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NEWS OF THE LEPIDOPTERISTS' SOCIETY

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Papaipema marginidens, reared ex larva *Dioscorea villosa*, Petersburg, Huntingdon County, Pennsylvania, June 30, 2019. Eclosed August 31, 2019. Images by Tony McBride (see related article, page 108).

On the adventures of rearing *Hemileuca hera* (Saturniidae)

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The Hera Buckmoth, *Hemileuca hera* (Saturniidae), is a large, black and white, diurnal moth found in sagebrush-steppe habitat across the western United States and southern parts of British Columbia, Alberta and Saskatchewan, Canada (Tuskes et al. 1996). It is notoriously difficult to rear and there are few published descriptions of rearing experiences. While looking for butterflies on April 20, 2019 north of Vantage Highway (N46.9662, W120.1397, 2190 ft elevation), Kittitas County, Washington, a tiny black clump on some *Artemisia tridentata* caught my attention (Figure 1). This area is almost exclusively a community of *A. tridentata* and *A. rigida* and smaller plants such as *Lupinus* spp., *Eriogonum* spp. and bunchgrasses (*Festuca* and *Poa*). Because of the lack of other *Hemileuca* hosts (bitterbrush, rose, snowberry and others) and the fact the larvae were on sagebrush, I knew immediately these must be *H. hera* larvae. Having reared *H. eglanterina* four times and *H. nevadensis* once, all with around 90% success to adult, I was determined to rear this prize and carried them home to southwest Washington with little thought of the complications inherent in providing them with fresh sagebrush, sunlight and warm temperatures during the cool, wet April-May at home.

Considering I found the larvae on a Saturday and could only obtain fresh sagebrush on weekends, it was natural to track larval growth and effectiveness of rearing methods on a weekly basis. Larvae molted to second instar the day after I found them (Figure 2), so April 21 marked the start of Week 1. First instar larvae (L1) were solid black. Newly molted L2 had a light gray body, light brown head and scoli, darkening to black head, body and scoli covered with silver-gray hairs (Figure 3). During Week 1, I fed the larvae on cut *A. tridentata* in a small cage indoors (Figure 4). I kept the ends wrapped in wet paper towels placed in plastic baggies and secured with twist ties. The cuttings stayed fresh for at least five days before starting to yellow. Indoor conditions were a steady 70-73 degrees F, 35-40% relative humidity and partially direct sunlight via south-facing windows for around 4-5 hours per day.

Figure 2 (top). L1 (black) and L2 (brown and gray) larvae on April 21. Figure 3 (bottom). L2 larva on April 24.

Figure 1. *Hemileuca hera* habitat with *Artemisia tridentata* and *A. rigida* in eastern Kittitas County, Washington on April 20, 2019. Inset shows the L1 larvae on *A. tridentata* before they were collected.

Figure 4 (upper left). Cage with cut *A. tridentata* and L2 larvae. Figure 5 (upper right). Cluster of L3 larvae on May 5. Figure 6 (lower left). Plant light and UVA/UVB bulb to simulate sun exposure. Figure 7 (lower right). L3 and L4 larvae on tentatively identified *A. cana* on May 17.

At the beginning of Week 2, I obtained two potted *A. tridentata* approximately 20 inches tall. I kept both plants in a 20x20x36-inch mesh cage on my northeast-facing balcony where the larvae were exposed to 1-2 hours of direct sunlight per day, 60-80% relative humidity, maximum daily temperatures between 67-70F and minimum overnight temperatures in the mid-40s. Larvae molted to L3 between May 3 and May 4 with no change to their coloration and remained in very tight groups (Figure 5), making it impossible to accurately count the total number. Their behavior was not noticeably different than when kept indoors, but I was concerned they lacked sufficient warmth or full sun, especially on frequently cloudy days. A plant light might provide consistent light but lacked elements of the sun, such as UVA/UVB. This is when it hit me: what about a reptile light? These lights are essential in helping reptiles absorb calcium and produce sufficient Vitamin D3. I already had a high-output fluorescent plant light, so rather than purchasing an expensive reptile sun lamp, I decided to buy a bulb rated for desert reptiles with 10% UVB output and 30% UVA output to use in conjunction with my plant light (Figure 6). During Week 3, I moved the cage with potted sagebrush inside and used this light combination along with a fan for 12 hours a day.

