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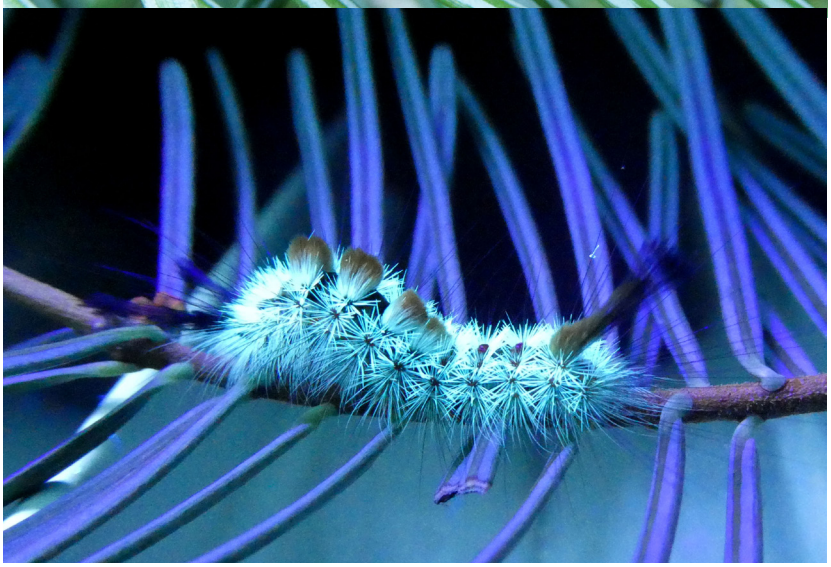

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Volume 60, Number 4
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Tussock moth caterpillar (*Orgyia sp.*) – July 8, 2018, Mount Shasta, California (photo: David Moskowitz; see related article page 169)

John Abbot, Jacob Hübner, and *Oreas helicta* (Nymphalidae: Satyrinae)

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The English artist-naturalist John Abbot (1751-c.1840) documented a staggering amount of information about southeastern Lepidoptera during the 64 years that he lived in Georgia. His achievements, however, have sometimes been cited in instances where there is no evidence of his knowledge or involvement. A notable example involves a butterfly originally named *Oreas helicta* Hübner.

Citing a number of differences (wing pattern, male genitalia, behavior, and habitat), Gatrelle (1999b) recognized a new species among southeastern butterflies that were previously identified as the Georgia satyr, *Neonympha areolatus* (J. E. Smith). He believed the new species was analogous to a butterfly that the German entomologist Jacob Hübner (1761-1826) had illustrated under the name *Oreas helicta* in the book *Sammlung Exotischer Schmetterlinge* [*Collection of Exotic Butterflies*] (Hübner 1806-[1838]) (Fig. 1). In making his case, Gatrelle (1999b) claimed that Hübner's illustration of *O. helicta* was copied from a drawing by John Abbot, implying that the figured specimens were from Georgia. Gatrelle (1999b) therefore applied the name *Neonympha helicta* to his newly recognized southeastern species. Because the original description of *Papilio areolatus* in Smith and Abbot (1797) was based on a drawing by Abbot, Gatrelle reasoned that Abbot "surely knew that his *helicta* and *areolatus* were two species." To reinforce this opinion, Gatrelle (1999b) designated a neotype of *Oreas helicta* from Aiken County, South Carolina, which is located across the Savannah River from Burke County, Georgia, where Abbot lived for many years. Gatrelle (1999b) also designated a neotype of *Papilio areolatus* (as "*areolata*") from Chatham County, Georgia, where Abbot also lived and collected butterflies. He restricted the "geoecological type locality" of *O. helicta* to "the upland sandhill habitats of Aiken County, South Carolina and Burke County, Georgia," and that of *P. areolatus* to "the marshy sedge forests of coastal Georgia." Gatrelle (1999a) proposed the term "geoecological type locality" to describe an area "occupied by the single colony, population, or phenotype from which the representative type specimen(s) was/were taken." It is not synonymous with a type locality, which is the geographical place of capture of the name-bearing type.

Fig. 1. Plate [95] of *Oreas helicta* from Hübner (1806-[1838]) (WU).

No descriptive letterpress accompanied Hübner's hand-colored, engraved plate of *Oreas helicta*, thus the figures serve as an indication (i.e. "original description") of that nominal taxon. Hübner himself never suggested that his *helicta* differed from *areolatus*. Living in Augsburg, Germany, he probably lacked access to a copy of Smith and Abbot (1797) — which was published in England — until after he proposed the name *helicta*. Hübner ([1808]-[1825], 1816-[1826]) later considered *helicta* and *areolatus* to be synonymous.

The status of *Neonympha helicta* remains uncertain. Many butterflies are known to exhibit wing characters of both *N. helicta* and *N. areolatus* (Ogard & Bright 2010, LeGrand & Howard 2017). In northern Florida wetlands, Kons et al. (2017) found continuous variation in wing pattern and male genitalia, and concluded that Gatrelle's (1999b)

wing characters for *N. helicta* fall within the range of intrapopulation variation of *N. areolatus*. Gatrelle (1999b) suggested that *N. helicta* and *N. areolatus* may hybridize where they are sympatric. Settling this taxonomic debate will require much more research.

Lack of evidence. Except for a few in private hands, I have examined all of John Abbot's known butterfly drawings, as well as his written observations, and correspondence. I also have located numerous butterfly specimens that he likely collected in Georgia. Based on my experience, I am not convinced that Abbot actually encountered a butterfly in Georgia that agrees with Gatrelle's concept of *Neonympha helicta*.

First of all, there is no indication that Hübner reproduced any of Abbot's drawings. This notion can possibly be traced to Harris (1972), who made the same unsupported assertion. A few illustrations in *Sammlung Exotischer Schmetterlinge* were reportedly based on drawings that Hübner received from others (Eisinger 1917), but there is no proof that he possessed, or even consulted, any of Abbot's original watercolors. I have conducted detailed comparisons of Abbot's artwork with Hübner's published illustrations. Their artistic styles significantly differ and there are no similarities in their figures. Moreover, Hübner made no mention of Abbot, nor are any of Abbot's drawings included among Hübner's surviving manuscripts at the Natural History Museum, London (UK; NHMUK). The origin of these claims can possibly be traced to 32 small drawings by Hübner's later assistant, Carl Geyer (see below). These drawings, deposited at NHMUK, portray figures of Lepidoptera that Geyer copied from plates in Smith and Abbot (1797). All are marked as "Abb." (Abbot), along with the number of the published plate. Only three portray butterflies, copied from Plates 14, 16, and 24 of Smith and Abbot (1797). It does not appear that any of these duplicate illustrations by Geyer were ever published. Hübner undoubtedly illustrated *Oreas helicta* from actual specimens.

Secondly, there is no reason to believe that Abbot personally recognized two different species of *Neonympha* in Georgia. There is nothing in Abbot's manuscripts to suggest any such insight. Abbot's notes mention that he encountered these butterflies "in Bays" and "on the sides of branches [streams]," or along "rivulets," implying that he found them only in wet situations. Gatrelle (1999b) observed that southeastern *N. helicta* seem to occur in dryer, upland habitats, whereas *N. areolatus* is limited to wet, marshy areas. Abbot's notes suggest that he encountered only what Gatrelle (1999b) defined as *N. areolatus*. Abbot never alluded to a second species.

The same goes for Abbot's drawings and specimens. None of his six known illustrations of *Neonympha* agree with Gatrelle's concept of *N. helicta*. This includes a drawing at the Thomas Cooper Library (University of South Carolina), which was used to illustrate *Satyrus areolatus* in Boisduval and Le Conte (1829-[1837], Pl. 63). In addition, four old specimens (two males, two females), believed to have been collected by Abbot, do not agree with *N. helicta* based on wing morphology. These specimens, deposited at the Linnean Society of London (UK) and the Museum of Comparative Zoology (Harvard University), are from the collections of James E. Smith (who described *Papilio areolatus*) and Thaddeus W. Harris (who corresponded with Abbot). Smith's specimens were presumably acquired after he described *areolatus*, as he made no mention of them in his description in Smith and Abbot (1797). Another female, probably collected by Abbot, is portrayed in a collection of drawings known as "Jones' Icones" (vol. 2, Pl. 92), which were rendered by William Jones beginning in 1783 (Hope Library of Entomology, Oxford University Museum of Natural History, UK; OUMNH). This specimen reportedly came from the collection of the London jeweler John Francillon (1744-1816), who acted as Abbot's agent in selling his specimens and drawings to European naturalists. Jones' illustration was cited by Smith in his description of *Papilio areolatus*. Francillon's specimen closely resembles the female figured in Smith and Abbot (1797), which was reproduced from an Abbot drawing.

Butler ([1867]) first suggested that Hübner's figured specimens of *O. helicta* were from Georgia when he considered *helicta* to be a synonym of *areolatus*, which he attributed to "Georgia, United States." However, the actual source of the specimens is unknown, and there are no references to this butterfly among Hübner's surviving manuscripts (Hemming 1937). All we know is that the specimens were collected prior to 1808, when Hübner's plate was first published. Nonetheless, there may be some evidence of their history before reaching Hübner. From 1801 to 1805, the Austrian entomologist Johann Carl Megerle (von Mühlfeld) (1765-1840) auctioned numerous insects, including North American Lepidoptera (Schenkling 1935, Kerzhner 1991). (His extremely rare auction catalogs can now be viewed online at Internet Archive and Biodiversity Heritage Library.) Some of Megerle's specimens likely made their way to Hübner (Clark and Clark 1941). His auctions of 1803, 1804, and 1805 offered butterflies identified as *"areolatus*. Sm[ith]." Although Megerle listed numerous butterflies and moths from "Georg[ia]" (which were surely collected by Abbot), no locality was given for the specimens of *areolatus*. While some of Hübner's North American specimens reportedly came from Georgia, New York, Pennsylvania, and Virginia, most are of unknown origin (Hemming 1937).

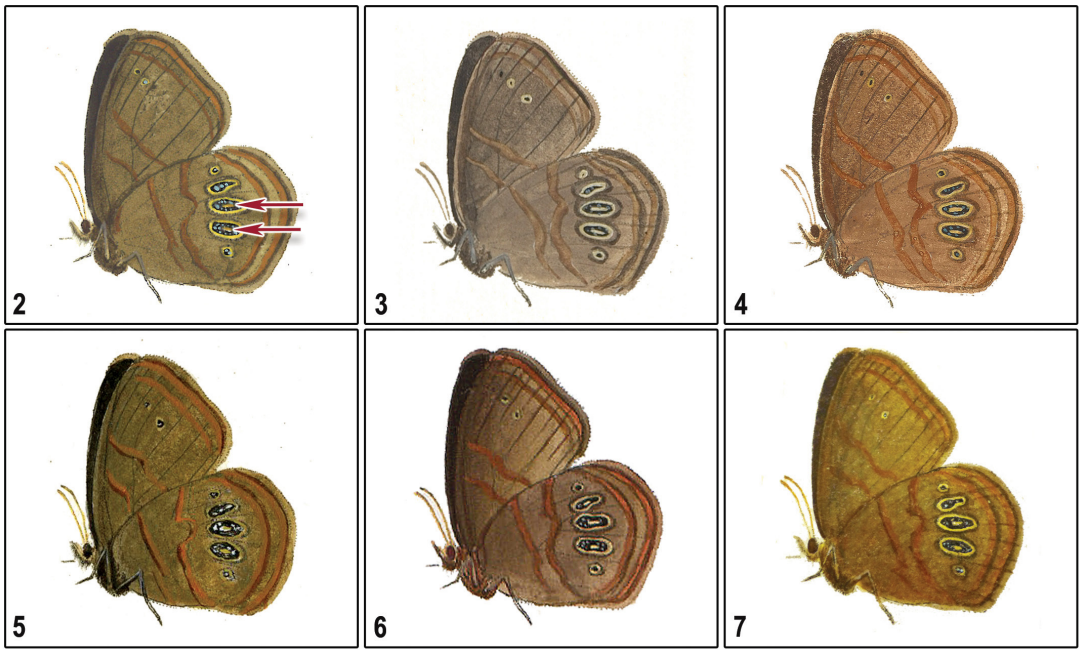
It is conceivable that Hübner's specimens of *O. helicta* originated from farther north along the Atlantic coast. They may represent a butterfly that Gatrelle (1999b) identified as *N. helicta septentrionalis* W. T. Davis. Originally described as a "race" of *N. areolatus*, Gatrelle (1999b) considered *septentrionalis* to be a subspecies of *N. helicta*, which ranges from North Carolina to New Jersey, though the most northerly populations may be a discrete

species (Gotchfeld & Burger 1997, Schweitzer 2005). Unfortunately, we know nothing about the distribution of *Neonympha* butterflies within the Mid-Atlantic region two centuries ago. They were possibly more widespread within suitable habitats, which were long ago lost to agriculture and urban development.

Discrepancies in Hübner's figures. I was surprised to discover that Hübner's figures of *Oreas helicta* do not entirely agree with Gatrelle's definition of *Neonympha helicta*. According to Gatrelle (1999b), the ventral hindwing of *N. areolatus* tends to have "prominent yellow areas in the center on at least one or two spots," while *N. helicta* has "little, if any, yellow pupiling." For his analysis of *O. helicta*, Gatrelle received a digital image of Hübner's plate from the Naturhistorisches Museum (Vienna, Austria; NMW) (G. M. Tarmann pers. comm.). It clearly shows conspicuous yellow pupils within the two largest eyespots of the ventral female (Fig. 2) and the largest eyespot of the ventral male. Gatrelle (1999b) did not address this contradiction.

To make certain that the yellow pupils were intentionally included on the NMW plate of *O. helicta*, I received a higher resolution scan of this print, and compared it to four others at the American Museum of Natural History (New York; AMNH) (Fig. 3), Cullman Library (National Museum of Natural History, Smithsonian Institution; NMNH) (Fig. 4), Thomas Rare Book Library (Wittenberg University; WU) (Fig. 5), and Universitätsbibliothek Heidelberg (Heidelberg, Baden-Württemberg, Germany; UH) (Fig. 6). All the female figures on these prints have prominent yellow pupils within the same two hindwing eyespots. The UH print also has a pupil within a third eyespot (Fig. 6). The only male figures that possess yellow pupils are those at WU and NMW; all others lack this feature. Yellow pupils are also present in two of the eyespots of the ventral female in the later facsimile of *Sammlung Exotischer Schmetterlinge* by Wytsman and Kirby (1894-1908). This is not surprising, given that the facsimile was presumably based on the copy of Hübner's book at NMNH (Fig. 4), which was once owned by the facsimile's co-editor, Philogène A. G. Wytsman. In addition to these prints, I consulted the original pattern plate of *O. helicta* (NHMUK), which was created by Hübner as a guideline for coloring the published plates. It, too, displays yellow pupils within the eyespots of the ventral female (Fig. 7).

The pattern plate further violates Gatrelle's concept of *N. helicta*. According to Gatrelle (1999b), the coloration of the bands on the ventral wings are brighter orange in *N. areolatus*, and those of the ventral forewing of *N. helicta* are nearly always brown. While the NMW print of Hübner's plate (which Gatrelle consulted) (Fig. 2) agrees with this description, the wing banding on the pattern plate is orange-red throughout, as in *areolatus* (Fig. 8). The banding on the UH print (Fig. 6) is also decidedly red on both the forewing and hindwing, bearing little resemblance to the NMW print (Fig. 2). In addition, the ventral eyespots vary in shape between prints, some being more rounded than others (Figs. 2-7). The tints and quality of the coloring also vary considerably between copies, with no two being alike. The pattern plate (Fig. 7) is probably the most faithful representation of the original specimens, as it presents a more nuanced, realistic coloration than the published copies. It was presumably colored by Hübner directly from the specimens. Gatrelle (1999b) mistakenly considered the NMW print to be a definitive representation of Hübner's plate. Regrettably, the wings of all the specimens that Hübner figured in *Sammlung Exotischer Schmetterlinge* were supposedly pasted into scrapbook-like volumes, which are now missing (Hemming 1937).



Figs. 2-7. Ventral female of *Oreas helicta* from Hübner (1806-[1838]). **2,** NMW (arrow denotes yellow pupils in hindwing eyespots, which are present in all prints examined); **3,** AMNH; **4,** NMNH; **5,** WU; **6,** UH; **7,** pattern plate, NHMUK (© The Natural History Museum, London).

It should also be noted that the general configuration of the eyespots on the ventral female of Hübner's *O. helicta* is virtually identical to a female *N. areolatus* that Gatrelle (1999b, fig. 7) figured, right down to the yellow pupils. Moreover, the engraved plate of *Papilio areolatus* in Smith and Abbot (1797) (Fig. 8, right) lacks

yellow pupils within the ventral hindwing eyespots, which violates Gatrelle's definition of *N. areolatus*. Abbot's original drawing for that plate also lacks yellow pupils (Fig. 8, left). Such discrepancies reflect what we see in the actual butterflies, which display an enormous amount of variation and overlap in wing characters between populations of *N. areolatus* and those ascribed to *N. helicta*.

Many factors affected the accuracy of engraved illustrations like those published by Hübner. To create such prints, artists made preliminary drawings of the specimens that would be figured. For some publications, such as Smith and Abbot (1797), preexisting drawings took the place of physical specimens. The precision of the initial drawings varied considerably. Engravers traced the new (or preexisting) drawings onto thin sheets of paper, which were then used to render reverse (mirror) images onto flat copper plates (hence the term "plate," which is still used for illustrations that are inserted into books separate from the letterpress). The transferred outlines were then incised (cut) by hand into the surfaces of the copper plates. Any inaccuracies of the original drawings were invariably introduced onto the engraved plates, if not worsened. Plate captions were engraved in the same manner (i.e. in reverse). Next, the copper plates were inked and pressed onto softened paper, resulting in black and white impressions, which were mirror images of the copper engravings. As such, they displayed the same orientation as the original drawings. Finally, the resulting impressions were hand-colored with paint, often by more than one person. Most colorists never saw the physical specimens, but instead based their work on a set of colored pattern plates, which were created to show how the published plates should appear. If pattern plates were unavailable, previously colored prints were used. The artistic abilities of the colorists are reflected in the finished prints, each of which is a unique work of art. As a result of this complex process, published engravings invariably deviated from their original drawings, and, in turn, the specimens they portrayed. For example, the engraved figures of *Papilio areolatus* in Smith and Abbot (1797) are not identical to Abbot's original drawing (Fig. 8).

Hübner is credited with drawing, engraving, and coloring nearly all the plates in his publications. He was a talented artist and engraver, but the production of so many plates for *Sammlung Exotischer Schmetterlinge* would have been a daunting task if he personally handled every aspect of their creation. Thousands of hand-colored prints were required to fulfill orders for this and other books that he published. Hübner also maintained a job as a calico designer, forcing him to work on his books in his spare time. As Hemming (1937) remarked, such an accomplishment would have been superhuman. Hübner reportedly employed one, and at times several, assistants (Pfeuffer 2004). This included Carl Geyer (1796-1841), a distant relative of Hübner's wife. Geyer, also a talented artist and engraver, began working with Hübner in 1817

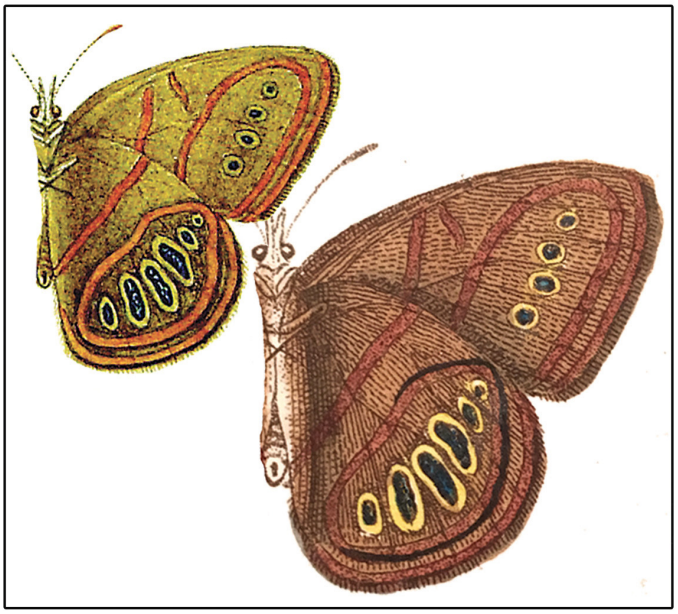


Fig. 8. John Abbot's original drawing (left; Johns Hopkins Univ.) and the corresponding engraved figure of *Papilio areolatus* in Smith and Abbot (1797).

on installments of *Sammlung Exotischer Schmetterlinge* and other publications, which he continued to produce after Hübner's death (Geyer 1827a, 1827b; Fischer 1976, Pfeuffer 2004). The use of colorists would explain the variation between prints of *Oreas helicta* (Figs. 2-5) and other plates in the book (Calhoun 2018). The fact that Hübner created pattern plates for *Sammlung Exotischer Schmetterlinge* implies that colorists were employed, as he could have consulted his original drawings or even specimens in his collection. The authors (or select artists) typically colored presentation copies of such works, while all other copies were colored by assistants (Gilbert 2000). Hübner maintained a broad network of local friends (Fischer 1977) who may have assisted him with resources, including colorists.

In addition to producing plates for each new part of *Sammlung Exotischer Schmetterlinge*, Hübner probably reissued earlier plates for late subscribers who desired to purchase previous parts or entire works. After Hübner's death, Geyer (1837b) not only produced new installments of Hübner's books, he advertised that he took orders for entire copies of books, as well as individual parts. Geyer retained all the copper plate stock and managed the publication of *Sammlung Exotischer Schmetterlinge* for twelve years after Hübner's death, the proceeds of which helped to support Hübner's surviving daughter. This suggests that some parts of *Sammlung Exotischer Schmetterlinge* were reissued one or more times after their original publication dates. While such practices were not uncommon among serialized publications of the nineteenth century, the quality of the prints frequently suffered, as they were often colored years apart by different people (Calhoun 2013, 2017). The production of such books was rather chaotic and not nearly as straightforward as generally supposed.

Associating new taxonomic concepts with names that are based on old illustrations is tricky, especially when the provenance of the figured specimens is unknown, and distinctive morphological characters are subtle and highly variable. The question of whether *N. helicta* represents a valid species can probably be settled through genetic research. Proving that Hübner's *Oreas helicta* is akin to Gatrelle's *Neonympha helicta* is an act of futility.

