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Butterflies diversity from a remnant of semiurban Caatinga, Septentrional Sertaneja Depression Ecoregion, Patos, Paraíba, Brazil (Lepidoptera: Papilionoidea)

A. Ferreira-Júnior

Abstract

In order to perform a concise characterization and evaluation of the butterflies taxocenosis structure of the Rural Health and Technology Center (CSTR) of the Federal University of Campina Grande (UFCG), a semiurban area of the Caatinga biome, Semiarid region, in the Septentrional Sertaneja Depression Ecoregion, a species inventory with entomological net was conducted. There were recorded 81 species of butterflies, distributed in a general abundance of 2531 individuals; among them, 808 specimens were captured and collected, and none of the individuals marked with nontoxic pen and released were recaptured. The list of species was complemented by adding nine more butterflies species, mostly Hesperidae, from collection before and after the sampling period, constituting a total of 90 species. Many of the butterflies species found in the CSTR are new records for Paraíba state and only four species are considered for the Northeast geographic region, based on other checklists for areas of Atlantic Forest, Caatinga, Cerrado and Amazon biomes in this region: *Junonia genoveva infuscata* Felder & Felder, 1867, *Staphylus melangon epicaste* Mabille, 1903, *Clito sompa* Evans, 1953 and *Lerema ancillaris* (Butler, 1877).

KEY WORDS: Lepidoptera, Papilionoidea, species list, urban ecology, semiarid, seasonally dry tropical forest, Brazil.

**Diversidad de mariposas de un remanente de Caatinga semiurbana,
Ecorregión de la Depresión Sertaneja Septentrional, Patos, Paraíba, Brasil
(Lepidoptera: Papilionoidea)**

Resumen

Para caracterizar y evaluar rápidamente la estructura de taxocenosis de mariposas del Centro de Salud y Tecnología Rural (CSTR) de la Universidad Federal de Campina Grande (UFCG), un área semiurbana del bioma Caatinga, región Semiárida, Ecorregión de Depresión Sertaneja Norteña, fue realizado un inventario de especies con red entomológica. Fueron registradas 81 especies de mariposas, distribuidas en una abundancia general de 2.531 individuos; de estos, 808 especímenes fueron capturados y colectados, ninguno de los individuos marcados con pluma no tóxica y liberados fueron recapturados. La lista de especies se complementó agregando nueve especies de mariposas más, principalmente Hesperidae, de las recopilaciones antes y después del período de muestreo, lo que ha constituido un total de 90 especies. Muchas de las especies de mariposas encontradas en el CSTR son nuevos registros para el estado de Paraíba y solo cuatro especies se mencionan como nuevos registros para la región geográfica Noreste, basado en otros inventarios para las áreas de los biomas Bosque Atlántico, Caatinga, Cerrado y Amazonas de esta región: *Junonia genoveva infuscata* Felder & Felder, 1867, *Staphylus melangon epicaste* Mabille, 1903, *Clito sompa* Evans, 1953 y *Lerema ancillaris* (Butler, 1877).

PALABRAS CLAVE: Lepidoptera, Papilionoidea, lista de especies, ecología urbana, semiárido, bosque tropical estacionalmente seco, Brasil.

Introduction

Brazil is cited as one of the main megadiverse countries, housing a significant number of terrestrial invertebrates (LEWINSOHN & PRADO, 2005). However, knowledge of the diversity of this group, especially butterflies, is still incipient and unequally distributed among the political (geoeconomic) and biogeographic divisions, with evident negligence for the Northeastern Semi-arid region (LEWINSOHN *et al.*, 2005; CARNEIRO *et al.*, 2008; FREITAS & MARINI-FILHO, 2011; SANTOS *et al.*, 2011). Thus, it is required to acquire knowledge of biodiversity for its contribution and development of multiple conservation approaches, mitigation strategies and compensation of the various environmental impacts, given the growing pace of imbalance of natural ecosystems, habitat loss, extinction of species and the devastating effects of the global warming (WILSON, 1997; CHAPIN *et al.*, 2000; BONEBRAKE *et al.*, 2010; WARREN *et al.*, 2013; GARCÍA-ROBLEDO *et al.*, 2016; MELLO *et al.*, 2016).

The term diversity, commonly used in works focusing on Community Ecology and Conservation Biology, represents the variety of living beings and may include information on richness and equitativity, this last expressing the relative importance of each species through abundance in sampling (MELO, 2008). Information about the diversity of butterflies in a given habitat, even those considered urban or with varied anthropogenic disturbance, can contribute to their conservation and understanding landscape connectivity, quali-quantitative monitoring and as a starting point for detecting spatial or temporal environmental changes, in addition to supporting biogeographic studies and specific patterns (HARDING *et al.*, 1995; BROWN-JUNIOR & FREITAS, 1999; SOGA & KOIKE, 2012).

Specifically, the species richness (A, B, C, D, E or 1, 2, 3, 4, 5) does not express the number of individuals, a function of the abundance (A, A, A, A or 1, 1, 1, 1, 1, or yet A1, A2, A3, A4, A5, ... AN, or eventually for the composition A1, B1, B2, B3, B4, C1, C2, C3, D1, D2, E1, structure of distinct qualities with equal or different quantities of individuals), and consist of key metrics in the various fields of research in Ecology that generally underestimate the counts in samples of different characteristics (homogeneous and heterogeneous), with two large structural groups of statistical tests, parametric and non-parametric models, and two approaches to infer species richness based on data measures (computational simulations), incidence (absence 0 or ≥ 1 presence), numbers of uniques (1 sample) and duplicates (2 samples), and abundance (0 or ≥ 1), numbers of singletons (1 individual) and doubletons (2 individuals), - as expressed by KHALIGHIFAR *et al.* (2020), with more details, depending of the disposition and conformation, the data of binary incidence, 0 or 1, cannot be permuted into abundance finite data, however, the contrary transformation is possible - asymptotic and non-asymptotic approaches, that can be compared to the multiple assemblies (convergent/divergent, similar/dissimilar) and arrive at a theoretical (speculative) and experimental relationship of the appropriate real number of the richness (statistical approximation theory) in certain environments with possible undetected species, hypotheses that can be proven indispensably through the standardized application of collection protocols (sample integrity) and the sampling effort, once again highlighting the support to the understanding of the arbitrators to the causes of biodiversity phenomena and the consequences of unsustainable human exploration for making decisions based on a well-founded environmental policy (CHAO & CHIU, 2016a; 2016b; CHAO & COLWELL, 2017).

