ZooKeys 1118: 21–38 (2022)
doi: 10.3897/zookeys.1118.85810
https://zookeys.pensoft.net

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

An updated list of butterflies (Lepidoptera, Papilionoidea) of two Guatemalan seasonally dry forests

Jiichiro Yoshimoto[1], José Luis Salinas-Gutiérrez[2], Mercedes Barrios[3], Andrew D. Warren[4]

1 *Laboratorio de Entomología Sistemática, Centro de Estudios Ambientales y Biodiversidad, Universidad del Valle de Guatemala, Apartado Postal 82, 01901, Guatemala City, Guatemala* **2** *Departamento de Biología Evolutiva, Facultad de Ciencias, Universidad Nacional Autónoma de México, Apartado Postal 70–399, México 04510 DF, Mexico* **3** *Centro de Estudios Conservacionistas (CECON), Universidad de San Carlos de Guatemala, Avenida La Reforma 0-53, Zona 10, Guatemala City, Guatemala* **4** *McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, 3215 Hull Rd., UF Cultural Plaza, Gainesville, Florida 32611-2710, USA*

Corresponding author: Jiichiro Yoshimoto (jyoshimoto@uvg.edu.gt)

Academic editor: Martin Wiemers | Received 25 April 2022 | Accepted 26 July 2022 | Published 17 August 2022

https://zoobank.org/65FEBFBE-4565-4D86-8DFA-8D79F03C2533

Citation: Yoshimoto J, Salinas-Gutiérrez JL, Barrios M, Warren AD (2022) An updated list of butterflies (Lepidoptera, Papilionoidea) of two Guatemalan seasonally dry forests. ZooKeys 1118: 21–38. https://doi.org/10.3897/zookeys.1118.85810

Abstract

Guatemala has a great diversity of butterflies, although there have been few intensive surveys on Lepidoptera in the country so far. We present an updated list of 218 species in 149 genera, 19 subfamilies, and six families of butterflies sampled at two seasonally dry forests in the Salamá and Motagua valleys in central and eastern Guatemala, by integrating new data from field surveys conducted in 2014–2021 into our previously published data (Yoshimoto et al. 2018, 2019), with *Amblyscirtes elissa elissa* Godman, 1900, *Repens florus* (Godman, 1900), and *Niconiades nikko* Hayward, 1948 (Hesperiidae: Hesperiinae) as new country records. We collected a hairstreak species, *Chalybs hassan* (Stoll, 1790) (Lycaenidae: Theclinae), at the Motagua Valley site, representing the second record for Guatemala since the early 20th century, after we rediscovered it at the Salamá Valley site in 2011 and 2012 (Yoshimoto and Salinas-Gutiérrez 2015). Nymphalidae and Hesperiidae had larger numbers of species than the other four families at both sites. In Pieridae and Nymphalidae, species composition was similar between the sites, whereas in Lycaenidae, Riodinidae, and Papilionidae it differed more greatly between the sites. These results confirm the relatively high lepidopteran diversity of Guatemalan dry forests, noteworthy for the small areas that comprise the study sites, and represent marked similarities and differences in butterfly fauna and phenology within these forests.

Keywords
Annotated list, dissimilarity, Hesperiidae, inventory, Mesoamerica, Neotropics, seasonality

Introduction

Neotropical seasonally dry forests are rich in flora and fauna (Pennington et al. 2006; Dirzo et al. 2011), although their ecosystems have been deteriorating because of various anthropogenic disturbances, such as deforestation due to agricultural expansion (e.g., Chazdon et al. 2011). Dry forests in Guatemala also harbor high lepidopteran diversity as well; our previous studies documented more than 150 and 100 butterfly species at the two small forest reserves in central and eastern Guatemala, respectively (Yoshimoto et al. 2018, 2019). These species lists, however, are still incomplete, and obviously, more species remain to be sampled at these sites. Moreover, we detected marked seasonal patterns in butterfly species richness and several conspicuous differences in the lepidopteran fauna between the two sites (Yoshimoto et al. 2019). Thus, it was apparent that additional field surveys were needed to make quantitative between-site comparisons of species composition, in order to enhance our understanding of butterfly fauna and phenology of these forests.

In Guatemala, approximately 400 species of Hesperiidae and nearly 700 species of the remaining families of Papilionoidea have been reported (Austin et al. 1998; Barrios et al. 2006; Salinas-Gutiérrez et al. 2009, 2012; Salinas-Gutiérrez 2013). Despite such high lepidopteran diversity, Guatemala's butterfly fauna has been studied less intensively compared to neighboring countries; for example, in Mexico, exhaustive species lists for the whole country and for several states have been published (de la Maza et al. 1989, 1991; Luis-Martínez et al. 2011, 2016; Llorente-Bousquets et al. 2014), whereas Guatemala has had little research on Lepidoptera and few published inventories since the 20th century (but see Austin et al. 1996 and Yoshimoto et al. 2021). Continued field surveys in various parts of Guatemala are thus important to fill a gap in our knowledge of the Neotropical butterfly fauna, which will in turn contribute to biodiversity conservation in the country.

Here, we present an updated and integrated list of papilionoid species (including Hesperiidae; van Nieukerken et al. 2011) for the same dry forest sites where we conducted our previous studies (Yoshimoto et al. 2018, 2019), by adding the new data from subsequent field surveys performed in 2014–2021, correcting identification errors, and modifying some of the species names based on taxonomic changes. Additionally, we examine between-site differences in butterfly fauna by comparing species composition at the family level, and identify seasonal patterns at the species level.

Materials and methods

This study was conducted at the Los Cerritos Municipal Park (hereafter, Los Cerritos; Fig. 1a) in the Salamá Valley (a subwatershed of the Chixoy region) of Baja Verapaz

Department in central Guatemala (15°05'N, 90°18'W, 960–1160 m a.s.l., 69 ha), and at the Heloderma Natural Reserve (hereafter, Heloderma Reserve; Fig. 1b) in the Motagua Valley of Zacapa Department in eastern Guatemala (14°53'N, 89°47'W, 510–790 m a.s.l., 58 ha). The rainfall patterns are similar between the two areas, in which the rainy season usually begins in late May and ends in October; these six months were accordingly defined as the rainy season and the remaining months (November-April) as the dry season. This climatic trait fits the definition of seasonally dry tropical forests (4–6 months with rainfall being < 100 mm; Dirzo et al. 2011); see fig. 1 in Yoshimoto et al. (2018) and fig. 3 in Yoshimoto et al. (2019) for detailed precipitation information of each area.

The vegetation of both regions is characterized by an abundance of various aculeate plants such as cacti (Cactaceae). The most dominant species is a columnar cactus *Stenocereus pruinosus* (Otto) Buxb., with *Pilosocereus leucocephalus* (Poselg.) Byles & G. D. Rowley and *Pereskia lychnidiflora* DC., also being abundant at both sites. On the other hand, there exist some marked differences in flora and in forest landscape. Heloderma Reserve has a dense forest with many arboreal species such as *Bucida macrostachya* Standl. (Combretaceae), *Lysiloma divaricatum* (Jacq.) J. F. Macbr., *Leucaena collinsii* Britton & Rose (both Mimosaceae), and *Bursera excelsa* (Kunth) Engl. (Burseraceae), all of which can grow taller than the columnar cactus (Ariano-Sánchez and Salazar 2015; D. Ariano-Sánchez, pers. comm.; Fig. 1b). By contrast, none of these species have been reported from Los Cerritos (M. R. Álvarez, pers. comm.), where there are fewer high arboreal species and abundant shrubs and herbaceous plants (thus commonly called a spiny bush or scrub), thereby the columnar cactus being prominent in its forest landscape (Fig. 1a).

Field surveys were conducted on 21 days from July 2014 to August 2021 at Los Cerritos, and on 19 days from October 2017 to November 2021 at Heloderma Reserve. We collected adult butterflies with an insect net or photographed them in the daytime (09:00–17:00) at each site and in neighboring areas (a small garden at the foot of Los Cerritos and on a farm road adjacent to Heloderma Reserve). The individuals collected were mounted as voucher specimens and were deposited at the Colección de Artrópodos, Laboratorio de Entomología Sistemática, Universidad del Valle de Guatemala. All the individuals collected or photographed were identified to species or subspecies according to Warren et al. (2017). We did not include data for specimens that were not identified to species, except for *Calephelis* spp. (Riodinidae) and *Bolla* sp. (Hesperiidae: Pyrginae); see the footnotes of the Appendix 1 for the rationales for the inclusion of these data. We added all these data to our previous data (Yoshimoto et al. 2018, 2019), corrected identification errors, and modified scientific names of some of the species based on taxonomic changes, in order to compile an updated and integrated species list of the two sites. Note that the sampling methods were partially different in the previous surveys; only netting was done at Los Cerritos from January 2011 to November 2012, whereas at Heloderma Reserve between February 2016 and March 2017, data were obtained through netting, photographing, and observation; see Yoshimoto et al. (2018, 2019) for detailed information on the sampling methods for each site.