Acknowledgements.

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Biological notes on the willow ghost moth *Sthenopis thule* (Strecker, 1875) (Lepidoptera: Hepialidae)

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From mid to late July one might have the unexpected pleasure of finding the willow ghost moth *Sthenopis thule* (Strecker, 1875), either at a light or flying at dusk. This midsized moth with prominent yellow and pale brown wings (Figs. 1-3) was first recorded for a specimen from Montreal (Fig. 4) and may be encountered across southeastern Canada and the northeastern United States (Fig. 5). Although easy to recognize and almost impossible to confuse with any other species, this insect is not among the most familiar elements of the North American Lepidoptera fauna. This is probably due to its low frequency at artificial light sources and the secluded larval habits. For example, only one specimen of *S. thule* was collected from light over an eight year period in Minnesota (John Ciseski pers.com.),

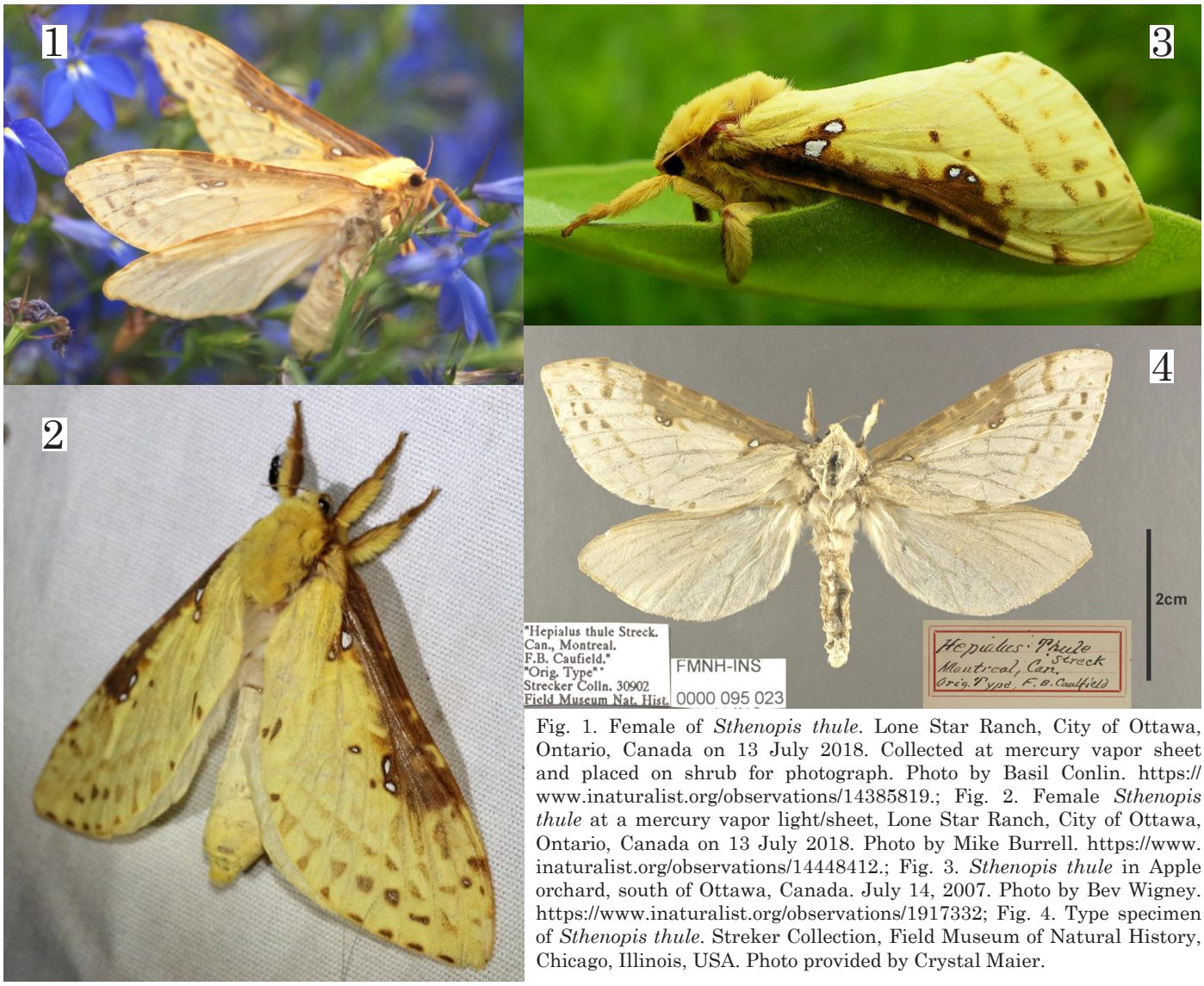

Fig. 1. Female of *Sthenopis thule*. Lone Star Ranch, City of Ottawa, Ontario, Canada on 13 July 2018. Collected at mercury vapor sheet and placed on shrub for photograph. Photo by Basil Conlin. https://www.inaturalist.org/observations/14385819.; Fig. 2. Female *Sthenopis thule* at a mercury vapor light/sheet, Lone Star Ranch, City of Ottawa, Ontario, Canada on 13 July 2018. Photo by Mike Burrell. https://www.inaturalist.org/observations/14448412.; Fig. 3. *Sthenopis thule* in Apple orchard, south of Ottawa, Canada. July 14, 2007. Photo by Bev Wigney. https://www.inaturalist.org/observations/1917332; Fig. 4. Type specimen of *Sthenopis thule*. Streker Collection, Field Museum of Natural History, Chicago, Illinois, USA. Photo provided by Crystal Maier.

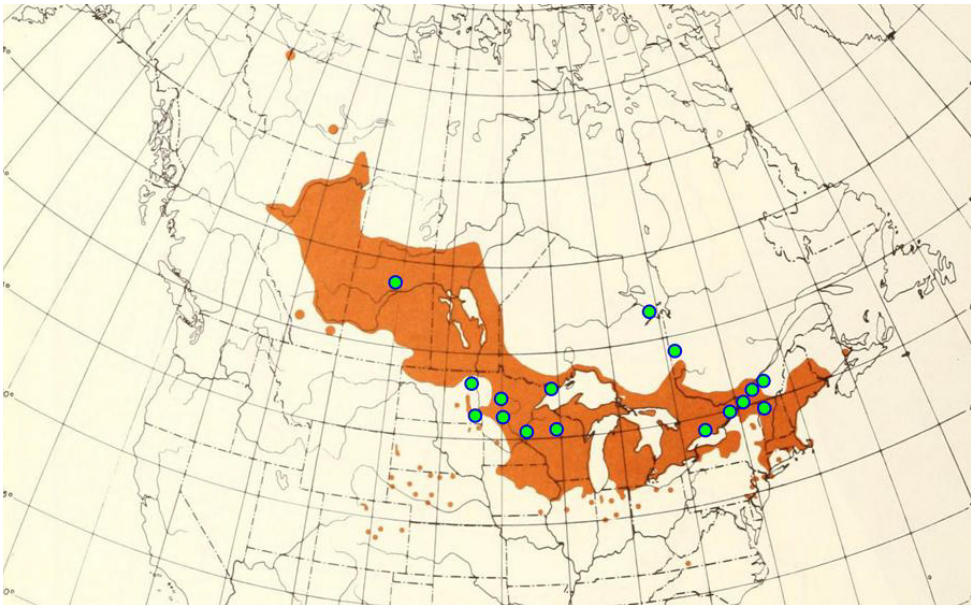

Fig. 5. Distribution of *Sthenopis thule* (green circles) and principle range of the host plant *Salix petiolaris* (orange shading). Moth distribution data from Lyman (1905), University of Minnesota Insect Collection, North Dakota State Insect Reference Collection, the North American Moth Photographers Group (http://mothphotographersgroup.msstate.edu/species.php?hodges=21), iNaturalist (https://www.inaturalist.org/taxa/231734-Sthenopis-thule), Bug-Guide (https://bugguide.net), and University of Minnesota Insect Collection records. Distribution range of *S. petiolaris* from Little (1977). See text for further northern records.

and only a single specimen was found in Vermont despite more than five years of sustained light trapping (Grehan *et al*., 1995). This lack of attraction to light occurs in other Hepialidae, including the North American *Korscheltellus gracilis* found in much higher numbers on sticky traps than at light (Tobi *et al*., 1992; Leonard & Parker, 1993). The willow ghost moth is one of four species in the genus *Sthenopis* which has a total distribution range across much of Canada and the eastern United States south to northern Georgia and northeastern Alabama and with an isolated southwestern record in Arizona (Grehan & Mielke, 2018).

Adult behavior and courtship

At the turn of the 19th and 20th centuries *S. thule* attracted the interest of a number of Lepidopterists who recorded larval and adult behavior. Lyman (1893) recorded moths from July 5th to the 20th flying at dusk over a 15-20 minute period between 8:10-8:30 pm. A similar pattern was later reported by Denny (1907) and Lyman (1907). Courtship behavior was first recorded by Gibson (1905) who watched a male flying rapidly up and down in an oscillating pattern near a cedar tree. When a female flew along and settled near the end of a twig on the tree the male immediately flew around her and in a very short time copulation took place. Lyman (1907) also referred to oscillating flights and moths were seen flying up to heights of about 50 feet (50 m). Swaine (1909) frequently found recently emerged moths resting at the base of willow stems about 15 cm above the ground between 6-8 pm. Often, only wings would be found and as they were usually in perfect condition he suggested this was the result of predation, possibly by mice. Winn (1909) noted that cloudless evenings with a light west wind were most favorable for observing moths with moths flying a few minutes earlier on cloudy nights. He described one such experience as follows:

"Five minutes past eight, and there is nothing flying, and nothing to indicate there ever will be, and we begin to get anxious as to whether there will be any sport, our eyes fixed on the air over the willows. The minutes pass - ten minutes past eight - now is the time. A shout comes from one of the party, "Look out, there's one," and flying quickly over the bushes, perhaps ten feet up, is seen a yellowish-white object, a moth expanding a little over three inches, with a long, thin body. There is no mistaking it for anything else, the position and shape of the wings in flight is entirely unlike any other moth. We probably miss it as it passes by, but it turns, and comes back a little further in the swamp, suddenly arrests in its long flight, and begins to hover over a certain bush, dancing in the air, backwards and forward, as if it were the ball of a pendulum having a stroke of about two feet. Another moth of the same kind appears, apparently from nowhere, and joins the other in a mad gambol. Another, several more, till perhaps 12 or even 20 are all at it close together in the air [known as a lek]...on a willow twig below the swarm was the lady moth, whom they all sought. When a partner was selected, the others went off, perhaps to form other oscillating groups nearby..."."

Courtship behavior in ghost moths involves a variety of patterns, even within a single species. Turner (2015) summarized the spectrum of behaviors under three principal categories he called *Procedure 1* (Classic moth), *Procedure 2*, and *Procedure 3*. In *Procedure 1* courtship involves a female flying through or alongside a lek before coming to rest and fanning its wings; lekking males will then come to the female. In Procedure 2 a female will fly toward a male, and then perch while fanning her wings. This behavioral pattern has three subcategories: *version 2a* where the male is pendulating, singly or in a group and the male(s) will then follow the female until she perches, after which one of the males successfully mates; and *version 2c* where the female flies close to a pendulating male, and when she perches nearby he flies to her in order to mate. In *version 2*b the male is already perched, and the female flies directly to him. In *Procedure 3* there is simultaneous or alternating attraction between males and females (Turner, 2015).

The account by Winn (1909) is too generalized to definitively categorize behavior of *S. thule* as he only refers to a swarm of males and a resting female that mates with one male before the others fly away, without information on earlier behavior by the female or whether multiple males attempted to mate. The observation by Gibson (1905) of a female flying near a pendulating male before coming to rest and then being joined by that male conforms to *Procedure 2c*.

A more detailed observation of *S. thule* courtship was recently made by BC who observed a female that was attracted to a halogen shop light where it was first seen resting motionless on the ground after 10.30 pm. A male approached from above and landed beside the sessile female, sitting motionless. The female then began to fan her wings rapidly and curl her abdomen under her body. She then extended the abdomen and swung it heavily in a lateral side-to-side motion toward the male. The male then became active and crawled closer to the female. The male began to fan his wings in the same fashion as the female and crawled around her until they aligned themselves so that the male's head was facing the female's posterior abdominal segments. After a few seconds the male turned in a smooth clockwise direction, so that his head was facing the same way as the female, and then proceeded to pair with the female, briefly using his front legs to grip the female near the thorax while the female was still on the ground. Once pairing had occurred, the female took off into the air while the male was still attached, at which point BC interrupted the copulation by netting the female. The male quickly detached and flew off. This mating occurred much later after dusk than previously noted in the literature, suggesting that *S. thule* at least occasionally court and mate well into the night.

The courtship behavior observed by BC is not identical to the categories described by Turner (2015), but appears to be closest to Procedure 1, with a flying male approaching a perched female followed by a somewhat complicated copulation procedure. It is possible that interactions in this case have deviated a bit from "normal" because the female was pulled in by the light, and it is just possible that the male landed by the female without being attracted to her, but simply because he was pulled in by the same light patch. Resting female attraction is also recorded for *S. argenteomaculatus* (Harris, 1841) whereas it is the male that rests and fans its wings in *S. pretiosus* (Herrich-Schäffer, 1856) and probably *S. purpurascens* Packard (1863) (Turner, 2015: Table 2).

In butterflies, a copulating female (or male according to the species) may carry its mate in flight but this behavior does not appear to have been reported for moths. All observations for Hepialidae in the literature involve paired individuals at rest, with the male hanging below the female, and held by the grip of the genitalia. If disturbed, they do a dead drop, and then crawl back up again, with the female pulling the male along to where they can hang in their usual position (Turner 2013). So it is not all that surprising that in *S. thule* they can retain their physical connection while flying, and this flight may result from the moths having mated on a horizontal surface, rather than in the perpendicular posture normal for hepialids. The mated female proceeded to lay 200 eggs within three hours of being captured inside of a glassine envelope, despite having only been attached to the male for a few seconds (in general ghost moth females may start laying eggs without having mated). The eggs were not reared. The voucher specimen is in the collection of BC.

Larval biology

Larval morphology and development of *S. thule* in willow was described by Swaine (1909) who noted that the earliest larval habits were unknown. When excavating a host plant he found that the smallest larvae dropped from roots or stems while all larger larvae were within tunnels in the base of the stem or in the main stem mass (Fig. 6). Tunnels were found to be usually no longer than 15- 28 cm, nearly cylindrical and sometimes with short side tunnels. An exit hole from the tunnel is usually located below the ground. Nutrition was thought to occur by enlarging the tunnel. At pupation a cylindrical cocoon of decayed bark and roots fastened with silk is usually made at the tunnel mouth or in loose soil just below the ground surface. Some pupae were also found within tunnels without any trace of a cocoon. Larvae that were placed in a tin box often produced a sharp rattling sound which was thought to result from tapping of the head against the tin. The noise stopped when touched or when walking nearby. Swaine (1909) suggested this behavior was similar to tapping that occurred during cocoon construction by larvae of *Phymatopus californicus*. Larvae of *S. thule* were found in both healthy and dying stems. The main stem is usually pierced by several old tunnels while most larval activity occurred in younger tissues near ground surface. Pupal exuvia are usually found projecting from leaves and debris on ground near the mouth of the tunnel, usually at or slightly below the surface, but sometimes also within the mouth of the tunnel.

Larval tunneling into woody tissues also occurs in *S. argenteomaculatus* and *S. purpurascens* whereas *S. pretiosus* is known to feed only in fern rhizomes (McCabe & Wagner, 1989). The mature tunnels of *S. argenteomaculatus* extend from the roots into the lower stem where a pupal exit hole is cut and the adult emerges (JRG pers. obs.) but this behavior does not appear to apply to *S. thule*. The tunnels in woody tissues show no evidence of callus feeding as found in several stem boring ghost moth genera and some root feeders in Australia (Grehan, 1989). Two stem boring species that do not feed on callus tissue are *Phymatopus californicus* in the western United States, and *Leto venus* in South Africa. *P. californicus* larvae tunnel in roots and also tunnel in stems without involving the roots. In these species the consumption of woody tissues during tunnel formation appears to provide the nutritional source and

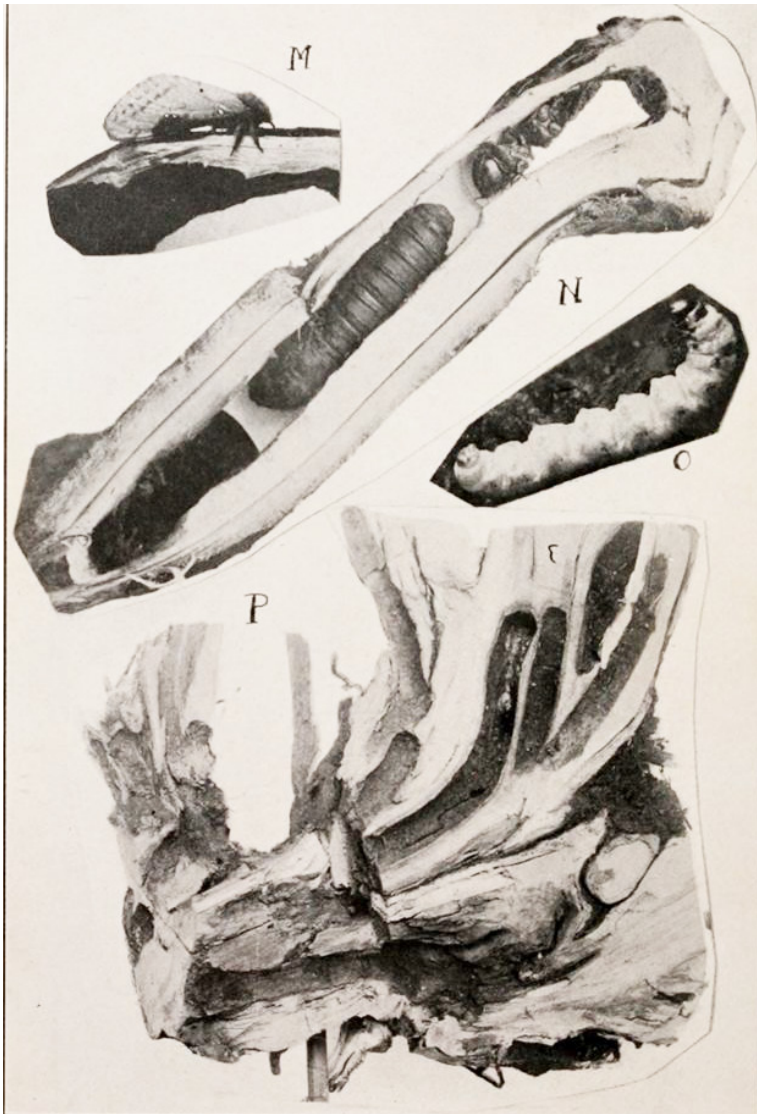

Fig. 6. Larval damage to willow by *Sthenopis thule* (reproduced from Swaine 1909: Plate 10).

there is considerable ejection of frass. The nutritional source is uncertain for *Leto venus* as the tunnels are often less than 32 mm after two or three years occupation (Grehan & Ralston, in press). Whether the excavation of tunnels in woody tissue by *Sthenopis* species provides a primary source of nutrition remains to be determined. The larval tunnels of *S. argenteomaculatus* open to the surrounding soil near the ground surface (JRG pers. obs.) and it is possible that larvae consume other substrates other than the 'host plant' (Mark Klingler, pers. comm.).

Initial development of *S. thule* larvae remains unknown. As with other Hepialidae, the females of *S. thule* produce a considerable number of eggs and Lyman (1893) counted 2,151 for a single moth. Winn (1909) also referred to females dropping eggs in a regular stream while in flight and the sound of eggs landing was described as similar to the discharge of bullets from a rapid firing Maxim gun. When a sheet of paper was held beneath the moth, whether flying or held, the eggs could be heard pattering on the paper as if fine sand were being sifted. As with other Hepialidae, eggs of *S. thule* would fall to the ground and develop into larvae within the surface soil litter and debris. The early instars of many ghost moths are known feed on dead plant detritus, fungi, or a combination of both, before transferring to live plants (Grehan, 1989).

The feeding biology of early instars for species with woody root hostplants is known only for *Zenophassus shamyl* (Christoph, 1888) where artificially reared early instars were recorded by Slastshevisk (1929) feeding on various fungi growing on decaying wood and leaves of cabbage, and later potatoes and beetroot. The youngest larvae were observed to reside near the surface among plant debris and leaves while older instars would burrow deeper into soil and tunnel into potatoes, turnip, and mushroom. Under natural conditions larvae are recorded tunneling into the root collar zone of grape vines (Milyanovskii & Mitrofanov, 1952; Zagaini & Iurchenko, 1955). The possibility of an initial detrital feeding stage in *S. thule* is suggested by observations (JRG) of some larvae reared from eggs provided by John Ciseski in 2015. About five first instar larvae were placed in a small container of moist, dead plant detritus and soil along with some moss. Larvae were observed to consume both dead and live tissues and one specimen successfully molted to the second instar. Further rearing efforts need to be made along with detailed surveys of ground debris near host plants in August, assuming eggs take about two weeks to mature.

Habitat

The only confirmed hostplant is the swamp or scrub willow, *Salix petiolaris* Sm. (Lyman 1907, Swain 1909), which is usually found in disturbed habitats, fens (calcium-rich wetlands), meadows, fields, and shores of rivers and lakes (Maiz-Tome 2016). Most *S. thule* records lie within the principle distribution range of the swamp willow (Fig. 5). Northern records of *S. thule* from central Quebec and southern Hudson Bay probably represent additional willow sites as indicated by scattered records from the Hudson Bay region (Riley 2003, Argus 2007, Oldham *et al*. 2015).

