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NEWS OF THE LEPIDOPTERISTS' SOCIETY

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Inside:

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Contents

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Front Cover:

Top: *Siseme militaris,* Bosque de Shollet, Km12, 2250m, Peru, 06-02-2016; bottom: *Metacharis regalis,* Mishquiyaco near Moyobamba, 950m, Peru, 06-09-2016. Photos by Bill Berthet (see related article, pg. 74).

Unusual 2015 weather affects day-count field data

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Abstract. Frequent day-flying adult Lepidoptera counts have been made at Powell Butte Nature Park since 2005. Occurrence days on 10 species have been tabulated to assess the effects of 2015 weather changes on their first flight days and seasonal flight-days. These occurrence days have been compared to similar days averaged from earlier years. The occurrence day changes are attributed to the unusually hot and dry weather in 2015. Of the 10 different species assessed, results show that in 2015, all 10 of them had significant earlier first flight days when compared to prior years. Five of them had significantly longer seasonal flight-days when compared to prior years. One of the day-flying moths (*Ctenucha rubroscapus*) had slightly shorter 2015 seasonal flight-days when compared to prior years. This is attributed to drought damage to its nectaring source, Tansy Ragwort (*Senecio jacobaea*).

Additional key words: First flight days, Seasonal flight days.

In 2005, Portland, Oregon had an unusually warm and dry January and February, compared with prior years that I had experienced since moving here in December, 1974. In 2005, the delayed rain finally arrived in March, April, and May. I knew that there would be an unusual explosion of butterflies, which I had never seen here before. I selected Powell Butte Nature Park as the best place to observe the expected phenomenon. I was not disappointed. Upon my arrival I noticed that there were large numbers of *Vanessa cardui* Linnaeus, 1758, flying. They were composed of two populations of differing background color shade and nectaring habits. However, they had identical markings. On a subsequent day, I brought my butterfly net to the park to collect samples of both populations to verify my observations. This began the data collection which eventually resulted in this article. For these reasons this article is a retrospective study, and not a prospective study.

On 30 March 2015, Portland's well-known frequent spring and early summer cloud cover disappeared earlier than usual. I unexpectedly saw 31 butterflies distributed among four different species on Powell Butte. My field impression was that these species appeared many days before they were expected, and that perhaps their seasonal flight days would be altered as well. My paper demonstrates 2015 weather effects by comparing that year's day-count data with those from prior years.

Materials and Methods

Survey protocol. Powell Butte Nature Park is located on S.E. Powell Boulevard at S.E. 162nd Avenue in east Multnomah County, has an elevation of 614 feet, and is at latitude 45° 29' 14" N. Although surrounded by suburban neighborhoods, this Park contains 600 acres of vegetation retained in its near natural state. This vegetation consists of a largely grassland butte top surrounded on its flanks by a mixed hardwood and coniferous forest, which intrudes into the grassland along scattered swales. These botanical junction zones provide an ideal habitat for the diverse Lepidoptera which I observed on the Butte. My survey protocol consisted of one pass counting of all species within a 20-foot zone on both sides of park trails and dirt roads, which I surveyed in the same order for each inventory (Fig. 1). In mid-morning, I first visited forest margin park trails and dirt roads with southeastern sun exposure (middle Pipeline Lane and Forest Edge Trail). Next, using my special permission, I visited selected off-trail botanically diverse forest margin grassland swales with southeastern sun exposure (south of southeast Elderberry Trail, and north of northeast Douglas Fir Trail). At mid-day, I visited park trails and dirt roads in the central grassland (Meadowland Lane, Summit Lane, and the grassland part of Hawthorne Trail). I included an off-trail botanically diverse central low ridge within this area using my special permission. In the middle to late afternoon, I visited park trails and dirt roads within forest margins having western sun exposure (west Pipeline Lane, west and southwest Elderberry Trail, and middle Cedar Grove Trail). My protocol is best designated as a linked series of Pollard Walk transects (Royer et al. 1998).

Species selection. I am presenting Tables 1 & 2 to give readers a general overview of the community that occurs on Powell Butte. In Table 1, they are frequency-listed from highest to lowest. In Table 2, they are listed by their order of empirically expected first flight day (FFD). To use the data pool to accomplish the purpose of this paper, it was necessary to limit species to those occurring in usable quantities. Of the 28 species identified, 13 species had sufficient day-count data for comparing 2015 with prior data. Of these species, *Pieris rapae* Linnaeus, 1758 (Pierinae), *Vanessa cardui* Linnaeus, 1758 (Nymphalinae), and *Vanessa atalanta* Linnaeus, 1758 (Nymphalinae) were determined to be migrant visitors from areas away from Powell Butte. These were omitted, leaving 10 species for analysis, 7 butterflies and 3 moths (see Table 4).

Survey dates selection. To compare 2015 FFDs and seasonal flight days with those from prior years as seen in Tables 4 and 5, I restricted the required years to those

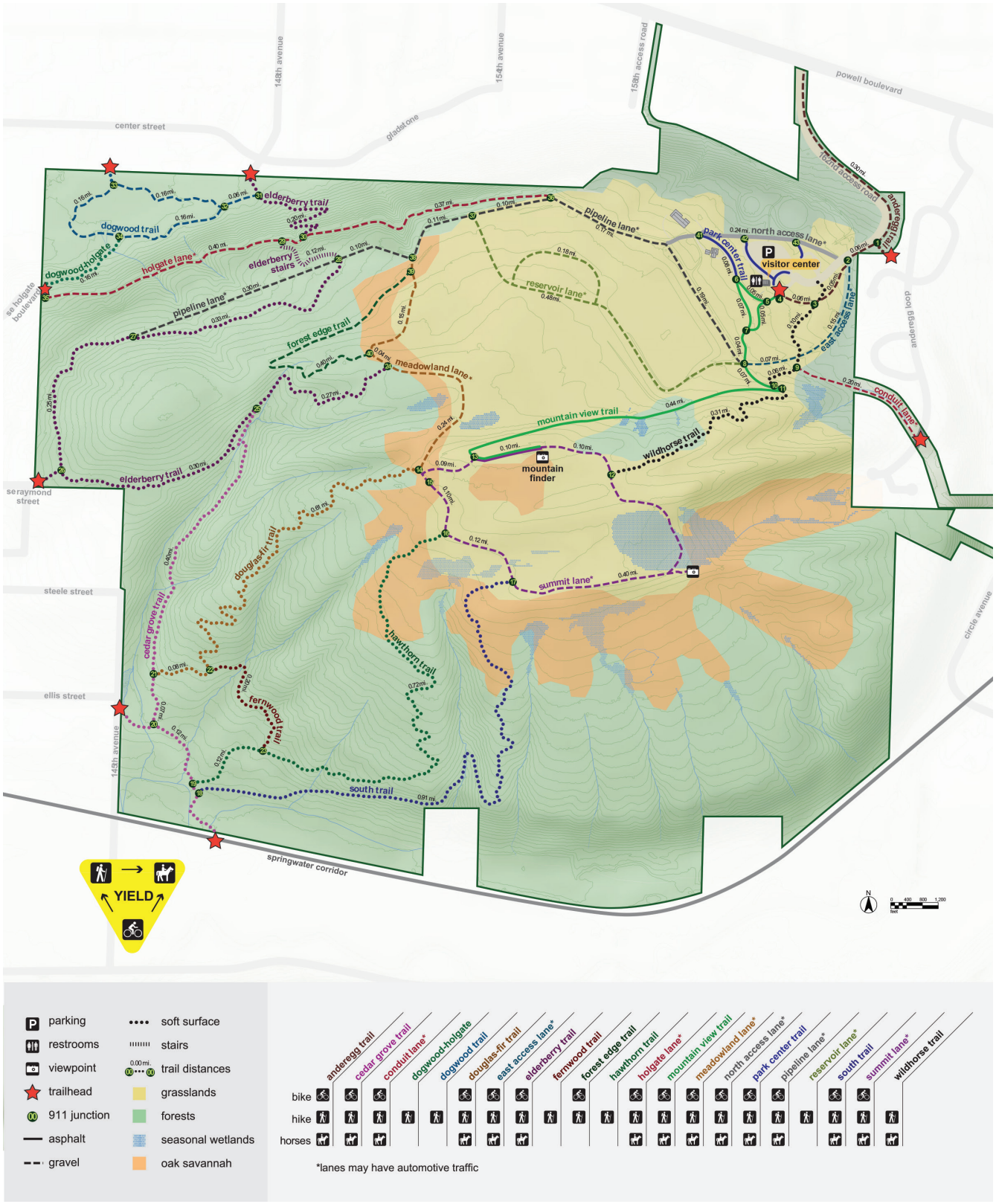

Figure 1. **POWELL BUTTE NATURE PARK -** *Trail Map* **PORTLAND PARKS & RECREATION**

Table 1. Powell Butte Nature Park Lepidoptera Check List Reporter: Dave Specht
Arranged sequentially by total counts summed for all years.

		2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	sum
1	*Coenonympha tullia*	150E	150E	60		289E	147	277	243	228	235	140	1919
2	*Ctenucha rubroscapus (moth)*	6		8	1	17	351E	295	321	187	52	32	1270
3	*Cercyonis pegala incana*	150E		103	150E	183E	159	178	113	92	94	45	1267
4	*Phyciodes mylitta*	50E	106E	75	6	169E	28	112	183	129	108	65	1031
5	*Arctia virginalis (moth)*			13		44	196E	308	59	77	52	109	858
6	*Ochlodes sylvanoides*	10		29		3	3	101	68	96	44	1	355
7	*Vanessa cardui*	150E		8	1			6		25	61	3	354
8	*Vanessa atalanta*	100E	1	11	2	11	7	9	14	13	80	62	310
9	*Tyria jacobaeae (moth)*		4	7		2	16	16	155	37	15	5	257
10	*Polygonia satyrus*	5			3	3	12	14	17	17	35	11	117
11	*Papilio rutulus*	4	8	17		6	19	10	6	11	17	13	111
12	*Celastrina echo*	2	4	19				2	11	10	25	13	86
13	*Pieris rapae*	2		5		11	14	4	6	4	14	11	71
14	*Enchoria lacteata (moth)*									50	9		59
15	*Stamnodes topazata (moth)*									50	4		54
16	*Vanessa annabella*	50E	1										51
17	*Polites sonora*			1		4	3	9	1	2	4		24
18	*Limenitis lorquini*	1	11	7					1	2			22
19	*Colias occidentalis*	4			1				1	1	9		16
20	*Nymphalis californica*		4		7	3							14
21	*Strymon melinus*									2	4	6	12
22	*Euphyes vestris*			2			1	3	1	2	1	1	11
23	*Hesperia juba*											6	6
24	*Cupido comyntas*								2				2
25	*Danaus plexippus*		1					1					2
26	*Nymphalis antiopa*									1			1
27	*Adelpha californica*		1										1
28	*Callophrys gryneus*											1	1

E is estimated assigned countes, small - 50, moderate - 100, large - 150
some years have dates with actual counts added to the assigned estimates

having a full season's day-count data, so that valid average days' occurrences could be calculated. There were 7 prior years having full season day-count data, namely 2005, 2008, 2010, 2011,2012, 2013, and 2014 as marked in the Table 3 footnote. Because butterflies roost in hiding on cloudy days, Portland's frequent cloud cover during March, May, June, and the first half of July limited the choice of days suitable for quantitative surveys. For these reasons the survey intervals varied from every two weeks to monthly. Surveys did not start and end on the same day every year. To compensate for the bias introduced by lack of a standardized initial surveying date, I included and averaged the full season 2015 day-count data with the prior 7 years, and marked it in the Table 3 footnote as an eighth year.

In Portland, the seasonal flight period, in which survey suitable numbers of individual diurnal Lepidoptera occur, is usually April through middle September. The earliest seasonal date which I surveyed was 13 March 2009, and the latest seasonal date which I surveyed was 6 October in 2008 and 2010. Once the frequent cloud cover returns accompanied by a temperature drop in the fall, most diurnal Lepidoptera abruptly disappear. Except for 30 March 2015, the main date of interest for this paper, when I saw 31 butterflies distributed among four different species; my March observations yielded only two small diurnal moths which I saw on 24 March 2014, and one overwintering infrequent butterfly which I saw on 13 March 2009 and 23 March 2010 (see species numbers 14,15, and 20 in Table 1).

Table 2. Powell Butte Nature Park Lepidoptera Check List
Species ordinal first-flight-day by year, followed by all-years ordinal first-flight-day averages (AVG)

Species arranged sequentially by average ordinal day #												AVG
Reporter: Dave Specht												ordinal
	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	day#
Nymphalis californica				72	82							77
Enchoria lacteata (moth)									82	89		86
Stamnodes topazata (moth)									82	89		86
Celastrina echo	172		125				113	121	127	89	139	127
Nymphalis antiopa									127			127
Hesperia juba											139	139
Cupido comyntas								140				140
Tyria jacobaeae (moth)			151		174	154	146	121	127	120	139	142
Vanessa cardui	172		125	198			132		127	89	152	142
Phyciodes mylitta	195		125	198	190	132	132	121	127	89	164	147
Vanessa atalanta	179		165	198	181	139	132	121	127	89	139	147
Coenonympha tullia	172		151		174	154	146	140	141	134	139	150
Polygonia satyrus	172			198	208	160	132	121	127	106	152	153
Polites sonora			193		174	168	162	140	157	120		159
Pieris rapae	188		193		190	132	113	121	179	166	164	161
Papilio rutulus	179	159	178		181	160	158	155	157	148	139	161
Arctia virginalis (moth)			178		174	177	179	155	157	148	152	165
Adelpha californica		165										165
Danaus plexippus		159					187					173
Colias occidentalis	223			198				155	190	106		174
Limenitis lorquini	179	159	178					200	157			175
Vanessa annabella	172	177										175
Ctenucha rubroscapus (moth)	188		182	198	190	196	179	183	179	166	179	184
Euphyes vestris			193			215	187	200	179	181	195	193
Callophrys gryneus											195	195
Cercyonis pegala incana	195		206	198	208	203	207	200	190	181	195	198
Strymon melinus									219	181	195	198
Ochlodes sylvanoides	230		223		217	215	207	231		196	211	216

For weather-related tabular data assessment in this paper, I treated 30 March 2015 survey data as if they occurred in April, being only two days earlier. On the single 6 October survey date, I only saw 7 butterflies distributed among 3 species in 2010 (see species numbers 1,4, and 13 in Table 1), and only 2 butterflies representing 2 species in 2008 (see species numbers 10 and 19 in Table 1). I treated species number 10 as an outlier for this date. Because 6 October is only six days beyond September, these data are allocated to September for weather-related tabular data assessment.

Data processing. The occurrence dates I selected, as described in the preceding section, formed an eight year control cohort for which I calculated full season average first flight days (FFDs) for each of the 10 control cohort species. I facilitated the averaging by using internet charts to convert calendar days to day-number-of-the-year days (Calendar-365[2018]) hereafter designated as ordinal days (Cayton et al. 2015). During this conversion, leap years were taken into account. I used Microsoft Corporation's Excel spreadsheet program (Microsoft Office 2010) to array the 10 control cohort species, and their FFDs by year as follows: I placed the 10 species horizontally across the top margin, and full season years vertically along the left margin. Then, I entered the ordinal FFD in the matrix columns formed by the 10 top margin species headings and left margin years. At the bottom of the columns, I sequentially installed Excel's formulas for calculating the eight

Table 3. Powell Butte Lepidoptera Survey Dates Arranged by Survey Years

Reporter: Dave Specht

2005**	2006	2007	2008**	2009	2010**	2011**	2012**	2013**	2014**	2015**	2016
6-21	No	4 early*	5-4	3-13	3-23	5-12	4-22	5-1	3-24	3-30	5-18
6-28	Surveys	4 late*	5-14	7-17	6-22	5-19	5-11	5-20	5-7	4-16	5-31
7-7		5 early*	5-15		6-23	6-3	5-25	6-4	5-21	4-30	6-12
7-14		5 late*	5-27		6-30	6-9	6-6	6-28	6-6	5-14	6-27
7-23		6-8	5-30		7-9	6-17	6-10	7-2	6-23	5-28	7-13
8-11		6-14	6-8		7-27	6-26	6-27	7-19	6-28	6-15	7-29
8-18		6-26	6-13		8-5	7-13	7-2	8-19	7-9	6-30	8-15
8-25			6-26		9-13	7-15	7-5	9-1	7-25	7-15	
9-1			6-30		10-6	7-22	7-23		8-7	7-28	
9-8			7-11			8-3	7-25		8-27	8-12	
9-15			7-24				8-24		9-10	8-26	
9-22			8-10							9-10	
			8-29							9-23	
			10-6							9-24	

*date day not recorded **full seasons selected for Paper's Purpose

Table 4. Comparison of 2015 First-Flight Days to Prior Years' First-Flight Day Averages

Species arranged sucessively by average expected date. Reporter: Dave Specht

	2015 Observed Day		Average Expected Day			
Species	Calendar Date	2015 Ordinal Date	Prior Years' Average* Calendar Date**	Prior Years' Average* Ordinal Date>>>	<<< SD	2015 Deviation from Average Days**
Celastrina echo	March 30	89	May 5	124.5	27.1	-36
Polygonia satyrus	April 16	106	May 16	136.3	24.9	-30
Tyria jacobaeae (moth)	AprilL 30	120	May 17	136.5	15.6	-17
Phyciodes mylitta	March 30	89	May 19	138.9	35.9	-50
Coenonympha tullia	May 14	134	May 31	151.4	14.7	-17
Papilio rutulus	May 28	148	June 15	165.5	12.4	-18
Arctia virginalis (moth)	May 28	148	June 16	166.9	13.0	-19
Ctenucha rubroscapus (moth)	June 15	166	July 2	182.9	9.0	-17
Cercyonis pegala incana	June 30	181	July 14	195.0	11.9	-14
Ochlodes sylvanoides	July 15	196	August 4	215.7	13.2	-20

*all full seasons: 2005, 2008, 2010, 2011, 2012, 2013, 2014, 2015
**nearest full day

year average FFD for each of the 10 species followed by their Standard Deviations (SDs). These formulas contain not only mathematical operators, but also matrix cell addresses. In Table 4, I subtracted the average FFD for each of the 10 control cohort species from their respective 2015 FFDs to obtain their 2015 deviations, where a (-) value indicates earlier appearance in 2015. The SD for the FFD for each of the 10 control cohort species appears in Table 4 to the left of its respective 2015 species deviations from the control cohort. If the 2015 deviation numerical value is larger than the corresponding control cohort SD value, the 2015 deviation value is significant. Fig. 2 graphs each year's FFD deviations for each of the 10 species from each of their average values, seen along the zero central line, but numerically displayed at the top with the species names. In order to perform seasonal flight-days calculations, I used the same days-count data base, to collect last appearance days for both 2015 and the prior eight year control cohort for the same 10 species. I arrayed these last occurrence days for the 10 species in a second Microsoft Excel spreadsheet designed exactly like the first occurrence spreadsheet. In a third spreadsheet of the same design, I installed Microsoft's subtraction formulas in the cells with addresses which accessed the last and first day appearances in the second and first spreadsheets respectively, to obtain the full seasonal flight days. These data appear in Table 5. Then in Table 5, I subtracted the 8 year average prior full seasonal flight-days for each of the10 species from each of their respective 2015 seasonal flight-days. I obtained flight-days' changes, where (-) values were shorter seasonal flight-days and (+) values were longer seasonal flight-days than the average seasonal flight-days for each species. I also calculated the Standard Deviation (SD) for each of the 10 control cohort species

Average first		*Cl.ec*	*Pl.st*	*Ty.jc*	*Ph.my*	*Cn.tl*	*Pp.rt*	*Ar.vr*	*Ct.rb*	*Cr.pg*	*Oc.sy*
appearance day# >>		124.5	136.3	136.5	138.9	151.4	165.5	166.9	182.9	195.0	215.7
Deviations >	2015	-35.5	-30.3	-16.5	-49.9	-17.4	-17.5	-18.9	-16.9	-14.0	-19.7
	2014	2.5	-9.3	-9.5	-11.9	-10.4	-0.5	-9.9	-3.9	-5.0	-9.7
	2013	-3.5	-15.3	-15.5	-17.9	-11.4	-10.5	-11.9	0.1	5.0	15.3
	2012	-11.5	-4.3	9.5	-6.9	-5.4	-7.5	12.1	-3.9	12.0	-8.7
	2011		23.7	17.5	-6.9	1.6	-5.5	10.1	13.1	8.0	
	2010				51.1	22.6	15.5	7.1	7.1	13.0	1.3
	2008	0.5		14.5	-13.9	-0.4	12.5	11.1	-0.9	-19.0	7.3
	2005	47.5	35.7		56.1	20.6	13.5		5.1	0.0	14.3

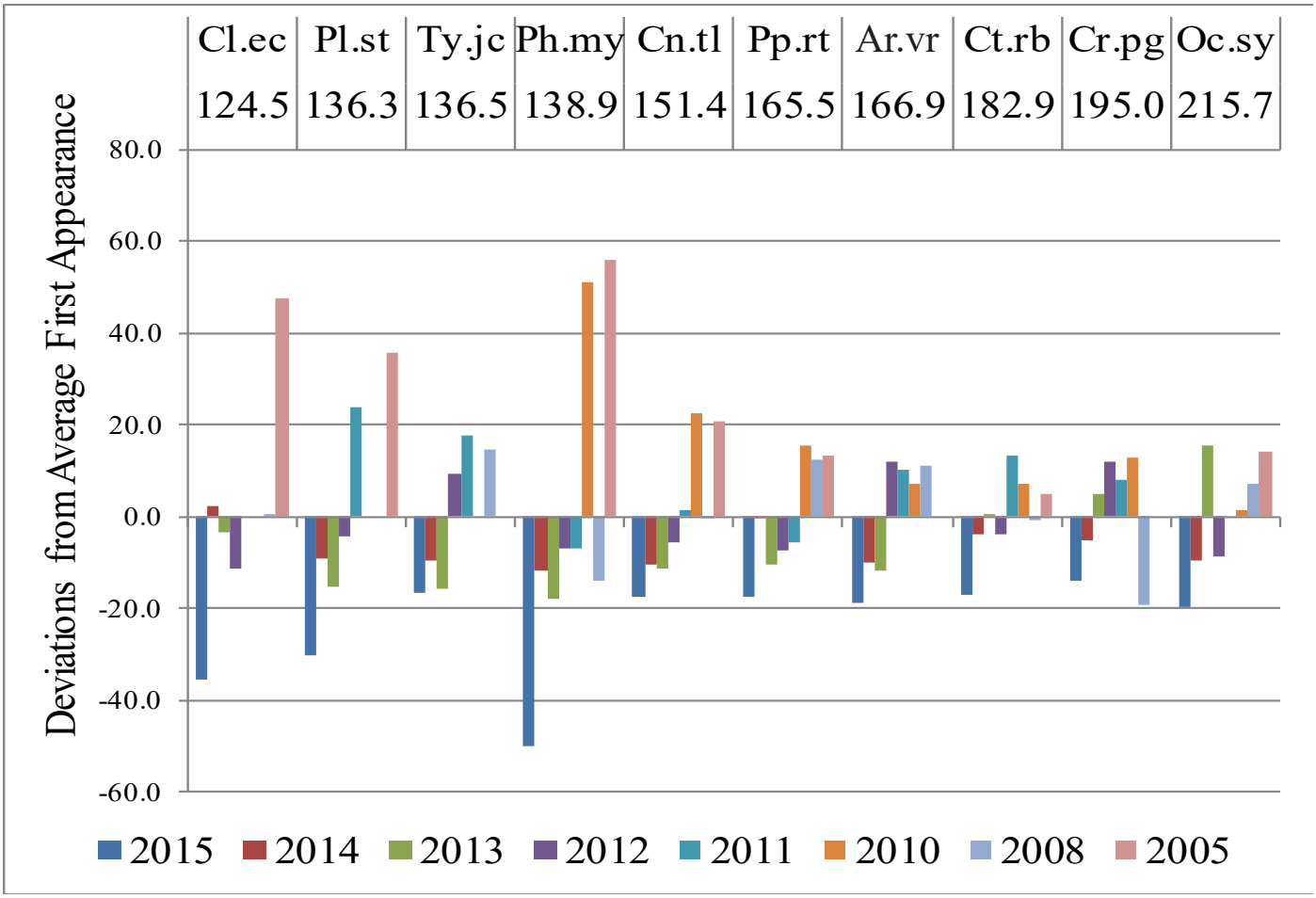

Figure 2. Species Array of Yearly First Appearance Deviations from Their All-Year Averages. Analyzer: David Specht. Legend: Cl.ec, *Celastrina echo;* Pl.st, *Polygonia satyrus;* Ty.jc, *Tyria jacobeae;* Ph.my, *Phyciodes mylitta;* Cn.tl, *Coenonympha tullia;* Pp.rt, *Papilio rutulus;* Ar.vr, *Arctia virginalis;* Ct.rb, *Ctenucha rubroscapus;* Cr.pg, *Cercyonis pegala;* Oc.sy, *Ochlodes sylvanoides.*

seasonal flight-days, which appear to the right of the 10 control cohort species seasonal flight-days, and also to the left of the 2015 seasonal flight-days' respective changes. If the numerical value of a 2015 seasonal flight-days' change is larger than the numerical value of its respective species SD in the seasonal flight-days' cohort, it is significant.

