On the Pyraloidea fauna of Nicaragua

Bernard Landry[1*], Yves Basset[2], Paul D. N. Hebert[3], and Jean-Michel Maes[4]

1. Muséum d'histoire naturelle, Malagnou Road 1, 1208 Geneva, Switzerland; 2. ForestGEO, Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancon, Panamá; 3. Centre for Biodiversity Genomics, University of Guelph, Ontario, N1G 2W1, Canada; 4. Museo Entomologico de León, A.P. 527, 21000 León, Nicaragua; *Correspondence: bernard.landry@ville-ge.ch

Date of issue online: 21 December 2020
Electronic copies (ISSN 2575-9256) in PDF format at: http://journals.fcla.edu/troplep; https://zenodo.org; archived by the Institutional Repository at the University of Florida (IR@UF), http://ufdc.ufl.edu/ufir; **DOI**: 10.5281/zenodo.4317575

Abstract: Based on light trap collections made at three sites in 2015 and 2017, the minimum species richness of the Pyraloidea of Nicaragua is evaluated by morphological identifications. Altogether, 477 putative species belonging to 16 subfamilies were recorded. A list of these species is provided, along with illustrations of all Crambinae species. Two thirds of the species belonged to three subfamilies (Spilomelinae - 207; Chrysauginae - 68; Phycitinae - 46). Positioned in the North Central Highlands at 1300 m in the cloud forest, Selva Negra Ecolodge had the highest diversity of the sites sampled, with 154 and 168 species in both 2015 and 2017 respectively. Overall estimates of species richness suggest these three sites support at least 790 species of pyraloids that can be recognized by morphology-based taxonomy and captured at light.

Resumen: La riqueza de especies de Pyraloidea de Nicaragua es evalúada mediante identificaciones morfológicas de especímenes capturados con trampas de luz en tres sitios en 2015 y 2017. En total, se registraron 477 especies putativas pertenecientes a 16 subfamilias. Se proporciona una lista de estas especies junto con ilustraciones de todas las especies de Crambinae. Dos tercios de las especies pertenecían a tres subfamilias (Spilomelinae - 207; Chrysauginae - 68; Phycitinae - 46). Ubicada en las tierras altas del norte central a 1300 m en el bosque nublado, Selva Negra Ecolodge tuvo la mayor diversidad con 154 y 168 especies en 2015 y 2017, respectivamente. Las estimaciones generales de la riqueza de especies sugieren que los tres sitios muestreados soportan al menos 790 especies de Pyraloidea que pueden ser diferenciadas taxonómicamente en base a sus características morfológicas y capturadas con trampas de luz.

Key words: Crambidae, Pyralidae, rarefaction curves, seasonal and ecosystem effects on diversity, species richness

INTRODUCTION

Located between 10.71° - 15.02° north, Nicaragua is the largest country in Central America, with a landmass of 130,967 km^2. It possesses a diverse array of ecosystems in three main geographical regions, i.e. the Pacific lowlands in the west, culminating at about 600 m in elevation and including the two largest lakes in Central America and 40 volcanoes; the North Central Highlands, between 610 and 1,524 meters in elevation and with a longer and wetter rainy season than the Pacific lowlands; and the Caribbean lowlands, covering 57% of the country with a tropical rainforest .

The Lepidoptera of Nicaragua are poorly known (for a summary, see Maes, 2020). Pyraloidea is the fifth most diverse superfamily of Lepidoptera with 16,138 described species worldwide (Nieukerken *et al*., 2011; Nuss *et al*., 2020). Despite this, the Pyraloidea fauna of Nicaragua has rarely been studied, with the exception of a few species of economic importance (e.g. Hruska & Gould, 1997). Maes (2020) lists 68 pyraloid species for the whole country. Only three species of Pyraloidea have been described with Nicaragua as the type locality: *Myelobia nicaraguensis* Landry & Maes in Landry *et al*., 2015 in Crambinae, *Aponia major* Munroe, 1964 in Pyraustinae, and *Schoenobius arimatheella* Schaus, 1922 in Schoenobiinae (Nuss *et al*., 2020).

With the aim of expanding the knowledge of the Pyraloidea of Nicaragua and obtaining material for taxonomic and phylogenetic projects, three localities in Nicaragua were sampled at light in 2015 and 2017. We then used this dataset to estimate the species diversity of Pyraloidea at these three sites and compare our results with data available from other Mesoamerican countries to discuss potential Pyraloidea species diversity in Nicaragua.

MATERIAL AND METHODS

Specimens were collected at three localities (Fig. 1) on the western side of Nicaragua. Surveys were performed in December (2015), at the end of the rainy season, and in June (2017) at the onset of the rainy season. The sites were Refugio Bartola (www.facebook.com/RefugioBartola; N10.97317°, W084.33893°) (Figs. 2, 3), about 50 m above sea level along the San Juan River, Selva Negra Ecolodge (www.selvanegra.com; N13.00036°, W085.90923°) (Fig. 4) at 1300 m in elevation, north of Matagalpa, and the Lost Canyon (lost-canyon.org; N12.70582°, W086.41777°) private reserve at 150 m in elevation (Fig. 5). The collecting sites were selected for convenience, presence of protected habitats, and to sample the three main ecosystems of Nicaragua. In terms of ecoregions as defined by Olson *et al*. (2001), Lost Canyon is in the Central

Figure 1. Map of Nicaragua showing the locations of the three collecting localities: 1- Lost Canyon Nature Reserve; 2- Selva Negra Ecolodge; 3- Refugio Bartola.

Figure 2. Forest along Bartola Creek near Refugio Bartola and junction with San Juan River in 2015.

Figure 3. Forest along Bartola Creek near Refugio Bartola and junction with San Juan River in 2017, showing devastation of forest from Hurricane Otto.

Figure 4. Forest behind reservoir at Selva Negra Ecolodge in 2015.

Figure 5. Thorny vegetation at Lost Canyon in 2017.

American dry forests, Selva Negra in the Central American pine-oak forests, and Refugio Bartola in the San Juan coastal river ecoregion. Selva Negra and Refugio Bartola each included pristine forest habitats. About 18% of the 40 hectare Lost Canyon site was covered by primary forest in 2006 with the rest being pasture, scrub and secondary forest. The pasture was replanted with 7,500 native trees between 2006-2019, and the whole reserve now contains 138 tree species (R. Leonardi, pers. comm.).

Each collecting trip lasted three weeks, with 6, 6 and 5 collecting nights respectively at Lost Canyon, Selva Negra and Refugio Bartola in 2015, and 4, 5, and 6 collecting nights at the same sites in 2017. Collecting was performed with an ultra-violet neon light in 2015 and the Lepiled, made with ultraviolet and other light emitting diodes (Brehm, 2017) in 2017. These lights were placed inside a 2-meter high tower of white gauze. In addition, a mercury-vapor light set in front of a white sheet was used on some nights. Collecting was performed from the onset of darkness until no later than 11:00pm. All of the Pyraloidea species were collected. Specimens were captured in vials of various sizes, depending on moth size, or killed on the spot with ammonia in jars for the larger specimens. The smaller moths were kept alive under cold conditions and pinned and spread immediately after killing with ammonia vapors (Landry & Landry 1994). The exportation of specimens was authorized by the "Dirección de Biodiversidad, Ministerio del Ambiente y Recursos Naturales" of the government of Nicaragua (permit nos. DGPN-DB-016-2015 and DGPN-DB-IC-034-2017). The specimens are deposited in the "Muséum d'histoire naturelle", Geneva, Switzerland (MHNG). The classification of Pyraloidea adopted here follows the phylogenetic results of Regier *et al*. (2012) as well as Léger *et al*. (2019, 2020). Species were identified with the help of the reference collection of New World Pyraloidea at MHNG. In the past 20 years, BL has enhanced the representation and curation of this collection by comparing specimens with type specimens at the Canadian National Collection of Insects (Ottawa, Ontario, Canada), Natural History Museum (London, UK), and National Museum of Natural History (Washington, D.C., USA). This collection was also enhanced directly with the help of experts Eugene Munroe, Herb Neunzig, Alma Solis, Michael Shaffer, and James Hayden, with the use of Vitor Becker's collection (Camacan, Brazil), and with the available literature and information available on the internet (e.g., the Barcode of Life initiative; v4.boldsystems.org). No dissections were performed to identify specimens, except for the Crambinae, for which photos of the type specimens of all New World species, including their dissected genitalia, have been made or requested from the relevant museums by BL over the last 30 years.