Unfortunately, the potted sagebrush turned yellow by the end of Week 3, so I was back to obtaining fresh cuttings. That weekend I loaded up my hungry caterpillars for a 600-mile round trip (I'm a very dedicated caterpillar momma!). I found some lush sagebrush growing near a road pullout west of the Deschutes River mouth in the Columbia River Gorge. The shrubs had big, long leaves compared to most of the surrounding sage. Thinking that the bigger the leaves, the better for feeding hungry caterpillars, I loaded up a trash bag full of cuttings and headed home. After sharing my larvae photos with Michael Collins, he suggested that it looked like a different species from *A. tridentata*. Upon studying sagebrush ranges and identification guides, I tentatively identified it as *A. cana* (Figure 7). Most descriptions of *A. cana* indicate the leaves are rarely lobed but are usually 3-8 cm long, compared to the 1-3 cm long leaves of *A. tridentata*. The bushes I found were around 2-3 feet tall and covered with leaves around 5 cm long, some entire and some with 1-4 lobes, leading me to speculate that it may be a hybrid of the two species. The only published confirmation of *hera* ever using *A.*

cana is a single larva found on that species in the Sierra Nevada of California (Tuskes et al. 1996). A drawing of a *hera* larva on an unidentified sagebrush in Packard (1905) appears to illustrate *A. cana*. All other *hera* records are on *A. tridentata* with the exception of *H. hera magnifica* using *A. filifolia* in central New Mexico and Arizona (Tuskes et al. 1996). My larvae continued to feed well on the "*A. cana*" cuttings during Week 4 and Week 5 and were kept indoors with the artificial lighting and partial sun exposure for both weeks, molting to L4 near the end of Week 4. L4 displayed numerous black-tipped yellow spines on dorsal scoli, fewer and paler yellow spines on lateral scoli, white spiracles, and a medium black body covered with silvery hairs (Figure 8).

Cuttings presented to the larvae were placed in jars of water with the openings thoroughly covered with plastic wrap and paper towels to prevent larvae from accidental drowning. The cut ends of extra branches were wrapped in wet paper towels and the entire cuttings were placed in large trash bags, one in the refrigerator and one at room temperature to see which might last longer. Refrigerated cuttings stayed fresh for almost two weeks while the room-temperature cuttings began to turn yellow and mold after a week. Because of this, I gave the larvae new cuttings from the refrigerated stockpile around every three days and removed debris from the bottom of the cage.

On May 25, I purchased twelve *A. tridentata* plugs between 10-12 inches tall from a native plant nursery in central Washington. To keep the narrow pots upright and space out the maturing larvae, I built a frame out of PVC pipe and used masking tape to create a grid to hold the plants. Despite my earlier failure of keeping potted sagebrush alive more than two weeks in my west-side climate, I figured if the larvae followed the pattern of 12-13 days per instar, they would pupate before I needed more sagebrush. I distributed 1 or 2 larvae per potted sagebrush and kept them outside during Week 6 with temperatures in the upper 60s. Larvae molted to L5 around May 28, right on schedule.

L5 were similar to L4 with the addition of variable lateral markings in pale yellowish cream and a pinkish cream ventral (Figure 9). These and previous stages match other published descriptions (Packard 1905, McFarland 1974, Tuskes et al. 1996), with the exception that cream markings were more broken on my larvae. The white spiracles darkened to rust brown around 10 days after molting (Figure 10). The larvae began to dramatically change their behavior during Week 7, spending more time resting on the plants or wandering instead of eating. I rotated back to keeping them indoors with the UVA/UVB light and warmer temperature, occasionally moving them outside on sunnier days. By the end of the week, I would find most larvae on the bottom of the cage each morning but they did not have the typical dull color or filled-out appearance of pre-pupal larvae, and when I transferred them back onto the sagebrush they immediately resumed feeding. Late instar *Hemileuca* larvae are known to disperse and feed singly

Figure 8 (top). Lateral and dorsal view of L4 larva on May 17. Figure 9 (middle). L5 larvae on May 30, around two days after molting. Figure 10 (bottom). L5 larva on June 8.

