BUTTERFLIES (LEPIDOPTERA: PAPILIONOIDEA) OF LA HONDA BASIN, MESA DE LOS SANTOS, SANTANDER, COLOMBIA

Mariposas (Lepidoptera: Papilionoidea) de la cuenca de La Honda, Mesa de Los Santos, Santander, Colombia

Título corto: Butterflies of La Honda basin, Santander

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Abstract

Colombia is a privileged country given the geographical position, the diversity of ecosystems and the great plant complexity, conditions that allow it to occupy the third place in diversity of diurnal butterflies. The objective of this work was to establish the composition of species of diurnal butterflies in four locations of the La Honda basin for which captures were made using entomological nets of 45 cm in diameter, in the project of Characterization of the wild Entomofauna of La Honda basin, located in the northeast of the Colombian Andes. Analysis of inventory quality and analysis of similarity between sampling sites were performed. A total of 226 specimens were

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collected belonging to 95 species of the family Hesperiidae, Papilionidae, Pieridae, Lycaenidae, Riodinidae and Nymphalidae, the last having greatest abundance (134) and richness of species (53). La Navarra was the site with greatest abundance (110) and richness of species (54). The analysis of inventory quality indicated a potential richness of 167.13 species, a proportion of observed species of 56.24% and a sampling effort of 99.82%. The comparison of inventories allowed establishing that butterfly communities are different for all sampling sites, although there is a slight similarity between La Navarra and La Purnia. Based on the analysis of the inventory quality, it is proposed to carry out new sampling for these and other locations, as well as at different times of the year.

Key words: Abundance and richness, Colombian Andean, analysis of similarity, butterflies.

Resumen

Colombia es un país privilegiado dada su posición geográfica, la diversidad de ecosistemas y la gran complejidad vegetal, condiciones que la ubican en el tercer lugar en diversidad de mariposas diurnas. El objetivo del presente trabajo fue establecer la composición de especies de mariposas diurnas en cuatro localidades de la cuenca de La Honda, para lo cual, se realizaron capturas utilizando redes entomológicas de 45 cm de diámetro, en el marco del proyecto de Caracterización de la Entomofauna silvestre de la cuenca de La Honda, que se ubica en el nororiente de los Andes colombianos. Se realizaron análisis de la calidad del inventario y de similitud entre los sitios de muestreo. Se colectaron 226 ejemplares pertenecientes a 95 especies de las familias Hesperiidae, Papilionidae, Pieridae, Lycaenidae, Riodinidae y Nymphalidae, esta última con mayor abundancia (134) y riqueza de especies (53). La vereda La Navarra fue el sitio con mayor abundancia (110) y mayor riqueza de especies (54). El análisis de la calidad del inventario indicó una riqueza potencial de 167,13 especies, una proporción de especies observadas del 56,24% y un esfuerzo de muestreo del 99,82%. La comparación de los inventarios permitió establecer que las comunidades de mariposas son diferentes para todos los sitios de muestreo, aunque se observa una leve similitud entre La Navarra y La Purnia. Con base en el análisis de la calidad del inventario se propone la realización de nuevos muestreos para estas y otras localidades, así como en diferentes épocas del año.

Palabras clave: Abundancia y riqueza; Andes colombianos; análisis de similitud; mariposas diurnas.

Introduction

Colombia is a privileged country in biodiversity due to its geographical position, variety of ecosystems and great vegetal complexity, which ranks it in the third place in the world in butterflies diversity with more of 3,780 species, grouped in the families Hesperiidae, Papilionidae, Pieridae, Nymphalidae, Riodinidae and Lycaenidae (Andrade-C, 1990; Andrade-C,

2011; Huertas & Arias, 2007; Lamas, 2004; Rangel-Ch, 1995). Department of Santander, and northeaster of Colombia, has been few studied, and has fragmented studies and isolated samplings in degree works, pedagogical outputs, consulting and projects of characterization. In this way, there are still areas of Colombian Andes that have a lot of information in biological and environmental terms (Agudelo & Pérez, 2015; Arbeláez-Cortez, 2013; Campos *et al.*, 2011; Pardo-Locarno & Villalobos-Moreno, 2016; Villalobos-Moreno, 2013, 2017; Villalobos-Moreno *et al.*, 2012, 2013; Villalobos-Moreno & Gómez, 2015; Villalobos-Moreno & Salazar, 2020a).

The biodiversity crisis requires tools to evaluate the natural environmental using different methodologies, which has allowed developing the concept of bioindicator, apply rapid evaluation techniques and use of nonparametric estimators, with the above, has been possible to reduce the research time and the cost (Oliver & Beattie, 1996). The butterflies are important bioindicators due to the utility to establish the state of the environment in diversity parameters or human intervention degree. In addition, these are used in ecological studies, because certain species indicate changes in variables such as sunshine, temperature, microclimate and humidity, parameters that are drastically altered in disturbed habitats (Brown & Freitas, 2002; Constantino, 1997; Ramírez *et al.*, 2007). The preference that exist to study butterflies is based on the great attractiveness, abundance and ease of encounter, endemism, space-time stability, ecological sensitivity, easy field handling and taxonomical stability (Brown, 1991; Kremen, 1992, 1994; Kremen *et al.*, 1994; Llorente & Martínez, 1998; Ospina-López, 2014). Finally, it is widely known that the degradation of wild areas contributes to extinction of many species of butterflies, particularly critical in the Andean area due to the extension of the agricultural and urban frontier (Maso & Piojan, 1997; Palacios & Constantino, 2006).