A 'typical' habitat record for *S. thule* was recently observed by BC, Mike Burrell and Jason Dombroskie on July 13 in Ottawa during the 2018 Lepidopterist's Society Congress, when two female moths were attracted to a mercury vapor light at 10:18pm. This habitat consisted of an open field near a hydro cut with some alvar-like areas (alvars are open areas with thin soils over flat limestone, dolostone or marble bedrock where vegetation cover is sparse and tree cover is absent or discontinuous – Catlin *et al*. 2014). The disturbed ground was full of *Salix* bushes and bordered by

a mixed hardwood-softwood forest. Both moths that came to the light were females, and one of them laid over 400 eggs in a 3-day period before she expired. A similar habitat was observed by BC in 2012 and 2015 when two female moths, one male, and one moth of unknown sex were found after 10:30 pm at halogen shop lights in two locations in Peterborough, Ontario (Jackson Park: 44.311566, -78.337133 and Trent University: 44.359487, -78.284715). Both locations comprised disturbed habitats within 500 meters of flowing water and contained multiple mature groupings of *Salix* and *Alnus* bushes. Both sightings occurred during the first week of July. The timing of these sightings suggests that the moths continue flying well into the night following courtship at dusk and females may be depositing eggs over that time. One of the specimens is in the collection of BC, the other collected by Jason Dombroskie is in the Cornell Insect Collection. The eggs from the July 13 specimen hatched after 23 days (BC pers. obs.).

Future conservation status

The future health and sustainability of *S. thule* populations is likely to be linked closely to the quality and extent of alvar and similar ecological communities supporting *S. petiolaris*. In Canada these habitats face several threats from human impacts including quarrying, urban and industrial development, overgrazing, dominance of invasive alien plants, unrestricted offroad vehicle use, fire suppression and waste dumping (Catling *et al*., 2014). Because egg-laying females are observed most frequently coming to lights, light pollution may affect populations already suffering from the above threats. Females of *S. thule* have been collected at compact halogen shoplights, full spectrum LED, and mercury vapor bulbs (BC pers. obs.).

The location of an early observation of *S. thule* by Gibson (1905) at the north end of Lake Dow in Ottawa is adjacent to a park that now designated as the Dominion Arboretum and Fletcher Wildlife Garden. If the vegetation has not been overly manicured the moth may still survive in this urban parkland within the city of Ottawa. The conservation status of *S. thule* attracted concern 125 years ago when Lyman (1893) expressed his fear that the population above the St. Henry swamp on the western outskirts of Montreal was "…doomed to extinction as the Canadian Pacific Railway runs along the brown of the terrace and the swamp at its base is being drained and cultivated and built over in a few years." A report by Denny (1907) on 75 specimens collected in a single night prompted the editor of *Canadian Entomologist* to add a footnote recording the unanimous opinion of those present at the original presentation that "such wholesale captures of this rare moth were most strongly to be deprecated. Collectors should be satisfied with a few specimens annually, and not run the risk of exterminating a most interesting species, which is only known to frequent a few very limited localities." This negative reaction probably reflected the perceived rarity of *S. thule* which, like most insects, is probably under greater threat from habitat loss than collecting specimens (unless already on the verge of extinction due to disappearance of habitat). But certainly the ecological status of *S. thule* is deserving of future attention and investigation.

Acknowledgements

We thank the following for their kind assistance with our investigations: Mike Burrell (Ontario Natural Heritage Information Centre, Ottawa, Peterborough, Canada), John Ciseski (Wisconsin, USA), Mark Klingler (Pennsylvania, USA), Charlene Donahue (Maine Museum, Maine, USA), Gerald Fauske (North Dakota State University, Fargo, North Dakota, USA), Michelle Locke (Secretary for the Entomological Society of Ontario, Ottawa, Canada), Crystal Maier (Field Museum of Natural History, Chicago, Illinois, USA), Michael Oldham (Ontario Natural Heritage Information Centre, Ottawa, Peterborough, Canada), Felix Sperling (University of Alberta, Edmonton, Alberta, Canada), Robin Thomson (Department of Entomology, University of Minnesota) and Bev Wigney (Round Hill, Nova Scotia, Canada).

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***References** continued on pg. 183*

Hunting caterpillars with a UV flashlight -- part 2

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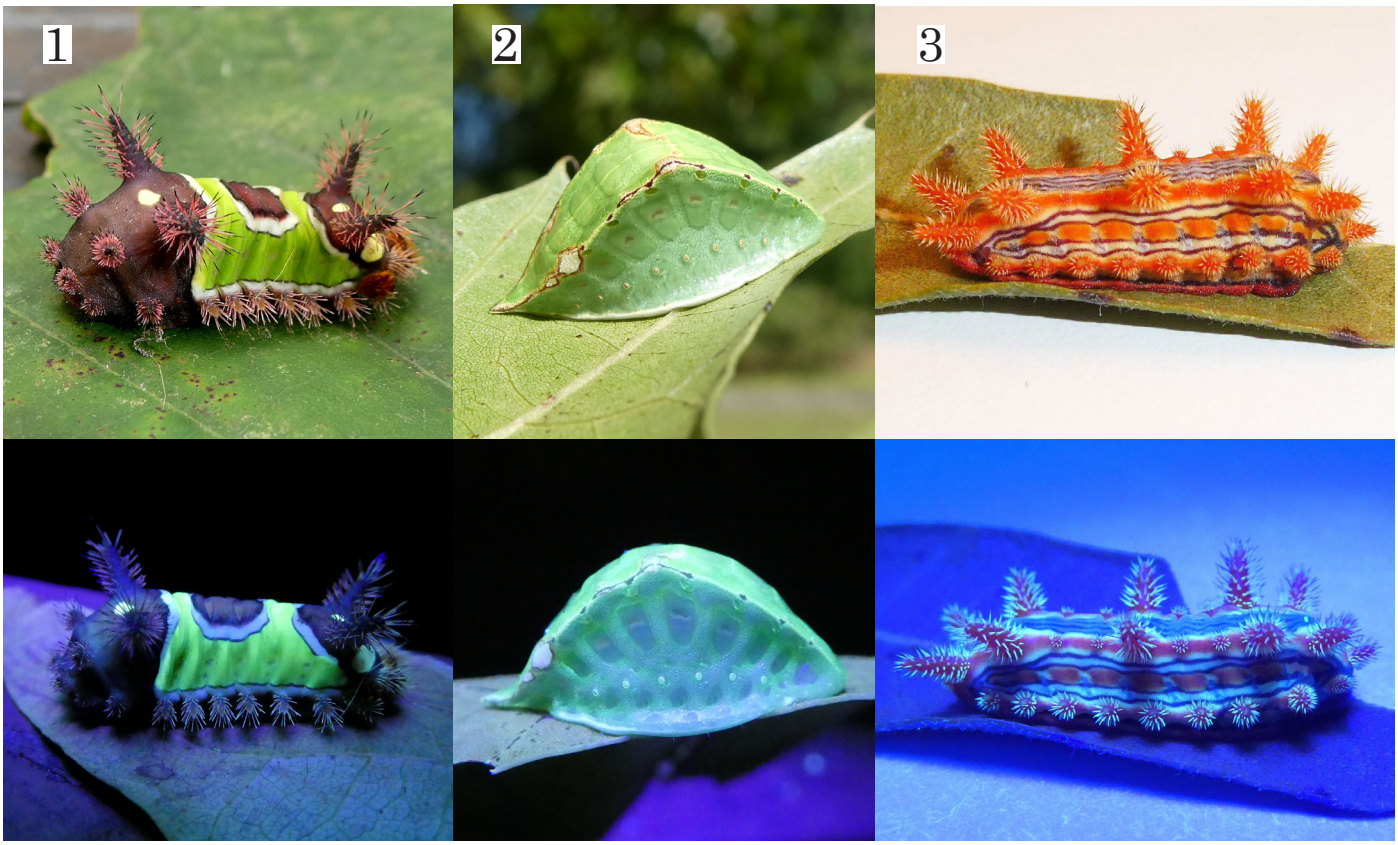
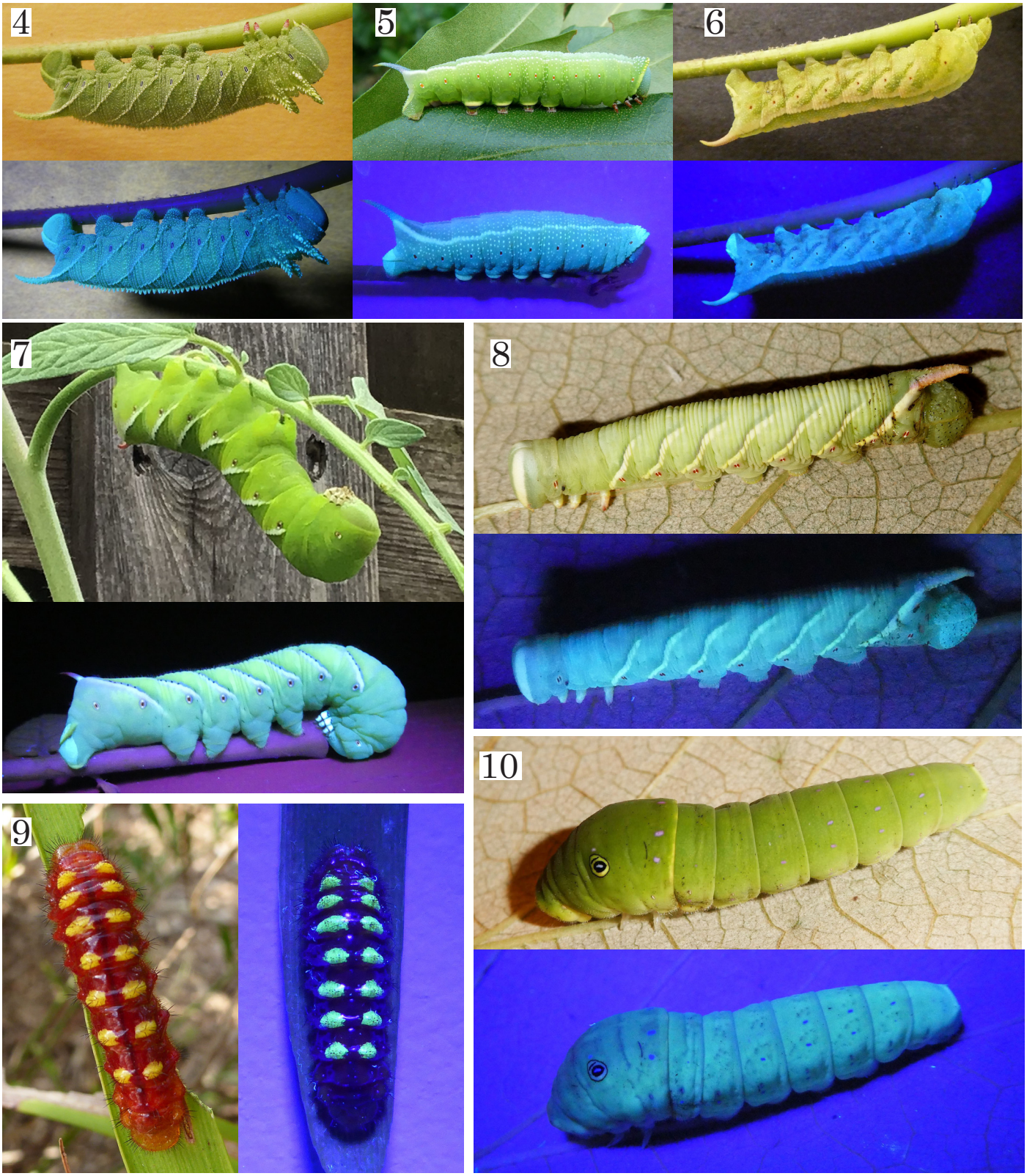
From the moment I opened Dave Wagner's fantastic book, Caterpillars of Eastern North America more than a decade ago, I was instantly hooked on caterpillars. My tattered copy of the field guide is a testament to the use it's been put through. But I quickly learned that finding caterpillars isn't easy and it takes a lot of searching to tease them out from the vegetation. Many species "hide in plain sight", blending seamlessly with the plants they are on, or having fantastic shapes and patterns that disrupt our search image of what a caterpillar should look like. An ultraviolet flashlight (UV) is a great equalizer, allowing many species to be easily found at night. In a previous article in the News (V. 59, No. 1 pp: 42-44), I described using an ultraviolet flashlight at night to find caterpillars that either fluoresce or stand out brightly against the background of the plant they are on. A subsequent very interesting article in the News by Andrei Sourakov (V. 59, No. 2 pp: 96-101) explored other potential uses of UV light for studying Lepidoptera.

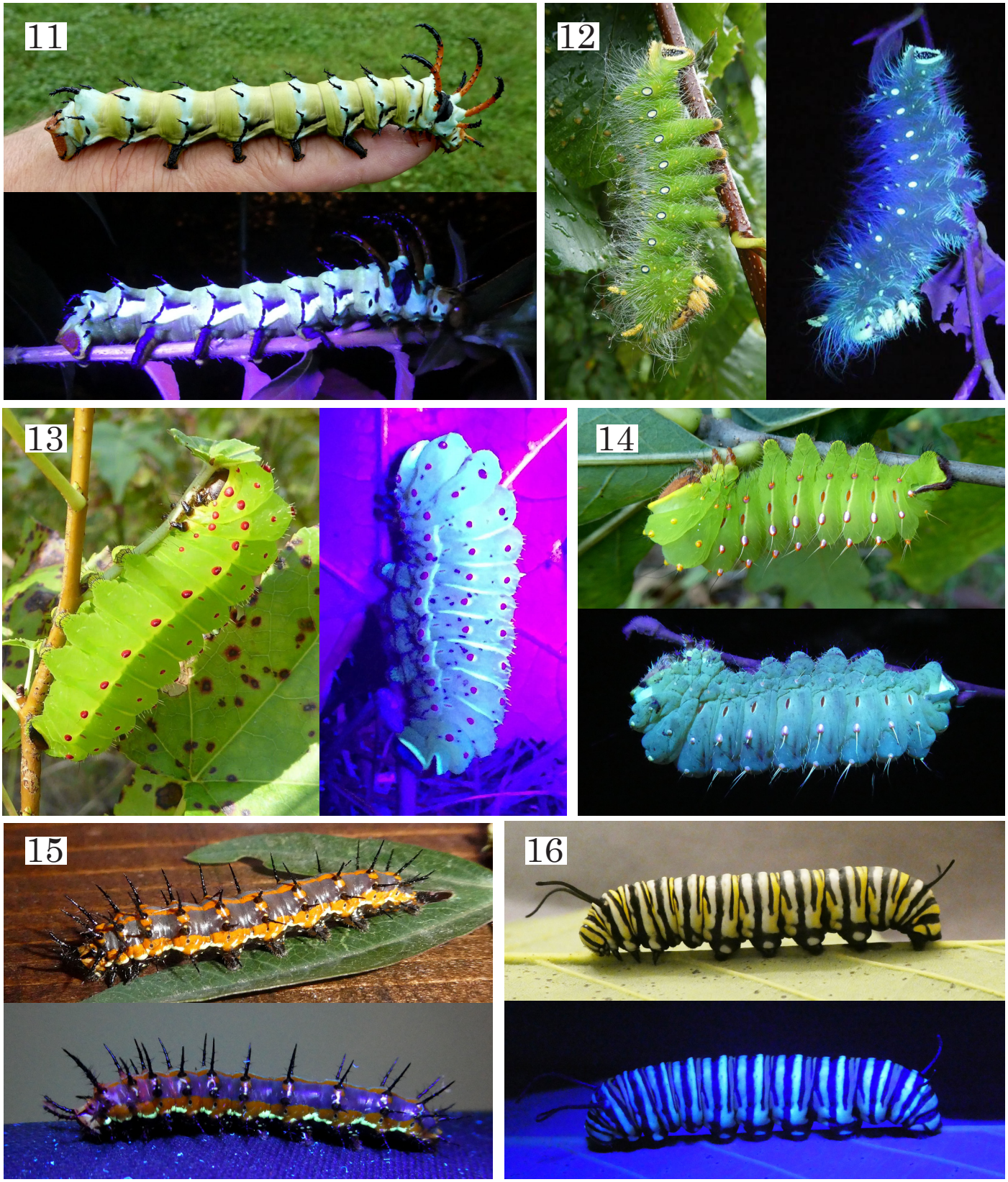
My focus on using UV light is on finding caterpillars, and as an extension gaining a better understanding of their ecology (which is much easier when you can actually find them). I have been able to apply what I've learned at night by locating caterpillars with the UV light to day time searches that have then yielded caterpillars I might not have previously found. On a number of occasions, I have searched areas during the day and then the same area at night with the UV flashlight, and the ability to find caterpillars is vastly improved with the UV flashlight. It would be interesting to test the use of UV light for species surveys in a more rigorous manner. It may also provide a non-invasive survey methodology for sensitive species where trapping adults isn't warranted or where light trapping is not easily accomplished. If nothing else, finding glowing caterpillars at night is incredibly fun and has certainly added numerous tatters to my copy of the Caterpillars of Eastern North America.



1. Saddleback caterpillar (*Acharia stimulea*) - August 23, 2018, East Brunswick, New Jersey; 2. Skiff moth caterpillar (*Prolimacodes badia*) – September 16, 2017, Sicklerville, New Jersey; 3. Stinging Rose caterpillar (*Parasa indetermina*) - September 28, 2017, Cape May. New Jersey.



4. Elm Sphinx (*Ceratomia amyntor*) – August 31, 2017, Presquile Provincial Park, Brighton, Canada; 5. Hummingbird Clearwing (*Hemaris thysbe*) – July 30, 2018, South Bethany, Delaware; 6. Virginia Creeper Sphinx (*Darapsa myron*) – August 24, 2018, North Brunswick, New Jersey; 7. Tobacco Hornworm (Manduca sexta) – August 8, 2018, Matawan, New Jersey (Found by Jacob Moskowitz); 8. Waved sphinx (*Ceratomia undulosa*) – September 1, 2017, Presquile Provincial Park, Brighton, Canada; 9. Atala (*Eumaeus atala*) – February 4, 2017, Boyton Beach, Florida; 10. Canadian Tiger Swallowtail (*Papilio canadensis*) - August 31, 2017, Presquile Provincial Park, Brighton, Canada.



11. Hickory Horned Devil (*Citheronia regalis*) – August 21, 2018, East Brunswick, New Jersey; 12. Imperial moth (*Eacles imperialis*) – September 14, 2017, South Brunswick, New Jersey; 13. Luna moth (*Actias luna*) – September 16, 2016 (Visible Light), Old Bridge, New Jersey; October 6, 2017 (UV light), Old Bridge, New Jersey; 14. Polyphemus moth (*Antheraea polyphemus*) – September 12, 2018, East Brunswick, New Jersey; 15. Gulf Fritillary (*Agraulis vanillae*) – April 9, 2017, Los Angeles, California; 16. Monarch (*Danaus plexippus)* – August 23, 2018, East Brunswick, New Jersey.

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. SLS holds its annual meeting in Sept. or Oct. (just completed for 2018). 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 only.

The annual meeting is held each year in November, at the University of Kentucky, Lexington. This year's meeting featured Brian Scholtens speaking on Lepidoptera in your own backyard.

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. Recent meetings have been joint gatherings with the Southern Lepidopterists Society at the McGuire Center for Lepidoptera & Biodiversity in Gainesville. FL. 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 Ron Leuschner Memorial Fund for Research

The Lepidopterists' Society has established the Ron Leuschner Memorial Fund for Research on the Lepidoptera. Each year, the Society will fund up to 2+ grants for up to $500 each to undergraduate or graduate students depending on merit. Applicants must be members of the Lepidopterists' Society. The applications are due January 15 annually and must include submission of the application form (see the Lepidopterists' Society website at www.lepsoc.org), a brief (500 word maximum) proposal, and a letter of recommendation or support from the student's academic advisor or major professor. Submit all of the above to Shannon Murphy at **Shannon.M.Murphy@du.edu**. Snail mail applications should be sent to Shannon Murphy, Associate Prof., Boettcher West 302, Dept. of Biological Sciences, University of Denver, 2050 E. Iliff Avenue, Denver, Colorado 80208. Successful applicants will be notified by March 15. The review committee consists of members of the Lepidopterists' Society, including the previous year's successful candidates (who are thus not eligible for a new award in the subsequent year's competition). Award recipients will be expected to produce a short report for the committee at the conclusion of their year of funding, which summarizes the positive impact of the award on their research. Recipients must also acknowledge the Fund's support in any publications arising out of the funded work.

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

New MONA Fascicles coming!

The Wedge Entomological Foundation is dedicated to producing volumes in the series "The Moths of North America". 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 governing board members of the Wedge are pleased to announce that there are at least three volumes "in the pipeline" of the Moths of North America series at the present time. The first of these is the Notodontidae Part 1 (see Marketplace), which is to be produced in December 2018. Immediately following this is the Acronictinae volume, and following that is the second volume of the Notodontidae. Thus, 2018, 2019 and 2020 volumes are in the process of production at the present time.

The first volume of Notodontidae presents a monumental work led by James Miller, and with two new genera and eight new species will be a welcome addition to any library. With the research done now on early stages, representations of larval stages are expanded to nine plates.

Call for Season Summary Records

The Chief Season Summary Editor has changed this year, and the format of the final copy will likely be quite different from past issues of the SS, so bear with us during the transition. The Society cannot thank Leroy Koehn enough for his service in this position for many years. The new Chief Coordinators are Brian Scholtens and Jeff Pippen.

The Season Summary database (http://www.flmnh.ufl.edu/lepsoc/) increases in value as your data gets added each year. Please take the time to consider your field season and report range extensions, seasonal flight shifts, and life history observations to the appropriate Zone Coordinator. Zone Coordinators, their contact information, and the scope of their zone appears on the inside back cover of every issue of the "News". The Season Summary Spread Sheet and Spread Sheet Instructions are available on the Lepidopterists Society Web Site at **http://www.lepsoc.org/season_summary.php.** Use this submit your records (check with Zone coordinators first). Send your completed report to the Zone Coordinator for each state, province or territory where you collected or photographed the species contained in your report.

If you have yet to submit records, DO IT NOW!! The deadline is (or WAS) **DECEMBER 15, 2018.**

Be choosy about your records you submit. You may submit as many as you like, and it is important to report anything that may be of interest, but realize many of the submitted records will go in the database, and not in a printed Season Summary. The Season Summary had gotten quite large, and prohibitively expensive to print. As indicated the format will be different from before, and may evolve going forward, so bear with us.

Photographs for Front and Back Covers

Please submit photos for the front or back covers of the Season Summary to the editor of the News, James K. Adams (**jadams@daltonstate.edu**). Photos can be of live or spread specimens, but **MUST** be of a species that will actually be reported in the Season Summary for this year.

