad of these basal lines are a series of iridescent rectangular markings extending from outer to inner wing margins to base of the black tail. Outer margin accentuated by four indentations edged with off-white scales which are more visible than those of dorsum.

The green iridescent dorsal markings of both forewing and hindwing in *U. fulgens poeyi* are similar in distribution to those found on *U. fulgens* and show similar variation in the arrangement of the boldest green forewing bar. Ventrally, the iridescent blue markings of the hindwing appear to be slightly finer on *U. fulgens poeyi*. The hindwing tails in each taxon are also similar and are approximately 8 mm in length. In both taxa there is a transverse iridescent bar on the head between the filiform antennae.

Female: Wing markings similar to those of the male but females of both *U. fulgens* and *U fulgens poeyi* with an additional faint partial line of green scales distad of boldest green bar; outer margin finely edged with off white scales, divided by black vein endings.

Too few Jamaican specimens are available to make statistical analyses possible, but three male *U. fulgens* from Colombia have an average wingspan of 54.3 mm, and a female a wingspan of 62 mm, while two male *U. fulgens poeyi* mm from Jamaica had an average wingspan of 71 mm and that of a female 80 mm, suggesting the *U. fulgens poeyi* might prove to be a slightly larger insect.

Distribution

There are six records of this subspecies in Jamaica; the first, a male, on 17 October 1944 from southwestern Jamaica at Malvern, St. Elizabeth Parish, was fifty-seven years after the last recorded sighting of *U. sloanus*. This was followed by a second male specimen collected in Kingston after being knocked down by a vehicle in 1950 by Lord R. Graham and given to the Natural History Museum of the Institute of Jamaica. The third, a female specimen, was collected while nectaring at *Lantana camara* L. (Verbenaceae), by G. B. Whitelocke at Grange Hill, Westmoreland Parish, in southwestern Jamaica. Another male specimen was collected, in Kingston after being struck by a vehicle, by D. Reynolds in 1987. In July 1995 two specimens presumed to be *U. fulgens poeyi* were observed flying together high along the edge of forest at Pantrepant (M. Lockwood pers. obs.) on the northern side of the Cockpit Country, Trelawny Parish. The Cockpit Country is one of the areas where *Omphalea triandra* still occurs, but at present time there is no evidence suggesting that this subspecies is a permanent resident in Jamaica.

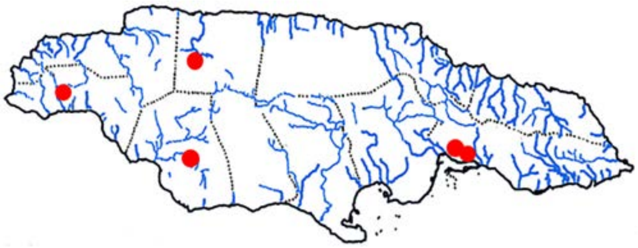

Figure 6. Distribution map of *Urania fulgens poeyi*.

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The butterflies (Lepidoptera: Papilionoidea) of the Nipe-Sagua-Baracoa mountains: a preliminary checklist of the most biodiverse Cuban region

Yosiel Álvarez[1*], Douglas M. Fernández[2], Marc C. Minno[3] and Rayner Núñez[4]

1. Departamento de Colecciones Zoológicas, Instituto de Ecología y Sistemática, Carretera de Varona km 3. 5, Capdevila, Boyeros, CP 11900, La Habana, Cuba; * Author for correspondence: alvarezyosiel@gmail.com; https://orcid.org/0000-0002-0687-3094. 2. B No. 61 e/2da y 3ra, Caridad de Méndez, Camagüey 71100, Cuba; douglas7010@nauta.cu. 3. 600 NW 35th Terrace, Gainesville, FL 32607, USA; marccminno@gmail.com. 4. Lepidoptera & Trichoptera Section, Research Museum Alexander Koenig - Leibniz Institute for Animal Biodiversity (ZFMK), Bonn, Germany; R.Nunez@leibniz-lib.de, raynernunez75@gmail.com; https://orcid.org/0000-0001-7921-5028.

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Abstract: Here we present a list of the butterflies of the Nipe-Sagua-Baracoa mountain range, comprising the easternmost Cuban massif and the largest biodiversity hotspot within the Antillean Islands. We retrieved information from the literature and from our own surveys in the area. We compiled butterfly species lists from 25 localities in four of the six phytogeographical districts in which the range is divided: Sierra de Nipe, Sierra Cristal, Sierra de Moa-Toa and the Baracoa limestone mountains. A total of 158 species of six butterfly families were registered, 78% of the known Cuban fauna. The district totals are 69 species from Sierra de Nipe, 76 from Sierra Cristal, 153 from Sierra de Moa-Toa and 114 from the Baracoa limestone mountains. Some 79% of all Cuban endemic butterfly taxa are represented. These values outnumber any other Cuban region and are likely to be caused by the proximity of Hispaniola, elevated age of the mountains and presence of serpentine soils, which together with climatic factors likely triggered the formation of a rich mosaic of highly diverse habitats. The Nipe-Sagua-Baracoa mountain range is one of the richest butterfly hotspots within the Antilles. Further work should focus on the less sampled and non-sampled districts and on the ecology, biogeography and life history of the butterflies in the range, especially species of greatest conservation relevance.

Key words: endemism, habitat, massif, mountain, richness, survey.

Resumen: Se presenta una lista de las mariposas del sistema montañoso Nipe-Sagua-Baracoa, el cual comprende el macizo más oriental del Cuba y el área más biodiversa de las Antillas. Se obtuvo información de la literatura y de las visitas de los autores al área. Se compilaron listas de especies de mariposas de 25 localidades dentro de cuatro de los seis distritos fitogeográficos en los cuales el sistema se divide: Sierra de Nipe, Sierra Cristal, Sierra de Moa-Toa y las montañas calizas de Baracoa. Se registraron un total de 158 especies de las seis familias de mariposas, un 78% de la fauna cubana conocida. Las cifras totales por distrito fueron 69 de Sierra de Nipe, 76 de Sierra Cristal, 153 de Sierra de Moa-Toa y 114 de las montañas calizas de Baracoa. El 79% de las formas de mariposas endémicas de Cuba está representado. Estos valores superan cualquier otra región de Cuba y deben estar causados por la proximidad del sistema a La Española, la edad elevada de las montañas y la presencia de suelos serpentínicos, los cuales en conjunto con factores climáticos impulsaron la formación de un rico mosaico de hábitats muy diversos. El sistema montañoso Nipe-Sagua-Baracoa es una de las regiones más ricas en mariposas dentro de las Antillas. El trabajo futuro debe enfocarse en los distritos menos muestreados y en los no muestreados, y en la ecología, biogeografía e historia de vida de las mariposas en este sistema, especialmente en especies de mayor interés para la conservación.

Palabras clave: endemismo, hábitat, macizo, montaña, riqueza, muestreo.

INTRODUCTION

The Antillean Islands feature a remarkably poor butterfly diversity in comparison to continental Central America, with less than 400 recorded species (Riley, 1975; Smith *et al.*, 1994; Warren *et al.*, 2022). Nonetheless, few butterfly faunas have been as extensively studied as the ones inhabiting the four major Antillean Islands: Cuba, Hispaniola, Jamaica and Puerto Rico (Comstock, 1944; Brown & Heineman, 1972, Alayo & Hernández, 1987; Schwartz, 1989; Pérez-Asso *et al.*, 2017; Turner & Turland, 2017; Racheli, 2019; Mancina *et al.*, 2020). The area's complex biogeographical history has shaped a distinctive fauna, featuring several endemic genera and species, particular distribution patterns, and high endemism due to insularity (Smith *et al.*, 1994). A prominent feature of this fauna, the Satyrinae are only represented by the genus *Calisto* Hübner, which is also exclusive to the area, and has impressively radiated into 52 currently known species, with more surely to be found (Smith *et al.*, 1994; Pérez-Asso *et al.*, 2016; Núñez *et al.*, 2019a). The Riodinidae are only represented by the monotypic endemic genus *Dianesia* Harvey & Clench, a rare and restricted butterfly about which little is known, and, as with the previous genus, seems to represent an old, long isolated lineage (Harvey & Clench, 1980; Espeland *et al*., 2015).

Cuba, the largest of the Antillean Islands, has 200 documented butterfly species in six families and 20 subfamilies; 78 taxa are endemic, including 42 species and 36 subspecies (Mancina *et al*., 2020). Inventories of the butterfly diversity of several localities and regions have been published (Fontenla, 1985, Fontenla & de la Cruz, 1986; Fontenla 1987a,b, 1989a,b, 1992, 1994; Hernández *et al*., 1994; Fernández & Rodríguez, 1998; Smith *et al*., 1998; Fontenla, 2003; Núñez & Barro, 2003; Núñez, 2004; Aborrezco, 2006; Fernández, 2007; Núñez, 2010a, 2012; Luna & Hernández, 2013; Fernández & Minno, 2014a,b; Bermúdez *et al*., 2016; Álvarez & Corso, 2020). Most of these projects have focused on a local scale and only explored the butterfly fauna of a single or few habitats within a small area. Comprehensive butterfly lists of large biodiverse regions with heterogeneous habitats in Cuba are limited to the Isle of Pines (Holland, 1916; Hernández *et al*., 1994), the Guanahacabibes peninsula (Smith *et al.*, 1998) and the Camagüey province (Fernández & Rodríguez, 1998; Fernández, 2007).

The Nipe-Sagua-Baracoa (NSB) massif is the easternmost Cuban mountain range, extending through the north of Cuba's eastern region, from Sierra de Nipe to Punta de Maisí, Cuba's eastern tip. A geologically complex region, its origin dates to the Cretaceous period and it has experienced several different formative events during the paleogeographical history of the Caribbean (Iturralde-Vinent, 2005). Due to this, several soil types coexist in this mountainous area, formed by ophiolitic, volcanic-arc and sedimentary, metamorphosed and not metamorphosed ultramafic (serpentine) rocks (Iturralde-Vinent *et al*., 2006). The area is characterized by its high biodiversity, with an extremely diverse flora that is one of the richest in the Caribbean and contains 750 regional or local endemics (Samek, 1973a; Borhidi, 1991). Several habitat types have developed in the varied soils of the area, including broadleaf evergreen forest, broadleaf semideciduous forest, serpentine sclerophyllous montane rainforest, semi-dry montane serpentine scrub-woodland, serpentine pine forest, montane evergreen serpentine scrub-woodland, dry serpentine scrub-woodland and mangrove forest, amongst many others (Samek, 1973a,b; Borhidi, 1991). Due to the relevance of this area for Cuban biodiversity, several zones within it have been declared protected areas by the Cuban National System of Protected Areas (SNAP), including the National Reserve "Cuchillas del Toa", the National Parks "Pico Cristal", "Mensura-Pilotos" and "Alejandro de Humboldt", and the minor range reserves "Cañón del Río Yumurí", "Yara-Majayara" and "Yunque de Baracoa" (Ruiz, 2017).

The area is home to many Cuban butterfly species, including

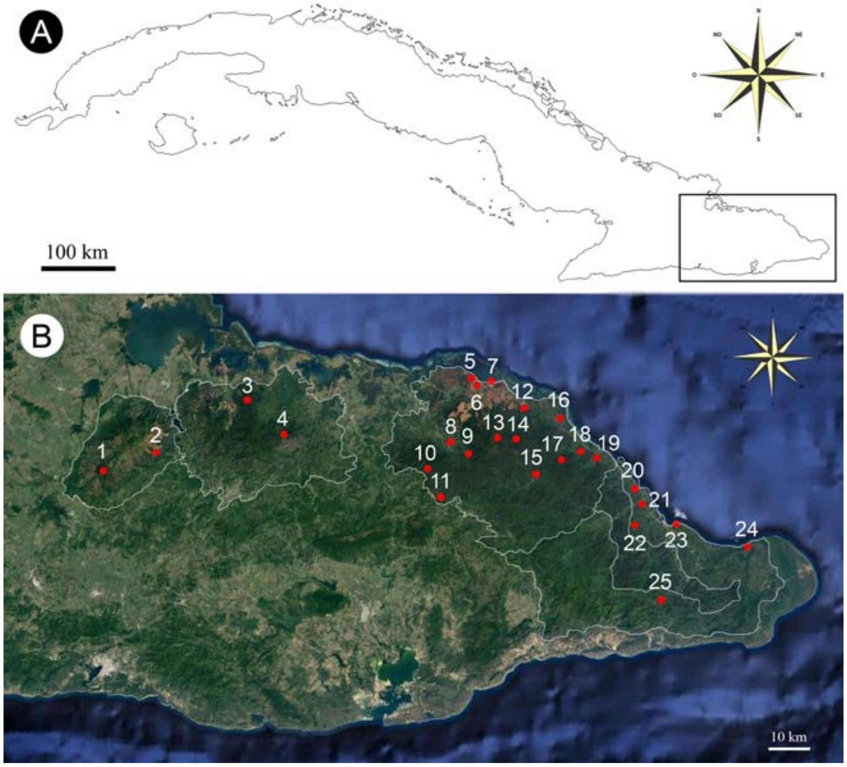

Figure 1. Geographical location (A) and satellite image (B) of the Nipe-Sagua-Baracoa mountain range, Eastern Cuba, including its phytogeographical districts and the surveyed localities. In B, districts are highlighted by thin white lines and localities are marked by red dots. Districts, from left to right: Sierra de Nipe, Sierra de Cristal, Sierra de Moa-Toa, and the limestone mountains of Baracoa. Within the latter, a boot-shaped area lacking red dots represents the serpentine mountains of Baracoa, another district, absent from our sampling. Localities, numbered: 1. La Mensura. 2. La Cueva. 3. La Zoilita. 4. Pico Cristal. 5. Miraflores. 6. Rolo Monterrey. 7. Los Mangos. 8. Ojito de Agua. 9. Farallones de Moa. 10. Cupeyal del Norte. 11. Las Municiones. 12. Monte Lejos. 13. El Toldo (peak). 14. El Toldo (slopes). 15. La Melba. 16. Yamanigüey. 17. Meseta de Iberia. 18. Balcón de Iberia. 19. Los Mellizos. 20. Cayo Güin. 21. Río Toa. 22. Yunque de Baracoa. 23. Playa Blanca. 24. Boca de Yumurí. 25. Alto de Cotilla. Satellite image © Google.