The objective of the present investigation was to contribute to the knowledge of structure and composition of butterfly communities in four rural areas (veredas) in La Honda basin in the northeaster Andes of Colombia. We provide data about composition, abundance and distribution of butterflies in the study area, basic information that will be used to carry out in-depth works and, if possible, it will be an important resource for to establish preservation programs in this zone.

Materials and methods

Study area

La Honda basin has an area of 1,782 hectares and almost 40 kilometres of perimeter. This basin form part of Sogamoso river basin and it is a natural limit between the municipalities of Los Santos and Piedecuesta; it supplies water to, at least, eight rural areas (veredas) of the 28 existing ones, principally to agricultural work (Calderón, 2011). La Honda basin is south to Bucaramanga, capital of department of Santander, and northeaster of Colombian Andes (Fig. 1). Although much of the basin is highly intervened with cow pastures, varied

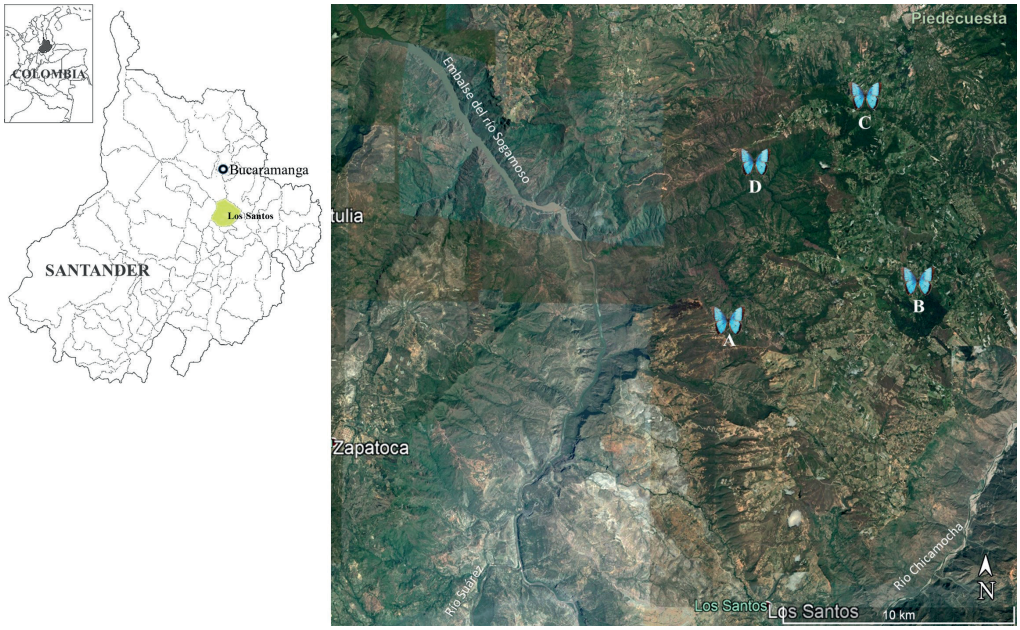

Figure 1. Location of the sampling places in La Honda basin, Mesa de Los Santos, Santander, Colombia. A: La Purnia; B: Cacaos; C: La Navarra; D: San Javier (Adapted of Google Earth Pro).

agricultural crops, sheds for chickens, mining, tracks and urbanized areas. We established the sampling places in four rural areas (veredas), one in an agroecological coffee crop with tree cover, another one in a relatively preserved forest and two others in fragmented forest (Fig. 2). The sampling places are described below:

- ***Locality 1 - Vereda Cacaos***: 6°51'39.75"N, 73°02'29.99"W; 1,700 masl. This sampling place corresponds to a mature coffee plantation with 15 years. It present high vegetal cover with a canopy greater than 15 m. According to Holdridge (2000), it corresponds to a Tropical rain forest (bh-T by the initials in Spanish). According to Cuatrecasas (1989), it corresponds to a sub-Andean jungle.

- ***Locality 2 - Vereda La Navarra***: 6°56'08.04"N, 73°04'21.96"W; 1,510 masl. This sampling place corresponds to a Tropical rain forest (bh-T) (Holdridge, 2000), or a sub-Andean jungle (Cuatrecasas, 1989). The vegetal cover is relatively well preserved, although fragmentation processes are evident in its periphery.

- ***Locality 3 - Vereda La Purnia***: 6°53'07.27"N, 73°06'32.90"W; 1,237 masl. According to Holdridge (2000), this sampling place corresponds to a Tropical dry forest (bs-T by the

Figure 2. General view of sampling places in La Honda basin, Mesa de Los Santos, Santander, Colombia.

initials in Spanish) transitional to a Tropical rain forest (bh-T). According to Cuatrecasas (1989), it corresponds to a Neotropical lower jungle with elements of sub-Andean jungle. It is a secondary forest with evident fragmentation processes and very small forest relics.