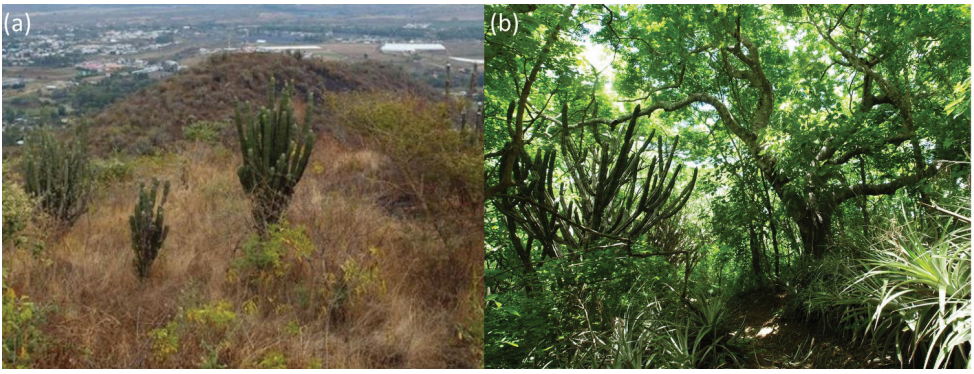

Figure 1. a Forest landscape of Los Cerritos Municipal Park and **b** Heloderma Natural Reserve.

The site-level estimated species richness was calculated by using the Chao II index (Chao et al. 2005; Gotelli and Colwell 2011), after pooling the data across observation dates for each month for each site. The total estimated species richness was similarly obtained after pooling these data across both sites. The Jaccard dissimilarity index was used to quantify the between-site similarity in species composition; this index was calculated for all data and for each of the six families (Papilionidae, Pieridae, Lycaenidae, Riodinidae, Nymphalidae, and Hesperiidae). All the analyses were performed using R 4.1.2. (R Development Core Team 2021) with the package Vegan (Oksanen et al. 2020).

Results

By integrating our previous data (Yoshimoto et al. 2018, 2019), a total of 218 species (including one unidentified taxon and 107 subspecies) in 149 genera from 19 subfamilies of six families were recorded at the two sites (Appendix 1). Hesperiidae was the richest family (71 species), followed by Nymphalidae, Lycaenidae, Pieridae, Riodinidae, and Papilionidae (66, 36, 20, 16, and 9 species, respectively). Los Cerritos had 166 species in 117 genera, and Heloderma Reserve had 139 species in 107 genera (Appendix 1), 16 and 41 species of which had been newly recorded in the subsequent surveys, respectively (Fig. 2). The estimated species richness (mean±SE) of each site based on the Chao II index is 216.27±16.35 and 187.35±17.74, respectively, indicating that approximately 76.8% and 74.2% of the species inhabiting each site were sampled. The total estimated species richness for both sites is 272.80±17.85 (79.9%).

We detected identification errors for 20 individuals (identified as 11 species in our previous studies) and determined them to represent 13 species in this study; ten individuals from Los Cerritos and ten from Heloderma Reserve have been determined to number eight and six different species, respectively, with one species, *Cissia themis*, shared between sites (Table 1). Additionally, Yoshimoto et al. (2019) incorrectly listed *Piruna* (Hesperiidae: Heteropterinae) in the subfamily Hesperiinae.

The following three skipper species (Hesperiidae: Hesperiinae) were recorded for the first time in Guatemala:

- ***Amblyscirtes elissa elissa*** **Godman, 1900.** Reserva Heloderma, Cabañas, Zacapa, GUATEMALA. Three specimens: 30-08-2016, J442; 26-09-2016, J478; 01-06-2018, J769. Collected by Jiichiro Yoshimoto. Identified by Andrew D. Warren. Note that the two individuals (J442 and J478) were misidentified as *Piruna* sp.1 in Yoshimoto et al. (2019), as shown in Table 1. The specimens were deposited in the Colección de Artrópodos, Laboratorio de Entomología Sistemática, Universidad del Valle de Guatemala, and are being cataloged (Fig. 3c). Distribution: Southwestern Mexico (Warren et al. 2017).
- ***Repens florus*** **(Godman, 1900).** Reserva Heloderma, Cabañas, Zacapa, GUATEMALA. One specimen: 23-10-2018, J800. Collected by Jiichiro Yoshimoto. Identified by Andrew D. Warren. The specimen was deposited as above and is being cataloged (Fig. 3d). Distribution: Eastern and Western Mexico, Belize, and Nicaragua (Warren et al. 2017).
- ***Niconiades nikko*** **Hayward, 1948.** Los Cerritos, Salamá, Baja Verapaz, GUATEMALA. One specimen: 16-11-2020, J1024. Collected and identified by Jiichiro Yoshimoto. The specimen was deposited as above and is being cataloged (Fig. 3e). Distribution: Eastern Mexico to Ecuador, Southern Brazil, and Paraguay (Warren et al. 2017).

Eighty-six species were shared between Los Cerritos and Heloderma Reserve (Table 2), which amounts to 51.8% and 61.9% of the species sampled at each site (the Jaccard dissimilarity index is 0.606). At both sites, species richness of Nymphalidae

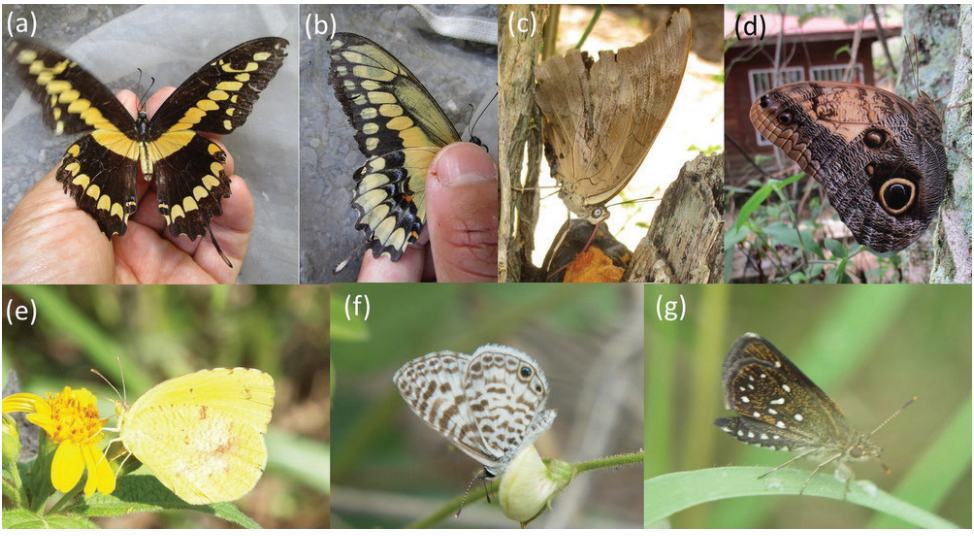

Figure 2. Six of the species that were newly recorded in the present study at Los Cerritos or Heloderma Reserve **a, b** *Heraclides rumiko* Shiraiwa & Grishin, 2014 (Papilionidae) **c** *Archaeoprepona demophon centralis* (Fruhstorfer, 1905) **d** *Caligo telamonius memnon* (C. Felder & R. Felder, 1867) (both Nymphalidae) **e** *Abaeis nicippe* (Cramer, 1779) (Pieridae) **f** *Leptotes cassius cassidula* (Boisduval, 1870) (Lycaenidae) **g** *Piruna aea* (Dyar, 1912) (Hesperiidae) **a–d, g** Heloderma Reserve **e, f** Los Cerritos. Note that *P. aea* had already been collected and identified to genus (*Piruna* sp.1) by Yoshimoto et al. (2019).

Table 1. Butterfly species that were sampled at Los Cerritos and Heloderma Reserve (abbreviated as LC and HR, respectively) and were misidentified in Yoshimoto et al. (2018, 2019). Corrected species names are shown in bold.