(McFarland 1974, Tuskes et al. 1996, Tuttle et al. 2020), so I assume the behavior I observed was this dispersal and that the larvae were unable to climb the tall plastic pots to find the leaves again. During this time, I returned larvae to the plants at least twice a day.

Week 8 was spent in Kittitas County, where the larvae were kept outside in full sun exposure with 85-92F temperatures all week. They were provided with the remaining potted *A. tridentata* along with large bundles of fresh cut *A. tridentata*. The larvae freely moved between both options and the large branches allowed them to shelter from direct sunlight as needed. They still dropped off the sagebrush frequently but were able to return to the branches from the sides of the cage and eventually went back to feeding.

Figure 11. Prepupal larva on June 29.

By this point, around 25 days as L5, I wondered when they would ever pupate. I brought home another bag full of *A. tridentata* cuttings to supplement the remaining potted sagebrush. Week 9 was spent fussing over them every day, moving larvae back onto plants morning and evening, keeping them inside under the reptile lamp or moving them outside depending on the daily weather and giving them fresh cuttings from the fridge every two days. Towards the end of Week 9 and beginning of Week 10 they were acting even more strange, mostly hanging out at the top of the cage instead of the bottom. However, they did appear to be showing some signs of shrinkage and less movement. Finally, at the end of Week 10, one larva was in prepupal stage (Figure 11) and the rest were persistently crawling at the bottom of the cage, at which time I placed them in a well-ventilated container full of torn and crumpled paper towels.

The tight cluster of larvae up through L3 made it impossible to accurately count how many I started with. Even as L4 they were difficult to count because several kept together in clusters and others were camouflaged in the dense leaves of sagebrush cuttings. Counts were usually between 21-23 larvae with the possibility of double counting those in clusters. By L5, I was consistently counting 19 larvae. Although I was very careful to inspect the debris and old branches when cleaning the cage, dead larvae from the earlier stages may have been mistaken for shed skins. One L5 larva died around a week before the others entered the prepupal stage. The remaining 18 larvae successfully pupated (Figure 12).

I tucked the pupae between folds of cotton towels placed in a cage on my balcony to be overwintered. Much to my surprise, one emerged on September 22, 2019 (Figure 13). The remaining pupae have come through the winter and will hopefully emerge later this summer. Based on a weather sensor placed in the folds of the towels with the pupae, they have experienced fairly steady relative humidity around 70% and temperatures between 20-40 degrees F through the winter. Even if nothing else emerges this coming summer, I will still feel successful to have grown one of these finnicky beauties all the way to adulthood.

Figure 13. Adult female on September 22.

Based on this experience, *hera* are easy to rear until the fifth instar. L1 through L4 grew quickly and stayed on sagebrush compared to L5, which were extremely finnicky and spent more time resting or wandering than eating (Figure 14), even when provided with fresh sagebrush. L5 exhibited atypical pre-pupation behavior, consistently resting near the top of the cage away from the sagebrush for a few days prior to beginning normal behavior of crawling around the bottom of the cage around 7 days before finally pupating. Unlike *H. hera*, my experience with *H. eglanterina* was typical of other Saturniids in that they ate heartily until one or two days prior to exhibiting pre-pupal behavior. There was no discernable difference in larval behavior between having 1-2 hours of natural sun exposure compared to 8-10 hours per day of full-spectrum lighting. Larvae were more active in warm temperatures and therefore seemed to do best indoors with temperatures around 70-73F rather than outdoors when temperatures were below 65F and often cloudy and wet. Considering the

Figure 12. Prepupal larvae and pupae on July 9.