- ***Locality 4 – Vereda San Javier***: 6°55'23.51"N, 73°05'18.55"W; 948 masl. This sampling place corresponds to a Tropical dry forest (bs-T) (Holdridge, 2000), or a Neotropical lower jungle (Cuatrecasas, 1989). It is a secondary forest with fragmentation processes, which include forest clearing and burn to establish crops and livestock.

Sampling and identification

We carried out butterfly sampling in the project Characterization of Entomofauna of La Honda basin, jurisdiction of the Regional Autonomic Corporation for Defense of Bucaramanga Plateau (CDMB). Four sampling areas were established between 948 and 1,700 masl. The sampling was done five days in each area in routes with undefined extension. Two people made

the collections using entomological nets of 70 cm of diameter, between 9:00 am and 5:00 pm, for a total sampling effort of 80 hours/locality. Further, at each sampling place, six van Someren-Rydon traps baited with decomposing banana were installed, which were checked every four hours, for a total sampling effort of 720 hours/locality. The collected specimens were stored in dove paper envelopes and taken to the CDMB laboratory and were assembled, labelled and stored in Schmitt (Triplehorn & Johnson, 2005). The taxonomical determination was made with the keys and illustrations of Le Crom *et al.* (2002, 2004) and Neild (1996, 2008), as well as by comparison in Entomological Collection of Institute of Natural Sciences of National University of Colombia, Bogotá. The species were organized based on Lamas (2004).

Analysis of inventory quality

We carried out an analysis of sampling effort to establish the level of knowledge regarding inventory of species and to predict the potential richness in the sampling area. We considered as unit of sampling effort (USE) to the sum of data of each sampling day, therefore, 20 USE were established. Through the EstimateS program (Colwell, 2000), data entry was randomized (1,000 iterations) to avoid bias in calculation of observed richness. To predict the potential richness, we used the nonparametric Chao1 (based in abundances), as it is a robust estimator of minimum richness and, usually, offers better results than others estimators (Gotelli & Colwell, 2001; Walther & Moore, 2005). Using the CurveExpert program (Hyams, 2009), the estimates were adjusted to a Clench asymptotic curve, to calculate the different parameters of the curve (Jiménez-Valverde & Hortal, 2003).

Structure and composition of butterfly communities at sampling places

Using the values of abundance and richness observed in each of the sampling localities, were established for each of these, the series of diversity numbers of Hill: ^0D = potential richness, ^1D = diversity of order 1 (exponential of Shannon-Wiener index: eH') and ^2D = diversity of order 2 (inverse of Simpson index: $1/DSi$) (Moreno *et al.*, 2011; Núñez & Barro 2003; Villalobos-Moreno & Salazar, 2020b; Villalobos-Moreno *et al.*, 2016). The potential richness (^0D) was calculated with a similar procedure to the analysis of sampling effort, coinciding this richness with the asymptote of curve adjusted of Clench (Colwell, 2000; Hyams, 2009). The diversities of order 1 (^1D) and order 2 (^2D) was calculated with the program Spade (Chao & Shen, 2009), which offers these values, together with its standard deviation. The diversity numbers of Hill, which have as a unit the number of species, measure the effective number of species presents and these are a measure of distribution degree of relative abundances between the species of a sampling. ^0D corresponds to the total number of species, ^1D is the number of abundant species and ^2D is the number of very abundant species ($^0D > {}^1D > {}^2D$) (Jost, 2010).

Comparison between sampling places

With the purpose of establishing possible differences between sampling areas within La Honda basin, the inventory of taxa reported for each sampling place. Using a presence-absence matrix and the PRIMER 6 v6.1.6 program (PRIMER-E Ltd., 2006), the distances of Bray-Curtis were calculated and the respective phenogram was constructed using an average grouping method, thus estimating the possible similarity between the sampling areas (Ludwig & Reynolds, 1988; Magurran, 1988).

Results and discussion

We collected 226 specimens belonging to 95 species, grouped in the families Hesperiidae, Papilionidae, Pieridae, Lycaenidae, Riodinidae and Nymphalidae (Appendix 1). The family Nymphalidae was the best represented in all sampling places, and with the greatest abundance (134) and richness of species (53) (Fig. 3), given that this group has a wide geographical distribution, generalist habits, a high proportion of species and easy adaptation to disturbed environments (DeVries, 1987). La Navarra, perhaps due the extension and quality of the forest, presented the highest values of diversity, with the highest abundance (110) and richness of species (54), followed by La Purnia with 52 specimens and 38 species reported (Fig. 4).