Family	Species		Sampling month, year, and site
	Correct identification	Previous identification	
Papilionidae	***Heraclides rumiko* Shiraiwa & Grishin, 2014**	*Heraclides cresphontes* (Cramer, 1777) [A]	Oct 2016 HR*
Pieridae	***Abaeis nicippe* (Cramer, 1779)**	*Pyrisitia proterpia* (Fabricius, 1775) [A]	Jul 2016 HR
Lycaenidae	***Strymon megarus* (Godart, [1824])**	*Strymon melinus franki* W. D. Field, 1938 [A]	Oct 2016 HR
Nymphalidae	***Anthanassa tulcis* (H. Bates, 1864)**	*Anthanassa dracaena phlegias* (Godman, 1901) [B]	May 2011 LC
Nymphalidae	***Chlosyne erodyle erodyle* (H. Bates, 1864)**	*Chlosyne lacinia lacinia* (Geyer, 1837) [B]	Oct 2011 LC, Jul 2012 LC
Nymphalidae	***Chlosyne rosita rosita* A. Hall, 1924**	*Chlosyne lacinia lacinia* (Geyer, 1837) [B]	Sep 2011 LC
Nymphalidae	***Cissia similis* (A. Butler, 1867)**	*Cissia pompilia* (C. Felder & R. Felder, 1867) [B]	May 2012 LC, Jun 2012 LC
Nymphalidae	***Cissia themis* (A. Butler, 1867)**	*Cissia pompilia* (C. Felder & R. Felder, 1867) [A, B]	Aug 2011 LC, Aug 2016 HR**, Oct 2016 HR
Hesperiidae	***Urbanus viterboana* (Ehrmann, 1907)**	*Urbanus proteus proteus* (Linnaeus, 1758) [B]	Nov 2011 LC
Hesperiidae	***Heliopetes macaira macaira* (Reakirt, [1867])**	*Heliopyrgus domicella domicella* (Erichson, [1849]) [B]	Jul 2012 LC
Hesperiidae	***Amblyscirtes elissa elissa* Godman, 1900**	*Piruna* sp.1 [A]	Aug 2016 HR, Sep 2016 HR
Hesperiidae	***Copaeodes aurantiaca* (Hewitson, 1868)**	*Ancyloxypha arene* (W. H. Edwads, 1871) [B]	Mar 2011 LC
Hesperiidae	***Cymaenes trebius* (Mabille, 1891)**	*Cymaenes tripunctus theogenis* (Capronnier, 1874) [A]	Sep 2016 HR**

[A] Listed in Yoshimoto et al. (2019).

[B] Listed in Yoshimoto et al. (2018).

*Specimen not collected (recorded only by photographing; see Fig. 2a, b for its images).

**Two individuals collected.

and Hesperiidae was greater than that of the other four families, although family-level species richness differed greatly between the sites (Table 2; Fig. 4). In particular, the proportion of Lycaenidae was much higher at Los Cerritos (18.7%) than at Heloderma Reserve (8.6%), which was mainly due to differences in the subfamily Theclinae (26 and 7 species, respectively: Appendix 1).

Family-level species composition also differed between the sites, and the magnitude of this difference varied among the six families (Table 2). The dissimilarity indices for Riodinidae, Lycaenidae, and Papilionidae were considerably larger, indicating that species composition differed more greatly between the sites in these families. Pieridae and Nymphalidae, by contrast, had smaller indices with many shared species, demonstrating that their species composition was relatively similar between the sites.

Ninety-three species (42.7%) occurred in both dry and rainy seasons, whereas 103 (47.2%) appeared only in the rainy season and 22 species (10.1%) only in the

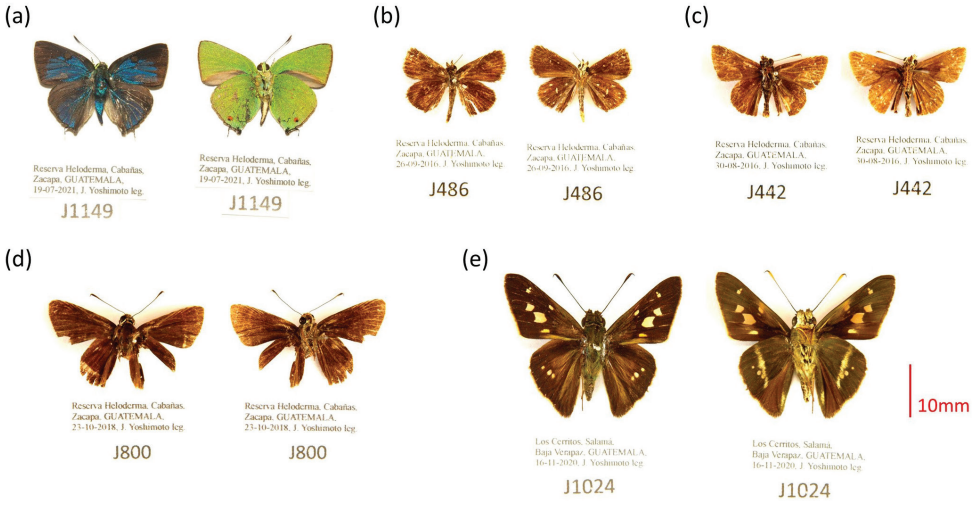

Figure 3. One species of hairstreak (Lycaenidae: Theclinae) **a** *Chalybs hassan* (Stoll, 1790), one species of skipperling (Hesperiidae: Heteropterinae) **b** *Piruna aea* (Dyar, 1912), and three species of grass-skippers (Hesperiidae: Hesperiinae) **c** *Amblyscirtes elissa elissa* Godman, 1900 **d** *Repens florus* (Godman, 1900), and **e** *Niconiades nikko* Hayward, 1948. The three grass-skipper species were newly recorded for Guatemala. Dorsal and ventral views, respectively, are shown at the left and right in each photograph.

Table 2. Species richness for six families at Los Cerritos and Heloderma Reserve, and comparisons of species composition at the family level between the sites, based on the number of shared species and the Jaccard dissimilarity index.

Family	Total No. species		No. shared species	Jaccard index
	Los Cerritos	Heloderma Reserve		
Papilionidae	7	4	2	0.778
Pieridae	16	17	13	0.350
Lycaenidae	31	12	7	0.806
Riodinidae	10	9	3	0.813
Nymphalidae	57	46	37	0.439
Hesperiidae	45	51*	24	0.662*

*The data for *Bolla* sp. were included in the species count but excluded from the Jaccard index analysis (see the footnote 7 of the Appendix 1 for its rationale).

dry season. The most frequently recorded species was *Eurema daira eugenia* (Wallengren, 1860) (Pieridae: Coliadinae), which was collected or observed throughout the year (Appendix 1). The second most frequently recorded species (in 11 months) were *Kricogonia lyside* (Godart, 1819) (Coliadinae) and *Hamadryas glauconome glauconome* (H. Bates, 1864) (Nymphalidae: Biblidinae), followed by *Pyrisitia proterpia* (Fabricius, 1775) (Coliadinae: in ten months), *Phoebis sennae marcellina* (Cramer, 1777) (Coliadinae), *Mestra amymone* (Ménétriés, 1857) (Biblidinae), and *Urbanus dorantes dorantes* (Stoll, 1790) (Hesperiidae: Eudaminae: all in nine months).

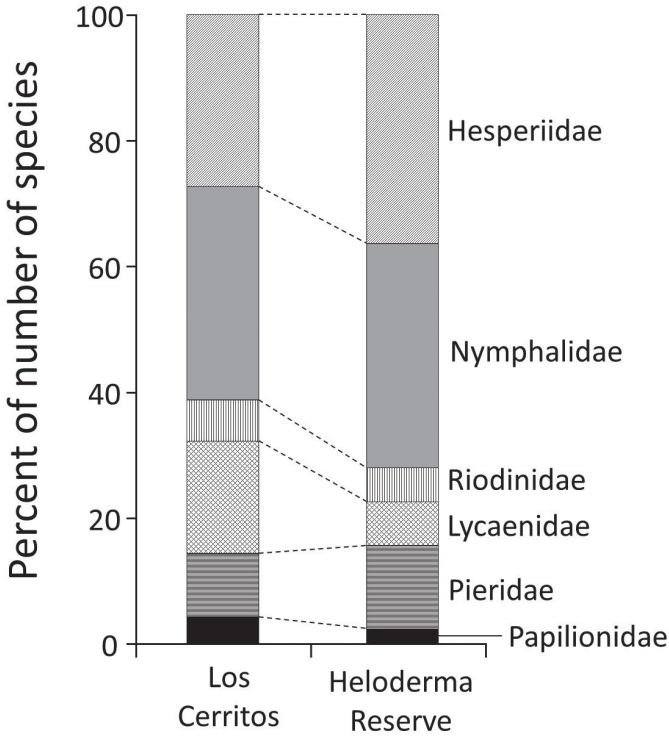

Figure 4. Proportion of species richness at the family level at Los Cerritos and Heloderma Reserve.