Brian Scholtens/Jeff Pippen, Season Summary Co-Chief Coordinators. (see contact information inside back cover).

The Joan Mosenthal DeWind Award

The Xerces Society is now accepting applications for two $3,750 awards for research into Lepidoptera conservation.

Submission Deadline (by email to dewind@xerces.org) Sunday, January 13, 2019, at 11:59 PM PDT. Award winners will be announced by March 31, 2019, with the awards given by May 2019. For all directions/requirements go to **http://www.xerces.org/joan-dewind-award/**

Corrections for the Fall 2018 Issue

The Editor apologizes for two typos in two different places: 1) In the call for Season Summary Records, (see this page), I added an "s" to the end of Jeff Pippen's name twice in the announcement; this has been corrected here; 2) I deleted the first "o" in "Exoporia" in the title for the Grehan, Ochse, and Ritky article (Vol 60 (3): 147-149).

Bob Pyle also submitted some corrections for his Lincoln Brower article, as follows:

"Society member Peter Hubbell and Monarch scholar Donald Davis of Ontario kindly pointed out to me two errors in my recent Conservation Matters article. (*NEWS* 60 (3): 116-118). Both of them concern national leaders, for which I may have a blind spot.

Here are the corrections:

1)" Cuauhtémoc Cardenas, son of Lazaro Cardenas, first president after the revolution." should read "Cuauhtémoc Cárdenas, son of Lázaro Cárdenas, the Mexican president from 1934-1940, responsible for land reform and creation of the *ejidos* system of collective ownership."

2)" And ultimately, when three presidents met in their vaunted 2016 "Three Amigos" parley in Ottawa, and among other things, Srs. Trudeau, Obama, and Nieto discussed the future of the monarch of the Americas, this too resulted from the gentle but steady influence of LPB."should of course read "And ultimately, when two presidents and a prime minister met in their vaunted 2016 "Three Amigos" parley in Ottawa, and among other things, Srs. Trudeau, Obama, and Nieto discussed the future of the monarch of the Americas, this too resulted from the gentle but steady influence of LPB."

Robert Michael Pyle, 369 Loop Road, Gray's River, WA, **tlpyle@willapabay.org**

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 early to mid 2019. So stay tuned.

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!

Announcements *continued on pg. 201*

Hormius sp. (Hymenoptera: Braconidae) and *Horismenus fraternus* (Hymenoptera: Eulophidae), parasites of larval *Cymaenes tripunctus tripunctus* (Hesperiidae)

Mark H. Salvato and Holly L. Salvato

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The Three-spotted Skipper, *Cymaenes tripunctus tripunctus* (Herrich-Schäffer) (Fig. 1) is a wide-ranging subspecies occurring in southern Florida and throughout the West Indies (Cech and Tudor 2005). Smith *et al*. (1994) and Minno and Emmel (1993) described many aspects of *C. t. tripunctus* natural history, while Salvato and Salvato (2008) noted increased distribution of the subspecies in Florida over the past several decades. Scaramuzza and Barry (1959) indicated that *C. t. tripunctus* larvae were attacked by a tachinid in Cuba. However, to our knowledge, no additional larval parasites have been reported for *C. t. tripunctus*.

On 27 July 2013 we collected late instar *C. t. tripunctus* larvae from hammock habitats in Vero Beach (Indian River County) (n = 1) and Palm Bay (Brevard County) (n = 1) in central Florida. These larvae had appeared to have been parasitized based on black spots observed on their integument. The larvae were found on Guineagrass (*Panicum maximum* Jacq.), one of several hostplants used by the species (Minno *et al*. 2005). *Cymaenes t. tripunctus* caterpillars are easily located as they construct tubular shelters on the hostplant, and frequently cut the grass blade at the midrib, such that the leaf shelter dangles downward from the tip (Minno *et al*. 2005).

The collected larvae behaved lethargically in the laboratory and fed only minimally until 29 July 2013, when they became moribund while attempting to pupate. On 7 August and 8 August 2013 several parasitic braconid wasps (Hymenoptera) (Fig. 2) began to emerge within the vials containing the moribund larvae. Subsequently, additional parasitized *C. t. tripunctus* larvae (n = 3) were collected from the above locations (Table 1) on *P. maximum* and other grasses.

During field observations we noted numerous minute parasitic wasp larvae, gregariously feeding on or around developing late instar *C. t. tripunctus* larvae (Fig. 3). The wasp larvae spun individual silken cocoons, loosely bound together, within the leaf shelters, alongside the moribund larvae (Fig. 4). Adult wasps eclosed at approximately 10 days after pupation.

Table 1. Summary of observations of *Hormius* sp. and *Horismenus fraternus* parasitism on *Cymaenes t. tripunctus* larvae.

Date Collected	Location (County)	No./Type of Wasps Produced
27 July 2013	Jungle Trail – Indian River	17 *Hormius* sp.
27 July 2013	Palm Bay – Brevard	6 *Hormius* sp.
8 August 2013	Jungle Trail – Indian River	2 *Hormius* sp.
5 October 2013	Palm Bay – Brevard	6 *Hormius* sp.
4 January 2014	Palm Bay – Brevard	4 *Hormius* sp.
26 September 2015	Snake Bight – Monroe	4 *Hormius* sp.; 1 *Horismenus fraternus*
26 September 2015	Snake Bight – Monroe	1 *Hormius* sp.; 9 *Horismenus fraternus*

The parasitic wasps were identified as *Hormius* sp. Nees by Dr. Michael Sharkey (University of Kentucky) and Dr. Robert Kula (USDA-ARS-Systematic Entomology Laboratory, Beltsville, MD. *Hormius* wasps have been recorded as ectoparasites of shelter-building Lepidopteran larvae throughout the Americas (Shaw 2002; Schneider *et al*. 2014) and globally. However, little is known regarding their status, distribution and natural history within Florida. Therefore, we searched for additional parasitized late instar *C. t. tripunctus* larvae in an attempt to document *Hormius* or other parasitoids of the skipper in Florida.

On 26 September 2015 two parasitized *C. t. tripunctus* larvae were collected along the Snake Bight Trail in Everglades National Park (Monroe County), each of which produced *Hormius* wasps, suggesting this braconid may serve as a parasitoid of *C. tripunctus* throughout its range in Florida. In addition to *Hormius*, these two *C. t. tripunctus* larvae were also parasitized by a eulophid wasp identified by Dr. Michael Gates (USDA-ARS-Systematic Entomology Laboratory, Beltsville, MD) as *Horismenus fraternus* (Fitch) (Table 1). *Horismenus* wasps serve as primary or secondary parasitoids on a wide range of hosts, including hesperiids (Dr. Christer Hansson, Lund University, Sweden, pers. comm.) and braconids (Hansson *et al*. 2014). Therefore additional studies may help to determine the role of *H. fraternus* in the natural history of *C. t. tripunctus* and *Hormius* within the Everglades.

Table 1 summarizes our observations of *Hormius* sp. and *Horismenus fraternus* parasitism on *C. t. tripunctus* larvae.

Acknowledgements

We thank Drs. Michael Sharkey, Robert Kula and Michael Gates for wasp identifications. We thank Dr. Christer Hansson for information on *Horismenus* parasitism of hesperiids. We thank the staff of Everglades National Park, particularly Jimi Sadle, P. J. Walker and Tonya Howington for permitting and technical assistance.

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Fig. 1. *Cymaenes t. tripunctus* in Vero Beach, Florida (Indian River County) (Photo Credit: H.L.Salvato); **Fig. 2.** The parasitic wasp, *Hormius* sp. (Braconidae) (Photo Credit: H.L.Salvato); **Fig. 3.** *Hormius* sp. larvae, feeding gregariously on a developing late instar *C. tripunctus* larva in Palm Bay, Florida (Brevard County) (Photo Credit: H.L.Salvato); **Fig. 4.** *Hormius* sp. pupae, loosely bound together within the leaf shelter of a moribund *C. tripunctus* larva in Everglades National Park (Monroe County) (Photo Credit: H.L.Salvato). (See facing page)

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Erucism and population bursts of the moth *Hylesia nigricans* (Berg, 1875) (Saturniidae: Hemileucinae) in Brazil

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Additional key words: *caterpillars, invansion, feeding behavior, Trema micranta*

Saturniidae is a noteworthy and diverse family of moths, and includes species of medical importance. Hemileucinae is the most diverse of the nine saturniid subfamilies and has the most species that are responsible for accidents with humans, such as dermatitis (Lemaire 2002). Allergic reactions, caused by adults (moths), are known as lepidopterism, whereas the caterpillars cause an allergic reaction labeled as erucism (Haddad & Cardoso 2003). *Hylesia* is the second most diverse genus within Hemileucinae and exclusively Neotropical, with about 110 species (Lemaire 2002). Population bursts of some species of *Hylesia* have caused public health problems (Carrera 1991, Scoble 1992, Glasser et al. 1993, Cabrerizo et al. 2014); therefore, preventive actions have been examined in a few studies (Salomon et al. 2005, Iserhard et al. 2007). Although *Hylesia* larvae have structures that cause urticanting reactions (Lemaire 2002, Specht et al. 2008), most accidents recorded that involve this genus are cases of lepidopterism, especially in Brazil (Mascarenhas et al. 1980, Glasser et al. 1993, Iserhard et al. 2007).

To prevent accidents caused either by contact with larvae or with adults, it is necessary to reduce the population levels of *Hylesia* through the control of larvae (Salomon et al. 2005). Therefore, information on cases of erucism caused by species of *Hylesia* is important in order to identify the distribution of the population of these moths and also to prevent and anticipate potential incidences. In this study, we provide information on the first recorded case of erucism caused by the species *Hylesia nigricans* (Berg, 1875) (Saturniidae, Hemileucinae) in Brazil and discuss some ecological aspects of this species.

The population burst of *H. nigricans* caterpillars was first observed on the 21st October 2014 in the urban area of Joinville, Southern Brazil (26°20'S, 48°47'W), where there is a predominant remnant of the Atlantic Forest. The invasion was discovered by local citizens, including children, who reported many larvae in their backyards and on the walls of the school. Consequently, several cases of dermatitis caused by contact with these larvae during the first two days of the invasion were reported (October 21st and 22nd). The population outbreak of *H. nigricans* was estimated with a handheld counter on two occasions; on October 24th a total of 5541 individuals were counted and on October 25th approximately 3600 caterpillars were observed at night. These estimates (n=9141 larvae) do not account for larvae removed by the local residents in the city. On the first occasion, only dead larvae were counted (these larvae were killed by local residents). In contrast, on the second occasion, the counting of caterpillars was based on the surviving individuals.

Behavioral observations of the caterpillars were performed *in loco* on October 24th and 25th for 16 hours. On October 24th, the larvae were observed from 1600h to 2000h in an area indicated by local residents (about 0.15 ha). The caterpillars foraged by moving on walls, houses, and other buildings including schools and vacant lots (Figure 1A). The larvae exhibited processionary behavior, a common behavior among gregarious caterpillars where individuals make long lines of head-to-tail contact (see Fitzgerald & Pescador-Rubio 2002). At night (~2000h), we observed the movement of larvae towards the canopy of a *Trema micrantha* (L.) Blume (Cannabaceae), we then located the larvae sheltering on the ground close to this tree (about 20 cm away from the tree). The shelter was built with silk, leaves, and twigs. On October 25th, observations were carried out between 1900h and 0700h, with focal sampling in the host tree (*T. micrantha*). After dusk (around 1940h), we observed that the larvae (most of them last instar) left the shelter, displaying processionary behavior, and moved to the canopy of the host tree (Figure 1, B,C). Around 2100h, all the larvae were foraging on the tree canopy. These caterpillars remained on the tree for approximately nine hours. The larvae returned to the shelter at approximately 0600h the next morning. During this period, we observed birds preying on the caterpillars.

In order to identify the moth species responsible for the cases of erucism, we collected 20 larvae in the study area on October 24th. The individuals were taken to the laboratory where they were reared in groups and fed *ad libitum* with branches from the host plant. Upon reaching the pre-pupal stage, the immatures were individually kept in transparent plastic pots (500 mL) (Specht et al. 2006). The larvae and adults were deposited in Coleção Entomológica Padre Jesus Santiago Moure (Universidade Federal do Paraná, Curitiba, Brasil). In the field we collected a parasitized

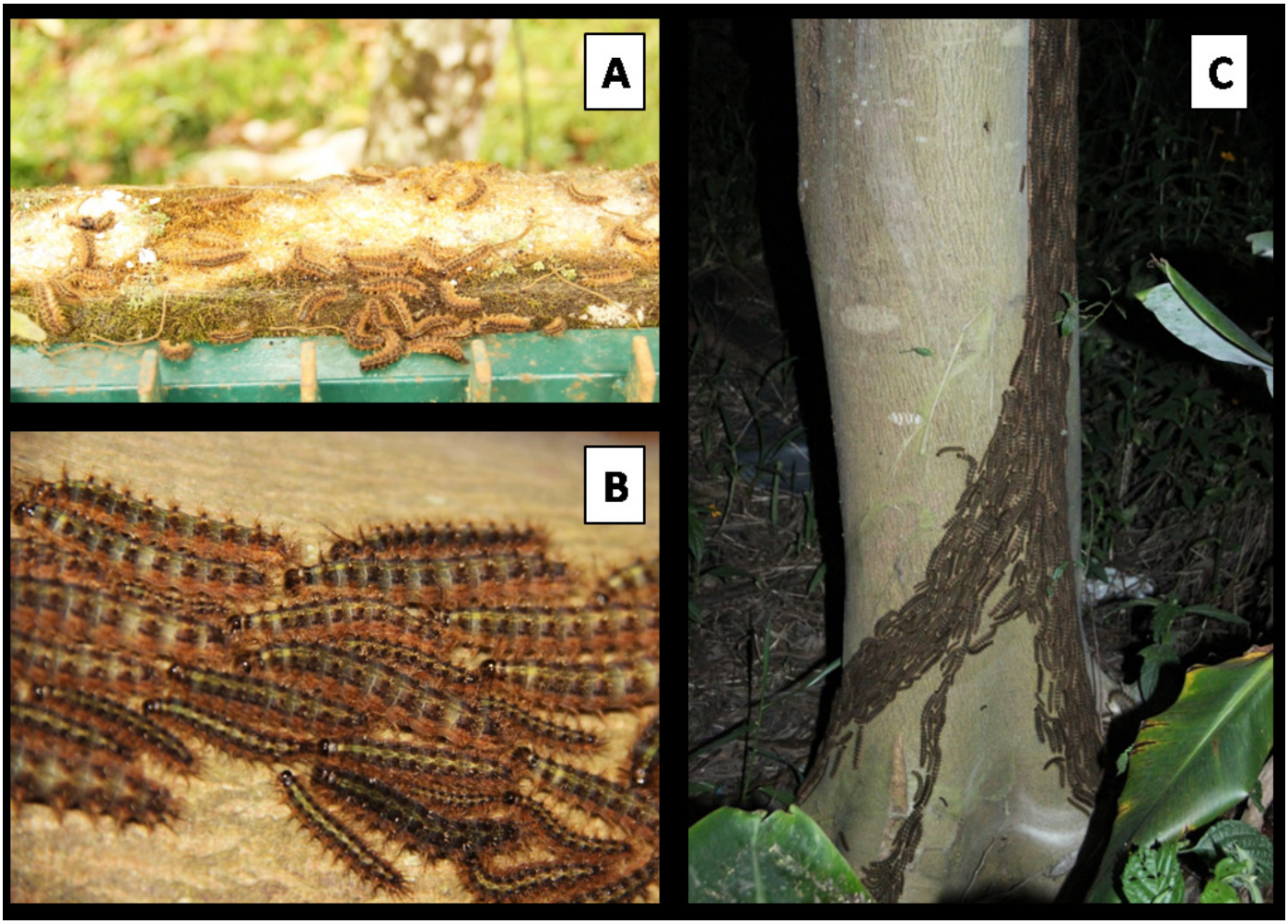

Figure 1. *Hylesia nigricans*: (A) caterpillars moving on walls; (B) group of last instar larvae; (C) grouped larvae moved to the canopy of the host tree during night.

caterpillar that had two pupae microhymenopterans attached to its body. The parasitized caterpillar was kept in the laboratory until the emergence of the two microhymenopteran specimens. Samples of the host plant were deposited at Herbário Joinvillea (Universidade da Região de Joinville, Joinville, Brasil). During the field observations, both authors suffered from dermatitis caused by contact with caterpillars *in loco*.

According to our observations, only three days after the population outbreak of *H. nigricans* there were approximately 9141 individuals. Only one individual *T. micrantha* was recorded as a host tree. As the population sampling of *H. nigricans* was partial, it is possible that the initial population used other individuals of *T. micrantha* or even another plant species as a food plant. *Trema micranta* is a non-endemic species commonly found in Brazil (Lorenzi 2008, Romaniuc-Neto et al. 2015), while *H. nigricans* has been recorded on several families of host plants, 38 species belonging to 17 families of plants (Specht et al. 2006, Iserhard et al. 2007). Our study adds a new family (i.e. Cannabaceae) as a *H. nigricans* host plant.

In general, *Hylesia* species are known for their population peaks, ultimately causing several reports of dermatitis (Scoble 1992). In the case of *H. nigricans*, a species with a wide distribution across South America, lepidopterism reports have been recorded in countries including Argentina and Brazil (Iserhard et al. 2007, Cabrerizo et al. 2014). In addition to medical importance, *H. nigricans* is considered as a pest to crops (Specht *et al.* 2006). Intriguingly, studies of erucism caused by this species have been overlooked. On the one hand, the absence of such information for this species may be a consequence of the difficulty in identifying species in this genus (Lemaire et al. 2002, Cardoso & Haddad-Júnior 2005). On the other hand, the fact that cases of erucism caused by *H. nigricans* have remained insufficiently studied, and therefore underestimated, may represent a barrier to successfully controlling epidemics of this pest moth. For Salomón et al. (2005), the control of *H. nigricans* larvae is more effective than the use of insecticides on adults, as caterpillars are easier to find (given their "processionary behavior") and identify and are susceptible to biopesticides. Conversely, adults have short life spans, release urticanting bristles and respond less effectively to the use of insecticides

This study provides pioneering information on the occurrence of erucism caused by the moth *H. nigricans* in Brazil, as well as the first record of this species in the Joinville municipality. So far this species has been recorded in only two cities in the state of Santa Catarina (Siewert et al. 2010) and in some cities in the state of Rio Grande do Sul (Corseuil et al. 2002, Specht et al. 2006, Iserhard et al. 2007), where detailed information on *H. nigricans* natural history was first investigated. Our study provides a new record of a host tree, *T. micrantha*, for the *H. nigricans* larval stages. This is a common and widely distributed tree in Brazil, which may facilitate the dispersion of this moth, and hence outbreaks of dermatitis. Thus, information on host plants, the habits of the caterpillars, and erucism are fundamental for controlling and preventing outbreaks caused by *H. nigricans*.

Acknowledgements

We thank Angela Andrzejewski and her husband for contacting us and providing information on the occurrence of the moth; the staff of Escola Municipal Professora Ada Sant'anna, Joinville, Santa Catarina for reports of the invasions of *Hylesia nigricans* and cases of dermatitis; Rogério Nunes Barbosa, Enderlei Dec, Andressa K. G. dos Santos, Pedro Paulo do Santos and Jefferson Willian Schneider for assistance in the field; Fábio Luis dos Santos for moth identification and Karin Esemann de Quadros for host plant identification. Financial support was provided by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq 158906/2014-4 to AB).

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Left: Chuck Harp, Jackie Miller, and Oskar Brattström; right: Steve Nanz, Kyhl Austin and Jean-François Landry (photos by James Adams)

Surprise encounter between ant and Ceraunus blue

Tor Hansen

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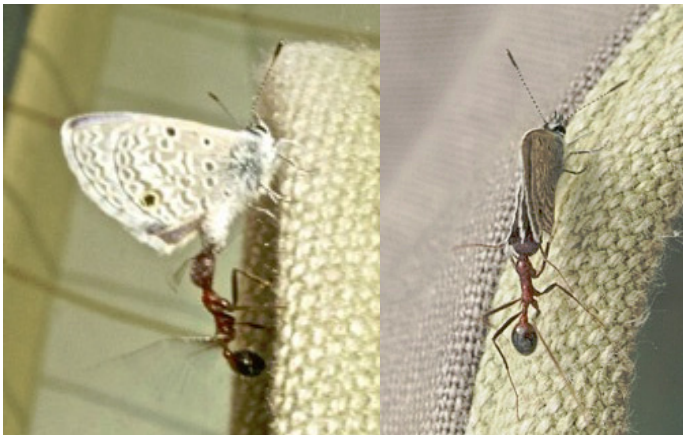
What is this unexpected encounter? There I was connecting with fellow artists living today at Linda Vista Ranch, Oracle, Arizona. During my undergraduate years (late 60's) at The University of Arizona, I had enjoyed fellowship and artistic growth with students and faculty residing in an artist colony called Las Lomas in the sonoran desert, in the Tucson Mts. foothills. Later many had moved to Oracle outside city limits. While visiting my former Professor of Ichthyology (fishes) in Tucson later in 2014, I endeared to photograph butterflies and of course hummingbirds as well. Parking my car in a desert wash, I placed my camera bag on the closed trunk for easy access to accessories. After conversing with an artist whom I had not seen in years, I returned to find roosting on the camera bag one small Ceraunus Blue, a common Lycaenid usually imbibing nectar at flowers, or puddling streamside i.e. Molino Canyon.

As close as my macro lens would allow, I took pictures of this solitary blue, known to occur in riparian habitats where intermittent streams flow down through the many canyonlands and foothills of these Santa Catalina Mountains. But when I looked again the blue was attended by an ant! Low and behold, the ant proceeded to address the anal end of the blue's abdomen, perhaps to extract a sugary substance. How easy it is to assume that this lone ant sought to extract some honeydew from the stationary blue. There is much data worldwide on Lycaenid blues' larvae yielding liquid secretions to certain ants, well known to extract a sweet sugary substance that ants treasure for rearing their young. No resistance to the ant, nor harm from the ant was evident. The blue appeared resigned to the "milking" as if the measure was routine, and after a brief minute or more the ant vanished and the blue flew away. Did the ant obtain any honeydew for its effort? Since only one brief encounter was observed, and no record of routine possible milking exists, it might be a stretch to claim this milking is commonplace among southwest ants and blue butterflies. But any more sightings of such interactions would be invaluable!