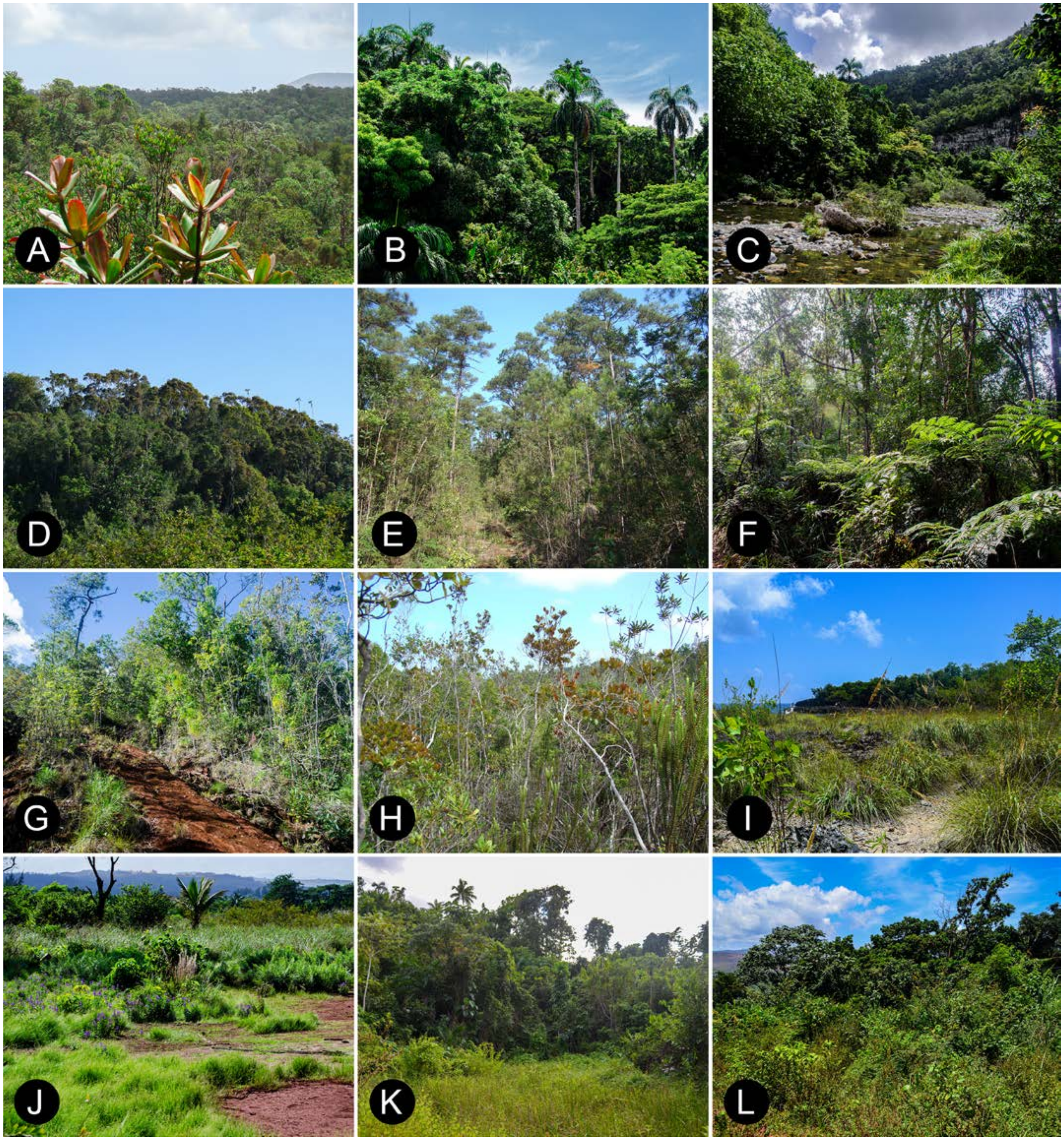

Figure 2. Photographs of habitat types present throughout the Nipe-Sagua-Baracoa mountain range, Eastern Cuba. A. Broadleaf evergreen forest in Meseta de Iberia. B. Broadleaf semideciduous forest in the base of Yunque de Baracoa. C. Gallery forest along the margins of the Yumurí River in Boca de Yumurí. D. "Mogote" vegetation complex of limestone patches in La Munición. E. Serpentine pine forest in La Zoilita. F. Serpentine sclerophyllous montane forest in Balcón de Iberia. G. Dry serpentine scrub-woodland in Los Mellizos. H. Montane evergreen serpentine scrub-woodland in Yamanigüey. I. Coastal scrub-woodland in Playa Blanca. J. Low vegetation associated with mangrove forest in Los Mangos. K. Secondary forest in the base of Yunque d Baracoa. L. Ruderal vegetation along urban areas in Rolo Monterrey. Photographs A, D, E, H © Rayner Núñez; B, C, F, G, I-L © Yosiel Álvarez.

national, regional and local endemics, such as *Atlantea perezi* (Herrich-Schäffer, 1862), *Lycorea halia demeter* Felder & Felder, 1865, *Burca cubensis* (Skinner, 1913), *Oarisma bruneri* Bell, 1959 and several species of *Calisto* (Alayo & Hernández, 1987; Núñez *et al*., 2020a). Alayón & Solana (1987) published a list of the butterflies from four localities of "Cuchillas de Toa" reserve, reporting 113 species. More recently, Varona-Álvarez (2022) elevated to 74 the known species of Cupeyal del Norte, one of the localities surveyed by Alayón and Solana (1987). Based on these initial accounts and given the biogeographical and ecological relevance of this area for biodiversity, we add more observations to provide a more comprehensive, yet still preliminary, butterfly list of the Nipe-Sagua-Baracoa massif.

MATERIALS AND METHODS

Description of the study area

According to the criteria of Samek (1973a) and Borhidi (1991), the NSB massif is the northeastern section of their Cuban phytogeographical arrangement, which they further divided into six districts. We obtained butterfly data from four of these districts: Sierra de Nipe, Sierra Cristal, Sierra de Moa-Toa and the Baracoa limestone mountains (Fig. 1). The remaining, unsampled districts are the Baracoa serpentine mountains and the karstic "mogotes" of Nipe-Yateras (Borhidi, 1991). Habitat classification followed the criteria of Capote & Berazaín (1984), adapted to the descriptions of Borhidi (1991). Photographs of the most representative of these habitats are shown on Figure 2.

Sierra de Nipe. Located south of the Bay of Nipe, at the western end of the mountain range, this area is 600 km^2 in extent and comprises a plateau (500-700 m altitude) delimited west and south by the Cauto Valley and north by the Bay of Nipe. The area continues to the east in Sierra Cristal. The Mayarí River forms the natural boundary between these ranges (Samek, 1973b). Loma de la Mensura reaches a peak altitude of 995 m, and serpentine soils occupy 280 km^2 within the core of the plateau, surrounded by limestone slopes with numerous rivers. There are two annual rain peaks (August-February and April-June), with total precipitation up to 230 cm per year, and annual temperatures oscillate between 23.5-29°C (Borhidi, 1991).

A well-defined phytogeographical district, the Sierra de Nipe comprises endemic-poor broadleaf evergreen and semideciduous forests along the limestone slopes, and endemic-rich serpentine sclerophyllous montane rainforest, serpentine pine forest and montane evergreen serpentine scrub-woodland on the serpentine plateau (Samek, 1973a,b). Human disturbance has affected large areas of these habitats, allowing the development of semi-natural pine forests and ruderal vegetation. The floristic composition resembles that of Sierra Cristal, with many shared endemic taxa (Borhidi, 1991).

Sierra Cristal. Located east of the previous range, this area is nearly 2000 km^2 in extent and consists of a mountain massif (700-1000 m altitude) narrowly separated from Sierra de Nipe by the Mayarí River, whilst the northern and southern boundaries are the same as the previous range, and the eastern boundary is Sagua de Tánamo Valley (Samek, 1973a; Borhidi, 1991). Pico Cristal reaches an altitude of 1231 m (the highest peak of the entire NSB massif), and reddish serpentine soils extend from 700 m up to the top, replaced at lower elevations by limestone-derived mountain clays. More uniform in terms of climate than the previous range, in January-February a short dry season occurs in the lower areas, while the upper hills feature uninterrupted rains; annual precipitation oscillates between 160-230 cm and annual temperatures range between 20-29°C (Borhidi, 1991).

Although it has lower plant diversity than the previous and next ranges, Sierra Cristal is also distinctive and shares many phytogeographical similarities with Sierra de Nipe due to their minimal separation. Moist, broadleaf evergreen forests are found up to 600 m from the base, with scattered patches of secondary forest amongst these; serpentine pine forests extend between 600-1100 m. From this altitude up to the summit, semi-dry montane serpentine scrub-woodlands dominate, a type of cloud forest on serpentine bedrock (Samek, 1973a; Borhidi, 1991).

Sierra de Moa-Toa. The largest and most complex of the districts, this mountain range extends nearly 3000 km^2 and comprises several sharp mountains, plateaus and ridges (500-900 m altitude) along the coast between Sagua de Tánamo Valley and the limestone areas of Baracoa, delimited south by the karstic mountains of Nipe-Yateras (Samek, 1973a; Borhidi, 1991). Pico El Toldo reaches an altitude of 1175 m. The district has a variety of different serpentine soils, with older representatives found in the inner hills and younger ones predominating near the coast. The most humid area of Cuba, in this range precipitation oscillates between 140-300 cm per year, with local peaks of 500 cm. The core features a moist climate throughout the year, while in all boundaries, with exception of the eastern one, two short dry seasons are present between January-February and March-April. Annual temperatures oscillate between 16-30°C (Borhidi, 1991).

This area is considered to be the oldest district of the Cuban flora and the core of biodiversity of the region (Borhidi, 1991). Biogeographic isolation of this serpentine range, a product of its wide limestone boundaries such as Sagua de Tánamo Valley and the mountains of Baracoa, has shaped a distinctive flora. Many endemic plant genera and species are found within the several vegetation types present in the range (Samek, 1973a; Borhidi, 1991). A brief, accurate habitat description is challenging. Broadleaf semideciduous and evergreen forest cover most inner mountains up to 250 m, with serpentine sclerophyllous montane rainforest replacing them up to nearly 1000 m. Summits are covered by semi-dry montane serpentine scrub-woodlands. Serpentine pine forests thrive in the Cupeyal Plateau and the Toa Valley, as well as above 1000 m in many northern hills. These pine forests mix with microphyllous evergreen serpentine scrub-woodland along the coast and with dry serpentine scrub-woodland in higher areas. Mangrove forests and coastal scrub-woodlands grow near the coast, and secondary forests and ruderal vegetation replace native habitats in disturbed areas (Samek, 1973a; Borhidi, 1991)

Baracoa limestone mountains. The easternmost area of the massif, this district occupies nearly 2500 km^2 and consists of a highly varied landscape of mountains, "mogotes" (karstic, irregularly-shaped isolated hills) and plateaus (100-400 m altitude) extending along the coast between Sierra de Moa-Toa and Punta de Maisí, Cuba's eastern tip, with the Santiago-Guantánamo coast district being the southern geological boundary (Borhidi, 1991). The Baracoa serpentine mountains are contained within this district but their boundaries are quite evident (see Fig. 1). Yunque de Baracoa reaches a peak altitude of 575 m, and limestone-derived soils predominate. Several climate types coexist and no transition is perceptible between these: some areas receive rains all throughout the year with precipitation of up to 220 cm per year, while others feature two long dry seasons, and northern mountains have dry summers. Annual temperatures range between 23-28°C (Borhidi, 1991).

Lower plant diversity and endemism are features of this limestone area, and broadleaf evergreen forest covers most of the hills, with some montane humid forest occurring at the summit of the moist highest peaks. The karstic cliffs of Yumurí Valley are occupied by the "mogote" vegetation complex and

Table 1. Localities included in the compilation of the butterfly list (Lepidoptera: Papilionoidea) from the Nipe-Sagua-Baracoa mountain range, eastern Cuba. Geographic placement, habitats and survey dates of the visited localities are also provided. Habitats: BEF: Broadleaf evergreen forest. BSF: Broadleaf semideciduous forest. CSW: Coastal scrub-woodland. DSW: Dry serpentine scrub-woodland. GF: Gallery forest. MF: Mangrove forest. MSW: Montane evergreen serpentine scrub-woodland. MVC: "Mogote" vegetation complex. RV: Ruderal vegetation. SF: Secondary forest. SSW: Semi-dry montane serpentine scrub-woodland. SMF: Serpentine sclerophyllous montane forest. SPF: Serpentine pine forest.