Considering the ontological and ontogenetic mutability of the linguistic sign "species", this word can express multiplicity of significant (among the various idioms and languages of the human species) and significances (concept) according to the dialectical contextual insertion in the systems (analogy, minor valence relationship, and homology, major valence relationship, of

Aristotelian origin applied over time), introduced and felt between enunciator (emitter) and enunciated (receptor) through of the channels of enunciation of the enunciated (D'SAUSSURE, 2012). Species can be defined in the stricto sensu as a biological taxonomic category that includes its taxa by the unified concept of species, - genophenotypic (intrinsically) and/or phenogenotypic (extrinsically) living beings/organisms - segments of metapopulation lineages evolving separately, possible common denominator, through secondary and primary contingent properties used as operational criteria of the point of cut and circumscription of the lines of speciative evidence, with the metamorphosis occurring at the level of anagenesis and the speciation in the dimension of cladogenesis, analyzed by the robustness of integrated methods (emphasize for the phylogenetic-cladistic with your inferences) by genetic scrutineers (coalescence theory), phylogeographic, morphological, physiological and behavioral, among other aspects of the evolutionary biological taxonomic systematic (organization of knowledge), conducted and legislated by associations and commissions with yours consolidated international nomenclature codes, botanical (IAPT, 1950; TURLAND *et al.*, 2018) and zoological (ICZN, 1895; ICZN, 1999), in addition to international committees and codes for the nomination of prokaryotes (ICSP, 2020; PARKER *et al.*, 2019) and viruses (ICTV, 2018; ICTV, 2019); additional groups with their supra and infracategorical epithets, inter and intraspecific interactions, evolutionarily involved throughout natural history through the various types of speciation with potential gene introgressions, parallel speciation and hybridizations in the flow of genetic pools (*e.g.*, ecotypes zones with semipermeable reproductive barriers and occurrence of at least two sympatric subspecies of the same species of butterfly that do not evolve completely apart), followed by heuristic, syntactic-semantic, nomenclatural-terminological conflicts (controversies), subject to the reviews and adequations submitted to the scientific community consensus or dissent (see MAYDEN, 1997; D'QUEIROZ, 2007; ALEIXO, 2007; HAUSDORF, 2011; NAOMI, 2011; BRABY *et al.*, 2012 for more details of the heated debate about delimitation and conceptualization parameters of species and subspecies).

While the identity of the "species" can be applied to objects and subjects, living and non-living beings, memes, money banknotes, agents, patients, epidemiological cases (medical science), bugs in software programs (computer science and information technologies), characters that make up the atomicity of numbers and letters in different languages in the websites, books and physical-digital-virtual articles (Literature), genes or alleles of the genetic code and other discrete, elementary and substantial entities, contents within of categorical continents of the monistic hierarchical organization, not only of biological sciences, trans-interdisciplinary topics in the spectrum of conceptual applications and discussions of information theory (CHAO & CHIU, 2016a; 2016b); including not only the pertinent contemporary philosophical-anthropological-sociological reflections (considering other perspectives, see DANOWSKI & D'CASTRO, 2014), that together with Biology representatives (Zoology, Ecology, etc.) try to restructure and balance the coexistence of desires among beings for a more reasonable, tolerable, peaceful and just world during the probable most prominent viral pandemic of the 21st century, probably caused by the random events, misfortunes of the consequence by the human hyper-impaction on wild biodiversity, through the unpredictable strains of high mutagenic power transversely the species of the new coronavirus (SIDDELL *et al.*, 2020) of Chiroptera origin (ZHOU *et al.*, 2020), etiological agent Sars-Cov-2 (CSG/ICTV, 2020) that infects millions of individuals of the human species expressing ample deadly power pathogenic by the Covid-19 disease (ICTV, 2019).

Various environmental factors, biotic and abiotic, can influence relatively on the distribution and structure of neotropical butterfly communities, such as different latitude and altitude gradients, topographic, floristic and microhabitat heterogeneity, seasonality, microclimatic conditions and varying degrees of fragmentation and vegetative disturbance, thus the assemblies may have different composition, richness and abundance (BROWN-JUNIOR, 1991; BROWN-JUNIOR & FREITAS, 2000a, b; BROWN-JUNIOR & FREITAS, 2002).

Specifically, the effects of urbanization gradient and other anthropogenic disturbances in

natural ecosystems, associated on butterfly assemblages, can lead to forest fragmentation, modification of habitats and species composition, through the emergence of exotic or cultivated species and the loss of native species, with consequent decrease in diversity (BROWN, 1989; RUSZCZYK & SILVA, 1997; HARDY & DENNIS, 1999; NEW & SANDS, 2002; FAHRIG, 2003; MCKINNEY, 2008). So, the presence or absence and population density of a particular species may serve as bioindicators of the conservation level and quality of the environmental landscapes, as they are insects characteristic of this assessment and susceptible to such impacts (FREITAS *et al.*, 2003; FREITAS *et al.*, 2006; OLIVEIRA *et al.*, 2018).

In contrast, urban environments, with green areas that maintain considerable vegetation and favorable weather conditions, even provide shelter and resources for the establishment and survival of adults and butterfly larvae, also becoming refuge for birds, reptiles and other insects, highlighting the importance of these remnants for the study and conservation of the biodiversity (RUSZCZYK, 1986a, 1986b, 1986c, 1986d; MURPHY, 1997; BROWN-JUNIOR & FREITAS, 2002; KOH & SODHI, 2004; COLLIER *et al.*, 2006; CLARK *et al.*, 2007). From this perspective, there is a tendency in the reduction of butterfly dispersion and diversity in relation to the increased degree of urbanization and alteration, where less impacted semiurban and peripheral areas present greater richness compared to more altered central urban green areas, with few exceptions (RUSZCZYK & ARAÚJO, 1992; FORTUNATO & RUSZCZYK, 1997; RUSZCZYK, 1998; HARDY & DENNIS, 1999; NEW & SANDS, 2002; HOGSDEN & HUTCHINSON, 2004; OLIVEIRA *et al.*, 2018; TZORTZAKAKIA *et al.*, 2019).

Most of the Brazilian works developed with butterflies in fragments of urban and semiurban vegetation are described for areas of plazas, cemeteries, university campuses, municipal parks and other conservation units for the Atlantic Forest (*sensu lato*), involving the listing of species through active and/or passive collection, and various ecological analysis, with greater representativeness for the Southern (RUSZCZYK, 1986a, b, c, d, e; RUSZCZYK, 1987; RUSZCZYK & ARAÚJO, 1992; LEMES *et al.*, 2008; SACKIS & MORAIS, 2008; BONFANTTI *et al.*, 2009; BONFANTTI *et al.*, 2011; LEMES *et al.*, 2015; FAVRETTO *et al.*, 2015; PEREIRA *et al.*, 2015) and Southeast regions (RODRIGUES *et al.*, 1993; FORTUNATO & RUSZCZYK, 1997; RUSZCZYK & SILVA, 1997; VANINI *et al.*, 1999; BROWN-JUNIOR & FREITAS, 2002; SILVA *et al.*, 2007; PEREIRA *et al.*, 2011; SILVA *et al.*, 2012; SOARES *et al.*, 2012). Few inventories can be cited for Midwest region (PINHEIRO *et al.*, 2008; BOGIANI *et al.*, 2012), Northern region (GARCIA *et al.*, 1990; GARCIA & BERGMANN, 1994) and Northeast region, described for Cerrado and Amazon (MARTINS *et al.*, 2017; PEREIRA *et al.*, 2018), Atlantic Forest (KESSELRING & EBERT, 1982; VASCONCELOS *et al.*, 2009; OLIVEIRA *et al.*, 2018; MELO *et al.*, 2019) and Caatinga urban areas (COSTA *et al.*, 2013; ROQUE *et al.*, 2014), where very few butterfly studies are known for the urban locations of the Semi-arid region, demonstrating the importance of this survey work.

The present study was developed to contribute to the knowledge and conservation of the butterflies fauna of the Semi-arid region of Northeastern Brazil through the elaboration of a species list and characterization of alpha diversity in an area of semiurban xerophytic caatinga located in the town of Patos, state of Paraíba. It is noteworthy that the area covered by the municipality is considered of extreme biological importance for the invertebrate group and priority for knowledge and conservation of the Caatinga biome biodiversity (MMA/SBF, 2002; SILVA *et al.*, 2003).