Weather data collection. Using the National Climate Data Center/National Oceanic and Atmospheric Administration Website, and selecting "Data Access" (National Climate Data Center 2017), I operated their 32 step program to collect monthly temperature and rainfall tables for 2004 through 2015. For the zip code in which Powell Butte is located, two weather stations were displayed as options, the Portland Weather Forecast Office and the Portland Troutdale Airport. Since these stations are equidistant west and east of Powell Butte, the data entries from both stations were averaged to more accurately estimate weather conditions at Powell Butte itself (see Table 6). In the top one third of the table, I have averaged the 2015

Table 5. Comparison of 2015 with Prior Years Flight Days Using Last and First Day of the Year Appearances Reporter: Dave Specht

Species	2015 Observed Last Appearance Ordinal day	2015 Flight Days Observed Last -First** Appearance Days	Average* Prior Years' Expected Last Appearance Ordinal day	Average* Prior Years' Flight Days Expected Last -First** Appearance Days>>>	<<< SD	2015 Flight Days Observed minus Average* Prior Years' Flight Days Expected Yields Flight Days Change
Celastrina echo	196	107	179.3	54.8	33.8	52.2
Polygonia satyrus	224	118	213.8	77.5	26.2	40.5
Tyria jacobaeae (moth)	166	46	179.3	42.8	16.1	3.2
Phyciodes mylitta	267	178	250.3	111.4	33.5	66.6
Coenonympha tullia	267	133	250.3	98.9	20.4	34.1
Papilio rutulus	209	61	211.0	45.5	17.8	15.5
Arctia virginalis (moth)	166	18	183.6	16.7	7.5	1.3
Ctenucha rubroscapus (moth)	196	30	214.3	31.4	14.5	-1.4
Cercyonis pegala incana	253	72	245.6	50.6	21.3	21.4
Ochlodes sylvanoides	238	42	244.9	29.1	10.4	12.9

*all full seasons: 2005, 2008, 2010, 2011, 2012, 2013, 2014, 2015
**from Table 4

diapause months' temperatures. Then I have averaged the 2014 through 2010 plus 2008 and 2005 diapause months' temperatures, and calculated their SDs. Similarly, I have averaged the 2015 flight-months' temperatures. Then I have averaged the 2014 through 2010 plus 2008 and 2005 flight months' temperatures, and calculated their SDs. In addition, I have totaled the 2015 flight months' rainfall. Then I have totaled the 2014 through 2010 plus 2008 and 2005 flight months' rainfall, and divided by seven to obtain the average total flight months' rainfall. In the bottom two thirds of the table, I have match color-coded the six groups of monthly data that were used to generate the over-all average temperatures (4 groups), and total flight months' rainfall (2 groups) seen in Table 6 at the top.

Results

In the last column of table 4, I compare the 2015 first-flight-day (FFD) with the average FFD for each of the 10 species selected for their indigenous occurrence. You can see that all of the species assessed have negative deviations. This demonstrates an earlier FFD for each of them in 2015 compared with their average prior years' control cohort FFDs, despite including the 2015 FFDs in the prior years' control cohort. These 2015 FFDs ranged from 14-50 days earlier than the average FFDs of the prior years' control cohort for each of the same species. For each of these species, the numerical value of their 2015 FFD deviations exceeds the prior years' control cohort average FFDs' standard deviations (SDs) by 1.1 to 1.9 times. In the last column of table 5, I compare the 2015 seasonal flight-days with the average seasonal flight-days for the 10 selected species. You can see that there is an increase in the seasonal flight-days for 9 of 10 species, despite including the 2015 seasonal flight-days in the prior years' control cohort. However, the increase is more than the SD of the prior years' control cohort for only 5 of the 10 species. These are *Celastrina echo* Linnaeus, 1780 (Polyommatinae), *Polygonia satyrus* WH Edwards, 1869 (Nymphalinae), *Phyciodes mylitta* W.H. Edwards, 1861 (Nymphalinae), *Coenonympha tullia* Muller, 1764 (Satyrinae), and *Ochlodes sylvanoides* Boisduval,1852 (Hesperiinae). For these species the seasonal flight-days in rounded figures were 52, 41, 67, 34, and 13 days respectively; and correspondingly the increases were 1.5, 1.5, 2.0, 1.7, and 1.2 times greater than the SDs of their respective prior years' control cohort seasonal flight-days. You can also see that *Ctenucha rubroscapus* Menetries, 1857 (Arctiinae) shows the only flight-days decrease. Its numerical value, rounded to the day, was one day less than the prior year's control cohort, or 0.1 times its flight-days' SD for this species.

In Table 6, I compare the 2015 average diapause months' temperature with the 2014 through 2010 plus 2008 and 2005 average diapause months' temperature. There is a 4.0 ^{0}F rise in 2015, which is 0.4 ^{o}F more than the prior years' SD of 3.6 ^{o}F. In Table 6, there is also a 3.0 ^{0}F rise in the 2015 average seasonal flight months' temperature, which is less than the prior years' SD of 6.8^{o}F. Also in Table 6, there is a 6.69" shortfall in 2015 seasonal flight months' total rainfall compared with the 2014 through 2010 plus 2008 and 2005 seasonal flight months' average total rainfall. This is more than 2 SD (6.10) less than the expected rainfall.

Table 6. Past Weather Data from N.O.A.A. Web-Site for Portland, OR. (2 station avgs)

Comparison of monthly averages: 2015 with 2014 to 2010+ 2008 & 2005. Analyzer-Dave Specht

2015	Average Diapause Temperature°F -- months color coded	49.2
2014 to 2010+	Average Diapause Temperature°F -- months color coded	45.2
2008 & 2005	Standard Deviation	3.60
2015	Average Flight-time Temperature°F--months color coded	65.2
2014 to 2010+	Average Flight-time Temperature°F--months color coded	62.2
2008 & 2005	Standard Deviation	6.8
2015	Total Flight-time Rainfall inches--months color coded	6.51
2014 to 2010+	Average Total Flight-time Rainfall inches--months color coded	13.20
2008 & 2005	Yearly Standard Deviation	3.05

Monthly Data Log>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	Temperatures°F			monthly averages								
	44.3	49.5	52.5	52.6	60.6	69.7	73.7	71.6	62.7	59.8	45.5	42.8
2014 through 2004	Temperatures°F			monthly averages								
2014	41.7	40.0	49.1	53.9	61.1	63.4	71.7	72.6	67.2	59.5	46.0	43.6
2013	37.7	44.1	48.8	52.5	59.3	65.3	69.7	70.8	64.7	53.1	46.6	36.7
2012	40.5	42.9	44.4	52.8	57.2	60.4	67.2	70.2	64.6	55.5	48.1	42.5
2011	41.2	40.0	45.6	47.6	53.7	61.1	65.7	68.6	66.4	54.8	44.6	38.7
2010	44.5	46.6	48.3	50.8	55.1	60.4	67.2	67.6	63.8	55.1	44.5	41.5
2009	39.2	41.6	44.3	51.1	58.7	64.1	72.2	68.8	65.0	53.5	46.7	35.6
2008	37.9	44.5	44.5	47.7	57.9	60.6	67.6	68.7	63.5	53.2	48.8	36.5
2007	37.6	43.7	49.4	51.4	57.8	62.0	70.3	67.4	61.5	52.3	45.0	40.4
2006	45.2	42.0	46.1	53.0	58.5	65.2	69.7	67.4	64.1	52.7	46.4	39.4
2005	41.5	44.0	50.2	52.1	60.0	60.9	69.3	69.7	61.1	56.0	44.5	39.0
2004	37.8	44.6	50.8	55.4	59.0	64.8	70.9	70.8	62.4	55.7	45.8	43.5
2015	Rainfall inches			monthly totals								
	3.21	3.54	4.86	2.12	0.78	0.62	0.62	1.09	1.28	4.63	4.82	13.80
2014 through 2004	Rainfall inches											
	Rainfall inches			monthly totals								
2014	3.10	4.31	6.39	3.80	2.93	2.43	1.07	0.09	0.98	6.74	3.67	5.43
2013	3.91	1.40	1.88	3.17	4.90	1.97	0.00	0.50	5.18	1.62	3.62	2.22
2012	7.02	3.43	8.49	3.77	3.52	4.77	0.42	0.01	0.07	7.03	8.35	6.89
2011	4.30	4.74	7.67	5.00	3.86	1.03	1.08	0.08	1.01	2.85	6.11	2.86
2010	5.81	3.30	4.52	3.47	4.13	5.23	0.26	0.46	2.63	5.11	7.74	8.62
2009	5.17	1.65	4.72	3.42	3.84	1.49	0.39	0.68	1.43	3.73	5.67	4.45
2008	6.46	3.00	4.42	2.99	1.92	1.29	0.26	1.17	0.55	1.94	6.26	2.82
2007	3.80	5.18	5.25	2.85	1.53	1.4	0.49	0.6	1.91	3.84	5.31	9.82
2006	11.48	2.82	3.34	3.55	2.56	1.12	0.22	0.09	1.4	2.05	14.24	6.41
2005	2.49	1.46	4.39	4.7	5.04	3.36	0.71	1.21	1.35	4.76	5.54	8.95
2004	6.62	4.93	2.24	1.28	2.34	1.67	0.19	3.34	1.79	4.71	2.91	4.68

Discussion

The analyzed data demonstrate that my field impression is true: adult Lepidoptera appeared earlier in 2015 at Powell Butte than in prior years. The 2015 earlier appearance is statistically significant for all of the 10 species analyzed. In addition, the analyzed data show that 2015 seasonal flight-days were statistically significantly longer in 5 of 10 species, mildly prolonged in 4 of the 10 species, and minimally decreased in the diurnal moth *Ctenucha rubroscapus*. Although the flight-days shortening of *Ctenucha rubroscapus* is not significant by statistical criteria, it may be significant for the biologic reason which follows: In 2015, I noticed for the first time ever, that the *Senecio jacobaea* (Tansy Ragwort; Asteraceae) blossom clusters on which I have regularly seen *Ctenucha rubroscapus* nectaring in large numbers previously (see Fig. 3), were severely wilted due to the drought. The *Ctenucha rubroscapus* were not nectaring on the damaged blossoms. This could be the cause of their shortened flight-days this year. This is likely correlated with one of the main 2015 weather changes seen in Table 6, namely the 6.69 inch shortfall in flight-months' rain. The minimal flight-days decrease in this species, compared with the increases seen in 9 of the others, may indicate relative suffering of it in 2015. All these 2015 changes are most likely due to increased temperatures during the October 2014 through March 2015 diapause and the 2015 April through September flight time, as well as the shortfall in flight-months rainfall. Although the changes in temperature seem small, they are average temperatures, and it is well known that small changes in average temperatures can lead to large changes in the biosphere.

Using regression analysis of 31 years of both date-of-first-flight (DFF) butterfly survey data and temperature data derived from the lands adjacent to University of California at Davis in the central valley of the state, Forister & Shapiro (2003) generated sloping graph lines from which they could read progressively earlier DFFs and increasing temperatures. They found that 16 species (70%) of their butterfly fauna had shifted to earlier DFFs during the 31 year period. To illustrate their findings they used 4 species where shifts of 27,28,19, and 20 days (rounded) had occurred over 31 years. This calculates to 0.87, 0.9, 0.61, and 0.65 days per year, respectively. During the 31 years their nearby weather station reported increases in both maximum and minimum temperatures. For comparison purposes with my data, I have converted their temperatures to average and Fahrenheit. Over 31 years their average temperature change was 2.0 °F. This calculates to 0.065 °F per year. These are all small changes compared with the 2015 changes which I have documented for Powell Butte in Portland, Oregon. The differences are easily explained by taking into account the well known stability of the climate in the central valley of California, which makes it a world class site for stone fruit production. The small changes reported by Forister and Shapiro (2003), have nevertheless been shown to be significant, and they are not alone. Others, such as Kharouba et al. (2014) have shown earlier FFDs with increasing temperatures.

Fig. 3. *Ctenucha rubroscapus* nectaring on *Senecio jacobaea* (Asteraceae (Tansy Ragwort), 7/15/2011, Powell Butte Nature Park (photo by H. D. Specht)

Acknowledgements

I thanks Ron Lyons, for his data processing and manuscript content suggestions. In addition, Mart Hughes, emeritus ecologist/botanist from the Portland Park Bureau, was the one to originally invite me to conduct Lepidoptera surveys in Powell Butte Nature Park, which formed the genesis of this project. Finally, I thank Jaymee Cuti, for permission to use her trail map which she produced, for the combined Portland Parks and Recreation, and Portland Water Bureau's Information Brochure, for Powell Butte Nature Park.

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Announcements:

The Southern Lepidopterists' Society invites you to join

The Southern Lepidopterists' Society (SLS) was established in 1978 to promote the enjoyment and understanding of butterflies and moths in the southeastern United States. As always, we are seeking to broaden our membership. Regular membership is $30.00. Student and other membership categories are also available. With membership you will receive four issues of the SLS NEWS. Our editor J. Barry Lombardini packs each issue with beautiful color photos and must-read articles. The SLS web page (http://southernlepsoc.org/) has more information about our group, how to become a member, archives of SLS NEWS issues, meetings and more.

Please write to me, Marc C. Minno, Membership Coordinator, at **marc.minno@gmail.com** if you have any questions. Dues may be sent to Jeffrey R. Slotten, Treasurer, 5421 NW 68th Lane, Gainesville, FL 32653.

Society of Kentucky Lepidopterists

The Society of Kentucky Lepidopterists is open to anyone with an interest in the Lepidoptera of the great state of Kentucky. Annual dues are $15.00 for the hard copy of the News; $12.00 for electronic copies. The annual meeting is held each year in November, at the University of Kentucky, Lexington. Jason Dombroskie will be this year's featured speaker. In addition, there will be a fall field meeting held in Georgia early in September. Follow the Society's facebook page (https://www.facebook.com/societykentuckylep/) for announcements of this and other field trips.

To join the Society of Kentucky Lepidopterists, send dues to: Les Ferge, 7119 Hubbard Ave., Middleton, WI 53562.

The Association for Tropical Lepidoptera

Please consider joining the ATL, which was founded in 1989 to promote the study and conservation of Lepidoptera worldwide, with focus on tropical fauna. Anyone may join. We publish a color-illustrated scientific journal, Tropical Lepidoptera Research, twice yearly (along with a newsletter), and convene for an annual meeting usually in September, though that may change with the recent move to Spring for the SLS meeting in 2019, with whom we typically share a meeting. Dues are $95 per year for regular members in the USA ($80 for new members), and $50 for students. Regular memberships outside the USA are $125 yearly. See the troplep.org website for further information and a sample journal. Send dues to ATL Secretary-Treasurer, PO Box 141210, Gainesville, FL 32614-1210 USA. We hope you will join us in sharing studies on the fascinating world of tropical butterflies and moths.

The 2017 Season Summary

Leroy Koehn has assured me (the editor) that there WILL be a 2017 Season Summary. He has completed part of the work, and is not certain as to when the rest will be compiled. But he indicated he is committed to getting it out sometime in 2019. So stay tuned.

The 2018 Season Summary

The 2018 Season Summary is in the works, but is not ready yet, either. Hopefully, you will receive at least one of them with the Fall issue of the News.

PayPal -- the easy way to send $ to the Society

For those wishing to send/donate money to the Society; purchase Society publications, t-shirts, and back issues; or to pay late fees, PayPal is a convenient way to do so. Sign on to www.PayPal.com, and navigate to "Send Money", and use this recipient e-mail address: **kerichers@wuesd.org**; follow the instructions to complete the transaction, and be sure to enter information in the box provided to explain why the money is being sent to the Society. Thanks!

New MONA Fascicles coming!

The Wedge Entomological Foundation is dedicated to producing volumes in the series "The Moths of North America (MONA)". Volumes are produced as authors complete them on an anticipated schedule (due to budgetary constraints) of one volume per year, if manuscripts are available.

The Wedge is pleased to announce that there are two more "in the pipeline" of the MONA series at this time. The first notodontid fascicle is already out. The Acronictinae volume is next, and following that is the second volume of the Notodontidae. Thus 2019 and 2020 volumes are in the process of production at the present time.

2019 Eagle Hill Natural History Science Field Seminars, Steuben, Maine 2019

Leaf and Stem Mining Insects: July 28 – Aug 3

Leaf and stem miners are insect larvae that feed within the tissues of plants for at least part of their development, forming externally visible feeding patterns (mines). In North America, they include well over 2000 species of moths, flies, beetles, and sawflies. They tend to be highly host-specific, feeding on one or a few closely related plant genera, and each miner leaves a species-specific pattern as it feeds. It is therefore generally possible to identify these insects by noting the host plant and studying the mine characteristics. This course will introduce students to the identification and biology of leaf and stem miners. On field trips, we will visit a variety of habitats to observe and collect mines from as many different plant species as possible. In the lab, we will use the hostplant-based keys in Leaf-

miners of North Americato identify what we have found. Slideshow presentations will give overviews of the many groups of leaf and stem mining insects and their natural history. We will also discuss how to rear leaf and stem miners to adults, with a brief introduction to the various types of parasitoid wasps that inevitably emerge in the process.

Microlepidoptera: Collection, Preparation, Dissection, Identification, and Natural History: Aug. 4 - 10

This lab-intensive course will systematically cover all of the families of the microlepidoptera from Micropterigidae to Mimallonidae in the United States and Canada. The focus will be on identification characters for each family and most of the major subfamilies and tribes through talks rich in photos and examination of specimens. Overall natural history will be covered with special focus on ecologically and economically important species. There will be practical training on collecting methods, pinning techniques, and genitalic dissection along with a discussion of larval rearing techniques.

Eagle Hill Institute, PO Box 9, 59 Eagle Hill Rd, Steuben, ME 04680. www.eaglehill.us. 207-546-2821 Ext 4. office@eaglehill.us

2019 Lepidoptera Course: August 1-10

The 2019 Lep course will be held August 1-10 at the Southwestern Research Station (SWRS) in the Chiricahua Mtns. of Southeastern Arizona (a 2 1/2 hour drive from Tucson). This area is a hot spot for the highest Lepidoptera diversity in North America. With low desert scrub oak and mixed oak-pine woodland, lush riparian, juniper, Douglas fir, and mountain meadow habitats all within a 40 minute drive from the station, the SWRS is an ideal location from which to sample this diversity of both habitats and species.

The emphasis of the Lep Course is to train graduate students, post-docs, faculty, and serious citizen-scientists in the classification and identification of adult Lepidoptera and their larvae. The course includes lectures, field trips and labs. Topics to be covered include an extensive introduction into adult and larval morphology with a focus on taxonomically important traits, extensive field work on both adults and larvae, collecting and curatorial techniques, genitalic dissection, larval classification, and general issues in Lepidoptera systematics, ecology, and evolution.

Instructors will include Chris Grinter, Sangmi Lee, Richard Brown, Ray Nagle, Jennifer Bundy, Bruce Walsh, Ron Rutowski, John Brown, and James Fordyce.

Updates and further information is available online at www.lepcourse.com

Applications to the Lep Course can be made at the following site: https://www.amnh.org/our-research/southwestern-research-station/education/lepidoptera-course

The Lepidopterists' Society annual meeting

Davis, California – July 9-12, 2019

The 68th annual meeting of the Lepidopterists' Society will be from Tuesday, July 9 – Friday July 12, 2019 at the Odd Fellows Hall in Davis, California – 415 2nd St. between C and D. The meeting will be hosted by the Bohart Museum at University of California at Davis (http://bohart.ucdavis.edu/). The Bohart Museum has the 7th largest insect collection in North America with more than 7 million specimens and is the home of the California Insect Survey.

We encourage contributed papers and posters and will have a special symposium on Lepidoptera and environmental change. The Bohart Museum will be open, and those interested in visiting or working in the collection are encouraged to contact Collections Manager Dr. Steve Heydon – slheydon@ucdavis.edu. A welcome reception will occur at the Bohart Museum Tuesday evening. Main sessions and the Friday banquet will take place at the Odd Fellows Hall in downtown Davis, a short distance from the campus. The Thursday BBQ will be at a local park within walking distance of the Odd Fellows Hall and the downtown hotels.

Online registration and abstract submission are open on the Lepidopterists' Society website (https://www.lepsoc.org/content/annual-meeting). Registration includes facility fees, snacks, and the BBQ. Banquet tickets are available separately. Additional tickets for both the BBQ and banquet are available for purchase on the registration site. A meeting T-shirt is available for purchase and can be ordered separately on the registration site.

Airline, bus, housing, and local Davis, CA information are all provided in the original announcement in the previous issue of the News, 61(1): 23.

Local hosts of the meeting are Jeff Smith and Dr. Lynn Kimsey of the Bohart Museum and Dr. Michael Collins of Nevada City, CA. Please contact Jeff Smith at 916-624-9401 or bugman@starstream.net for questions or concerns. Hope to see you in Davis this July!

Correction to the Spring News 61:1

In the Digitial Collecting article on Ecuador by Bill Berthet, Bill indicates that the image labelled *Adelotype huebneri* should be *Menander hebrus*.

Lep Soc Statement on Diversity, Inclusion, Harassment, and Safety

This is available at any time, should you need to know at: **https://www.lepsoc.org/content/statement-diversity**

www.lepsoc.org and https://www.facebook.com/lepsoc

The Wedge Entomological Research Foundation Revises Categories of Financial Support

In 1989 the Wedge Entomological Research Foundation created the financial contributor category of Patron to recognize persons and organizations donating $2,000 in support of the Foundation's publication efforts, The Moths of North America series of monographs. Each Patron is recognized in every publication of the Foundation. Currently, there are eleven patrons.

The Wedge Entomological Research Foundation is updating its categories of financial support. Until the year 2021, any person or organization desiring to become a Patron can pledge $2,000 to be paid in full or in three annual installments (to be paid in full by 31 December 2021). Beginning in January 2021 the Foundation will introduce new categories of financial support; Platinum = $10,000, Gold = $5,000, and Silver = $2,500. For all three levels of support, payments can be made in full or in three annual installments. Beginning in January 2021, the category of Patron will be closed, and all Patrons will be designated as Founding Patrons.

Founding Patrons, and contributors at the Platinum, Gold, or Silver level will be recognized in all future publications of the Wedge Entomological Research Foundation.

For further information please contact Kelly Richers, Treasurer **krichers@wuesd.org** Thank you for your continued support.

Leuschner Award Recipients

This year the Lepidopterists' Society gave two students awards from the Ron Leuschner Memorial Fund for Research on the Lepidoptera. The two awardees were 1) Su'ad Yoon (see photos, page 98) from the University of Nevada, Reno for her proposal entitled "Do viral load and larval nutrition predict immune defense in the specialist butterfly *Lycaeides melissa*?" and 2) Ryan Spahn (see photo page 99) from the George Washington University for her proposal entitled "The Effect of Climate Change on the Relationship Between Agricultural Pests and their Parasitoids." Each student received $500 to support their research project. The next deadline to submit a proposal for consideration by the review committee will be January 15, 2020. The application form will be posted on the Lepidopterists' Society website later in 2019. Additional information about the research fund or a copy of the application can also be obtained by writing to Dr. Shannon Murphy (Shannon.M.Murphy@du.edu).