It is well known that local observed species richness depends on sampling effort (e.g., the number of individuals collected at light; Colwell *et al*., 2012). One approach to compare species richnesses of different assemblages is to use rarefaction to down-sample the larger samples until they contain the same number of observed individuals as the smallest sample (Hsieh *et al.*, 2016). However, an improved method that prevents discarding data includes the sample-size integration of rarefaction (interpolation) and extrapolation (prediction) of Hill numbers. Hill numbers include the three most widely used species diversity measures: species richness (q = 0), Shannon diversity (q = 1) and Simpson diversity (q = 2; Hsieh *et al.*, 2016). This represents a powerful method for quantifying and comparing species diversity across multiple assemblages (Hsieh *et al*., 2016). We compared species richness (q = 0) among assemblages sampled at study sites and years with unequal sampling effort using the R package "iNEXT" (Hsieh *et al.*, 2016). Raw abundance data of each species collected at a particular study site and year were used to compute species richness estimates and the associated 95% confidence intervals, as well as plot rarefaction and extrapolation curves (methodological details in Hsieh *et al.*, 2016). We extrapolated sampling curves of species richness to about 800 individuals per site and year (i.e. 3-4X the number collected at each site). We also computed an asymptotic estimate of total species richness (with s.e.) for each site and year with iNEXT. Eventually, we pooled all data among sites and years and calculated an asymptotic estimate of species richness that represents an estimate of total species richness at the three sites.

Although it would have been informative to include habitus photos of all species collected, it would not be relevant for most subfamilies, as many species remain unidentified (see Appendix 1). Because the main taxonomic expertise of BL is on Crambinae, most species collected could be identified by morphology and specimens of these are illustrated in Figures 6 and 7. They were photographed with a Leica M205 stereomicroscope, a Leica DFC425 camera, and associated imaging software. The photos were stacked using Zerene Stacker of Zerene Systems LLC and minimally enhanced using Adobe Photoshop Elements. Figures 6 and 7 show the smaller species in Figure 6 and the larger ones in Figure 7. The specimens illustrated were collected in Nicaragua except for those of *Microcrambus psythiella* (Schaus) and *M. pusionellus* (Zeller) (Fig. 6, M and N) because available specimens from Nicaragua for these two species were damaged. Specimens presented without their abdomen were dissected for identifications before photos were shot.

RESULTS

Tables 1 and 2 summarize the species that were collected, while Appendix 1 provides a species list. In total, 477 morphospecies of Pyraloidea were collected (287 in 2015, 350 in 2017). Among these taxa, 32.3% were identified to a species and another 31.4% to genus while the others were only placed to a subfamily. The most diverse subfamilies were Spilomelinae (207 species) followed by Chrysauginae (68 species) and Phycitinae (46 species).

In both years, Selva Negra was the most productive site with 154 and 168 species collected, respectively in 2015 and 2017. Lost Canyon was the least productive site by far. Based on the estimations (Fig. 8, Table 3), Selva Negra would support at least 216 species, Refugio Bartola 188 species, and Lost Canyon 135 species (Table 3). Considering all three sites, the estimated asymptotic total richness was 691 species (Table 3).

The number of species collected at more than one locality was higher in 2015 than 2017 (Table 1) and, in terms of percentages, the Pyraustinae and Spilomelinae had more faunal overlap (20%) than the other subfamilies, with zero overlap in 2017 for the Epipaschiinae and Glaphyriinae.

Excluding those represented by less than 10 species, the subfamilies with the greatest seasonal turnover, were Epipaschiinae as only 11% of its species were collected in both years and Chrysauginae and Phycitinae, each with 22% of their species collected both years. By comparison, the least seasonal subfamilies were the Crambinae (57% of the species collected in both years), the Acentropinae (44%), and the Spilomelinae (38%).

With regard to seasonality and weather, 2015 was dry as expected in December at Lost Canyon, but light rain fell on one evening, an event not observed during the previous 10 years in December (R. Leonardi, pers. comm.). In June 2017, moths