Material and methods

STUDY AREA

The Health and Rural Technology Center (CSTR) of the Federal University of Campina Grande (UFCG) is located on the outskirts of the urban area of Patos town, Paraíba state (07°03'32" S e 37°16'29" W), it has an average altitude of 250 meters, rocky outcrops and an approximate area

of 220 m², inserted in the Caatinga biome, Semiarid region, Septentrional Sertaneja Depression Ecoregion (VELLOSO *et al.*, 2002). The regional climate is semiarid, BSh, according to the classification of Köppen, marked by a dry and a rainy season (ÁLVARES *et al.*, 2014). The annual average temperature is around 25°C, while the relative humidity 65,9% and the rainfall has an annual average of inferior 1000 mm (SOUSA *et al.*, 2019), being irregularly distributed between the months of the year. It is in a high degree of anthropization, with much of the total area occupied by constructions. However, it has an area that concentrates a relatively considerable vegetation, where is inserted a forest vivarium with seedlings, next to one of the largest and oldest water reservoir of the municipality, Jatobá weir; besides extensions with ruderal vegetation spots, especially during the rainy season, and shrub-tree caatinga, which undergo periodic weeding and pruning. Both places provide food and oviposition substrates to butterflies, where native angiosperm species of different habits are present, mostly represented by families Fabaceae, Anacardiaceae, Bignoniaceae, Euphorbiaceae and Myrtaceae (SOUSA *et al.*, 2019), Convolvulaceae, Malvaceae, Rubiaceae, Apocynaceae, Asteraceae, in addition to exotic and native ornamental species of others families located in regularly irrigated flower beds.

SAMPLING

The butterflies were captured with the aid of an entomological net, identified in the field when possible, marked with a nontoxic pen and released or collected. Visual counts were also performed of individuals of species with population explosions, once per transect and without net capture, mostly some species of Pieridae and Nymphalidae. At the time of the catch the transect was recorded. Registries were made in ruderal open areas, shrub and tree vegetation spots, within three transects proportional to the campus length and explored from February 2011 to December 2011 (10 months), except October, one day per month, from 08 am to 04 pm, alternately, 2:40 hours per transect, totaling a sampling effort of 80 hours/net/collector with one more auxiliary for spreadsheet annotations and marking of the entomological envelopes. Also, butterfly species that were not captured during the sampling period, but they have records for the study area, were added to complement the richness of the CSTR.

Specimens (vouchers) were deposited in the butterfly Collection of the Caatinga Insect Ecology and Interactions Laboratory (CLEIIC) of the Federal University of Campina Grande (UFCG), Patos, Paraíba, Brazil.

The systematic follows the one proposed by LAMAS (2004, 2008) and ESPELAND (2018). For the suprageneric categories of Nymphalidae, WAHLBERG *et al.* (2009), Riodinidae, SERAPHIM *et al.* (2018) and Hesperidae, WARREN *et al.* and LI *et al.* (2019). Many identifications were obtained through physical (BROWN-JUNIOR, 1992; CANALS, 2003) and digital guides (WARREN *et al.*, 2013), consulting specialists when needed.

DATA ANALYSIS

Are described richness data, absolute and relative frequencies by abundance of species, subfamilies and families, as well as the presence and absence of species in the rainy and dry seasons of the year. In sequence, to evaluate the collection effort, richness extrapolations (previsions) were performed through the nonparametric estimators that quantify rarities, Bootstrap, Jackknife 1, 2 and Chao 1, 2 (DIAS, 2004), using the software PAST 3.24 (HAMMER *et al.*, 2019), comprising only the information for the 10 months of sampling.

The constancy of the butterfly species was obtained through the relation between the proportion of the samples in which a given species was registered and the total number of samples, through the formula $C = p.100/N$, being p the number of sampling occasions recorded for each species and N the total of sampling occasions, categorizing the species as constant, present in more than 50% of the collections (6-10 months), accessory, between 25 and 50% (3-5 months), and

accidental, in less than 25% of the collections (1-2 months) (BODENHEIMER, 1955; SILVEIRA-NETO *et al.*, 1976); while the dominance was calculated from the relative abundance of each species using the formula $D = (i/t) \cdot 100$, being i the total of individuals of a species and t the total of sampled individuals, characterized as eudominant > 10%, dominant > 5-10%, subdominant > 2-5%, recessive = 1-2% and rare < 1% (FRIEBE, 1983).

Simple comparisons of richness and composition were also made with the intention to achieve some similarity with other available inventories for urban green areas in the Pampa, Cerrado and Atlantic Forest biomes (SILVA *et al.*, 2007; SACKIS & MORAIS, 2008; PINHEIRO *et al.*, 2008; BONFANTTI *et al.*, 2009; VASCONCELOS *et al.*, 2009; BONFANTTI *et al.*, 2011; SOARES *et al.*, 2012; BOGIANI *et al.*, 2012; PEREIRA *et al.*, 2015; LEMES *et al.*, 2015; MELO *et al.*, 2019), and with the other inventories developed in the northeastern Semiarid region (NOBRE *et al.*, 2008; PALUCH *et al.*, 2011; ZACCA & BRAVO, 2012; LIMA & ZACCA, 2014; KERPEL *et al.*, 2014; RAFAEL *et al.*, 2017). New records for the Northeast region were obtained from the inventories available in scientific literature (CARDOSO, 1949; KESSELRING & EBERT, 1982; NOBRE *et al.*, 2008; ZACCA *et al.*, 2011; PALUCH *et al.*, 2011; ZACCA & BRAVO, 2012; LIMA & ZACCA, 2014; KERPEL *et al.*, 2014; PALUCH *et al.*, 2016; RAFAEL *et al.*, 2017; MARTINS *et al.*, 2017; PEREIRA *et al.*, 2018; MELO *et al.*, 2019).

Results and Discussion

Eighty-one (81) butterfly species were recorded distributed in 30 species of HesperIIDae (37%), 26 of Nymphalidae (32%), 13 of Pieridae (16%), eight of Lycaenidae (10%), three of Papilionidae (4%) and one species of Riodinidae (1%) (Table I). The list of species was complemented by adding nine more species, mostly HesperIIDae, from anterior and posterior collections to the sampling period, constituting a total of 90 species: *Historis acheronta* (Fabricius, 1775) (Nymphalidae); *Anteos clorinde* (Godart, [1824]) (Pieridae); *Electrostrymon endymion* (Fabricius, 1775), *Strymon crambusa* (Hewitson, 1874), *Pseudolycaena marsyas* (Linnaeus, 1758) (Lycaenidae); *Aguna megaeles* (Mabille, 1888), *Staphylus* sp., *Staphylus melangon epicaste* Mabille, 1903, *Heliopterus arsalte* (Linnaeus, 1758) (HesperIIDae) (Table I).

For the general abundance a total of 2531 individuals were registered, represented by 987 of Nymphalidae (39%), 945 of Pieridae (37.3%), 331 of HesperIIDae (13%), 239 of Lycaenidae (9.4%), 22 of Riodinidae (1%) and seven of Papilionidae (0.3%) (Table II). Among these records, 808 specimens were captured and collected, none of the marked and released individuals were recaptured.