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and https://www.
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Larva of *Callophrys* (*Mitoura*) *dospassosi* on Juniper. From female collected by Doug D. Mullins, Sonora, Mexico, 18 September, 2006 Route 16, on roadside *Baccharis salicifolia*, photo by Nancy Hancen.

Underside of adult of *Callophrys* (*Mitoura*) *dospassosi*; collected by James K. Adams, just west of El Lobo, along Hwy. 120, Queretaro, Mexico, September 3, 1991.

Figure 1. *Eumaeus toxea* from Cameron Co., TX. (photo by Christi Jaeger)

Mexican Cycadian (*Eumaeus toxea*) U.S. specimens in the Canadian National Collection, Ottawa, Ontario

Peter Hall

Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario **halljp@rogers.com**

Eumaeus toxea, a colourful hairstreak also known as the Mexican Cycadian, has a documented range in Central America and Mexico. Older records listed this species under the synonym *Eumaeus minijas*. The status of this species in Texas has been mentioned numerous times in the literature of North American butterflies. In 1984, Roy Kendall and William McGuire published an article in the Bulletin of the Allyn Museum (Number 86, 19 April) titled "*Some New and Rare Records of Lepidoptera Found in Texas."* In two pages, they summarized what was known about *Eumaeus toxea* from the literature citations as occurring or not in Texas (the only known claims for the U.S.). Then, after enquiring at major insect collections in the U.S., they found only eight specimens labelled from Texas, seven in the Los Angeles County Museum labelled Hidalgo County, March 1915 and one in the National Museum of Natural History, Washington from Burnet County, July with no year. In an extensive investigation of these specimens, they concluded that the source for the specimens is not clearly known and this led them to the conclusion that records for the species in Texas are unsubstantiated by observational details or credible specimens and thus probably doubtful.

In the late 1990s, a very large collection of Lepidoptera was donated by Jean-Guy Filiatraut from Quebec to the Canadian National Collection of Insects, Arachnids, and Nematodes in Ottawa, Ontario. At about 50,000 specimens, mostly butterflies, the Filiatraut collection has taken many years to be curated into the main Lepidoptera collection. Recently, in one drawer, I found a tray with a series of *Eumaeus toxea* (eight specimens). It was first assumed that they were from Mexico. However, the labels indicate that seven of the specimens were from Cameron County near Brownsville in southern Texas, collected 20-21 November, 1956 (Figure 1) and one specimen from Hidalgo County at Bentsen/Rio Grande State Park taken 6 August, 1965. The labels also named the species as *Eumaeus minyas* but that name now applies only to South American individuals of a group of similar species.

I contacted by e-mail Jean-Guy Filiatraut who is long since retired. I asked him for any details on how he acquired these specimens. In his reply, he stated that "It has been such a long time that I forgot most details." However, he also stated that "The hairstreaks you are asking about were collecting (sic) (I did all the collecting myself) near Brownsville TX. …we, my wife and I, stayed there for 2 ½ days so close to the border that I remember seeing it… So all these specimens were caught by me not knowing they were uncommon as, I think, there were several but I just caught a few." This likely refers to the series of seven collected in 1956. He had no specific recollection of the specimen labelled from Bentsen-Rio Grande State Park in 1965. In a review of selected Filiatraut specimens from North America now in the CNC Lepidoptera collection, all contained a label (like the *Eumaeus toxea* specimens) stating "LEG: J.G. Filiatraut." The dates of capture range from 1956 to 1991 and come from a variety of U.S. locations. These would indicate a number of trips to collect butterflies made by Mr. Filiatraut to these U.S. locations, the Brownsville, Texas trip being the earliest. Other non-North American specimens from the Filiatraut collection supplied by dealers and other collectors do not have this label.

In a search through the online butterfly reporting websites NABA Sightings, eButterfly, BAMONA and iNaturalist for possible, more recent, records, several were found from the vicinity of Ciudad Victoria in southern Tamaulipas State in Mexico about 250 km south of the Rio Grande. These were the records closest to the U.S. border. BAMONA had two historical records from Hidalgo County and Blanco County, Texas. There were no dates, specific locations or observers recorded. After contacting (via e-mail) Paul Opler, who entered many of the historical records into BAMONA, and the USGS - Northern Prairie Wildlife Research Center in Jamestown, North Dakota, where the records in BAMONA were hosted, no further details to substantiate them were available.

The known larval foodplant for *Eumaeus toxea* in Mexico is the cycad *Zamia loddigessii*. This plant reaches north in Mexico only to southern Tamaulipas State. According to Kendell and McGuire (ibid, p. 16), 'It is doubtful that (*toxea*) would become established in Texas because there are no native stands of (its) larval foodplants in the state. Introduced ornamental cycads might, however, support a temporary brood, but these ornamentals are usually species not used by *toxea*.'

Acknowledgements: Thanks to Christi Jaeger for the photos of the *Eumaeus toxea* specimen from the Canadian National Collection of Insects, Arachnids and Nematodes and to Dr. Christian Schmidt, Dr. Don Lafontaine and Dr. Jean-François Landry, scientists at the CNC, and to Dr. Paul Opler, author of several books in the Peterson Field Guide series on butterflies and moths of North America, for their comments on the article.

In the footsteps of John Abbot: the first modern record of *Chlosyne gorgone* (Nymphalidae) and other gems from coastal Georgia

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The pioneer English naturalist John Abbot (1751-c.1840) arrived in Georgia in early 1776. He first lived within the British administrative district of St. George Parish, which was renamed Burke County in 1777 in honor of Edmund Burke, an Irish parliamentarian who supported the rights of American colonists during the Revolutionary War. Abbot remained in Burke County until 1806, when he moved to the town of Savannah (Chatham County) on the Georgia coast. Some previous biographers believed that Abbot's entire time in Georgia was spent in Screven County (originally spelled "Scriven"), which was established in 1793 from parts of Burke and Effingham counties. Abbot's letters indicate that he lived in Screven County only about three years, from 1813 to 1816.

During his residence in Burke County, Abbot collected and reared a butterfly that was illustrated and named *Dryas gorgone* in 1810 by the German naturalist Jacob Hübner. Now recognized as *Chlosyne gorgone*, Hübner's figured specimens were probably collected by Abbot (Calhoun 2018). Abbot's earliest known drawing of this species, depicting a male and a female (Fig. 1), was probably completed around 1792 (Calhoun 2005). He copied the figures in this drawing for an illustration that portrayed the life history of this species, which he rendered between 1804 and 1810. His notes for this drawing mentioned that he found the butterfly in Burke County, Georgia (Calhoun 2003). In turn, Abbot duplicated this life history composition, and its accompanying notes, for many years (Calhoun 2018).

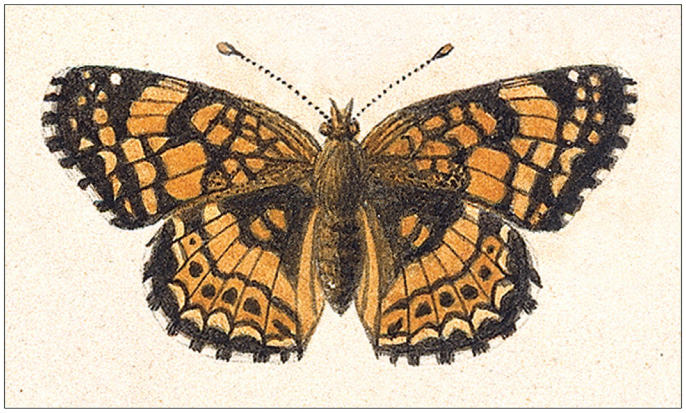

Fig. 1. Drawing of female *C. gorgone* (dorsal) by John Abbot, c. 1792 (© The Natural History Museum, London).

Consequently, the specimens that he collected in Burke County were the subjects of all his illustrations of this species, including the poorly-rendered figures on which Boisduval and Le Conte (1829-[1837]) based their original description of *Melitaea ismeria* (Calhoun 2003). In a later version of his notes, Abbot remarked that the butterfly "is not in the lower parts of the Country," referring to southern Georgia. This implies that Abbot never found *C. gorgone* outside of Burke County. The formation of Screven County predates Abbot's earliest known written observations of *C. gorgone*, thus his allusions to Burke County probably refer to its boundaries as they exist today.

Gatrelle (1998) claimed that in 1993 he rediscovered *C. gorgone* in Burke County, Georgia, and insisted that this species had not been "seen or collected anywhere in east coastal Georgia or coastal South Carolina since its description in 1810." As it turns out, this was not the first modern record of *C. gorgone* in eastern Georgia. In the Lepidopterists' Society Season Summary for 1989, Beck (1990) listed a record of *C. gorgone* from Burke County, dated 9 April 1989, which was reported by C. A. Adams. Ron Gatrelle was a regular contributor of data to the Season Summary, thus it is surprising that he overlooked Adams' important published record.

Adams photographed a single female *C. gorgone* on the morning of 9 April 1989 in a mobile home park where he lived while working as a security guard at the nearby Vogtle Electric Generating Plant, which is a nuclear power facility located in eastern Burke County along the Savannah River. The mobile home park and an adjacent motel were abandoned many years ago. This site is located only 6 mi northeast of Abbot's former home in Burke County, and less than 1.5 mi south of where Ron Gatrelle found the species in 1993. Although Gatrelle (1998) did not indicate the specific locality of his captures, the label on a male *C. gorgone* that he collected in Burke County in 1993 (designated as the neotype of *Dryas gorgone*) reads "River Rd. at Hancock Landing Rd." (Calhoun 2018). Burke County is very large (835 sq. mi) and Adams never corresponded with Gatrelle. Their independent discoveries of *C. gorgone* in such close proximity appear to be a coincidence. Calhoun found a pair of *C. gorgone* in the same general area in 2003, but with knowledge of the previous records.

Fig. 2. Female *C. gorgone* (dorsal), 9 April 1989, Burke County, Georgia. Photo: C. Adams.

Adams' Kodachrome slide of *C. gorgone*, one among thousands in his extensive photographic collection, was not retrieved until after the publication of Calhoun's (2018) analysis of the species. It reveals a slightly worn female perching on grass with outstretched wings (Fig. 2). The only individual of this species seen, it displays a well-developed band of submarginal spots across the hindwing and a minute white pupil in the postmedian black spot of cell M_3. This individual closely matches other females from Burke County, including Abbot's figured specimen (Fig. 1), as well as one collected by Ron Gatrelle on 29 April 1993 and another collected by Calhoun on 26 April 2003 (Calhoun 2018, figs. 7, 10). This phenotype contradicts Gatrelle's (1998) narrow definition of nominotypical *C. gorgone*, which he limited to eastern coastal Georgia and adjacent South Carolina. Southeastern populations of *C. gorgone* appear to be predominantly univoltine, with adults flying from late March to early June, depending upon locality and seasonal conditions. This is followed by a staggered, partial second brood, with some adults emerging from late May to September or early October. The number of adults that emerge later in the season varies from year to year and by locality (Calhoun 2018).

Adams recorded several other interesting butterfly species in Burke County in 1989, including *Glaucopsyche lygdamus* (E. Doubleday), which is a very rare inhabitant of the southeastern coastal plain. Like *C. gorgone*, the original description of *G. lygdamus* was probably based on specimens that were collected in Georgia by John Abbot. Adams photographed a fresh male *G. lygdamus* on 8 April 1989 as it perched on low vegetation at the same locality where he encountered *C. gorgone* the following day (Fig. 3). Although the Season Summary for 1989 listed *G. lygdamus* as "locally common" in Burke County, Adams observed only two males, both on 8 April. Calhoun and Wright independently searched that locality in early April 2006 for *G. lygdamus* without success. Other species encountered in the same area by Adams during the spring of 1989 include *Amblyscirtes alternata* (Grote & Robinson) (4 or 5 adults) and *Anthocharis midea* (Hübner) (moderately common). These species were also found in eastern Georgia by Abbot. In fact, the specimen used by Hübner to illustrate *Mancipium midea* (=*A. midea*) – representing the original description of this species – was likely collected by Abbot, but farther south near Savannah.

Unfortunately, several of Adams' records in the Season Summary for 1989 were incorrectly attributed to Burke County: *Staphylus hayhurstii* (W. H. Edwards) was found in Hall County in northern Georgia; *Hesperia metea* Scudder was also found in northern Georgia; and the report of *Polygonia progne* (Cramer) actually applies to an odd *P. comma* (T. Harris) from Walker County.

We are optimistic that *C. gorgone* and *G. lygdamus* continue to fly in eastern Georgia, where Abbot long ago discovered them in the pine woods of Burke County.

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Fig. 3. Male *G. lygdamus* (ventral), 8 April 1989, Burke County, Georgia. Photo: C. Adams.

Digital Collecting:

Peru

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Leg 1. Cosnipata Valley Manu Road S.E. Peru May 11-23-2016; Leg 2. Central Peru May 23-June 6-2016; Leg 3. Northern Peru June 6-21-2016.

All 3 legs were organized by David Geale of **www.mariposabutterflytours.com.** Trips leaders included David Geale and Kim Garwood.

Leg 1: I flew into Lima a day early and then transferred to the Hostel Torre Blanca located a block away from the Pacific Ocean in the hip district of Miraflores. I spent the late afternoon strolling along the sidewalk at the top of the bluff overloooking the ocean, families enjoying each others company, places to play soccer, surfers, hand gliding, sailing, and fine restaurants along the beach, ending with a beautiful sunset.

Early the next morning I was greeted by John, an ex-hippie from Oakland, California -- we have plenty in common.

Our first stop in Lima is the Spanish Baroque Basilica and Convent of San Francisco completed in 1674, featuring catacombs made from Pelican eggs and sandstone (that contain around 25,000 bodies), a world renowned library with over 25,000 books, a 1074 pipe organ, a 3000 pound silver altar, and a number of fabulous paintings.

John recommends lunch at a place where one of his friends is co-owner. We share an incredible platter consisting of cebiche de lenguado, conchitas a la parmesana, pulpo al olivo, yuquitas rellenas, and lan gostinos a la milanesa.

The lunch platter.

With full bellies we head south of Lima to the ruins of Pachacamac (A feared God because of his power for causing earthquakes) that goes back to 200 BC. Hiking the Temple of the Sun we watched a ceremony consisting of various Peruvian tribes. While at the top we observed a bull ring, polo grounds, and 20 plus foot waves crashing on the beach below.

The final stop for the day was Museo Largo established in 1926, situated in a viceroyalty mansion featuring a fascinationg collection of around 45,000 pre-Colombian objects and the largest collection of pre-Colombian erotic art, offering a unique perspective of ancient Peruvian sexuality.

Some of the artifacts at the Museo Largo.

After meeting the rest of the group we all flew to Cusco where Juan (our bus driver) met us for the 6-7 hour drive to Cock of the Rock Lodge, our home for the next 9 nights.

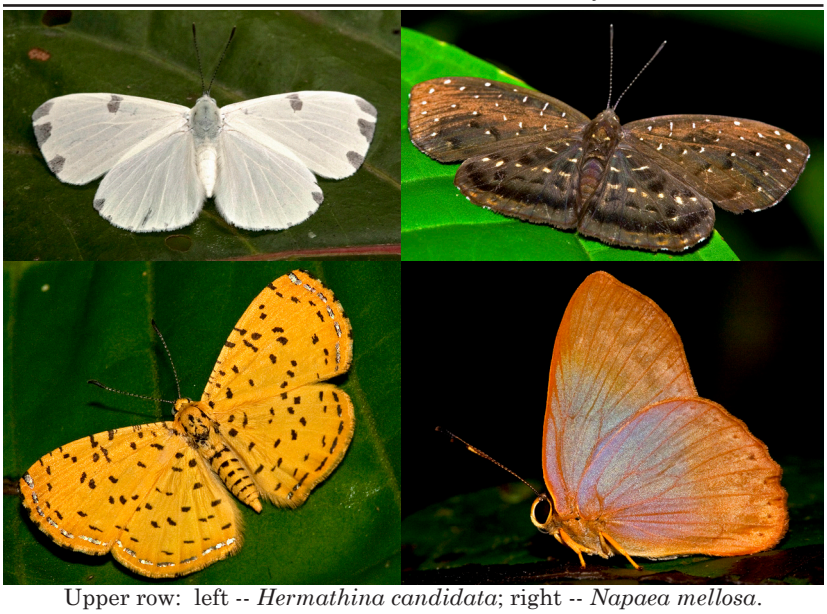
We were constantly entertained by several monkeys on top of the roof that were sometimes peering through a gap looking to snag unattended fruit or bread on the various dining tables.

The butterfly sun gods were not to kind to us on our 8 day stay here, having only a few sunny days. Weather is getting more unpredictable everywhere.

Upper row: left -- *Anteros kupris*; right -- *Anteros chrysoprasta*.
Lower row: left -- *Arcas imperialis*; right -- *Chalybs hassan*.

May 14 turned out to be our best day on leg #1. Butterflies were everywhere including 4 species of Anteros: *A. acheus, A. bracteata, A. kupris*, and the hairylegged, gold spotted, yellow and gold colored *A. chrysoprasta*. The star of the day was my first *Arcas imperialis*, with metallic green scales glowing from the direct sunlight. I looked up and thought of the incredible beauty and entertainment Mother Nature can provide. The metallic green scaled hairstreak *Chalybs hassan* also made an appearance.

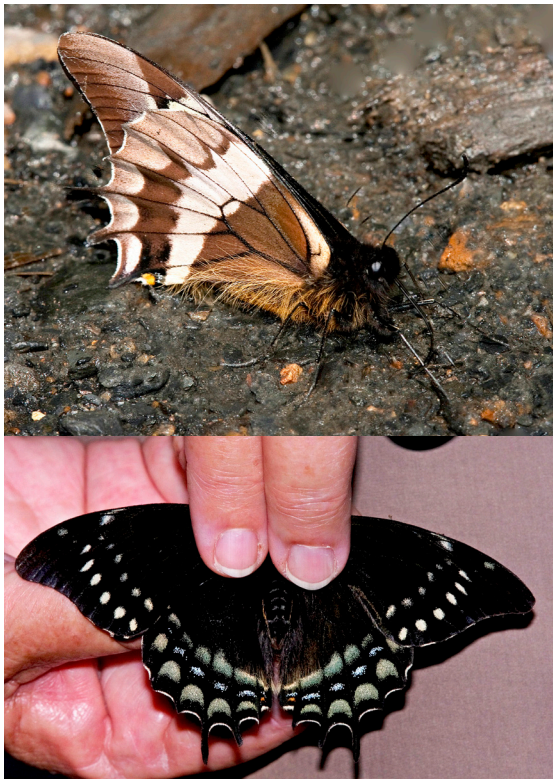
David baited along some of the road margins between km 62 to km 82.5 in the Quitacalzones area in the Cosnipata valley, 950-1250m, a great spot for numbers and diversity, providing a combination of some lowland species, yet high enough for cloud forest species. "Goodies" included the mosaic *Colobura annulata* that usually sits on trees with its head facing down, a portion if its hind wing looking like a second head, fooling predators into attacking a less vulnerable portion of the butterfly.



Upper row: left -- *Hermathina candidata*; right -- *Napaea mellosa*.
Lower row: left -- *Argyrogrammana stilbe*; right -- *Euselasia gelanor*.

The metalmarks *Hermathina candidata, Argyrogrammana stilbe, Napaea mellosa*, and the glowing gold and light purple colored *Euselasia gelanor*. Only one swallowtail, the very hairy *Pterourus warscewiczii,* was seen here. For some ID's and other reasons Kim or David will gently pick up a butterfly showing the open wing portion for photos then gently release it as we watch it fly away. Skippers here included the spectacular green bodied

Colubura annulata



Pterourus warscewiczii

Upper row: left -- *Astraptes talus*; center -- *Pyrrhopyge phidias*; right -- *Eurybia juturna*.
Lower row: left and center -- *Mimardaris montra*; right -- Cock of the Rock.

Astrapes talus, Pyrrhopyge phidias, along with *Eurybia juturna*, the beautiful orange and black striped firetip *Mimardaris montra*, and the spectacular bright red male bird Cock of the Rock.

We left early the next morning and stopped at the 2200m site, about 10km above the town of Paucartambo, and photographed the dark red velvet colored *Lasiophila orbifera*, before finally crashing at Wayqecha Research Station at 2950m. Current research at Wayqecha includes a multidisciplinary project studying carbon cycling in soils and montane forests and their response to climate change, and studies of plant and animal diversity patterns along the Andean elevational gradient.

Upper row: left -- *Lasiophila orbifera*; right -- *Catasticta superba*.
Lower row: left -- *Apexacuta ashtoreth*; right -- *Metardaris cosinga*.

We woke up to a sunny, very clear morning, observing the multi-green colored valley below, then watched as the clouds slowly made their way up the valley. David baited the 3100 m high road. We had very few butterflies but got good clicks of *Apexacuta ashtoreth*. Heading back down to the 2200m site, Fred found a *Catisticta superba* in the water. While driving, David spotted the high elevation firetip *Metardaris cosinga*, at which point I jumped out of the van, got two clicks, then watched it buzz off.

Later that afternoon we arrived at Cusco's Marqueses Hotel a beautiful Colonial house built at the end of XVII century that has recently been refurbished and renovated. The ancient stone fountain, the woodwork of balconies and doors, the colorful Andean weavings and the classic paintings from the famous Cusco´s school ... we ended leg one with a delicious grilled trout with fancy Incan side dishes at The Inca Grill.

Upper row: left -- *Caeruleuptychia lobelia*; center -- *Chloreuptychia chlorimene*; right -- *Dynamine tithia*. Lower row: left -- *Helia phalaenoides*; right -- *Phanus vitreus*.

Leg 2: We departed Lima for a 4 hour drive to Hotel Cerro Verde in San Ramon. In the morning we left San Ramon for a about a 2 hour drive to Catarata de Bayoz, a wide scenic waterfall cascading amid the forest into several natural pools. At around 750-900m the elevation is low enough to get Amazonian speces. David baited the area, and we all had a great time with cameras clicking away at well over 100 species. Water was trickling down the main road, making a wet area in the ditch that attracted mudpuddling parties of sulphurs and whites. Favorites that day included the glowing greyish blue *Caeruleuptychia lobelia, Dynamine tithia, Helias phalaenoides*, the ghost-skipper *Phanus vitreus*, and *Chloreuptychia chlorimene*.

I Spot the eye Spot -- Eye spots are a prominent feature of butterfly wing patterns. Up close they help scare predators, and from a distance they help butterflies blend into their surroundings. In many species, eye spots are quite variable in size and number. In some Satyrine butterflies the presence and prominence of these eye spots changes with seasons of the years.

Recent research from the University of Singapore suggests that the male and female of certain species of butterflies in the genus *Bicyclus* have different levels of the hormone ecdysone which regulates their different-sized eye spots.

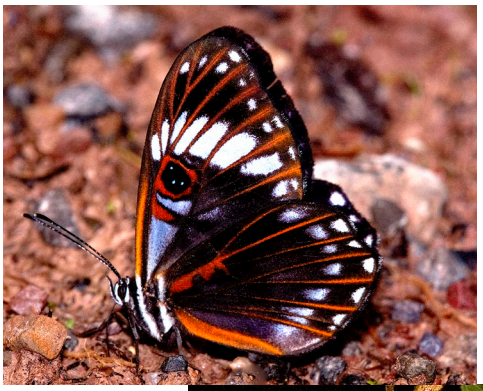
The next day our group took a 5 hour drive to Pozuzo, stopping at a steeply hilled, nice forest at Yanachaga Chemillen Nacional Parque around 1400m. There were completely different species than the previous day, including *Perisama*s, *Heliconius*, and *Altonotes*, all cloud forest species. The bug of the day was *Teratophthalma maenades*.

Heading down the mountain to Pozuzo, we get stopped by a small landslide, but luckily a bulldozer was there to clear things up in around 45 minutes. The driver then tells Juan to drive fast, and he does so, as small rocks are still tumbling down.

Later that afternoon we arrived in Pozuzo at Trip Advisers 5 star rated Albergue Frau Maria Egg at 750m, with comfortable sleeping in open windowed cabins. In the morning we shared our favorite breakfast for leg 2, including wonderful homemade dark bread, seeded on top.

