

Butterflies (Lepidoptera: Papilionoidea) of Montes de María sub-region: Preliminary list of species from El Carmen de Bolívar (Bolívar, Colombia)

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Abstract

We provide a preliminary list of the diurnal butterflies of El Carmen de Bolívar based on specimens captured between 2015 and 2017 using entomological nets during active searches. Six of the Colombian families of diurnal butterflies were registered. In this study, we provide the distribution of each species throughout the Colombian Caribbean and we confirmed the presence of some species in the region: *Emesis fatimella*, *Eurybia lycisca* (Riodinidae) and *Urbanus teelus* (Hesperiidae). This research contributes to the knowledge of diurnal butterflies in one of the most biodiverse areas of the Caribbean region, which undergoes a progressive transformation of their ecosystems.

Key words: Bolívar; Diurnal Lepidoptera; Species list; Montes de María; Taxonomy.

Mariposas (Lepidoptera: Papilionoidea) de la sub-región de Montes de María: lista preliminar de especies de El Carmen de Bolívar (Bolívar, Colombia)

Resumen

Se presenta el listado preliminar de las mariposas diurnas de El Carmen de Bolívar (Bolívar, Colombia) basado en especímenes capturados con redes entomológicas durante búsquedas activas entre los años 2015 y 2017. Se registraron seis de las familias de mariposas diurnas reportadas para Colombia. En este estudio se proporciona la distribución de cada especie en todo el Caribe colombiano, y se confirma la presencia de algunas especies en la región: *Emesis fatimella*, *Eurybia lycisca* (Riodinidae) y *Urbanus teelus* (Hesperiidae). Este estudio contribuye al conocimiento de las mariposas diurnas en una de las áreas con mayor biodiversidad de la región Caribe, que experimenta una transformación progresiva de sus ecosistemas.

Palabras clave: Bolívar; Lepidópteros diurnos; Lista de especies; Montes de María; Taxonomía.

Introduction

The Caribbean is the Colombian region with the largest and best-preserved fragments of Tropical Dry Forest (TDF) (Pizano & García, 2014), but it is also threatened by its increasing transformation (Freitas, *et al.*, 2003; Orozco, *et al.*, 2009; Montero, *et al.*, 2009). The progressive loss of the forest enhances the importance of each fragment and its biodiversity and demands its conservation (Montero, *et al.*, 2009). The tropical dry forest serves to the diagnosis and evaluation of conservation strategies (Vargas-Zapata, *et al.*, 2011) and, therefore, its study is of great scientific interest.

Lepidoptera is the third most studied order of butterflies; the specimens are abundant and easy to collect and to identify (Llorente, *et al.*, 1993; Montero, *et al.*, 2009); they also play important roles in trophic chains and as plant pollinators (Constantino & Andrade-C., 2007). Many species have been used for environmental monitoring as indicators of habitat quality due to their rapid biological

cycles, ecological specificity, and their easy evaluation at any time of year (Brown, 1991; Freitas, *et al.*, 2003; Montero, *et al.*, 2009).

The list of Colombian butterflies has undescribed areas of our country and the department of Bolívar is one such areas. The information on species is scarce and its Northern area is thought to house between one to 20 species (REF: Colombian Butterfly Database), whereas peripheral areas remain poorly explored (Andrade-C., 2002).

This study provides a species list of diurnal butterflies from El Carmen de Bolívar, in Montes de María sub-region including new findings for the Colombian Caribbean region. Our results offer basic scientific information for

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future studies, as the taxonomic listings are not only used for describing the biodiversity but also contribute to the conservation, monitoring, and improvement of the national biodiversity inventory and the elaboration of management plans for natural areas (Mielke, *et al.*, 2008; Núñez, 2009).

Material and methods

Study area. Our study was conducted in Saltones de Mesa (9° 47' 34.23" N 75° 18' 5.58" W) and Camarón (9° 50' 32.32" N 75° 17' 36.53" W), in the jurisdiction of Santo Domingo de Mesa, El Carmen de Bolívar municipality (Figure 1), located in the Northeast of Montes de María, an undulating area with altitudes ranging from 50 to 989 m above sea level (Plataforma de Organizaciones de Desarrollo Europeas en Colombia - PODEC, 2011) and temperatures between 27 and 30 °C exhibiting both a semi-dry and slightly humid climate with a unimodal and bi-seasonal rainfall distribution regime (annual average: 174 mm) (Rangel-Ch. & Carvajal-Cogollo, 2012).

The vegetation in the studied areas consists in a mixture of fragments of semi-humid transitional dry forest (as classified by Etter, *et al.*, 2008) in a good state of conservation, areas intervened by deforestation, shrub vegetation, small crops (such as corn, yucca, yam and avocado), and gardens of floral plants such as Asteraceae.

Fieldwork and laboratory. Specimens were collected using entomological nets between 8:00 and 16:00 hours from July 1 to 5, 2015, December 1 to 7, 2016, and May 21 to 27, 2017 with an effort of 152 hours-man in Santo Domingo de Mesa (Figure 1). The butterflies were sacrificed by digital pressure on the thorax and then stored in triangular paper envelopes; later, they were hydrated in a humid chamber and prepared for mounting. All these procedures were carried out according to the collection, preservation, and mounting protocol proposed by Andrade-C., *et al.* (2013). Specimens were identified using the keys provided by

Le Crom, *et al.* (2004) and the illustrated list of American Butterflies by Warren, *et al.* (2017). The names of the species were updated and contrasted using the Neotropical Atlas of Lamas (2004). The identification of some species was confirmed with the Entomology Reference Collection of the Instituto de Ciencias Naturales of the National University of Colombia (ICN). The specimens were collected with permission granted through resolution 0751 of June 27, 2014, by the Corporación Autónoma Regional del Canal del Dique (CARDIQUE) and then stored in the research laboratories of the Biology program at Cartagena University (CUDC-INS).