Casa-Pinilla *et al.* (2017) carried out an investigation in La Mesa de Los Santos in an altitude range between 280 and 1,200 masl. They collected 1,389 specimens belonging to 121 species and the same families, except Hesperiidae that was not reported. The present manuscript has 35 species in common with Casa-Pinilla *et al.* (2017),

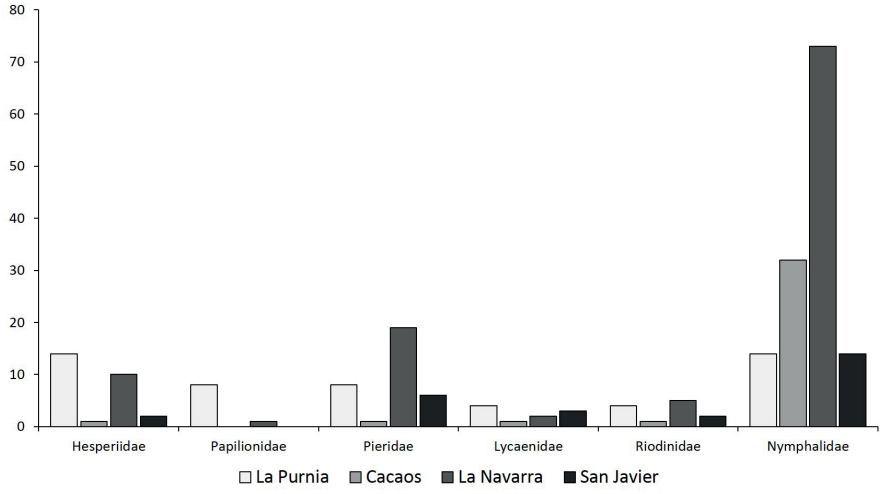

Figure 3. Abundance of the families of butterflies in the sampling places.

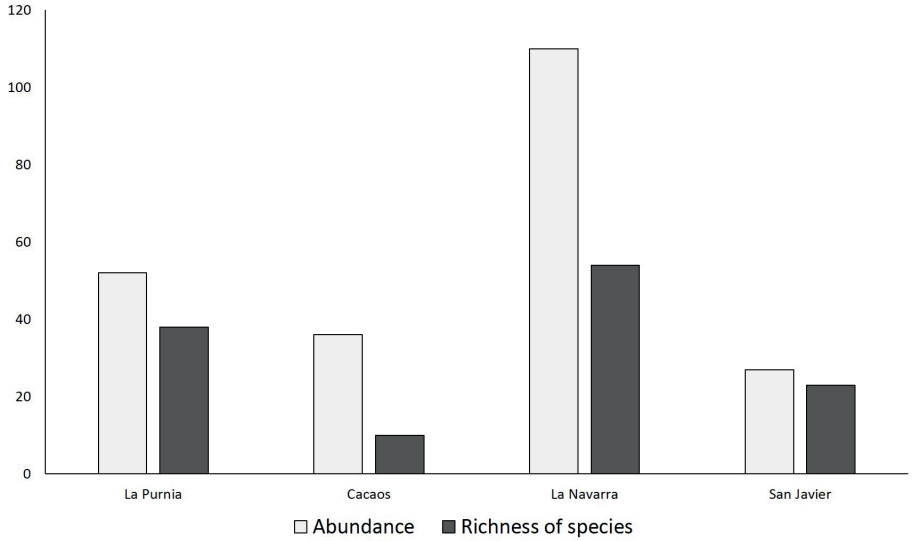

Figure 4. Abundance and richness of species in the sampling places.

the most of which are those registered for the low areas. Another explanation for not having more species in common, may be related to the phenology of species and the season of the year in which the samplings were carried out. In this way, it could be affirmed that both works are complementary in terms of species inventory and altitude gradient; Casa-Pinilla *et al.* (2017) sampled between 280 and 1,200 masl and the present manuscript presents results of a gradient between 948 and 1,700 masl. In this order of ideas, both works are complementarity to better understand the composition of the lepidopterofauna of the area.

Appendix 1 presents the list of species in the study area, classified under **abundant** species: more of 10 records; **common** species: 6–10 records; **scarce** species: 2–5 records; and **rare** species: only one record (Fagua, 1996; Henao, 2006; Henao & Stiles, 2018). We observed that only 2.11% of species were abundant, while 3.16% were common, 48.41% were scarce and 46.32% rare. The species with greatest abundances were *Euptychoides saturnus* (26) and *Hermeuptychia hermes* (11). On the other hand, 43 species were represented by only one specimen and they were considered in the category rare, for example *Adelpha irmina, Arawacus togarna, Archaeoprepona demophon, Catonephele numilia, Dismorphia amphione, Dismorphia crisia, Doxocopa pavon, Dynamine artemisia, Euptoieta claudia, Hamadryas feronia, Hamadryas fornax, Heraclides astyalus, Leucochimona lepida, Pseudopieris nehemia, Pseudopieris viridula* and *Rekoa meton.*

Appendix 2 shows some species of butterflies collected in La Honda basin. Most of the collected species are widely distributed and have historically been recorded for open

areas. Within the registered species, only a few are historically related to conserved forest areas, such as *Fountainea ryphea, Heraclides astyalus*, *Lycorea halia and Memphis moruus.* The low presence of species of forested areas could be explained by the high level of fragmentation of forests in La Honda basin, and it highlights the urgent need to reforest deteriorated areas and protect some remnants that still exist. It is important to highlight the presence of *Pseudoscada timma* which has a restricted distribution between Colombia and Venezuela, *Forsterinaria inornata* endemic species for Colombia and *Eumaeus godartii* whose host, *Zamia encephalartoides* (Zamiaceae), is an endemic plant of the dry forest near the Chicamocha canyon (González, 2004).