Discussion

A total of 218 species were recorded at the two dry forest sites during our 10-year field surveys, which confirms the relatively high lepidopteran diversity of Guatemalan seasonally dry forests for the small areas that comprise the study sites (<70 ha each). The estimated species richness suggests that nearly a quarter of the species inhabiting each site have yet to been recorded. The number of the additional species yielded in the subsequent surveys was more than twice greater at Heloderma Reserve than at Los Cerritos. The proportion of newly recorded species was much higher in Lycaenidae and Riodinidae; seven lycaenid species were added to the list for Los Cerritos, and seven lycaenid and four riodinid species were added to that of Heloderma Reserve, which nearly doubled the species richness of each family at this site (six lycaenid and five riodinid species in Yoshimoto et al. 2019). Among these species, the record of *Chalybs hassan* (Stoll, 1790) at Heloderma Reserve is highly important (Fig. 3a), as this species had not been reported for more than 100 years in Guatemala before we collected four individuals at Los Cerritos in 2011 and 2012 (Yoshimoto and Salinas-Gutiérrez 2015). These results highlight the importance of continuing butterfly surveys at both sites to create more exhaustive inventories, especially on small and taxonomically difficult taxa such as Lycaenidae and Riodinidae. Moreover, it is important to conduct research in other dry regions (e.g., the Nentón Valley in

northwestern Guatemala) and to make quantitative among-site comparisons of species richness and composition as well. All these studies will contribute to a comprehensive understanding of Neotropical butterfly fauna and distribution, and would serve as a scientific baseline for biodiversity conservation in Guatemalan dry regions.

More than half of the species sampled at each site were shared between the sites, suggesting that species composition is partially and moderately similar between Los Cerritos and Heloderma Reserve. Importantly, between-site similarity greatly differed among the six families. Higher similarity in Pieridae (especially in Coliadinae) would likely be associated with the distribution and abundance of their host plants, considering that coliadine larvae mostly feed on fabaceous plants such as *Senna* (e.g., DeVries 1987) and that these plants appear to be abundant at both sites.

In Lycaenidae and Riodinidae, species composition largely differed between the sites; in particular, Theclinae had considerable differences in species richness and composition (Appendix 1). In addition, most of these thecline species tended to be highly seasonal, as 25 out of 30 species were sampled only in the rainy season. In contrast to their marked seasonal pattern, *Strymon megarus* (Godart, [1824]) and *S. rufofusca* (Hewitson, 1877) occurred frequently also in the dry period at Heloderma Reserve; three and five individuals of each species were collected in both December and January at this site (Appendix 1). It should also be mentioned that *Hechtia guatemalensis* Mez (Bromeliaceae), one of the dominant bromeliad species at Heloderma Reserve (Fig. 1b), may be a possible foodplant for *S. megarus* at this site, as the larvae of this species are known to feed on bromeliads (Robbins 2010). Examination of abundance and distribution of host- and nectar-plants, as well as of larval and adult feeding behavior in relation to their phenology, would be an initial step to elucidate the bionomics of these species. Such surveys may also identify factors underlying the regional similarity and dissimilarity in the butterfly fauna.

We recorded *Amblyscirtes elissa elissa* Godman, 1900, *Repens florus* (Godman, 1900), and *Niconiades nikko* Hayward, 1948 (Hesperiidae: Hesperiinae) for the first time in Guatemala (Fig. 3c, d, e). Austin et al. (1998) listed *A. e. elissa* and *N. nikko* as species with a potential distribution in Guatemala. *Repens florus* could have been included in this category as well, as it is known to be distributed in the adjacent countries (Mexico, Belize, and Nicaragua; Warren et al. 2017). These results indicate that there still exists a gap in our knowledge of geographic distribution of Neotropical skipper species, again emphasizing the importance of more intensive research in Guatemala to bridge this gap.

Four individuals of *Piruna aea* (Dyar, 1912) (two in the previous survey and two in the subsequent one: Figs 2g, 3b) were collected at Heloderma Reserve. This is an interesting result, since most species in this genus are distributed in humid areas at higher elevation (1000–2700 m; Warren and González-Cota 1998). As Yoshimoto et al. (2019) pointed out, the wing pattern of these individuals is somewhat different from Mexican *P. a. aea* (Dyar, 1912), implying that *Piruna cingo sombra* Evans, 1955, described from Guatemala and currently considered a synonym of *P. a. aea*, may be a valid subspecies-level taxon. At present, this is difficult to determine, as very few specimens of this species have been sampled in Guatemala (Barrios et al. 2006).

Acknowledgements

We are grateful to Robert K. Robbins and Arturo Arellano Covarrubias for verifying some of our identifications of Theclinae and Riodinidae, respectively. We also thank Daniel Ariano Sánchez and María Renée Álvarez for providing us useful information on the fauna, flora, and geography of Guatemalan dry forests, Asociación Zootropic for permitting us to use the scientific station of Heloderma Reserve during our field surveys, Gilberto Salazar and Erick López for their logistic assistance at Heloderma Reserve, Edwin Reyes for helping us with butterfly sampling at Heloderma Reserve, and Fundación de Defensa del Medio Ambiente de Baja Verapaz (FUNDEMABV) for allowing us to conduct entomological surveys continuously at Los Cerritos. The authors have no support to report.

References

Ariano-Sánchez D, Salazar G (2015) Spatial ecology of the endangered Guatemalan Beaded Lizard *Heloderma charlesbogerti* (Sauria: Helodermatidae), in a tropical dry forest of the Motagua Valley, Guatemala. Mesoamerican Herpetology 2(1): 64–74. https://library.iucn-isg.org/documents/2015/Ariano-Sanchez_2015_Mesoamerican_Herpetology.pdf

Austin GT, Haddad NM, Méndez C, Sisk TD, Murphy DD, Launer AE, Ehrlich PR (1996) Annotated checklist of the butterflies of the Tikal National Park area of Guatemala. Tropical Lepidoptera 7(1): 21–37. https://journals.flvc.org/troplep/article/view/90056

Austin GT, Méndez C, Launer AE (1998) A preliminary checklist of Guatemala butterflies: Hesperiidae (Lepidoptera: Hesperioidea). Tropical Lepidoptera 9(Supplement 2): 8–19. https://journals.flvc.org/troplep/article/view/90138

Barrios MV, Méndez CA, Austin GT (2006). Las Hesperiidae (Lepidoptera: Hesperioidea) de Guatemala. In: Cano EB (Ed.) Biodiversidad de Guatemala Vol. I. Universidad del Valle de Guatemala, Guatemala, 431–439.

Brower AVZ (2006) Problems with DNA barcodes for species delimitation: 'ten species' of *Astraptes fulgerator* reassessed (Lepidoptera: Hesperiidae). Systematics and Biodiversity 4(2): 127–132. https://doi.org/10.1017/S147720000500191X

Brower AVZ (2010) Alleviating the taxonomic impediment of DNA barcoding and setting a bad precedent: names for ten species of '*Astraptes fulgerator*' (Lepidoptera: Hesperiidae: Eudaminae) with DNA-based diagnoses. Systematics and Biodiversity 8(4): 485–491. https://doi.org/10.1080/14772000.2010.534512

Chao A, Chazdon RL, Colwell RK, Shen TJ (2005) A new statistical approach for assessing similarity of species composition with incidence and abundance data. Ecology Letters 8(2): 148–159. https://doi.org/10.1111/j.1461-0248.2004.00707.x

Chazdon RL, Harvey CA, Martínez-Ramos M, Balvanera P, Stoner KE, Schondube JE, Avila Cabadilla LD, Flores-Hidalgo AM (2011) Seasonally dry tropical forest biodiversity and conservation value in agricultural landscapes of Mesoamerica. In: Dirzo R, Young HS, Mooney HA, Ceballos G (Eds) Seasonally dry tropical forests: ecology and conservation. Island Press, Washington DC, 195–219.

Cong Q, Grishin NV (2014) A new *Hermeuptychia* (Lepidoptera, Nymphalidae, Satyrinae) is sympatric and synchronic with *H. sosybius* in southeast US coastal plains, while another new *Hermeuptychi*a species not *hermes* inhabits south Texas and northeast Mexico. ZooKeys 379: 43–91. https://doi.org/10.3897/zookeys.379.6394

de la Maza RG, de la Maza J, White-López A (1989) La fauna de mariposas de México. Parte I. Papilionoidea (Lepidoptera: Rhopalocera). Revista de la Sociedad Mexicana de Lepidopterología 12: 39–98.

de la Maza J, White-López A, de la Maza RG (1991) La fauna de mariposas de México. Parte II. Hesperioidea (Lepidoptera: Rhopalocera). Revista de la Sociedad Mexicana de Lepidopterología 14: 3–44.

DeVries PJ (1987) The Butterflies of Costa Rica and their Natural History. Papilionidae, Pieridae and Nymphalidae. Princeton University Press, Princeton, 327 pp.

Dirzo R, Young HS, Mooney HA, Ceballos G (2011) Seasonally dry tropical forests: ecology and conservation. Island Press, Washington DC, 392 pp. https://doi.org/10.5822/978-1-61091-021-7

Gotelli NJ, Colwell RK (2011) Estimating species richness. In: Magurran AE, McGill BJ (Eds) Biological diversity: frontiers in measurement and assessment. Oxford University Press, Oxford, 39–54.