The butterflies were photographed with a Nikon Coolpix compact camera and the pictures were edited with Adobe Photoshop® CS6 software.

Results

We found 67 species distributed in six families, 16 subfamilies, 31 tribes, and 57 genera (Table 1, figures 2-29). The richest family was Nymphalidae with 34 species followed by Pieridae with 12, whereas Lycaenidae was the least representative with three species, followed by Papilionidae and Riodinidae with four species. The most representative genera were *Eurema* and *Phoebis* with four and three species, respectively (Table 1).

The following are the geographical distributions of the species registered for the first time in the Colombian Caribbean:

Family Riodinidae

***Eurybia lycisca* Westwood, 1851**

Examined material (Annexed, <https://www.racefyn.co/index.php/racefyn/article/view/808/2551>): 1♂. COLOMBIA, Bolívar, El Carmen de Bolívar, Santo Domingo de Mesa, Saltones de Mesa, 9° 47' 34.23" N 75° 18' 5.58" W, 110 m, entomological net, 1-7 xii. 2016, H. Vides Leg. CUDC-INS-654.

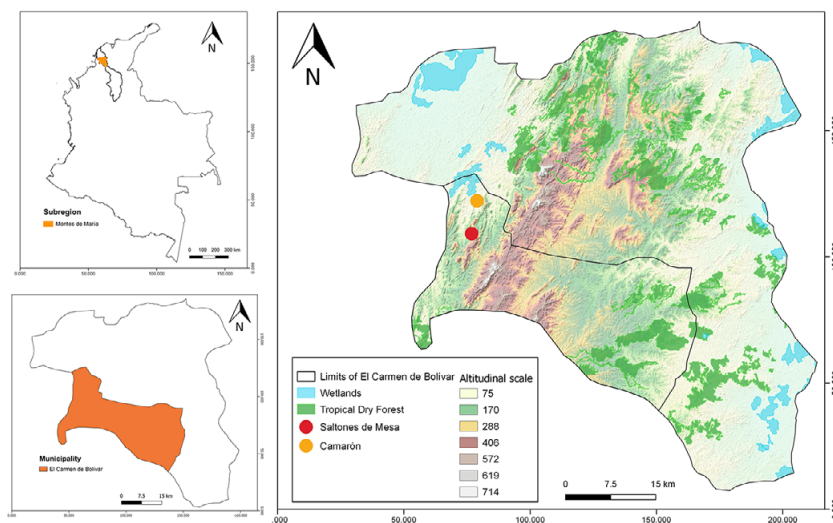


Figure 1. Location of the study area: Camarón and Saltones de Mesa, El Carmen de Bolívar municipality, Bolívar department, Colombia

Table 1. Species of diurnal butterflies registered for Santo Domingo de Mesa, El Carmen de Bolívar, Montes de María, Bolívar