Province	District	Locality	Habitat	Date	Source
Holguín	Sierra de Nipe	La Mensura	MSW	8/XI/2015; 13 & 15/VI/2016; 2/IX/2018; 7/XII/2018	Authors' visit
		La Cueva	BSF, MSW, SPF	2-9/VII/ 2018; 27/VI/2019	Vallejo *et al.* (2021) Authors' visit
	Sierra Cristal	La Zoilita	MSW, SPF, GF	15-19/II/2010; 3-10/IV/2012	Authors' visit
		Pico Cristal	SSW, SPF	No date specified	ENPFF (2009)
	Sierra de Moa-Toa	Miraflores	DSW	11/XI/2017 24/VIII/2018; 8/XII/2018; 3/VII/2022	Authors' visit
		Rolo Monterrey	SF, RV	9/XI/2015; 11-12/XI/2017; 11/XII/2018; 17/VI/2019; 20/XI/2021; 3/V/2022; 15/VII/2022	Authors' visit
		Los Mangos	MF	21/XI/2021	Authors' visit
		Ojito de Agua	BEF, BSF, RV	1987 (no date specified)	Alayón & Solana (1987)
		Farallones de Moa	BSF, RV	1987 (no date specified) 23/VIII/2018; 9/XII/2018; 18/VI/2019	Alayón & Solana (1987) Authors' visit
		Cupeyal del Norte	BSF, SMF	1987 (no date specified); 11-17/VI/2019	Alayón & Solana (1987) Varona-Álvarez (2022)
		Las Municiones	MVC, SPF	20-21/VIII/2021	Authors' visit
		Monte Lejos	SMF, GF	26/VIII/2018; 10-11/XII/2018; 19 & 21/VI/2019	Authors' visit
		El Toldo (peak)	SSW, SMF	21/VII/2001	Authors' visit
		El Toldo (slopes)	BEF, BSF	23-24/VII/2001	Authors' visit
		La Melba	SMF, GF	1987 (no date specified)	Alayón & Solana (1987)
		Yamanigüey	MSW	24/IX/2009; 27/VIII/2018; 22/VI/2019	Authors' visit
Guantánamo		Meseta de Iberia	BEF, SMF	28-30/IX/2009; 29/IV/2011; 4-8/IV/2012; 12-13/VII/2022	Authors' visit
		Balcón de Iberia	BSF, SMF	10/XI/2015 30/VIII/2018; 20/VI/2019; 27/XI/2021	Authors' visit
		Los Mellizos	DSW, SPF	16/VI/2016; 28/XI/2021	Authors' visit
	Baracoa limestone mountains	Cayo Güin	MSW	5/II/2013; 23/VI/2019	Author's visit
		Río Toa	GF	26/VII/2001; 22 & 29/VI/2019	Authors' visit
		Yunque de Baracoa	BEF, GF, RV	2/VI/2007; 23/IX/2009; 18/VI/2019; 26/XI/2021; 8/VII/2022	Núñez (2010) Authors' visit
		Playa Blanca	CSW	22/XI/2021; 5/VII/2022	Authors' visit
		Boca de Yumurí	GF, MVC, RV	23/XI/2021; 6-7/VII/2022	Authors' visit
		Alto de Cotilla	SF	21/VI/2016	Authors' visit

gallery forest thrives along the numerous, powerful rivers. Coastal scrub-woodlands cover seashores, and broadleaf semideciduous forest and secondary vegetation are found elsewhere at lower elevations (Samek, 1973a; Borhidi, 1991).

Data sources

For the compilation of this list, we retrieved data from 25 localities from within the four aforementioned districts of the NSB massif (see Fig. 1). From these localities, two belong to the Sierra de Nipe district, two to the Sierra Cristal district, 15 to the Sierra de Moa-Toa district and six to the Baracoa limestone mountains district. Butterfly lists from these localities were obtained from published papers (Alayón & Solana, 1987; Núñez, 2010b; Vallejo *et al*., 2021; Varona-Álvarez, 2022), as well as unpublished lists from field surveys performed by the authors, comprising 88 sampling days from 2001 to 2022, covering most months and seasons. These surveys consisted of walks along trails of the visited localities, with butterflies identified and recorded as they were seen. Data from these localities and surveys are summarized in Table 1. Family arrangement and taxonomic treatment of species follows the criteria of Mancina *et al*. (2020), except for the genera *Phoebis* Hübner and *Agraulis* Boisduval & Le Conte, which follow the modifications proposed by Núñez *et al*. (2019b) and Núñez *et al*. (2021), respectively.

Although we compiled an individual list for each one of the available localities, we combined all these lists to obtain a single list for each district. Even though habitat and microclimate varied somewhat between the localities within a district, their overall similar biogeographical and phytogeographical structure (Samek, 1973a; Borhidi, 1991) suggested this was the best approach. Individual lists from all localities are available in Supplementary File 1 (DOI: 10.5281/zenodo.7796591).

Table 2. Butterflies (Lepidoptera: Papilionoidea) detected in four of the six phytogeographical districts of the Nipe-Sagua-Baracoa mountain range, Eastern Cuba. Taxonomic treatment followed the criteria of Mancina *et al*. (2020) with modifications of Núñez *et al*. (2019b, 2021). For butterflies: E. Endemic species. S. Endemic subspecies. R. Regional endemic (species or subspecies). G. Greater Antillean endemic species. Antillean endemic species refers to species mostly restricted to the four Greater Antilles, the Lucayan Archipelago (Bahamas and Turks and Caics Islands), the southernmost portion of Florida and Cayman and the Virgin Islands. Districts: NIP. Sierra de Nipe. CRI. Sierra Cristal. MOT. Sierra de Moa-Toa. BAR. Baracoa limestone mountains.

Species	Districts			
	NIP	CRI	MOT	BAR
Nymphalidae				
Apaturinae				
Asterocampa idyja idyja (Geyer, 1828)			X	X
Doxocopa laure druryi (Hübner, 1823) S	X	X	X	X
Biblidinae				
Dynamine postverta mexicana d'Almeida, 1952			X	X
Dynamine serina calais Bates, 1934 S/G	X	X	X	
Eunica heraclitus (Poey, 1847) E			X	
Eunica monima (Stoll, 1782)			X	X
Eunica tatila tatilista Kaye, 1926			X	
Hamadryas februa diasia (Fruhstorfer, 1916)	X	X	X	X
Lucinia sida sida Hübner, 1923 S/G	X	X	X	X
Charaxinae				
Anaea cubana (Druce, 1905) G			X	
Archaeoprepona demophoon crassina (Fruhstorfer, 1904) S			X	X
Cymatogramma echemus echemus (Doubleday, 1849) S/G			X	
Hypna clytemnestra iphigenia (Herrich-Schäffer, 1865) S			X	
Siderone galanthis nemesis (Illiger, 1802)		X	X	X
Cyrestinae				
Marpesia chiron chironides (Staudinger, 1886) S	X	X	X	X
Marpesia eleuchea eleuchea (Hübner, 1818) S/G	X	X	X	X
Danainae				
Anetia briarea numidia Hübner, 1823 S/G		X	X	
Anetia cubana (Salvin, 1869) E			X	
Danaus eresimus tethys Forbes, 1943			X	
Danaus gilippus berenice (Cramer, 1779)		X	X	X
Danaus plexippus plexippus (Linnaeus, 1758)		X	X	X
Greta cubana (Herrich-Schäffer, 1862) E			X	
Lycorea halia demeter Felder & Felder, 1865 S			X	

Species	**Districts**			
	NIP	**CRI**	**MOT**	**BAR**
Heliconiinae				
Agraulis insularis Maynard, 1869	X	X	X	X
Dryas iulia nudeola (Bates, 1934) S/G	X	X	X	X
Eueides isabella cleobaea Geyer, 1832 S/R			X	
Euptoieta claudia (Cramer, 1779)			X	
Euptoieta hegesia hegesia (Cramer, 1779)		X	X	X
Heliconius charithonia ramsdeni Comstock y Brown, 1950	X	X	X	X
Libytheinae				
Libytheana motya (Hübner, 1826) E	X		X	
Limenitidinae				
Adelpha iphicleola iphimedia Fruhstorfer, 1915 S			X	X
Nymphalinae				
Anartia chrysopelea Hübner, 1825 E			X	X
Anartia jatrophae guantanamo Munroe, 1942	X	X	X	X
Anthanassa frisia frisia (Poey, 1832)	X	X	X	X
Antillea pelops anacaona (Herrich-Schäffer, 1864) S/G			X	X
Atlantea perezi (Herrich-Schäffer, 1862) E/R	X		X	X
Colobura dirce wolcotti (Comstock, 1942)	X	X	X	X
Historis acheronta semele (Bates, 1939)	X		X	X
Historis odius odius (Fabricius, 1775)	X	X	X	X
Hypanartia paullus (Fabricius, 1793) G		X	X	
Junonia neildi (Brévignon, 2004)			X	X
Junonia zonalis Felder & Felder, 1867	X	X	X	X
Siproeta stelenes biplagiata (Fruhstorfer, 1907)	X	X	X	X
Vanessa virginiensis (Drury, 1773)			X	
Satyrinae				
Calisto brochei Torre, 1973 E/R			X	
Calisto bruneri Michener, 1949 E/R	X	X	X	X
Calisto dissimulatum Núñez, 2013 E/R		X	X	X
Calisto herophile Hübner, 1823 E	X	X	X	X
Calisto israeli Torre, 1973 E/R		X	X	
Calisto lastrai Núñez, 2019 E/R			X	
Calisto occulta Núñez, 2012 E/R			X	
Calisto sharkeyae Núñez, Minno & Fernández, 2019 E/R	X			
Riodinidae				
Riodininae				
Dianesia carteri ramsdeni (Skinner, 1912) S/G	X		X	X
Lycaenidae				
Polyommatinae				
Cyclargus ammon (Lucas, 1857) G	X	X	X	X
Cyclargus thomasi noeli (Comstock & Huntington, 1943) G			X	X
Hemiargus ceraunus filenus (Poey, 1832)		X	X	X
Leptotes cassius theonus (Lucas, 1857)	X	X	X	X
Theclinae				
Allosmaitia coelebs (Herrich-Schäffer, 1862) E			X	X
Chlorostrymon simaethis simaethis (Drury, 1770)			X	
Electrostrymon angelia angelia (Hewitson, 1874) G	X	X	X	X
Eumaeus atala (Poey, 1832) G	X		X	X
Ministrymon azia (Hewitson, 1873)				X
Nesiostrymon celida celida (Lucas, 1857) S/G	X		X	
Strymon acis casasi (Comstock & Huntington, 1943)			X	
Strymon bazochii gundlachianus Bates, 1934			X	X
Strymon istapa cybira (Hewitson, 1874)		X	X	X
Strymon limenia (Hewitson 1868) G			X	
Strymon martialis (Herrich-Schäffer, 1864) G			X	

Species	**Districts**			
	NIP	**CRI**	**MOT**	**BAR**
Pieridae				
Coliadinae				
Abaeis nicippe (Cramer, 1779)	X	X	X	X
Anteos clorinde (Godart, [1824])	X	X	X	X
Anteos maerula (Fabricius, 1775)	X	X	X	X
Eurema daira palmira (Poey, 1852)		X	X	X
Eurema elathea elathea (Cramer, 1777)			X	X
Eurema lucina (Poey, 1853) E			X	
Kricogonia cabrerai Ramsden, 1920 E			X	X
Kricogonia lyside (Godart, 1819)			X	X
Nathalis iole Boisduval, 1836			X	X
Phoebis agarithe antillia Brown, 1929			X	X
Phoebis argante minuscula (Butler, 1869) S			X	X
Phoebis avellaneda (Herrich-Schäffer, 1864) E	X		X	X
Phoebis neleis (Boisduval, 1836) G		X	X	X
Phoebis philea philea (Johansson, 1763)	X	X	X	X
Phoebis sennae sennae (Linnaeus, 1758)	X	X	X	X
Phoebis statira cubana d'Almeida, 1939	X	X	X	X
Phoebis thalestris huebneri Fruhstorfer, 1907 S/G			X	
Pyrisitia dina dina (Poey, 1832) S/G	X	X	X	X
Pyrisitia larae (Herrich-Schäffer, 1862) G	X	X	X	X
Pyrisitia lisa euterpe (Ménétriés, 1832)	X	X	X	X
Pyrisitia messalina (Fabricius, 1787) G	X		X	X
Pyrisitia nise nise (Cramer, 1775)	X		X	X
Pyrisitia proterpia (Fabricius, 1775)			X	X
Zerene cesonia cesonia (Stoll, 1790)	X			
Dismorphiinae				
Dismorphia cubana (Herrich-Schäffer, 1862) E			X	
Pierinae				
Ascia monuste eubotea (Godart, 1819)	X	X	X	X
Ganyra menciae (Ramsden, 1915)			X	X
Glutophrissa drusilla poeyi (Butler, 1872)	X	X	X	X
Melete salacia cubana Fruhstorfer, 1908 S/G			X	
Papilionidae				
Papilioninae				
Battus devilliers (Godart, 1823) G	X	X	X	X
Battus polydamas cubensis (Dufrane, 1946) S	X	X	X	X
Heraclides andraemon andraemon Hübner, [1823] G	X	X	X	X
Heraclides androgeus epidaurus (Godman & Salvin, 1890)	X	X	X	X
Heraclides aristodemus temenes (Godart, 1819) G			X	
Heraclides caiguanabus (Poey, [1852]) E			X	
Heraclides oviedo (Gundlach, 1866) E		X	X	X
Heraclides oxynius (Geyer, 1827) E			X	X
Heraclides pelaus atkinsi (Bates, 1935) S/G	X	X	X	X
Neographium celadon (Lucas, 1852) E		X	X	
Papilio demoleus malayanus (Wallace, 1865)			X	X
Papilio polyxenes polyxenes Fabricius, 1775 S			X	
Parides gundlachianus gundlachianus (Felder & Felder, 1864) E/S	X	X	X	X
Hesperiidae				
Eudaminae				
Aguna asander haitiensis (Mabille & Boullet, 1912)			X	
Autochton potrillo potrillo (Lucas, 1857)		X	X	X
Cecropterus dorantes santiago (Lucas, 1857)	X	X	X	X
Phocides batabano batabano (Lucas, 1857) S/G			X	
Polygonus leo histrio Röber, 1925		X	X	X
Proteides maysi (Lucas, 1857) E	X		X	X