Was there any real exchange of nourishing matter between the two? I accept insufficient evidence to claim a commensal or mutualistic relationship among ant and butterfly. Time and observation may later reveal a more obvious relationship between the two. However man's intervention or opportune entry into this event, brought about by timely road travel, may have assisted in sparking or enabling a welcome pit-stop for both insects! I am reminded of a Darwinian distinction known from spontaneous or brief incipient interactions, this one interspecific (between different species) called saltation. This term is given to incomplete events arising from interactions. It enables me to try to visualize what ant & butterfly encounters may have evolved in tandem epochs ago to solve needs of both insects. This is a form of interaction wherein both organisms may prosper from their mutual association.

Furthermore, this camera bag carried by human hands, offered chemicals that attracted the butterfly. And apparently the ant was attracted by another chemical purposely or coincidentally released by the blue. This event may have been a brief incomplete event that could be an example of saltation. (See the article involving saltation in birds "The Springtime Dance of the Eiders" by Tor Hansen in "The Cape Naturalist", published by The Cape Cod Museum of Natural History, Brewster, in spring 1986. Therein, the spontaneous dense flocking of swimming eider ducks speaks to this phenomena seldom seen, perhaps seldom performed, and can be dubbed saltation by its spurious formation, and its behavioral, not structural, characterization.) Although Darwin objected to the strained use of saltation regarding structural mutations, we have it as a tool to analyze the evolutionary biology, certainly in the behavioral scope of things. (See works by Charles Darwin, such as "The Origin of the Species 6th edition 1872" and Ernst Mayr "Evolution and the Diversity of Life" 1976 Belknap Press Harvard University). I welcome discussion to the state of evolutionary theory and our thoughts considering behavioral adaptation and saltation.



Ceraunus blue (*Hemiargus ceraunus*) with ant.

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A new ant-butterfly interaction from Upaon-Açu Island on the Amazon coast of Brazil

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Maranhão, a Brazilian state with 33.2 million hectares, is where the Amazon and the Cerrado (Brazilian Savanna) biomes converge. In the coastal zone, Upaon-Açu Island (140 thousand hectares) hosts highly diverse ecosystems endangered by rapid urbanization (Rêgo et al, 2018). Most of its biodiversity is being lost before its description by science. Until today, there is no species listing of butterflies and ants in Maranhão state, but rather only a few inventories of particular sites where diversity is huge (Martins et al., 2017; Gutiérrez et al; 2017). Beyond the loss of species, destruction of ecosystems leads to the extinction of ecological interactions (Valiente-Banuet et al., 2015), which can impact species evolution and ecosystems resilience.

Interactions between Lepidoptera and Hymenoptera have been registered worldwide, ranging from mutualism to parasitism and predation (Cottrell, 1984; Pierce et al., 2002). Pierce et al. (2002) report that most of the Lycaenidae have an association with ants, either facultative (mainly nonspecific) or obligate (with considerable specificity). Indeed, their larvae and pupae use complex chemical and acoustical signals to manipulate ants (Pierce et al., 2002). One of these interactions between caterpillars and ants is the so-called "food-for-defense", where ants protect the caterpillar in exchange for food resources. Indeed, some species have a dorsal nectary organ that secretes a soup of sugar and different amino acids (Daniels et al, 2005). Hojo et al (2015) show that exocrine secretions can manipulate ant behavior via dopaminergic regulation, as a drug.

Among the abundant literature about ant-butterfly interactions, all the reported mutualistic associations occur with larvae and pupae before emergence of the adult butterfly. In 2016, we found and registered a different interaction between an ant and a freshly eclosed butterfly. After consulting the scientific literature and specialists in ants and butterflies, we found no information of this particular type of myrmecophilic association. The objective of this short note it to describe this phenomenon.

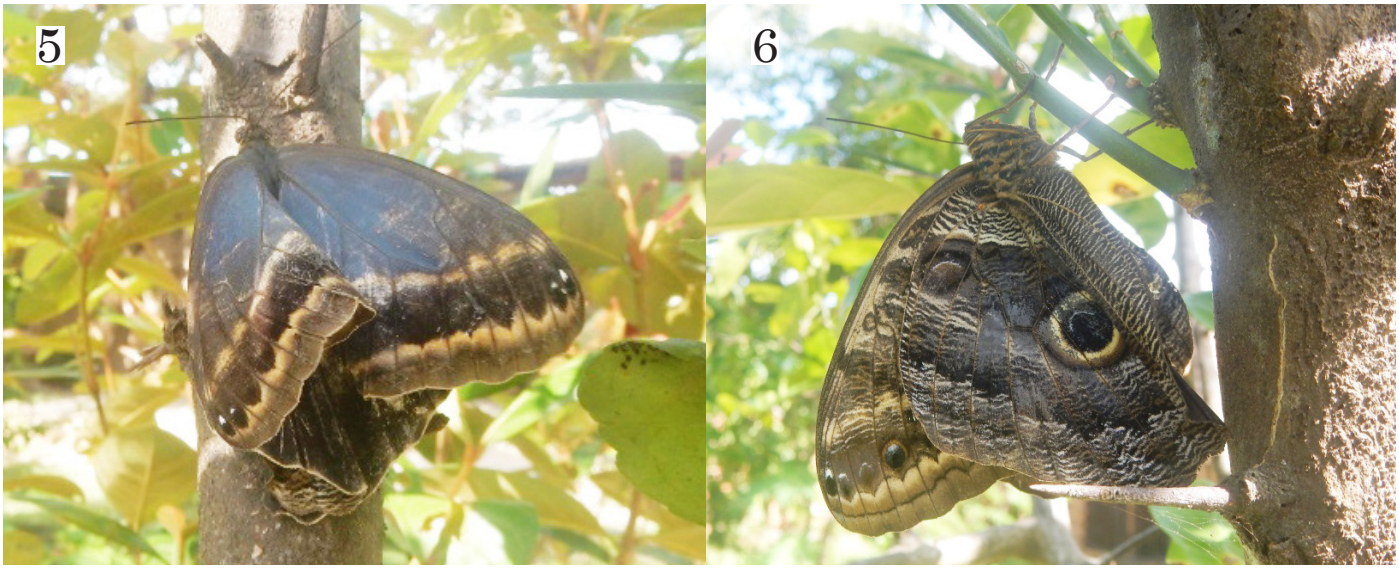
The observation happened on the 1st of June of 2016 (morning period), in the municipality of Raposa (2°27'33"S; 44°09'13"W), on Upaon-Açu Island in Maranhão state (eastern Amazon) in our home garden. Climate is classified as Tropical Aw according to the Köppen climate classification. The region presents two well-defined seasons, a rainy season from January to June and a dry season from July to December. The onsite precipitation registered in 2016 was 1,237mm. Mean air temperature is 27 °C, without any remarkable differences across the year (INMET, 2016). Soils are quartz sands of maritime origin, and very poor in nutrients (Maranhão, 2002). The original natural vegetation is "Restinga forest", but the area was cleared many years ago. Since 2012, the area has been occupied by a highly diverse home garden.

Caligo illioneus (Cramer) (Nymphalidae: Morphinae: Brassolini) and *Camponotus arboreous* (Smith) (Formicidae: Formicinae: Camponotini) are both very common species on the site. Immature stages of *C. illioneus* were described in Brazil by Specht and Paluch (2009). Quaresma and Yoshi (2015) cataloged camponotine genera in the Amazon region, and found that *C. arboreus* as one of the most representative species. No discussions of interactions between *C. illioneus* and *C. arboreus* were found in the literature.

Our observation started after butterfly eclosion from pupae, during the wing expansion phase, when *C. arboreus* individually (Figures 1 and 2) and collectively (Figures 3 and 4) seemed to be cleaning the remaining liquid from the chyrsalis on *C. illioneus* wings. The butterfly was on a *Citrus* sp. (Rutaceae) tree and no residue of the pupal membrane (exuvia) was present, suggesting that it moved from the eclosion location. We observed the interaction for about 30 minutes, until the butterfly finished opening its wings (Figures 5 and 6), and flew about 1 hour later. Even though this observation is not a result of any scientific research, we speculate that this interaction is opportunistic but that the "cleaning service" may speed up this phase when the butterfly is extremely vulnerable to predation. Ants probably benefit from the nutrient-rich composition of this secretion (Pierce et al., 2002). Indeed, on nutrient-poor soils extra nutrient supply is highly useful by fauna (Miranda, 2007).

Another similar observation took place on the 18 of June of 2018 at 10am, in the same spot of our garden. This time a single *C. arboreus* approached another butterfly species (*Heliconius* sp.) during the wing expansion phase, trying to get the fluid from its wings (Figures 7 and 8). However, differently from the *C. Illioneus* that stood waiting for the ants cleaning, *Heliconius* sp. rejected the advances of the ant running out constantly.

Figures 1-4. *Camponotus arboreous* (Smith) ants individually (Figs. 1 and 2) and collectively (Figs. 3 and 4) cleaning residual pupal fluids from a *Caligo illioneus*. The butterfly was on a *Citrus* sp. (Rutaceae). Since the exuvia was not nearby, clearly it had moved from the eclosion location. This observation took place on June 1, 2016, in the municipality of Raposa (2°27'33"S; 44°09'13"W), Upaon-Açu Island in Maranhão state.



Figures 5-6. *Caligo illioneus* (same indiviaul from Figs. 1-4) completing expansion of the wings.

Figures 7-8. *Camponotus arboreous* ants approaching a *Heliconius* sp. The advances by the ant were rejected by the *Heliconius*. The observation took place June 18, 2018 at same location as the *Caligo* observation.

Brazil suffers from a shortage of scientists, especially in the Amazon, the most biodiverse region of the country where it is possible to register new species and interactions in home gardens. In a region of such diversity, degradation and lack of resources for biological research, mobilizing amateurs and volunteers may be a strategy to register and monitor species, as in other countries (Swaay et al., 2008). Butterflies tend to promote amateur participation due to their beauty and symbology. Children should also be involved to stimulate early human connection with nature, as this connectedness influences not only individual well-being and happiness (Howell et al., 2011; Capaldi et al., 2014), but also societal behavior (Restall & Conrad, 2015; Amel et al., 2017) and Earth's future through Integral Ecological Restoration (Celentano & Rousseau, 2016). Butterflies may enthuse human connectedness to and protectiveness toward nature.

Acknowledgements

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Authors' contributions

ACR and NCR identified the phenomenon, DC photographed it, and DC and GXR conceived and wrote this note.

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The Arizona Hairstreak caterpillar (*Erora quaderna*): A photo essay

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Introduction:

I was able to take some photos of the life stages of *Erora quaderna*, and thought it might be interesting to many, as this caterpillar is just not often seen!

With a passion for hairstreaks, and living in Tucson Arizona, its only natural that our paths meet; *Erora quaderna* (ssp. *sanfordi)* and I. If you are not familiar with *Erora*, its not surprising, because this genus is "one of those hairstreaks" that lives in the tree tops; mostly invisible to ground dwellers like me.

I've been determined to learn more about these hairstreaks, so what better way to start observing and learning than get some eggs, and raise a butterfly family!?

The first *E. quaderna* flight starts early…. I consistently see Arizona Hairstreaks in March. The males are strong hilltop/tree toppers, and I've seen them on bushes on ridge tops of Carr Canyon in the Huachuca mountains, on the top of Gamble oaks on Mount Bigelow in the Santa Rita mountains, and on alligator juniper tree tops along the highway on Grey's Peak north of Morenci. But if you only go looking at the treetops, you don't often see females. One finds the females on nectar sources! In early spring a very attractive nectar source for *E. quaderna,* is Manzanita (*Arctostphylos pungens).* When in bloom Manzanita is covered with small pinkish bell shaped flowers that attract many pollinators!

Having researched host plants, it appeared that Emory oak (*Quercus emoryi*) and perhaps Arizona White oak (*Q. arizonica*) are expected host plants. Also in discussions with Jim Brock and with Dave Wagner, I learned that both have found *E. quaderna* larvae on buck brush (*Ceanothus fendleri*). Jim Brock mentioned to me that Manzanita itself may be a host as well.

Methods:

In April 2018 I caged a female *E. quaderna* with a choice of different oaks (some oak flowers) and also Manzanita with buds and flowers. The female oviposited, but only on the Manzanita. I was excited, however the eggs never hatched for some reason.

(The "cage" is a one-foot rectangular terrarium, with sliding screening on one side. The cage was kept indoors at 76F, with artificial light timed for 12-hour daylight periods. Host plant was set up in a water "vase" (empty coke can) to try to keep as fresh as possible. In addition to plants, diluted honey water or Gatorade water was refreshed on a cotton pad for butterfly use.)

I tried again in June (with the second *E.quaderna* flight), and caged a female with several choices, including flowering *Ceanothus fenderli.* The female oviposited on the *Ceanothus* in various crevice locations, but always on *C. fenderli* flower buds or fruits. The eggs are very small, and beautifully lime-blue green (photos 1a, b). I could count maybe twelve.

Rearing Results:

In just a few days the eggs started hatching. The hatchlings were so small, they were tough to keep track of, let alone take good photos. Here are about the best I have showing a fresh hatchling (photo 2) and also showing a larva burrowing into a flower bud (photo 3).

A few first instars died of unknown causes, but nine larvae continued eating and to grow. The larvae ate ONLY plant reproductive parts, though they seemed to like resting on the leaves. I kept them all together, and there was no cannibalism seen.

By day nine after the first hatching, one could see some of the caterpillars had molted into second instar. Though still very small, only about the size of the flower buds, this instar had a dramatically different "vestiture" (photo 4)! See for yourself!

With day fifteen, some larvae were on to the third instar and were quickly growing and adding size and appetite. They continued to only eat reproductive parts of the *Ceanothus* ravishingly. By now they were several times the size of the *Ceanothus* buds. You can much more clearly see the crowned chalazae; some chalazae were white, while others red (photo 5, 6).

By day nineteen from the first hatching, the fourth instars starting showing up, and OH MY what a difference in shape and morphology had arrived (photo 7).

After twenty-two days there were last instars (photo 8), which, though similar in appearance, continued to get larger.

As last instars, they became active crawling around their enclosure for a couple days before pre-pupation. After

Photos: Arizona Hairstreak eggs on *Ceanothus fendleri*: 1a. fruit; 1b. flower stem.

Photo 2: First hatchling.

Photo 3: Hatchling burrowing into *Ceanothus fendleri* flower bud.

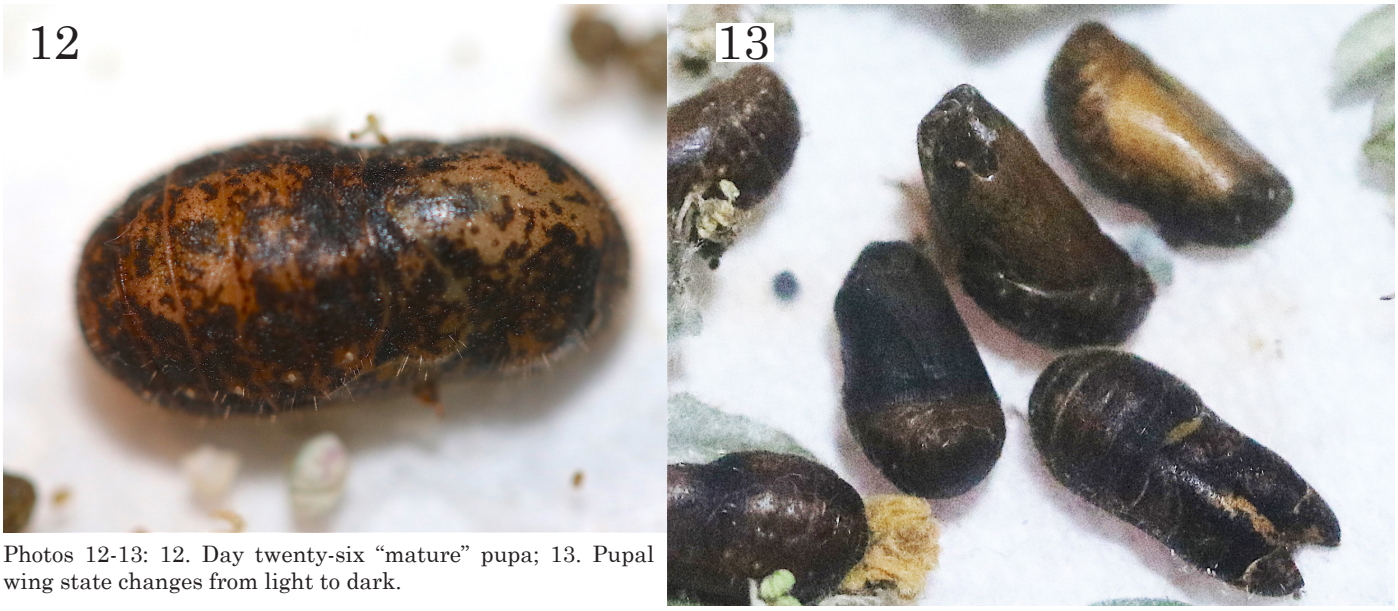
Photo 4. Second instar having "crowned chalazae."

Photo 5: Day 15 Third instar.

Photo 6: Day seventeen photo illustrating the size and shape difference between a 2nd and 3rd Instar .

Photos 7-9: 7. Day 19 fourth instar side profile; 8. Day 22 last instar; 9. Pre-pupa on leaf with slight silk girdle.

Photos 10-11: 10. Fresh pupa and last instar; 11. Pupa on leaf with silk girdle.



Photos 12-13: 12. Day twenty-six "mature" pupa; 13. Pupal wing state changes from light to dark.

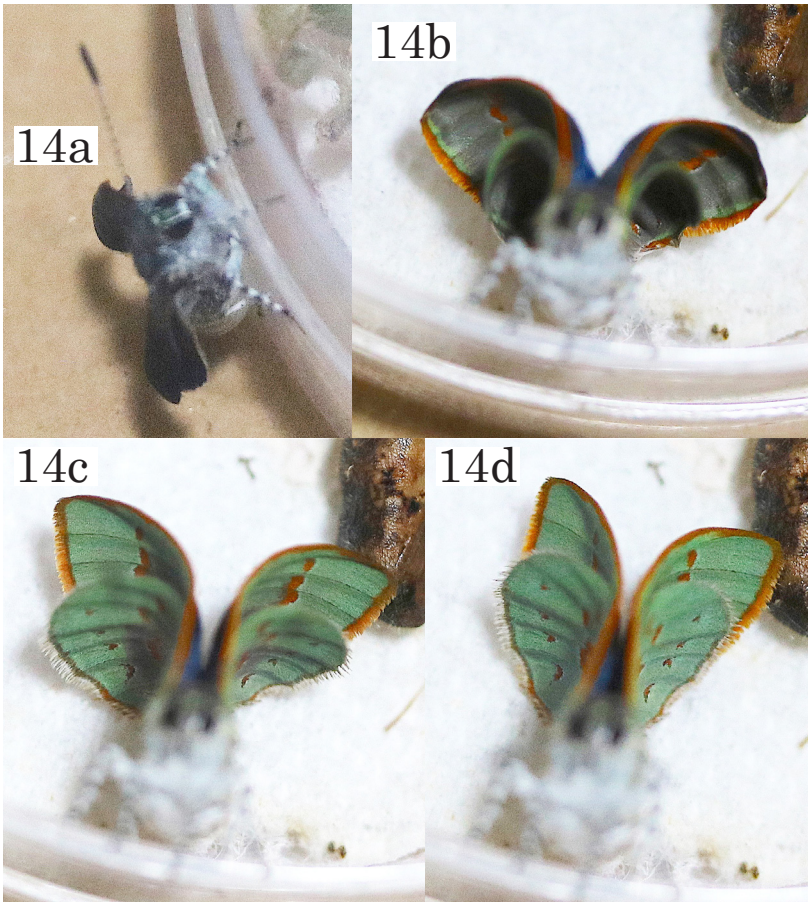
choosing a pupation location, they became lethargic. In the pre-pupal state, they shrunk in length, lost most of their external shape, and became a slightly flattened oval (photo 9).

Some of the larvae chose a leaf to pupate on, and these formed a slight but obvious silk girdle to hold them in place (photo 11). Other larvae chose a location under a leaf or paper, with some sparse silk attachments, but not having any obvious girdle (photo 10, 12).

On the first pupae preparing to eclose, (after sixteen days), the wing area visible thru the pupal skin as a light cream colored area noticeably got very dark overnight, as the wing membrane became pigmented (photo 13). You can see the difference.

Eclosing pupae staged over some time, but on the day a pupa eclosed, the event always happened between 9:00 and 930 am.

Once out of the pupal skin (almost an instant move), the adult would find a place to rest vertically, and there spread its wings for drying and hardening (photo 14). This also happened fairly quickly, 10 or 12 minutes at most, to full wing extension. Once fully open (photo 15), the butterfly would rest for a couple hours before more movement and flight.



Photos 14a,b,c,d: Wing unfolding and drying.

Discussion:

Hairstreak eggs are a whole study area in and of themselves. My *E. quaderna* egg pictures are pretty scant, but there is an *E. laeta* egg picture and some discussion by Downey and Allyn (1984) regarding this subject.

In their classic work "A survey of the last instar larvae of the *Lycaenidae* (Lepidoptera) of California", Ballmer and Pratt included comparative larval work for *Erora quaderna* as one of several "exotic" species selected. This was "to understand better the distribution of morphological characters among higher taxa"! MOST LUCKY for us! In their data tables including *E. quaderna* larval characteristics, several stand out and are noted as somewhat unique; for example larval honey gland (none), and chalazae (stellate), as we've seen. This study is well worth having handy.

Erora Background:

In the U.S., *Erora quaderna's* range is almost exclusively central and southeastern Arizona. A handy reference is "Butterflies of Southeastern Arizona" (Bailowitz and Brock). *E. quaderna* has a "cousin" in the eastern US (and Canada), the Early Hairstreak *Erora laeta.* These

Photo 15: Eclosed male.

Photo 16: Female specimen, ventral.

are the only two members of *Erora* in the US. Physically they are so similar in outward appearance that they were considered the same butterfly for many years.

While eastern *E. laeta* is uncommonly seen, *E. quaderna* is usually friendly for adult sightings during its flights in Arizona. *E quaderna* has at least two flights, and perhaps more.