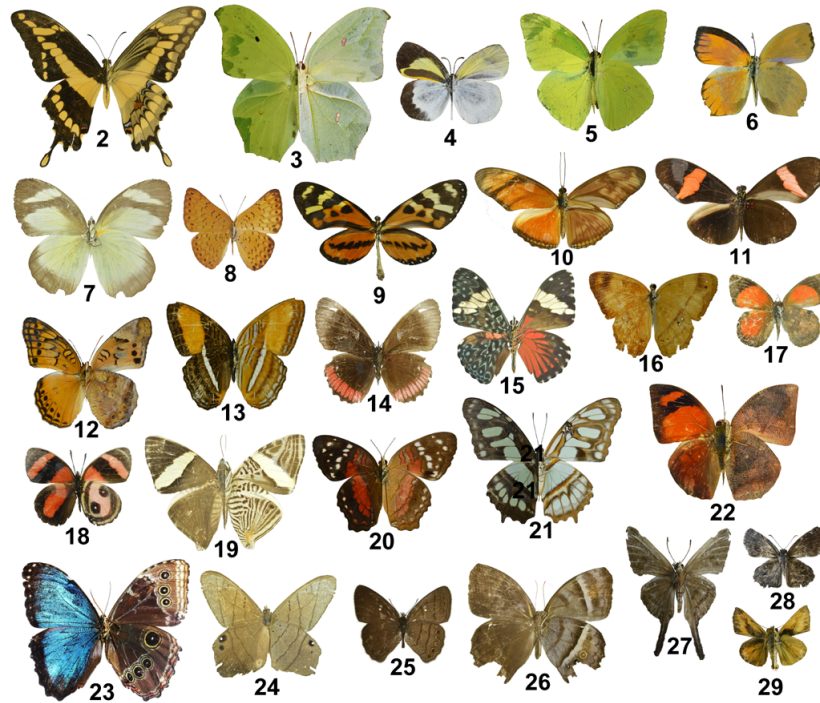
Family	Subfamily	TAXA		P/A		Distribution in the Colombian Caribbean	Source
		Tribe	Specie	Loc 1	Loc 2		
Papilionidae	Papilioninae	Troidini	<i>*Battus polydamas</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena, Sucre, Bolívar	1,3,4,8,9,11,12
			<i>Parides iphidamas</i> (Fabricius, 1793)	1	1	Atlántico, Cesar, Sucre	3,7,11,14
			<i>Parides anchises serapis</i> (Boisduval, 1836)	0	1	Atlántico, Córdoba, Cesar (including Serranía del Perijá), Sucre	1,3,5,7,8,9,11,13
		Papilionini	<i>*Heraclides thoas nealces</i> (Rothschild & Jordan, 1906)	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena	3,4,5,6,8,9
Pieridae	Coliadinae		<i>*Anteos maerula</i> (Fabricius, 1775)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira	1,5,7,8,9,10
			<i>Eurema agave</i> (Cramer, 1775)	1	1	Cesar (including Serranía del Perijá), Córdoba	5,8,9
			<i>Eurema albula</i> (Cramer, 1775)	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena	1,2,4,5,6,7,9
			<i>*Eurema दौरa</i> (Godart, 1819)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Sucre, San Andrés	1,2,3,5,6,9,11,13
			<i>Phoebis agarithe</i> (Boisduval, 1836)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba	1,2,8,9
			<i>*Phoebis philea</i> (Linnaeus, 1763)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba	1,2,5,7,8,9
			<i>Phoebis sennae</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés and Providencia, La Guajira, Magdalena, Bolívar	1,2,3,4,5,8,9,10,12,13
			<i>*Pyrisitia proterpia</i> (Fabricius, 1775)	1	1	Atlántico, Cesar, Córdoba, Bolívar	1,2,5,7,9,12
			<i>Pyrisitia venusta venusta</i> (Boisduval, 1836)	0	1	Cesar (including Serranía del Perijá)	7,9
			Pierinae	Pierini	<i>Ascia monuste</i> (Linnaeus, 1764)	0	1
			<i>*Itaballia demophile calydonia</i> (Boisduval, 1836)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena, Sucre	1,2,3,4,7,8,9,11
			<i>Glutophrissa drusilla</i> (Cramer, 1777)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Sucre	1,5,8,9,11

Family	TAXA			P/A		Distribution in the Colombian Caribbean	Source
	Subfamily	Tribe	Specie	Loc 1	Loc 2		
Lycaenidae	Theclinae	Eumaeini	<i>Arawacus lincoides</i> (Draudt, 1917)	1	1	Cesar	7
			<i>Pseudolycaena marsyas</i> (Linnaeus, 1758)	1	0	Atlántico, Cesar, Córdoba	1,5,7,9
	Polyonmatinae		<i>Hemiargus hanno</i> (Stoll, 1790)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba	1,5,7,8,9
Riodinidae	Riodininae	Eurybiini	<i>Eurybia lycisca</i> Westwood, 1851	1	0	Bolívar	15
		Helicopini	* <i>Emesis fatimella</i> (Westwood, 1851)	0	1	Bolívar	15
		Nymphidiini	<i>Aricoris erostratus</i> (Westwood, 1851)	0	1	Atlántico, Cesar	1,9
			<i>Nymphidium onaenum</i> Hewitson, 1869	0	1	Serranía del Perijá, Córdoba	1,9
Nymphalidae	Danainae	Danaini	<i>Danaus plexippus</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés and Providencia	1,5,8,9,13
			<i>Danaus gilippus</i> (Cramer, 1775)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira, Magdalena	1,4,5,7,8,9,10
		Ithomiini	* <i>Mechanitis polymnia</i> Linnaeus, 1758	1	1	Córdoba, Serranía del Perijá	5,8,14
			<i>Pteronymia aletta</i> (Hewitson, [1855])	0	1		13
	Heliconiinae	Heliconiini	<i>Agraulis vanillae vanillae</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés, La Guajira	1,5,7,8,9,10,13
			* <i>Dryas iulia</i> (Fabricius, 1775)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés and Providencia, Magdalena, Sucre	1,2,5,7,8,9,11,13
			<i>Eueides isabella</i> (Stoll, 1781)	1	1	Cesar (including Serranía del Perijá)	7,8
			* <i>Heliconius erato hydara</i> (Hewitson, 1867)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira, Sucre	1,2,5,3,6,7,8,9,10,11
		Argynniini	* <i>Euptoieta hegesia</i> (Cramer, 1779)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira, Magdalena	1,4,5,7,8,9,10
		Limenitidinae	Limenitidini	* <i>Adelpha cytherea daguana</i> (Fruhstorfer, 1913)	1	0	Serranía del Perijá