Among the most representative families in number of species are HesperIIDae, Nymphalidae, Pieridae and Lycaenidae, respectively. Such representativeness was not maintained in relation to the proportion of the number of individuals, there was an inversion between the first three families, showing Nymphalidae as the most abundant, followed by Pieridae, HesperIIDae and Lycaenidae, while Papilionidae was the least abundant family and Riodinidae obtained the lowest proportion of richness, a single species, *Aricoris campestris* (H. Bates, 1868) - common in open vegetation and with characteristic distribution to the northeastern Semiarid region (NOBRE *et al.*, 2008; PALUCH *et al.*, 2011; ZACCA & BRAVO, 2012; KERPEL *et al.*, 2014; RAFAEL *et al.*, 2017) and in an area of Cerrado and Amazon of the Maranhão state (MARTINS *et al.*, 2017) - being slightly higher to the total proportion of the number of individuals of the three species recorded for Papilionidae.

The most significant subfamilies in richness are HesperIinae (13 species, 16%), Coliadinae (10 species, 12%), Pyrginae (9 species, 11%), Eudaminae (8 species, 10%), Nymphalinae and Theclinae (6 species, 7% each), respectively; when it comes to abundance, Coliadinae (845 specimens, 33.39%), Heliconiinae (329 specimens, 13%), Nymphalinae (272 specimens, 10.75%), Biblidinae (245 specimens, 9.68%) and Polyommatainae (206 specimens, 8.14%) are the prominent ones (Table II).

Table II.– Absolute and relative frequencies of the richness and abundance by butterfly families and subfamilies, and for the different seasons of the sampling period at the Health and Rural Technology Center (CSTR), Patos, Paraíba, Brazil, between February 2011 and December 2011, except October. Legend: S = richness, N = abundance; RAI = rain period (Feb-Jun), DRY = dry period (Jul-Dec).

Families/ subfamilies	S	%	N	%	Season (N)			
					RAI	%	DRY	%
Papilionidae	3	4	7	0.3	4	0.3	3	0.2
Papilioninae	3	4	7	0.28	4	0.3	3	0.2
Pieridae	13	16	945	37.3	430	36.3	515	38.3
Coliadinae	10	12	845	33.39	376	31.7	469	34.8
Pierinae	3	4	100	3.95	54	4.6	46	3.4
Lycaenidae	8	10	239	9.4	148	12.5	91	6.8
Theclinae	6	7	33	1.3	29	2.4	4	0.3
Polyommatainae	2	3	206	8.14	119	10	87	6.5
Riodinidae	1	1	22	1	5	0.4	17	1.3
Riodininae	1	1	22	0.87	5	0.4	17	1.3
Nymphalidae	26	32	987	39	384	32.4	603	44.8
Libytheinae	1	1	1	0.04	1	0.1	0	0
Danainae	5	6	75	2.96	25	2.1	50	3.7
Heliconiinae	4	5	329	13	169	14.3	160	11.9
Biblidinae	5	6	245	9.68	34	2.9	211	15.7
Cyrestinae	1	1	44	1.74	29	2.4	15	1.1
Nymphalinae	6	7	272	10.75	109	9.2	163	12.1
Charaxinae	2	3	12	0.47	10	0.8	2	0.1
Satyrinae	2	3	9	0.36	7	0.6	2	0.1
Hesperiidae	30	37	331	13	214	18.1	117	8.7
Eudaminae	8	10	120	4.74	50	4.2	70	5.2
Pyrginae	9	11	144	5.69	125	10.5	19	1.4
Hesperiinae	13	16	67	2.65	39	3.3	28	2.1
Total	81	100	2531	100	1185	100	1346	100

Of the 81 sampled species, 67 are recorded for the rainy season, 20 exclusive species, and 61 for the dry period, 14 exclusive species, with slightly more than half shared between both seasons, 47 species or 58% (Table I), with the highest peak of richness and abundance for the month of June (42 species, 406 individuals), followed by the richness of September (41 species, 267 individuals), April (40 species, 193 individuals), March (39 species, 179 individuals), February (38 species, 190 individuals), July and August (37 species each, 277 and 294 individuals), May (36 species, 217 individuals), November (31 species, 293 individuals) and December (29 species, 215 individuals); different from the total registered individuals, divided into 53% for the dry season, 1346 individuals, and 47% for the rainy season, 1185 individuals (Table II). Such findings between the different periods and among the months of sampling can express a seasonal fluctuation in the frequency of individuals and transience of species in the studied community, showing active individuals of different species in both seasons.

Potentially, the irregularity of the smallest number of individuals for the rainy season in the CSTR (Table II) results of the discontinuity of collections during the sampling year, possible differences in the collection effort during the samples (CALDAS & ROBBINS, 2003), inconstant and extemporaneous rains, in addition to other local characteristics.

Comparatively, for a more conserved area in the Caatinga, VASCONCELLOS *et al.* (2010) quantified and qualified Lepidoptera as the seventh order of the most abundant and representative

insects for the rainy season, collected mainly with the malaise trap (independent of the collector's effort) at Fazenda Almas, Paraíba, where they registered the significance of the precipitation and relative humidity as fundamental predictors of the patterns of abundance and activity in most insect orders in this conservation unit. There are experiments to the identification of the specific patterns of the seasonal and spatial distribution of insects, however, they continue with incipient definitions for the butterflies and moths of the Semiárid, needing stimuli and more traction to acquire knowledge and resolutions of the contingents. The greater abundance recorded in the CSTR for the most adverse dry period (Table II) can be considered an anomaly to the logic of the greater availability of resources by the favorable climatic conditions through the months of greater precipitation and consequent vegetal mass increase, also followed by the increase of the insect populations of many species, among the evident population explosions of Pieridae, with relatively robust wings and involved in characteristic migrations in the Semiárid of the Northeast region, not exclusive to Brazil (SEMIÁRIDOS, 2013), during the rainy season, being influenced by an exogenous geomagnetic compass (biological clock), assessed through of the degrees of angles between the solar zenith (positive phototropism) and the directional azimuth of the individuals (OLIVEIRA *et al.*, 1998), masses and air currents, large scale climatic phenomena such as El Niño-Southern Oscillation (ENSO) (its oscillation is the main factor of temperature and continental precipitation) and La Niña, which occurred at the moderate level for the sampling year of 2011 (CPTEC/INPE, 2016), and by the climatic seasons that drive higher primary productivity and stimulates the phenology of host plants, mainly Fabaceae for pierids (BECCALONI *et al.*, 2008), with annual migrations of butterflies from wet tropical forests for the dries (SRYGLEY *et al.*, 2006; SRYGLEY *et al.*, 2010), and presumably, during the interval of greatest precipitations in the Caatinga ecoregions, at least in the Septentrional Sertaneja Depression, areas located between Ecuador and the parallel of the Tropic of Capricorn.

For the year of 2020, in the urban zone of the city of Brejo do Cruz, Paraíba, distant about of 100 km from Patos, many Pieridae were seen following a constant flow at different hours of the day, with flight direction from west to east, with a considerable reduction in the number of individuals in April, coinciding with the rainfall reduction. SRYGLEY *et al.* (2014), expresses that the influence of the environment, oriented by the frequency and amplitude of the ENSO cycle, acts in the phenology of larvae and adult butterflies, in the frequencies and amplitudes of insects population outbreaks and physiological-behavioral changes related to migration, with a consequent increase or decrease in the herbivory rate, making it possible to predict through modeling how the plants and insects of wet and dry neotropical forests may respond to climate change. It should be noted that for the Semiárid region of the Caatinga biome the rainy period match around the seasons of the summer (beginning on December 22 - solstice, highest pluviosity) and autumn (beginning on March 21 - equinox), while the dry period corresponds around of the seasons of winter (beginning on June 21 - solstice) and spring (beginning on September 23 - equinox); see BEDAQUE & BRETONES (2020) for more elucidations.