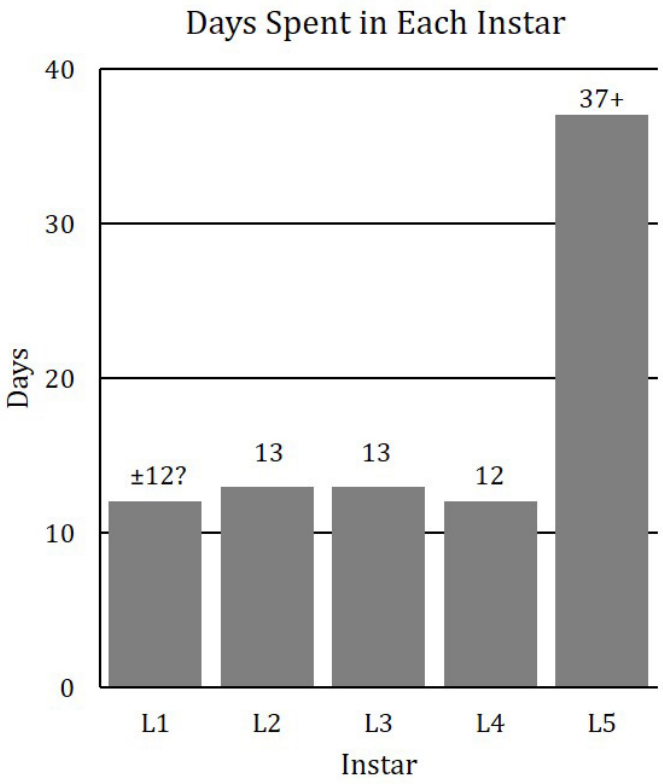

Figure 14. Number of days spent in each instar. L1 estimated based on L2-L4 and experience with *H. eglanterina*. L5 number based on time between the first larvae to molt to L5 and the first to pupate.

observations of McFarland (1974) that daily sunlight is vital, I propose that heat is also a necessary component and if sunlight and its radiant heat is not reliable (as with my west-of-the-Cascades location through May), bright lighting that includes a strong UVA/UVB output together with warm temperatures may be a tolerable substitute.

Visit my blog at northwestbutterflies.blogspot.com to see these and other images. Many thanks to Michael Collins and Jonathan Pelham for providing helpful tips and putting up with my numerous email updates, and to everyone else who provided encouragement along the way. Thanks to my dad for providing the landscape image (Figure 1) and a piece of wisdom when I took the caterpillars: "but they're on sagebrush, you live on the westside, how are you going to keep them alive?" The answer came with a large price tag calculated to around $25 per pupa!

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The Mailbag . . .

A response to "Monarch Anomalies"

In "Monarch Anomalies" (Summer issue, Vol. 62:2), Ranger Steve Mueller raised questions regarding Monarch sightings throughout winter months in the South. Fortunately, I can offer an explanation—at least for most such sightings here in my home state of Louisiana: The adults were hand-reared by citizen scientists/butterfly enthusiasts, and then released on a warm winter day. I know of at least a dozen or so folks in Baton Rouge and New Orleans who almost compulsively continue to care for Monarch larvae on tropical milkweed (*Asclepias curassavica*) that they protect from frosts throughout our southern mild winters. (The laudable goal is to augment the overwintering population of Monarchs in central Mexico.) Because larval/pupal metabolism slows down in the cooler weather, protected adults emerge at various times throughout winter months. Such butterflies, of course, DO NOT migrate to Mexico; because of differences in photoperiod between autumn and winter, the insects' hormonal expression is altered—a necessity for migration. Instead, the butterflies fly about on mild winter days seeking nectar plants, which are few and far between. But many Louisiana homeowners do employ cool season flowering annuals (pansies, violas, snapdragons, and petunias for examples) in their flower beds. While not a source of high-octane nectar, these ornamentals nonetheless are capable of providing moisture that can sustain a butterfly over an extended period—perhaps even until the warmer days of March set in. Then, native/naturalized good nectar-producers blossom. Examples include Carolina jasmine, dewberry, thistle, butterweed (*Packera glabella*), white clover, and false onions/garlic. But there is a down side: winter-released Monarchs most assuredly alter the species' gene pool. The result is that scientific research on historic Monarch migration is rapidly being compromised. As such, winter releases should be avoided. But then, one can argue: Due to global warming, the increasing number of winter released Monarchs may be the harbingers of what in the future will be a stable (non-migratory) winter population along the Gulf Coast—similar to the Monarch population that currently exists in southern Florida. Only time will tell. I personally intend to let Nature take its course.