Family	Subfamily	TAXA		P/A		Distribution in the Colombian Caribbean	Source
		Tribe	Specie	Loc 1	Loc 2		
Nymphalidae	Biblidinae	Biblidini	<i>*Biblis hyperia</i> (Cramer, 1779)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba	1,5,6,7,8,9
		Ageroniini	<i>Ectima thecla</i> (Fabricius, 1796)	0	1	Serranía del Perijá	8
			<i>*Hamadryas amphinome</i> (Linnaeus, 1767)	1	0	Atlántico, Cesar (including Serranía del Perijá)	1,2,7,8,9
			<i>Hamadryas feronia</i> (Linnaeus, 1758)	1	0	Cesar (including Serranía del Perijá), Córdoba, La Guajira, Sucre	5,8,9,10,11,14
		Epiphelini	<i>*Nica flavilla</i> (Godart, [1824])	1	1	Atlántico, Cesar, Córdoba, Sucre	1,2,3,5,7,11
		Callicorini	<i>*Haematera pyrame</i> (Hübner, [1819])	1	0	Atlántico	1
	<i>*Callicore pitheas</i> (Latreille, [1813])		1	0	Atlántico, Cesar (including Serranía del Perijá), Magdalena, Córdoba, Sucre	1,2,4,5,6,7,8,9,11	
	Nymphalinae	Cocini	<i>Historis odius dious</i> Lamas, 1995	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés and Providencia, Magdalena	2,3,4,5,7,8,9,13
		Nymphalini	<i>*Colobura dirce</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Sucre	2,5,7,8,9,11
		Victorinini	<i>*Anartia amathea</i> (Linnaeus, 1758)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena	3,4,5,8,9
			<i>Anartia jatrophae</i> (Linnaeus, 1763)	0	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, San Andrés and Providencia, La Guajira, Bolívar	1,3,5,8,9,10,12,13
			<i>*Siproeta stelenes</i> (Linnaeus, 1758)	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Sucre, San Andrés	1,3,5,7,8,9, 11,13
		Junoniini	<i>Junonia evarete</i> (Cramer, 1979)	1	1	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira, Magdalena, Bolívar	1,3,4,5,7,8,9,10,12
		Melitaeini	<i>Anthanassa drusilla</i> (C. Felder y R. Felder, 1861)	1	1	Cesar (including Serranía del Perijá), Córdoba, Magdalena	4,5,7,8,9
			<i>Chlosyne lacinia</i> (Geyer, 1837)	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, Magdalena, Sucre	1,3,4,5,7,8,9,11
Charaxinae		Anaeini	<i>*Fountainea ryphea</i> (Cramer, 1775)	0	1	Serranía del Perijá	8,13

Family	Subfamily	TAXA		P/A		Distribution in the Colombian Caribbean	Source	
		Tribe	Specie	Loc 1	Loc 2			
Nymphalidae	Satyrinae	Morphini	<i>*Morpho helenor peleides</i> Kollar, 1850	0	1	Cesar (including Serranía del Perijá), Córdoba, Magdalena	4,5,7,8,9,14	
		Brassolini	<i>Caligo brasiliensis</i> (von Felder, 1862)	1	1	Sucre	11,14	
		Haeterini	<i>*Pierella luna luna</i> (Fabricius 1793)	1	0	Cesar (including Serranía del Perijá), Córdoba	5,8,9,14	
		Satyrini	<i>Cissia pompilia</i> (C. Felder & R. Felder, 1867)	1	1	Cesar (including Serranía del Perijá), Córdoba	5,7,8,9	
			<i>*Hermeuptychia hermes</i> (Fabricius, 1775)	0	1	Cesar (including Serranía del Perijá), Córdoba, Sucre	5,7,8,9,11,14	
			<i>Magneuptychia libye</i> (Linnaeus, 1767)			Cesar (including Serranía del Perijá), Córdoba	5,7,8,9	
			<i>Pareuptychia ocirrhoe</i> (Fabricius, 1776)	1	1	Cesar (including Serranía del Perijá), Córdoba	5,8,9	
			<i>*Taygetis laches laches</i> (Fabricius, 1793)	1	0	Atlántico, Cesar (including Serranía del Perijá), Córdoba, La Guajira, Sucre	1,5,7,8,9,10,11,14	
		Eudamminae	Eudamini	<i>Typhedanus undulatus</i> (Hewitson, 1867)	0	1	Atlántico, Córdoba, Cesar (including Serranía del Perijá)	1,5,8,9
				<i>*Urbanus simplicius</i> (Stoll, 1790)	1	1	Cesar (including Serranía del Perijá), Córdoba	5,8,9,14
				<i>Urbanus teleus</i> (Hübner, 1821)	1	1		15
		Hesperiinae	Carcharodini	<i>*Nisoniades</i> sp.	1	0		
			Hesperiini	<i>*Hylephila phyleus</i> (Drury, 1773)	1	1	Atlántico, Cesar, Providencia	1,7,13,14
		Hesperiidae	Pyrginae	Erynnini	<i>Timochares trifasciata</i> (Hewitson, 1868)	1	0	Atlántico, Cesar
<i>Helioptetes arsalte</i>	1	1			Cesar (including Serranía del Perijá), Córdoba	5,7,8		
<i>Polycctor</i> sp.	1	1						
<i>Pyrgus orcus</i> (Stoll, 1780)	1	1			Cesar (including Serranía del Perijá), Córdoba	5,7,8,9		
<i>Timochreon satyrus</i> (C. Felder & R. Felder, 1867)	0	1			Cesar (including Serranía del Perijá), Córdoba	5,6,7,8		