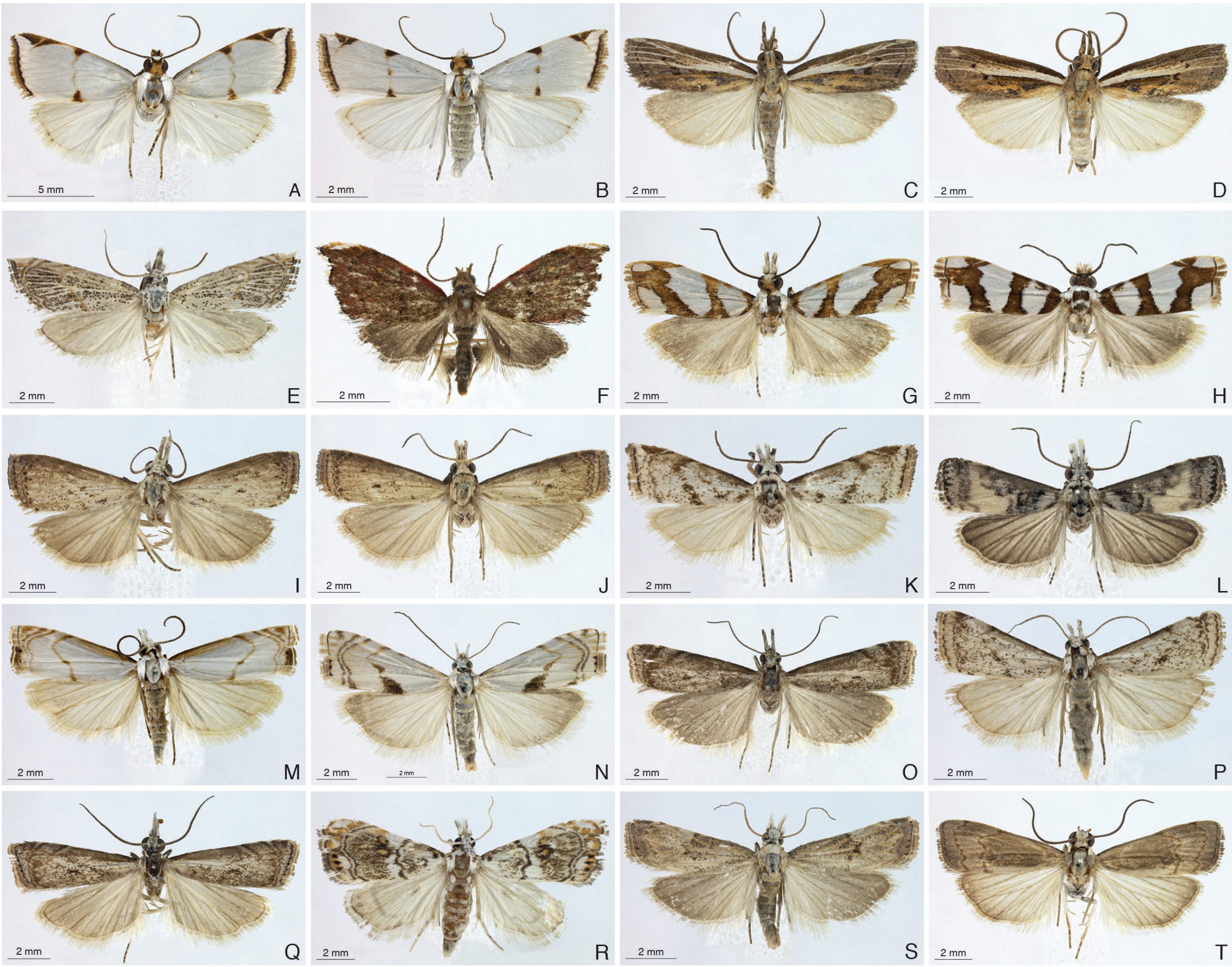

Figure 6. Smaller species of Crambinae collected in Nicaragua in 2015 and 2017, in alphabetical order of genera and species. **A.** *Argyria centrifugens* Dyar, 1914; **B.** *A. lacteella* (Fabricius, 1794); **C.** *Fissicrambus fissiradiellus* (Walker, 1863); **D.** *F. profanellus* (Walker, 1866); **E.** *Haimbachia* cf. *quiriguella* Schaus, 1922; **F.** *Microcausta* sp.; **G.** *Microcrambus* cf. *belliferens* (Dyar, 1914); **H.** *M.* cf. *eucosmella* (Dyar, 1914); **I.** *M. hippuris* Bleszysnski, 1967; **J.** *M.* cf. *holothurion* Bleszysnski, 1967; **K.** *M. jolas* Bleszysnski, 1967; **L.** *M. meretricella* (Schaus, 1913); **M.** *M. psythiella* (Schaus, 1913), specimen from Brazil, Bahia; **N.** *M. pusionellus* (Zeller, 1863), specimen from Ecuador, Pichincha; **O.** *M.* cf. *retuselloides* Bleszysnski, 1967; **P.** *M. strabelos* Bleszysnski, 1967; **Q.** *M. subretusellus* Bleszysnski, 1967; **R.** *Neoeromene* cf. *parvalis* (Walker, 1866); **S.** *Novocrambus propygmaeus* Bleszysnski, 1962; **T.** *Parapediasia tenuistrigatus* (Zeller, 1881), with labial palpi broken.

had mostly disappeared following the onset of the rains in May, when they emerged in abundance at the lights (R. Leonardi, pers. comm.). In 2017, the forest at Refugio Bartola (Fig. 3) showed much damage due to Hurricane Otto that made landfall at peak intensity on the south eastern coast of Nicaragua on November 24, 2016.

DISCUSSION

Total species richness. The collecting method used and the brief collecting time period mean that species will have been overlooked that are not attracted to the lights employed or those that only fly after 11pm, or at different times of the year. Also, although all morphologically distinct species were collected, cryptic species will have been overlooked.

In total, 477 morphospecies of Pyraloidea were collected over 32 nights in Nicaragua in 2015 and 2017 (Appendix 1), seven times more than the 68 species listed in Maes (2020) who focused on species of economic importance. The overlap in species composition between our list and Maes (2020) is uncertain as both only identify many taxa to the genus level. Nevertheless, a close comparison of these lists indicates a combined total of at least 516 species. Noticeably, Maes' (2020) includes species mostly associated with human settlement (e.g. *Corcyra cephalonica* (Stainton, 1865) and *Plodia interpunctella* (Hübner, 1810–1813)) that were not collected in 2015 and 2017. Since the cryptic species will have been overlooked by the methods used, we expect the actual species count to increase by about 10% when all of the specimens are CO1 barcoded.

Based on the number of species estimated for each site (Fig. 8, Table 3) and the low (20% or less) number of species collected at more than one of the collecting sites in each year (Table 1), we estimate there are at least 790 species at the three sites. This is certainly an underestimate of the richness of the

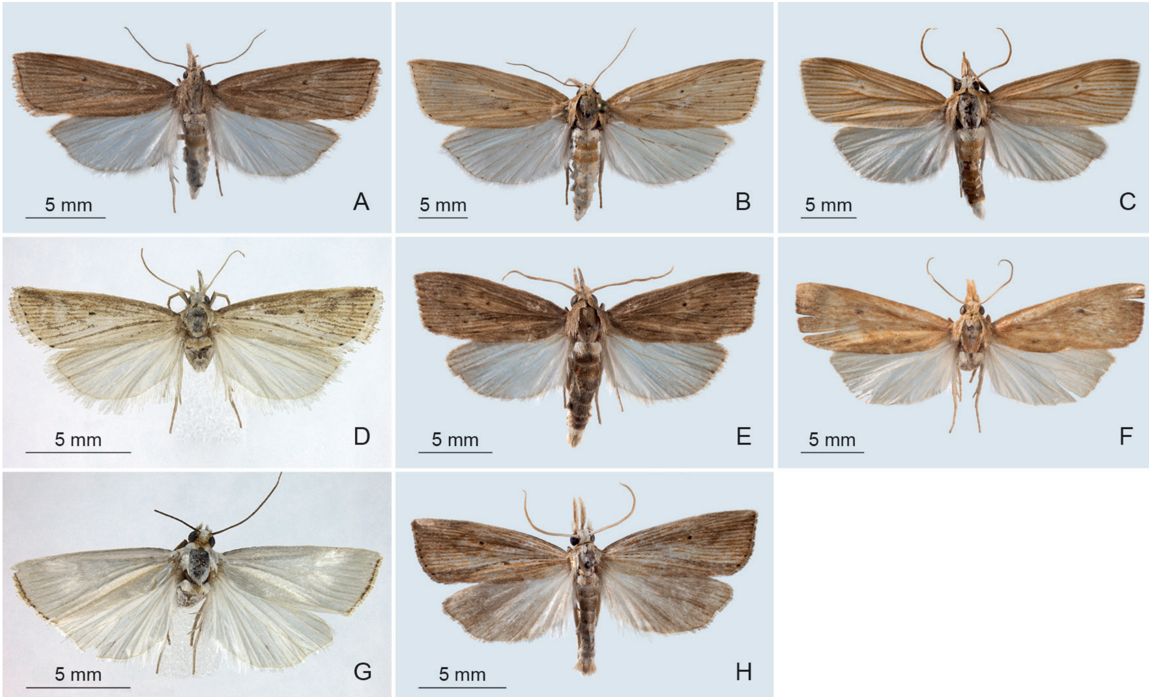

Figure 7. Larger species of Crambinae collected in Nicaragua in 2015 and 2017, in alphabetical order of genera and species. **A.** *Diatraea* cf. *evanescens* Dyar, 1917; **B.** *D. guatemalella* Schaus, 1922; **C.** *D. lineolata* (Walker, 1856); **D.** *D. lisetta* (Dyar, 1909); **E.** *D. tabernella* Dyar, 1911; **F.** *Donacoscaptes* sp.; **G.** *Urola* cf. *fimbrialis* (Dyar, 1914); **H.** *Xubida* sp.

Pyraloidea fauna in Nicaragua as only three sites (albeit in different ecoregions) were surveyed with low sampling effort. However, we can use this figure as a more reliable minimum estimate for the country than the 68 species of Maes (2020).