We woke up to rain, but that gives us time on the computer to catch up on id's and previous photos, Later that day with intermittent rain we headed to a ranger station. There were very few butterflies, but we were entertained by a Lanceolated Monklet, a reclusive bird.

Another several tasty breakfast's with sunny to partly cloudy days, and we were off to Yanachanga Chemillen National Parque at 1100-1150m. This area has one side going up the road from the ranger station to the bridge, a second side from the bridge to the start of the trail at the top of the ravine, and the third side down through the forest back to the ranger station making the whole triangle shaped loop around 2.5 km.



Teratophthalma maenades.

Lanceolated Monklet.

Upper row: left -- *Emesis cerea*; center -- *Chrysoplectrum bahiana*; right -- *Ridens nora*. Middle row: left -- *Chloreuptychia chlorimene* and *Cissia confusa*; middle -- *Chorinea sylphina*; right -- *C. octauius*. Lower row: left -- *Pericheres adela*; middle -- *Potomanaxas laoma*; right -- *Siseme pallas*.

There were lots of fresh species. I took hundreds of photos, including the bright golden colored *Emesis cerea, Chrysoplectrum bahiana, Ridens nora*, the kissin cousins *Chloreuptychia chlorimene* and *Cissia confusa,* and the black veined, clear winged, *Chorinea sylphina* and *C. octauius*. We then headed 7km to the San Alberto entrance to Yanachaga Chemillen Nacional Parque at 2175m, and photo'ed *Perichares adela, Potomanaxas laoma*, and *Siseme pallas xanthogramma*, the lovely riodinid with thin orange lines.

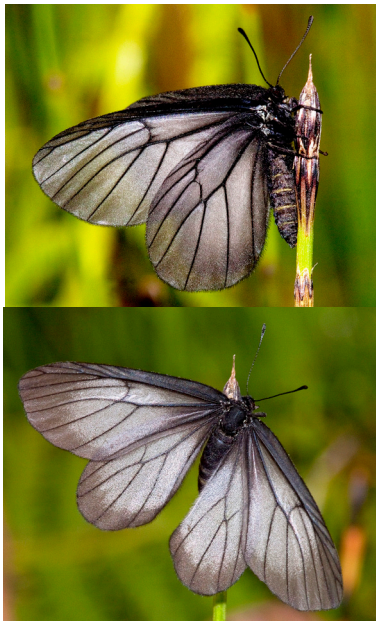
Our Lodge in Oxapampa is Casa Oxapampa. We had several delicious dinners including pollo a la plancha, and fried trout with lots of veggies, a great salad and cooked to order french fries. I get hungry just thinking about it!

We tried a new location the next day over a pass west of Oxapampa to Ulcumano Reserve at 2200m. It was a bit cool and wet. You can hike up to the paramo here and see many fantastic plants and birds. I got good clicks including *Parataygetis albinotata*, along with the two hairstreaks *Calycopis suda* and *Ocaria aholiba*.

We woke up to a pleasant sunny day the next day, and had a 45 minute drive to Bosque de Shallett, a preserved patch of forest above Oxapampa about 2400m at the top. I walked down the road stirring up a number of swallowtails that turned out to be *Battus madyes*, ending at a stream that crosses the road. David found the cool looking riodinid *Siseme militaris* (see front cover) that Kim had wanted to see for years. I got good clicks of the hairstreak *Rhamma comstocki* here as well.

Later we all heard Kim yelling *Styx*! *Styx*! We watched this unusual looking, smoky grey riodinid drift across the road into the rocks along the

Left column: top -- *Parataygetis albinotata*; bottom -- *Battus madyes*.
Right column: top -- *Calycopis suda;* middle -- *Ocaria aholiba;*
bottom -- *Rhamma comstocki*.



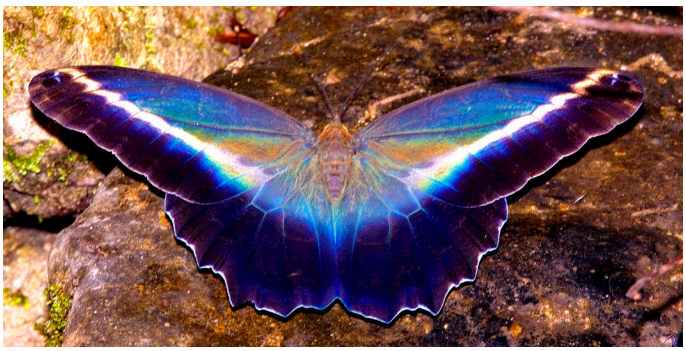
Styx infernallis.

stream below. David and I scurried for a good photographic position that neither of us were able to manage. Meanwhile the butterfly takes off and lands on a rush, balancing on the top of the plant, being rotated around by the wind. We all surround the area shooting like mad at all different angles. What a great experience.

We drove back to San Ramon for 3 nights at the Monte Prado with good internet. The next couple of days we had good weather and take a 4x4 on a 24km rough road that takes us a long hour and a half over a steep, bumpy, dusty mountain road, ending at Pampa Hermosa. This is one of my favorite places in the world for butterflies. David baited the various trails attracting scads of butterflies, Fred and Kristine were in a daze down by the stream from so many butteflies to shoot.

One morning I came across the giant owl butterfly *Caligo superbus*. Every 4 or 5 minutes it opened its wings then quickly closed them. Being patient, with camera ready, this butterfly finally opened its wings briefly, and I got several clicks, after which it flew away. Other "goodies' included *Napaea octoris, Johnsonita chlamydem, Godyris zavaleta*, the very striking open winged *Epiphile orea*, a pair of mating *Sarota myrtea*, with a combined wingspan around 22 mm, and the cryptic spreadwing skipper *Diaeus variegata*.

With leg 2 almost finished we drove to the Los Portles hotel in Tarma. We were at 3100m, and it was chilly at night, but the room had heaters that worked great. We scored Crepes with dulce de leche for dessert, a chocolate symphony with bananas in rum, topped by chocolate ice cream.



Caligo superbus.

Heading back to Lima we stopped near Ticlo Pass at 4818m, got out of the car, and started seaching for butterflies at 4470m. While walking you could hear your heart beating. With 40% less oxygen than at sea level, we struggled to get enough oxygen to breath. David found a pair of mating *Colias euxanthe*. I struggled to bend down for a picture, and when I stood up, I was light headed and off balance, a weird feeling I had never experienced before. We slowly slugged ourselves back to the car. We were shivering from being under dressed and my earlobes felt frozen.

We were near the tracks and tunnels of one of the highest railroads in the world, opened in 1893, with snow covered peaks near by.

Upper row: left -- *Napaea octoris*; center -- *Johnsonita chlamydem*; right -- mating *Sarota myrtea*. Middle row: left -- *Epiphile orea*; right -- *Diaeus variegata*. Lower row: left -- *Godyris zavaleta*; right -- mating *Colias euxanthe*.

Leg 3: Our group flew into Tarapoto where our driver Juan, met us. It took him 2 days to drive up here, in the North. He arranged for another driver to transfer us from Tarma to Lima the previous day.

Pterourus menatius

We headed for 3 nights to the Hostel Rumipata owned by a Japanese couple near the town of Moyobambo, stopping along the way to visit a deep ravine with oil birds, but it was shaded in the afternoon so the birds were quiet.

The Hostel had several fish ponds stocked with Tilapia. The owner could walk about 100 feet from the kitchen, throw his net to catch fish, then prepare them in various ways including sushi one night, baked with herbs and lots of veggies another night. Best Tilapia I have ever had.

The next couple of days we walked the trails at the hotel, up the water pipeline into the forest. "Keepers" included the small brilliant green hairstreak *Chalybs janias*, and a very fresh *Jemadia hewitsonii albescens* basking on a moist sandy area in the middle of the stream that was a challenge to get to.

Our group headed just down the road to a birding spot near Lodge Yakanki. The sun was fickle that day, sunny, overcast, then becoming sunny again in the afternoon when the butterflies became more active. It was a nice forest with rocky uneven terrain.

Top: *Heraclides androgeus;* bottom: *Pterourus zagreus*

Upper row: left -- *Chalybs janias*; center -- *Cyrenia martia*; right -- *Mesosemia erinnya*.
Lower row: left -- *Jemadia hewitsonii albescens*; right -- *Eurybia molochina*.

I found the red, white, and blue metalmark *Cyrenia martia*, a cooperative open wing *Mesosemia erinnya*, the striking blue velvet colored *Metacharis regalis* (see front cover), and a pair of *Eurybia molochina* nectaring on ginger.

On the way to and back from the Owlet Lodge at 2300m, we stopped several times at another of my most favorite places, Playa las Mariposas at 1050m. Weather conditions ranged from light rain to sunny skies, but when it was sunny this swimming hole was loaded with scads of bugs, including 12 species of swallowtails. These included *Pterourus menatius, Heraclides androgeus, Heraclides astyalus*, and *Pterourus zagreus* mineralizing on the moist sand. This was our best place for butterflies on leg 3.

Top: *Calycopis centoripa* (male and female).
Bottom: *Heliconius erato emma* x *favorinus*.

Working the narrow dirt road we scored fresh male and female *Calycopis centoripa*, and the hybrid *Heliconius erato emma* x *favorinus*.

For the next several days we used the Owlet Lodge as a base, first taking the hour or so drive west to Servidumbro Ecological Huembo featuring a large flowering garden to observe the Marvelous Spatuletail Hummingbird. There were not many butterflies but we all got good looks at the hummer in an obscure very shady habitat that was a real challenge to get a decent click.

Back on the trails at Owlet Lodge we watched the spectacular *Morpho sulkowskyi* floating over the bamboo filled ravines. Clicks here included *Penaincisalia loxurina, Pronophilla cordillera*, and *Oleria attalia*.

I will never forget the night of June 12th, 2016 when we were sitting around the table and one of the participants viewed on his computer that a 29 year old security guard killed 49 and wounded 53 others inside Pulse, a gay bar night club in Orlando, Florida. We looked at each other stunned.

The next couple of days we worked The UNSM Bio Diversidad Tarapoto 1050m trail getting good clicks of *Heliconius numata silvana*, then Cordillera Escalara Preserve with bug of the day *Myscelia capenas* near the toilets, always a good place to check, and ending leg 3 exploring a dry seasonal forest 40 minutes east of Tarapoto. Specialties of the day included the very long tailed skipper *Chioides catillus, Dynamine artemisia, Hamadryas chloe,* and the stunning sparkly green metalmark *Caria mantinea*. So it was a good way to end our fabulous leg 3 trip.

A heartfelt thanks to David Geale for all his excellent baiting, guiding, and butterfly id's and to Kim Garwood for allowing me to share some text from her Peru trip reports.

Left column: top -- *Pronophila cordillera*; bottom -- *Hamadryas chloe*. Middle column: top -- *Chioides catillus*; middle -- *Dynamine artemisia*; bottom -- *Caria mantinea*. Right column: top -- *Oleria attalia*; bottom -- *Heliconius numata silvana*.

Novel approach to rearing callus feeding larvae of *Aenetus* Herrich-Schäffer, 1855 in Australia (Lepidoptera: Hepialidae)

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Rearing ghost moth larvae can be a challenging task, especially where the goal is to rear large numbers. Ghost moth larvae occupy a tunnel excavated within a substrate (host stem or root, humus, or soil) (Grehan 1989) and artificial rearing is not simply a matter of providing fresh host plant material (even where that is feasible). It is also necessary to maintain a combination of required temperature, humidity, and physical conditions along with appropriate handling techniques (Atijegbe et al. 2017). Methods for artificial rearing have been principally directed at pasture pests such as species of *Oxycanus, Wiseana*, and *Oncopera*. In these genera larvae reside in the soil and those species that are pasture pests feed on the leaves of grasses and herbs (Grehan 1989, Dugdale 1994, Simonsen 2018). The Australian species *Oncopera brachyphylla* Turner, 1925 and *O. mitocera* Turner, 1911 have been reared on a diet of decayed plant debris and fresh leaf blades of guinea grass (*Panicrum maxiumum*) with a maximum viability of 50% (Elder 1970). Rearing of New Zealand *Wiseana* larvae has been accomplished by placing larvae in Petri dishes containing moistened bark or commercial potting mix along with a semi-synthetic diet based on white clover and carrot. Successful pupation was accomplished for 61% and 68% of *W. cervinata* (Walker, 1865) and *W. copularis* (Meyrick, 1912) respectively (Ferguson & Crook 2004).

The European root feeding ghost moth *Hepialus humuli* (Linnaeus, 1758) was successfully reared on its host plant carrot by placing eggs or first instars on a tray of chopped carrot. On this diet larvae were found to grow better if saprophytic fungi were also present, but first instar mortality was often greater than 90% in the first week. Larvae were reared on the carrot bed for the first two or three instars before transferring individual larvae into a small vial or jar with 3-4 carrot pieces each. The method was further enhanced by placing older larvae in artificial tunnels in moist blocks of plaster (Edwards 1964). This method was also tried unsuccessfully for *O. brachyphylla* and *O. mitocera* (Elder 1970). Carrot as a non-typical food source was applied to *Korscheltellus gracilis* (Grote, 1865) and *Phymatopus* species in North America. Larvae of *K. gracilis* feed on the bark of seedlings or outer tissues of woody conifer and angiosperm trees, and perhaps also mosses (Wagner et al. 1987) while larval food of *Phymatopus* include stems and roots of woody shrubs, although ferns and grasses have been recorded for one species (Wagner 1985, Maron 2001). Successful rearing was achieved after larvae were overwintered outdoors, but the percentage survival was not recorded (Wagner 1989). Carrots used for laboratory rearing larvae of the root-feeding genus *Thitarodes* resulted in survival rates of 2.6% for *T. pui* (Zou *et al* 2012), 12.0% for *T. jianchuanensis* (Yang, 1994) and 1.6% for *T. armoricanus* (Oberthür, 1909) (Tao *et al*. 2015).

Wagner (1989) found that late instar *Sthenopis pretiosus* (Herrich-Schäffer, 1856) larvae could not be transferred from ostrich fern to carrot. Carrot was acceptable to larvae of *Phassus triangularis* Edwards, 1885 but there is no report of feeding through to pupation. *Phassus* belongs to a major feeding category where larvae tunnel into stems but rely on callus growth around the tunnel entrance to feed under a protective web of silk and debris. This feeding mode also occurs in the *Aenetus, Endoclita,* and *Zelotypia* (Grehan 1989) and probably all the Meso and South American 'cibyrine' genera (sensu Grehan 2012) This feeding mode precludes indoor rearing of larvae where stems are removed and kept moist because callus production ends when the stem dies. If larvae are close to pupation it is possible to rear adults, but otherwise larvae eventually die before maturity.

In the absence of a viable alternative food source, callus feeding represents a major constraint for artificial rearing. To obtain accurate host plant records it is necessary to associate adult moths with host species where there is or may be more than a single ghost moth species present. If sampling occurs when larvae have pupated it is possible to remove pupal tunnels and rear adults by placing the base of sectioned stems in water. This approach requires sampling only at times when pupae are available. Where large geographic distances are involved this may not always be practical and the time window for such opportunities may be short and vary among species. If alternative host plants are available at a research base, larvae could be physically transferred to those plants where they can continue to develop, and adults later collected within a surrounding mesh cage.

The problems outlined above are resolved if there is a viable food choice alternative and this option was discovered by EB where apple fruit was provided to larvae residing within sections of host stem (Beaver & Grehan 2018). In this study stem sections with larval tunnels were stored vertically with the lower portion of each stem immersed

Fig. 1. Apple slice placed within feeding web of *Aenetus eximia* in *Callicoma serratifolia* (Cunoniaceae).

in water. Larvae were presented with pieces of fresh apple slices by carefully cutting open the upper section of the feeding web and inserting 10-30 mm-long rectangular sections of skinned apple into the cavity between the feeding web and callus but leaving enough room to allow the larva to enter and exit the bore freely (Fig. 1). Commercial mushroom and carrot were also occasionally used when apple was not available.

This study confirmed five species by successful emergence: *A. eximia* (Scott, 1869) (9-10 months), *A. scotti* (Scott, 1869) (8-11 months), *A. blackburnii* (Lower, 1892) (2-3 months), *A. ligniveren* (Lewin, 1805) (2 months) (Fig. 2), and *A. lewinii* (Walker, 1856) (10-12 months). During this time only one larva died. These time periods only represent the duration of rearing whereas the complete larval development may take considerably longer and some larvae on this study were still active fore a further 6-12 months at the time these initial results were published. Since then the method has been successfully used for *O. ombraloma* (Lower, 1902), *O. tindalei* Simonsen, 2018 by EB and for *A. cohici* Viette, 1961 by Thierry Salesne in New Caledonia (pers. comm).

This method should be very helpful for researchers interested in documenting host plant relationships as well as distribution (as some species may not be strongly attracted to light) and allows field surveys to be made at any time of the year. The resulting species identifications also allow further characterization of tunnel characteristics which can differ between species (Grehan 1988) as well as morphological studies on the larval and pupal stages. We believe that apple represents a potentially viable food source for rearing other callus feeding Hepialidae and may even be effective for Hepialidae in general. We hope that other researchers will have the opportunity to apply this method to other species and further enhance knowledge of this still relatively poorly known group of Lepidoptera.

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(References continued on page 85)

Fig. 2. Reared specimens of *Aenetus ligniveren* female (left) and male (right).

New state records from the genus *Hahncappsia* (Lepidoptera: Crambidae) in the United States

Paul Dennehy

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The Crambid genus *Hahncappsia* contains 14 species in North America north of Mexico (Scholtens & Solis, 2015), many of which are superficially similar and can be identified to the species level only by examination of the genitalia. The records presented here of *Hahncappsia fordi* from western Texas and *Hahncappsia neobliteralis* from western Nebraska expand the known ranges of these two species and highlight the need for further examination of collected material to better appreciate the distributions of the North American *Hahncappsia*.

Both *H. fordi* and *H. neobliteralis* were first described and placed in the genus *Loxostege* (Hübner) by Capps in his 1967 revision of the genus *Loxostege*, and moved to the new genus *Hahncappsia* by Munroe in The Moths of North America: Fascicle 13.2.

The type location of *H. fordi* is Tuscon, Arizona, and Capps lists paratype specimens from Arizona, California, and Sonora, Mexico. Munroe also lists the range as "Palm Springs, California, to southern Arizona and south into Sonora, Mexico". I have seen specimens of *H. fordi* from Clark County, Nevada (complete data of one example is listed below), and while Nevada specimens are not explicitly mentioned by Capps or Munroe, southern Nevada is certainly within the range established in both their publications. However, three specimens of *H. fordi* collected on 31 July 2017 in Val Verde County, Texas, represent a substantial eastward extension of the known range of the species. All three specimens were collected at an MV light near the town of Langtry, and one male and one female were dissected (figures 2 and 3). In a personal email communication in October 2017, Ed Knudson of the Texas Lepidoptera Survey indicated that *H. fordi* was not a species previously recorded from the state of Texas. *Hahncappsia fordi* may be rare east of Arizona, or it may be overlooked in collections due to confusion with the superficially similar species *H. alpinensis*, which occurs from eastern Arizona to Brownsville, Texas (Capps, 1967). The genitalia of the species are easily distinguished, however. In males of *H. fordi*, the sacculus has three stout spines at the base and a patch of many smaller spines at the distal end (figure 2), while males of *H. alpinensis* have a linear arrangement of small spines on the sacculus extending from the base nearly all the way to the patch of spines at the distal end (Munroe, 1976). The genitalia of female *H. fordi* (figure 3) can be recognized by the "crinkled" sclerotization below the ventral margin of the ostium, a trait not seen in *H. alpinensis* (Capps, 1967).

The type specimen of *Hahncappsia neobliteralis* was collected in Hubberton, Vermont, and Capps includes specimens from nine states and provinces, extending as far west as Soldier, Iowa, in the paratype series. Solis (2008) lists the species' range as those same nine states and provinces from Capps (1967). A single specimen collected in Dawson County, Nebraska, on 31 July 2011 extends this range westward by approximately 200 miles. The specimen was taken at an MV light on a flood plain along the Platte River. *H. neobliteralis*, like *H. fordi*, is a species that may be overlooked and under-reported due to confusion with superficially similar species. *H. marculenta* and *H. neomarculenta* are both species which are externally indistinguishable from *H. neobliteralis*, yet are easily identified by examining the genitalia, as described in Capps (1967). Both species occur with *H. neobliteralis* in the eastern United States and southeastern Canada.

The following are the data from the specimens examined, all of which are deposited in my personal collection:

Hahncappsia fordi: three specimens: "Texas: Val Verde County, Town of Langtry, 29.8052ºN 101.5558ºW, 31 July 2017, Paul Dennehy leg."; one specimen: "Nevada: Clark County, 13 miles east of Searchlight, 5 October 2016, Steven Johnson and Jim Vargo leg."

Hahncappsia neobliteralis: "Nebraska: Dawson County, 1 mile south of Willow Island, 40.875ºN 100.0676ºW, 31 July 2011, Paul Dennehy leg."

Hahncappsia fordi and *Hahncappsia neobliteralis* are both likely more widespread than published records indicate. Further collection and examination of *Hahncappsia* specimens from the United States and Canada will likely lead to more new state and provincial records.

Acknowledgements

I would like to acknowledge the late Ed Knudson for providing his input on the *Hahncappsia fordi* record from Texas, and Steve Johnson for providing a specimen of *Hahncappsia fordi* from Nevada.

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Figure 1. *Hahncappsia fordi* from Val Verde County, Texas (top), and *Hahncappsia neobliteralis* from Dawson County, Nebraska (bottom)

Figure 2. Male genitalia of *Hahncappsia fordi* from Val Verde County, Texas

Figure 3. Female genitalia of *Hahncappsia fordi* from Val Verde County, Texas

A novel approach to rearing *Aenetus* (Hepialidae)

Continued from p. 83

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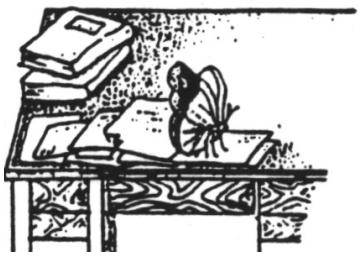


From the Editor's Desk

James K. Adams

Hopefully you are enjoying the News. This is to let you know that typically anymore the next issue of the News is already full by the time the current one goes to press. That means that squeaking something in at the deadlines (inside back cover) rarely will insure your article is in the next issue. Here's some eye candy for you!

Schinia arefacta, Fall Line Sandhills WMA, western section, 8 miles WSW of Butler, Taylor County, GA, September 3, 2018. This was a new county record, 150 miles west of the previous, and only other, known locality in Georgia.

The Marketplace

IMPORTANT NOTICE to ADVERTISERS: If the number following your ad is "611" then you must renew your ad before the next issue if you wish to keep it in the Marketplace!

Equipment

FOR SALE: Light Traps: 12 VDC or 120 VAC with 18 inch vanes (15 & 32 Watt) and 24 inch (40 Watt). Rigid vanes of Stainless Steel, Aluminum, or Plexiglass. Rain Drains and beetle screens to protect specimens from damage.

Collecting Light: Fluorescent UV 15, 32 & 40 Watt. Units are designed with the ballast enclosed in a weather tight plastic enclosure. Mercury Vapor: 160 & 250 Watt self ballast mercury vapor with medium base mounts. 250 & 500 Watt self ballast mercury vapor with mogul base mounts. Light weight and ideal for trips out of the country.

Bait Traps: 15 inch diameter and 36 inches in height with a rain cloth top, green Lumite plastic woven screen, and supported with 3/16 inch steel rings. A plywood platform is suspended with eye bolts and S hooks. Flat bottom has a 3/16 inch thick plastic bottom that will not warp or crack. Bait container is held in place by a retainer.

Drawers: Leptraps now offers Cornell/California Academy storage drawers. Drawers are made of Douglas Fir, hardboard bottom and glass top. Finished in clear satin gloss varnish. A single card holder with pull or two card holder with a knob pull. Foam pinning bottom is available.

Price does not include shipping. If purchasing 20+ drawers, and you live within 350 miles from Georgetown, KY, I will meet you half way for delivery. Mastercard/Visa, Pay Pal, checks accepted.