The richness estimators Jackknife 1 and 2 returned a result of 98 and 104 species, Bootstrap predicted 89 species, while the Chao 1 and 2 revealed an extrapolation of 105 and 92 species, indicating that more species can be recorded if a greater collection effort is employed. This observation can be supported by the register of nine additional species outside the sampling, as well as a new species of Riodinidae described for Caatinga, *Pheles caatingensis* Callaghan & Nobre, 2014 (CALLAGHAN & NOBRE, 2014), later transferred to another genus, *Melanis caatingensis* (Callaghan & Nobre, 2014) (DIAS *et al.*, 2015), with the record of one individual killed, in a spider web in the middle of a house bell on João Soares Street, on the way to the work in Diocesan Social Action of Patos (Ação Social Diocesana de Patos - ASDP), in the Brasília neighborhood, near the degraded riparian forest of the polluted extension of the Espinharas River, that runs through the town, about five kilometers from the CSTR.

The non-parametric estimator that responded best to the results found was the Chao 2, 92

species, - richness prediction based on incidence, presence or absence of species that define rarity, number of uniques (species found only in one sample) and duplicates (species found in only two samples) - considering only the data of the heterogeneous distribution of the 81 species in the sampling period between February and December 2011 (except October), and the addition of 9 registered species, part before and after of the sample period in the CSTR, totaling 90 species. These 90 species are added with *Melanis caatingensis* (Callaghan & Nobre, 2014) and more the visual record of a single individual of a non-resident clearwing butterfly, observed passing through the city center, plaza of the Bandstand I (Coreto I), hypothetically flying in direction to the Pico do Jabre State Park, where it is relatively common (FERREIRA-JÚNIOR *et al.*, in prep.), both species registered outside the CSTR, but obviously within the city of Patos, resulting in the totality of 92 species that match the 92 species predicted by the estimator Chao 2 (asymptote).

CHAO & JOST (2012) express that a sample of a certain size may be sufficient to fully characterize a low diversity assembly and insufficient to represent a rich assembly (see Table III) because if there are many undetectable species ("invisibles") in an assemblage with high diversity it will be statistically impossible to obtain a good estimate of species richness; therefore, a precise lower limit is usually more practical than an inaccurate point estimate, with the need of uniques/duplicates (incidence) and singletons/doubletons (abundance), basic concept of intuitive design in the non-parametric estimation of the species richness that will be detected in samples showing that abundant species contain almost no information about the richness of undetected species, while rare species, which are unlikely to be recorded or rarely seen, contain almost all information about the richness of undetected species; consequently, most non-parametric estimators of the number of undetected species are based on the lower-order frequency counts (CHAO & CHIU, 2016b).

However, considering the relationship of the richness and the proximity between the caatinga environments of the CSTR and Tamanduá Farm (approximately 20 km distance), with 24 species that were not registered for the CSTR, and knowing that in the adult phase many species of Lepidoptera are migratory and remain in metapopulations during the seasons (seasonality) through the high dispersion capacity by the flight and other survival strategies, such as diapause, it becomes probable in time that part of this difference in the species composition can move from one environment to another and be recorded, according to the specificity of habitat inherent to each species, expressing possible faunistic transient interchangeability in space and time (turnover). In the future, perhaps the cumulative number of the butterflies richness of the CSTR or town of Patos undergo changes, being able to increase and achieve momentary equality and temporarily with the previsions of the other estimators, with least chance of overmatch the Chao 1 because of the tendency of landscape modification by the anthropic actions, while possible resamples by monitoring can express different results for a comparative diagnosis, in addition to possible changes by the taxonomic revisions. In the worst case, a considerable decrease in the number of species if effective conservation programs are not properly implemented in the conservation units and ecological buffer zones surrounding the CSTR, ideally reinforcing them or creating new units for the maintenance of wild flora and fauna.

Species constancy revealed a value of 31 accidental species, 27 constants and 23 accessory (Table I). There are twelve species, mainly Pieridae, among the most common constant that were present throughout the sampling period: *Anteos menippe* (Hübner, [1818]), *Phoebis philea* (Linnaeus, 1763), *Phoebis sennae marcellina* (Cramer, 1777), *Eurema elathea flavescens* (Chavannes, 1850), *Pyrisitia leuce* (Boisduval, 1836), *Pyrisitia nise tenella* (Boisduval, 1836) and *Ascia monuste orseis* (Godart, 1819) (Pieridae), *Euptoieta hegesia meridiania* Stichel, 1938, *Anartia jatrophae* (Linnaeus, 1763), *Hamadryas februa* (Hübner, [1823]) and *Marpesia petreus* (Cramer, 1776) (Nymphalidae), *Hemiargus hanno* (Stoll, 1790) (Lycaenidae).

Regarding dominance, 72% of the species were categorized as rare (58 species), most of them represented by Hesperidae (26 species), Nymphalidae (16 species), Lycaenidae (7 species), Pieridae (5 species), Papilionidae (3 species) and Riodinidae (1 species), respectively, reaching

only 13% of the total abundance sampled, 338 individuals (Table I). Only one species of Pieridae was considered eudominant, *E. elathea flavescens*, with 12% of the sampled (310 individuals); particularly, due to population explosions, visual counts were made of many individuals of this species, not all of them captured and marked, which may have resulted in a lack of recaptures. While five species were characterized as dominant, totaling 39% and the majority of the sample, 974 individuals: two of Nymphalidae, *A. jatrophae* (248 individuals) and *E. hegesia meridiania* (205 individuals), one of Lycaenidae, *H. hanno* (198 individuals), and two of Pieridae, *A. menippe* (178 individuals) and *P. sennae marcellina* (145 individuals).

It is noted that the CSTR environment is home to a butterfly fauna characteristic of the northeastern Semiarid region (81 shared species), representing approximately 20% of the registered species by the largest butterfly survey of this region (KERPEL *et al.*, 2014), and more distinct from green areas of the Atlantic Forest (65 shared species), Cerrado (60 shared species) and Amazon (26 shared species), in the Northeast region of Brazil (Table I and IV).

The richness obtained in the present study is nearly (SILVA *et al.*, 2007; SACKIS & MORAIS, 2008; PEREIRA *et al.*, 2015) or it is bigger (VASCONCELOS *et al.*, 2009; SOARES *et al.*, 2012; BOGIANI *et al.*, 2012) than many of the major urban butterfly inventories in Brazil, conducted with sampling effort and relatively distinct methodologies in the Pampa, Cerrado and Atlantic Forest biomes, and it is much lower in five of the eleven works used for comparison (PINHEIRO *et al.*, 2008; BONFANTTI *et al.*, 2009, 2011; LEMES *et al.*, 2015; MELO *et al.*, 2019); it is observed that less than half of the CSTR species have distribution records for these urban areas, except one, described in Table III. In compensation, most of the recorded species are shared with the available inventories for the Caatinga biome, Semiarid region, carried out in different phytophysiognomies of the ecoregions of Meridional Sertaneja Depression, Borborema Plateau, Chapada Diamantina Complex, Ibiapaba-Araripe Complex and Campo Maior Complex; although they have a considerably larger number of species, because they are more conserved environments and, also, they are outside the urban matrix (Table IV). Moreover, there is a good similarity between the richness and species composition of the CSTR with a more conserved caatinga area, Tamanduá Farm, and very close to the campus, approximately 20 km distance, where the applied collection effort was practically doubled, being that share 76% of all recorded species in both localities, 68 species, with 22 exclusive species to the CSTR and 24 exclusive species to the Tamanduá Farm (FERREIRA-JÚNIOR *et al.*, in prep.).