P/A: Presence/Absence, **Loc 1**: Saltones de Mesa, **Loc 2**: Camarón. The column “Source” lists the publications made in the Colombian Caribbean recording the presence of species of diurnal butterflies in the departments of Atlántico: **1** = **Montero, et al.** (2009), **2** = **Boom-Urueta, et al.** (2013), **3** = **Prince-Chacón, et al.** (2011); Magdalena: **4** = **Vargas-Zapata, et al.** (2011); Córdoba: **5** = **Campos-Salazar, et al.** (2011); Cesar: **6** = **Pulido-B. & Andrade-C.** (2007), **7** = **Erazo & González-Montaña** (2008), **8** = **Pulido-B. & Andrade-C.** (2009), **9** = **Campos-Salazar & Andrade-C.** (2009); La Guajira: **10** = **Moreno-M. & Acuña-Vargas** (2015); Sucre: **11** = **Mercado-Gómez, et al.** (2018); Bolívar: **12** = **Ahumada-C.** (2017); San Andrés and Providencia Islands: **13** = **Emmel** (1975); and records for the Caribbean region without specific location: **14** = **Andrade-C.** (2002). Additionally, number fifteen (**15**) was used to indicate the new records for the Colombian Caribbean. The asterisk (*) refers to the species shown in figures 2-29.



Figures 2-29. Representatives of the six families of diurnal butterflies found in Santo Domingo de Mesa. Dorsal face to the left, ventral face to the right. **Papilionidae** (2). 2. *Heraclides thoas* (CUDC-INS 838). **Pieridae** (3-7). 3. *Anteos maerula* (CUDC-INS 587), 4. *Eurema दौरا* (CUDC-INS 571). *Phoebis sennae* (CUDC-INS 616), 6. *Pyrisitia proterpia* (CUDC-INS 662), 7. *Itaballia demophile* (CUDC-INS 584). **Riodininae** (8): 8. *Emesis fatimella* (CUDC-INS 772). **Nymphalidae** (9-26) 9. *Mechanitis polymnia* (CUDC-INS 907), 10. *Dryas iulia* (CUDC-INS 768), 11. *Heliconius erato* (CUDC-INS 814), 12. *Euptoieta hegesia* (CUDC-INS 789), 13. *Adelpha cytherea daguana* (CUDC-INS 911), 14. *Biblis hyperia* (CUDC-INS 673), 15. *Hamadryas amphinome* (CUDC-INS 808), 16. *Nica flavilla* (CUDC-INS 907), 17. *Haematera pyrame* (CUDC-INS 807), 18. *Callicore pitheas* (CUDC-INS 692), 19. *Colobura dirce* (CUDC-INS 711), 20. *Anartia amathea* (CUDC-INS 918), 21. *Siproeta stelenes* (CUDC-INS 954), 22. *Fountainea ryphea ryphea* (CUDC-INS 804), 23. *Morpho helenor peileides* (CUDC-INS 906), 24. *Pierella luna luna* (CUDC-INS 679), 25. *Hermeuptychia Hermes* (CUDC-INS 844), 26. *Taygetis thamyra* (CUDC-INS 957). **Hesperiidae** (27-29): 27. *Urbanus simplicius* (CUDC-INS 1030), 28. *Nisoniades* sp. (CUDC-INS 960), 29. *Hylephila phyleus* (CUDC-INS 966)

Distribution: From the southeast of México to Ecuador (Warren, *et al.*, 2017). In Colombia, this species has been recorded in the Andean regions of Quindío and Antioquia departments (Orozco, *et al.*, 2009, Marín-Gómez, *et al.*, 2011) and in the Pacific region of Nariño and Chocó departments (Palacios & Constantino, 2006, Vargas-Ch. & Salazar, 2014).

Emesis fatimella (Westwood, 1851)

Examined material (Annexed, <https://www.raccefyfyn.co/index.php/raccefyfyn/article/view/808/2551>): 1♂. COLOMBIA, Bolívar, El Carmen de Bolívar, Santo Domingo de Mesa, Camarón, 9°50'32.32"N 75°17'36.53"W, 91 m, entomological net, 1-5. vii. 2015, A. Sandoval, A. Segovia-Paccini, G. Ríos, D. Ahumada-C. and D. Rodríguez Leg. CUDC-INS 772 (Figure 8).

Distribution: From México to Colombia, Guianas and Trinidad (Warren, *et al.*, 2017). In Colombia, this species has been recorded in the Pacific region of Chocó department (Vargas-Ch. & Salazar, 2014) and in the Amazon region (Andrade-C., *et al.*, 2015) in Vaupés Department (Rodríguez & Miller, 2013).

Family Hesperiidae

Urbanus teleus (Hübner, 1821)

Examined material (Annexed, <https://www.raccefyfyn.co/index.php/raccefyfyn/article/view/808/2551>): 1♂, 1♀. COLOMBIA, Bolívar, El Carmen de Bolívar, Santo Domingo de Mesa, Camarón, 9°50'32.32"N 75°17'36.53"W, 91 m, entomological net, 1-5. vii. 2015, A. Sandoval, A. Segovia-Paccini, G. Ríos, D. Ahumada-C. and D. Rodríguez Leg. CUDC-INS 1038, 1039.

Distribution: from Texas in the USA to Argentina (Valencia, *et al.*, 2005, Warren, *et al.*, 2017). In Colombia, it has been registered for the Andean region (González & Andrade-C., 2008) in the departments of Tolima (Camero, *et al.*, 2007), Cundinamarca (Suárez, 2014), Antioquia (Orozco, *et al.*, 2009), Caldas (Ríos-Málaver, 2007) and Santander (Quintero, *et al.*, 2014). In the Pacific region, it has been registered for Valle del Cauca department (Zambrano-González & Ortiz-Ordóñez, 2009, Ascuntar-Osnas, *et al.*, 2010, Gaviria-Ortiz & Henao-Bañol, 2011), and in the Orinoquia region, in the Casanare department (Urbano, *et al.*, 2014).