The Pyraloidea fauna of Nicaragua can be best compared to that of Costa Rica, for which there are considerable data, thanks to the efforts of Daniel H. Janzen, Winnie Hallwachs, their team of parataxonomists, and Lepidoptera taxonomists (mainly Eugene Munroe, Herb Neunzig, and Alma Solis) over many years (Janzen & Hallwachs, 2016). Based on Barcode Index Numbers (see Ratnasingham & Hebert, 2013), there are at least 1880 species of Pyraloidea (1245 Crambidae, 635 Pyralidae) in “Area de Conservacion Guanacaste,” in northwestern Costa Rica alone.

As the surface area (51,100 km^2) of Costa Rica is only 39% of that of Nicaragua, the complete pyraloid fauna of Nicaragua certainly includes many species that await discovery. A more intensive sampling effort, similar to that in ACG, would be essential to obtain a better understanding of pyraloid diversity in Nicaragua. Such effort should survey additional ecosystems such as the pine forests (*Pinus oocarpa* Schiede ex Schltdl.) of Madriz and Nueva Segovia, in the north of the country and culminating at 2000 meters in elevation, the karstic massifs of Kilambe and Peñas Blancas (Department of Jinotega), the northern Atlantic coast in the rain forest lowlands, and the Caribbean slopes and higher elevations (Cerro Saslaya and others). In other insect families, these areas support rare taxa, but they are difficult to access and accommodation is nonexistent for most sites.

In many other groups of better sampled animals Nicaragua include lower recorded numbers of species than Costa Rica. For example, Nicaragua has 193 recorded species of land mammals (Medina-Fitoria & Saldaña Tapia, 2012) compared to 203 for Costa Rica (Wilson, 1983), and 763 bird species (Chavarría-Duriaux *et al.*, 2018) versus ca. 840 (excluding Cocos Island) (Stiles *et al*., 1989). The same is true for the flora, with 5,796 species of plants recorded in Nicaragua (Stevens *et al*., 2001) versus 5,815 species listed in the “Flora de Costa Rica 1937-38”, although the 'higher plant' flora of Costa Rica is thought to include some 8,000 species (Hartshorn, 1991), and is likely to be at least 12,000 species (D.H. Janzen, pers. comm.).

Although Costa Rica has higher peaks, with the highest at 3,819 meters, and is situated to the south of Nicaragua, thus possibly including more species from South America, Nicaragua's larger landmass may partially compensate for these factors, suggesting that the country might even support a richer flora and fauna than Costa Rica, including Pyraloidea. The known species richness of pyraloids in Nicaragua will also likely increase significantly with the widespread application of DNA barcoding studies.

Another comparison is possible with Barro Colorado Island (BCI), a 1500 ha forest island created by damming the Chagres River around 1910 in Panama (Leigh, 1999). The ForestGEO Arthropod Initiative has been monitoring several insect taxa on BCI since 2009 (Lamarre *et al*., 2020). On BCI, 888 trap nights have so far produced 10,431 individuals representing 97 species of Pyralidae and 23,752 individuals representing 348 species of Crambidae (Y. Basset *et al*., unpubl. data). Although 500 species of Pyraloidea may be plausible for BCI, we currently lack estimates of species richness for the whole country of Panama, but this could easily amount to twice or three times as much as the BCI figure.

Table 1. Number of species collected for 16 subfamilies of Pyraloidea in Nicaragua in 2015 and 2017. The species overlap for each year refers to species collected at more than one site, 'double(s)' referring to double overlaps or species collected at the three localities that year.

Pyraloidea	Lost Canyon	Bartola	Selva Negra	Total spp.	Species overlap
Pyralidae					
Chrysauginae 2015	6	14	14	30	4
Chrysauginae 2017	6	27	25	53	5
Epipaschiinae 2015	5	3	7	13	2
Epipaschiinae 2017	6	15	5	26	0
Galleriinae 2015	1	0	2	3	0
Galleriinae 2017	0	0	1	1	0
Phycitinae 2015	10	9	12	29	2
Phycitinae 2017	7	9	12	26	2
Pyralinae 2015	1	1	1	2	1
Pyralinae 2017	1	2	0	2	1
Crambidae					
Acentropinae 2015	6	12	5	20	3
Acentropinae 2017	4	14	4	20	2 (incl. 1 double)
Crambinae 2015	3	13	5	20	1
Crambinae 2017	1	15	10	24	2
Glaphyriinae 2015	3	2	4	8	1
Glaphyriinae 2017	5	7	9	21	0
Lathrotelinae 2015	0	0	0	0	0
Lathrotelinae 2017	0	0	1	1	0
Midilinae 2015	0	1	0	1	0
Midilinae 2017	0	1	0	1	0
Musotiminae 2015	1	2	4	6	1
Musotiminae 2017	1	2	3	6	0
Odontiinae 2015	0	0	1	1	0
Odontiinae 2017	0	0	1	1	0
Pyraustinae 2015	5	0	7	10	2
Pyraustinae 2017	2	2	8	11	1
Schoenobiinae 2015	1	1	0	1	1
Schoenobiinae 2017	0	2	1	3	0
Scopariinae 2015	0	0	2	2	0
Scopariinae 2017	0	1	5	6	0
Spilomelinae 2015	25	56	88	141	25 (incl. 3 doubles)
Spilomelinae 2017	27	59	81	146	19 (incl. 2 doubles)
Undet sfam. 2015	0	0	2	0	0
Undet sfam. 2017	0	0	2	2	0
Totals 2015	67	114	154	287	
Totals 2017	60	152	168	350	

Bordering Nicaragua to the north is Honduras, for which a recent Lepidoptera survey gives a list of 290 species of Pyraloidea (Miller *et al*., 2012). Of particular interest is the record of 27 morphospecies of Acentropinae, compared to the 25 collected in Nicaragua in 2015 and 2017, even though collecting in both countries was performed alongside rivers or creeks.

Diversity at subfamily level. All subfamilies of Pyraloidea represented by Neotropical taxa were collected in Nicaragua during the 2015 and 2017 sampling efforts by BL, except the Linostinae. This subfamily is represented only by one genus (*Linosta* Möschler) and includes four species described from Mexico (Chiapas), Peru, and Suriname (Nuss *et al*., 2020).

Table 2. Numbers of species collected for 16 subfamilies of Pyraloidea at three sites in Nicaragua in 2015 and 2017. Species numbers found twice, in parentheses, refer to species collected in both 2015 and 2017, thus reflecting the effect of seasonality for each subfamily.

Subfamily	Species numbers in total and (found twice)
Chrysauginae	68 (15, or 22%)
Epipaschiinae	35 (4, or 11%)
Galleriinae	3 (1, or 33%)
Phycitinae	46 (10, or 22%)
Pyralinae	4 (1, or 25%)
Acentropinae	25 (11, or 44%)
Crambinae	28 (16, or 57%)
Glaphyriinae	21 (7, or 30%)
Lathrotelinae	2 (0)
Midilinae	1 (1)
Musotiminae	10 (3, or 30%)
Odontiinae	2 (0)
Pyraustinae	16 (5, or 31%)
Schoenobiinae	3 (1, or 33%)
Scopariinae	6 (2, or 33%)
Spilomelinae	207 (78, or 38%)
Total	477 (155, or 32%)

Table 3. Mean asymptotic estimated number of species with s.e. (standard error) and lower (LCL) and upper coefficient limits (UCL) as calculated with iNext for each site and collecting year.