Species	**Districts**			
	NIP	**CRI**	**MOT**	**BAR**
Proteides mercurius sanantonio (Lucas, 1857) S	X	X	X	X
Telegonus anaphus anausis (Godman & Salvin, 1896)			X	
Telegonus cassander (Fabricius, 1793) E			X	X
Telegonus habana (Lucas, 1857) E		X	X	X
Telegonus talus (Cramer, 1799)			X	
Telegonus xagua xagua (Lucas, 1857) S/G		X	X	X
Urbanus proteus domingo (Scudder, 1872)	X	X	X	X
Hesperiinae				
Asbolis capucinus (Lucas, 1857) G	X	X	X	X
Atalopedes mesogramma mesogramma (Latreille, [1824]) G			X	X
Calpodes ethlius (Stoll, 1782)		X	X	X
Choranthus radians (Lucas, 1857) G	X	X	X	X
Cymaenes tripunctus tripunctus (Herrich-Schäffer, 1865)			X	X
Euphyes cornelius cornelius (Latreille, [1824]) S/G	X		X	X
Euphyes singularis singularis (Herrich-Schäffer, 1865) S/G			X	X
Holguinia holguin Evans, 1955 E	X	X	X	X
Hylephila phyleus phyleus (Drury, 1773)		X	X	X
Lerodea eufala eufala (Edwards, 1869)		X	X	X
Nyctelius nyctelius nyctelius (Latreille, [1824])		X	X	X
Oarisma bruneri Bell E/R	X		X	
Oarisma nanus (Herrich-Schäffer, 1865) E	X	X	X	X
Panoquina corrupta (Herrich-Schäffer, 1865) E	X		X	X
Panoquina lucas lucas (Fabricius, 1793)	X	X	X	X
Panoquina ocola ocola (Edwards, 1863)		X		X
Parachoranthus magdalia (Herrich-Schäffer, 1863) G	X		X	X
Perichares philetes (Gmelin, 1790) G	X	X	X	X
Polites baracoa baracoa (Lucas, 1857) G	X	X	X	X
Pyrrhocalles antiqua orientis Skinner, 1920 S/G	X	X	X	X
Rhinthon cubana (Herrich-Schäffer, 1865)			X	
Saliana esperi soroa Smith & Hernández, 1992 S			X	X
Synapte malitiosa malitiosa (Herrich-Schäffer, 1865)		X	X	X
Wallengrenia misera (Lucas, 1857) G	X	X	X	X
Pyrginae				
Burca braco braco (Herrich-Schäffer, 1865) S/G			X	
Burca concolor concolor (Herrich-Schäffer, 1865) S/G	X		X	X
Burca cubensis (Skinner, 1913) E/R	X		X	
Burnsius crisia (Herrich-Schäffer, 1865) G			X	
Burnsius oileus (Linnaeus, 1767)		X	X	X
Eantis munroei (Bell, 1952)				X
Eantis papinianus (Poey, 1832) G	X		X	X
Ephyriades brunnea brunnea (Herrich-Schäffer, 1865) G	X	X	X	X
Ephyriades zephodes (Hübner, 1820) G			X	X
Erynnis zarucco (Herrich-Schäffer, 1865)			X	X
Gesta gesta (Herrich-Schäffer, 1863) G		X	X	X

RESULTS AND DISCUSSION

A total of 158 butterfly species belonging to six families were detected in the NSB massif (Table 2). This number represents 78% of all known Cuban butterfly species (Mancina *et al.*, 2020). From these, 69 species were listed from Sierra de Nipe, 76 from Sierra Cristal, 153 from Sierra de Moa-Toa and 114 from the Baracoa limestone mountains. The family with the largest number of species was Nymphalidae with 52, followed by Hesperiidae with 48, Pieridae with 29, Lycaenidae with 15, Papilionidae with 13 (100% of the Cuban resident taxa), and Riodinidae with 1 species. These proportions of representatives per family were similar in Sierra de Nipe and Sierra de Moa-Toa districts, but in Sierra Cristal both Hesperiidae and Nymphalidae were represented by the same number of species, and in the Baracoa limestone mountains Hesperiidae outnumbered Nymphalidae (Table 2). Photographs of most of the endemics among the observed species are shown in Figures 3-4.

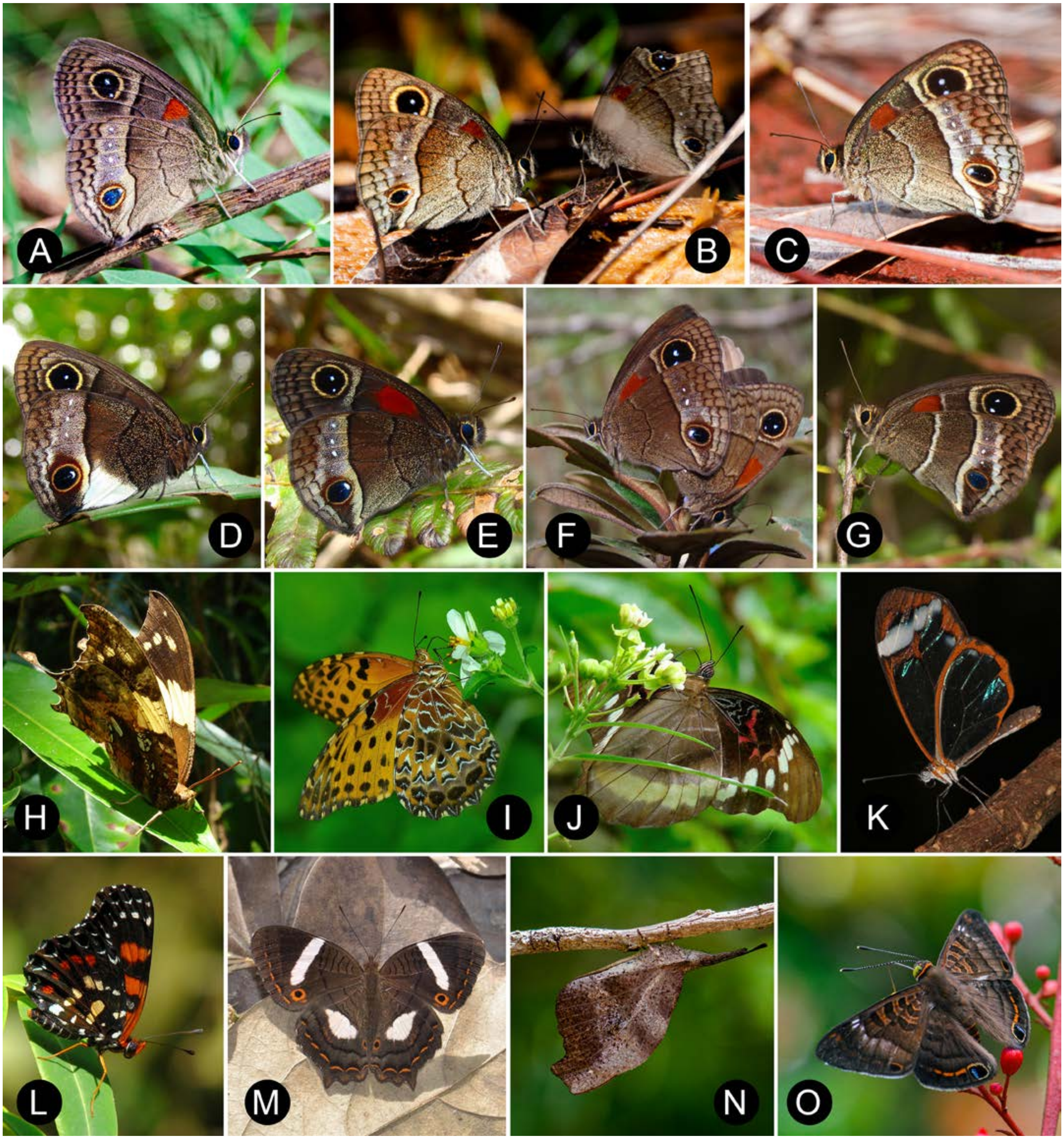

Figure 3. Photographs of live specimens of endemic butterfly species and subspecies of the Nipe-Sagua-Baracoa mountain range, Eastern Cuba. Families Nymphalidae and Riodinidae. A. *Calisto herophile*. B. *Calisto bruneri*. C. *Calisto dissimulatum*. D. *Calisto israeli*. E. *Calisto brochei*. F. *Calisto occulta*. G. *Calisto sharkeyae*. H. *Hypna clytemnestra iphigenia*. I. *Anetia briarea numidia*. J. *Anetia cubana*. K. *Greta cubana*. L. *Atlantea perezi*. M. *Anartia chrysopelea*. N. *Libytheana motya*. O. *Dianesia carteri ramsdeni*. Photographs A-C, N-O © Yosiel Álvarez; D-J, L-M © Rayner Núñez; K © Marc C. Minno.

Several scarce and intermittently distributed Cuban butterflies, many of them endemic, are present in the massif, including: *Hypna clytemnestra iphigenia* (Fig. 3H), *Anetia cubana* (Fig. 3J), *Greta cubana* (Fig. 3K), *Lycorea halia demeter*, *Hypanartia paullus*, *Dianesia carteri ramsdeni* (Fig. 3O), *Nesiostrymon c. celida* (Fig. 4A), *Strymon acis casasi*, *Kricogonia cabrerai* (Fig. 4D), *Phoebis avellaneda* (Fig. 4E), *Phoebis thalestris huebneri*, *Pyrisitia proterpia*, *Melete salacia cubana* (Fig. 4G), *Dismorphia cubana, Heraclides pelaus atkinsi*, *Telegonus cassander* (Fig. 4K), *Holguinia holguin* (Fig. 4L), *Oarisma nanus* (Fig. 4M), *Rhinthon cubana*, *Saliana esperi soroa* (Fig. 4O), *Burca b. braco, Burca c. concolor,*

Figure 4. Photographs of live specimens of endemic butterfly species and subspecies of the Nipe-Sagua-Baracoa mountain range, Eastern Cuba. Families Lycaenidae, Pieridae, Papilionidae and Hesperiidae. A. *Nesiostrymon c. celida*. B. *Allosmaitia coelebs*. C. *Eurema lucina*. D. *Kricogonia cabrerai*. E. *Phoebis avellaneda*. F. *Phoebis argante minuscula*. G. *Melete salacia cubana*. H. *Parides g. gundlachianus*. I. *Heraclides oxynius*. J. *Proteides maysi*. K. *Telegonus cassander*. L. *Holguinia holguin*. M. *Oarisma bruneri*. N. *Oarisma nanus*. O. *Saliana esperi soroa*. P. *Pyrrhocalles antiqua orientis*. Q. *Burca cubensis*. Photographs A, C, E, G-O, Q © Rayner Núñez; B, D, F, P © Yosiel Álvarez.

Burnsius crisia and *Ephyriades zephodes* (Table 2) (Alayo & Hernández, 1987).

Forty-nine species were found in all four districts, including common butterflies such as *Anartia jatrophae*, *Agraulis insularis*, *Calisto herophile*, *Dryas iulia*, *Leptotes cassius*, *Ascia monuste*, *Phoebis sennae*, *Pyrisitia lisa*, *Choranthus radians*, *Ephyriades brunnea* and *Urbanus proteus*. However, some scarce species were also present in all the districts, such as *Heraclides pelaus*, *Parides gundlachianus*, *Holguinia holguin* and *Oarisma nanus*. The presence of *Dynamine postverta* *mexicana*, previously believed to be limited to western Cuba (Alayo & Hernández, 1987), appears to reflect its eastward dispersal.

Except for the widespread, generalist species *Calisto herophile*, all representatives of the genus *Calisto* in NSB are regional endemics; some of them, such as *C. lastrai* and *C. sharkeyae,* are recently described (Fig. 3A-G) (Núñez *et al*., 2012, 2013, 2019a). *Calisto bruneri* seems to be the most widespread and habitat tolerant of these, while *C. brochei*, *C. lastrai*, *C. occulta* and *C. sharkeyae* are the most restricted, according to the available data. The exceptional representation of the genus in the area suggests that NSB is the center of radiation of Cuban *Calisto* (Núñez *et al*., 2019a). According to Iturralde-Vinent *et al.* (2006), before the Miocene this range formed a large land mass along with Puerto Rico and Northern Hispaniola. The last island is the main center of radiation of *Calisto*, and likely the homeland of the closest relatives to Cuban *Calisto* (Matos-Maraví *et al*., 2014; Núñez *et al*., 2019a). Thus, NSB probably hosted the first Cuban populations of the genus. The age and vegetation diversity of these ranges, along with the poor dispersal abilities of these insects, provided the perfect scenario for a rapid diversification of the genus in the region, which subsequently dispersed throughout the rest of the island (Núñez *et al*., 2019a).