In the localities of Tropical dry forest (bs-T) samplings, San Javier and La Purnia, were recorded six species that were not reported for this important and fragile biome by Henao-Bañol & Gantiva (2020). In this way, the present investigation expand the list of species for dry forests of Colombia. We add to that list to *Calefelis inca*, *Dynamine racidula*, *Eurema gratiosa*, *Leucochimona lepida*, *Orthos orthos* and *Pyrgus oileus*.

Analysis of inventory quality

The potential richness according to the adjusted Clench curve was 167.13 species (Fig. 5), the proportion of observed species was 56.24%, and the estimated sampling effort

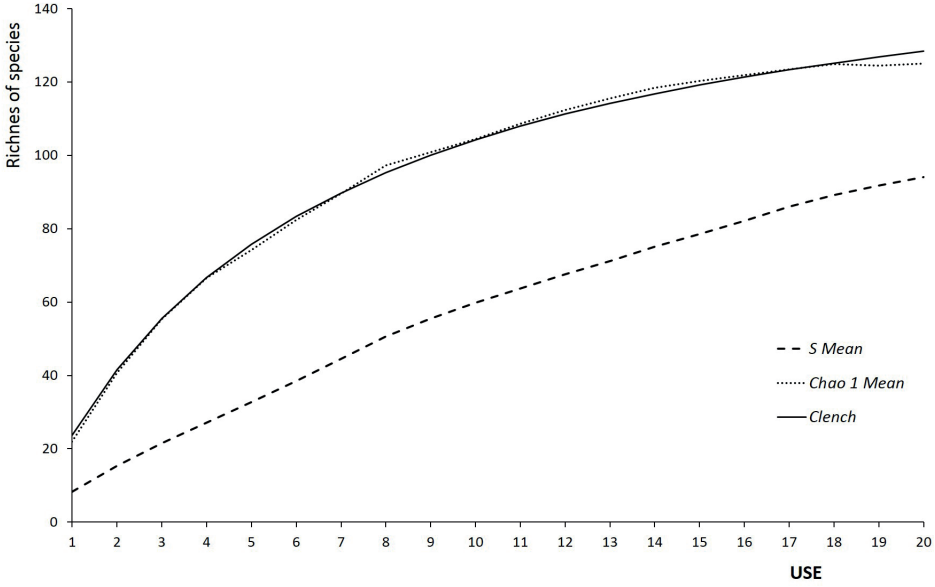

Figure 5. Analysis of inventory quality. *S Mean*: curve of observed richness randomized; *Chao 1 Mean*: curve of potential richness obtained with the nonparametric estimator Chao1; *Clench*: Adjusted curve to the asymptote Clench [y = (27.69 • x)/(1+0.17 • x)]; Standard error: 1.44; Coefficient of correlation: 0.99.

Table 1. Summary of analysis of inventory quality for each sampling site.

PLACES	Observed richness	Potential richness	% Observed species	Sampling effort	Coefficient of correlation
Cacaos	11	63.81	17.24	96.40	0.999
La Navarra	55	93.56	75.58	99.97	0.999
La Purnia	38	78.55	26.20	99.30	0.999
San Javier	23	68.13	50.66	99.81	0.953

of 99.82%. With these calculated values, the sampling could be considered relatively appropriate, but also, that obviously there are species still to be reported in the sampling area. In addition, we did analysis of inventory quality in each sampling area, resulting in that all areas more collections are required to establish a list of species that represents the real richness of La Honda basin.

Although the results to La Navarra was acceptable with 75.58% of observed species (potential richness = 93.56), the results for other sampling areas support the need to increase collections in the study zone, considering the possibility of making them at different season of the year. Table 1 resumes the results of analysis of inventory quality in each sampling area.

Structure and composition of butterfly communities at sampling places

Regarding the butterfly communities in the four sampling localities in La Honda basin, La Navarra presented the highest values of abundance, richness of species (observed and potential), dominance and equity (Table 2), which could be explained by the extension and quality of the forest. It stands out that the abundance of butterfly community collected in La Navarra was more equally distributed than the other localities. The comparison with other localities at similar altitudes, specifically La Tigra and Planadas in Playonero river basin (Villalobos-Moreno *et al.*, in prep.), El Diviso and La Esperanza in Frio river basin (Villalobos-Moreno & Salazar, 2020a) and Puente Rojo in Tona river basin (Villalobos-Moreno & Salazar, 2020b), shows that all parameters of diversity in the four localities of La Honda basin are low, which could be explained by the high level of forest fragmentation, as well as the limited sampling effort that was established by the characterization project for this basin.

Comparison between the sampling places

The inventories comparison established that the communities of butterflies are different between the four sampling areas. A slight similarity was observed between La Navarra and La Purnia (Fig. 6), possibly because of the size and complexity of forests, but also due to the altitudinal and geographical

Table 2. Parameters of diversity established to the sampling localities in La Honda basin, Mesa de Los Santos, Santander, Colombia, compared to localities on similar altitudes. *Ab*: Abundance; *Ro*: Richness observed of species; *No*: Richness potential of species; *N1*: Number of abundant species; *N2*: Number of very abundant species.