Site	Observed	Estimated	s.e.	LCL	UCL
Bartola2015	83	121.1	15.49	100.7	165.0
Bartola2017	130	187.9	19.73	160.2	240.8
LostCanyon2015	43	74.3	18.89	53.5	136.3
LostCanyon2017	40	135.0	67.86	67.0	374.4
SelvaNegra2015	119	186.8	22.35	155.2	246.2
SelvaNegra2017	142	215.8	22.35	183.3	273.9
All sites	477	691.3	41.4	626.0	790.6

As *Linosta* has been recorded also in Costa Rica (http://www.boldsystems.org, accessed 1 November 2020), it is likely to occur in Nicaragua. The combined number of species collected in 2015 and 2017 in each subfamily would be expected to follow the total number of species described for each subfamily at the Neotropical level (based on Nuss *et al*., 2020), the Spilomelinae being the richest subfamily with 1430 species, followed by the Phycitinae (526 spp.), Crambinae (374 spp.), Chrysauginae (335 spp.), Pyraustinae (261 spp.), Acentropinae (201 spp.), Epipaschiinae (175 spp), Glaphyriinae (160 spp.), Musotiminae (70 spp.), Odontiinae (50 spp.), etc. However, in the combined 2015 and 2017 sample, although the Spilomelinae came first as expected with 207 species collected, the rest of the ranking is lost, with the Chrysauginae in 2nd place with 68 species, followed by the Phycitinae, Epipaschiinae, and Crambinae (see Table 2). This discrepancy likely reflects the limited sampling effort, or that the Nicaraguan fauna evolved within a biogeographical framework that favoured the emergence of a more diverse fauna of Chrysauginae and Epipaschiinae.

Diversity based on site sampled. The overall collecting results at each site suggests a less diverse fauna at Lost Canyon than at Selva Negra, which is confirmed statistically when accounting for unequal sampling effort and comparing the asymptotic estimator of species richness for 2015 vs. 2017 data (Table

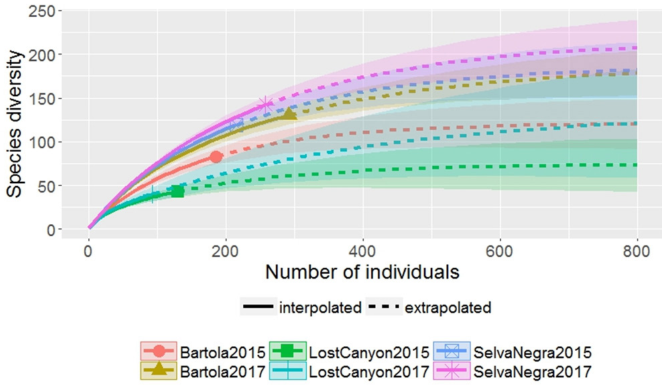

Figure 8. Estimations of species richness of Pyraloidea in Nicaragua based on collecting effort (number of individuals collected) in 2015 and 2017.

3). Insect species richness may be expected to be lower at the seasonally dry Lost Canyon than in more humid localities such as Selva Negra, as observed by Janzen & Schoener (1968). The fact that more species were collected at more than one locality at the end of the rainy season in 2015 than in 2017 (see Table 1) could be related to moths being able to spread and reach a larger area until the end of the rainy season compared to the beginning (2017). The fact that the Pyraustinae and Spilomelinae in 2015 had more species (20%) collected at two or three sites than any other subfamilies, while in 2017 the Epipaschiinae and Glaphyriinae respectively had none of their 26 and 21 species collected at more than one site, may be related to a general pattern of Epipaschiinae and Glaphyriinae using more specific habitats compared to Pyraustinae and Spilomelinae.

Influence of seasonality. Based on the number of species encountered in 2015 and 2017, Pyraloidea collecting was better at the beginning of the rainy season (2017) than at its end (2015), except at Lost Canyon, which produced seven species less in 2017. A peak in the abundance of herbivorous insects is often observed at the onset of the rainy season, coinciding with the flush of new leaves (Wolda, 1978). However, our results should probably be attributed partly to a lower sampling effort at Lost Canyon in 2017 compared to 2015, and possibly because the onset of the rains in May 2017 triggered moth emergences (R. Leonardi, pers. comm.). The high species richness in both years at Selva Negra at 1300 m may reflect the well-known pattern of peak species richness at mid-elevation for several insect groups (e.g., Brehm *et al*., 2007).

FINAL REMARKS

While this study shows that there is an obvious knowledge gap concerning Pyraloidea in Nicaragua, we hope that it will instill a broader interest in these fascinating moths and provide insight into comparisons of the faunas and floras of Mesoamerica in general. Given the development state of Nicaragua, which ranks 137th in gross domestic product per capita as estimated by the United Nations in 2017 (https://en.wikipedia.org/wiki/List_of_countries_by_GDP (nominal)_per capita, accessed 1 November 2020), compared to the 60th rank of Costa Rica, it is clear that most of the citizens of Nicaragua have higher priorities than moth diversity. The iNaturalist (www.inaturalist.org) citizen science platform reflects this in terms of observations of Pyraloidea (Nicaragua: 56 observations, 19 species; Costa Rica: 2,646 observations, 264 species, as of 1 November 2020) and other groups. However, protected areas offer great interest to biodiversity researchers around the world and a program to encourage them to visit Nicaragua in order to increase knowledge would benefit the country. Sampling moths is not difficult nor does it require sophisticated and expensive technology, but a secure facility for the preservation of collected specimens is essential, as is a governmental system for authorizing and managing genomic study throughout the endeavor. Although species determinations in most groups of Neotropical Lepidoptera is challenging, the online publication of images of type specimens of all species-level taxa by museums and resources such as the Barcode of Life initiative (v4.boldsystems.org) and that of the North American Moth Photographers group (http://mothphotographersgroup.msstate.edu/) are very helpful to identify Pyraloidea.

ACKNOWLEDGMENTS

Richard Leonardi and his family, owners of Lost Canyon Nature Reserve, and Orlando Pichardo are gratefully acknowledged for accommodation, guidance, information, field help, and friendly support. The same heartfelt thanks are extended to Sandra Castrillo, Carlos Tablada and their friendly staff at Refugio Bartola for two splendid visits, as well as to the owners and staff of the Selva Negra Ecolodge. We also thank Florence Marteau and Philippe Wagneur of the "Muséum d'histoire naturelle", Geneva, the former for producing the map in Fig. 1 and the two plates of Crambinae moths (Figs. 6, 7), the latter for photographing most of the specimens in Figure 7. BL is also grateful to Alma Solis for her interest in these specimens and for sharing images of holotypes deposited at the National Museum of Natural History, Washington, D.C., U.S.A.. James Hayden, Florida State Collection of Arthropods, Gainesville, Florida, U.S.A., also helped with species determinations. Lastly, we are deeply grateful to Daniel Néron and Félix Lorrain-Landry for help and companionship to BL in the field, to Daniel H. Janzen for the comments that he provided on the pre-submission manuscript, and to manuscript reviewers Alma Solis and James Hayden for their excellent comments.

LITERATURE CITED

Brehm, G. 2017. A new LED lamp for the collection of nocturnal Lepidoptera and a spectral comparison of light-trapping lamps. *Nota Lepidopterologica* 40: 87-108.

Brehm, G., Colwell, R. K., Kluge, J. 2007. The role of environment and mid-domain effect on moth species richness along a tropical elevational gradient. *Global Ecology and Biogeography* 16(2): 205-219.

Chavarría-Duriaux, L. Hille, D. C., Dean, R. 2018. *Birds of Nicaragua; A Field Guide*. Comstock Publishing Associates. 469 pp.

Colwell, R. K., Chao, A., Gotelli, N. J., Lin, S.-Y., Mao, C. X., Chazdon, R. L., Longino, J. T. 2012. Models and estimators linking individual-based and sample-based rarefaction, extrapolation and comparison of assemblages. *Journal of Plant Ecology* 5: 3-21.

Hartshorn, G. S. 1991. *Capitulo 7, Plantas,* pp. 119-354. *In*: Janzen, D. H.