In this work we provide the first record of *Dianesia carteri ramsdeni* from a non-serpentinic locality in the NSB range, namely Yunque de Baracoa (Supplementary File 1), where it was not reported by Núñez (2010b). We found the butterfly flying in the shade of the humid montane forest at the summit of this karstic plateau-like mountain, in July 2022. The observed individuals are identical to the typical ones that fly at Meseta de Iberia. Our data suggest that the species, although undetected in Sierra Cristal, may inhabit all the districts in which the NSB range is divided, wherever habitat conditions are favorable. Further study will clarify the current distribution and ecological details of this rare butterfly.

This work also presents the first record of the rare endemic skipper *Holguinia holguin* from a karstic locality of the Baracoa limestone mountains, Boca de Yumurí (Supplementary File 1). This elusive butterfly has been sparsely collected at different localities belonging to the other three surveyed districts of the range (Fernández *et al*., 2020; Núñez *et al*., 2020b). We observed the insect in the deepest areas of the gallery forest that surrounds the Yumurí River, a few miles inland. The karstic nature of the area agrees with the ecological requirements of the species, as reported in the literature (Alayo & Hernández, 1987; Fernández *et al*., 2020).

Eunica heraclitus (Poey, 1847) is an extremely rare, long unrecorded Cuban endemic butterfly (Alayo & Hernández, 1987; Núñez *et al*., 2020a). The voucher specimen collected by Alayón & Solana (1987) during their surveys in Ojito de Agua, Moa, is the last record of the species in Cuba (Supplementary File 1). This individual seems to have been destroyed and no further evidence of is existence is available (Núñez & Barro, 2016). However, we decided to include the record in this list suggesting that it might be an elusive, yet still present, member of the NSB butterfly fauna. Further field surveys might provide new records of this rare insect.

A total of 63 endemic taxa were registered, representing 79% of all Cuban endemic butterfly taxa. Specifically, 30 endemic species and 33 endemic subspecies were registered (Table 2), representing 71% and 91% of all known Cuban endemic butterfly species and subspecies, respectively (Mancina *et al*., 2020). Nine species (including seven species of *Calisto, Atlantea perezi* (Fig. 3) and *Burca cubensis* (Fig. 4Q)) are regional endemics, as well as the subspecies *Eueides isabella cleobaea*. Nine further taxa are exclusive to the eastern region of Cuba (Núñez *et al*., 2020a). NSB also harbors 44 of the 49 Cuban species that constitute Greater Antillean endemics, each inhabiting only one or just a few more islands (Table II).

The butterfly species richness and endemism of NSB outnumber any other Cuban region, as previously highlighted by Mancina *et al*. (2020). Two principal factors have contributed to this. First, the NSB massif contains within its territory some of the oldest emerged Cuban lands, which arose near 70 million years ago (Iturralde-Vinent, 2005). This allowed a continuous, uninterrupted diversification process that was prompted by several colonization events from continental America, and by local evolution, both of flora and fauna (Smith *et al*., 1994). This supposition is reinforced when we examine the NSB regional endemics, which include old, long isolated taxa that have evolved in these mountains, speciating even parapatrically in different habitats of a same range, with the genus *Calisto* being one of the most evident examples (Núñez *et al*., 2012, 2013, 2019a). This diversity is also a consequence of the second factor: the soil diversity of the area, especially the predominance of serpentine rocks and their derivatives. These soils had a tremendous effect on the richness and endemism of the vegetation of the range due to their older age and physiochemical features, including high heavy metal content and low nutrient content (Alexander, 2004). They act as “evolutionary islands”, accelerating plant diversification by the stimulation of adaptations in these plants to endure the soil’s harsh conditions (Harrison & Inouye, 2002; Kazakou *et al*., 2008). The preliminary results of Barro *et al.* (2004) suggest that the highest butterfly endemism values in Cuba are those of ultramafic (serpentine) areas. Azor & Barro (2014) also found that the higher endemism values of Cuban butterflies were expected to be those of the eastern mountain ranges, including NSB.

The lower richness detected in Sierra de Nipe and Sierra Cristal is a consequence of the small number of localities surveyed in these areas. However, the greater richness of the other ranges, which are phytogeographically related to the aforementioned ones, suggests that a greater richness is likely to be found in these. Due to their biogeographical similarities because of their geological history (Samek, 1973a; Borhidi, 1991), these ranges are also expected to share many butterfly species, including rare and endemic taxa such as *Dianesia carteri, Nesiostrymon celida, Oarisma bruneri* and *Burca cubensis*. Further field work is necessary on Sierra de Nipe, Sierra Cristal, the non-surveyed districts and non-visited areas of Moa-Toa and Baracoa, not only for a better assessment of this diversity, but also to understand potential distribution, habitat preference, environmental correlates, resource use and threats for this unique, ancestral fauna.

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Notes on *Telchin evalthe viryi* (Boisduval, [1875]) (Castniidae: Castniinae) in Mexico

José de Jesús García Díaz

Sociedad Mexicana de Lepidopterología A.C. E-mail: chuchogd@live.com.mx

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Abstract: *Telchin evalthe viryi* (Boisduval, [1875]) is one of the rarest castniids of the Gulf of Mexico slope that is not endemic to the country. Based on examination of various collections, field studies and greater knowledge about its distribution, relevant information about this subspecies is provided as well as data on its ecology, behavior, variability (in both sexes), and geographical distribution in Mexico.

Key words: biogeography, bionomics, castniid, geographic distribution, Lepidoptera, Neotropical, variability.

Resumen: *Telchin evalthe viryi* (Boisduval, [1875]) es uno de los cástnidos más raros de la vertiente del Golfo de México que no es endémico para el país. Con base en la revisión de distintas colecciones entomológicas, estudios de campo realizados y mayor conocimiento sobre su distribución, se proporciona información relevante sobre esta subespecie, así como breves datos ecológicos y de comportamiento, variabilidad del taxón (para ambos sexos) y su distribución geográfica en México.

Palabras clave: aspectos bionómicos, biogeografía, cástnido, distribución geográfica, Lepidoptera, Neotropical, variabilidad.

INTRODUCTION

Castniinae (Castniidae) is a Neotropical subfamily of giant-butterfly moths that includes species with diurnal or crepuscular habits (González & Stüning, 2007; Vinciguerra, 2008; González & Worthy, 2017; González *et al.*, 2017; van den Berghe *et al.*, 2020; García-Díaz & Turrent-Carriles, 2022), and it is in turn divided into two tribes, Castniini and Synemonini. Castniini occurs in the Americas, while the Synemonini presents a restricted distribution in Australia (Miller, 1986, 2000; González & Hernández-Baz, 2012; Moraes & Duarte, 2014; González & Domagała, 2019). According to López-Godínez & Porion (2012), Moraes & Duarte (2014), González *et al.* (2019), González *et al.* (2021), and García-Díaz & Turrrent-Carriles (2022), this subfamily is currently thought to contain 90 species in 18 genera. *Telchin* Hübner, [1825] is one of these genera, and it possibly has the broadest distribution in the Americas, with its species found from Mexico to South America. Some of these species are very common and of great economic and commercial importance (*e.g.*, *T. atymnius* (Dalman,1824), *T. licus* (Drury, 1773)), since they are pests of crops such as bananas (*Musa* spp., Musaceae) and sugar cane (*Saccharum officinarum*, Poaceae) in several Latin American countries (Gallego, 1946, 1963; Lara, 1964; Miller, 1986; González & Cock, 2004; González *et al.*, 2010; González *et al.*, 2017; LAICA, 2017; Salazar-Blanco *et al.*, 2018; Cadet-Piedra *et al.*, 2019; González & Domagała, 2019; Aya *et al.*, 2021; García-Díaz, 2022). Conversely, other *Telchin* species tend to be less common and are sparsely represented in collections. Among them is *Telchin evalthe* (Fabricius, 1775), a species broadly distributed from Mexico to southeastern Brazil (González & Cock, 2004; Parrales-R. & Vargas-Fonseca, 2017; Rodríguez-Ramírez *et al.*, 2020). Currently, *T. evalthe* is thought to include ten subspecies, with *Telchin evalthe viryi* (Boisduval, [1875]) having the northernmost distribution and possibly being one of the rarest in the group (van den Berghe *et al.*, 2020).

Telchin evalthe viryi can be easily distinguished from the nominal subspecies by the absence of the yellowish subapical band on the forewings in males (Miller, 1986; González *et al.*, 2010). The taxon was described as *Castnia viryi* based on material from Mexico (Boisduval, [1875]). Houlbert (1918) later transferred *C. evalthe*, *C. viryi*, *C. euphrosyne* (Perty, 1833) and other taxa into the genus *Xanthocastnia* Houlbert, 1918. This situation remained unchanged for almost a century until Moraes & Duarte (2014) synonymized *Xanthocastnia* with *Telchin*, a position that is currently accepted. Since its description until the checklist of Miller (1995), *viryi* was considered a distinct species; furthermore, Miller (1995) assigned four subspecies (including the nominal) to *viryi* (*intermedia, vicina, vicinoides, viryi*). However, Lamas (1995) reclassified it as subspecies of *evalthe*, a position that remains accepted to this date.

The aim of this work is: (1) to present novel ecological and behavioral information about *T. evalthe viryi* found in Mexico; (2) to illustrate and provide a detailed diagnosis for males and females of this taxon; and (3) to present an updated distribution map of the taxon in Mexico, based on data gathered from specimens in institutional and private collections worldwide.

MATERIALS AND METHODS

Telchin evalthe viryi distribution records were located while searching the following institutional and private collections: Private collection of Bernardo López-Godínez, Guadalajara, Mexico (BLG); Private collection of the De la Maza Family, Mexico City, Mexico (CDM); Private collection of the Haghenbeck Family, Tehuacán, Puebla, Mexico (CFH); Private collection of the Turrent Family, Mexico City, Mexico (CFT); Private collection of the Villarreal Family, Oaxaca, Oaxaca, Mexico (CFV); Private collection of Julián A. Salazar-Escobar, Caldas, Colombia (CJASE); Private collection of Dirk Casteleyn, Brugge, West Flanders, Belgium (DC); Private collection of Daniel J. Curoe, Mexico City, Mexico (DJCC); Private collection of José de Jesús García-Díaz, Tehuacán, Puebla, Mexico (JJGD); Private collection of Robert Worthy, Caterham, Surrey, U.K. (RW); American Museum of Natural History, New York, USA (AMNH); Colección Entomológica del Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, Bogotá, Colombia (C-ICNMHN); Cornell University Insect Collection, Ithaca, New York, USA (CUIC); Colección Lepidopterológica de El Colegio de la Frontera Sur, Chetumal, Quinta Roo, Mexico (ECO-CH-LN); Colección Nacional de Insectos del Instituto de Biología de la Universidad Nacional Autónoma de México, Mexico City, Mexico (CNIN-IBUNAM); Essig Museum of Entomology Collection, University of California, Berkeley, USA (EMEC); Museum für Naturkunde, Berlin, Germany (ex-ZMHB: Zoologisches Museum der Humboldt Universität zu Berlin, Germany) (MfN); Colección Entomológica Alfredo Barrera del Museo de Historia Natural de la Ciudad de México, Mexico City, Mexico (MHNCM); Museo Nacional de Costa Rica, San José, Costa Rica (MNCR); Museo de Historia Natural de la Universidad de San Marcos, Lima, Perú (MUSM); Natural History Museum, London, U.K. (NHMUK); Oxford University Museum of Natural History, Oxford, U.K. (OUMNH); Entomological Collection, Texas A & M University, College Station, Texas, USA. (TAMU); Georgia Museum of Natural History - University of Georgia Collection of Arthropods, Athens, Georgia, USA (UGCA); Colección Entomológica de la Facultad de Ciencias Agronómicas de la Universidad Autónoma de Chiapas, Villaflores, Chiapas, Mexico (UNACH); Yale Peabody Museum of Natural History, New Haven, USA (YPM).

Bionomic information was obtained based on the personal observations of Roberto G. de la Maza and Daniel J. Curoe in Dos Amates, Veracruz and Santa Cruz Tepetotutla, Oaxaca, respectively. The distribution map was prepared using SimpleMappr (Shorthouse, 2010). Georeferencing of localities was done by means of Google Earth. The photos of the specimens illustrated in Figure 2 were taken with a Fujifilm FinePix HS20EXR camera. Adobe Photoshop 2020 was used for figure editing.

RESULTS

Biogeographical and distributional comments. Several authors have cited records for the subspecies from Mexico to Colombia and Venezuela (Westwood, 1877; Druce, 1883; Miller, 1986; González *et al.*, 2010; van den Berghe *et al.*, 2020). This taxon is strongly associated with very humid ecosystems. In Mexico, *Telchin evalthe viryi* is distributed in rainforests, semideciduous forests and cloud forests of the central and southern Gulf of Mexico slope. To the north, its distribution appears to be limited by the Trans-Mexican Volcanic Belt, while the arid region of the Isthmus of Tehuantepec seems to be a natural barrier that has prevented its distribution on the Pacific slope of Mexico. According to the biogeographic provinces of the Neotropical region proposed by Morrone *et al.* (2022), in Mexico *T. e. viryi* flies in localities that belong to the Veracruzan province of the Mesoamerican dominion in the

Figure 1. Geographic distribution of *Telchin evalthe viryi* in Mexico.