Table III.— Simple comparison of the richness and composition butterflies at the Health and Rural Technology Center (CSTR) with the main urban butterfly inventories developed with sampling effort and relatively different methodologies and available for Brazil. Legend: FAT = Atlantic Forest, CER = Cerrado, CAA = Caatinga, PAM = Pampa; N = entomological net, T = bait traps.

Work	State	City	Biome	Method	Effort	Richness	Shared species
Present study CSTR	PB	Patos	CAA	N	80 h/net	81 (90)	-
SILVA <i>et al.</i> (2007)	MG	Belo Horizonte	FAT CER	N (T)	72 h/net	83 (91)	33
SACKIS & MORAIS (2008)	RS	Santa Maria	PAM	N	113 h/net	89	26
PINHEIRO <i>et al.</i> (2008)	DF	Brasília	CER	N (T)	-	128 (-)	35
BONFANTTI <i>et al.</i> (2009)	RS	Frederico Westphalen	FAT	N	80 h/net	161	24
VASCONCELOS <i>et al.</i> (2009)	BA	Salvador	FAT	N (T)	144 h/net	55 (70)	26
BONFANTTI <i>et al.</i> (2011)	PR	Curitiba	FAT	N (T)	240 h/net	166 (-)	17
SOARES <i>et al.</i> (2012)	MG	Belo Horizonte	FAT	N (T)	104 h/net	64 (78)	25
BOGIANI <i>et al.</i> (2012)	MS	Campo Grande	CER	N (T)	100 h/net	62 (-)	25
PEREIRA <i>et al.</i> (2015)	PR	Curitiba	FAT	N	120 h/net	85	15
LEMES <i>et al.</i> (2015)	RS	Santa Maria	FAT	N	360 h/net	130	27
MELO <i>et al.</i> (2019)	PE	Recife	FAT	N	464 h/net	273 (288)	58

Many of the butterfly species found in the CSTR are new records for the state of Paraíba and practically all of them can be considered for this locality in the Semiarid portion of the state. Only four species are appointed as new records for the Northeast region, *S. melangon epicaste* Mabille, 1903, *Clito sompa* Evans, 1953, *Lerema ancillaris* (A. Butler, 1877) (Hesperiidae) and *Junonia genoveva infuscata* C. Felder & R. Felder, 1867 (Nymphalidae), based on the other inventories available for Atlantic Forest, Caatinga, Cerrado and Amazon biomes of this geographic region; although types of *C. sompa* and *J. genoveva infuscata* are described for states of this region (LAMAS 2004; WARREN *et al.*, 2013). It is also noteworthy the registration of *Fountainea halice moretta* (H. Druce, 1877), considered an endemic species of the Semiarid region and commonly mentioned for other areas of Caatinga and high altitude wetlands in Northeast (ZACCA & BRAVO, 2012; NOBRE *et al.*, 2008; LIMA & ZACCA, 2014; KERPEL *et al.*, 2014).

Just a single individual of *Mechanitis lysimnia nesaea* Hübner, [1820] (Ithomiini) and *Lycorea halia discreta* Haensch, 1909 (Danaini) was registered, and only two frugivorous species of Satyrinae, *Pharneuptychia phares* (Godart, [1824]) (Satyrini) and *Opsiphanes invirae* (Hübner, [1808]) (Brassolini). The low representativeness of Ithomiini and Satyrini can presumably demonstrate that the richness of these tribes is considered low for the Septentrional Sertaneja Depression and to other specific areas of the Semiarid, due to the high anthropogenic disturbance of the CSTR, as well as adverse microclimatic and vegetative conditions, absence of food resources for adults and immatures, essential to the survival of other representatives of these groups (NOBRE *et al.*, 2008, 2012). There is a strong specificity of occurrence of these groups with the food resources for the Satyrini adults, butterflies restricted to the frugivorous diet, and Solanaceae host plants, almost exclusive for the oviposition of the immatures (coevolution) of Ithomiini (BECCALONI *et al.*, 2008). These taxa or clades between parentheses, specifically Satyrini and Ithomiini, together with other species of Riodinidae, are more common and well distributed in areas of high altitude wetland, Atlantic Forest, Cerrado and Amazon of the Northeast (PALUCH *et al.*, 2011; ZACCA *et al.*, 2011; ZACCA & BRAVO, 2012; LIMA & ZACCA, 2014; KERPEL *et al.*, 2014; PALUCH *et al.*, 2016; RAFAEL *et al.*, 2017; MARTINS *et al.*, 2017).

Table IV.– Simple comparison of the richness and composition butterflies at the Health and Rural Technology Center (CSTR) with available butterfly works developed in the Semiarid region of the Brazilian Northeast. Legend: DSS = Septentrional Sertaneja Depression, DSM = Meridional Sertaneja Depression, PBO = Borborema Plateau, CHD = Chapada Diamantina Complex, CIA = Ibiapaba-Araripe Complex, CCM = Campo Maior Complex; N = entomological net, T = bait traps.

Work	State	Altitude	Caatinga Ecoregion	Effort	Richness	Shared species
Present study CSTR	PB	250 m	DSS	80 h/one collector/N	81 (90)	-
NOBRE <i>et al.</i> (2008)	PE	600-1000 m	PBO e DSM	360 h/one collector/N (T)	121 (15)	63
PALUCH <i>et al.</i> (2011)	PE	840 m	PBO	216 h/two collectors/N (T)	197	55
ZACCA & BRAVO (2012)	BA	480-1290 m	CHD	392 h/one collector/N (T)	169	52
LIMA & ZACCA (2014)	BA	400-1020 m	CHD	97 h/one collector/N (T)	121 (24)	44
KERPEL <i>et al.</i> (2014)	PI, CE, PB, PE e BA	Varied	DSM, PBO, CHD, CIA	N (T)	389	79
RAFAEL <i>et al.</i> (2017)	CE	450-854 m	CIA e CCM	49 h/N (T)	107	42

Only one individual of *Vanessa myrinna* (E. Doubleday, 1849) was registered and apparently not a Nymphalinae resident butterfly, since its occurrence is usually cited in the Atlantic Forest and high altitude wetland from Northeast (ZACCA *et al.*, 2011; PALUCH *et al.*, 2011; KERPEL *et al.*, 2014; MELO *et al.*, 2019), and so far there are no records of their Asteraceae host plants, *Achyrocline* sp. and *Gamochaeta* sp. (BECCALONI *et al.*, 2008), for the study area and surroundings. Also, a single frugivorous individual of Nymphalinae, *H. acheronta*, was captured at

CSTR in the rainy season after the sampling year. According to NOBRE *et al.* (2012), it is a non-resident species, as its larvae feed on *Cecropia* sp. (BECCALONI *et al.*, 2008), characteristic plant of Atlantic Forest and without natural records for the Meridional and Septentrional Sertaneja Depression Ecoregions. Nevertheless, a higher incidence of individuals of this species had been recorded with bait traps for frugivorous butterflies in the Pico do Jabre State Park (S. M. Kerpel, unpublished data), high altitude wetland in the Borborema Plateau Ecoregion and approximately distant 47 km from the CSTR, where there is no record of this host plant genus as well (AGRA *et al.*, 2004). A single individual of *A. megaeles* was also recorded after the sampling period in the rainy season and its host plant species, *Bauhinia forficata* Link (BECCALONI *et al.*, 2008), is registered in the campus (SOUSA *et al.*, 2019).