PLACES	Altitude masl	Parameters of diversity				
		Ab	Ro	No	N1	N2
Cacaos	1,700	36	11	63.81	4.67 (±0.97)	2.83 (±0.39)
La Navarra	1,510	110	55	93.56	45.82 (±2.45)	39.80 (±0.08)
La Purnia	1,237	52	38	78.55	34.51 (±2.22)	30.73 (±0.13)
San Javier	948	27	23	68.13	21.99 (±1.34)	20.83 (±0.17)
La Tigra	880	120	51	74.70	41.28 (±2.66)	31.86 (±0.16)
Planadas	1,020	120	53	85.11	40.40 (±2.74)	31.44 (±0.11)
La Esperanza	1,050	231	75	134.70	47.35 (±3.09)	29.56 (±0.21)
Puente Rojo	1,700	168	72	165,20	52.44 (±3,40)	36.66 (±0,16)
El Diviso	1,733	152	62	100,96	47.59 (±2.89)	36.10 (±0.13)

proximity. Cacaos, where sampling was done in a coffee cultivation with shade and organic management, presents the biggest differences with respect to the other sampling places, which can be explained by the homogeneity of this agricultural system.

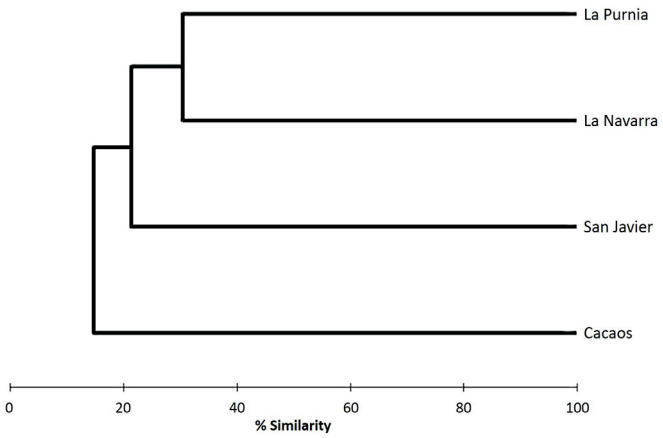

Figure 6. Analysis of Similarity between the sampling places in La Honda basin, Santander.

Conclusions

Although the collections were not made in a specific project of lepidopterology, but in general collections of insects in the study site, the present manuscript has an important contribution to knowledge northeastern butterflies in Colombia. The analysis of inventory quality shows that there are still species to be reported to the study site, which allows proposing new samplings in the studied areas and other rural areas, as well as during different seasons. The data provided in this investigation can be an important start to carry out deepening work and as supply to establish preservation programs in the study site.

Acknowledgements

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Appendix 1. List of species of butterflies and categories. N: Total abundance, CT: Category. A: Abundant, C: Common, E: Scarce, R: Rare.

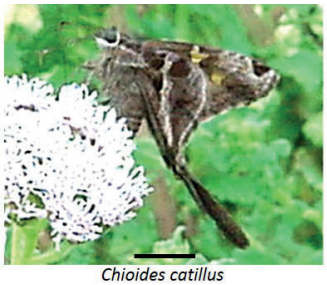
Family	Specie	N	CT
Hesperiidae	***Chioides catillus catillus* (Cramer, 1779)**	**2**	**E**
	Cogia sp.	1	R
	Dalla sp.	1	R
	Heliopetes arsalte (Linnaeus, 1758)	2	E
	Heliopetes laviana (Hewitson, 1868)	1	R
	Orthos orthos (Godman, 1900)	2	E
	Pyrgus oileus (Linnaeus, 1767)	5	E
	Pyrrhopyge aziza Hewitson, 1866	2	E
	Urbanus dorantes (Stoll, 1790)	4	E
	Urbanus simplicius (Stoll, 1790)	6	E
	Vettius coryna (Hewitson, 1866)	1	R

Papilionidae	*Battus polydamas polydamas* (Linnaeus, 1758)	4	E
	Heraclides anchisiades ideaus (Fabricius, 1793)	1	R
	Heraclides astyalus (Godart, 1819)	1	R
	Heraclides paeon (Boisduval, 1836)	1	R
	Heraclides thoas (Linnaeus, 1771)	2	E
Pieridae	*Ascia monuste* (Linnaeus, 1764)	4	E
	Eurema albula (*Cramer, 1775)*	5	E
	Eurema daira (Godart, 1819)	2	E
	Eurema elathea (*Cramer, 1777)*	1	R
	Eurema gratiosa (Doubleday, 1847)	1	R
	Eurema phiale (Cramer, 1775)	2	E
	Melete lycimnia (Cramer, 1777)	1	R
	Dismorphia amphione praxinoe (Rosenberg & Talbot, 1914)	1	R
	Dismorphia crisia foedora (Lucas, 1852)	1	R
	Phoebis philea philea (Linnaeus, 1763)	1	R
	Phoebis sennae marcellina (Cramer, 1758)	4	E
	Pseudopieris nehemia nehemia (Boisduval, 1836)	1	R
	Pseudopieris viridula viridula (C. Felder & R. Felder, 1861)	1	R
	Pyrisitia proterpia (Fabricius, 1775)	2	E
	Pyrisitia venusta (Boisduval, 1836)	7	C
Lycaenidae	*Apuecla* sp.	5	E
	Arawacus togarna (Hewitson, 1867)	1	R
	Eumaeus godartii (Boisduval, 1870)	1	R
	Hemiargus hanno (Stoll, 1790)	2	E
	Leptotes cassius (Cramer, 1775)	2	E
	Rekoa meton (Cramer, 1779)	1	R