Brazilian subregion. The northernmost known locality for this taxon appears to be Motzorongo, Veracruz. The following is a list of localities where the taxon has been sighted or collected in Mexico: **Chiapas:** Cañón del Sumidero, Chajul; **Oaxaca:** Chalchijapa, Chiltepec, Matías Romero Avendaño, Metates, Puerto Eligio, San Juan Guichicovi, Santa Cruz Tepetotutla, Santa María Chimalapa, Vista Hermosa; **Veracruz:** Cerro El Vigía, Dos Amates, Motzorongo, Popoctépetl, Comoapan (see below), Volcán San Martín, Volcán Santa Martha (Fig. 1).

A male specimen of *T. evalthe viryi* deposited at the EMEC was, according to information on its label, collected on May 23, 1979, seven miles north of "Santa Comapan", Veracruz; however, there does not appear to be a town with this name in the state, which could suggest that the location indicated on the label might be wrong. Considering the known distribution of the taxon, the town of Comoapan within the municipality of San Andrés Tuxtla, Veracruz, could correspond to the locality mentioned on the label (Roberto de la Maza, pers. comm.).

Ecology and behavior. In Mexico, depending on the locality, *T. e. viryi* coexists with different castniid species. In most localities it is sympatric with *Athis inca orizabensis* (Strand, 1913), while in a few others it flies together with *A. delecta* (Schaus, 1911), *A. inca inca* (Walker, 1854), *Telchin atymnius futilis* (Walker, 1865) and/or *Divana diva diva* (Butler, 1870). According to current knowledge of its distribution in the country, the localities where it occurs vary from 0-1700 m, but it has been more frequently observed or collected from 400-1200 m. As with most Mexican castniids, its flight period varies depending on locality and the onset and duration of the rainy season. Temporal distribution records range between March and November, but most come from May to September.

According to published records, bromeliads (*Bromelia* spp., Bromeliaceae) and heliconias (*Heliconia* spp., Heliconiaceae) might be the host plants of some subspecies of *T. evalthe* (Moss, 1945; Miller, 1986; González & Cock, 2004; González *et al.*, 2010; González *et al.*, 2013; González *et al.*, 2017; González & Domagała, 2019; Rodríguez-Ramírez *et al.*, 2020; Aya *et al.*, 2021), but we have not been able to determine the host plant of this subspecies in Mexico.

This is a diurnal species that, like most known castniids, is highly territorial. On sunny and hot days (between 28 and 33°C), adults often fly up to 2 m high between 12:00 hr and 16:00 hr; their preferred sites are along the edges of bodies of water such as streams or springs and along wide and sunny trails or dirt roads. They do not fly in the shade nor within forests and they usually perch on dry twigs, tree branches or leaves of medium-sized plants (Roberto de la Maza, pers. comm.). Their particular coloration (black, dark orange-red and yellow) makes them unmistakable in the field. Males fly rapidly, like *T. atymnius futilis*; females, on the other hand, have a slower and heavier flight. Males and females do not fly on cloudy days nor during rain. In Santa Cruz Tepetotutla, Oaxaca, a male was sighted sunning itself in the morning on a leaf, in a stegopterous position (Daniel J. Curoe, pers. comm.). This suggests that males and females of this species might sun themselves in the morning to raise their temperature before flight activity around midday. Adults have not been recorded feeding on flowers, decomposing fruits or mud. Courtship behavior and copulation has not been observed, and the life cycle is unknown.

Material examined. Data from 49 specimens (39♂♂, 10♀♀) were recorded from several collections:
1♂, Holotype, *viryi* B. d. v., Mexico, Type, ex Musaeo Dris Boisduval (NHMUK); 1♂, Mexico (NHMUK); 1♂, mssn. G. / *Castnia viryi* B.d., Mexico (MfN); **Chiapas:** 1♀, Marqués de Comillas, Boca de Chajul, 26-VI-1980, *leg.* J. de la Maza E. (CDM); 1♂, Chiapa de Corzo, Cañón del Sumidero, XI-2012 (DC); **Oaxaca:** 1♂, Santiago Comaltepec, Puerto Eligio, 25-V-1980, *leg.* C. Velázquez M. (JJGD); 1♀, Santiago Comaltepec, Metates, 30-VI-1977, *leg.* R. F. de la Maza. R. (CDM); 1♂, Santiago Comaltepec, Metates, 06-V-1977, *leg.* R. F. de la Maza. R. (CDM); 1♂, San Felipe Usila, Santa Cruz Tepetotutla, 16-VI-2018, *leg.* D. J. Curoe (DJCC); 1♂, Santiago Comaltepec, Metates, III-1996, *leg.* F. G. Haghenbeck F. (CFH); 1♂, Santiago Comaltepec, Metates, III-1997, *leg.* F. G. Haghenbeck F. (CFH); 3♂♂, Santiago Comaltepec, Metates, 28-III-1999, *leg.* F. G. Haghenbeck F. (CFH); 1♂, Santiago Comaltepec, Metates, VI-1980, *leg.* C. Velázquez M. (CFH); 1♂, Santiago Comaltepec, Metates, VII-1980, *leg.* C. Velázquez M. (CFH); 4♂♂, Santiago Comaltepec, Puerto Eligio, 20-V-1980, *leg.* C. Velázquez M. (CFH); 1♀, Santiago Comaltepec, Vista Hermosa, V-1964 (CNIN-IBUNAM); 1♂, Matías Romero Avendaño, Matías Romero (Istmo), VIII-1967, *leg.* A. Díaz F. (CNIN-IBUNAM); 1♂, Santa María Chimalapa, Chalchijapa, 31-V-1995, *leg.* J. L. Salina G. (CNIN-IBUNAM); 2♂♂, Santiago Comaltepec, Puerto Eligio, 20-V-1980, *leg.* C. Velázquez M. (CNIN-IBUNAM); 1♂, San Juan Guichicovi, San Juan Guichicovi (Istmo), VIII-1973, *leg.* A. Díaz F. (CNIN-IBUNAM); 1♂, San José Chiltepec, Chiltepec, V-1967, *leg.* A. Díaz F. (CFT); **Veracruz:** 1♀, Santiago Tuxtla, El Vigía, 02-IX-1963, *leg.* R. F. de la Maza R. (JJGD); 1♀, 1♂, Santiago Tuxtla, El Vigía, 10-VII-2017 (JJGD); 2♂♂, Santiago Tuxtla, El Vigía, 12-VI-2018 (JJGD); 3♂♂, Santiago Tuxtla, El Vigía, 20-VI-2019 (JJGD); 1♂, Santiago Tuxtla, El Vigía, 21-VII-2021 (JJGD); 1♀, Santiago Tuxtla, El Vigía, 22-VIII-1963, *leg.* R. F. de la Maza R. (CDM); 1♂, Catemaco, Dos Amates, 20-VI-1963, *leg.* R. F. de la Maza R. (CDM); 1♂, Santiago Tuxtla, El Vigía, VII-2012 (CFH); 1♀, Santiago Tuxtla, El Vigía, 20-VIII-2009 (BLG); 1♂, Santiago Tuxtla, El Vigía, 20-VII-2010 (BLG); 1♀, Santiago Tuxtla, Popoctépetl, VIII-1972, *leg.* A. Díaz F. (CNIN-IBUNAM); 1♂, Santiago Tuxtla, Popoctépetl, IX-1973, *leg.* A. Díaz F. (CNIN-IBUNAM); 1♂, Santiago Tuxtla, El Vigía, VII-1978, *leg.* A. Díaz F. (CNIN-IBUNAM); 1♀, San Andrés Tuxtla, Estación Biológica "Los Tuxtlas" (180 m), 15-V-1985, *leg.* P. Sinaca (CNIN-IBUNAM); 1♂, Santiago Tuxtla, El Vigía, 20-III-2017 (CFT); 1♂, No. 2702, Motzorongo, V, *leg.* R. Müller (MHNCM); 1♀, No. 2703, Motzorongo, V, *leg.* R. Müller (MHNCM); 1♂, 7 mi N Santa Comapan [*sic*], Ver., Mex. V-23-1979, *leg.* J. R. Powers (EMEC).

Diagnosis and variability. *Telchin evalthe viryi* exhibits strong sexual dimorphism (Fig. 2). Dorsally, males present a blackish ground coloration on both fore- and hindwings. On the forewings they have a pale yellowish diagonal band that extends from the costa to the anal angle. On the hindwings there is a blurry spot on the costa; 5-6 dark orange-red submarginal spots between M_1 and 3A (the two middle ones being the largest); and on the anal angle, between 2A and 3A, a large dark orange-red patch that extends toward the discal area and merges with four yellow discal spots (the two middle ones being the largest). Ventrally, the ground coloration of the forewings is blackish brown and the same diagonal band as on the dorsal side is present, although wider. The costal margin as well as the apical and subapical regions are dark orange-red; the veins are black. On the hindwings, the base coloration is dark orange-red. The yellow costal spot and the four yellow discal spots are also present; between the spots and the margin the veins are black.

Unlike males, the females present on the forewings (both dorsally and ventrally) a pale yellow diagonal subapical band; the diagonal band that extends from the costa to the anal angle is also present, though wider than in males. Dorsally, on the hindwings the submarginal spots are larger than in males and

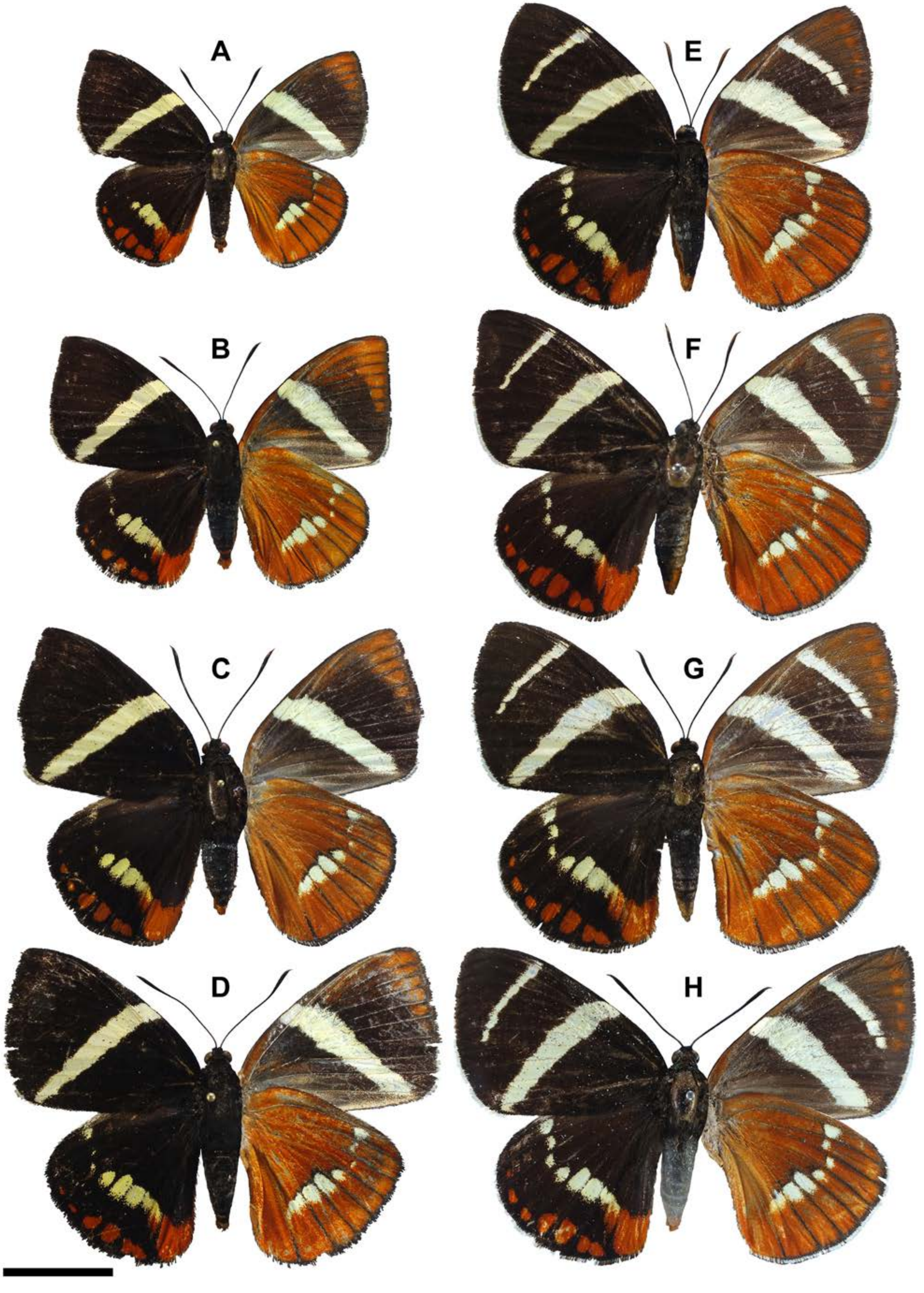

Figure 2. Dorsal and ventral variation of *Telchin evalthe viryi* males (A-C) and females (D-F) collected in Santiago Tuxtla, Veracruz. A-C) Males, 20-VI-2019 (JJGD); D) male, 21-VII-2021 (JJGD); E) female, 10-VII-2017 (JJGD); F) female, 02-IX-1963, *leg.* R. F. de la Maza R. (JJGD); G) female, 20-VIII-2009 (BLG); H) female, VIII-1972, *leg.* A. Díaz F. (CNIN-IBUNAM). Scale bar = 2 cm.

there is an extra spot between Rs and M_1. The yellow discal spots are larger and there are also two extra spots, thereby linking the costa and the anal angle. Ventrally, on the forewings the subapical and diagonal bands that appear on the dorsal side are also present; the submarginal region between R_4 and Cu_1 is dark orange-red. As in males, the female hindwings present the same yellowish discal spots as on the dorsal side, and the same black veins between these and the margin.