For more information visit: **www.leptraps.com**, or contact Leroy C. Koehn, Leptraps LLC, 3000 Fairway Court, Georgetown, KY 40324-9454; Tel: 502-542-7091, e-mail: **leptraps@aol.com**. indefinite

(Speaking of Leptraps) **FOR SALE**: LEPTRAPS LLC

After 32 years of designing, fabricating and marketing globally, I would like sell Leptraps LLC and retire. I would like to collect Lepidoptera and travel.

The business includes all the drawings, inventory, and some equipment. I operated the company from my home.

To successfully manage Leptraps LLC you must have knowledge of Insects, especially Lepidoptera. You must have design skills, knowledge of Sheet Metal and machining, plastics and electronics (12VDC & 120VAC & 220/208 VAC.). Leptraps LLC is a well known global company. Leptraps LLC has sold product into Canada, South America, Australia, South Pacific, Asia, Europe and every state in the United States. Leptraps LLC has also sold product into Greenland, Iceland and many countries that are poorly known.

The price is $150,000 USD. Or, make me a reasonable offer.

Leroy C. Koehn, Leptraps LLC, 3000 Fairway Court, Georgetown, KY 40324-9454; Tel: 502-542-7091, e-mail: **leptraps@aol.com** indefinite

The aim of the Marketplace in the **News of the Lepidopterists' Society** is to be consistent with the goals of the Society: "to promote the science of lepidopterology...to facilitate the exchange of specimens and ideas by both the professional and the amateur in the field,..." Therefore, the Editor will print notices which are deemed to meet the above criteria, without quoting prices, except for those of publications or lists.

We now accept ads from any credible source, in line with the New Advertising Statement at the top of this page. **All advertisements are accepted, in writing, for two (2) issues unless a single issue is specifically requested.** All ads contain a code in the lower right corner (eg. 564, 571) which denotes the volume and number of the **News** in which the ad first appeared. **Renew it Now!**

Note: All advertisements must be renewed before the deadline of the third issue following initial placement to remain in place.

Advertisements should be under 100 words in length, or **they may be returned for editing.** Some leeway may be allowed at the editor's discretion. Ads for Lepidoptera or plants must include full latin binomials for all taxa listed in your advertisement.

The Lepidopterists' Society and the Editor take no responsibility whatsoever for the integrity and legality of any advertiser or advertisement. Disputes arising from such notices must be resolved by the parties involved, outside of the structure of The Lepidopterists' Society. Aggrieved members may request information from the Secretary regarding steps which they may take in the event of alleged unsatisfactory business transactions. A member may be expelled from the Society, given adequate indication of dishonest activity.

Buyers, sellers, and traders are advised to contact state department of agriculture and/or ppqaphis, Hyattsville, Maryland, regarding US Department of Agriculture or other permits required for transport of live insects or plants. Buyers are responsible for being aware that many countries have laws restricting the possession, collection, import, and export of some insect and plant species. Plant Traders: Check with USDA and local agencies for permits to transport plants. Shipping of agricultural weeds across borders is often restricted.

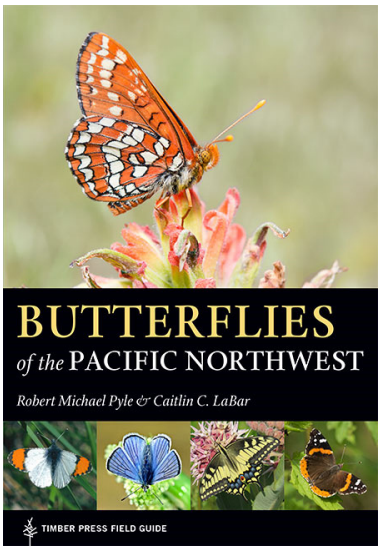
No mention may be made in any advertisement in the **News** of any species on any federal threatened or endangered species list. For species listed under CITES, advertisers must provide a copy of the export permit from the country of origin to buyers. **Buyers must beware and be aware.**

Publications

Butterflies of the Pacific Northwest

by Robert Michael Pyle and Caitlin C. LaBar. Timber Press, 2018. Flexibind, 464 pp., 612 color photos, 198 maps, 20 illustrations. (ISBN-10: 1604696931) List price $27.95. Maybe ordered from any bookstore or on-line service, including Powells.com and Indiebound. More info at http://www.timberpress.com/books/butterflies_pacific_northwest/pyle/9781604696936.

Winner of the 2018 National Outdoor Book Award for Nature Guides.

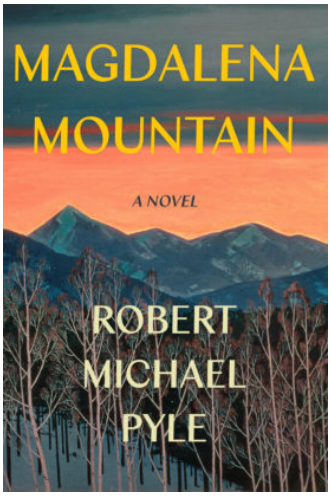


Easy to use and beautifully illustrated with more than 600 color photographs and nearly 200 maps, *Butterflies of the Pacific Northwest* is a definitive field guide to all species known from Washington, Oregon, western Idaho, northern California, and British Columbia. The profiles include accepted names for genus and species, type locality, conservation status, distinguishing traits and variation of every species, the preferred foodplants and nectar plants, habitat and range, as well as personal, lyrical, and familiar accounts of each butterfly. 17 illustrative plates are included to help users compare and identify species. Additional information includes a brief introduction to how butterflies work and details on ecology, biogeography, and conservation. *Butterflies of the PNW* updates and expands upon *Butterflies of Cascadia*, with new images superbly curated by Caitlin LaBar. The text, taxonomy, and maps are all entirely up-to-date. 612

Magdalena Mountain: A Novel

by Robert Michael Pyle. Counterpoint Press, 2018. Paperback, 400 pp. (ISBN: 9781640090774) List Price: $16.95. May be ordered from any bookstore or online service, including Powells.com and Indiebound. More info at https://www.counterpointpress.com/dd-product/magdalena-mountain/

In *Magdalena Mountain*, Robert Michael Pyle's first and long-awaited novel, the award-winning naturalist proves he is as at home in an imagined landscape as he is in the natural one. At the center of this story of majesty and high mountain magic are three Magdalenas -- Mary, a woman whose uncertain journey opens the book; Magdalena Mountain, shrouded in mystery and menace; and the all-black Magdalena alpine butterfly,the most elusive of several rare and beautiful species found on the mountain. And high in the Colorado Rocky Mountain wilderness,

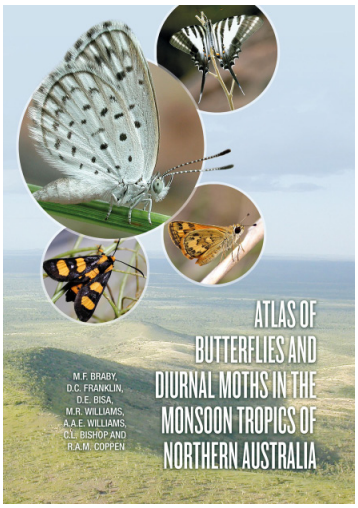


sharing the remote territory of *Erebia magdalena*, lives the enigmatic Oberon, a reluctant de facto leader of the Grove, a diverse community of monks who share a devotion to nature. Converging in the same wilderness are October Carson, a beachcomber-wanderer in pursuit of the alpine butterflies he collects for museums; James Mead, a young graduate student intent upon learning the ecology of this seductive creature and the whereabouts of Carson; and Mary Glanville, who also seeks the butterfly but can't remember why. While the mystery surrounding Mary takes a sinister turn, their shared quest pulls them deeper into the high mountain wilderness, culminating in a harrowing encounter on the stony slopes of Magdalena Mountain.

Lepidopterist-readers will take special pleasure in this story, as they recognize many of their ilk, by their actual names or not, populating the pages of this delicious and taut butterfly caper. 612

Atlas of Butterflies and Diurnal Moths in the Monsoon Tropics of Northern Australia

by M.F. Braby, D.C. Franklin, D.E. Bisa, M.R. Williams, A.A.E. Williams, C.L. Bishop, R.A.M. Coppen. The Australian National University Press, Acton, Australian Capital Territory, Australia 2601; $135.00 print.



Northern Australia is one of few tropical places left on Earth in which biodiversity—and the ecological processes underpinning that biodiversity—is still relatively intact. However, scientific knowledge of that biodiversity is still in its infancy and the region remains a frontier for biological discovery. The butterfly and diurnal moth assemblages of the area, and their intimate associations with vascular plants (and sometimes ants), exemplify these points.

However, the opportunity to fill knowledge gaps is quickly closing: proposals for substantial development and exploitation of Australia's north will inevitably repeat the ecological devastation that has occurred in temperate

southern Australia—loss of species, loss of ecological communities, fragmentation of populations, disruption of healthy ecosystem function and so on—all of which will diminish the value of the natural heritage of the region before it is fully understood and appreciated. Written by several experts in the field, the main purpose of this atlas is to compile a comprehensive inventory of the butterflies and diurnal moths of northern Australia to form the scientific baseline against which the extent and direction of change can be assessed in the future. Such information will also assist in identifying the region's biological assets, to inform policy and management agencies and to set priorities for biodiversity conservation.

You can download the whole Northern Australian Atlas or individual chapters free of charge at this link: **http://doi.org/10.22459/ABDM.12.2018.** 612

Ctenuchina de Guyane française, Lepidoptera, Erebidae, Arctiinae, Arctiini (partie 1)

by Jean-Aimé Cerda. In French and English.

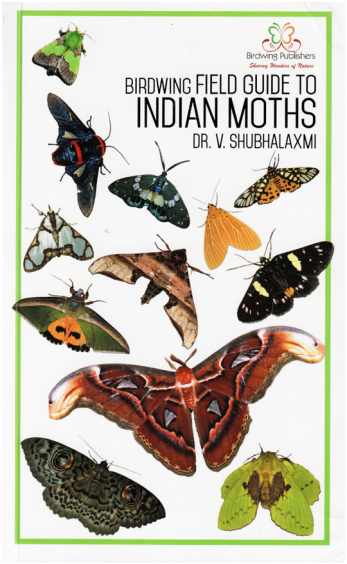
$90.00 softcover. 2017. 181 p., 20 full-page color plates with 149 photos of adult moths & 1 map of collecting zones; 115 figs. in text (photos of male genitalia). [Memoir No. 7, Société Linnéenne de Lyon] Treats 119 species currently known from French Guiana: 43 species added & 15 species removed from the fauna of French Guiana. Describes 2 new genera & 18 new species; 16 new combinations, 10 species with revised status, 11 new synonyms. Companion volume (Euchromiini de Guyane Française, 2008, softcover with 2 CDs of photos of adults & male genitalia) also available for $105.95. Entomological Reprint Specialists, 2985 E. Manzanita Ridge Pl., Tucson, AZ 85718-7342. Free U.S. shipping if you order direct (bugbooks@aol.com), or order online (no free shipping) at https://tinyurl.com/yaeeoy84 or on Amazon.com. 613

Seeking OOP Books: If you or someone you know has copies no longer being referenced, or you know of a source for **The Butterflies of Colorado, Part 1** (Satyriinae) and/or **Part 2** (Heliconiinae and Danainae) and/or **Part 3** (Nymphalinae), by Michael S. Fisher (C. P. Gillette Museum series), please contact Parker Backstrom at **dpbackstrom@embarqmail.com**.

Marketplace continued on pg. 99

Book Reviews

Birdwing Field Guide to Indian Moths (2018). By Vaylure Shubhalaxmi; vi + 461 pp., 11.5 cm × 18 cm, soft laminate cover; ISBN 978-81-931736-0-2; Birdwing Publishers, Mumbai; available directly from the publisher (**team@birdwingpublishers.com**) for ₹3,500 (~US$50) and from Pemberley Books, UK.



We are delighted to review this excellent book, which fills a large void in the literature on the moths of India. Finally, there is now a nice field guide that covers hundreds of macro moth species, and a few micros. The format closely agrees with the recent field guide on North American moths (Leckie & Beadle 2018) that was reviewed by Adams et al. (2018). As in the American book, the moths are shown mostly life-size (larger ones reduced, tiny ones magnified) in color photos, resting in a natural position with wings partially or completely folded, like we see them at rest in nature. As in the American book, most text is on the left pages with figures on the facing pages, but the distributions are stated in words giving the Indian states and neighboring countries, instead of as range maps. The Indian book goes farther by giving the authorship and year for each species name, although the parentheses are sometimes missing when needed or there when not needed. Misspellings are virtually absent. The families are arranged alphabetically which makes it easy to find everything, but this may be a bit uncomfortable for those of us who are used to seeing families arranged phylogenetically.

Dr. Shubhalaxmi has spent many years traveling all over India to collect moths. She wisely sought records and photos from regional collectors and advice from experts, resulting in a field guide with all the families, subfamilies, and tribes arranged according to current classifications. Roger Kendrick in Hong Kong, one of the foremost experts on East Asian moths, has written a Foreword, thus putting his stamp of approval on the book. Isaac Kehimkar of Mumbai is also a well-known entomologist in India (Kehimkar 1997) and was the author's mentor during her undergraduate and graduate studies. Introductory chapters discuss morphology, food and diet, rearing, adult behavior, photography, how to identify moths, importance of moths in the environment, and educating the public about moths. Although collecting is not given a section, there are plenty of comments and photographs pertaining to collecting.

It is intriguing to compare the Indian moth fauna to those of Europe and North America, when flipping through this field guide. Although much of India belongs to the tropical Oriental faunal zone, many Himalayan moths have obvious affinities to ones in the Nearctic and western Holarctic regions. The Indian geometrid *Amblychia pardicelata* (pages 201-202) is an exact match for *Epimecis hortaria* from eastern USA, and there are many more examples of such matches in the larger families. Many genera such as *Catocala, Biston,* and *Agrius* have species in India, Europe and North America. In this book we see Indian species of *Paectes, Mocis*, *Scopula, Timandra, Dolbina*, *Atteva*, and *Oreta*, to name only a few, that closely resemble North American species in those same genera. Apparently, farmers in India also must contend with *Agrotis ipsilon*. *Helicoverpa armigera* is called the cotton bollworm in India, whereas *Helicoverpa zea* is called the cotton bollworm in the USA. The unidentified thyridid on page 376 is a close match for *Meskea dyspteraria*, which Peigler has collected (yes, *collected*) in his yard in San Antonio.

Since we both work primarily on Saturniidae, we will offer some comments on the treatment of that family. Most species are shown correctly, but the correct name of the tasar silkmoth is *Antheraea paphia*, not *A. mylitta,* as we explained in a detailed study that looked at original type specimens, many larvae, genitalia, and moths from various populations (Naumann & Peigler 2016). Shubhalaxmi treated *Attacus taprobanis* from western India and Sri Lanka as a species distinct from *A. atlas* from northern and eastern India, in agreement with Peigler (1989). She also treats *Saturnia cidosa* correctly (Naumann & Löffler 2005), still called *Eriogyna pyretorum* by many authors, but unfortunately still places *S. thibeta* in the invalid genus *Caligula*. For sure the male specimen figured as *Cricula trifenestrata* is a misidentified *C. andrei* specimen, although all information on biology of this taxon is given correctly. The specimen of *Samia* on page 336 identified as *S. cynthia* is certainly not that species because the crescents are too narrow, and *S. cynthia* only occurs in northeastern China and Korea. The figured specimen most closely resembles the Japanese *S. pryeri*, but it is more likely *S. kohlli*, which is recorded from nearby China and Myanmar. The author incorrectly uses the name *S. cynthia* for the eri silkmoth on page 335, but on page 337 cites its correct name *Samia ricini* (Peigler & Naumann 2003). Of course, some rarer species such as *Sinobirma bouyeri* and the fauna from the Andaman Islands are missing.

Among other Bombycoidea the author also covers Brahmaeidae and Eupterotidae. In Brahmaeidae Dr. Shubhalaxmi shows the two known Indian species plus larvae of *Brahmaea hearseyi* and gives a short introduction into the family. Although the stated number of members (65 taxa) is somewhat overestimated, even with all synonyms included, it is obvious that the author knows the recent phylogenetic papers and accepts the inclusion of Lemoniidae in the family. The given distribution range is sometimes a little unfortunate, as these taxa do not occur only on the Indian subcontinent and the cited neighboring countries, but mostly all over Asia. The chapter on Eupterotidae is short, corresponding with the limited published knowledge on this family, so is therefore adequate. Due to the limited information available, there are a few minor mistakes: The family also occurs in Central America, and the male figured as *Ganisa plana* should be the corresponding male to the female specimen figured as male of *Tagora patula* which is probably determined correctly. Nevertheless, the figured specimens and information given make identification of specimens in the field very reliable, and thereby the aim of the book is completely fulfilled. We are not qualified to spot any misidentifications in other families, but we hope these are few, since the primary purpose of a field guide is to enable correct identifications.

Copies of the Birdwing Field Guide to Indian Moths should be in libraries of every natural history museum and many universities. For entomologists in South Asia, it would be an indispensable reference. To anyone broadly interested in moths, we highly recommend this book.

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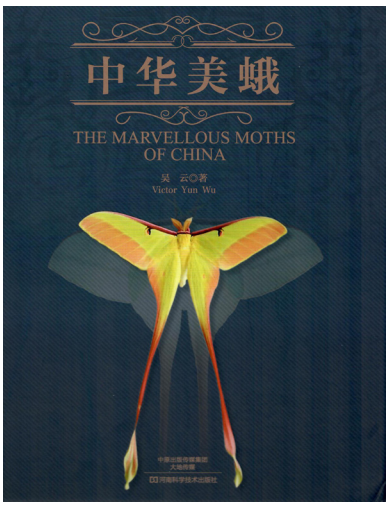
The Marvellous Moths of China (2017). By Victor Yun Wu. Henan Science & Technology Press, Zhongzhou, Henan. Hardbound, 13 + 403 pp., 24 cm × 30 cm. ISBN 978-7-5349-8407-5



Dual text in Chinese and English. Available from China Scientific Book Services, Beijing, for US $120.00.

It has been several years since any books on Saturniidae have been published but this is a mighty fine one that treats most of the Saturniidae of China (47 species), plus some Sphingidae (13, some rarely collected), and a few larger moths in the Erebidae (5), Epicopeiidae (2), Brahmaeidae (4), Uraniidae (1), and Zygaenidae (2). Several pages are also devoted to the papilionid *Bhutanitis thaidina*. It is surprising *Samia cynthia* was omitted since it is probably the most iconic Chinese saturniid; the exquisite *Samia watsoni* and the common and widespread *Samia wangi* are also missing. The book is filled with excellent photographs showing the Lepidoptera as living adults, eggs, larvae of all stages, pupae, cocoons, and habitats. It is thus a valuable resource for taxonomists. For each species, Wu describes his field observations, foodplants of the larvae, and lists the Chinese provinces for the distribution. The one-page bibliography at the end of the book is minimal. This book is far better than most of the Lepidoptera books published in China, which are usually faunal surveys containing misspellings of scientific names and misidentifications. The quality of the binding, printing, and color reproduction is excellent since it was printed in Singapore, exceeding that of most scientific books we have seen coming out of China.

The author spent over 20 years tracking down many species of larger moths in China and rearing most of them. His Foreword and Introduction detail his excitement with all these successes but the self-congratulatory narrative is excessive. Wu happily proclaims that he was the first to discover several hostplants and first to record and photograph many life-histories, and in most cases, he is probably correct. However, sometimes he simply is not familiar with the literature. For example, he claims to have been the first to discover that *Actias dubernardi* is a pine feeder, but Rudolf Mell (1950, Entomologische Zeitschrift 60: 41-45, 53-56), a German lepidopterist who lived for many years in China, reported this long ago.

Dr. Wu is affiliated with the MGM Butterfly Pavilion in Macau, China. He is especially interested in presenting Lepidoptera for their beauty, as well as in a scientific perspective. Over 30 pages are devoted to a favorite craft of his, namely creating pictures that are a collage or mosaic of butterfly wings suitable for framing and hanging on the wall. He is the artist of some of the illustrated pieces, but he shows the creations of others as well. Subjects include many birds, vases of cut flowers, and landscapes. Beyond this, the book contains hundreds of attractive images showing living Lepidoptera and mountains, so from the aesthetic perspective, the book is a huge success. On about 20 pages, we see photographs where Wu placed a live moth on human female bodies, so the backgrounds are bare hips, legs, feet, etc. which we thought strange, but Ryan St Laurent was clear by saying this would be considered sexist.

The author has collaborated with amateur lepidopterists in Europe, especially ones who rear Saturniidae and exchange livestock. Unfortunately, Wu did not seek input from those who have taxonomic expertise, so he has published some errors that could have been easily avoided with peer reviews. Some of the errors are misidentifications, primarily in the genera *Antheraea, Actias*, and *Loepa*, but the treatments of the genera *Samia, Attacus, Cricula, Lemaireia, Rhodinia, Salassa*, and *Saturnia* all appear to be correct for the most part. It is frustrating to see *Archaeoattacus edwardsii* still being placed in the genus *Attacus*, after it was separated more than a century ago; *Archaeoattacus* has been the broadly accepted generic name for *edwardsii* for decades, including by Chinese authors. Misspellings are few. The most serious errors are his attempts to name a few new species and subspecies, but these are all *nomina nuda* since no type specimens were designated, so they are all invalid and future authors are free to ignore the names. The taxonomic errors will be corrected in forthcoming publications by S. Naumann and W. A. Nässig.

On pages 359-361, Wu gives photographs of a "mystery larva" and its green cocoon, describing the rearing. It bears a remarkable resemblance to a saturniid in the subfamily Ceratocampinae, but that group does not occur in the Old World. We also could not figure out what it is, but Ryan St Laurent immediately identified it as belonging to the genus *Mirina* of the Endromidae.

The book is well organized, and with the table of contents and index, everything is easy to find. There are color figures on almost every page. For those who collect or rear Saturniidae, this book would be a very nice addition to their personal libraries. Anyone interested in the immature stages of the other families will find useful information and photographs as well. Despite its taxonomic shortcomings, we highly recommend this beautiful book.

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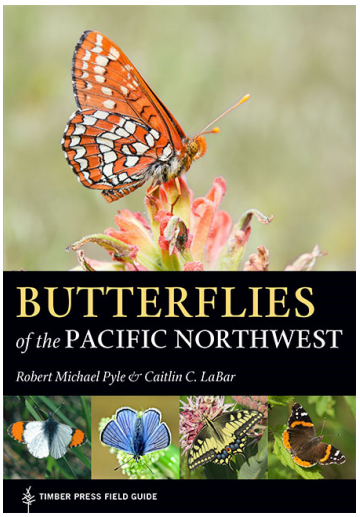
Butterflies of the Pacific Northwest (2018). By Robert Michael Pyle and Caitlin C. LaBar. Timber Press, 2018. Flexibind, 464 pp., 612 color photos, 198 maps, 20 illustrations. (ISBN-10: 1604696931) List price $27.95. More info at http://www.timberpress.com/books/butterflies_pacific_northwest/pyle/9781604696936.



Being a "kid" of the midwest and now the southeast, I hesitated to offer my services to review this book, thinking that I might not be able to offer a knowledgeable enough review. I'm glad I chose to, and that Bob Pyle accepted my offer to do so.

The book treats all species found (and likely to be found) in Washington and Oregon, as well as immediately adjacent areas in southern British Columbia, western Idaho, and northern California. The species accounts provide type localities, legal conservation status, tips on recognition, notes on variation, host plants, flight times, habitat and range (including maps), and remarks on the biology, similar species, etc. In addition, the accounts are richly illustrated, typically with at least two live images, including some combination of male/female and upperside/underside, and often three or all four. The authors did an excellent job of finding these photographs from a variety of photographers, who are listed in a LONG separate "Photo and Illustration Credits" section near the back of the book.

Scattered amongst the species accounts are plates of spread specimens, provided so that species in difficult groups can be seen side by side. For anyone familiar with the western butterfly fauna, some of the plates are obvious inclusions, such as the three *Speyeria* plates and the three plates of blues. Additional plates include six plates of skippers, two of the genus *Colias*, two plates of hairstreaks, one plate of *Boloria* ventral hindwings, a small one for comparison of *Euphydryas editha* and *anicia* ventral hindwings, and a plate of the ventral aspect of the species in the genus *Cercyonis*. These plates are a VERY useful addition.