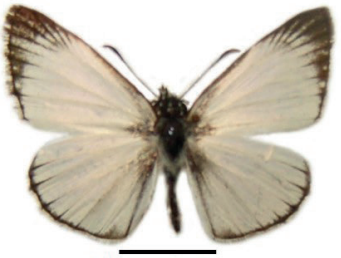
Riodinidae	*Calephelis inca* McAlpine, 1971	2	E
	Esthemopsis clonia C. Felder & R. Felder, 1865	2	E
	Leucochimona lepida (Godman & Salvin, 1885)	1	R
	Melanis marathon (C. Felder & R. Felder, 1865)	4	E
Nymphalidae	*Actinote parapheles* Jordan, 1913	4	E
	Actinote pellenea equatoria (H. Bates, 1864)	4	E
	Adelpha alala completa Fruhstorfer, 1907	2	E
	Adelpha irmina tumida (A. Butler, 1873)	1	R
	Anartia amathea (Linnaeus, 1758)	2	E
	Anartia jatrophae (Linnaeus, 1763)	1	R
	*Archaeoprepona demophon (*Linnaeus, 1758)	1	R
	Castilia ofella (Hewitson, [1864])	2	E
	Catonephele numilia (Cramer, 1775)	1	R
	Catonephele nyctimus (Westwood, 1850)	2	E
	Chlosyne lacinia (Geyer, 1837)	2	E
	Cissia terrestris (A. Butler, 1867)	1	R
	Colobura dirce (Linnaeus, 1758)	2	E
	Danaus gilippus (C. Felder & R. Felder, 1865)	1	R
	Diaethria clymena dodone (Guenée, 1872)	1	R
	Doxocopa pavon (Latreille, [1809])	1	R
	Dryadula phaetusa (Linnaeus, 1758)	1	R
	Dryas iulia (Fabricius, 1775)	2	E
	Dynamine agacles (Dalman, 1823)	2	E
	Dynamine artemisia (Fabricius, 1793)	1	R
	Dynamine racidula (Hewitson, 1852)	6	E
	Episcada salvinia apia (C. Felder & R. Felder, 1865)	1	E
	Euptoieta claudia (Cramer, 1775)	1	R
	Euptychoides saturnus (Butler, 1867)	26	A
	Forsterinaria inornata (C. Felder & R. Felder, 1867)	4	E

Fountainea ryphea ryphea (Cramer, 1775)	3	E
Greta andromica andromica (Hewitson, [1855])	1	R
Hamadryas feronia (Linnaeus, 1758)	1	R
Hamadryas fornax (Hübner, [1823])	1	R
Heliconius charithonia (Linnaeus, 1767)	2	E
Heliconius clysonimus Latreille, [1817]	3	E
Heliconius cydno cydno (E. Doubleday, 1847)	3	E
Heliconius erato hydara (Hewitson, 1867)	1	R
Heliconius hecale anderida (Hewitson, [1853])	2	E
Heliconius melpomene (Linnaeus, 1758)	2	E
Hermeuptychia hermes (Fabricius, 1775)	11	A
Hyposcada virginiana neustetteri Bargmann, 1928	2	E
Junonia evarete (Cramer, 1779)	3	E
Lycorea halia atergatis Doubleday (1847)	1	R
Magneuptychia libye (Linnaeus, 1767)	1	R
Marpesia chiron (Fabricius, 1775)	1	R
Mechanitis menapis Hewitson, [1856]	2	E
Megeuptychia antonoe (Cramer, 1775)	5	E
Memphis moruus phila (H. Druce, 1877)	2	E
Morpho helenor peleides Kollar, 1850	2	E
Nica flavilla (Godart, [1824])	1	R
Oressinoma typhla E. Doubleday, [1849]	3	E
Pareuptychia ocirrhoe (Fabricius, 1776)	1	R
Pedaliodes phrasis Grose-Smith, 1900	1	R
Pseudoscada timna ssp.	2	E
Pteronymia latilla latilla (Hewitson, [1855])	1	R
Pteronymia aletta aletta (Hewitson, [1855])	1	R
Tegosa anieta (Hewitson, 1864)	3	E
Vanessa virginiensis (Drury, 1773)	1	R

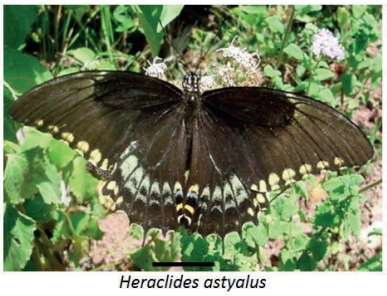
Appendix 2. Some butterflies collected in La Honda basin, Mesa de Los Santos, Santander, Colombia. Scale = 1cm.