June 18, 2020, Gary Noel Ross, Ph.D., Baton Rouge, LA 70808, **GNRoss40@yahoo.com**

Search for the host of *Papaipema marginidens* (Noctuidae: Apameinae)

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When I first spoke at length with apameine moth expert Eric Quinter in 2010 about the mystery surrounding the Brick Red Borer Moth, *Papaipema marginidens* (Guenée, 1852), he joked that the consensus among noctuid moth experts was that telephone poles were the only possible host "plant" in common across the wide range of this moth. What other food choice of substance could there be for a large boring larva in locales as diverse as the mountains of North Carolina, the river valleys of Kentucky, the driftless area of Wisconsin, and the pine barrens of New Jersey?

Indeed, the natural history of this large *Papaipema* species has long been a mystery. Early workers knew this moth as *Papaipema nephrasyntheta* (Dyar), since Guenée's *marginidens* for many years was confused with the similar umbellifer borer, *Papaipema birdi* (ironically, also described by Dyar and named for Henry Bird of Rye, New York). Bird, who revealed the secret host plant choices of many species in the genus, spent years searching for the larva and host of *nephrasyntheta* (true *marginidens*). His searches for this larva led to discoveries of new species, including *Papaipema polymniae* Bird (Bird 1917). Eric Quinter stated that since the obvious choices of thick-stemmed herbaceous plants had been ruled out as potential hosts, a plausible theory was that *marginidens* bored twigs in the forest canopy, with larval habits similar to the ash tip borer *Papaipema furcata* (Smith). Canopy feeding provided an explanation why the larva of such a widespread moth had escaped detection. Over the years, several colleagues who had expended substantial effort on the quest for the life history of this borer offered their guesses for the host. Possibilities included ash (*Fraxinus*), *Catalpa*, black walnut (*Juglans nigra*), winged sumac *(Rhus copallina*), *Sassafras*, and blackberry (*Rubus*). I spent a long while online trying somehow to match range maps of trees to the range of *P. marginidens*.

My own search for the host of *marginidens* began in July 2011 on Mt. Jefferson (4,665 ft.) in Ashe County, North Carolina. Eric Quinter informed me that Bo Sullivan caught 15 specimens of *marginidens* in one light trap on the mountain. After a conversation with Bo, I knew the exact location to begin my search. Although many potential host trees were present, I did not detect any bored twigs. I returned to Mt. Jefferson that October, with a permit to place blacklight traps on the mountain. My goal was to secure a female moth so that I could obtain eggs for rearing and also conduct experimental tests placing larvae on various tree twigs to note their behavior. My light trap catch on that trip included *Papaipema rigida* (Grote) and *P. polymniae*, but no *P. marginidens*.

During October of 2014 I made another trip, this time to the Midwest, to search for the elusive *marginidens* female. Loran Gibson introduced me to a Kentucky locality which over the years had produced some magnificently large examples of *marginidens*, but *Papaipema cataphracta* (Grote) was all we saw at lights that evening. From Kentucky, I continued west and met Jim Wiker in Illinois. Jim and I caught several male *marginidens* at a 400 watt mercury vapor light, but at last a female was taken at wine ropes that Jim had deployed earlier in the evening. The female *marginidens* was worn and had deposited most of her eggs, but over a few days of coaxing with sugar water feedings, she produced 60 more. The following spring, I removed the eggs from cold storage just before the local trees were breaking bud. About ten days later, and with the help of a dissecting microscope, I watched as tiny *marginidens* neonates explored the twigs and sprouting buds of 21 species of trees, shrubs, and vines. The newly-hatched larvae eschewed twig after twig, sometimes taking a brief taste before moving on, and sometimes seemingly hurling themselves from the plant in disgust. Hopes

Figure 1. A. Early ultimate instar *Papaipema marginidens* on potato. Note the relatively pale coloration, tiny dorsal pinnacula, prognathous mouthparts and lack of black edging on the prothoracic shield. **B.** Early ultimate instar *Papaipema araliae* boring in *Aralia spinosa*. The contrasting coloration and large, dark pinnacula are characteristic of some tree and shrub borers.

ran high when a larva bored into the unfurling leaves of smooth sumac, but the larva quickly abandoned the effort after being swamped with milky sap.