The subspecies seems to exhibit little variability within both sexes. In males and females the size and width of the forewing diagonal band and the hindwing discal and submarginal spots is variable in both dorsal and ventral view. In some males there are two extra discal spots on the hindwings, as in females, but these are much reduced in size and barely perceptible (Fig. 2).

DISCUSSION

As with *T. atymnius futilis* and *Divana diva diva*, the presence of this taxon in Mexico seems to be relatively recent, since it is not endemic to the country. It is not distributed in arid regions of the country and does not have a sister species on the Pacific slope, unlike other castniids (*e.g.*, *Athis hechtiae* (Dyar, 1910), *A. inca* (Walker, 1954), *A. delecta* (Schaus, 1911), *Escalantiana chelone* (Hopffer, 1856)).

The rarity of this subspecies could be linked to its host plant. It is well established that many castniids are closely associated with their host plants, which are sometimes endemic and/or present in very local or ecologically restricted distributions (García-Díaz *et al.*, 2019; García-Díaz *et al.*, 2020; González *et al.*, 2021; García-Díaz & Turrent-Carriles, 2022). Thus, it appears that Heliconiaceae, whose species are broadly distributed, might not be its host plants in Mexico, because unlike *T. atymnius futilis* (a taxon that feeds on heliconias and is frequently observed in Mexico), *T. evalthe viryi* has been reported only from a few localities on the Gulf of Mexico slope. If *T. evalthe viryi* is indeed associated with the genus *Bromelia*, the species *B. karatas* L., 1753, and *B. pinguin* L., 1753, being distributed in Mexico, Central America and northern South America (Espejo-Serna *et al.*, 2005), could be its potential host plants. However, more field work is required to know in detail this taxon's ecology and its host plants.

Of the ten currently recognized subspecies of *T. evalthe* (*cuyabensis* (Lathy, 1922), *euphrosyne* (Perty, 1833), *evalthe* (Fabricius, 1775), *evalthoides* (Strand, 1913), *quadrata* (Rothschild, 1919), *tica* (Lamas, 1995), *vicina* (Houlbert, 1917), *vicinoides* (Hopp, 1925), *viryi* (Boisduval, [1875]), *wagneri* (Buchecker, [1899])), the closest relative of *T. e. viryi* seems to be *T. e. tica*, which is distributed in southern Central America and whose phenotype is very similar in both dorsal and ventral view. However, a study involving a broad revision of specimens from different known populations from throughout the continent is necessary to confirm the limits of and relationships among species and subspecies (González *et al.*, 2010; González & Domagała, 2019; González & Domagała, 2021).

ACKNOWLEDGMENTS

Sincere thanks are extended to the following individuals: Roberto G. de la Maza and Daniel J. Curoe for providing information on the taxon and for reviewing the manuscript; Robert Worthy for providing information and images of specimens deposited at NHMUK, and for reviewing the manuscript; and Gerardo Lamas for sharing images of the type specimens of several subspecies of *Telchin evalthe*. Thanks to the following individuals for providing access to collections under their care: Omar Villarreal (CFV); Bernardo López-Godínez (BLG); Dirk Casteleyn (DC); Robert Worthy (RW); Daniel J. Curoe (DJCC); Roberto and Javier de la Maza (CDM); Francisco and Luis Haghenbeck (CFH); Alonso and Rafael Turrent (CFT); Cristina Mayorga, Ivonne Garzón, Alejandro Zaldívar and Adolfo Ibarra (CNIN-IBUNAM); María Eugenia Díaz-Batres (MHNCM); Noemí Salas-Suárez, Carmen Pozo and Humberto Bahena-Basave (ECO-CH-LN); Alessandro Giusti and Geoff Martin (NHMUK); Lawrence Gall (YPM); Carlos Joaquín Morales (UNACH); Julián A. Salazar-Escobar (CJASE) (C-ICNMHN); Suzanne Rab Green and David Grimaldi (AMNH); Viola Richter and Théo Lédger (MfN); Emily Jernigan and Jason Dombroskie (CUIC); Bernardo A. Espinoza-Sanabria (BioAlfa-GDFCF) and Germán Vega (MNCR); Karen Wright and Edward Riley (TAMU); Gerardo Lamas (MUSM); Peter T. Oboyski (EMEC); James Hogan (OUMNH); Richard Hoebeke (UGCA). Finally, thanks to Jorge M. González, Bernardo López-Godínez and Amy McAndrews for their careful reviews and thoughtful comments that improved this manuscript.

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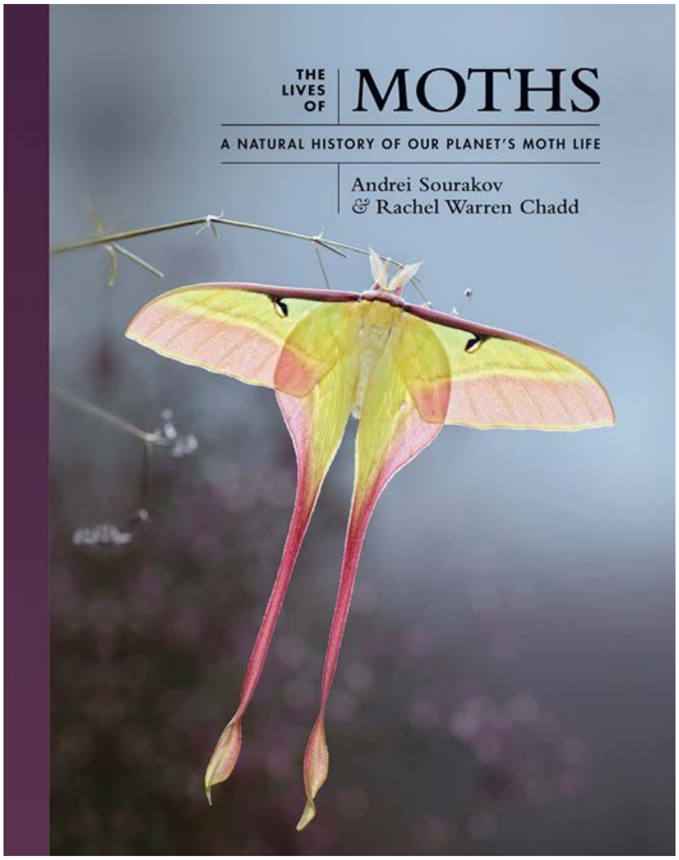
Book Review: *The Lives of Moths: A Natural History of our Planet's Moth Life*, by Andrei Sourakov and Rachel Warren Chadd (2022)

Princeton University Press, Princeton and Oxford. 288 pages hardcover 7 ¾ by 10 inches, in English. ISBN 978-0-691-22856-3.



This handsome tome is profusely illustrated with high definition, brilliantly colored photographs. In the introduction Sourakov recalls an encounter that he had in the 1970s. While walking from school he recognized the triangular shape of the Red Underwing Moth on a brick wall and slowly touched it. His touch evoked the moth to expose its hidden red markings, a defensive action. Then, after a second touch, it flew to a high perch where it perfectly blended in with the bark of a poplar. He goes on to explain how moths are intimately connected to plants and that appropriate plants for different moths are determined by the environment. Furthermore, each moth community bears a distinct impact of its environment.

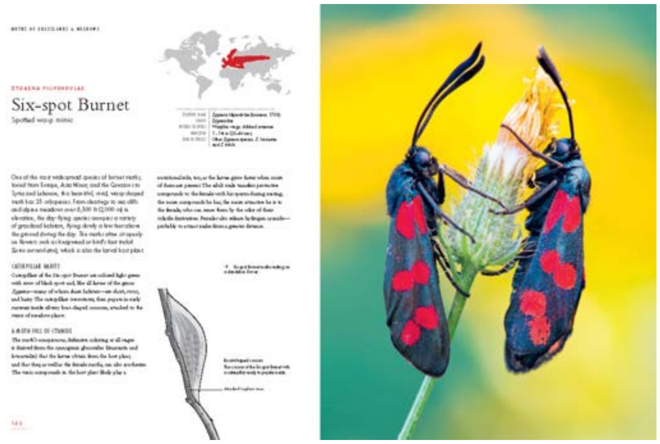
The first four chapters describe what a moth is, its biology, and classification. The writing is clear and concise using appropriate terminology while giving understandable definitions as needed. There are high quality illustrations and voluminous photographs which support the dialogue. In the section on interactions the reader discovers how moths attempt to survive in the hostile world of predators and parasitoids, including new discoveries in research on sound production and warning calls.

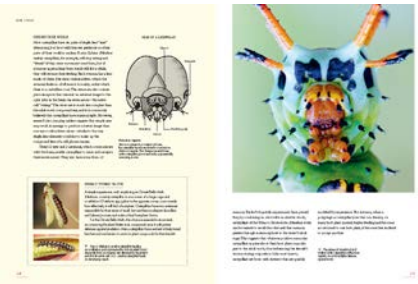
The last six chapters explore moths of different habitats: Tropical Rainforests, Grasslands and Meadows, Desert & Tundra, Temperate Deciduous Forests, Coniferous & Wetland Plants, and finally Moths in Agroecosystems & Around Homes. Each chapter is described and illustrated with high definition color photographs and illustrations in addition to world map images indicating where specific species are found.

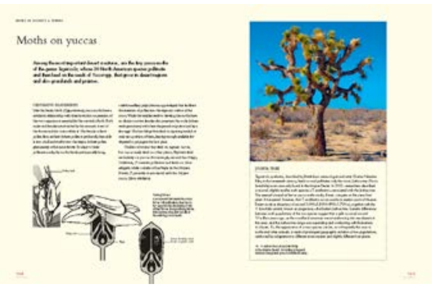
Finally, the book includes a Glossary, a list of major moth families giving the authority, date, number of described genera and species, a list of References, and a detailed Index. This is a *tour de force* of up-to-date knowledge, illustration, and photography presented in an easily understandable, comprehensive, and interesting way.

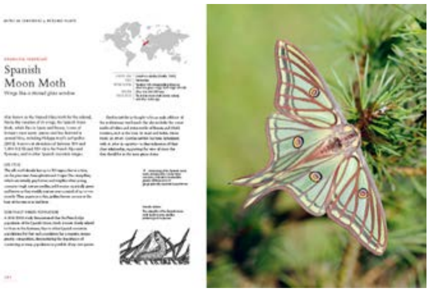
F. Matthew Blaine

McGuire Center for Lepidoptera and Biodiversity,
Florida Museum of Natural History,
University of Florida,
Gainesville, FL, USA.









Book Review: *Mariposas de Argentina: Guía de Identificación / Butterflies of Argentina: Identification Guide*, by Juan F. Klimaitis, Ezequiel O. Núñez Bustos, Cristian L. Klimaitis and Roberto M. Gueller (2018)

Vazquez Mazzini Editores, Buenos Aires, Argentina. 328 pp, ~1500 figs.

As a Brazilian *gaucho*[1] who is deeply interested in Argentinean culture and biodiversity, being the son of an Argentinean man[2] from the *Sierras de Cordoba*, it is a great pleasure to be invited to write this book review. The monumental bilingual Spanish-English book "Mariposas de Argentina: Guía de Identificación / Butterflies of Argentina: Identification Guide" is the result of 12 years of the authors' work to compile information on the nearly 1200 butterfly species recorded in Argentina. This book is successful in presenting a synthesis of the taxonomic diversity of diurnal butterflies for this large South American country. To this end, the authors made an enourmous effort in fieldwork and museum research, by visiting various public and private collections, reviewing the extensive literature and consulting specialists around the word from the main taxonomic groups.

Argentina is a biogeographic laboratory, harboring an extensive latitudinal and altitudinal gradient, marked by variations in sea level and climatic oscillations that have shaped its biodiversity. These biogeographical patterns leap to the eye when flipping through the pages of the book. The maps illustrate amazing cases of allopatric distribution of forest species with different subspecies in the Yungas and Paranaense forest, as seen in contrasting mimetic patterns of *Archonias brassolis negrita* (C. Felder & R. Felder, 1862) and *Archonias brassolis tereas* (Godart, 1819) (Pieridae). Due to the range of fauna contemplated in the book, this guide also serves to identify butterflies in neighboring countries, such as Bolivia, Paraguay, Uruguay, and southern Brazil. Many little-known species are illustrated for the first time in color, especially Hesperiidae. Due to its ease of handling and the possibility of comparatively viewing many species at the same time, it is an excellent book for a quick first identification of specimens. At the end of each butterfly family section, the authors present a valuable list of taxonomic comments and decisions, and these comments point to still open questions about the taxonomic diversity of Argentine butterflies.

The book has a general introductory part on classification, morphology, biology, history of lepidopterology in Argentina and conservation, and all these sections are well illustrated by original photos of species, habitats and behavior. This introduction is very useful for people starting to observe and study butterflies. Some anecdotal comments about migrations and seasonality in *Danaus erippus* (Cramer, 1775) and size variation in *Vanessa carye* (Hübner, [1812]) (Nymphalidae) are interesting and deserve detailed studies. Among the defense strategies in caterpillars, the authors could have mentioned the symbiotic interactions between caterpillars and ants (myrmecophily), described in the classic work by Carlos Bruch (1926), who was an eminent entomologist present in the historic photo of the Sociedad Entomológica Argentina meeting (page 39) and a pioneer in describing this type of interaction in riodinid caterpillars. In fact, it is a relevant topic because some genera with potential cases of endemism in Argentina such as *Pseudolucia* Nabokov, 1945 (Lycaenidae) and *Aricoris* Westwood, 1851 (Riodinidae) have myrmecophilous species (Bruch, 1926; Benyamini, 2013).