The introductory parts of the book are exceptional. Starting with the list of Scientific Advisors that reads like a "who's who" of northwestern butterfly biologists, the authors then delve into "How to use the book". This might seem obvious, but they correctly point out that "Books cannot substitute for careful observation. Canny naturalists find that a useful field guide is only as good as the information they bring to it. . . . take notes: don't squander your original observations in the dimestore of your memory." Butterflies in nature vary (as the authors also point out) and so you should be ready to NOT have every image or specimen precisely match the images in the book. Taking notes of location, habitat, time of year, etc. can help you significantly narrow your search for a matching species in the book.

The authors then offer a short, standard account of "How Butterflies Work", followed by an extensive and extremely informative section on the biogeography of the PNW. The 15 ecoregions of the area are discussed in some detail, along with specialist butterflies that may be found in each region. The "Maps and Mapping" section explains their approach to providing the range maps that go with each species account. They indicate that the dot map approach is probably the most appropriate representation for the range of a species, as each dot represents an actual data point. However, there is a LOT of data for many species and dots for every single voucher would be prohibitive in some cases, and as such they have settled for a "shaded area" method, indicating correctly that a species should not necessarily be expected everywhere within the shaded region. For anyone wanting to add information on the range of a butterfly, the authors also emphasize that a voucher specimen, or at the very least an unmistakable photograph, should accompany each data point that is reported.

The authors also provide a section on the "Ecology and Conservation of Cascadian Butterflies". They indicate the threats to many butterflies, lamenting the "extinction of experience", as many, particularly the young, lose places to experience nature as urbanization and development encroach further and further on natural areas. Thankfully, there has been more interest in the PNW to develop new management regimes in many places, to help maintain and re-establish native habitats and their butterflies. In the section "Enjoying Butterflies" the authors support ALL activities: collecting, watching, gardening, photographing, rearing, participating in counts. They "urge tolerance and mutual understanding among all users of [butterflies]." They remind the readers that we would not know what we know without the collectors, and yet we should respect that many choose to appreciate butterflies in other ways.

I found but one error: the image of "Lucia's Azure" on page 229 is identified as male, but the image appears to be female. I was surprised to find that "Rhopalocera" was included as a heading, although the authors themselves indicate this is an outdated term. This is also the first time I have seen members of "Papilionoidea" called "Scudders". This is an appropriate honor for famous lepidopterist Samuel H. Scudder, but apparently it also refers to the "scudding flight" (as opposed to skipping flight of Hesperioidea). I had to look up what "to scud" means, and, having done so, not all Scudders "scud" (though not all skippers skip). That said, I am impressed, and you will be, too, by this book!

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What one can learn from collecting 25,000 moths in one's backyard during two years

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Abstract: Based on 25,000 voucher specimens of moths that were collected over two years (2005, 2006), this study is directed at understanding the overall abundance and seasonal composition of a moth community in North Central Florida and determining the phenology of its members. The dominant moth species at different times of the year, as well as the overall community composition, differed significantly for these two years. Analyzing phenologies of species in several major moth families showed that these families as a whole have different reproductive strategies in terms of voltinism, overwintering stages, and the time of flight of the first brood. The overall contribution of each Lepidoptera family to the biomass in the ecosystem changed between years. All taxa, regardless of the taxonomic level, exhibit a typical gamma species abundance distribution. At the genus level, analyses of phenologies suggest the presence of niche partitioning by means of allochronic distribution, supporting similar studies on birds. Analyses of speciose genera show marked differences in local abundance across related taxa which may be the result of adaptation to different life history strategies to reduce competition. Despite a significant increase in the diversity of adult Lepidoptera in April-September, peaking in May, assessing monthly species composition suggests that the fauna remains relatively unique throughout the year. Even during the normally colder months of November-February, there are many species that are not found during the summer. Hence, even in subtropical ecosystems, where below freezing temperatures shut down normal plant growth and most insect activity, sampling should be conducted throughout the year, if one is to comprehensively assess faunal composition.

Moths provide an enormous volume of biomass that feeds vertebrates, such as birds, bats, and even grizzly bears (Robinson & Holmes, 1982; Freeman, 1979; White et al., 1998). The pressure from moth caterpillars is responsible for much of the chemical defense found in plants (e.g., Feeny, 1970). They are also an important group of pollinators (e.g., Atwater, 2013), and, of course, many species are notorious pests (e.g., Solomon, 1995).

Despite the importance of moths, our knowledge of their biology is vastly incomplete. Even though we have a relatively good knowledge of the overall species composition of the moth community in Florida (e.g., Heppner, 2003; Kons and Borth, 2006), much less is known about their biology. The Lepidoptera of Florida catalog, compiled by John Heppner (2003) in collaboration with Lee Adair, David Baggett, Terry Dickel, Linwood Dow, Tom Emmel and Dale Habeck, offered a comprehensive (but now somewhat outdated) checklist and summarized known hostplant information. Kons and Borth (2006) led the way in providing an impressive amount of information on seasonal diversity and phenology of moths from the central and northern parts of the state, basing their assessment on 47 collecting localities. This region is located in a contact zone of temperate and tropical vegetation, and hence exhibits a diverse flora: the state as a whole has more native tree species than any other US state – over 480 (Nelson, 2010), but it is the north-central part of the state where the great majority of them are found. For instance, there are over 20 species of oaks and over 10 species of pines found around Gainesville, and while these are representatives of temperate genera, they are intertwined with tropical plants, such as palms, passion vines, pipevines, coral beans, and bromeliads. For one of their localities (a mesic hardwood-pine forest habitat in south Gainesville at the former location of the American Entomological Institute), Kons and Borth used 49,000 collecting records between 2001 and 2004 to thoroughly assess seasonal variation in diversity.

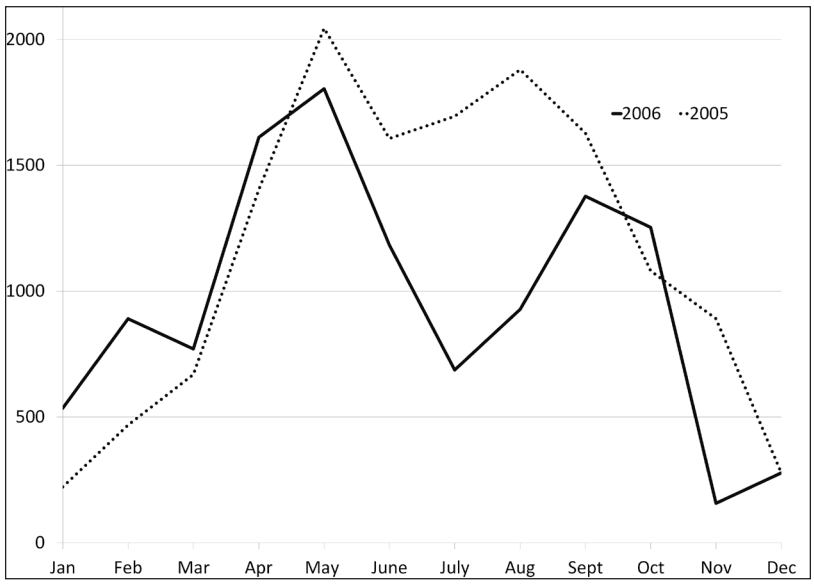


Fig. 1. Phenology of overall moth fauna estimated based on 2 years of indiscriminate collecting with a 12-volt black light near Paynes Prairie, north-central Florida.

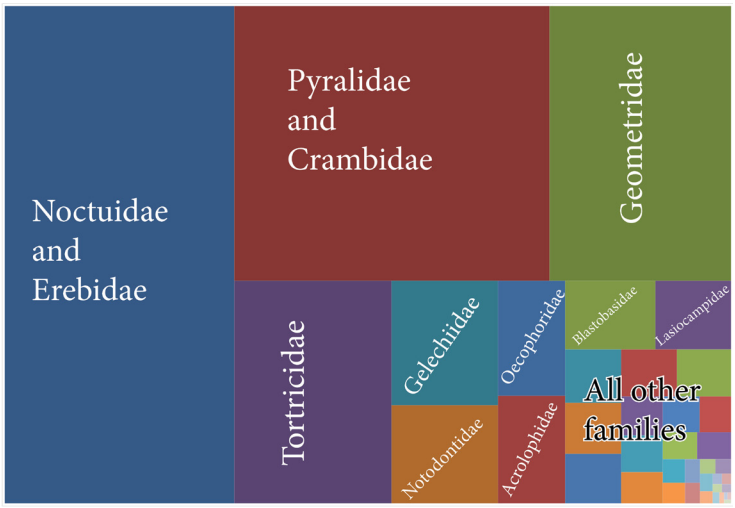


Fig. 2. Abundance of moths by family in 2006. The fauna was dominated by Pyraloidea, Noctuoidea, Geometridae and Tortricidae.

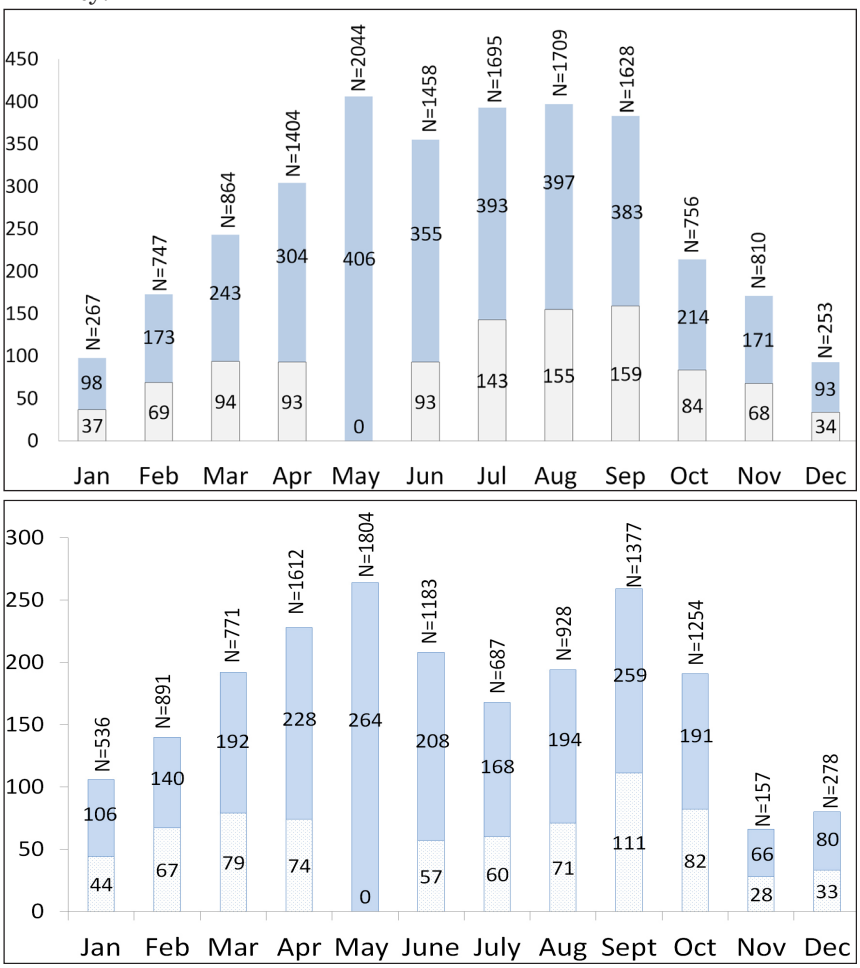
The present study is directed at analyzing phenology of moths found in a single habitat outside of Paynes Prairie, in Gainesville. The habitat is located only about 6 miles east of the main Kons and Borth (2006) survey site but is much closer to the wetlands. The richness of plant community translates into a similarly rich moth community. In this particular habitat, which is a secondary mixed forest surrounded by roadsides, pastures, and wetlands, close to 900 species of moths have been found (Austin, 2010). The second author started surveying his backyard for moths when he moved to Gainesville in 2004. Shortly after, upon suggestion from the first author, he began to collect regularly and indiscriminately and did so for two full years. During 2005-2006, every moth that came to a white sheet illuminated by a 12-volt black tube light was collected, spread, and identified by the second author and databased by the first author. The sampling occurred twice a week every month of the year, resulting in over 25,000 individual moths, which were deposited in the collection of the McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History.

In the present article, the first author attempted to analyze the rich collections made by the second author in his backyard, where he resided from 2004 until his untimely departure in 2009. The checklist of collected species was published shortly after the second author's death (Austin, 2010), while the preliminary results of the analyses were presented by Sourakov and Austin (2006) at the Lepidopterists' Society annual meeting and at the Forum Herbulot in 2010. While the temporal and geographical scope of this study are quite limited, the results offer another glimpse into community ecology and population dynamics of these ecologically important insects.

Results

Overall diversity and phenology

April through October are the months when the moths were the most abundant, and there were two peaks of abundance in May and August-September (Fig. 1), which likely represent two emergence peaks of two subsequent generations for many bivoltine species (e. g., *Automeris io*), combined with massive emergence of some univoltine species (e. g., *Malacosoma* sp.). The overall moth population decline in mid-summer may also be attributed to hotter temperatures of June-July, which coincide with more rain and fewer flowering nectar plants as compared with May and September. The sharp decline in moth numbers began in October and hit its lowest point in December, which coincided with the normal seasonal senescence of many plants due to lower temperatures and shorter days. Most of the moths found in this ecosystem throughout the year could be attributed to either pyraloids, noctuoids, geometrids or tortricids (Fig. 2).



Figs. 3 & 4. Number of moth species in any given month and their uniqueness as compared to the most speciose month (May). Year: 2005 (top) & 2006 (bottom).

Despite the drop in overall moth numbers in the middle of the summer, the species diversity remained high from May (when it was the greatest in both years of sampling) through September, declining sharply in October and hitting the bottom in December (Figs. 3-4). But despite high spring diversity, even in May, only about half of the total species found throughout the year was present. Moths, therefore, seem to exhibit high degree of individual seasonality. For instance, in the month of February, despite the fact that it is one of the colder months of the year, 40% and 47% of the total fauna present was not observed in the month of May in 2005 and 2006, respectively.

Viewed collectively by family, moths of different families tended to exhibit somewhat unique phenology patterns, which also differed by year (Figs. 5-6). For instance, in 2005, while geometrids peaked in February and May, the noctuoids and pyraloids peaked three times: in May, July, and September, perhaps reflecting three generations for most of the noctuid species. However, in 2006, while geometrids followed a similar pattern, the other two groups had two distinct peaks around May and September. Such changes in pattern could result from any number of abiotic conditions or from explosions in generalist moth predators, disease or parasites.

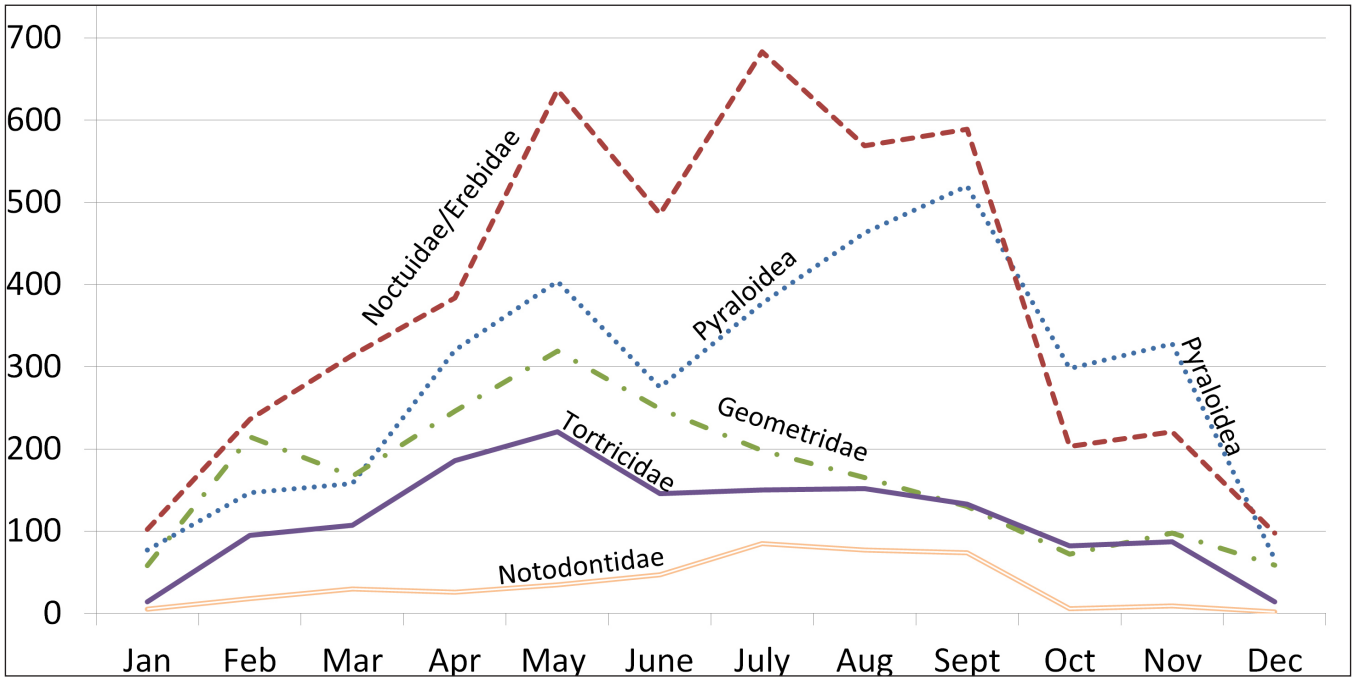


Fig. 5. Phenology of moths by family. Year 2005.

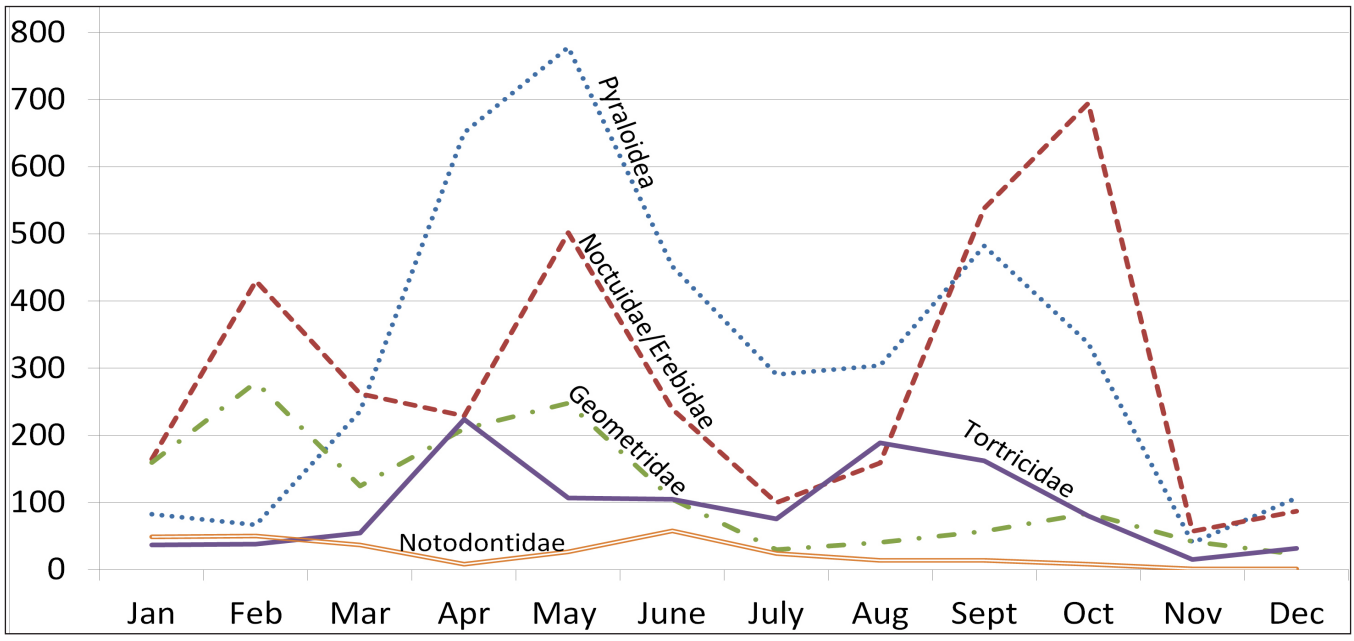


Fig. 6. Phenology of moths by family. Year 2006.

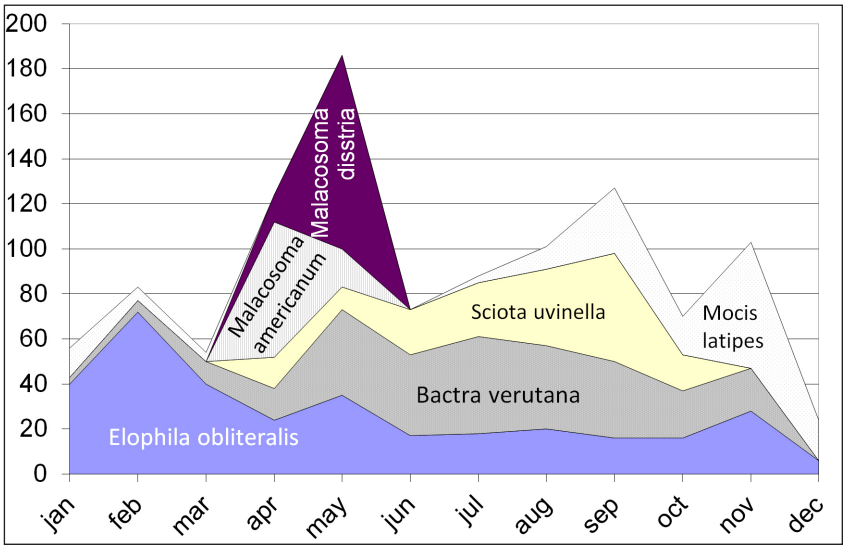


Fig. 7. Phenology of most dominant moth species in 2005: *Elophila obliteralis*, *Malacosoma americanum*, *Malacosoma disstria*, *Bactra verutana*, *Sciota uvinella*, *Mocis latipes*.

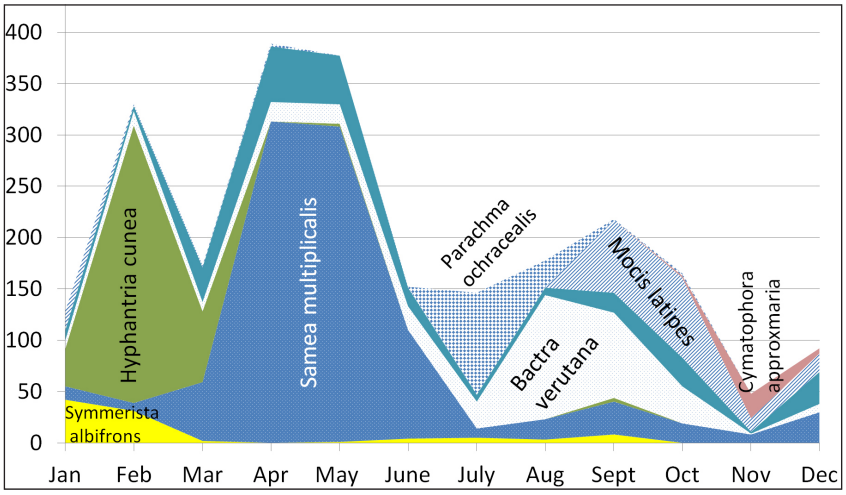


Fig. 8. Phenology of most dominant moth species in 2006: *Symmerista albifrons*, *Hyphantria cunea*, *Samea multiplicalis*, *Parachma ochracealis*, *Bactra verutana*, *Mocis latipes*, *Cymatophora approximaria*.