(Ed.), *Historia natural de Costa Rica*. San José, Universidad de Costa Rica.

Hruska, A. J., Gould, F. 1997. Fall armyworm (Lepidoptera: Noctuidae) and *Diatraea lineolata* (Lepidoptera: Pyralidae): Impact of larval population level and temporal occurrence on maize yield in Nicaragua. *Journal of Economic Entomology* 90(2): 611-622.

Hsieh, T. C., Ma, K. H., Chao, A. 2016. iNEXT: An R package for rarefaction and extrapolation of species diversity (Hill numbers). *Methods in Ecology and Evolution* 7: 1451-1456.

Janzen, D. H., Schoener, T. W. 1968. Difference in insect abundance and diversity between wetter and drier sites during a tropical dry season. *Ecology* 49: 96-110.

Janzen, D. H., Hallwachs, W. 2016. DNA barcoding the Lepidoptera inventory of a large complex tropical conserved wildland, Área de Conservación Guanacaste, northwestern Costa Rica. *Genome* 59: 641-660.

Lamarre, G. P. A., Fayle, T. M., Segar, S. T., Laird-Hopkins, B., Nakamura, A., Souto-Vilarós, D., Watanabe, S., Basset, Y. 2020. Monitoring tropical insects in the 21st century. *Advances in Ecological Research* 62: 295-330.

Landry, J.-F., Landry, B. 1994. A technique for setting and mounting Microlepidoptera. *Journal of the Lepidopterists' Society* 48: 205-227.

Landry, B., Maes, J.-M., Passoa, S. C., Léger, T. 2015. Description of a new species of *Myelobia* Herrich-Schäffer (Lepidoptera, Pyralidae s.l., Crambinae) from Nicaragua feeding on cultivated bamboo, *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae). *Journal of Research on the Lepidoptera* 48: 65-81.

Léger, T., Landry, B., Nuss, M. 2019. Phylogeny, character evolution and tribal classification in Crambinae and Scopariinae (Lepidoptera, Crambidae). *Systematic Entomology* 44: 757-776.

Léger, T., Mally, R., Neinhuis, C., Nuss, M. 2020. Refining the phylogeny of Crambidae with complete sampling of subfamilies (Lepidoptera, Pyraloidea). *Zoologica Scripta*. DOI: 10.1111/zsc.12452.

Leigh, E. G. 1999. *Tropical forest ecology: a view from Barro Colorado Island*. Oxford University Press, Oxford.

Maes, J.-M. 2020. *Fauna Entomológica de Nicaragua, Lepidoptera*. http://www.bio-nica.info/Ento/Lepido/lepidoptera.htm (accessed 1 April 2020).

Medina-Fitoria, A., Saldaña Tapia, O. 2012. *Lista patrón de los Mamiferos de Nicaragua. Check-list of the Mammals of Nicaragua*. Managua, FUNDAR. 17 pp.

Miller, J. Y., Matthews, D. L., Warren, A. D., Solis, M. A., Harvey, D. J., Gentili-Poole, P., Lehman, R., Emmel, T. C., Covell, Jr., C. V. 2012. An annotated list of the Lepidoptera of Honduras. *Insecta Mundi* 0205: 1-72.

Munroe, E. G. 1964. Some neotropical genera resembling *Epicorsia* Hübner (Lepidoptera: Pyralidae). *Memoirs of the Entomological Society of Canada* 96 (33): 1-75.

Nieukerken, E. J. van, *et al*. 2011. Lepidoptera, pp. 212–221. *In*: Zhang, Z.-Q., *Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness*. *Zootaxa* 3148.

Nuss, M., Landry, B., Mally, R., Vegliante, F., Tränkner, A., Bauer, F., Hayden, J., Segerer, A., Schouten, R., Li, H., Trofimova, T., Solis, M. A., De Prins, J., Speidel, W. 2020. *Global Information System on Pyraloidea*. www.pyraloidea.org (accessed 01 April 2020).

Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., D'Amico, J. A., Itoua, I., Strand, H. E., Morrison, J. C., Loucks, C. J., Allnutt, T. F., Ricketts, T. H., Kura, Y., Lamoreux, J. F., Wettengel, W. W., Hedao, P., Kassem, K. R. 2001. *Terrestrial ecoregions of the World: A new map of Life on Earth*. *BioScience* 51: 933-938.

Ratnasingham, S., Hebert, P. D. N. 2013. A DNA-based registry for all animal species: the Barcode Index Number (BIN) system. *PloS ONE* 8(8): e66213.

Regier, J. C., Mitter, C., Solis, M. A., Hayden, J. E., Landry, B., Nuss, M., Simonsen, T. J.,Yen, S.-H., Zwick, A., Cummings, M. P. 2012. A molecular phylogeny for the pyraloid moths (Lepidoptera: Pyraloidea) and its implications for higher-level classification. *Systematic Entomology* 37: 635-656.

Schaus, W. 1922. New species of Pyralidae of the subfamily Crambinae from tropical America. *Proceedings of the Entomological Society of Washington* 24: 127-145.

Stevens, W. D., Ulloa Ulloa, C., Pool A., Montiel, O. M. (Eds.). 2001. *Flora de Nicaragua*. St. Louis, Missouri Botanical Garden Press. 3 volumes (xlii, 2666 pp.).

Stiles, F. G., Skutch, A. F, Gardner, D. 1989. *A Guide to the Birds of Costa Rica*. Ithaca, Cornell University. 511 pp.

Wilson, D. E. 1983. *Checklist of mammals*, pp. 443-447. *In*: Janzen, D. H. (Ed.), *Costa Rican Natural History*. Chicago, The University of Chicago Press.

Wolda, H. 1978. Seasonal fluctuations in rainfall, food and abundance of tropical insects. *The Journal of Animal Ecology* 47: 369-381.

Appendix 1. List of the 477 Pyraloidea species collected by B. Landry in Nicaragua in 2015 and 2017.
LC: Lost Canyon; RB: Refugio Bartola; SN: Selva Negra

PYRALIDAE

Chrysauginae

Abaera sp.; SN
Arta sp.; LC & RB
Carcha hersilialis Walker, 1859; SN
Casuaria sp.; SN
Casuaria sp.; RB
Clydonopteron pomponius Druce, 1895; RB
Cryptoses choloepi Dyar, 1908; RB & SN
Dasycnemia sp.; LC & RB
Epidelia damia (Druce, 1889); SN
Galasa sp.; RB
Galasa sp.; RB & SN
Gephyra saturatalis (Walker, 1859); SN
Gephyrella parsimonalis Dyar, 1914; LC & SN
Hyperparachma bursarialis (Walker, 1866); SN
Hypocosmia sp.; RB
Parachma rufoflavalis Hampson, 1906; RB & SN
Paramacna arnea (Cramer, 1775); RB
Salobrena sp.; SN
Streptopalpia minusculalis (Möschler, 1890); LC & SN
Tamyra inclyta (H. Edwards, 1884); SN
Tosale oviplagalis (Walker, 1866); SN
Zanclodes falculalis Ragonot, 1891; RB
Chrysauginae gen. 8 spp.; LC
Chrysauginae gen. 18 spp.; RB
Chrysauginae gen. sp.; RB & SN
Chrysauginae gen. 18 spp.; SN

Epipaschiinae

Cacozelia elegans (Schaus, 1912); LC & RB
Carthara brupta (Zeller, 1881); RB
Deuterollyta basilita (Schaus, 1912); SN
Incarcha aporalis Dyar, 1910; RB
Milgithea suramisa Schaus, 1922; SN
Phidotricha erigens Ragonot, 1889; LC & SN
Pococera cf. *texanella* Ragonot, 1888; RB
Tancoa sp.; SN
Tancoa 2 spp.; RB
Epipaschiinae gen. 6 spp.; LC
Epipaschiinae gen. 12 spp.; RB
Epipaschiinae gen. 7 spp.; SN