As highlighted by the authors, the study of Argentinean butterflies has historically oscillated, marked by a flourishing beginning of applied entomology carried out mainly by immigrants, going through an obscure period with little investment in basic research, to reaching a growth of interest in natural history and publication of excellent regional field guides (e.g., Canals, 2003; Núnez-Bustos, 2010; Volkmann & Núnez-Bustos, 2010). This book arrives in good time and constitutes a must-read for anyone interested in butterflies in Argentina. There are currently many Argentinean naturalists using citizen science platforms to record and identify butterflies and moths (see https://www.inaturalist.org/projects/mariposas-y-polillas-de-argentina-lepidoptera-of-argentina). These naturalists have already recorded new species of butterflies for Argentina, such as *Brangas moserorum* Bálint & Faynel, 2008 (Lycaenidae) (see Mantinian, 2020). Science advances, and certainly this book constitutes a benchmark for the restoration, monitoring, and conservation of South American biodiversity.

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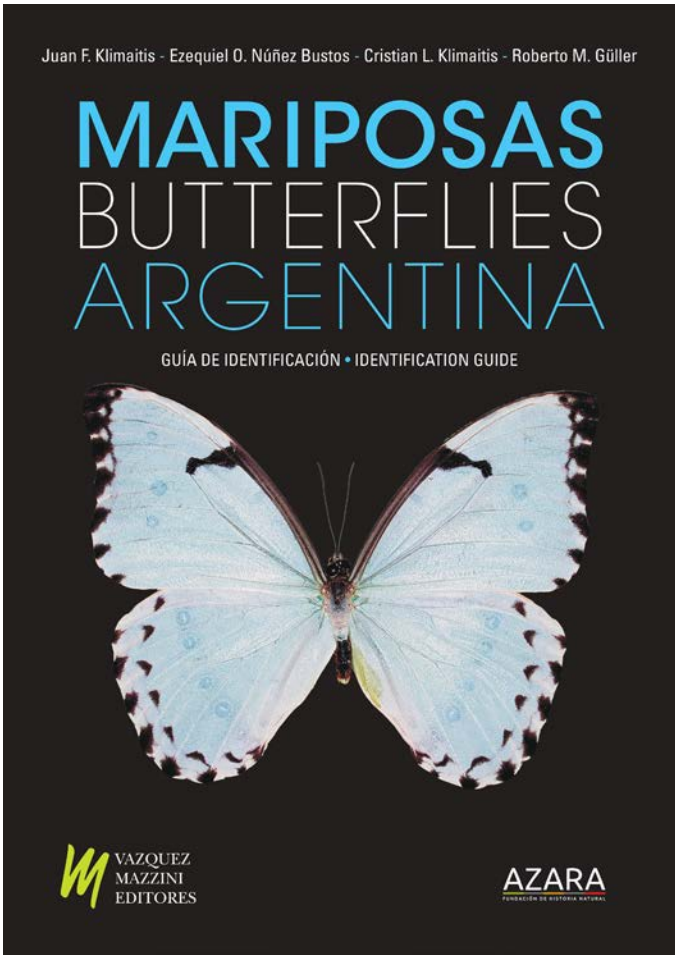
[1] *Gaúcho* in Brazil is the gentile of those born in the Rio Grande do Sul (RS) state. According to the dialectical frontier theory, it is a term that originated on the frontier zone between Spanish and Portuguese language, in the region among Argentina, Brazil and Uruguay (Rona, 1964).

[2] My biological father Jose Alfredo Bustos (1947-2020) is from Cosquín, Córdoba, Argentina.



Juan F. Klimaitis - Ezequiel O. Núñez Bustos - Cristian L. Klimaitis - Roberto M. Güller

MARIPOSAS
BUTTERFLIES
ARGENTINA

GUÍA DE IDENTIFICACIÓN • IDENTIFICATION GUIDE

VAZQUEZ
MAZZINI
EDITORES

AZARA
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26) *Heraclides androgeus* (Cramer, 1775)
ANDROGEO 85-115 mm. Yungas y selva paranaense. Matorrales en senderos y abras soleadas. Vuelo veloz a media altura, a menudo siguiendo cursos de agua. ♂ forma asambleas con otros papiliónidos. ♀ vuelo alto. 2S (alopátricas): **a-*androgeus*** (Cramer, 1775). ♂: **AP con ancha base amarillo-intenso y margen externo con hilera difuminada de manchas en U, amarillentas.** ♀ mayor, más escasa y **base de AA y mayor parte de AP, azul.** Aguas Blancas (Salta). [Guayanas a Bolivia]. **b-*laodocus*** (Fabricius, 1793). ♂: **amarillo-pálido;** ♀: **AA negra con notable faja central amarillenta; AP: faja central e hilera submarginal de manchas en U, celeste-azulinas.** Recuerda a ♀ de 12) pero **AP con margen dentado y larga y puntiaguda cola.** PP Uruguá-í (Misiones). [Paraguay y sur de Brasil]. **III**

ANDROGEUS SWALLOWTAIL 85-115 mm. Yungas and Paranaense forest. ♀ resembles ♀ of 14) but **HW has dented margin and long pointed tail.** Scrub on sunny paths and glades. Rapid flight at medium height, often following water courses. ♂ forms assemblies with other Papilionids. ♀ flies high. 2 subspp. (allopatric): **a-*androgeus*** (Cramer, 1775). ♂: **wide intense yellow base and external margin with row of blurred yellowish U-shaped spots on HW.** ♀ larger, scarcer and **blue base on FW and most of HW.** Aguas Blancas (Salta). [Guianas to Bolivia]. **b-*laodocus*** (Fabricius, 1793). ♂: **pale yellow;** ♀: **black FW has notable yellowish central band; HW: bluish central band and submarginal row of U-shaped spots.** Resembles ♀ of 12) but **HW with dented margin and long pointed tail.** PP Uruguá-í (Misiones). [Paraguay & south of Brazil]. **III**

27) *Heraclides astyalus astyalus* (Godart, 1819)
LIMONERA CHICA 85-100 mm. Yungas, selvas paranaense y marginales; bosque ribereño. ♂ parecido a ♂ de 26) pero **AP con cola espatulada negra y borde menos dentado; notable hilera submarginal de grandes manchas amarillentas.** ♀ imita a ♀ de 14) pero mayor, con cola e **hilera central de manchas rojas en AP.** ♀ fenotipo ***oebalus*** parecida al ♂, pero **amplia base de ambas alas, amarillo-pálida.** ♂ vuelo alto en horas calurosas. Forma asambleas. Liba nutrientes con tremular de alas, apenas tocando tierra. ♀ en matorrales floridos. PP Finca Las Costas (Salta). [Bolivia, Paraguay, sur de Brasil y Uruguay]. **IV**

BROAD-BANDED SWALLOWTAIL 85-100 mm. Yungas, Paranaense and riparian forests; exotic riverside woods. ♂ similar to ♂ of 26) but **HW has black spatulate tail and less dented border; notable submarginal row of large yellowish spots.** ♀ mimics ♀ of 14) but larger, with tail and **central row of red spots on HW.** ♀ phenotype ***oebalus*** similar to ♂, but **wide pale yellow base on both wings.** ♂ flies high in hottest hours. Forms assemblies. Feeds on nutrients, quivering wings barely touching ground. ♀ on flowering shrubs. PP Finca Las Costas (Salta). [Bolivia, Paraguay, south of Brazil & Uruguay]. **IV**

578) *Blepolenis batea praegrandis* (Fruhstorfer, 1907) 136
DUENDE NARANJA 70-90 mm. Selva paranaense. **Mitad basal anaranjada; 3-4 notables manchas subapicales blancas.** ♀ mayor, más pálida. Cañaverales densos y matorrales arbustivos en caminos y abras. Territorial. Posa en perchas y pastos altos. PP Salto Encantado (Misiones). [Paraguay y sur de Brasil]. **II**

BATEA OWL 70-90 mm. Paranense forest. **Orange basal half; 3-4 notable white subapical spots.** ♀ larger, paler. Dense stands of cane and scrub; roads and glades. Territorial. Rests on porches and tall grass. PP Salto Encantado (Misiones). [Paraguay & south of Brazil]. **II**

579) *Brassolis astyra philocala* Stichel, 1904 138
PALMITERA PARDA 70-110 mm. Selva paranaense. Pardo-oscura. **AA: ancha e irregular faja anaranjado-amarillenta.** ♀ mayor y con menos ocelos en AP de FV. Capueras y palmerales. ¿Misiones? [Brasil y Uruguay]. **I**

ASTYRA OWL 70-110 mm. Paranense forest. Dark brown. **FW: wide, yellowish-orange, irregular stripe.** ♀ larger, less ocelli on HW of VS. Secondary forests and palm groves. ¿Misiones? [Brazil & Uruguay]. **I**

Lucas A. Kaminski
Núcleo de Ecologia e Biodiversidade,
Instituto de Ciências Biológicas e da Saúde,
Universidade Federal de Alagoas,
Maceió, AL, Brazil, and:
Departamento de Zoologia
Universidade Federal do Rio Grande do Sul,
Porto Alegre, RS, Brazil.

Book Review: *Guide to the Butterflies of Honduras*, by Robert J. Gallardo and Olivia Diaz (2023)

Emerald Valley International Butterfly Center/Fauna Ventures, Honduras. 370 pp., 113 pl.

Honduras is the "Darién Gap" of northern Central America, as noted by the authors in the Introduction to this book. Biogeographically, this is illustrated by the fact that almost 17% of Honduran butterfly species reach their northern or southern range limit within the country, but the comparison is also appropriate in view of the historically poor knowledge of the country's fauna, and the large expanses of wilderness still awaiting exploration. Starting their intensive inventory of Honduran butterflies only in 2016, the authors have added a remarkable 310 species to the previous checklist for the country (Miller *et al.*, 2012), with a further 100 species added by others, bringing the country total to 1270. Immediate taxonomic results of the authors' efforts in the field include the discovery of four new species (Gallardo *et al.*, 2021; Gallardo & Grishin, 2021), and the first evidence supporting species status for two nearly allopatric euptychiine satyrines (Nakahara & Gallardo, 2019).

This book is a field guide rather than an encyclopedic compilation of knowledge on Honduran butterflies. As such, the book draws almost exclusively on the observations of the authors and their network of correspondents, ranging from collectors to photographers to museum curators. Prominent online and literature sources were also consulted, but the result is still dominated by the authors' own work, and thus represents a primary research publication as well as a field guide.

The book begins by reviewing the geography and habitats of Honduras and important butterfly localities, followed by summary accounts for every species that provide, in telegraphic form, the scientific name, English name, similar species, habitats, flight height, elevation, abundance, habits, localities where observed, and broad distribution. The sections on habits and observations are particularly important, representing a vast amount of new data; observation information includes date, location, observer, and source of record. Sandwiched between the species accounts are 113 plates containing 1695 color images of Honduran butterflies, the great majority of which are living individuals, supplemented by pinned museum specimens.

The book concludes with a list of 92 species reported for the country in publications or other sources but not observed personally by the authors, and a list of 471 species expected from Honduras, including 195 that are almost certain to occur. There is thus still a large amount to learn about the butterfly fauna of Honduras, and the authors follow a holistic approach to improving knowledge of the country's butterflies. In addition to their own field work, the authors own and continue to enhance the landscape of the private reserve Emerald Valley (Gallardo, 2022), with more than 700 butterflies recorded. They have also launched an annual butterfly festival to promote the study, enjoyment, and conservation of butterflies. There are a small number of misidentifications and a few taxonomic names that need updating, but these are minor issues that will be resolved as the authors continue their efforts to promote and expand knowledge of this diverse and poorly known butterfly fauna.

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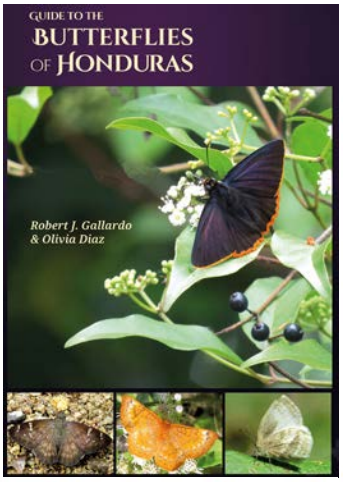
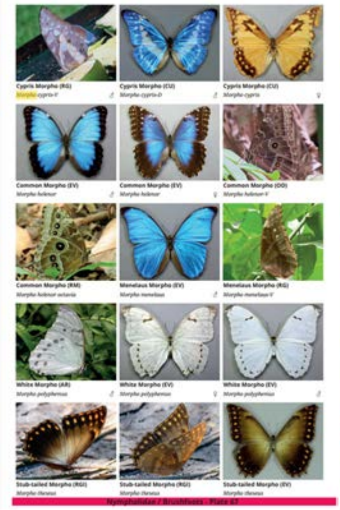
Keith R. Willmott
McGuire Center for Lepidoptera and Biodiversity,
Florida Museum of Natural History,
Gainesville, FL, USA.





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