Hebert PDN, Penton EH, Burns JM, Janzen DH, Hallwachs W (2004) Ten species in one: DNA barcoding reveals cryptic species in the neotropical skipper butterfly *Astraptes fulgerator*. Proceedings of the National Academy of Sciences of the United States of America 101(41): 14812–14817. https://doi.org/10.1073/pnas.0406166101

Llorente-Bousquets J, Vargas-Fernández I, Luis-Martínez A, Trujano-Ortega M, Hernández-Mejía BC, Warren AD (2014) Biodiversidad de Lepidoptera en México. Revista Mexicana de Biodiversidad 85(Supplement 1): 353–371. https://doi.org/10.7550/rmb.31830

Luis-Martínez MA, Salinas-Gutiérrez JL, Llorente-Bousquets J (2011) Papilionoidea y Hesperioidea (Lepidoptera: Rhopalocera). In: Álvarez F (Ed.) Chiapas: estudios sobre su diversidad biológica. Instituto de Biología, UNAM, México D.F., 363–391.

Luis-Martínez A, Hernández-Mejía B, Trujano-Ortega M, Warren A, Salinas-Gutiérrez J, Ávalos-Hernández O, Vargas-Fernández I, Llorente-Bousquets J (2016) Avances faunísticos en los Papilionoidea sensu lato (Insecta: Lepidoptera) de Oaxaca, México. Southwestern Entomologist 41(1): 171–224. https://doi.org/10.3958/059.041.0119

Oksanen J, Blanchet FG, Friendly M, Kindt R, Legendre P, Minchin PR, O'Hara RB, Solymos P, MH Stevens H, Szoecs E, Wagner H, Barbour M, Bedward M, Bolker B, Borcard D, Carvalho G, Chirico M, De Caceres M, Durand S, Evangelista HBA, FitzJohn R, Friendly M, Furneaux B, Hannigan G, Hill MO, Lahti L, McGlinn D, Ouellette M-H, Cunha ER, Smith T, Stier A, Ter Braak CJF, Weedon J (2020) Vegan: Community Ecology Package. R package version 2.5-7. https://CRAN.R-project.org/package=vegan

Pennington T, Lewis G, Ratter J (2006) Neotropical savannas and seasonally dry forests: plant diversity, biogeography, and conservation. CRC Press, Boca Raton, Florida, 484 pp. https://doi.org/10.1201/9781420004496

R Development Core Team (2021) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna.

Robbins RK (2010) The "upside down" systematics of hairstreak butterflies (Lycaenidae) that eat pineapple and other Bromeliaceae. Studies on Neotropical Fauna and Environment 45(1): 21–37. https://doi.org/10.1080/01650521003751712

Salinas-Gutiérrez JL (2013) Registros nuevos y aclaratorios de ninfálidos (Papilionoidea: Nymphalidae) para Guatemala. Acta Zoológica Mexicana 29(2): 431–436. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0065-7372013000200015

Salinas-Gutiérrez JL, Méndez C, Barrios M, Pozo C, Llorente-Bousquets J (2009) Hacia una síntesis de los Papilionoidea (Insecta: Lepidoptera) de Guatemala con una breve reseña histórica. Caldasia 31: 407–440. http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0366-52322009000200013

Salinas-Gutiérrez JL, Llorente-Bousquets J, Méndez C, Barrios M, Pozo C (2012) Introducción a los Papilionoidea (Papilionidae, Pieridae, Lycaenidae, Riodinidae y Nymphalidae) de Guatemala. In: Cano EB, Schuster JC (Eds) Biodiversidad de Guatemala. Vol. II. Universidad del Valle de Guatemala, Guatemala, 155–173.

Trujano-Ortega M, Callaghan CJ, Arellano-Covarrubias A, Luis-Martínez A, Avalos-Hernández O, Llorente-Bousquets J (2021) Geographical distribution of *Emesis* Fabricius (Lepidoptera: Riodinidae) in Mexico: Updated checklist and temporal patterns. Zootaxa 4964(3): 401–442. https://doi.org/10.11646/zootaxa.4964.3.1

van Nieukerken EJ, Kaila L, Kitching IJ, Kristensen NP, Lees DC, Minet J, Mitter C, et al. (2011) Order Lepidoptera Linnaeus, 1758. In: Zhang ZQ (Ed.) Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. Zootaxa 3148: 212–221. https://doi.org/10.11646/zootaxa.3148.1.41

Warren AD, González-Cota L (1998) Notes on the genus *Piruna* in western Mexico, with description of a new species (Lepidoptera: Hesperiidae). Tropical Lepidoptera 9(Supplement 2): 1–7. https://journals.flvc.org/troplep/article/view/90137

Warren AD, Davis KJ, Stangeland EM, Pelham JP, Willmott KR, Grishin NV (2017) Illustrated Lists of American Butterflies (North and South America). [21–XI–2017] http://www.butterfliesofamerica.com/

Yoshimoto J, Salinas-Gutiérrez JL (2015) First record of *Atlides gaumeri* and notes on *Chalybs hassan* in Guatemala. Southwestern Entomologist 40(3): 497–502. https://doi.org/10.3958/059.040.0307

Yoshimoto J, Salinas-Gutiérrez JL, Barrios M (2018) Annotated list of butterflies (Lepidoptera: Papilionoidea) of a Guatemalan dry forest, with two first records for Guatemala. Tropical Lepidoptera Research 28(1): 1–8. https://doi.org/10.5281/zenodo.1248159

Yoshimoto J, Salinas-Gutiérrez JL, Barrios M (2019) Butterfly fauna and phenology in a dry forest of the Motagua Valley, Guatemala. Journal of the Lepidopterists Society 73(3): 191–202. https://doi.org/10.18473/lepi.73i3.a8

Yoshimoto J, Barrios M, Salinas-Gutiérrez JL, Warren AD (2021) Fauna y fenología de mariposas diurnas (Lepidoptera: Papilionoidea) de un bosque secundario en el área urbana de Guatemala. Revista Mexicana de Biodiversidad 92(0): e923469. https://doi.org/10.22201/ib.20078706e.2021.92.3469

Zhang J, Shen J, Cong Q, Grishin NV (2019) Genomic analysis of the tribe Emesidini (Lepidoptera: Riodinidae). Zootaxa 4668(4): zootaxa.4668.4.2. https://doi.org/10.11646/zootaxa.4668.4.2

Appendix 1

Table A1. Butterfly species observed in 2011–2021 at two dry forests in Guatemala: Los Cerritos Municipal Park and Heloderma Natural Reserve, based on our previous studies (Yoshimoto et al. 2018, 2019) and on subsequent field surveys (July 2014 to August 2021 at Los Cerritos and October 2017 to November 2021 at Heloderma Reserve). Species and months in bold indicate the data newly obtained in the subsequent surveys. Year information is also shown with sampling months, when necessary. Nomenclature follows Warren et al. (2017).

	Family / Subfamily / Species and subspecies	Months when observed: Los Cerritos	Months when observed: Heloderma Reserve
	Papilionidae		
	Papilioninae		
1	*Neographium epidaus epidaus* (E. Doubleday, 1846) [PH, A]	Apr, May, **Jun**, **Jul**, **Aug**, **Nov**	–
2	*Neographium philolaus philolaus* (Boisduval, 1836) [PH, A]	Jun, Sep	Mar, Apr, May, Jun
3	*Battus polydamas polydamas* (Linnaeus, 1758) [PH, A]	Mar, Jul, **Aug**, Sep, **Dec**	–
4	***Parides photinus* (E. Doubleday, 1844)**	**–**	**Sep**
5	*Heraclides erostratus erostratus* (Westwood, 1847) [A, Y]	May, Oct	–
6	*Heraclides thoas autocles* (Rothschild & Jordan, 1906) [PH, A]	Feb, **Mar**, Apr, **Jun**, **Aug**, **Nov**	–
7	*Heraclides ornythion ornythion* (Boisduval, 1836) [PH]	**–**	May, Jun
8	***Heraclides rumiko* Shiraiwa & Grishin, 2014** [MI, PH]	**Jul**	Oct'16[MI], **Dec**
9	*Papilio polyxenes asterius* Stoll, 1782 [PH]	Mar, Apr, May, **Nov**	–
	Pieridae		
	Coliadinae		
10	*Kricogonia lyside* (Godart, 1819) [PH, A]	Mar	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Nov, Dec
11	*Eurema daira eugenia* (Wallengren, 1860) [PH, A, Y]	Jan, Feb, Aug, Nov	Jan, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Dec
12	*Eurema boisduvaliana* (C. Felder & R. Felder, 1865) [PH, A]	Feb, Oct, Nov	Jun, Jul, Aug, Sep, Oct, Nov
13	***Abaeis nicippe* (Cramer, 1779)** [MI, PH]	**Nov**	Jul'16[MI]
14	*Pyrisitia proterpia* (Fabricius, 1775) [PH, A]	May, Jun, Jul, Oct, **Dec**	Feb, Apr May, Jun, Jul, Aug, Sep, Oct, Nov
15	*Pyrisitia dina westwoodi* (Boisduval, 1836) [PH, A]	**–**	Jan, Feb, Jun, Oct, Nov, Dec
16	*Pyrisitia nise nelphe* (R. Felder, 1869) [PH, A, Y]	**Jun, Jul**, **Aug**, **Nov**	Jun, Jul, Aug, Sep, Oct, **Nov**, Dec
17	*Zerene cesonia cesonia* (Stoll, 1790) [PH, Y]	Jun, Aug	Jun, **Jul**
18	*Anteos maerula* (Fabricius, 1775) [PH, A]	Jun, **Sep**, Nov	**May**, Jun, Jul, Aug, Sep, Oct
19	*Anteos clorinde* (Godart, [1824]) [PH, A]	Apr, Jun	Jun, Aug
20	*Phoebis sennae marcellina* (Cramer, 1777) [PH, A]	Feb, **Mar**, Apr, Jun, Jul, Nov	Mar, May, **Jun**, Jul, Aug, Sep
21	*Phoebis philea philea* (Linnaeus, 1763) [A, Y]	May	Jul
22	*Phoebis argante* ssp. [A]	May	Jul
23	*Aphrissa statira statira* (Cramer, 1777) [A]	Oct	–
	Pierinae		
24	*Hesperocharis crocea crocea* H. Bates, 1866	Mar, **Aug**	–
25	*Ascia monuste monuste* (Linnaeus, 1764) [PH, A, Y]	Feb, Jun	Jun