Chioides catillus


Heliopetes arsalte


Heliopetes laviana

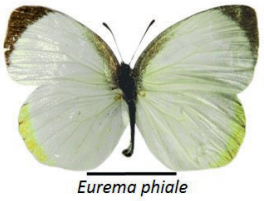

Battus polydamas

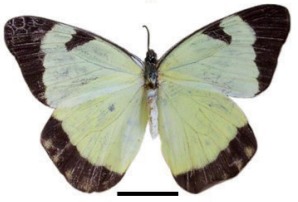

Heraclides astyalus


Heraclides paeon


Eurema albula

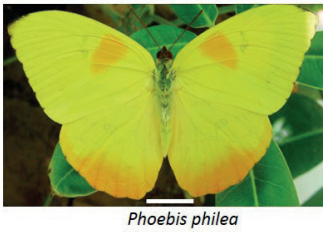

Eurema elathea


Eurema phiale

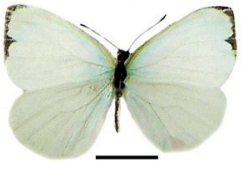

Melete lycimnia


Dismorphia amphione


Dismorphia crisia


Phoebis philea


Pseudopieris nehemia

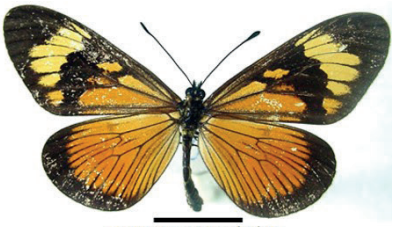

Pseudopieris viridula


Pyrisitia proterpia


Pyrisitia venusta

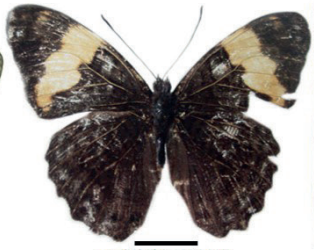
Arawaucus togarna

Leptotes cassius



Actinote parapheles

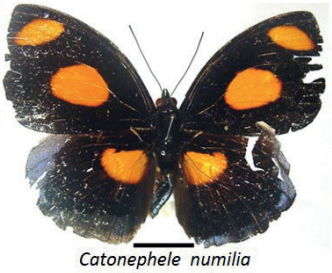
Actinote pellenea



Adelpha irmina

Anarthia jatrophae

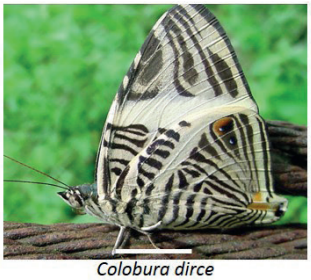
Archaeoprepona demophon



Catonephele numilia

Catonephele nyctimus

Chlosyne lacinia



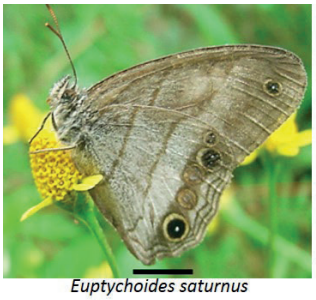
Colobura dirce

Danaus gilippus

Diaethria clymena

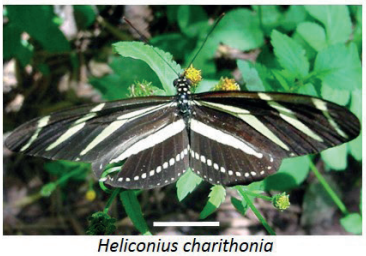
Dryadula phaetusa

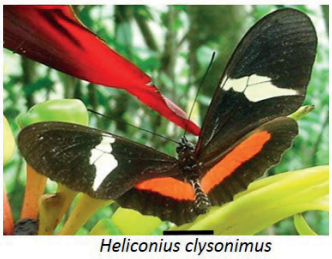
Dryas iulia


Euptychoides saturnus

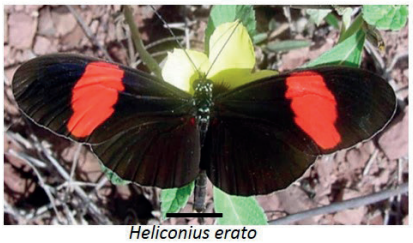

Fountainea ryphea

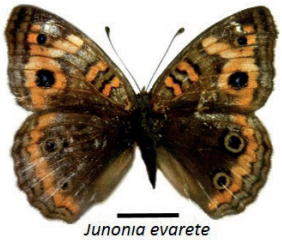

Hamadryas feronia


Heliconius charithonia

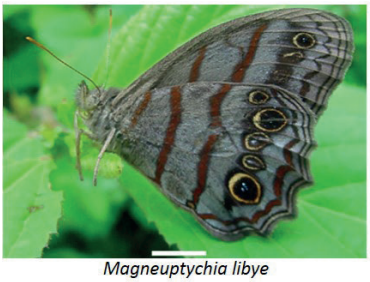

Heliconius clysonimus


Heliconius cydno


Heliconius erato

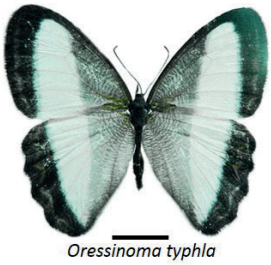

Junonia evarete


Lycorea halia


Magneuptychia libye


Memphis moorus


Morpho helenor


Oressinoma typhla


Tegosa anieta


Vanessa virginiensis

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