Galleriinae

Stenopaschia trichopteris Dyar, 1914; LC
Galleriinae gen. 2 spp.; SN

Phycitinae

Conobathra sp.; RB & SN
Phycitinae gen. 13 spp.; LC
Phycitinae gen. 2 spp.; LC & RB

Appendix 1, continued. List of the 477 Pyraloidea species collected by B. Landry in Nicaragua in 2015 and 2017.
LC: Lost Canyon; RB: Refugio Bartola; SN: Selva Negra

Phycitinae
Phycitinae gen. sp.; LC & SN
Phycitinae gen. 11 spp.; RB
Phycitinae gen. 2 spp.; RB & SN
Phycitinae gen. 16 spp.; SN
Pyralinae
Hypsopygia sp.; LC & RB
Hypsopygia sp.; RB
Hypsopygia sp.; SN
Neodavisia melusina Ferguson, Blanchard & Knudson, 1984; LC
CRAMBIDAE
Acentropinae
Aulacodes sp.; RB
Elophila sp.; LC
Guyanymphula cayennensis Heppner, 2015; RB
Neargyractis sp.; SN
Oligostigmoides cryptalis (Druce, 1896); SN
Oxyelophila 2 spp.; RB
Parapoynx diminutalis Snellen, 1880; LC
Parapoynx seminealis (Walker, 1859); RB
Petrophila sp.; LC
Petrophila 3 spp.; RB
Petrophila 2 spp.; RB & SN
Usingeriessa symphonalis (Dyar, 1914); LC, RB & SN
Acentropinae gen. sp.; LC
Acentropinae gen. sp.; LC & RB
Acentropinae gen. 4 spp.; RB
Acentropinae gen. 3 spp.; SN
Crambinae
Argyria centrifugens Dyar, 1914; SN
Argyria cf. *lacteella* (Fabricius, 1794); RB
Diatraea cf. *evanescens* Dyar, 1917; RB
Diatraea guatemalella Schaus, 1922; RB
Diatraea lineolata (Walker, 1856); LC, RB & SN
Diatraea lisetta (Dyar, 1909); SN
Diatraea tabernella Dyar, 1911; RB
Donacoscaptes sp.; RB
Fissicrambus fissiradiellus (Walker, 1863); LC
Fissicrambus profanellus (Walker, 1866); RB
Haimbachia cf. *quiriguella* Schaus, 1922; LC
Microcausta sp.; RefugioBartola
Microcrambus cf. *belliferens* (Dyar, 1914); RB & SN
Microcrambus cf. *eucosmella* (Dyar, 1914); RB
Microcrambus hippuris Bleszynski, 1967; RB
Microcrambus cf. *holothurion* Bleszynski, 1967; RB
Microcrambus jolas Bleszynski, 1967; RB
Microcrambus meretricella (Schaus, 1913); RB & SN
Microcrambus psythiella (Schaus, 1913); SN
Microcrambus pusionellus (Zeller, 1863); SN
Microcrambus cf. *retuselloides* Bleszynski, 1967; SN
Microcrambus strabelos Bleszynski, 1967; RB
Microcrambus subretusellus Bleszynski, 1967; SN
Neoeromene cf. *parvalis* (Walker, 1866); RB
Novocrambus propygmaeus Bleszynski, 1962; RB
Parapediasia tenuistrigatus (Zeller, 1881); RB
Urola cf. *fimbrialis* (Dyar, 1914); SN
Xubida sp.; SN
Glaphyriinae
Aureopteryx sp.; RB
Dichogama colotha Dyar, 1912; LC
Dicymolomia metalophota (Hampson, 1897); RB & SN
Eupoca bifascialis (Walker, 1863); SN
Eupoca chicalis (Schaus, 1920); RB
Eupoca sp.; SN
Glaphyria spinasingularis Solis & Adamski, 1998; LC
Glaphyria tetraspina Solis & Adamski, 1998; LC
Lipocosma ausonialis (Druce, 1899); SN
Lipocosma calla (Kaye, 1901); LC & RB
Lipocosma sp.; SN
Parambia gnomosynalis Dyar, 1914; RB
Psephis myrmidonalis Guenée, 1854; SN
Pseudoligostigma argyractalis (Schaus, 1912); RB
Pseudoligostigma enareralis (Dyar, 1914); RB
Pseudoligostigma punctissimalis (Dyar, 1914); RB & SN
Schacontia chanesalis (Druce, 1899); SN
Schacontia? sp.; LC
Stegea hermalis (Schaus, 1920); SN
Trischistognatha pyrenealis (Walker, 1859); SN
Glaphyriinae? gen. sp.; LC
Lathrotelinae
Sufetula sp.; RB
Sufetula sp.; SN
Midilinae
Midila guianensis Munroe, 1970; RB
Musotiminae
Neurophyseta clymenalis (Walker, 1859); SN
Neurophyseta sp.; LC & RB
Neurophyseta 2 spp.; RB
Neurophyseta 3 spp.; SN
Undulambia 2 spp.; SN
Musotiminae gen. sp.; LC
Odontiinae
Boeotarcha? *lithocymalis* Dyar, 1916; SN
Cliniodes underwoodi Druce, 1899; SN
Pyraustinae
Anania inclusalis (Walker, 1866); LC & SN
Aponia sp.; SN
Deltobotys sp.; SN
Epicorsia cf. *avilalis* Amsel, 1954; LC
Hanncapsia 2 spp.; SN
Hyalorista sp.; LC, RB & SN
Hyalorista sp.; SN
Neohelvibotys sp.; RB
Portentomorpha xanthialis (Guenée, 1854); SN
Pyrausta cf. *insignitalis* (Guenée, 1854); SN
Pyrausta cf. *panopealis* (Walker, 1859); LC & SN
Pyrausta sp.; LC
Pyrausta sp.; SN
Triuncidia? sp.; SN
Pyraustinae gen. sp.; LC
Pyraustinae? gen. sp.; SN
Schoenobiinae
Leptosteges flavicostella (Fernald, 1887); SN
Leptosteges sp.; RB
Rupela sp.; LC & RB
Scopariinae
Scopariinae gen. sp.; RB
Scopariinae gen. 5 spp.; SN
Spilomelinae
Agathodes designalis Guenée, 1854; RB
Apilocrocis glaucosia (Hampson, 1912); LC & RB
Apogeshna cf. *stenialis* (Guenée, 1854); RB & SN
Anarmodia sp.; SN
Arthromastix pactolalis (Guenée, 1854); SN
Asciodes? sp.; SN
Asturodes fimbriauralis (Guenée, 1854); RB
Ategumia dilecticolor (Dyar, 1912); RB & SN
Ategumia ebulealis (Guenée, 1854); SN
Ategumia sp.; RB
Azochis gripusalis Walker, 1859; SN
Azochis ruscialis (Druce, 1895); RB
Azochis sp.; SN
Blepharomastix ianthealis (Walker, 1859); RB
Blepharomastix sp.; RB
Blepharomastix sp.; SN
Blepharomastix? sp.; SN
Bocchoris darsanalis (Druce, 1895); LC & SN
Bocchoris marucalis (Druce, 1895); RB
Bocchoris placitalis Schaus, 1912; SN
Bocchoropsis pharaxalis (Druce, 1895); LC
Chilochromopsis? sp.; SN
Coenostolopsis apicalis (Lederer, 1863); LC & RB
Compacta hirtalis (Guenée, 1854); RB
Conchylodes cf. *arcifera* Hampson, 1912; LC, RB & SN
Conchylodes nolckenialis (Snellen, 1875); RB
Conchylodes salamisalis Druce, 1895; LC, RB & SN
Conchylodes sp.; SN
Condylorrhiza vestigialis (Guenée, 1854); SN
Desmia albisectalis (Dognin, 1905); LC & SN
Desmia bajulalis (Guenée, 1854); RB & SN
Desmia daedala (Druce, 1895); SN
Desmia odontoplaga Hampson, 1899; RB
Desmia ufeus (Cramer, 1777); LC
Desmia sp.; LC & SN
Desmia 2 spp.; RB
Desmia 2 spp.; RB & SN