Discussion

Six families of Neotropical butterflies were found in Santo Domingo de Mesa coinciding with observations by Emmel (1975), Pulido-B. & Andrade-C. (2007, 2009), Campos & Andrade-C. (2009), Montero, *et al.* (2009), Campos-Salazar, *et al.* (2011), Prince-Chacón, *et al.* (2011), Vargas-Zapata, *et al.* (2011), Boom-Uruetea, *et al.* (2013), and Moreno-M. & Acuña-Vargas (2015) in tropical dry forest fragments in the Caribbean region.

In this study, we registered 67 species, 12 more than those recorded by Mercado-Gómez, *et al.* (2018) for the Serranía de la Coraza, Montes de María, Sucre. As expected in the Neotropics (Brown, 1996, Marín-Gómez, *et al.*, 2011), the Nymphalidae was the family with the most subfamilies and species. Nymphalidae has been found to be associated with the dry forests of Montes de María, in Sucre department (Mercado-Gómez, *et al.*, 2018), and in all the Caribbean plain (Campos-Salazar & Andrade-C., 2009; Campos-Salazar, *et al.*, 2011, Montero, *et al.*, 2009, Prince-Chacón, *et al.*, 2011, Moreno-M. & Acuña-Vargas, 2015) including the Sierra Nevada of Santa Marta (Vargas-Zapata, *et al.*, 2011). The Pieridae family was the second family with the highest number of species coinciding with the study by Campos-Salazar, *et al.* (2011) in Córdoba department and Vargas-Zapata, *et al.* (2011) in Magdalena department.

Papilionidae had a low richness, which coincides with the findings by Montero, *et al.* (2009) and Prince-Chacón, *et al.* (2011) for Atlántico department, and so did Riodinidae, which coincided with the results obtained for the departments of Sucre (Montes de María) by Mercado-Gómez, *et al.* (2018), Córdoba by Campos-Salazar, *et al.* (2011), Atlántico by Boom-Urueta, *et al.* (2013), and Magdalena by Vargas-Zapata, *et al.* (2011). The Lycaenidae family also registered a low richness, which differs from studies conducted in the Neotropics where it is considered one of the most diverse families (Brown, 1996, Marín-Gómez, *et al.*, 2011).

Conclusions and recommendations

This is the first study on diurnal butterflies in Montes de María, Bolívar. We provide a preliminary list of species confirming the presence of three species for the Colombian Caribbean. Throughout history, the Montes de María subregion has been characterized by its difficult access but this has improved greatly since the post-conflict, thus opening the possibility of giving the first steps to investigate the insects in the area and highlighting the need of greater scientific explorations to establish the richness of this region, one of the most biodiverse areas of the Colombian Caribbean, which has been subjected to processes of agricultural and livestock transformation.

Author contributions

Daniela Ahumada-C. and Alejandro Segovia-Paccini: Field work, laboratory, and generation of species list. Daniela

Ahumada-C.: Manuscript writing and map design. Alejandro Segovia-Paccini and Gabriel R. Navas-S.: Figures preparation. All authors reviewed the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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Supplementary material

Annex. List of codes of specimens with their taxonomic identification. See the Annex in: <https://www.raccefyn.co/index.php/raccefyn/article/view/808/2551>

References

- Ahumada-C., D. (2017). Fauna. In Jardín Botánico de Cartagena “Guillermo Piñeres” (editors). Guía de especies de Flora y Fauna de la Ciénaga de la Virgen, sector UCG6 (130-172). Cartagena de Indias, Colombia: Jardín Botánico de Cartagena “Guillermo Piñeres” y Agencia para la Cooperación Alemana GIZ.
- Andrade-C., M.G. (2002). Biodiversidad de las mariposas (Lepidoptera: Rhopalocera) de Colombia. *Red Iberoamericana de Biogeografía y Entomología Sistemática*. **2**: 153-172.
- Andrade-C., M.G., Henao, E.R., Triviño, P. (2013). Técnicas y procesamiento para la recolección, preservación y montaje de mariposas en estudios de biodiversidad y conservación. (Lepidoptera: Hesperoidea-Papilionoidea). *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*. **37** (144): 311-325.
- Andrade-C., M.G., Henao-Bañol, E.R., Salazar, J.A. (2015). Las mariposas (Lepidoptera: Hesperoidea-Papilionoidea) de la región Amazónica Colombiana. *Revista Colombia Amazónica*. **8**: 92-122.