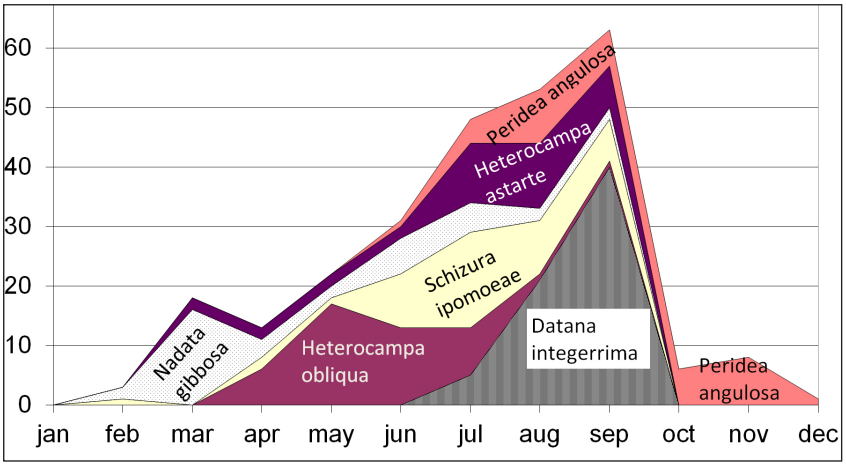


Fig. 9. Phenology of 6 most common Notodontidae species in 2005: *Nadata gibbosa*, *Heterocampa obliqua*, *Heterocampa astarte*, *Peridea angulosa*, *Datana integerrima*, *Schizura ipomoeae*.

Dominant and most common species

Only three species of moths that were most numerous throughout 2005 also proved to be dominant in any given month. In 2005 (Fig. 7), a crambid, the waterlily leafcutter moth, *Elophila obliteralis*, dominated the moth fauna in January-March; a pyralid, the sweetgum leafroller moth, *Sciota uvinella*, was a dominant species in October; a tortricid, the javelin moth, *Bactra verutana*, dominates the fauna from July until September, and also in November. Not among the most numerous moths, the two tent caterpillar moths, *Malacosoma americanum* and *M. disstria,* had a very compact emergence time and a short flight period, so they dominated moth fauna in April and May, respectively. The striped grass looper moth, *Mocis latipes* (Noctuidae) mostly flew in the fall and was the most numerous moth in November - December.

In 2006 (Fig. 8), the fauna in January was dominated by the white-headed prominent moth, *Symmerista albifrons* (Notodontidae); February was dominated by the fall webworm, *Hyphantria cunea* (Erebidae), followed in April-June by the salvinia stem-borer moth, *Samea multiplicalis* (Crambidae), and then by a sudden explosion of the parachma moth, *Parachma ochracealis* (Pyralidae) in July. While *B. verutana* was dominant again in August and September and the striped grass looper was present in high numbers again in September-October, the most numerous moth in November of 2006 was a geometrid, the giant gray moth, *Cymatophora approximaria*. Hence only three out seven dominant species in 2006 were also dominating the fauna in any given month in 2005.

As far as which moth species were the most numerous overall during the year, in addition to the above-mentioned *B. verutana*, *S. uvinella*, and *E. obliteralis*, in 2005, the most common were the waterlily borer moth, *Elophila gyralis*, the banded tiger moth, *Apantesis vittata*, and the geometrid, *Iridopsis defectaria*. Three of these species (*B. verutana*, *S. uvinella*, and *E. obliteralis*) remained among the six most numerous moths in 2006, joined by *M. latipes*, *H. cunea*, and *S. multiplicalis*.

Relative abundance of closely related moths

Analyzing phenologies of most common species within individual families (e.g., Figs. 9-10)

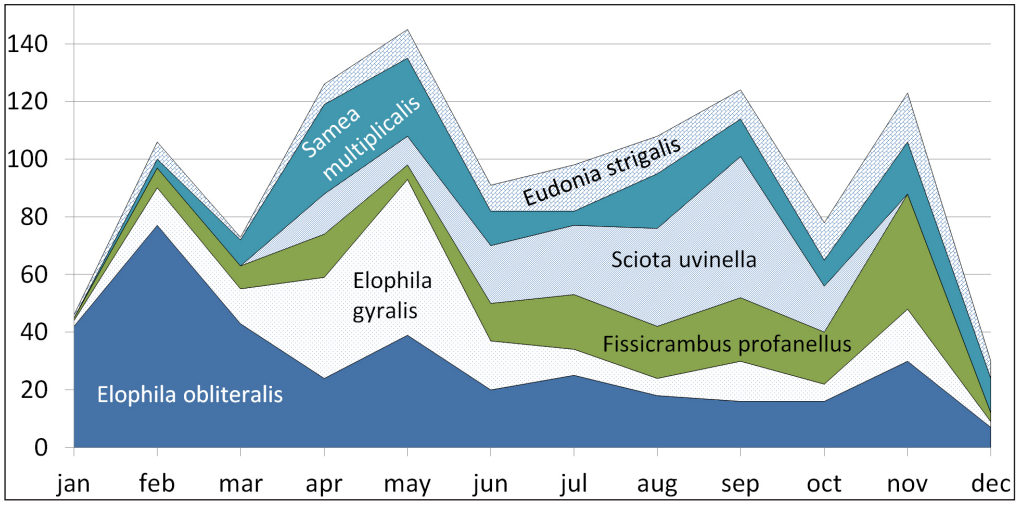


Fig. 10. Phenology of 6 most common Pyraloidea species in 2005: *Elophila obliteralis*, *Eudonia strigallis*, *Samea multiplicalis*, *Sciota uvinella*, *Elophila gyralis*, *Fissicrambus profanellus*.

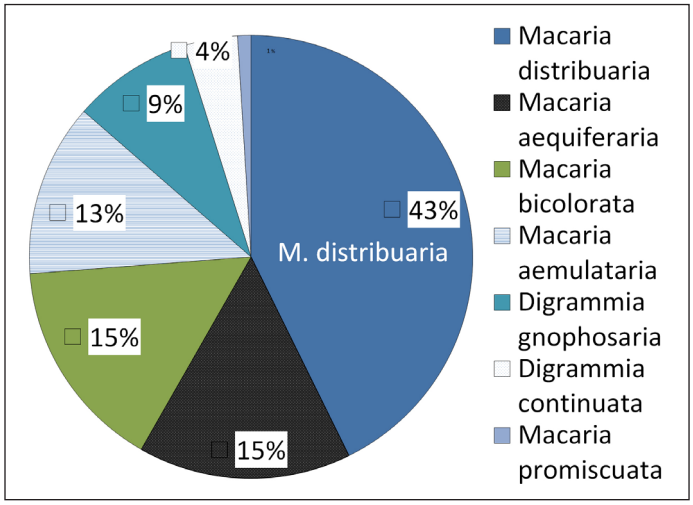


Fig. 11. Relative abundance of species within macariine geometrids in 2005.

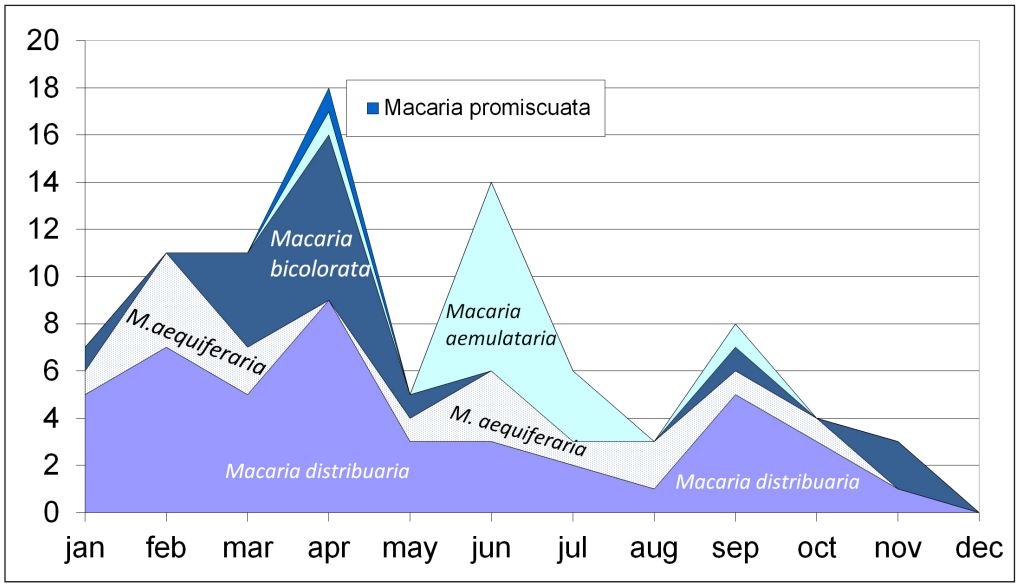


Fig. 12. Phenology of species within the genus *Macaria* (Geometridae) in 2005.

can provide some insight into the role of different species by family in the overall biomass of moths in the ecosystem. For instance, notodontids mostly peak in July-September (Fig. 9), pyraloids peaked throughout the season (Fig. 10), and tortricids and geometrids tend to peak in the spring.

Relative abundance showed similar pattern in all the families and speciose genera: following one or two unequivocal leaders, numbers of common species rapidly declined with the majority represented by few individuals (e.g., Figs. 11, 13, 15, 17). Members of the same genus normally were scattered more or less evenly through the abundance spectrum within their respective families (e. g., Fig. 15). Within speciose moth genera such as *Macaria* (Geometridae), *Catocala* (Erebidae), *Acronicta* (Noctuidae), *Choristoneura*, *Cydia*, *Epiblema* and *Platynota* (Tortricidae), or *Acrolophus* (Acrolophidae) the tendency was for one or two more common species to be responsible for more than 50% of all the captured individuals in that genus (e.g., Figs. 11, 13). Similar tendency was observed in smaller families, such as Sphingidae (Fig. 17).

Niche partitioning

If more than one species within a single genus was very common, they tended to peak at different times, perhaps as a result of evolving life history strategies that reduce competition. For instance, *Malacosoma americanum* flew in April and *M. disstria* – in May (Fig. 7). Together they accounted for 85% of all Lasiocampidae of which seven species were present, and both species flew in such high numbers that they dominated the entire moth fauna during these times. Congeneric extremely common aquatic crambids, *Elophila obliteralis* and *E. gyralis* were peaking at different times, with the former reaching the highest numbers in February and the latter in May (Fig. 10). Peaking of the third aquatic crambid, the salvinia stem-borer moth, *Samea multiplicalis*, began in April.

Among *Macaria* (Geometridae), *M. aequiferaria* peaked in

February and June, *M. bicolorata* in April, and *M. aemulataria* in June (Fig. 12). The most common, *M. distribuaria*, which accounted for 43% of *Macaria* specimens in 2005, peaked three times: in February, April and again in September.

At first glance, the noctuid genus *Acronicta* seems like an exception, as most of its 13 species peaked in July (Fig. 14). However, the two most common species in that genus, *A. oblinita* and *A. afflicta* (which together accounted for 43% of all *Acronicta* in 2005), peaked at different times from most of the species: *A. oblinita* in April, June and October, and *A. afflicta* – in March and June.

Among noctuids and erebids, both *Mocis disseverans* and *M. latipes* were extremely common in 2005, the former was more common in August, while the latter peaked in September-November (Fig. 16). The armyworms also peaked at different times: *Spodoptera eridania* was common from March through July, while *S. dolichos* increased in numbers in August-September (Fig. 16).

This study highlights the complexities of understanding insect population dynamics and making predictions about future insect abundance. While extremely time consuming, a similar study conducted over a longer period of time may reveal interesting trends on how a moth fauna responds to environmental changes, but these trends may not become apparent for a number of years. It will be of great interest to investigate further the ecological mechanisms underlying the supposed niche partitioning by congeneric species.

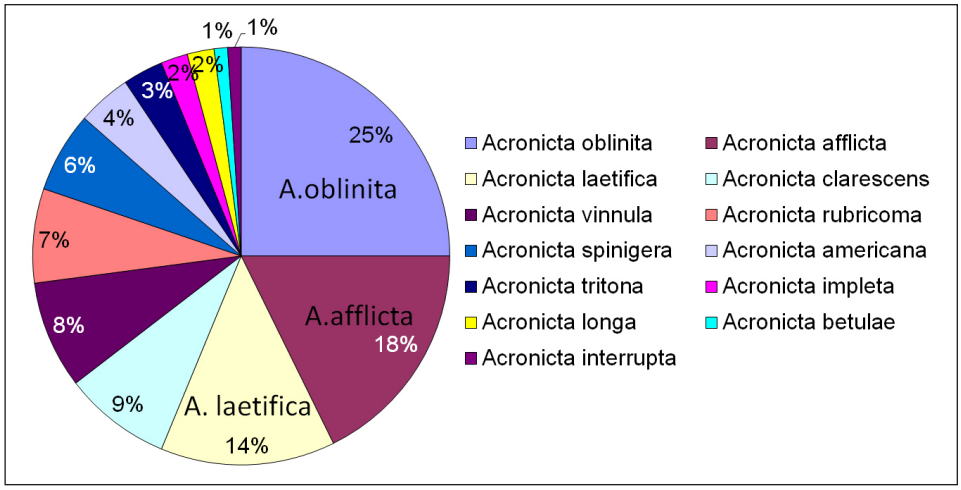


Fig. 13. Relative abundance of species within genus *Acronicta* (Noctuidae) in 2005.

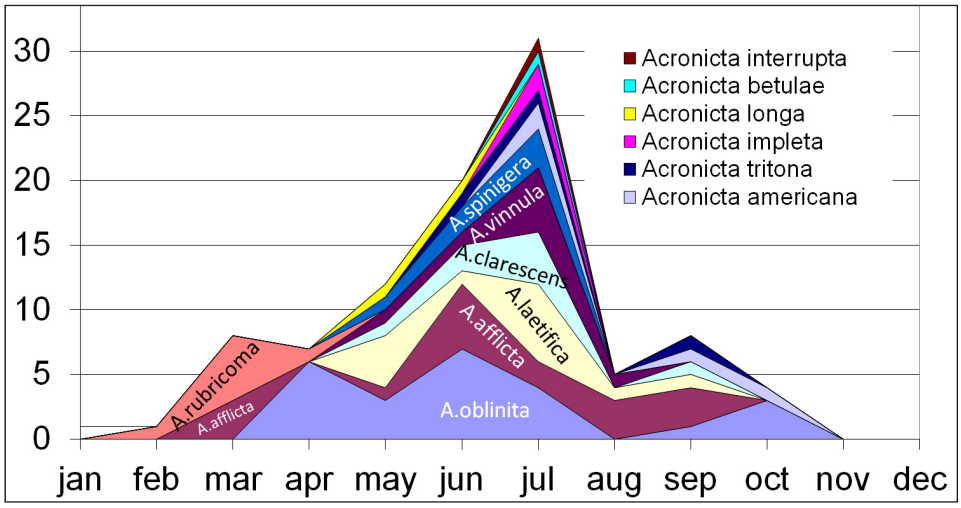


Fig. 14. Phenology of species within genus *Acronicta* (Noctuidae) in 2005

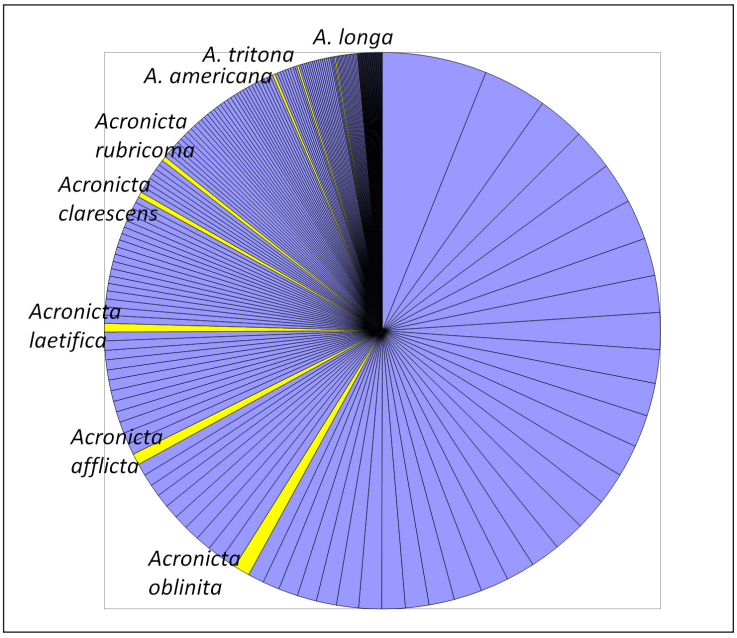


Fig. 15. Distribution of relative abundance of species of the genus *Acronicta* among 201 other noctuid/erebid species in 2005.

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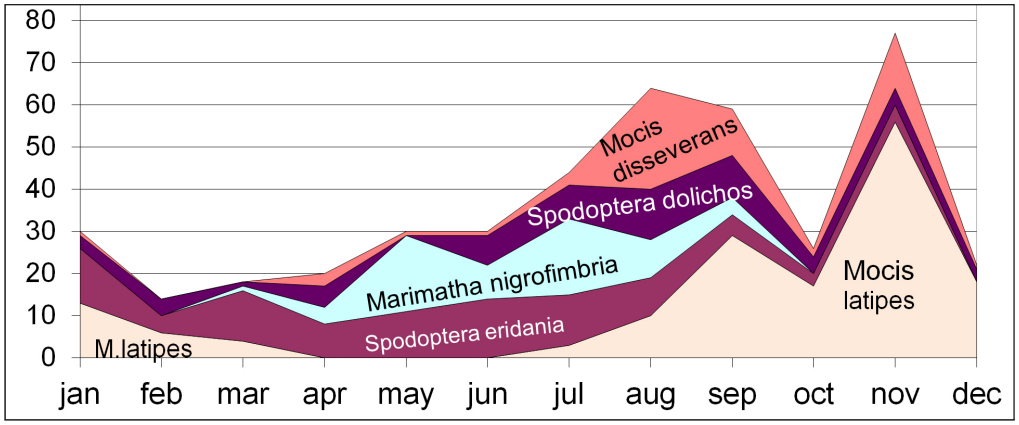

Fig. 16. Phenology of five most common noctuid/erebid species in 2005.

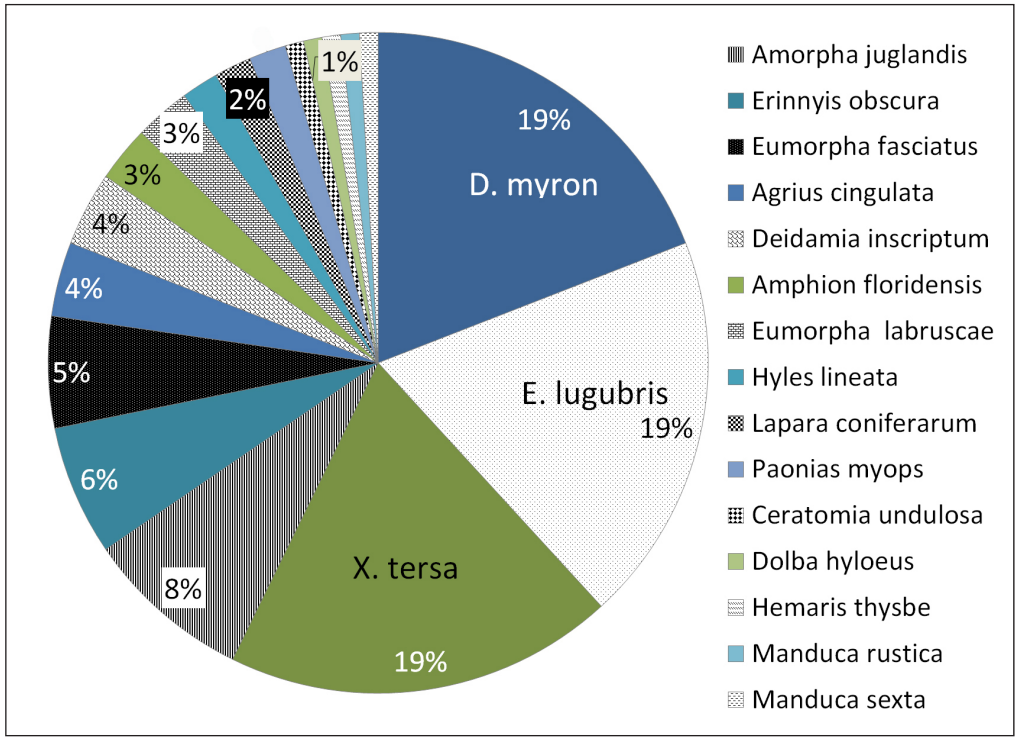

Fig. 17. Relative abundance of species within Sphingidae in 2005.

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Su'ad Yoon, one of the two winners of this year's Ron Leuschner Memorial Fund for Research on the Lepidoptera (see page 70)

Membership Updates

Chris Grinter

Includes ALL CHANGES received by May 1, 2019. Direct corrections and additions to Chris Grinter, **cgrinter@gmail.com.**

New Members: *Members who have recently joined the Society, e-mail addresses in parentheses. All U.S.A. unless noted otherwise. (red. by req. = address redacted by request*

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Andrew Chaulk: 33-554 Platts Lane, London, ON, CANADA (achaulk@uwo.ca)
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Ryan Spahn, one of the two winners of this year's Ron Leuschner Memorial Fund for Research on the Lepidoptera (see page 70)

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Sachith Srikanth: Univ. of Arkansas Little Rock, Dept of Biology, 2801 S University Ave., Little Rock, AR 72204 (sxsrikanth@ualr.edu)
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Lorenzo Pizzetti: via Benedetta 5/1, Parma, PR I-43122 ITALY (lpizzett@tin.it)

Marketplace

Continued from p. 88

Books and Equipement: Home wanted

I am in need of downsizing my lepidoptera cabinets/Cornell drawers as well as some books as my wife and I are looking at smaller homes. I don't want to simply "toss" any of this material that has been so special over the years, but I think many of us collectors will be going through this as we age! Here is what I have right now: 1). Complete set of Moths of Am N of Mexico fascicles; 2). Claude Lemaire's 3 vol set on Saturniidae; 3). An excellent 1000 watt Vernon Brou light trap/moth attractor in case with bulb ready to shine; 4) Also one or two 12 drawer Cornell cabinets with emptied drawers. There would be minimal charges to anyone who could provide a good home, though shipping would clearly be more difficult for the equipment than the books. If interested, contact Steve Mix at **citheroniaregalis@hotmail.com.** 612

Marketplace continued on pg. 104

www.lepsoc.org and https://www.facebook.com/lepsoc

Conservation Matters: Contributions from the Conservation Committee

The Chiricahua Mountains, sky islands and climate change

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We offer this essay to draw special attention to the unique high-elevation biotas of southeastern Arizona and northern Sonora, Mexico, and the threats they face from climate change and associated fires. Our focus is on the Chiricahua Mountains, which harbor one of the most globally significant moth faunas of any similar-sized range north of Mexico.

Biodiversity increases towards the equator and with topographic complexity. Mountains in particular, with their rich collection of different life zones, exposures, soils, hydrologies, and microclimates support much elevated species diversity. Montane species richness tends to peak in middle elevations, while the proportion of endemics tends to increase with altitude—see below.

Sky island ranges are those that are surrounded by lands that represent barriers to biotic dispersal. By definition, the sky island ranges of Southeastern Arizona are those massifs that rise far enough above the desert floor to include oak woodlands. More than a dozen ranges qualify, with the more renowned including the Chiricahuas, Huachucas, Pinaleños, Santa Catalinas, and Santa Ritas (Figure 1). The ranges include several different life zones (Chihuahuan or Sonoran): desert, juniper grassland, oak woodland chaparral, deciduous woodlands, Canadian mixed forest, and Hudsonian spruce-fir forests. Some of the ranges rise so abruptly that all six of these life zones can occur within close proximity of one another. The Chiricahua Mountains are special among these in that they form the largest sky island in southeastern Arizona, are among the highest ranges, have extensive area above 8000 feet, and are the most proximate to the Sierra Madre Occidental.

Endemism in mountains tends to increase with altitude because the biogeographic barriers to dispersal increase for the higher-elevation biota. For example, in southeastern Arizona, it is easier for an oak woodland species to disperse across low desert stretches, than for spruce-fir associates that have evolved to inhabit cooler, more mesic forests. And perhaps of greater relevance, the chance of a dispersing individual to fly to another oak woodland, a community type that occupies much of southeast Arizona is many times that of a moth dispersing to one of the few islands of spruce-fir forest, which occupy less than 2% of the land area. With cessation of gene flow, such isolated high-elevation populations eventually come to represent full species.