As recent as 1980 in a paper dedicated to Harry Clench, "A review of the *Erora laeta* group, with description of a new species (Lycaenidae)," Lee Miller organizes what was known about the *Erora laeta* group, which at the time was comprised of only three look alike species.

However, more and more *Erora* are being discovered, uncovered, or better resolved from the Neotropics. In the "Atlas of Neotropical Lepidoptera" Robert Robbins listed 33 species; 13 of them undescribed. Today it appears to be 35-45 (pers comm)! That's discovery!

These *Erora* butterflies' life histories remain for the most part a mystery. Even for *E. quaderna*, seeing an adult is far from investigating and discovering its life history! Kilian Roever in "Notes On *Erora* (Lycaenidae)" states "I have not been successful in locating the foodplant of *quaderna*," though his hours in the field have been incalculable!

Lab and fieldwork published in 1981 by Alexander Klots and Cyril F. dos Passos; "Studies of North American *Erora* (Scudder) (Lepidoptera, Lycaenidae)", remains one of the best compilation resources to read regarding our two *Erora*. The work represents years of study of *E. laeta, E. quaderna quaderna* and *E. quaderna sanfordi* (our Arizona hairstreak), including photos of adults, last instar and pre-pupae larvae and pupae. The sketches of the first instar caterpillar, and other caterpillar characteristics are invaluable!

Erora Host Plant

"Evidence supports the idea that *Erora* are polyphagous on flowers, oftentimes on the flowers of weeds. Behavior rather than food plant would appear to account for their rarity." (Robert Robbins pers. email.)

Using plant reproductive parts seems universally supported! As previously noted, both Jim Brock and Dave Wagner (twice) found active *E. quaderna* larvae on flowering *Ceanothus*. With my experience successfully raising a brood, it would seem this is not an uncommon host!

Klots and dos Passos conclude that the *E. laeta* larvae most likely prefer "flowers and developing fruits" of beech and/or beaked hazel trees, based on field discoveries. (With lab raisings of *E. laeta*, they show the larvae could survive on the host trees' leaf by skeletonizing if necessary, with pictures of a late instar doing such.)

Klots and dos Passos field studied *E. quaderna sanfordi* at the Southwestern Research station. Importantly they observed *E. quaderna* adults to "always associate with *Quercus arizonica* Sargent and *Q. emoryi* Torrey". Focusing on the oak trees, and with the help of Kilian Roever, they did find an *E. quaderna* larvae on *Q. emoryi* and raised it thru to adult.

Scott in "The Butterflies of North American" 1986 lists *Q. emoryi* as an *E. quaderna* host, and "supposedly also *Rhamnaceae: Ceanothus*". He notes that M. Douglas lab raised *E. quaderna* on Arizona white oak, and includes Klots discovery of a *E. quaderna* larvae on Emory oak.

In "Field Guide to Butterflies of North America" 2003, Brock and Kaufman list *E. quaderna* and *E. laeta* as separate species. They also agree with Scott that males treetop "on mountain summits to locate females", and that larval food plants are "Oak, buck-brush, and possibly manzanita".

All of this supports the opening statement regarding the use of plant reproductive parts, "…polyphagous on flowers"!

Wet Areas: Moisture/Mud/Minerals

E. quaderna adults appear to be often attracted to moist "mud" areas. In his article K. Roever reported that "… at that time of year they are easily taken at damp spots along the stream…"; and Jim Brock reports that both male and female equally visit mud…."I think I have totaled as many adults at mud as flowers…". (pers comm.) Whether for hydration in a dry climate, and/or gaining nutritional minerals, this habit appears to be somewhat similar to the reported reliable "woodroads" for finding *E. laeta* in the eastern states (Klots & dos Passos), i.e. on along dirt roads in habitat locales.

Nectar and non-nectar sources?

Most references note that *Erora* adults actively visit flowers for nectar, though maybe less so for *E. laeta*. My experience supports this and I've seen *E. quaderna* visit flowers of Manzanita, *C. fenderli,* white sweet clover (*Melilotus albus*) (photo 17), and seep willow (*Baccharis salicifolia*).

However, and less discussed, you might find interesting the observations of *E. quaderna* using oak tree sap for nourishment. I frequently flush *E. quaderna* from silver leaf oak (*Quercus hypoleucoides*) in the Santa Catalina mountains, the oak trees I've frequently photographed Colorado hairstreaks (*Hypaurotis crysalus*) using for food at sap "leaks". (Thicket hairstreaks too!) I have also photographed (with Fred Heath and Mary Klinkel) *E. quaderna* competing for sap directly with *H. cryslaus* (Pinaleno mountains near Safford) on Gambel oak (*Quercus gambelii*) (photo 18).

Just imagine, why wouldn't *Erora* routinely feed up in the oak trees they call home, if the sap is flowing?

Having read Gagliardi and Wagner's great 2016 article "'Northern' Oak Hairstreak (*Satryrium favonius ontario*) (Lepidoptera: Lycaenidae): Status survey in Massachusetts, false rarity, and its use of non-nectar sugar resources" it could make pieces of the *Erora* puzzle fall more into place; and perhaps some of the why *Erora laeta* seems so "rare" for no apparent reason!

Just imagine!

Photo 17: Female *Erora quaderna* on white sweet clover. Photo 18: Colorado and Arizona Hairstreaks (*Hypaurotis chrysalus* and *Erora quaderna*) competing for sap resources on Gambel Oak (*Quercus gambelii*); Pinaleno Mountaina near Safford, AZ.

Acknowledgements

Gratitude and thanks for help goes to Jim Brock, Fred Heath, Mary Klinkel, Robert Robbins and Dave Wagner. The author accepts full responsibility for any errors in this paper.

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Book Review -- Discovering Jamaican Butterflies

Continued from p. 196

The book ends with a comprehensive discussion on the biogeographic origins of Jamaican butterflies and efforts for their conservation, drawing from many recent publications. The book is not without errors such as a mistake in the abbreviation of this author's name in the references, and I am sure there may be one or two more, but who would not expect to find errors in a work of this magnitude? All these simple errors can be fixed in the next version, which I hope is already being worked on. All in all, this is a splendid work, very comprehensive and detailed, popping with magnificent images, figures, and tables – simply a must have.

Delano S. Lewis *is an Associate Professor of Biology with speciality in insect systematics and Research Associate at the McGuire Center, Florida Museum of Natural History.*

This review was originally published online in Tropical Lepidoptera Research, 28(2): 47-48, Oct. 3, 2018.

A male of *Protographium marcellinus* (Papilionidae), a species in danger of extinction through ongoing destruction of its larval food plant (photo by V. Turland, from Discovering Jamaican Butterflies).

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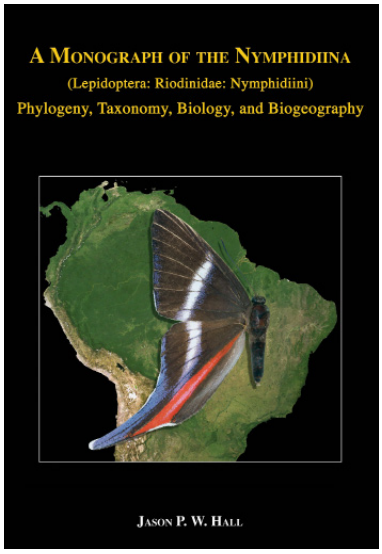
Publications

Discovering Jamaican Butterflies and their relationships around the Caribbean, by Thomas Turner and Vaughan Turland - See book review, pages 194-195, this issue. 611

A Monograph of the Nymphidiina (Lepidoptera: Riodinidae: Nymphidiini): Phylogeny, Taxonomy, Biology, and Biogeography, by Jason P. W. Hall.



2018. Hard cover, 7 x 10.25 in, 990 pp. (ISBN 978-0-692-98754-4). Published by and available from The Entomological Society of Washington (entsocwash.org). $125 + postage.

Includes a comprehensive phylogenetic revision of 26 genera (159 species), descriptions of 8 new genera and 11 new species, 39 color plates of spread/live adults, 1121 other figures (cladograms, immatures, genitalia, maps). 604

Rare Books for Sale

Please: serious, informed inquiries/offers only; to Ernest H. Williams **(ewilliam@hamilton.edu)**

Denton, Sherman F. 1900. *Moths and Butterflies of the United States East of the Rocky Mountains.* Boston: Bradlee Whidden. 2 vols. Copy #3 of 500 sets. Half leather, half marbled board, gilded edges; slight shelf wear. Rather than colored images, these volumes contain actual transfers of scales from the wings of specimens.

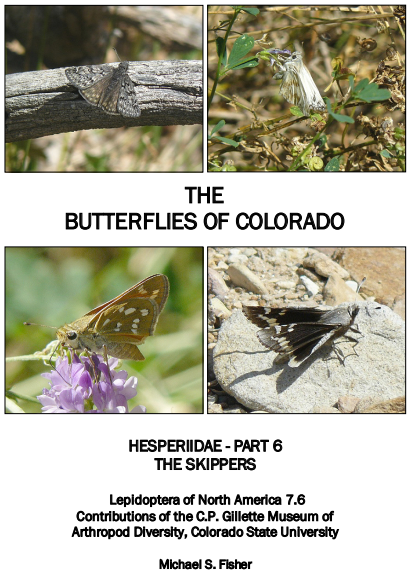
Part 1. The Moths, 161 pp. + 13 plates.
Part 2. The Butterflies, 361 pp. + 43 plates.

Scudder, Samuel Hubbard. 1889. *The Butterflies of the Eastern United States and Canada, with Special Reference to New England.* Cambridge: published by the author. 3 vols. Fine condition; a little shelf wear.

Vol. I, Introduction, Nymphalidae; xxiv + pp. 1-766 pp.
Vol. II, Lycaenidae, Papilionidae, Hesperidae; xi + pp. 767-1774.
Vol. III, Appendix, Plates; vii + pp. 1775-1958 + 89 colored plates + 1 folded map. 604

Looking for issues number 47 and 48 from The Journal of Research on the Lepidoptera. I would be willing to trade specimens for them or buy them. Contact Ricky Patterson at 601-638-6848, or email at **rpatte42@aol.com**. 604

Butterflies of Colorado - Part 6 - Hesperiidae - The Skippers, by Michael Fisher; $50.00 paperback.



The final part published as the sectional series, Lepidoptera of North America 7.6, Contributions of the C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Ft. Collins, Colorado (ISSN 1084-8819). 223 pages covers the 76 recorded/reported species, most of which are resident and includes all applicable subspecies; 382 color photographs with clear detail and current Colorado county distribution maps for all among the text pages. In most instances, behavioral and host plant information is included.

For ordering information email the author: butterfliesofcolorado@hotmail.com 611

A Checklist of Wisconsin Moths (Superfamilies Mimallonoidea, Drepanoidea, Lasiocampoidea, Bombycoidea, Geometroidea, and Noctuoidea) by Leslie A. Ferge, George J. Balogh and Kyle E. Johnson has been published by the Wisconsin Entomological Society. It treats 1284 species representing thirteen families. Distributions are summarized using the six major natural divisions of Wisconsin; adult flight periods and statuses are also reported. Examples of Wisconsin's diverse native habitat types in each of the natural divisions have been systematically inventoried, and species associated with specialized habitats such as peatland, prairie, barrens and dunes are listed. Four color plates include unusual or seldom illustrated species. It is available online at http://www.wisentsoc.org/publicationslinks/ and hard copies are available for $13.00 postpaid. Please send check payable to "WI Entomological Society" to Les Ferge, 7119 Hubbard Ave., Middleton, WI 53562-3231. indefinite

The Moths of North America, Fascicle 22.1A, DREPANOIDEA, **Doidae**; NOCTUOIDEA, **Notodontidae** (Part): Pygaerinae, Notodontinae, Cerurinae, Phalerinae, Periergosinae, Dudusinae, Hemiceratinae. By James S. Miller, David L. Wagner, Paul A. Opler, and J. Donald Lafontaine 339 pages, 78 species accounts, 20 colored plates, 23 monochrome plates. Hardbound with dust jacket. ISBN 978-0-9796633-3-8. Published in 2018 by the Wedge Entomological Research Foundation. Price $95.00, plus shipping. An introductory price of $85.00, plus shipping, is available until December 31, 2018. 604

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. 611

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

WANTED: An adult specimen, either sex, of *Lophocampa roseata* for chemical analysis of the red wing pigment. Observations, photos, specimens of larvae and adults of the Spotted Tussock Moth, *Lophocampa maculata*, and *Lophocampa roseata* from all areas of North America, recent or old data. Records from Alaska and northern Canada, the desert SW, southern Appalachians and Pacific Coast are especially needed to define range. Records of early or late season observations are particularly valuable. All larval and adult photographs are useful, especially if they show unusual patterns of coloration. Specimens are desired for future genetic analysis. Contact Ken Strothkamp, Portland State University (**kstrot2@pdx.edu**). 604

Conservation Matters: Contributions from the Conservation Committee

The extinction of meaning

Bryan Pfeiffer

2 Hillhead St., Montpelier, VT 05602 **bryan@bryanpfeiffer.com**

One of the most imperiled animals in North America isn't big and furry like a polar bear. It has neither the charisma of an ivory-billed woodpecker nor the elegance of a prairie finged orchid. It has incited no eco-wars like those over the gray wolf or the spotted owl. It is not even a tool in the machinery gearing up to weaken the Endangered Species Act (ESA). No, this endangered animal is merely *Oarisma poweshiek* (Poweshiek skipperling). Even though this butterfly once flew in untold numbers across prairies from Michigan to Manitoba, few Americans or Canadians have ever heard of it, let alone seen it. And despite its being federally listed, the Poweskiek skipperling is so imperiled that many of us who have watched it dance across the grasslands probably won't have a chance to say goodbye.

I first encountered *O. poweshiek* in a prairie fen in southern Michigan, on July 13, 2003. When one alighted on a flower bud, I dropped to my belly and snapped a quick photo. Since then, the skipperling's relentless decline has continued so that it is now extirpated from more than 90 percent of its sites. It may become the first species that I have seen and known in the wild to go extinct before I do.

So why should we save the skipperling? Those of us who love wildlife and wild places resort to some well-worn arguments in defense of the ESA and similar laws: that rare plants might serve humanity as medicine; that some of these animals are "canaries in the coal mines" alerting us to bigger problems in nature; or that imperiled species are part of our national heirtage, no less sacred than the Liberty Bell or Old Faithful. All worthy assertions, all anthropocentric, and all too often failures in the new littered landscape of public discourse.

In the end, I suspect few will mourn the passing of a butterfly. For most distracted Americans, the skipperling is yet another abstraction bound for oblivion, something they will never see, let alone understand or even appreciate. After all, what good is a butterfly that does not tweet or titillate?

Poweshiek Skipperling (*Oarisma poweshiek*), July 5, 2018, in Michigan. Photo by David Pavlik.

The old ideas for saving nature don't seem to work anymore -- for any number of reasons, including the ironic. We now watch more nature online than ever, swimming virtually along the Great Barrier Reef or soaring beside limestone cliffs of the Grand Canyon, even as the glowing screens move us farther from actual nature. A tiny fraction of humanity will ever actually swim along any reef and the average visitor to the Grand Canyon stays less than a day, a good portion of it indoors. What good is a butterfly that can't join us for a selfie?

Another strategy is to demonstrate that there's money to be made or saved from biological diversity. Nature provides us with tangible "ecosystem services" to which we can assign dollar values: mangrove swamps and barrier islands protecting us from coastal floods or storm surges, for example, forests sequestering carbon and easing the climate disaster, or even value in the peace of mind we find in the good company of wildlife. I don't expect these notions to find much traction in the Trump administration. What good is a butterfly that doesn't turn us a profit?

So environmentalists tend to practice a kind of identity politics of the charismatic, enlisting polar bears, gorillas, pandas and other megafauna in the fight to protect all endangered species. That's fine. These animals warrant our sympathies, even if the vast majority of us will never see one or know tangible value from them. For better or worse, they are avatars to actual nature.

One of the oddities of extinction is that despite its finality and irrevocability, we're almost never there to watch it happen (even as it's happening on our watch like never before). Sequestered behind our gadgets, or even if we do get oustide in the prairie looking for it, nobody will be around to see the last skipperling take its last flight. Its demise won't really hurt, certainly not like the closing of the local bookstore or the extinction of civility in our public discourse.

What worries me even more is that most Americans know little of -- and care even less about -- the spectacular natural diversity surrounding every one of us. We are ignorant of the rainbow of warblers passing through in migration each spring. We overlook the orchids growing in roadside ditches. Most can hardly identify what's singing or croaking or buzzing in their own backyard.

Robert Michael Pyle famously calls this the "extinction of experience" -- an estrangement from the familiar. If we do not know what lives next to us, we will not notice when it is gone.

"So it goes, on and on, the extinction of experience sucking the life from the land, the intimacy from our connections," Pyle writes. "This is how the passing of otherwise common species from our immediate vicinities can be as significant as the total loss of rarities. People who care conserve; people who don't know don't care. What is the extinction of the condor to a child who has never known a wren?"
And there among Pyle's degraded commons, I fear also an extinction of meaning. Besides its actual achievements, the ESA is a statement of our aspirations to live within our means in nature. As we inevitably encroach on plants and wildlife, as we push species to their limits, the Act becomes more a statement about us. It recognizes that we can, in fact, walk back our destructive footprints and try to make amends.

An undermining of the Act is an admission that we -- or at least the people a minority of us have elected -- don't care about the vulnerable and imperiled anymore. When it comes to skipperlings and the other silent nature we have pushed to the brink, like the carbon we pump into the atmosphere, there may soon be little practical or moral limitations on our excesses.

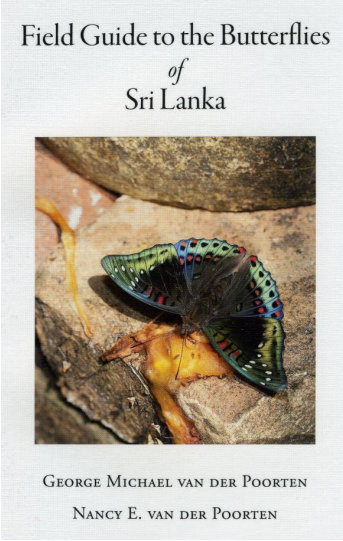
What has the skipperling done for us lately? Well, to be honest, not much. When it's gone, the prairie will still look the same. But not to me. It will be missing something intrinsic -- like St. Louis without the Gateway Arch, Yellowstone without eruptions of Old Faithful or Mexico without overwintering Monarchs. Without the skipperling, the prairie will still be the prairie -- but a prairie depleted.

And so too will we be depleted. Not just of a butterfly gone forever. But also a depletion of who we are, an extinction of what it means to love and live responsibly with nature.

Poweshiek Skipperling (*Oarisma poweshiek*), WI: Waukesha Co., Scuppernong Prairie, June 26, 1981. (Photo by Les Ferge)

Book Reviews

Field Guide to the Butterflies of Sri Lanka by George Michael van der Poorten and Nancy E. van der Poorten, 2018. Lepodon Books, Toronto, Canada. ISBN: 978-1-77136-605-2. vi, 250 pages, 19.05 cm x 12.06 cm, 350 grams, with flexible covers.



This new book on the butterflies of Sri Lanka by the husband and wife team of George and Nancy van der Poorten comes a little over two years after the publication of the authors' *magnum opus*, *The Butterfly Fauna of Sri Lanka* (2016), a book widely regarded (with good reason) as the standard work on the subject. It needs to be stated at the outset that the book under review is not a simplified and shortened version of the 2016 book but an entirely new work which is not only designed to meet the need of field identification of butterflies in Sri Lanka but is also the most up to date and accurate account of the composition of the butterfly fauna of Sri Lanka.

Unlike the previous monograph this field guide is a much more portable book designed to be carried in the field, measuring seven and a half inches by four and three quarter inches and weighing just over 12 ounces. The small size of the book is deceptive, however, because packed between its covers is a wealth of information. The book is superbly designed and organized with ease of accurate identification of species in mind. Introductory sections of the book deal with climatic zones in Sri Lanka and butterfly distribution, the anatomy and life cycle of butterflies, butterfly conservation, tips on how and where to observe butterflies and ways of enhancing gardens to attract butterflies. Following a section on how to use the book (explaining the organization of the book and the significance of various types of information, how to use keys, etc.) the main body of the field guide occupies pages 25-205, where the identification of butterflies is covered in detail, organized by family (Hesperidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, Riodinidae).

For each family a brief introduction is provided, which is followed by details for identifying species, with the information presented in text and carefully selected photographs on facing pages. For some species distribution maps are inserted next to the species accounts, for others (the majority) these are given in Appendix A. A useful feature of the book is the addition of arrows to photographs pointing out diagnostic features for telling apart some confusingly similar species. Another useful feature is the juxtaposition of superficially similar species on the same page even if they are not closely related, allowing easy comparison. Appendix B provides a complete checklist of the butterflies of Sri Lanka and includes taxonomic notes explaining recent changes in the status and nomenclature of species and subspecies, mostly since the publication of the 2016 monograph. Appendix C is a list of host plants, which is followed by a glossary, and there is a brief list of references relevant to this book. The distribution maps (next to species' accounts or in Appendix A) are a notable feature of this book and they are probably the first published maps for butterflies in Sri Lanka; no such maps were included in the 2016 publication. Records for individual species are indicated by different colored dots: blue (historical records prior to 1950), red (confirmed records after 1950), orange (doubtful records). A little more explanation regarding "confirmed" and "doubtful" records (e.g. specimen or photograph supported or not) would have been helpful.

Over the last few decades there has been a significant increase in the number of field guides and similar books for identifying various kinds of organisms in Sri Lanka, with birds, butterflies, reptiles and mammals perhaps being the groups most often featured. This is probably partly due to an increase in local awareness and interest in wildlife, the environment and conservation, and also due to an increase in ecotourism. While most of these new publications are interesting and commendable in many ways they vary in accuracy and scientific merit. A search in the online catalogues of retailers of natural history books will turn up a number of books dealing with the butterflies of Sri Lanka and someone looking for a book for identifying butterflies in Sri Lanka may feel unsure which book is best. The answer is quite simple: George and Nancy van der Poorten's *Field Guide to the Butterflies of Sri Lanka* is the most accurate and best designed book for identifying butterflies in the field in Sri Lanka. If you are interested in the butterflies of Sri Lanka you will want to have this book and if you intend to observe and identify butterflies in the field in Sri Lanka you need this book!