- Ascuntar-Osnas, O., Armbrecht, I., Calle, Z.** (2010). Butterflies and vegetation in restored gullies of different ages at the Colombian Western Andes. *Boletín Científico Museo de Historia Natural*. **14** (2):163-180.
- Boom-Urueta, C., Seña-Ramos, L., Vargas-Zapata, M., Martínez-Hernández, N.** (2013). Mariposas Hesperioidea y Papilionoidea (Insecta: Lepidoptera) en un fragmento de bosque seco tropical, Atlántico, Colombia. *Boletín Científico Museo de Historia Natural*. **17** (1): 149-167.
- Brown, K.S.Jr.** (1996). Conservation of threatened species of Brazilian butterflies. International symposium on Butterfly Conservation III, p. 45-62.
- Camero, E. & Calderón, A.M.** (2007). Comunidad de mariposas diurnas (Lepidoptera:Rhopalocera) en un gradiente altitudinal del Cañón del Río Combeima-Tolima, Colombia. *Acta Biológica Colombiana*. **12** (2): 95-110.
- Campos-Salazar, L.R. & Andrade-C., M.G.** (2009). Lepidópteros (Hesperioidea-Papilionoidea) asociados a bosque seco tropical del Caribe colombiano, un estudio de caso en el bosque El Agüil, Aguachica, y baja montaña de la serranía de Perijá. In J.O. Rangel-Ch. (editores). *Colombia Diversidad Biótica VIII*, p. 615-635. Bogotá D.C., Colombia: Instituto de Ciencias Naturales, Universidad Nacional de Colombia.
- Campos-Salazar, L.R., Gómez, M., Andrade-C., M.G.** (2011). Mariposas (Lepidoptera: Hesperioidea Papilionoidea) de las áreas circundantes a las ciénagas del departamento de Córdoba, Colombia. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*. **35** (134): 45-60.
- Constantino, L.M. & Andrade-C., M.G.** (2007). Mariposas diurnas y nocturnas. In G. Amat-García, M.G. Andrade-C., E.C. Amat-García (eds.). *Libro Rojo de Invertebrados Terrestres de Colombia*. p. 109-145. Bogotá D.C., Colombia: Panamericana Formas e Impresos S. A.
- Emmel, T.C.** (1975). The butterfly faunas of San Andres and Providencia islands in the Western Caribbean. *Journal of Research on the Lepidoptera*. **14** (1): 49-56.
- Erazo, M.C. & González-Montaña, L.A.** (2008). Mariposas. In J.V. Rodríguez-Mahecha, J.V. Rueda-Almonacid, T.D. Gutiérrez (editores). *Guía ilustrada de la fauna del Santuario de Vida Silvestre Los Besotes, Valledupar, Cesar, Colombia*. p. 28-71). Bogotá D.C., Colombia: Serie de guías tropicales de campo N° 7, Conservación Internacional-Colombia. Editorial Panamericana, Formas e Impresos.
- Etter, A., McAlpine, C., Possingham, H.** (2008). A historical analysis of the spatial and temporal drivers of landscape change in Colombia since 1500. *Annals of the American Association of Geographers*. **98**: 2-23.
- Freitas, A.V.L., Francini, R.B., Brown, K.S.Jr.** (2003). Insectos como indicadores ambientales. In L. Cullen, R. Rudran, C. Valladares-Pádua (editores). *Manual Brasileiro em Biologia da Conservação*. Washington D.C., United States of America: Smithsonian Institution Press.
- Gaviria-Ortiz, F.G. & Henao-Bañol, E.R.** (2011). Diversidad de mariposas diurnas (Hesperioidea-Papilionoidea) del Parque Natural Regional el Vínculo (Bugá, Valle del Cauca). *Boletín científico del Museo de Historia Natural*. **15** (1): 115-133.
- González, L.A. & Andrade-C., M.G.** (2008). Diversidad y biogeografía preliminar de las mariposas saltarinas (Lepidoptera: Hesperioidea) de Colombia. *Zoología*. **32** (124): 422-433.
- Lamas, G.** (2004). Atlas of Neotropical Lepidoptera, checklist: Part 4A: Hesperioidea-Papilionoidea. Florida, United States of America: Association for Tropical Lepidoptera. p. 439.
- Le Crom, J.F., Llorente, J., Constantino, L.M., Salazar, J.A.** (2004). *Mariposas de Colombia*, Tomo 2 Pieridae. Bogotá D.C., Colombia: Carlec Ltda. p. 123.
- Llorente, B.J., Martínez, L.A., Vargas, F.I., Soberón, M.J.** (1993). Biodiversidad de las Mariposas: su conocimiento y conservación en México, *Revista de la Sociedad Mexicana de Historia Natural*. **44**: 313-324.
- Marín-Gómez, O., García, H.R., Gómez, W.F., Pinzón, W.** (2011). Diversidad de mariposas y su relación con la fenología reproductiva de *Inga ornata* kunth (Mimosoidea) en un agroecosistema ganadero del Quindío, Colombia. *Boletín Científico del Museo de Historia Natural*. **15** (2): 105-118.
- Mielke, O.H.H., Emery, E.O., Pinheiro, C.E.G.** (2008). As borboletas Hesperioidea (Lepidoptera, Hesperioidea) do Distrito Federal, Brasil. *Revista Brasileira de Entomologia*. **52** (2): 283-288.
- Montero, F., Moreno-P., M., Gutiérrez-M., L.C.** (2009). Mariposas (Lepidoptera: Hesperioidea y Papilionoidea) asociadas a fragmentos de bosque seco tropical en el departamento del Atlántico, Colombia. *Boletín Científico Museo de Historia Natural*. **13** (2): 157-173.
- Moreno-M. G.P. & Acuña-Vargas, J.C.** (2015). Caracterización de lepidópteros diurnos en dos sectores del Santuario de Flora y Fauna Los Flamencos (San Lorenzo de Camarones, La Guajira). *Boletín Científico Museo de Historia Natural*. **19** (1): 221-234.
- Núñez, E.O.** (2009). Mariposas diurnas (Lepidoptera: Papilionoidea y Hesperioidea) del Parque Nacional Iguazú, Provincia de Misiones, Argentina. *Tropical Lepidoptera Research*. **19** (2): 71-81.
- Orozco, S., Muriel, S., Palacio, J.** (2009). Diversidad de Lepidópteros diurnos en un área de bosque seco tropical del occidente antioqueño. *Actualidades Biológicas*. **31** (90): 31-41.
- Palacios, M. & Constantino, L.M.** (2006). Diversidad de lepidópteros Rhopalocera en un gradiente altitudinal en la Reserva Natural El Pangán, Nariño, Colombia. *Boletín Científico Museo de Historia Natural*. **10**: 258-278.
- Pizano, C. & García, H.** (2014). *El Bosque Seco Tropical en Colombia*. Bogotá, D.C., Colombia: Biblioteca Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. p. 353.
- Plataforma de Organizaciones de Desarrollo Europeas en Colombia (PODEC).** (2011). Análisis del plan de consolidación de Montes de María. Bogotá D.C., Colombia: Editorial CÓDICE Ltda. p. 194.
- Prince-Chacón, S., Vargas-Zapata, M.A., Salazar, M.A., Martínez-Hernández, J.A.** (2011). Mariposas Papilionoidea y Hesperioidea (Insecta: Lepidoptera) en dos fragmentos de bosque seco tropical en Corrales de San Luis, Atlántico, Colombia. *Boletín de la Sociedad Entomológica Aragonesa*. **48**: 243-252.
- Pulido-B., H.W. & Andrade-C., M.G.** (2007). Mariposas de las partes altas de Perijá. In J.O. Rangel-Ch. (ed.). *Colombia Diversidad Biótica V*. p. 235-248. Bogotá D.C., Colombia: Instituto de Ciencias Naturales, Universidad Nacional de Colombia.
- Pulido-B., H.W. & Andrade-C., M.G.** (2009). Las mariposas de la serranía de Perijá. In J.O. Rangel-Ch. (ed.). *Colombia Diversidad Biótica VIII*. p.615-631. Bogotá D.C., Colombia: Instituto de Ciencias Naturales, Universidad Nacional de Colombia.