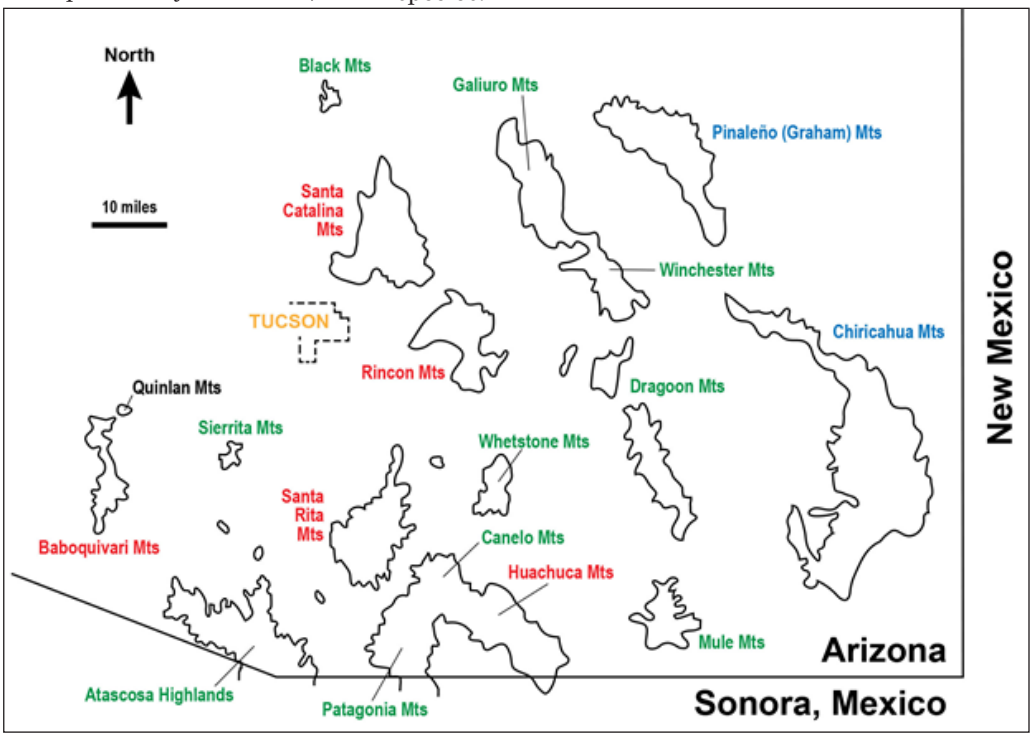


Fig. 1. Southeastern Arizona's sky island ranges. Mountains in green have a maximum elevation of 7,000 feet; those in red have a maximum elevation of between 8,000 to 9,500 feet; the blue ranges have a maximum elevation of 10,700 feet, with spruce-fir forests on top. Map adapted from Bruce Walsh's *Moths of Southeastern Arizona* website (with permission).

Table 1. Preliminary list of Chiricahuan Sky Island Lepidoptera. Species listed below are believed to be sky island taxa whose core range includes the Mogollon Rim, Southeast Arizona's sky island ranges, and Sonora (Mexico). Asterisks indicate taxa whose only populations in the United States are restricted to the upper elevations of the Chiricahua Mountains; two asterisks are used to indicate that we only know of Chiricahuan records; if only single asterisk appears after a name, the species is also known from Sonora Mexico (although we do not yet have genetic data from Mexican collections that could be used to determine to what degree the entities might represent different population segments). Disclaimer: our data and this list are both incomplete and preliminary.

DREPANIDAE	**GEOMETRIDAE** (continued)	**NOCTUIDAE**
Thyatira mexicana	*Melemaea virgata*	*Apamea walshi*
	Nemoria near *albaria*	*Dichagyris kyune*
EREBIDAE	*Nemoria mutaticolor*	*Dichagyris lobato*
*Agylla septentrionalis**	*Nemoria splendidaria*	*Dichagyris mixteca*
Ptychoglene phrada	*Nemoria strigataria*	*Hypotrix alamosa*
*Apantesis allectans***	New genus and species	*Hypotrix* new species
Gnophalea clappiana	*Paota fultaria*	*Lithophane leeae***
Lophocampa significans	*Pityeja ornata*	*Paratrachea viridescens*
Drasteria walshi	*Sabulodes hauchuca*	*Pseudanarta basivirida***
	Stamnodes apollo	
GEOMETRIDAE	*Stamnodes artemis***	**NOLIDAE**
Carptima hydriomenata	*Stamnodes lampra**	*Afrida exegens*
Chiricahua lichenaria	*Stamnodes splendorata*	
Chiricahua multidentata	*Stenoporpia* n. sp.	**NOTODONTIDAE**
Eriplatymetra lentifluata	*Vinemina perdita*	*Clostera* near *paraphora***
Eutreptsia inconstans		*Skevisia broidricci*
*Evita hyalinaria***	**HEPIALIDAE**	
Hydriomena chiricahuata	*Phymatopus* near *hectoides***	**PIERIDAE**
Hydriomena constipunctata		*Neophasia terlooii*
Hydriomena magnificata	**LASIOCAMPIDAE**	
Hydriomena sperryi	*Caloecia entima**	
?Lomographa species**	*Caloecia juvenalis**	

The special importance of the Chiricahuas derives from the amount of habitat above 8,000 feet. At about this elevation, fir becomes a much more significant element of the forest, the communities receive more annual precipitation, and it is spread over more months of the year. Road access to the higher-elevation forests of the Chiricahuas is modest. Historically, most collections of high-elevation Lepidoptera came from sites along the main road, i.e., Onion Saddle and the Rustler Park area. Many recent collections also include Barfoot Park, and the less accessible Long Park, which sits at 9,000 ft. None of these four sites are proximate to the spruce stands that grow on north slopes and in ravines at the highest elevations of the range. Chiricahua Peak, which rises over 9,750 feet, has not yet been well-sampled by entomologists. We are hopeful that the new LED blacklight traps that are in development will make it easier for us and others to sample from more remote locations across the range.

Sky Island Moths. We list some 50 species that are either endemic to the Chiricahuas or are believed to be restricted to high elevations of nearby sky islands (Table 1). A few are known only from the nearby Huachucas, but not yet from the Chiricahuas, e.g., *Nemoria splendidaria* and *Skevisia broidricci*. Nearly all represent taxa of global conservation importance. We have tentatively identified 11 moths known only from the Chiricahuas, and this we believe to be a conservative estimate; once more distributional and genetic data are in hand, this number could rise significantly. Given how much collecting has been carried out in the mountains of southeast Arizona and the proximity of the American Museum's Southwest Research Station, it is a bit surprising to find that at least six species are believed undescribed with one of these representing a new genus (Chris Schmidt pers. comm.). The list is dominated by geometrids, a fact that no doubt reflects their relatively weak flight abilities.

Virtually all are denizens of Canadian and Hudsonian forests, and perhaps as many as a half are believed to feed on spruce and fir. Another trait that stands out is that many are non-feeding as adults (e.g., some of the arctiines, the hepialid, lasiocampids, and the thyatirid), and thus would have low capacity for long-distance dispersal. In addition to the Chiricahua pine white butterfly (*Neophasia terlooii*) and *Gnophalea clappiana* (Arctiini: Pericopina), a number are believed to be wholly or partly diurnal, especially among the geometrids, e.g., *Eutrepsia inconstans* (Fig. 2), ?*Lomographa* n. sp., *Melemaea virgata*, and *Paota fultaria*.

Mistaken Entities. A substantial number of the moths that have been collected and curated into North American insect collections are going under names that are concealing their true identities. Our first glimpse of this phenomenon came with what was being called *Nemoria albaria* (Grote), a winsome emerald that feeds

Fig. 2. *Eutrepsia inconstans* is a rarely encountered day-flying geometrid restricted to high-elevation communities of southern Arizona and adjacent New Mexico. Tanner Matson and DLW discovered its larvae feeding on mountain giant hyssop (*Agastache pallidiflora*) in September, 2018 below Onion Saddle. Early and middle instar larvae maybe so deeply buried in the calyxes of hyssop as to be scarcely visible. Adult photo courtesy Richard C. Hoyer/Birdernaturalist.

on oceanspray (*Holodiscus discolor*) (Fig. 3), a plant that only grows in moist mountainous communities in southeastern Arizona. Barcode data from John Gruber and our Chiricahua collections immediately distinguished this entity as an undescribed species, distinct from *N. albaria*.

Over the course of the last three years, we have been barcoding moths from higher elevations of the Chiricahuas. We have now discovered multiple instances of moths that were thought to be conspecific with more widely distributed southwestern moths, but that are genetically distinct, with barcode distances of 2-6% from other individuals in the Barcodes of Life Databases. The new emerald differs from *N. albaria* by more than 6%.

We are in the process of assessing the genetic distinctness of more than 70 randomly selected moths from the higher elevations of the Chiricahuas collected by JP and Tanner Matson. We have only assessed data for a few of these randomly sampled individuals, but the same pattern is unfolding: many represent genetically distinct cryptic taxa, mistakenly confused with their more widespread western sister taxa.

Biogeography. It is unknown what fraction of these Chiricahuan moths listed in Table 1 represent global endemics. We suspect that the lion's share will have limited representation in the high-elevation communities of nearby ranges to the east (Sacramentos of New Mexico), north (Pinaleños and Mogollon Rim), west (Santa Catalinas and Santa Ritas), and especially to the south (Sierra Madre Occidental). Based on the multi-year collection efforts of JP in Sonora as part of the Madrean Discovery Project (www.madreandiscovery.org), it appears that a large fraction of the lepidopteran fauna from the Chiricahuas will also be found in proximate montane communities of northern Mexico. But given the geological and ecological isolation of the Chiricahuas—the mountains are surrounded by desert

Fig. 3 *Nemoria* near *albaria* was first recognized as new species from collections made at Barfoot Park. The moth, rare in collections, is restricted to high-elevation sky-island communities of Mogollon Rim, south through the Chiricahuas into northern Sonora. Specimens in collections have mistakenly been curated with *N. albaria* (Grote). The two emeralds occur sympatrically in high-elevations of the Santa Catalinas and Chiricahuas. The larvae of both are specialists on oceanspray. The uncorrected pairwise distance between the new *Nemoria* and its closest cousins, *N. diamesa* and *N. albaria*, are 6.5% and 6.4%, respectively—for most Lepidoptera differences > 2% are indicative full species status (and represent roughly a million years of separation from their shared ancestor).

and low ranges under 6,500 feet by more than 60 air miles in every direction—we suspect that a significant fraction of the taxa now isolated in the montane communities of the Chiricahuas will prove to be genetically distinct population segments. Thus, regardless of their taxonomic status as subspecies or full species, many will be found to be globally imperiled entities, and thus of special conservation concern.

The multiple threats of climate change and heightened fire risk. While many equate global warming with climate change, and many news stories focus on 2-3° C-projected increases in average global temperatures, the threats of climate change to biodiversity are not so much about the direct physiological effects of temperature increases, but rather about the indirect effects triggered by higher temperatures. Of particular worry are *changes in annual precipitation patterns* and *climate variability*. Droughts represent a particular threat to insects because of their great surface area to volume ratios—we suspect many will be ill-equipped to endure the droughts that are predicted to befall the American Southwest.

Climate models predict that droughts in the American Southwest will be more intense, of longer duration, and come with greater frequency. There will be compounding effects: as average air and ground temperatures warm, clouds and precipitation can be pushed away, acerbating aridity. Changing precipitation patterns will challenge many plants, and with them, their dependent herbivores—over 85% of lepidopteran species are thought to be hostplant specialists. Stressed plants may be ill-equipped to deal with their natural enemies: at least some of the bark beetle devastation through the Rocky Mountains and elsewhere has been linked to drought stress. And still worse, fire risks will be significantly elevated—this made abundantly evident by last summer's conflagrations across every western state and southern Canadian Provinces.

In 2011, the Chiricahua mountains were struck by the massive Horseshoe 2 fire, which burned 70% of the range. The area around Rustler Park was especially hard hit (Fig. 4). (A sense for the fire's extent and severity, particularly at higher elevations, might be best understood by taking a Google Earth flyover of the higher Chiricahuan peaks with current imagery and then sliding back in time to dates prior to May 2011.) Of worry is that the high-elevation spruce-fir communities, which are home to most of the endemic taxa that are the focus of this article, represent a relict forest type, dating to the period following the last glacial maximum 25,500 years ago. It is not at all clear that the historic spruce and fir forest will be able to replace itself given the catastrophic nature of the Horseshoe 2 fire. Soils that were perennially shaded and moist are now sunbaked. The acreage formerly given to Canadian and Hudsonian zone forests, is likely to be replaced by more arid-adapted pine woodlands, prematurely transforming the ecosystem to another life zone.

The frequency of fires in the West is sure to increase due to elevated human use and climate change. The Chiricahuas are one of Arizona's major routes for human migration and drug smuggling. With increasing aridity and human visitation the frequency of fires could easily outpace the range's ability to recover, with each fire and prolonged drought eating away at the Chiricahua's globally unique upper-elevation biota.

Thus our plea: we urge all, so far as feasible, to include mountain-top communities like the Chiricahuas in your plans, and do what you can to document the biota there, and the interactions among species. Share your findings on Moth Photographer's Group, iNaturalist, BugGuide, and like platforms; make sure your images, data, specimens, and collections are cared for, and in the case of collections, destined for a public institution. When home, make efforts to support clean energy, reduce your carbon emissions, and take other actions to reduce atmospheric carbon—it is among the greatest future threats to our wildlands and biodiversity, and especially to mountain dwellers with no upward path of retreat. The high-elevation flora and fauna of the Chiricahuas is at the top of the massif—those lineages that can't adapt could soon be pushed into oblivion by rapidly warming global temperatures and attendant fires.

Fig. 4. Rustler Park summer 2018. The Horse Two fire burned as much as 70% of the entire Chiricahua Mountain Range. Higher-elevations forests, e.g. those around Rustler Park were severely affected. Nearly one-hundred percent of Chiricahua National Monument, which sits to the west of Onion Saddle, burned. Photo courtesy of Tanner Matson.

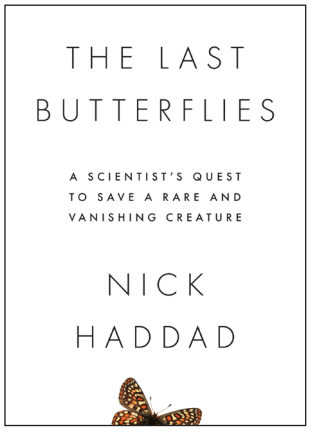
Marketplace

Continued from p. 99

Publications, continued

The Last Butterflies: A Scientist's Quest to Save a Rare and Vanishing Creature

by Nick Haddad



Most of us have heard of such popular butterflies as the Monarch or Painted Lady. But what about the Fender's Blue? Or the St. Francis' Satyr? Because of their extreme rarity, these butterflies are not well-known, yet they are remarkable species with important lessons to teach us. *The Last Butterflies* spotlights the rarest of these creatures—some numbering no more than what can be held in one hand. Drawing from his own first-hand experiences, Nick Haddad explores the challenges of tracking these vanishing butterflies, why they are disappearing, and why they are worth saving. He also provides startling insights into the effects of human activity and environmental change on the planet's biodiversity. A moving account of extinction, recovery, and hope, *The Last Butterflies* demonstrates the great value of these beautiful insects to science, conservation, and people.

Research

WANTED: spread, high-quality (i.e., scaled, undenuded) specimens of *Halysidota tessellaris, H. harrisii*, and *H. cinctipes* for a study testing the efficacy of new methods of species delimitation. +50 individuals of each sex needed for each species. Specimens will be imaged, have their DNA sequenced, and have their genitalia dissected to confirm IDs. Recently collected specimens (<5-10 years old) preferred. Live specimens greatly appreciated, though not necessary. Donators will be acknowledged in any publications using data derived from specimens, unless they prefer to remain anonymous. For more information please contact Dr. Nick Dowdy of the Milwaukee Public Museum (njdowdy@gmail.com). indefinite

To all it may concern: Search Notice.

We are searching for a very mysterious moth species : *Aphomia fuscolimbellus* Ragonot (Lepidoptera, Pyralidae) (see fig 1). It was described in 1887 by Ragonot under the name of *Melissoblaptes fuscolimbellus*, and the type locality given was «Amér. sep.». On the label of the type it is «Am. spt.» for «Amérique septentrionale» or «America septentrionalis». There is only one specimen known, actually in the Muséum National d'Histoire Naturelle, in Paris (France). The type is a male and it has a wingspan of 24mm. It was sent by Moeschler to Ragonot. We know that most of the specimens described by Moeschler from North America were coming from Labrador through the Moravian Missionaries. Was it the case with this specimen?

Nobody knows. The abdomen of the specimen seems to have been cut off. Was it for genitalic dissection purpose? In any case, no dissection was found in the Muséum in Paris (Patrice Leraut, pers. comm.).

According to Dr Alma Solis (pers. comm.), it could be a misslabeled specimen seemingly related to an Indo-Australian group of moths. But who knows? If North American, it could feed on dried materials, insects, etc., and it could be a late Autumn or an early Spring species.

SO, if anybody has one or more specimens in collection that could be this species, from America or other countries, please contact urgently: **Louis Handfield, 845 de Fontainebleau, Mont-Saint-Hilaire, Québec, Canada J3H 4j2; e-mail: lscal@netrover.com; and Phone : 450-467-8925**

It would be a great discovery. 612

Fig. 1 Type of Aphomia fuscolimbellus Rag. (image courtesy of Jean-François Landry).

Wanted, spring/summer 2019: Live specimens, any stage, of *Leptotes marina*. I prefer populations using *Plumbago* as a hostplant. Contact Raymond White (rrweditha@yahoo.com) to discuss numbers, timing, delivery, & payment. 612

Collections

WANTED: Large private collections or individual specimens of native or exotic species of Lepidoptera, Coleoptera, Hymenoptera, Diptera, etc. Experienced in dealing, thoughtfully, with family members who desire to sell the collection of a loved one who passed on and also those who have loads of stored specimens wanting to unload some to make room. No matter how common or rare, do not hesitate to contact me. Willing to travel. Only purchasing specimens/collections already in the United States; I am not interested in importing. Thank you for considering me and trusting my hands to see to it that your collection gets appreciated for many years to come. Please email Jay Timberlake at crossmoth777@aol.com or text me at (812)267-4319. Thank you! 612

Recent observations on the rarely encountered sesiid borer - *Synanthedon richardsi*

William H. Taft, Jr.

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Synanthedon richardsi was described by Engelhardt in his 1946 publication" The North America Clear-wing Moths of the Family Aegeriidae". The type and paratype male and female specimens were collected in moist meadows at buttonbush flowers in Clarke County, Georgia on June 13, 1938 by A. Glenn Richards. The range of this species would seem to be the Piedmont and Appalachian Plateaus from Maryland south to Georgia and west to Ohio and Kansas (Eichlin & Duckworth 1988). Since that publication, a single specimen was reported from Torreya State Park in Liberty County, Florida (Brown & Mizell 1993). Nothing has been published since then regarding the range, food plant, or biology. Specimens of this species are almost unknown in most North American museum collections even though it would appear to have a wide distribution in the eastern United States. To my knowledge, no male moths have ever been collected with sesiid pheromones.

While making identifications of sesiids on Bugguide.net several years ago, I came across a June 22, 2013 photo from Wayne, New Jersey of a female *Synanthedon richardsi* (Engelhardt) sitting on a light sheet taken by Jeffrey Cook (Figures 1 & 2). The moth was located within a residential neighborhood adjacent to an oak woodlot and lake. Since these first images were posted, several additional images have been added to the Bugguide internet site. One image was taken of a single female moth and another of a mating pair in Highland Park, Queens County, New York by Mike Feder on June 26, 2017. The moths were sitting on a leaf of a recently planted hedge which appeared to be Black Haw (*Viburnum prunifolium*) from the image. The area adjoining the hedge was extensively mowed lawn. I contacted the parks department staff regarding the shrub plantings and they indicated they were a cultivar of *Prunus caroliniana* commonly known as Carolina laurel cherry.

The most recent images were added to the Bugguide site in 2019 but the images were actually taken on May 29, 2017 in Columbia, South Carolina by H. Flamholtz. The female moth was emitting pheromones while sitting on a leaf of Black Haw (*Viburnum prunifolium).* This moth was also was found in a residential setting with Carolina laurel cherry present.

These images and data show that we are learning more about this rare moth species, its range and possible food plant relationships by assisting nature photographers on the various internet sites such as iNaturalist.org and Bugguide.net. Hopefully this information will lead to the resolution of the basic life history questions of this interesting species.

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Eichlin, T.D. & Duckworth, D. (1988) Sesioidae: *Sesiidae*. In Dominick, R.B. et al. (eds), The Moths of America North of Mexico. Fasc. 5.1. Washington: *Wedge Entomological Research Foundation*, 176 pp.

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Figures 1 & 2. *Synanthedon richards*i female in Wayne, NJ, June 22, 2013, at light sheet. Photos used with permission from Jeffrey Cook.

Membership

The Lepidopterists' Society is open to membership from anyone interested in any aspect of lepidopterology. The only criterion for membership is that you appreciate butterflies and/or moths! To become a member, please send full dues for the current year, together with your current mailing address and a note about your particular areas of interest in Lepidoptera, to:

Kelly Richers, Treasurer
The Lepidopterists' Society
9417 Carvalho Court
Bakersfield, CA 93311

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Active (regular)	$ 45.00
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(outside U.S., for above add 5$ for Mexico/Canada, and 10$ elsewhere)	
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Air Mail Postage, **News**	15.00
($30.00 outside North America)	

Students must send proof of enrollment. Please add $5.00 to your dues if you live in Canada/Mexico, $10.00 for any other country outside the U.S. to cover additional mailing costs. Remittances must be in U.S. dollars, payable to "The Lepidopterists' Society". All members receive the **Journal** and the **News** (each published quarterly). Supplements included in the News are the Membership Directory, published in even-numbered years, and the Season Summary, published annually. Additional information on membership and other aspects of the Society can be obtained from the Secretary (see address inside back cover).

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Submission Guidelines for the News

Submissions are always welcome! Preference is given to articles written for a non-technical but knowledgable audience, illustrated and succinct (under 1,000 words, but will take larger). Please submit in one of the following formats (in order of preference):

1. Electronically transmitted file and graphics — in some acceptable format — via e-mail. Graphics/figures should be at least 1200 x 1500 pixels/inch^2 for interior use, 1800 x 2100 for covers.

2. Article (and graphics) on disk or thumb drive in any of the popular formats/platforms. Indicate what format(s) your disk/article/graphics are in, and call or email if in doubt. The InDesign software can handle most common word processing software and numerous photo/graphics software. Media will be returned on request.

3. Color and B+W graphics; should be high quality images suitable for scanning. Original artwork/maps should be line drawings in pen and ink or good, clean photocopies. Color originals are preferred.

4. Typed copy, double-spaced suitable for scanning and optical character recognition.

Submission Deadlines

Material for Vol. 59 and 60 must reach the Editor by the following dates:

Issue		Date Due
61	3 Fall	August 15, 2019
	4 Winter	November 15, 2019
62	1 Spring	February 15, 2020
	2 Summer	May 12, 2020

Be aware that issues may ALREADY BE FULL by the deadlines, and so articles received close to a deadline may have to go into a future issue.

Reports for Supplement S1, the Season Summary, must reach the respective Zone Coordinator (see most recent Season Summary for your Zone) by Dec. 15. See inside back cover (facing page) for Zone Coordinator information.

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Verdant thornveld, Waterberg Plateau Escarpment, Namibia

at the end of the summer rainy season in February. There were good numbers and fair diversity of butterflies including: *Colotis* sp., *Belenois* sp., *Pinacopteryx eriphia*, *Charaxes* sp., *Junonia hierta*, *Hamanumida daedalus*, *Ypthima* sp., numerous (but not diverse) Polyommatinae, and *Axiocerses tjoane*, pictured here.

Photos by Danusia Antonowicz, captions by Steve Fratello.

Left: *Axiocerses tjoane* female, Waterberg Thornveld, perched close to ground level; Right: *Axiocerses tjoane* female close up