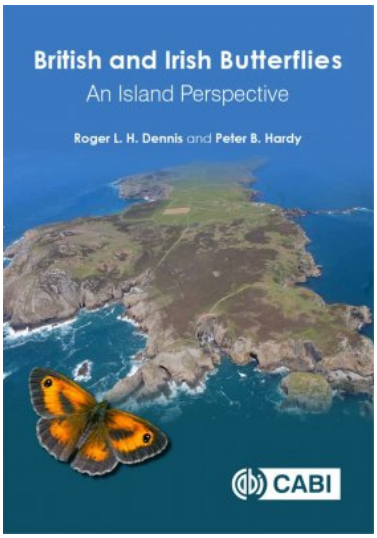
Field Guide to the Butterflies of Sri Lanka is available from Pemberley Books (**www.pemberleybooks.com**) and BioQuip (**www.bioquip.com**), and is also available direct from the authors (**www.lepodonbooks.com**). The book is scheduled to be released in Sri Lanka by the end of the year, in mid December.

***D. P. Wijesinghe**, Department of Natural Sciences, LaGuardia Community College, Long Island City, New York.*

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

British and Irish Butterflies: An Island Perspective
by Roger L.H. Dennis & Peter B. Hardy (2018)

£75.00 379pp. hardcover ISBN: 9781786395061 (ebook also available)



British and Irish Butterflies: An Island Perspective is a major work on the butterfly fauna of the offshore islands of Britain and Ireland (including the Isle of Man and the Channel Islands) covering not only faunistics but biogeography, ecology and evolution. The publishers have also made, as open access, a considerable amount of supplementary material downloadable to support this work. Downloads include an extremely useful Excel spreadsheet listing all the islands off Britain and Ireland with relevant data (e.g. species, presence/absence) and generously a copy of Dennis & Shreeve's 1996 work *Butterflies on British and Irish Offshore Islands: Ecology and Biogeography*. For quick access to the supporting material there is a QR code on the second printed page, or visit the CABI website **https://www.cabi.org/openresources/95061/**.

The first half of the book contains nine chapters, the first two of which cover the basics of island biogeography and a geographical and historical outline of the British & Irish islands. The all-important question of how many islands there are and the definition of what makes an island are stated here. The authors list all islands over 10 hectares in size, which equals over 900 islands. These are listed in appendix three and available as an Excel spreadsheet download. However on the downloadable Excel spreadsheet, the listed islands are stated to be over one hectare in size so I am assuming the statement in the book of 900 islands 'over 10 hectares in size' should in fact read 'over 1 hectare in size'.

In the remaining seven chapters the authors make full use of the extensive data available on British and Irish butterflies to examine and explore various subjects concerning island biogeography, ecology and evolution. There are many case studies concerning islands and British and Irish butterflies and these cover in-depth many topics including extinction & colonisation rates, and predictions of what species should occur where. All the topics are well explained, contain considerable number of figures illustrating their conclusions and are extensively referenced. The last chapter entitled 'Island studies: a glance back and the view ahead' emphasises the need for habitat conservation on the mainland and large islands if species are to survive and indicates that larger islands may well act as refugia as human disturbance is generally lower than on the mainland. There are also directions for future research, indicating that molecular work will play an essential role.

The centre of the book contains the plates. The first set of plates has 17 wonderful photos of some of the islands surrounding Britain and Ireland which have been mentioned in the preceding chapters. The second set of plates has one image of a living specimen of the 83 species the authors list as British and Irish in the appendix one checklist.

There then follows 15 appendices which make up the second half of the book. These appendices should not be skimmed over as they cover a variety of subjects and contain a wealth of information. Appendices one and two are checklists of British and Irish butterflies. As already mentioned, appendix three is a list of all the offshore islands in Britain and Ireland and the butterfly species recorded. Also listed here are islands with no current records which hopefully will be seen as a challenge for future recorders. Appendix four lists the data obtained from private sources used in the compilation of island records. I am sure it would be appreciated if these data could be made publicly available. Appendix five is a list of published distribution atlases for Britain and Ireland. Appendices six to fifteen show statistical methods, tables and analyses used to support data in earlier chapters.

Also included are a very useful glossary of terms used in the book, running to nearly 20 pages, and an extensive bibliography running to 47 pages.

The only minor criticism I can make of this work is the use of the term 'British Isles' and 'British' when referring to Irish islands and species. Even though the appropriate terminology (Ireland, Irish, Britain and Ireland or British and Irish) is used in the majority of instances where needed, there are still many instances where it is not, and this is particularly prominent on the plates of living specimens, where 11 pages of plates are titled 'Images of British Butterfly Species' even though one species, *Leptidea juvernica* only occurs in Ireland! I hope this is corrected in future editions.

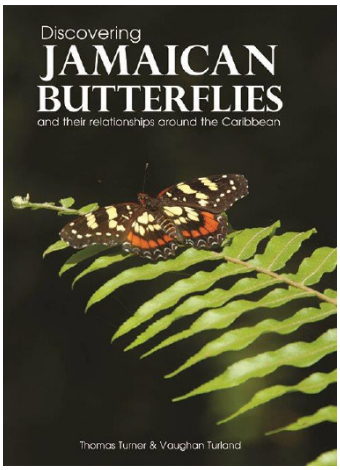
To conclude, this is an excellent book. The authors should be congratulated for producing such an in-depth analysis of the British and Irish butterfly fauna. This book is not only for anyone interested in British and Irish butterflies but should also be essential reading for students of island ecology and biogeography.

***Mr Geoff Martin**, Senior Curator in Charge (Lepidoptera), Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD*

Discovering Jamaican Butterflies and their relationships around the Caribbean. Thomas Turner and Vaughan Turland (2017).

English; Hard Cover, 512 pages; 1000+ color photographs and figures; 10.7 x 8.8 x 1.6 inches; 4.6 pounds, price: US $147.50. Publisher: Caribbean Wildlife Publications; Printers: Friesens Corporation, Manitoba, Canada; ISBN-10: 0692877061; ISBN-13: 978-0692877067.

Brief description: "Discovering Jamaican Butterflies and their Relationships around the Caribbean …… is the first comprehensive book on the subject since 1972" according to the authors. All butterfly species and subspecies (136) known from Jamaica are described in detail, including distribution, behavior, relationships, larval food plants, and immature stages, including some new information. This book is especially geared towards persons serious about the natural history of the Caribbean fauna, wildlife protection, wildlife conservation, habitat preservation, taxonomy, systematics, and phylogeny, especially as it relates to tropical butterflies.



Review: I have known of the development of this book since its inception in 2008 and have been eagerly waiting since then – and I was not disappointed. It has been made an even greater pleasure being acquainted with the work of both authors. Both authors bring a wealth of information, experience, and expertise to bear in this book and I was not disappointed at the outcome – it is simply a $1000 book being sold for under $200 – that's the simplest way I can put it. The brief introduction by the authors sets the tone for this book. This book is not one for the casual reader, even though the pictures and illustrations are captivating enough to enamour my three small children from whom I must constantly wrestle the book and on occasions must hide in places they cannot reach. This book is designed especially for "researchers interested in tropical butterflies" and persons "involved with studying the natural history of the Caribbean" and lastly, individuals who are "interested in wildlife protection and conservation". In reading the longer description, one gets a good picture of who the authors are, their experience and expertise, and the synergy with which they worked to produce this treasure of knowledge. To produce such a comprehensive assimilation of Jamaican natural history in under 10 years is astounding and a testament to what collaboration and an understanding of the strengths and weaknesses of one another and working with that understanding can do to achieve set goals.

The book starts with homage to Brown and Heineman's (1972) classic work "Jamaica and its Butterflies", which this work effectively replaces, and one should note that the first author of this book had input in the 1972 Jamaica and its Butterflies. From early collectors such as Hans Sloane (1687-1688) to present, this book introduces the work that has been done by collectors over the years. With the base of what early collectors did, the book goes on to establish some important butterfly study areas on the island, describes habitats and gives suggestions to collectors. The authors then provide a guide to classification and go on to describe butterfly habitats on the island, replete with detailed maps, photographs, and descriptions of habitat across the island. This section could in itself serve as an introduction to Jamaican forest ecology for entry-level college students at least. The authors then provide a table detailing the preferences of Jamaican butterflies for certain habitats. I would have preferred that they did not break the trend of thought from the brief chapter on study areas to the detailed descriptions of butterfly habitats with the chapter on classification. It would have been better to place that chapter right before chapter five (5) that deals with the detailed descriptions of the Jamaican butterflies. However, that is just personal taste and does not detract from the content of each chapter which was well supported by cited literature; in fact, the whole book is full of citations in support of information it contains, and conclusions drawn.

Chapter five (5) is the heart of the book; here we find detailed species descriptions of each species - the phylogenetic relationships are first described, then species descriptions follow this established phylogeny. The authors included in each description photographs of adults, pinned and naturally perched, immature stages, distribution maps and images of genitalia. Over 75% of the book is comprised of these detailed species accounts, including unidentified species and new species. This chapter is then garnished with images of eggs of some of the Jamaican butterflies, a table of larval foodplants, a list of important nectar plants for select species and more stunning pictures of butterflies nectaring. Lastly, a table dealing with the status of Jamaican butterfly species and their regional distribution can be found. The wealth of information contained in this section alone will be dissected by graduate students and professors for the foreseeable future and will form for the basis for many publications, as did its predecessor "Jamaica and its Butterflies". I hold advanced degrees in Zoology and Entomology and could be classified as a specialist in butterfly systematics, and it has taken me a while to dissect this chapter alone; in truth, I am still going over some parts as a lot of the information contained there is original research conducted by these individuals where they show immature stages and discuss behaviour of the species, including many previously poorly known taxa.

Book Review *continued on pg. 189*

Discovering Promethea

Tor Hansen

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Here I am again walking uphill in a deciduous woodland with a newly emerged female Promethea Moth in hand. As in years past this exercise is familiar to me in that I have carried out attempts to find a wild male Promethea Moth that homes in to the pheromone call of a female Promethea. She is perched inside a cloth holding cage, clinging to a branch where her promethea cocoon is attached by silken threads. I find the footpath passing through a Sassafras grove, where many of the elegant trees have died from an affliction darkening the smooth bark. But stalwart Sassafrass are still budding new succulent green leaves, those shaped like hand mittens, beckon me to stop here. Recognizing this grove as where last spring I farmed out some hit or miss larvae, the gauze cage is tethered to a tree.

I undo the zippered door to allow a male moth easy access to the female within. The hour is 4PM. These Promethea moths are crepuscular; that is they search for mates in late afternoon. One of three similar species, Promethea, Tulip Tree, and Sweet Bay have different flight times for following the pheromone trail to find the calling female. Within 20 seconds I see a dark maroon & black male fluttering past me. It searches the surrounding foliage for the source of the molecular streaming pheromone, circling ever closer to the suspended cage, and after some confusion, it enters the cage but is unable to locate her directly, and flies out into the perfuse greenery. I decide to remove her branch and all, to try a hand-held approach. The Promethea female is lighter in woody hues like mahogany shading to a white median line with wing margins beige like lichens on a log, with four distinct white "V" markings, one on each wing. I stand motionless with hand outstretched, offering the twig, cocoon, and moth to attract the persistent male moth. Within seconds the male flies directly to her, flutters a little, rubbing his wings on hers, and then couples with her and remains staionary. He is older and has lost the tiny hooks on his hindlegs, rendering them unable to grasp or cling. But the former four legs accomplish the sure hold, and Romeo has indeed united with his Juliet.

I was stunned to witness this spurious event, hoping that I could, like a wildest dream, be present at an arms length to a spontaneous pairing of male and female Promethea drawn together to procreate the next generation of these agile silk moths. Widely studied by enthusiastic lepidopterists caught up in the remarkable mystery of mate selection via a molecular perfume drift, Promethea is one of many giant silk moths in the widespread family Saturniidae that produce progeny despite a physical handicap. Most of the digestive tract is lost or sacrificed in cellular shifting or tissue rearrangement for pheromone production, and


Dimorphic Promethea Moths Mating Pair

thus Promethea and allies gain fast mating advantage at the expense of digestive organs, including loss of tongue, mouth, and alimentary canals. As such adult moths can neither eat nor drink, so moths must mate quickly as viable strength lasts. Energy reserves are depleted gradually, and the moth's life atrophies usually within one week after emerging from the cocoon. The last energy ingested by the caterpillar was obtained from those succulent green Sassafrass leaves, and must suffice for the adult stage.

Walking down to the parking lot in a state of sheer revelation I mused how I could have carried them all the way paired together into my van, and even all the way home some miles away. Despite windy gusts and jolting steps that rocked them like a pinwheel, they persisted in union, the male claspers holding the female abdomen in a firm "never let you go" grip. All these anatomical features and ingrained instinctual actions point to an insect surviving the rigors of natural selection, due to well deployed behavioral adaptations, today much the focus of intriguing studies in ethology, or the study of animal behavior. Evolutionary biology illuminates a vital role of instinctual actions to conquer the stresses of natural selection. *Callosamia promethea* is the scientific name dubbed by Drury, who named this wonder after the Greek God Prometheus, who brought fire to mankind. Promethea can be abundant, certainly common where its food trees are found, despite the increasing reduction of suitable unaltered habitat. Their survival tactics must outlast the ever widening threats from predatory animals especially tachinid flies, ichneumon wasps, and attacks from the micro-hymenoptera, ants, spiders, toxic weed killers, certain pesticides, and urban sprawl.

* * * * *

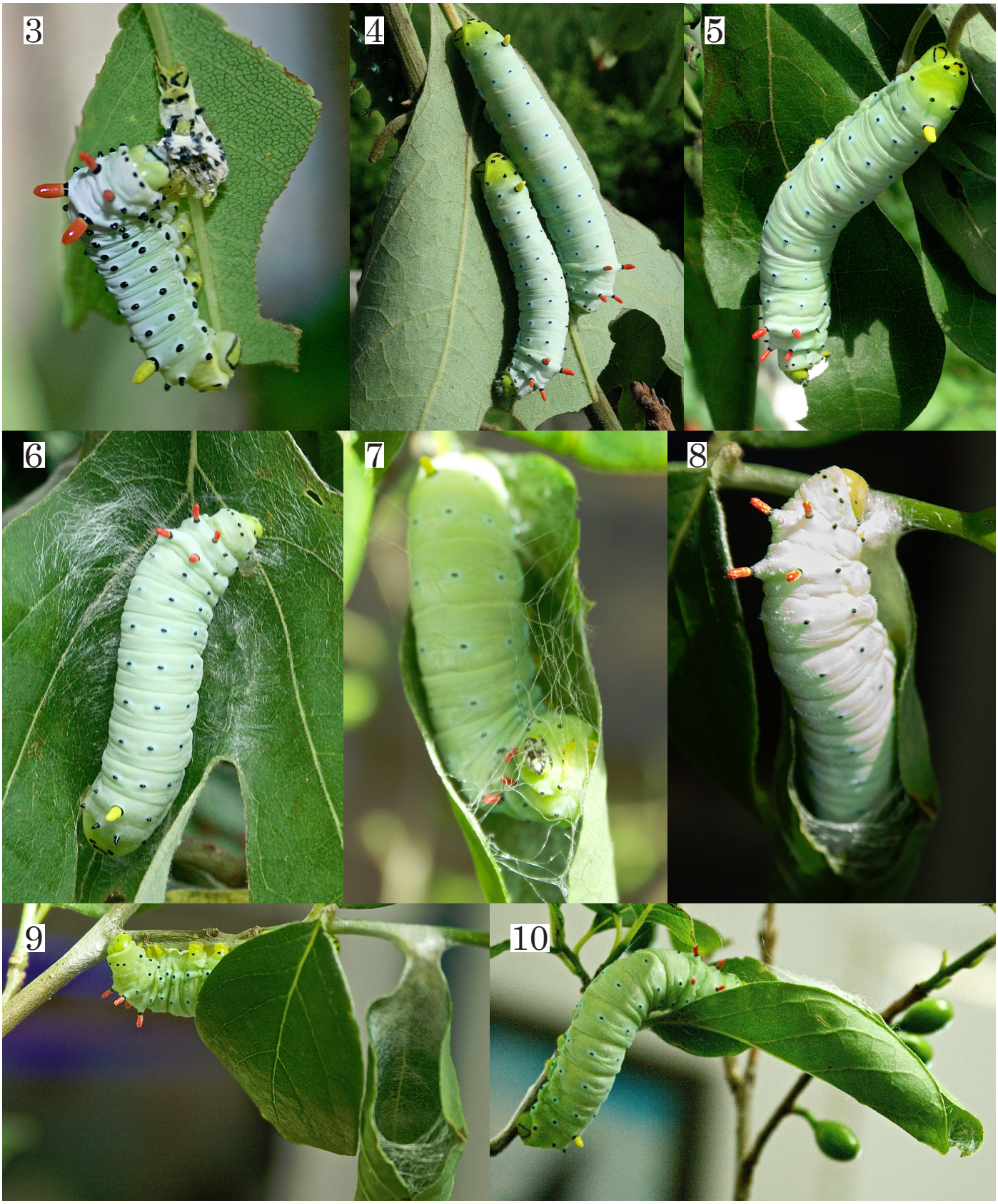
As the larvae feed and grow they must go through all important metamorphic changes, namely molting, or shedding the skin. The Promethea larva feeds judiciously on sassafras, spicebush, or buttonbush, and even viburnum until its skin can stretch no more. Technically known as ecdysis, the caterpillar has evolved a timely adaptation: a new soft skin is forming underneath the former exoskelton, and by bursting open the old skin, the larva extracts itself by shuffling forward and shedding the former all in one steady set of muscular contractions. This will happen four times as the larvae grows to full size. Each time span between molts is known as an instar. These larvae accomplish full growth in five instars, and with each molt these larvae change appearance, as is true for many larvae. Just leave it to the DNA to express these morphological changes; keep the wonder alive as these insects accomplish the nearly impossible!

When the caterpillar has reached terminal growth, it rests a day or so as phenomenal internal changes begin. By some remarkable instinct or such, the larva chooses a site to spin its cocoon. This appears to be well researched by the larva, for it will select a stem or thin branch with an ample leaf in which to enwrap its cocoon to be anchored by repeated silk strands. Secreting liquid silk like a nozzle on a garden hose from an organ called the spinneret associated with the mouthparts, the larva anchors itself to the leaf. It makes a silken web or mat, with to and fro or crazy eight motions, gradually pulling the leaf around and enclosing most the leaf, likely for stability to withstand the rigors of wind and cold winter and avoid predatory detection.

It attaches the leaf even more securely with additional silk threads, keeping the cocoon in the tree, off the ground, throughout the entire cold season. When renewed springtime warmth and increasing photoperiod (circadian rythms) are pronounced enough to promote synergistic hormone secretion, the moth will emerge (eclose). Just how this is accomplished is a testament to the favorable adaptations and positive mutations that have enabled the life cycle to come full circle. For more on the nature of mutations, a later addition to the Darwinian recipe for components of evolutionary theory, consult the writing of Ernst Mayr, "Evolution and the Diversity of Life".

Perhaps more remarkable than other phases of metamorphosis is the dormant pupal stage. Inside the silk cocoon, after the exit door is completed, the inner lining must be fine lined, and impregnated with a semi-waterproofing liquid called serecin. The larva makes a silken lining so tightly overlaid, that it seals out excessive moisture. Then the sleeping bag is completed, and the larva makes ready for extreme internal changes. The interplay of hormones PGH (prothoracic gland hormone) and JH (juvenile hormone) cause the pupal molt. The reduction of JH causes the moth structures inside the pupal skin to form, especially noticed by the well delineated organs at the pupal surface, namely head, antennae folded over thorax, and legs neatly tucked in like the sarcophagi of sleeping pharaohs. But inside the pupa the formation of moth-like anatomy is withheld until much later, about when the moth nears emergence time. Many researchers are surprised how much the interior suggests pea soup. How this green gel becomes distinct organs quite different from the previous larval organs is among the greatest wonders in the Animal Kingdom. Much research has concentrated on illuminating the imaginal discs, first appearing during the larval stages, the isolated structures most likely central to directing the amazing transformation from larval to adult moth anatomy.