	Family / Subfamily / Species and subspecies	Months when observed: Los Cerritos	Months when observed: Heloderma Reserve
26	*Ganyra josephina josepha* (Salvin & Godman, 1868) [PH, A]	–	Jan, Oct
27	*Leptophobia aripa elodia* (Boisduval, 1836) [Y]	Jan	–
28	*Itaballia demophile centralis* Joicey & Talbot, 1928	–	Jan
29	*Glutophrissa drusilla tenuis* (Lamas, 1981) [A]	–	Jun, Aug
Lycaenidae			
Theclinae			
30	*Evenus regalis* (Cramer, 1775) [A]	Sep	–
31	*Atlides gaumeri* (Godman 1901)	Aug	–
32	*Atlides carpasia* (Hewitson, 1868) [A]	Aug	–
33	***Rekoa zebina* (Hewitson, 1869)**	**Jun, Sep**	–
34	*Rekoa stagira* (Hewitson, 1867) [A]	Aug	–
35	*Arawacus sito* (Boisduval, 1836) [A, Y]	Aug	–
36	*Arawacus jada* (Hewitson, 1867) [A]	Jul	–
37	*Kolana lyde* (Godman & Salvin, 1887) [A]	Sep	–
38	***Chlorostrymon simaethis sarita* (Skinner, 1895)** [A]	**Nov**	–
39	*Cyanophrys herodotus* (Fabricius, 1793) [A]	Aug	–
40	*Cyanophrys miserabilis* (Clench, 1946)	**–**	Oct
41	***Electrostrymon hugon* (Godart, [1824])**	**–**	**Jul**
42	***Kisutam syllis* (Godman & Salvin, 1887)** [A]	**–**	**Oct**
43	***Calycopis clarina* (Hewitson, 1874)**	**Jun**	–
44	*Calycopis isobeon* (A. Butler & H. Druce, 1872)	Aug, Sep	–
45	*Strymon melinus franki* W. D. Field, 1938	Aug, Sep	–
46	*Strymon rufofusca* (Hewitson, 1877) [PH]	**Jul**, Nov	**Jan**, Aug, Oct, Nov, **Dec**
47	*Strymon bebrycia* (Hewitson, 1868) [PH]	**Jun**, Aug	–
48	***Strymon yojoa* (Reakirt, [1867])** [A]	**Jul**	–
49	*Strymon cestri* (Reakirt, [1867]) [A]	Aug	–
50	*Strymon bazochii bazochii* (Godart, [1824]) [A]	Jul	–
51	*Strymon istapa istapa* (Reakirt, [1867])	Aug, **Nov**	–
52	***Strymon megarus* (Godart, [1824])** [MI, PH]	–	**Jan**, **Jul**, Oct'16[MI], **Dec**
53	*Strymon ziba* (Hewitson, 1868)	Jul	–
54	***Ministrymon azia* (Hewitson, 1873)** [A]	**Jun**	**Jul**
55	***Ostrinotes keila* (Hewitson, 1869)** [A, Y]	**Aug**	–
56	*Panthiades bitias* (Cramer, 1777) [A]	Jun	–
57	*Michaelus hecate* (Godman & Salvin, 1887)	Sep	–
58	*Erora gabina* (Godman & Salvin, 1887)	May, Jun, Aug, Oct	–
59	*Chalybs hassan* (Stoll, 1790)	Aug, Sep, Nov	**Jul**
Polyommatinae			
60	*Celastrina echo gozora* (Boisduval, 1870) [Y]	Nov	–
61	***Leptotes cassius cassidula* (Boisduval, 1870)** [PH, A, Y]	**Jun**, **Dec**	**Sep**, **Oct**
62	*Cupido comyntas texana* (F. Chermock, 1945) [PH, A, Y]	**Sep**, Nov	**Oct**, Nov, **Dec**
63	*Hemiargus ceraunus astenidas* (Lucas, 1857) [A]	Mar, **Jul**, **Nov**	Feb, Jun, **Dec**
64	*Hemiargus hanno hanno* (Stoll, 1790) [PH, A]	**–**	Jul, Aug, Sep, Oct
65	*Echinargus isola* (Reakirt, [1867])	Feb, **Dec**	**Jun**, **Dec**
Riodinidae			
Riodininae			
66	*Rhetus arcius castigatus* Stichel, 1909 [A]	Sep	–
67	*Calephelis* spp. [PH, 1]	Jan, May, Jul, Aug, Oct, **Nov**, **Dec**	Jan, Jul, Aug, Sep, Oct, Nov, Dec
68	*Lasaia sula sula* Staudinger, 1888 [PH]	**–**	Jun, **Oct**
69	***Lasaia maria maria* Clench, 1972**	**–**	**Jun**, **Jul**, **Oct**
70	*Melanis pixe pixe* (Boisduval, 1836) [A]	Feb, Sep, Nov, Dec	–