Appendix 1, continued. List of the 477 Pyraloidea species collected by B. Landry in Nicaragua in 2015 and 2017.
LC: Lost Canyon; RB: Refugio Bartola; SN: Selva Negra

Spilomelinae
Desmia 5 spp.; SN
Deuterophysa cf. *albilunalis* (Hampson, 1913); RB
Deuterophysa 2 spp.; RB
Deuterophysa 2 spp.; SN
Diacme mopsalis (Walker, 1859); SN
Diacme? sp.; RB & SN
Diaphania cf. *costata* (Fabricius, 1775); LC, RB & SN
Diaphania elegans (Möschler, 1890); SN
Diaphania exclusalis (Walker, 1866); RB
Diaphania cf. *fuscicaudalis* (Möschler, 1881); RB & SN
Diaphania latilimbalis (Guenée, 1854); SN
Diaphania nitidalis (Stoll, 1781); LC & SN
Diaphania terminalis (Maassen, 1890); SN
Diaphania sp.; LC
Diaphania 3 spp.; RB
Diaphania sp.; RB & SN
Diathrausta sp.; LC
Diathrausta sp.; SN
Dichocrocis clystalis Schaus, 1920; RB
Epipagis cf. *fenestralis* (Hübner, 1796); SN
Erilusa croceiceps Walker, 1866; RB
Eulepte cf. *inguinalis* (Guenée, 1854); SN
Eulepte sp.; LC
Eulepte sp.; RB
Eulepte sp.; SN
Eurrhyparodes lygdamis Druce, 1902; LC & SN
Eurrhyparodes splendens Druce, 1895; LC & SN
Glyphodes rubrocinctalis (Guenée, 1854); LC, RB & SN
Glyphodes sibillalis Walker, 1859; SN
Goniorhynchus salaconalis (Druce, 1895); RB
Gonocausta cf. *zephyralis* Lederer, 1863; RB & SN
Herpetogramma bipunctalis (Fabricius, 1794); SN
Herpetogramma phaeopteralis (Guenée, 1854); LC & SN
Herpetogramma 2 spp.; SN
Hileithia cf. *aplicalis* (Guenée, 1854); LC
Hileithia decostalis (Guenée, 1854); RB
Hileithia 2 spp.; LC, RB & SN
Hoterodes ausonia (Cramer, 1777); SN
Hydropionea dentata (Druce, 1895); SN
Hydropionea 2 spp.; SN
Hymenia perspectalis (Hübner, 1796); LC, RB & SN
Lamprosema excurvalis (Hampson, 1912); RB
Lamprosema foviferalis (Hampson, 1912); LC
Lamprosema sp.; LC
Lamprosema 2 spp.; RB
Lamprosema sp.; SN
Leucochroma corope (Stoll, 1781); LC & RB
Leucochromodes cf. *eupharamacis* (Dyar, 1914); RB
Lineodes 2 spp.; SN
Maracaya chlorisalis (Walker, 1859); RB
Marasmia sp.; LC & SN
Marasmia 2 spp.; RB
Maruca vitrata (Fabricius, 1787); RB & SN
Massepha asiusalis (Walker, 1859); RB
Metoeca foedalis (Guenée, 1854); RB
Microphysetica hermeasalis (Walker, 1859); RB & SN
Microthyris anormalis (Guenée, 1854); LC & RB
Microthyris prolongalis (Guenée, 1854); LC, RB & SN
Microthyris sp.; SN
Microthyris? sp.; RB
Mimophobetron pyropsalis (Hampson, 1904); LC & RB
Mimorista trisemalis (Dognin, 1910); RB & SN
Mimorista sp.; RB & SN
Neoleucinodes cf. *torvis* Capps, 1948; RB
Neoleucinodes sp.; RB
Omiodes fulvicauda (Hampson, 1898); RB
Omiodes humeralis Guenée, 1854; RB & SN
Omiodes cf. *insolutalis* Möschler, 1890; SN
Omiodes cf. *martyralis* (Lederer, 1863); SN
Omiodes cf. *ochracea* Gentili & Solis, 1998; RB
Omiodes sp.; LC
Omiodes 2 spp.; RB
Omiodes sp.; RB & SN
Omiodes 2 spp.; SN
Ommatospila narcaeusalis (Walker, 1859); LC
Orphanostigma haemorrhoidalis (Guenée, 1854); RB & SN
Palpita flegia (Cramer, 1777); SN
Palpita quadristigmalis (Guenée, 1854); SN
Palpusia sp.; RB & SN
Pantographa scripturalis (Guenée, 1854); RB & SN
Patania silicalis (Guenée, 1854); SN
Phaedropsis alitemeralis (Dyar, 1914); RB
Phaedropsis fuscicostalis (Hampson, 1895); LC
Phaedropsis sp.; LC
Phaedropsis? sp.; LC
Phostria cf. *albirenalis* (Hampson, 1899); RB
Phostria persiusalis (Walker, 1859); RB
Phostria sp.; RB & SN
Piletocera albicilialis Hampson, 1907; RB
Piletocera? 2 spp.; SN
Pilocrocis cyrisalis (Druce, 1895); RB
Pilocrocis ramentalis Lederer, 1863; SN
Pilocrocis? sp.; SN
Polygrammodes sp.; LC
Prenesta fenestrinalis (Guenée, 1854); SN
Prenesta scyllalis (Walker, 1859); RB & SN
Prenesta sp.; RB
Psara obscuralis (Lederer, 1863); SN
Pycnarmon leucinodialis (Schaus, 1912); SN
Rhectosemia multifarialis Lederer, 1863; SN
Sacculosia isaralis (Felder, Felder & Rogenhofer, 1875); RB & SN
Salbia cassidalis Guenée, 1854; SN
Salbia 5 spp.; SN
Samea castellalis Guenée, 1854; LC, RB & SN
Samea multiplicalis (Guenée, 1854); LC
Samea sp.; LC
Samea? sp.; RB & SN
Samea? 2 spp.; SN
Sathria internitalis (Guenée, 1854); SN
Sisyracera inabsconsalis (Möschler, 1890); SN
Sisyracera subulalis (Guenée, 1854); LC
Spilomela discordens Dyar, 1914; RB
Spilomela pantheralis (Geyer, 1832); RB
Spoladea recurvalis (Fabricius, 1775); RB
Steniodes sp.; LC
Syllepte amando (Cramer, 1779); SN
Syllepte nitidalis (Dognin, 1905); RB
Syllepte sp.; SN
Synclera cf. *jarbusalis* (Walker, 1859); LC & SN
Syngamia florella (Stoll, 1781); LC & SN
Syngamilyta samarialis (Druce, 1889); SN
Trichaea pilicornis Herrich-Schäffer, 1866; RB & SN
Udea 3 spp.; SN
Zenamorpha discophoralis (Hampson, 1899); SN
Spilomelinae gen. 3 spp.; LC
Spilomelinae gen. 7 spp.; RB
Spilomelinae gen. 9 spp.; SN