- Quintero, J., Moreno, D., Otero, J.** (2014). Identificación de especies promisorias de lepidópteros en la hacienda el Roble para criadero in situ. *Citecsa*. **5** (8): 21-44.
- Rangel-Ch., J.O. & Carvajal-Cogollo, J.E.** (2012). Clima de la región Caribe colombiana. In J.O. Rangel-Ch. (editores). *Colombia Diversidad Biótica XII*. p. 67-129. Bogotá D.C., Colombia: Instituto de Ciencias Naturales, Universidad Nacional de Colombia.
- Ríos-Málaver, C.** (2007). Riqueza de especies de mariposas (Hesperioidea y Papilionoidea) de la quebrada "El Águila" Cordillera Central (Manizales, Colombia). *Boletín Científico Museo de Historia Natural*. **11**: 272-291.
- Rodríguez, G. & Miller, H.** (2013). Inventario preliminar de los Rhopalocera de Mitu Vaupés, Colombia (Insecta: Lepidoptera). *Boletín Científico Museo de Historia Natural*. **17** (1):196-218.
- Suárez, Y.** (2014). Mariposas (Lepidoptera: Papilionoidea) colectadas en Venecia (Cundinamarca, Colombia): Catálogo ilustrado (tesis de pregrado). Bogotá: Universidad Pedagógica Nacional.
- Urbano, P., Munevar, J., Mahecha-J., O., Hincapié, E.** (2014). Diversidad y estructura de las comunidades de Lepidoptera en la zona del ecotono entre el piedemonte llanero y sabana inundable en Casanare-Colombia (Lepidoptera: Papilionoidea). *SHILAP Revista de Lepidopterología*. **42** (167): 433-437.
- Valencia, C.A., Gil, Z.N., Constantino, L.M.** (2005). Mariposas diurnas de la zona central cafetera colombiana. *Guía de Campo*. Chinchiná, Colombia: Cenicafé. p. 244.
- Vargas-Zapata, M., Martínez-Hernández, N., Gutiérrez-Moreno, L., Prince-Chacón, S., Herrera-Colón, V., Torres-Periñán, L.** (2011). Riqueza y abundancia de Hesperioidea y Papilionoidea (Lepidoptera) en la reserva natural Las Delicias, Santa Marta, Magdalena, Colombia. *Acta Biológica Colombiana*. **16** (1): 43-60.
- Vargas-Ch. & J.I., Salazar, C.A.** (2014). Biodiversidad y mariposas en una región del alto Chocó, San José del Palmar, Colombia. *Boletín Científico Museo de Historia Natural*. **18** (1): 259-284.
- Warren, A.D., Davis, K.J., Stangeland, E.M., Pelham, J.P., Grishin, N.V.** (2017). *Illustrated Lists of American Butterflies*. Butterflies of America Foundation. Accessed on: January and October 2018. Retrieved from: www.butterfliesofamerica.com
- Zambrano-González, G. & Ortiz-Ordóñez, G.F.** (2009). Diversidad de lepidópteros diurnos en tres localidades del corredor biológico y multicultural Munchique - Pinche, Cauca, Colombia. *Boletín Científico Museo de Historia Natural*. **13** (1):214-224.