	Family / Subfamily / Species and subspecies	Months when observed: Los Cerritos	Months when observed: Heloderma Reserve
71	*Anteros carausius carausius* Westwood, 1851 [A]	Aug, Nov	**Sep, Nov**
72	*Calydna sturnula* (Geyer, 1837) [PH]	Aug, **Sep**, Oct	–
73	*Emesis mandana* furor A. Butler & H. Druce, 1872 [A]	Aug	–
74	*Emesis tenedia* C. Felder & R. Felder, 1861 [A, Y, 2]	Jul	–
75	*Emesis lupina lupina* Godman & Salvin, 1886 [2]	Oct	–
76	*Curvie emesia* (Hewitson, 1867) [PH, A, 3]	**–**	Jun, Oct
77	*Thisbe lycorias* (Hewitson, [1853]) [A]	Jun, Jul, Oct, Nov	–
78	***Juditha caucana* (Stichel, 1911)**	–	**Oct**
79	*Synargis mycone* (Hewitson, 1865) [A]	Mar, Jun, Jul	Jul
80	***Hypophylla zeurippa* Boisduval, 1836**	–	**Jan**
81	*Theope virgilius* (Fabricius, 1793) [A]	–	Feb, Nov
	Nymphalidae		
	Libytheinae		
82	*Libytheana carinenta mexicana* Michener, 1943 [PH, A, Y]	Jul	Jun, Aug, Sep
	Danainae		
83	*Lycorea halia atergatis* E. Doubleday [1847] * [PH, A, Y]	–	**May**, Sep
84	*Danaus eresimus montezuma* Talbot, 1943 [PH, A]	Aug, **Nov**, **Dec**	Jun, Aug, **Sep**
85	*Danaus gilippus thersippus* (H. Bates, 1863) [A]	**–**	Mar
86	*Mechanitis lysimnia utemaia* Reakirt, 1866 [PH, A, Y]	**–**	**May**, Aug, **Oct**
87	*Mechanitis polymnia lycidice* H. Bates, 1864 [PH, A, Y]	Sep	Sep, **Oct**
88	*Dircenna klugii klugii* (Geyer, 1837) [Y]	Sep, Oct, Nov	–
	Heliconiinae		
89	*Agraulis vanillae incarnata* (N. Riley, 1926) [PH, A]	Jun, Jul, **Nov**	Aug
90	*Dione moneta poeyii* A. Butler, 1873 [Y]	Jun, Nov	–
91	*Dione juno huascuma* (Reakirt, 1866) [PH, A]	Feb, Mar, **Dec**	Jul
92	*Dryas iulia moderata* (N. Riley, 1926) [PH, A, Y]	Aug	Aug, Sep, Oct
93	*Eueides isabella eva* (Fabricius, 1793) [A]	Nov	–
94	*Heliconius charithonia vazquezae* W. Comstock & F. Brown, 1950 [A, Y]	Jul	Jul, Oct
95	*Euptoieta hegesia meridiania* Stichel, 1938 [PH, A, Y]	Jun, Jul, Sep	Jun, Jul
	Limenitidinae		
96	*Adelpha paroeca paroeca* (H. Bates, 1864) [Y]	Oct, Nov	–
97	*Adelpha iphicleola iphicleola* (H. Bates, 1864) [PH]	Aug	Jun, Jul, Sep, Oct
98	*Adelpha melanthe* (H. Bates, 1864) [A]	Aug, Sep	–
	Biblidinae		
99	*Biblis hyperia aganisa* Boisduval, 1836 [PH, A]	Jul, **Dec**	Sep
100	*Mestra amymone* (Ménétriés, 1857) [A]	May, Jun, Jul	Mar, Jul, Aug, Sep, Oct, Nov, Dec
101	*Catonephele mexicana* Jenkins & R.G. Maza, 1985 [A]	Sep, Oct, Nov	–
102	*Eunica monima* (Stoll, 1782) [PH]	Jun, **Aug**	Mar, Jun, Jul, Aug, Oct, Dec
103	*Eunica tatila tatila* (Herrich-Schäffer, [1855]) [A]	Jun	–
104	*Hamadryas atlantis atlantis* (H. Bates, 1864) [PH]	Sep	Jun, Jul, Nov
105	*Hamadryas februa ferentina* (Godart, [1824]) [PH, A]	Apr, May, **Jun**, **Jul**, **Nov**, **Dec**	Feb, **Jul**, Oct
106	*Hamadryas glauconome glauconome* (H. Bates, 1864) [PH]	Jan, **Jul**, Oct, **Nov**, Dec	Jan, Feb, Mar, **May**, Jun, Jul, Aug, **Sep**, **Oct**
107	*Hamadryas guatemalena guatemalena* (H. Bates, 1864) [PH, A]	May, Jun, Jul	**Jul**
108	*Bolboneura sylphis sylphis* (H. Bates, 1864) [PH]	Jul, Aug, Sep	Mar, Jun, Jul, Sep, Oct
109	*Epiphile adrasta adrasta* Hewitson, 1861 [Y]	Aug, Oct	–

	Family / Subfamily / Species and subspecies	Months when observed: Los Cerritos	Months when observed: Heloderma Reserve
110	*Temenis laothoe hondurensis* Fruhstorfer, 1907 [A]	–	Oct
111	*Dynamine dyonis* Geyer, 1837 [A]	Jul, Aug, Oct, Nov, **Dec**	–
112	*Dynamine postverta mexicana* R.F. d'Almeida, 1952 [PH, A]	Jun, Jul, Oct, **Nov**	Sep, Oct
113	*Dynamine theseus* (C. Felder & R. Felder, 1861) [A]	**Aug**, Sep, Oct	–
114	*Diaethria astala astala* (Guérin-Méneville, [1844]) [A, Y]	May, Jul, Oct, Nov	**Oct**
	Cyrestinae		
115	*Marpesia petreus* ssp. [A, Y]	Jul, Sep	Jun
	Nymphalinae		
116	*Historis odius dious* Lamas, 1995 [PH, A]	**Jun**, **Jul**, Aug, Sep	Jul
117	*Smyrna blomfildia datis* Fruhstorfer, 1908 [PH, A, Y]	Jul	**May**, Nov
118	*Anartia fatima fatima* (Fabricius, 1793) [PH, A, Y]	May	**Jun**, Sep, Oct
119	*Siproeta epaphus epaphus* (Latreille, [1813]) [A, Y]	Sep	Sep
120	*Siproeta stelenes biplagiata* (Fruhstorfer, 1907) [PH, A, Y]	Jul, Sep	**Jun**, Aug, Sep, Oct
121	*Junonia evarete* (Cramer, 1779) [PH, A]	Jun, Jul, Aug	**Jan**, **Jul**, **Oct**
122	*Chlosyne janais janais* (Drury, 1782) [A]	Jun, **Aug**	–
123	***Chlosyne erodyle erodyle* (H. Bates, 1864)** [MI]	Jul'12[MI], **Jul'19**, Oct'11[MI], **Oct'17**	–
124	***Chlosyne rosita rosita* A. Hall, 1924** [MI]	Sep'11[MI]	**Jun**, **Jul**, **Sep**
125	*Chlosyne theona theona* (Ménétriés, 1855) [PH]	Apr, Jun, Sep	Jun, Jul, Aug, Sep
126	*Chlosyne lacinia lacinia* (Geyer, 1837) [PH, A, Y]	Mar, **Jun**, **Jul**, Aug, Nov	Jun, Jul, Aug
127	*Chlosyne melanarge* (H. Bates, 1864) [PH]	–	Aug, **Sep**, Oct
128	*Microtia elva horni* Rebel, 1906 [PH]	Jun, Jul, Aug, Nov	Jun, Jul, Aug, Sep, Oct, Nov
129	***Anthanassa tulcis* (H. Bates, 1864)** [MI, A]	May'11[MI]	**Jun**, **Sep, Dec**
130	*Anthanassa ptolyca ptolyca* (H. Bates, 1864) [Y]	Aug	**Dec**
131	*Tegosa guatemalena* (H. Bates, 1864) [A]	Feb, Nov	–
	Charaxinae		
132	*Zaretis ellops* (Ménétriés, 1855) [A]	Jul, Sep, Nov	–
133	*Anaea aidea* (Guérin-Méneville, [1844]) [PH, A]	May, Nov	Jun, Aug, Oct, Nov
134	*Fountainea glycerium glycerium* (E. Doubleday, [1849]) [PH]	Aug, Sep, Oct, **Nov**	–
135	***Archaeoprepona demophon centralis* (Fruhstorfer, 1905)** * [PH, A]	–	**Jul**
	Satyrinae		
136	*Morpho helenor* ssp.* [A]	–	Sep
137	***Caligo telamonius memnon* (C. Felder & R. Felder, 1867)** * [PH, A]	–	**Oct**
138	***Manataria hercyna maculata* (Hopffer, 1874)** [A, Y]	–	**Jun**
139	*Cissia similis* (A. Butler, 1867) [MI, PH, A]	May'12[MI], Jun'12[MI], Oct, Nov	Jan, Feb, Apr, May, Jun, Oct, Nov, Dec
140	*Cissia themis* (A. Butler, 1867) [MI, PH]	Jul, Aug'11[MI]	Feb, **Jun**, Jul, Aug'16[MI], Oct'16[MI], Dec
141	*Cyllopsis gemma freemani* (D. Stallings & J. Turner, 1947)	Sep, Nov	–
142	*Cyllopsis hedemanni hedemanni* R. Felder, 1869 [Y]	Feb	–
143	*Cyllopsis hilaria* (Godman, 1901)	Sep, Nov	–
144	*Cyllopsis pephredo* (Godman, 1901) [Y]	**Jun**, Nov	–
145	*Euptychia fetna* A. Butler, 1870	Aug, Sep	–
146	*Hermeuptychia hermes* (Fabricius, 1775) [A, Y, 4]	Jul	**Jan**, Feb, Sep, Oct
147	*Taygetis thamyra* (Cramer, 1779) [PH]	Nov	**Jun**, **Oct**