Although the CSTR is a very altered environment, as its vegetation is composed of abundant invasive ruderal plants, with less diverse fauna compared to more conserved areas, and more species characteristic of open and flexible environments, disturbance tolerants and more generalists (44 species), with lower habitat specificity; their irrigated flower beds provides floral resources in both seasons, maintainers of many characteristic species from the Brazilian northeastern semiarid. Thereby, necessary actions are proposed to stimulate the cultivation of native plants, with potential supply of food resources (fruits and nectar), oviposition (plant tissues) and shelter (shaded places) for the turnover, establishment and maintenance of the lepidopteran guilds and other floral visitors/residentes from this area, as an efficacious management strategy to increment and expand the value of urban and periurban green areas of zones predominantly urban, intermediate and predominantly rural (IBGE, 2017) for conservation of biodiversity, and as a maintenance source of colonizers and pollinators, better ecosystem functionality and faunal connectivity of the Caatinga landscapes, reducing dispersion barriers.

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Table I.– List of butterfly species sampled at the Health and Rural Technology Center (CSTR), Patos, Paraíba, Brazil, between February 2011 and December 2011, except October, and total frequencies. Legend: S = richness, N = abundance, AF = absolute frequency, RF = relative frequency; D = dominance of species, EU = eudominant, DO = dominant, SU = subdominant, RE = recessive, RA = rare; C = species constancy, CON = constant, ACE = accessory, ACI = accidental; RAI = rainy season (Feb-Jun), DRY = dry season (Jul-Dec); species that have been also recorded for at least one of the works described for the biomes and the apostrophe (') means records of different subspecies or just the same species for the 1 = Caatinga (NOBRE *et al.*, 2008; PALUCH *et al.*, 2011; ZACCA & BRAVO, 2012; LIMA & ZACCA, 2014; KERPEL *et al.*, 2014; RAFAEL *et al.*, 2017), 2 = Atlantic Forest (CARDOSO, 1949; KESSELRING & EBERT, 1982; ZACCA *et al.*, 2011; PALUCH *et al.*, 2016; MELO *et al.*, 2019), 3 = Cerrado (EMERY *et al.*, 2006; PINHEIRO & EMERY, 2006; MARTINS *et al.*, 2017), 4 = Amazon (MIELKE *et al.*, 2010; MARTINS *et al.*, 2017; PEREIRA *et al.*, 2018); * = butterfly species out of sampling and with records for the CSTR; ** = new records for the Northeast region of Brazil.

Taxa (S)	AF (N)	RF (%)	D	C	Season		Biomes
					RAI	DRY	
PAPILIONOIDEA (90)							
PAPILIONIDAE (3)							
Papilioninae							
Troidini							
<i>Battus polydamas</i> (Linnaeus, 1758)	1	0.03	RA	ACI		X	1/2/3/4
Papilionini							
<i>Heraclides anchisiades capys</i> (Hübner, [1809])	4	0.1	RA	ACE	X	X	1/2/3/4'
<i>Heraclides thoas brasiliensis</i> (Rothschild & Jordan, 1906)	2	0.1	RA	ACI	X	X	1/2/3/4'
PIERIDAE (14)							
Coliadinae							
<i>Anteos clorinde</i> (Godart, [1824])*							1/2/3
<i>Anteos menippe</i> (Hübner, [1818])	178	7	DO	CON	X	X	1/2/3/4
<i>Eurema albula</i> (Cramer, 1775)	32	1	RE	CON	X	X	1/2/3/4
<i>Eurema arbela gracilis</i> (Avinoff, 1926)	1	0.03	RA	ACI	X		1/3'/4'
<i>Eurema deva</i> (E. Doubleday, 1847)**	2	0.1	RA	ACI		X	2'/3'/4'
<i>Eurema elathea flavescens</i> (Chavannes, 1850)	310	12	EU	CON	X	X	1/2/3'/4'
<i>Phoebis argante</i> (Fabricius, 1775)	1	0.03	RA	ACI	X		1/2/3/4
<i>Phoebis philea</i> (Linnaeus, 1763)	39	1	RE	CON	X	X	1/2/3/4
<i>Phoebis sennae marcellina</i> (Cramer, 1777)	145	6	DO	CON	X	X	1/2/3/4
<i>Pyristia leuce</i> (Boisduval, 1836)	32	1	RE	CON	X	X	1/2/3/4
<i>Pyristia nise tenella</i> (Boisduval, 1836)	105	4	SU	CON	X	X	1/2/3
Pierinae							
Pierini							
<i>Ascia monuste orseis</i> (Godart, 1819)	92	4	SU	CON	X	X	1/2/3
<i>Ganyra phaloe endeis</i> (Godart, 1819)	5	0.2	RA	ACI		X	1
<i>Glutophrissa drusilla</i> (Cramer, 1777)	3	0.1	RA	ACI		X	1/2/4
LYCAENIDAE (11)							
Theclinae							
Eumaeini							
<i>Allosmaitia strophius</i> (Godart, [1824])	1	0.03	RA	ACI	X		1/2/3
<i>Chlorostyrymon simaethis</i> (Drury, 1773)	4	0.1	RA	ACE	X		1
<i>Electrostyrymon endymion</i> (Fabricius, 1775)*							1/2/3
<i>Kisutam sylis</i> (Godman & Salvin, 1887)	2	0.1	RA	ACI	X		1/2/3
<i>Pseudolycaena marsyas</i> (Linnaeus, 1758)*							1/2/3/4
<i>Strymon astiocha</i> (Prittwitz, 1865)	10	0.4	RA	ACE	X	X	1/2/3