Even though the host of *marginidens* remained out of my grasp, I was able to rear those larvae on a diet of potato, and so the venture to the Midwest was deemed successful. And what an unusual larva this was—one that departed from the typical *Papaipema* form—a disproportionately long, slender, and pale caterpillar with prognathous mandibles (Figure 1A). Even in early instars, when most other *Papaipema* are vibrantly striped with dark brown and white, larvae of *P. marginidens* are a pale, warm brown with barely-discernable pinnacula. It was this pale coloration and relative lack of dark pigment in all instars which first led me to question the association of this species with tree feeding. Larvae of *Papaipema* that bore in tree and shrub twigs such as *P. furcata* and *P. araliae* Bird & Jones (Figure 1B), as well as other shrub borers, such as *Achatodes zeae* (Harris), are vividly marked with stripes or large, dark pinnacula, and some are protected by blackened, heavily-sclerotized anal plates (E. Quinter pers. comm.). In contrast, the relatively unmarked and unarmored appearance of *Papaipema marginidens* suggested it was a subterranean borer.

…but in what plant?

In 2016, Sam Smith invited me to a site in Huntingdon County, Pennsylvania where numbers of *marginidens* could be found. The site was a large, open forest with diverse flora (Figure 2B). Our light traps and sheets deployed one night in late September produced 23 males and 1 fresh female that produced 930 eggs. I again overwintered the eggs so that I could experiment with new potential host possibilities the following spring.

At about this time, frustrated after years of searches and many miles of driving, I checked the internet for plant lists associated with known *marginidens* localities that might disclose potential host possibilities. I found two lists, one for Plummers Island in Maryland (the type locality of Dyar's *nephrasyntheta*) and another for Mt. Jefferson in North Carolina. The Mt. Jefferson plant list is a comprehensive, 430 page master's thesis by Derick Poindexter (2006), and having visited the location, I searched this list first. My curiosity piqued when I noted a plant I did not recognize known commonly as wild yam, though an internet search revealed that I had in fact seen this monocotyledonous vine before. *Dioscorea villosa* L. (Figure 2A) is considered a "true" yam and has heart-shaped leaves with parallel venation similar to greenbrier (*Smilax*). Plants in the Dioscoreaceae are largely tropical and are not related to edible yams, which are dicots in the Convolvulaceae. The vine of *D. villosa* is quite thin, only a few millimeters in diameter, casting doubt it could support *marginidens*; however, the root of the vine, technically a true storage stem (D. Poindexter pers. comm.), is thicker than the vine and can be quite long (Figure 2C). In addition, I found the range of *D. villosa* encompassed the known range of *P. marginidens*. A June 2018 trip to the Pennsylvania site confirmed that *D. villosa* was plentiful, but I was unable to detect any evidence of larval feeding damage.

Through continued captive breeding, I again overwintered *marginidens* ova, this time in a protected outdoor location, in the fall of 2018. I also located wild yam along a forest trail near my residence in New Jersey. On April 22, 2019, several *marginidens* emerged from their eggs. I visited my local wild yam colony to find tender new vine shoots 10-15 cm. in length. I placed a hatchling on one of the vines under the scope and watched intently. In less than a minute, the larva began chewing into the vine shoot, about 3 cm. from the terminal end, and fully ensconced itself within twenty minutes. After repeating this procedure with additional plants and larvae, I loosely wrapped the yam roots in wet toweling and set them in a plastic container. The plants were checked daily and frass was noted outside each bore entrance.

Expecting these larvae would continue consuming the internal vine tissues as they bored downward to the root, I was alarmed to find they chewed exit holes in the vines and departed, having mined only about 3-4 cm. of the stem. A search for the missing larvae disclosed white, sawdust-like frass on the root at the vine bases, and it was determined these early third instars had left their initial burrow, crawled down the vine, and tunneled into the root. How would it be possible for a small larva in the wild to accomplish this maneuver, as these storage stems lay 3 cm. or more below ground?