	Family	Months when observed	
	Subfamily	Los Cerritos	Heloderma Reserve
	Species and subspecies		
	Hesperiidae		
	Eudaminae		
148	***Phocides polybius lilea* (Reakirt, [1867])** [A]	**Nov**	–
149	*Phocides urania urania* (Westwood, 1852)	Aug	–
150	*Proteides mercurius mercurius* (Fabricius, 1787) [PH, A]	Jun	**Jun**, Sep
151	*Epargyreus exadeus cruza* Evans, 1952 [A, Y]	Feb, Mar, Apr, Jun, **Jul**	Aug
152	*Polygonus leo arizonensis* (Skinner, 1911)	Jul	Jun, Jul, Aug, Sep, Oct
153	*Chioides albofasciatus* (Hewitson, 1867) [A]	Jun	–
154	*Chioides zilpa* (A. Butler, 1872) [A]	Jan, Mar	–
155	*Typhedanus undulatus* (Hewitson, 1867) [A]	Feb, Mar, May	–
156	*Typhedanus ampyx* (Godman & Salvin, 1893) [A]	–	Oct
157	*Polythrix asine* (Hewitson, 1867) [PH, A, 5]	–	**Jan**, **Dec**
158	***Polythrix octomaculata* (Sepp, [1844])** [A]	–	**May**
159	*Cephise aelius* (Plötz, 1880)	–	Oct
160	*Codatractus alcaeus alcaeus* (Hewitson, 1867)	Mar, May	–
161	***Codatractus melon* (Godman & Salvin, 1893)**	–	**Jun**, **Jul**
162	*Urbanus viterboana* (Ehrmann, 1907) [MI, A, Y]	Sep, Nov'11 [MI]	Sep, Oct
163	*Urbanus esmeraldus* (A. Butler, 1877) [A, Y]	Aug, Sep	**Jun**
164	*Urbanus dorantes dorantes* (Stoll, 1790) [PH, A]	May, **Jul**, **Aug**, **Dec**	Apr, Jun, Jul, Aug, Sep, Oct, Nov
165	*Urbanus procne* (Plötz, 1881) [PH, A, Y]	May, Jul, **Nov**	–
166	*Urbanus doryssus doryssus* (Swainson, 1831) [A]	Jul	–
167	*Astraptes fulgerator azul* (Reakirt, [1867]) [A, Y, 6]	Oct, Nov	–
168	*Astraptes alector hopfferi* (Plötz, 1881) [A]	Sep	**Jan**
169	*Astraptes anaphus annetta* Evans, 1952 [PH, A, Y]	Jun, Oct	Jul
170	*Achalarus toxeus* (Plötz, 1882) [A]	–	Mar, **Apr**, Oct
171	*Achalarus albociliatus albociliatus* (Mabille, 1877) [A]	Feb, Mar	Oct, Nov
172	*Cabares potrillo potrillo* (Lucas, 1857) [A, Y]	–	Jun, **Jul**, Aug, **Oct**, Nov
173	*Cogia cajeta eluina* Godman & Salvin, 1894	May, **Jun**	–
	Pyrginae		
174	***Mysoria affinis* (Herrich-Schäffer, 1869)**	–	**Oct**
175	*Celaenorrhinus fritzgaertneri* (Bailey, 1880) [PH]	Feb, Aug	Mar, **Jun**
176	*Noctuana stator* (Godman, 1899) [PH, A, Y]	Feb, Mar, May, **Jul**, Sep	–
177	*Bolla evippe* (Godman & Salvin, 1896)	Mar	–
(177)	*Bolla* sp. [7]	–	**Oct** [7]
178	*Staphylus ascalaphus* (Staudinger, 1876) [Y]	May	Jan, Sep
179	*Staphylus azteca* (Scudder, 1872)	–	Feb, Aug, Nov
180	*Gorgythion vox* Evans, 1953 [A, Y]	–	Jun, Jul, Aug, Sep, Oct
181	***Mylon salvia* Evans, 1953**	**Nov**	–
182	***Mylon pelopidas* (Fabricius, 1793)** [A]	–	**May**, **Jun**
183	*Grais stigmaticus stigmaticus* (Mabille, 1883) [PH]	–	**Jan**, Jun, Jul
184	*Timochares trifasciata trifasciata* (Hewitson, 1868) [A]	–	Jan
185	*Chiomara georgina georgina* (Reakirt, 1868)	Jan, **Jul**, Sep, **Nov**	Aug
186	***Erynnis funeralis* (Scudder & Burgess, 1870)**	**Aug**	**Jun**
187	*Eantis tamenund* (W. H. Edwards, 1871) [PH]	Feb, Jul, Aug, **Nov**, Dec	–
188	*Atarnes sallei* (C. Felder & R. Felder, 1867) [A]	Jul	–
189	***Carrhenes fuscescens fuscescens* (Mabille, 1891)**	–	**Jun**
190	*Antigonus erosus* (Hübner, [1812]) [PH, A]	**Mar**, Oct	Feb, Mar, **Jun**, Aug, Oct
191	*Antigonus corrosus* Mabille, 1878 [A, Y]	–	Sep

	Family / Subfamily / Species and subspecies	Months when observed: Los Cerritos	Months when observed: Heloderma Reserve
192	*Zopyrion sandace* Godman & Salvin, 1896	**Mar**, Aug	**Jan**, Apr, **May**, **Jun**, Sep, Dec
193	*Pyrgus oileus* (Linnaeus, 1767) [PH, A, Y]	Apr	Jul, Aug, Sep, Oct, Dec
194	***Pyrgus orcus* (Stoll, 1780)**	–	**Jun**
195	*Heliopyrgus domicella domicella* (Erichson, [1849])	Sep	Sep, **Oct, Nov**
196	*Heliopetes laviana laviana* (Hewitson, 1868) [A]	–	Feb
197	*Heliopetes macaira macaira* (Reakirt, [1867]) [MI, A]	Jul'12[MI], **Nov**	Oct
198	*Heliopetes alana* (Reakirt, 1868) [A, Y]	Jul	–
Heteropterinae			
199	***Piruna aea* (Dyar, 1912)** [PH]	–	Jun [8], **Jul**, Sep [8], **Oct**
Hesperiinae			
200	*Perichares adela* (Hewitson, 1867) [A]	Aug, Sep	Oct
201	*Copaeodes aurantiaca* (Hewitson, 1868) [MI]	Mar'11[MI]	–
202	***Panoquina lucas* (Fabricius, 1793)** [A]		**Jan**
203	*Zenis jebus hemizona* (Dyar, 1918)	Jan	–
204	*Synapte shiva* Evans, 1955	Aug	Jun, Dec
205	*Synapte syraces* (Godman, 1901)	–	Sep
206	***Callimormus saturnus* (Herrich-Schäffer, 1869)** [A]	–	**Oct**
207	***Amblyscirtes elissa elissa* Godman, 1900** [NR, MI]	–	**Jun**, Aug'16[MI], Sep'16[MI]
208	*Amblyscirtes tolteca tolteca* Scudder, 1872 [A]	**Jun**, Jul	**May**
209	*Methionopsis ina* (Plötz, 1882) [A]	–	**Jan**, Oct, Nov
210	***Repens florus* (Godman, 1900)** [NR]	–	**Oct**
211	*Cymaenes trebius* (Mabille, 1891) [MI, A]	Aug	Sep'16[MI]
212	*Lerema liris* Evans, 1955	–	Jul, Sep
213	***Niconiades nikko* Hayward, 1948** [NR]	**Nov**	–
214	*Vettius fantasos* (Cramer, 1780) [A, Y]	Aug, Sep, Oct	**Jan**, Oct
215	*Hylephila phyleus phyleus* (Drury, 1773) [A]	Aug	–
216	*Polites vibex praeceps* (Scudder, 1872) [A]	Mar, Apr	–
217	***Pompeius pompeius* (Latreille, [1824])** [A, Y]	–	**Jun**
218	*Atrytonopsis ovinia* (Hewitson, 1866) [PH]	Jan, Feb, Mar, Apr, **Oct**	Oct, Dec

[PH] Species photographed.

[A] Species reported at Tikal in northern Guatemala by Austin et al. (1996).

[Y] Species reported at Parque Cayalá in Guatemala City by Yoshimoto et al. (2021).

* Specimens not collected (recorded only by direct observation or photographs).

[MI] Species misidentified in Yoshimoto et al. (2018 or 2019); their previous identification results are shown in Table 1.

[1] Listed at the genus level because of the difficulty of species-level identification derived from the confused taxonomic state of this genus.

[2] These two species, together with *Emesis tegula* and *E. toltec*, can be treated as a species complex. These taxa require further study, according to Trujano-Ortega et al. (2021).

[3] The genus name, treated as *Emesis* in Yoshimoto et al. (2019), was modified according to Zhang et al. (2019).

[4] The name "*hermes*" is correctly applied to a South American species, according to Cong and Grishin (2014). Thus, the individuals collected might include multiple species, none of which are true *hermes*.

[5] One sample which was photographed at Heloderma Reserve in October 2016 and was identified as this species in Yoshimoto et al. (2019) was excluded, as we found that it might have been of another species of this genus, which is unable to de determined because of the lack of a specimen.

[6] This is a species complex, which includes several species in Costa Rica (Hebert et al. 2004; Brower, 2006, 2010). Thus, the individuals collected might also be of multiple species.

[7] These data were included in the species count and Chao II analyses for Heloderma Reserve, since at this site none of the identified species of this genus had been recorded. In contrast, these data have been excluded from the Chao II analysis for all data (pooled across the sites) and from the Jaccard index analyses, as this individual might be of *Bolla evippe* (Godman & Salvin, 1896), which is unable to be examined because of the heavily damaged specimen of *Bolla* sp.

[8] Identified to genus (*Piruna* sp.1) and incorrectly listed as Hesperiinae in Yoshimoto et al. (2019).

[NR] New record for Guatemala.