<i>Strymon bubastus</i> (Stoll, 1780)	6	0.2	RA	ACE	X	X	1/2/3
<i>Strymon crambusa</i> (Hewitson, 1874)*							1/3
<i>Strymon rufofusca</i> (Hewitson, 1877)	10	0.4	RA	ACE	X		1/2/3
Polyommatainae							
<i>Hemiargus hanno</i> (Stoll, 1790)	198	8	DO	CON	X	X	1/2/3'/4'
<i>Leptotes cassius</i> (Cramer, 1775)	8	0.3	RA	ACE	X	X	1/2/3
RIODINIDAE (1)							
Riodininae							
Nymphidiini							
<i>Aricoris campestris</i> (H. Bates, 1868)	22	1	RA	CON	X	X	1/3/4
NYMPHALIDAE (27)							
Libytheinae							
<i>Libytheana carinenta</i> (Cramer, 1777)	1	0.03	RA	ACI	X		1/2/3'/4
Danainae							
Danaini							
<i>Danaus eresimus plexaure</i> (Godart, 1819)	4	0.1	RA	ACE	X	X	1/2/3/4'
<i>Danaus erippus</i> (Cramer, 1775)	35	1	RE	CON	X	X	1/2/3
<i>Danaus gilippus</i> (Cramer, 1775)	34	1	RE	CON	X	X	1/2/3/4'
<i>Lycorea halia discreta</i> Haensch, 1909	1	0.03	RA	ACI		X	1/2/3/4'
Ithomiini							
<i>Mechanitis lysimnia nesaea</i> Hübner, [1820]	1	0.03	RA	ACI		X	1/2/3'/4'
Heliconiinae							
Argynniini							
<i>Euptoieta hegesia meridiania</i> Stichel, 1938	205	8	DO	CON	X	X	1/2/3/4'
Heliconiini							
<i>Agraulis vanillae maculosa</i> (Stichel, [1908])	26	1	RE	CON	X	X	1/2/3/4'
<i>Eueides isabella dianasa</i> (Hübner, [1806])	7	0.3	RA	ACE	X	X	1/2/3/4'
<i>Heliconius erato phyllis</i> (Fabricius, 1775)	91	4	SU	CON	X	X	1/2/3/4
Biblidinae							
Biblidini							
<i>Biblis hyperia nectanabis</i> (Fruhstorfer, 1909)	21	1	RA	CON	X	X	1/2/3/4'
Catonephelini							
<i>Eunica tatila bellaria</i> Fruhstorfer, 1908	5	0.2	RA	ACI	X	X	1/3/4
Ageroniini							
<i>Hamadryas februa</i> (Hübner, [1823])	113	4	SU	CON	X	X	1/2/3'/4'
<i>Hamadryas feronia</i> (Linnaeus, 1758)	74	3	SU	CON	X	X	1/2/3/4'
Callicorini							
<i>Callicore sorana</i> (Godart, [1824])	32	1	RE	ACE		X	1/2/3
Cyrestinae							
Cyrestini							
<i>Marpesia petreus</i> (Cramer, 1776)	44	2	RE	CON	X	X	1/2'/3'/4'
Nymphalinae							
Coeni							
<i>Historis acheronta</i> (Fabricius, 1775)*							1/2/3/4
Nymphalini							
<i>Vanessa myrinna</i> (Doubleday, 1849)	1	0.03	RA	ACI		X	1/2/3
Victorinini							
<i>Anartia jatrophae</i> (Linnaeus, 1763)	248	10	DO	CON	X	X	1/2/3/4

Junoniini							
<i>Junonia genoveva infusca</i> C. Felder & R. Felder, 1867**	15	1	RA	ACI	X		
Melitaeini							
<i>Anthanassa hermas</i> (Hewitson, 1864)	4	0.1	RA	ACI	X		2/3
<i>Ortilia ithra</i> (Kirby, 1900)	3	0.1	RA	ACI	X		1/2/3
<i>Phystis simois</i> (Hewitson, 1864)	1	0.03	RA	ACI	X		1/3
Charaxinae							
Anaeini							
<i>Fountainea halice moretta</i> (H. Druce, 1877)	10	0.4	RA	ACE	X	X	1/4'
<i>Hypna clytemnestra forbesi</i> Godman & Salvin, 1884	2	0.1	RA	ACI	X		1/2/3'/4'
Satyrinae							
Brassolini							
<i>Opsiphanes invirae</i> (Hübner, [1808])	3	0.1	RA	ACI	X	X	1'/2'/3'/4
Satyrini							
<i>Pharneuptychia phares</i> (Godart, [1824])	6	0.2	RA	ACE	X		1/3/4
HESPERIIDAE (34)							
Eudaminae							
<i>Aguna megaeles</i> (Mabille, 1888)*							1/2
<i>Astraptes anaphus</i> (Cramer, 1777)	17	1	RA	ACE	X	X	1/2
<i>Chioides catillus</i> (Cramer, 1779)	13	1	RA	CON	X	X	1/2/3/4
<i>Cogia calchas</i> (Herrich-Schäffer, 1869)	18	1	RA	CON	X	X	1/2/3
<i>Epargyreus exadeus</i> (Cramer, 1779)	4	0.1	RA	ACI		X	1/2/3
<i>Typhedanus undulatus</i> (Hewitson, 1867)	3	0.1	RA	ACI	X	X	1/2/3
<i>Urbanus dorantes</i> (Stoll, 1790)	26	1	RE	CON	X	X	1/2/3/4
<i>Urbanus procne</i> (Plötz, 1881)	30	1	RE	CON	X	X	1/2/3/4
<i>Urbanus proteus</i> (Linnaeus, 1758)	9	0.3	RA	ACE	X	X	1/2/3/4'
Pyrginae							
Carcharodini							
<i>Staphylus</i> sp.*							1
<i>Staphylus melangon epicaste</i> Mabille, 1903***							3/4'
<i>Nisoniades macarius</i> (Herrich-Schäffer, 1870)	7	0.3	RA	ACE	X	X	1/2/3/4
Erynnini							
<i>Gesta gesta</i> (Herrich-Schäffer, 1863)	7	0.3	RA	ACE	X		1/2/3
<i>Mylon cristata</i> Austin, 2000	1	0.03	RA	ACI	X		2
Pyrgini							
<i>Clito sompa</i> Evans, 1953**	1	0.03	RA	ACI	X		3
<i>Helioptes macaira orbiger</i> (Mabille, 1888)	9	0.3	RA	ACE	X	X	1/3
<i>Helioptes arsalte</i> (Linnaeus, 1758)*							1/2/3/4
<i>Heliopyrgus domicella willi</i> (Plötz, 1884)	44	2	RE	CON	X	X	1
<i>Pyrgus orcus</i> (Stoll, 1780)	60	2	SU	CON	X	X	1/2/3/4
<i>Pyrgus veturius</i> Plötz, 1884	4	0.1	RA	ACE	X		1/2/4
<i>Zopyrion evenor thania</i> Evans, 1953	11	0.4	RA	ACE	X		1/2/3'
Hesperiinae							
Incertae-sedis							
<i>Perichares adela</i> (Hewitson, 1867)	1	0.03	RA	ACI		X	1'/2'/3'
Thymelicini							
<i>Copaeodes jean favor</i> Evans, 1955	4	0.1	RA	ACE		X	1
Calpodini							
<i>Panoquina lucas</i> (Fabricius, 1793)	8	0.3	RA	ACI	X	X	1/2/3'
<i>Synale hylaspes</i> (Stoll, 1781)	1	0.04	RA	ACI		X	1/2/3

BUTTERFLIES DIVERSITY FROM A REMNANT OF SEMIURBAN CAATINGA

Anthoptini							
<i>Synapte malitiosa equa</i> Evans, 1955	4	0.1	RA	ACE	X	X	1/2
Moncini							
<i>Callimormus saturnus</i> (Herrich-Schäffer, 1869)	6	0.2	RA	ACE	X	X	1/3
<i>Cymaenes tripunctus theogenis</i> (Capronnier, 1874)	20	1	RA	ACE	X	X	1/2/3/4
<i>Lerema ancillaris</i> (A. Butler, 1877)**	1	0.03	RA	ACI	X		
<i>Lerodea erythrostictus</i> (Prittwitz, 1868)	4	0.1	RA	ACE	X	X	1/3
<i>Methionopsis ina</i> (Plötz, 1882)	1	0.04	RA	ACI		X	1/3
Hesperiini							
<i>Hylephila phyleus</i> (Drury, 1773)	12	1	RA	CON	X	X	1/2
<i>Quinta cannae</i> (Herrich-Schäffer, 1869)	4	0.1	RA	ACI	X		1/2
<i>Wallengrenia otho clavus</i> (Erichson, [1849])	1	0.03	RA	ACI		X	1/2' /3'
Total	2531	100	81	81	67	61	83/70/74/46