I conducted an experiment by potting a *D. villosa* so that its horizontal root was 3 cm. under soil. Upon placing a third instar on the aboveground shoot, I was astonished to see the larva quickly descend the vine to the soil and without hesitation, dig downward! After unearthing the plant the following day, I discovered the larva had completely entered the root adjacent to the vine base below the soil. In the lab at room temperature, larvae spent approximately one week feeding in the aboveground vine until reaching the third instar, at which point their mandibles were larger and strong enough to penetrate the hard underground storage tissue. So far as is known, this is the only *Papaipema* species that burrows through the soil to locate the host's root. The prognathous head shape may facilitate this burrowing, and is also likely an adaptation for feeding within the slender storage stem. Other species that are root borers, such as *Papaipema rutila* (Guenée) in mayapple (*Podophyllum peltatum*), bore down through the plant stem to access the root, and continue to maintain an opening above the soil surface to deposit frass. In *P. marginidens*, frass is deposited mostly below ground. Eric Quinter (pers. comm.) posited that the *marginidens* strategy of entering the root as early as possible and abandoning a frass orifice above ground may be an adaptation to avoid parasitism.

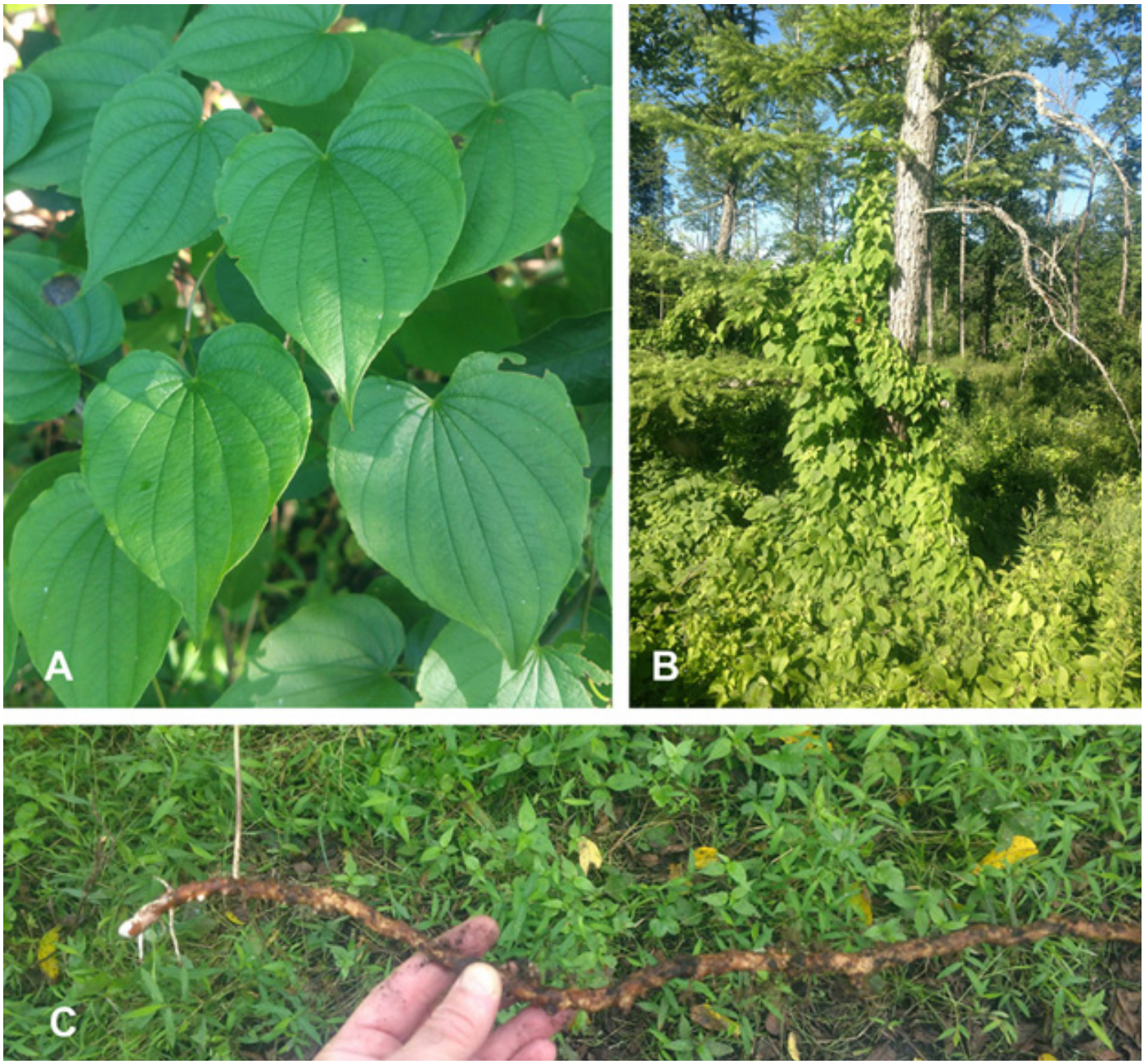

Figure 2. A. Leaves of *Dioscorea villosa*, a monocot. **B.** Growth habit of *D. villosa* in Huntingdon County, PA. This plant can cover large areas in forest openings, its preferred habitat, and can climb 15 feet into trees. **C.** The long, thin underground storage stem of *D. villosa* (the vine is seen rising from just behind the growth tip of the storage stem, on the left).

One hurdle now remained before this host could be confirmed—finding a wild larva. Over the years, I've had the opportunity to locate and rear wild larvae of 47 species of *Papaipema*, and *marginidens* proved one of the most difficult to find in the field. Most *D. villosa* roots support a single vine. If the root is commodious enough to support *marginidens* through its four-month development, the only evidence above ground is a short, wilted vine stem that shrivels and senesces by early May in a sea of lush new spring vegetation, while the larva burrows below ground, undetected. Sometimes though, a *D. villosa* root supports two or more vines. In this case, the consumption of root tissue by the larva stresses the plant, causing older vines on the root to wilt and then turn brown during June and July, but this proved rare (Figure 3B). Adding to the difficulty of the search was mechanical damage to the vines at ground level by walking vertebrates and gnawing rodents, which also caused vines to wilt and turn necrotic. In good habitat, several *D. villosa* vines will grow and twine together, so when a browned vine is found, it must be carefully traced back for more than a meter of twisting and turning length until at last the base is found. More than 90 percent of the time during my searches, these dead vines had been broken off at ground level by mechanical damage.