In the northeastern United States and Canada, these moths emerge in late spring, likely June, when the trees are in full leaf. Moths usually eclose in the mornings, when the hormone rush into the pupa's blood stream causes the awakening moth within to force its way out of the thin pupal skin, and then to push out through a door designed with an amazing instinct. Without a blue print or an instruction manual, the door is deliberately spun tight enough to keep out rain or snow, but open enough to allow the moth to escape. Softening the silk exit valve with an enzyme that breaks down silk, the new moth claws at the silken door to separate the strands with its brand new tarsal claws, that

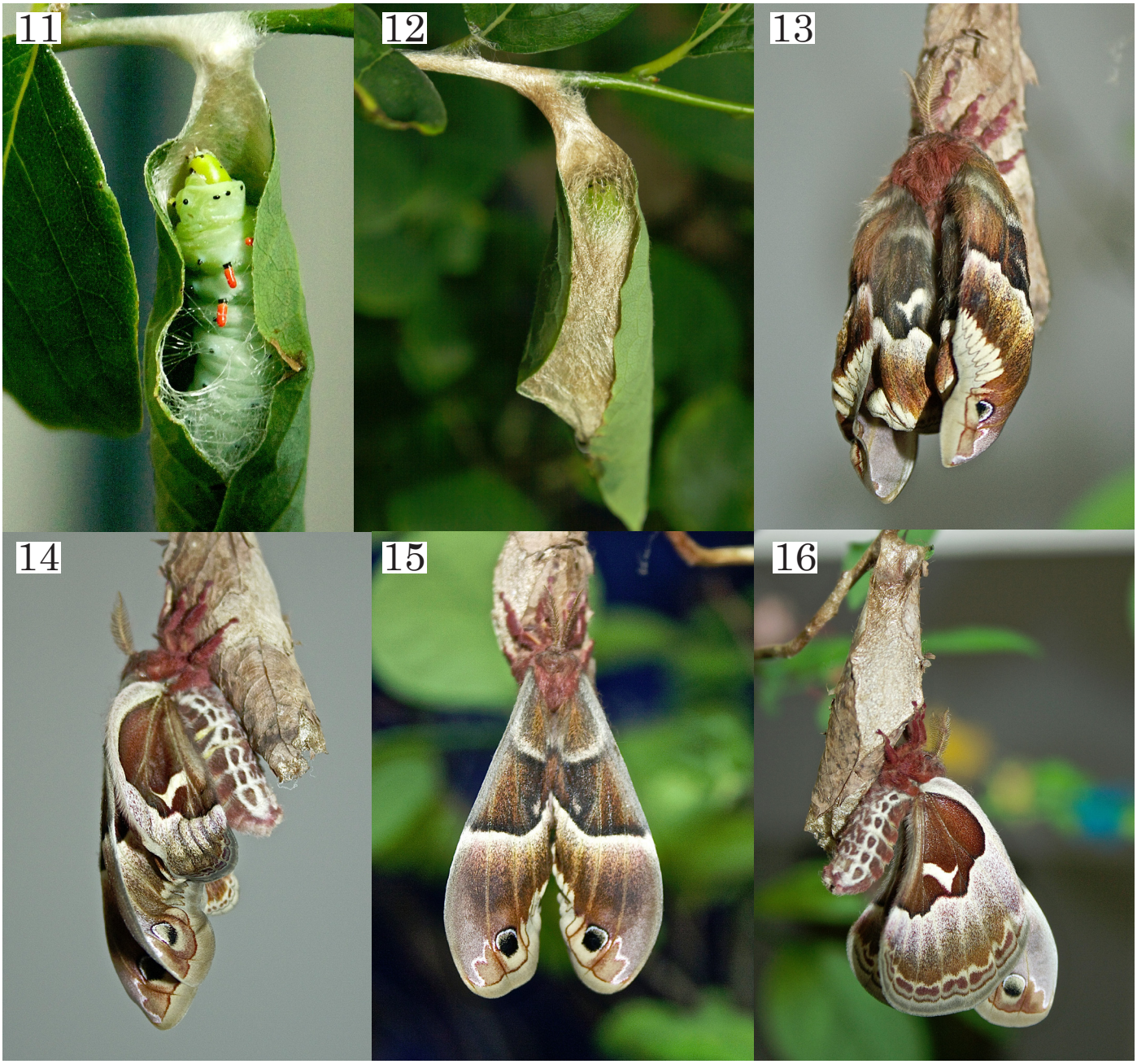


Figs. 3 - 10. 3) fourth instar larva feeding on shed skin; 4) fourth and fifth instar larvae; 5) feeding fifth instar larva; 6 - 7) early spinning of the cocoon; 8) leaf shelter part way complete, larva placing extra fortifying silk on nearby branch; 9) leaf shelter nearly complete, larva extending fortifying silk out a long ways to nearby branch; 10) larva crawling back into leaf shelter to complete cocoon.

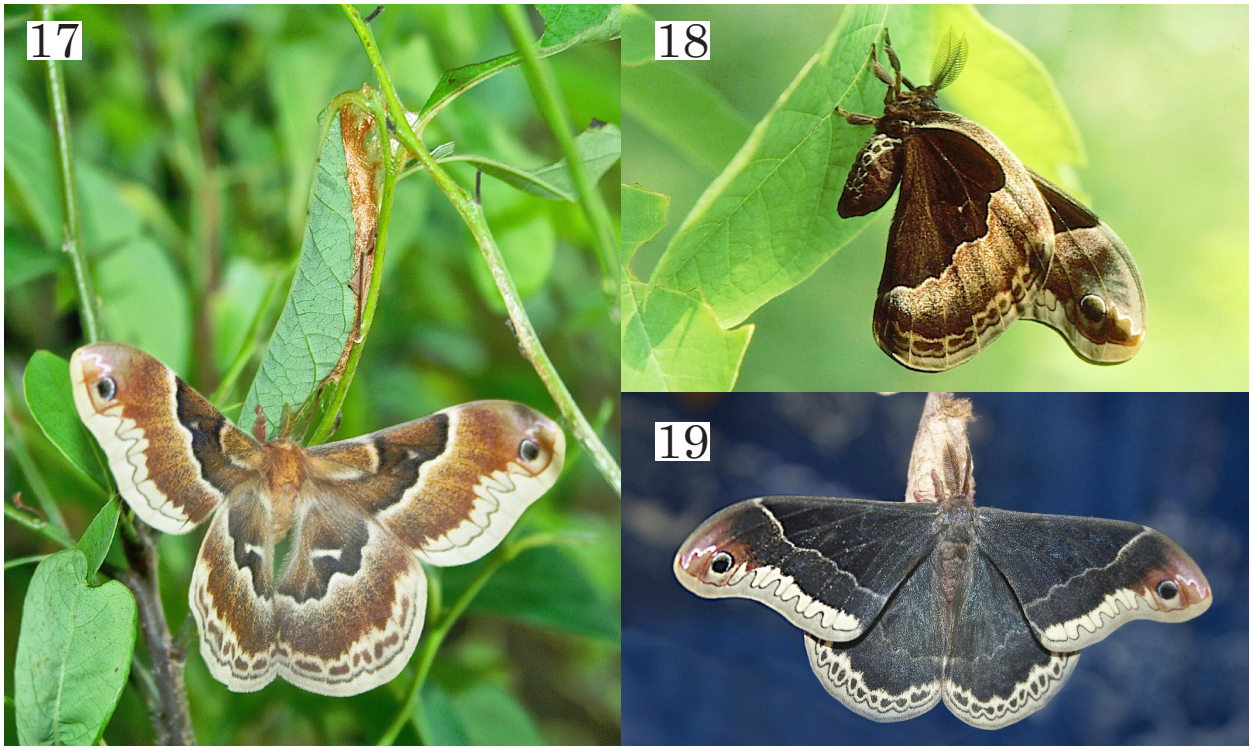
work like grappling hooks. The delicate plumose antennae, also totally new in form, must exit the cocoon intact.

Determined to emerge, the moth with persistent push-and-pull extracts itself with six true legs, now furry and much elongated, which grab for a foothold, even in a brisk wind or rain. With deliberate pumping the small heart fills out the crimped wings, sending hemolymph into the wing veins, and within one hour the wings have grown taught, the wing membranes within the colorful scales growing rigid in the oxidizing air. Like a prized man-made kite now assembled, the innovative male moth will take its maiden flight to find its mate and start the next generation anew.

Females usually remain stationary so not to confuse the incoming male following the pheromone trail to its source. Unable to drink or eat anything, quick reproduction is essential and foremost. They will separate the same night; males will fly away perhaps to mate again (?). She will begin her vigil to select a preferred larval food tree, lay her now fertile eggs on assorted leaves, located by specialized neurosensory cells on her feet and antennae (so we think), her eggs securely adhered by mother's own glue. Talk about ingenuity and will to survive in the great crucible of evolutionary biology. Promethea is engineered for the enduring long journey !!



Figs. 11 - 16. 11) putting last touches on the cocoon; 12) coccon virtually complete; 13 - 16) unfurling of wings of a newly emerged female.



Figs. 17 - 19. 17) Newly emerged female, wings open; 18) newly emerged male, wings closed; 19) newly emerged male, wings open

Announcements

Continued from p. 173

Rio de Janeiro National Museum of Natural History

The Lepidoptera collection in Rio de Janeiro, entirely lost [in a fire] recently, was [composed of] material collected by the museum staff and by the following collections (an excerpt from a 2016 presentation by Olaf Mielke to Brazilian Congress of Zoology):

Coll. Schmitt – 5,000 specimens
Coll. Brückner – 1,800 specimens
Coll. Edward May – 25,000 specimens
Coll. Julius Arp – 25,000 specimens
Coll. Gagarin (part) – 10,000 specimens (most in Curitiba)
Coll. Adhemar Adherbal Costa – 10,000 specimens
Coll. José Oiticica – 10,000 specimens
Coll. Benedicto Raymundo da Silva – 10,000 specimens
Coll. Henry Richard Pearson - 12,000 specimens

A total of about 190,000 specimens were lost.

-- Carlos Mielke

The Karl Jordan Medal

Established in 1972, the Karl Jordan Medal is an award given in recognition of outstanding published original research on the Lepidoptera that may be presented biennally by the Lepidopterists' Society at the Annual Meeting. Nominated publications must be of exceptional quality and focus on the morphology, taxonomy, systematics, biogeography and "natural history" of Lepidoptera. The criteria (J. Lep. Soc., 26:207-209) emphasize that the work may be based on a single piece of research or on a series of interrelated works and must be at least three but not more than 25 years old. The latter is to assure that the awarded work(s) have been used by lepidopterological community and stood the test of time. The Jordan Medal is not intended to be a career award for service rendered to the study of Lepidoptera inasmuch as the Society already has such an award, Honorary Life Member. In addition, the nominee does not have to be a member of the Society. A complete list of lepidopterists who have received the Karl Jordan Medal over the years is available on the Lepidopterists' Society website.

Dr. Karl Jordan was the curator of Lepidoptera at the Tring Museum. During his lifeitme he published 400 papers many with the Rothschilds and described more than 2,575 species. He was responsible for establishing the First International Congress.

Formal nominations for the Karl Jordan Medal will be accepted from any member of the Lepidopterists' Society for any lepidopterist and should be sent to Dr. Jacqueline Y. Miller, McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, P. O. Box 112710, Gainesville, FL 32611-2710 or via email (**jmiller@flmnh.ufl.edu**). Please include a list of the specific publications for which the candidate is nominated, a support letter outlining the significance of the work(s), and if possible, a copy of the nominee's curriculum vitae on or before February 20, 2019.

Surreptitious invasion into North America by the European ghost moth *Korscheltellus lupulina* (Lepidoptera: Hepialidae)

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The Canadian National Collection (CNC), Ottawa, includes five specimens of the European ghost moth *Korscheltellus lupulina* (De Geer, 1778) collected from Indiana Dunes State Park, Tremont, Indiana, on June 9, 1954 by David F. Hardwick and R. Coyles (**Fig. 1**). This is quite a remarkable record as it may be the first documented example of an exotic ghost moth species becoming established in North America as a long distance introduction. The nearest natural distribution range for *K. lupulina* is in western Eurasia (De Freina & Witt 1990) east to the Ural Mountains (Svyatoslav Knyazev pers. com) where it is found in many habitats ranging from meadows to gardens (Buser et al. 2000). Just over a century ago, Pierce (1917) listed two ghost moth species among the "dangerous insects" likely to be introduced into the United States through the importation of goods. The species were *Hepialus humulus* (Linneaus, 1758) for its potential to damage hops vines (*Humulus lupulus* Linnaeus), and *K. lupulina* (De Geer, 1778) for its potential to damage potato crops.

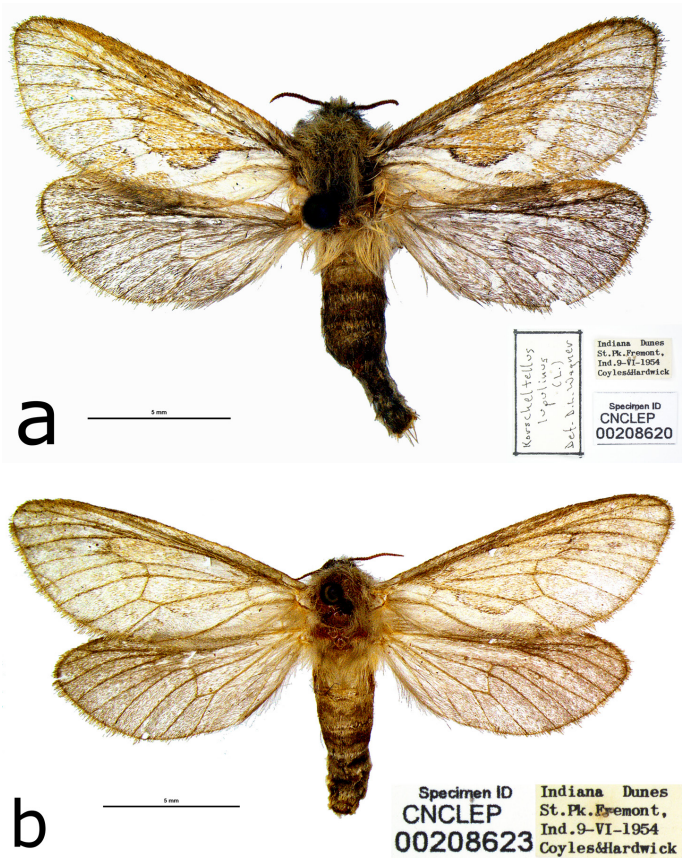

Fig. 1. Voucher specimens of *Korscheltellus lupulina* from Indiana Dunes State Park, Fremont, on June 9, 1954. Canadian National Collection, Ottawa, Canada. 1a male; 1b. female. Photos by François Landry

Several biological characteristics of Hepialidae may contribute to the apparent paucity of long-distance introductions through commercial imports. Adults lack functional mouthparts and are therefore usually short lived, often only a day or two in the wild as indicated by most specimens being in near perfect condition. Females do not lay eggs directly on a host plant, but 'broadcast' eggs into the habitat while in flight or at rest (Heath 1976, Nielsen & Kristensen 1989, Common 1990). The eggs then drop to the ground where they develop among plant debris and require very humid conditions to survive – as reported for *Wiseana cervinata* (Walker, 1865) (Dumbleton 1945), *Wiseana copularis* (Meyrick, 1912) (Stewart 2001) and *Fraus simulans* Walker, 1856 (Hardy 1973). It is conceivable that a fertilized female moth could survive a transatlantic flight, but it would then be necessary for the moth to locate suitable habitat where host plants are present and where eggs would fall onto humid plant debris on the ground. Importation of material with eggs is also improbable as it would require sufficient ground debris with eggs that was removed at a time when eggs were broadcast and then maintained in a condition for the eggs to develop and for the emergent larvae to locate a host plant. A potentially more viable mechanism would be for the importation of larvae burrowing within the roots or in surrounding soil included with plant cultivars. Current United States and Canadian regulations concerning importation of plants and soil are very stringent, but may not have been as intensive at the time *K. lupulina* was recorded from Indiana.

At this time we are not aware of any subsequent records of *K. lupulina* from Indiana or any other region of the United States, but the CNC records list a further 42 specimens between 1992 and 2008 that are all from the Canadian province of Ontario (Fig. 2). Photographic records of *K. lupulina* in Ontario have also been accumulating on the

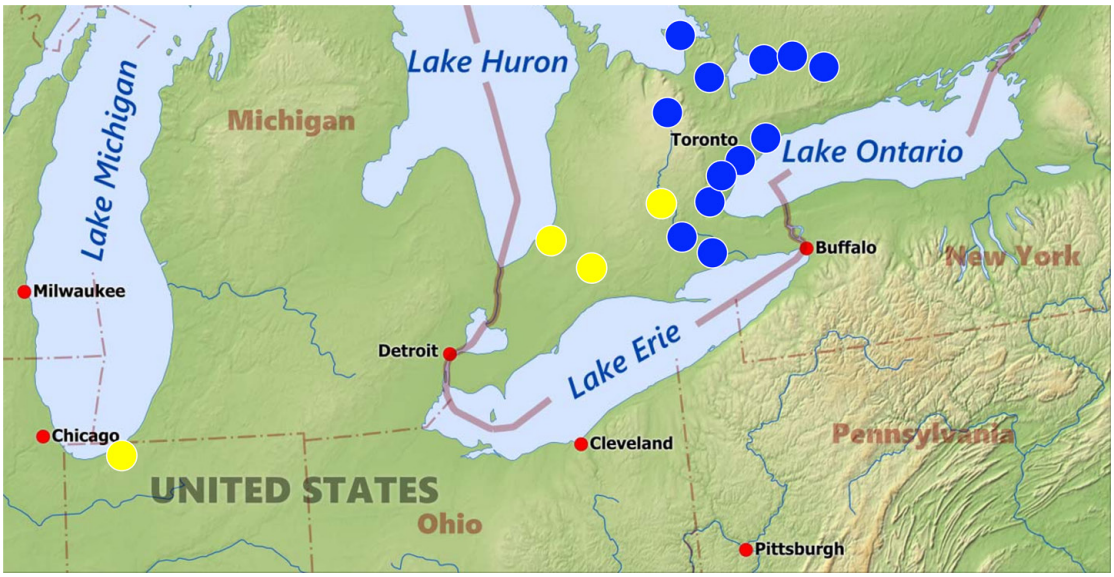

Fig. 2. Distribution map for *Korscheltellus lupulina* in the eastern Great Lakes region of Canada and the United States based on Canadian National Collection records (yellow circles) and photographic records in iNaturalist.org (blue circles), combined and simplified for general occurrence. Where specimen and photographic records may overlap in Ontario the specimen records are highlighted.

website iNaturalist.org from 2016 to the present, from late May through most of June. The geographic and temporal disjunction between the Indiana and Ontario records raises some interesting questions as to when and how *K. lupulina* became established in North America – whether there may have been two different introductions, into the United States and Canada respectively, or whether the Indiana population represents an original establishment that persisted undetected for an extended period of time before expanding geographically to include southeastern Canada

The adult of *K. lupulina* has a distinctive wing pattern that is easy to identify (Fig. 3). Larvae are typically hepialid with a translucent to white body, a reddish brown and blunt teardrop-shaped head, and a well sclerotized reddish brown thoracic shield (Fig. 4). Where larvae are found in the Great Lakes region associated with the roots of cultivated annuals and perennials it is a virtual certainty that they are *K. lupulina* as the endemic northeastern North American Hepialidae (*Sthenopis*, *K. gracilis*, *Gazoryctra*) are associated with forest, shrubland, or wetland environments. Larvae of *K. lupulina* are recorded from a wide range of annual and perennial host plants, including at least 63 species in 28 families. This host range is probably a considerable underestimate as many published records are only to genus (Grehan et al. in prep.). In Ontario Reiner Jakubowski (iNaturalist.org) has found *K. lupulina* larvae associated with the roots of creeping bellflower, *Campanula rapunculoides*, a new host record, and various peony hybrids ('Alice Harding') (Fig. 5). As many of the host plants of *K. lupulina* include agricultural and horticultural species it seems probable that *K. lupulina* in North America will become at least a nuisance species, if not a pest, depending on its future population density and geographic spread.

Acknowledgements

We are grateful for permission to use photos of *K. lupulina* by David Beadle (Toronto, Canada) and Reiner Jakubowski (Waterloo, Canada), and we also appreciate assistance from Svyatoslav Knyazev (Moscow, Russia) for information on the distribution of *K. lupulina*, and to Jim Vargo (Mishawaka, USA) for information on the Indiana locality.

(references on next page)

Fig. 3. Habitus of *Korscheltellus lupulina*, May 29, 2016, Toronto, Canada. Photo courtesy of David Beadle (https://www.inaturalist.org/observations/9514025)

Fig. 4. Larva of *Korscheltellus lupulina*. October 26 2017 From roots of peonies. Photo courtesy of Reiner Jakubowski (https://www.inaturalist.org/observations/8731015).

Fig. 5. Feeding damage to roots of Creeping Bellflower (*Campanula rapunculoides*) by *Korscheltellus lupulina*. October 25, 2018. Waterloo, Canada. Photo courtesy of Reiner Jakubowski.

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Membership Updates

Chris Grinter

Includes ALL CHANGES received by November 6, 2018. 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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Jeff Pippen, Rebecca Allmond, & Ashley Wick (photo: J. Pippen).

More Photos from the 67th Annual Lepidopterists' Society Meeting, held jointly with the Societas Europaea Lepidopterologica at Carleton University, Ottawa

Presenters: left: Jessica Linton; center: David Agassiz; right: Owen Lonsdale, one of the meeting organizers. (photos: Hossein Rajaei)

Left: Christi Jaeger's papillae anales tattoo. Center: Christi Jaeger and Jason Dombroskie. (photos by James Adams) Right: Felix Sperling sporting an excellent tie! (photo by Hossein Rajaei)

Left: Janet Mihuc, Mike Sabourin, JoAnne Russo. Right: Kyhl Austin, Joseph McCarthy, Chelsea Springs and Basil Conlin striking a pose at the BBQ. (photos by James Adams)

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

Dues Rate

Active (regular)	$ 45.00
Affiliate (same address)	10.00
Student	20.00
Sustaining	60.00
(outside U.S., for above add 5$ for Mexico/Canada, and 10$ elsewhere)	
Life	1800.00
Institutional Subscription	60.00
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).

Change of Address?

Please send permanent changes of address, telephone numbers, areas of interest, or e-mail addresses to:

Chris Grinter, Assistant Secretary
The California Academy of Sciences
55 Music Concourse Drive,
San Francisco, CA 94118
cell: 847-767-9688
cgrinter@gmail.com

Our Mailing List?

Contact Chris Grinter for information on mailing list rental.

Missed or Defective Issue?

Requests for missed or defective issues should be directed to Chris Grinter. Please be certain that you've really missed an issue by waiting for a subsequent issue to arrive.

Memoirs

Requests for Memoirs of the Society should be sent to the Publications Manager, Ken Bliss (address opposite).

Submissions of potential new Memoirs should be sent to:

Kelly M. Richers
9417 Carvalho Court
Bakersfield, CA 93311
(661) 665-1993 (home)
kerichers@wuesd.org

Journal of The Lepidopterists' Society

Send inquiries to:

Keith Summerville
(see address opposite)
ksummerville@drake.edu

Book Reviews

Send book reviews or new book release announcments to either of the following (do NOT send new books; authors will be put in contact with reviewers):

James K. Adams
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jadams@daltonstate.edu

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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	1 Spring	Feb. 15, 2019
	2 Summer	May 12, 2019
	3 Fall	August 15, 2019
	4 Winter	November 15, 2019

Be aware that issues may ALREADY BE FULL by the deadlines, and so articles received by 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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Refer to Season Summary for Zone coverage details.

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Top: The Students (way to represent!). 2nd row, left: Jeff Pippen, Melineh Petrosians, Peter Hall, James Adams and Jocelyn Gill (photo: Jeff Pippen); right: Hay-Ryun Choi, Sora Kim, Hossein Rajaei, Bong-Kyu Byun. 3rd row, left: Charlie Covell and Jayne Yack having a good laugh!; right: Kevin Keegan, Jenn Zaspel, Nick Dowdy, Katherine Hernandez. Bottom row, left: Thomas Simonsen, Erin Campbell, Federico Riva; right: Michal Rindoš and Reza Zahiri (photo: Hossein Rajaei) (where not indicated, photos by James Adams.)