When a wilted or browned vine was found intact at ground level, scraping with a trowel just under the soil surface revealed dry, whitish frass. Careful digging unearthed the first wild larva of *Papaipema marginidens* on June 30, 2019. During 5 long hours of searching through hundreds of twining *D. villosa* vines, I was able to locate 4 wild larvae.

My searching also revealed that when a root was not large enough to support the larva, it surfaced to find another plant. I saw evidence in late July that two large larvae had abandoned their original burrows, crawled to adjacent vines, and tunneled down through the soil to new roots. In these cases, there was substantial frass deposited on the soil surface, allowing possible detection by parasitoids. In fact, one of the wild larvae reared in 2019 produced an ichneumonid wasp in April 2020.

Larvae likely abandon the root burrow in August to pupate in soil. The pupa agrees with the typical noctuid form, and the adult ecloses in approximately 28 days (see front cover). Adults fly from mid-September through late October, earlier northward.

A description of the larva of *Papaipema marginidens* follows:

Mature larva: Integument pale, warm brown, darkest on A1-A4, becoming paler and more whitish with deposition of subcutaneous fat. Apex of head angled back beneath prothoracic shield, with mouthparts correspondingly prognathous. No lateral black edging on prothoracic shield, though leading edge may be darkened. Longitudinal middorsal and subdorsal white stripes most prominent on A5-A8; obliterated on A1-A4. Middorsal stripe constricted as it bisects prothoracic shield. Abdomen ringed with white at intersegmental sutures of A5-A8, especially in early last instar. D1 and D2 pinnacula tiny and scarcely differentiated from cuticle on T2 through A7; sometimes ringed with white. Dorsal pinnacula enlarged and more prominently pigmented on A8, with D2 much larger than D1. All dorsal pinnacula on A9 merged into a dark, transverse bar that is not broken by the middorsal stripe. Anal plate pale brown. Spiracles black, roughly twice as high as broad; largest on T1 and A8. L1 in the normal position behind and above spiracle on abdominal segments, but located well behind and below spiracle on A7. Anterior prolegs with 11-16 crochets. Larva to 50 mm.

Acknowledgements

I would like to thank James Adams, Les Ferge, Loran Gibson, Richard Henderson, Ted Herig, Jeff Hooper, Kyle Johnson, Steve Johnson, Eric Quinter, Dale Schweitzer, Sam Smith, Bo Sullivan, Dave Wagner, and Jim Wiker for stimulating conversations, information, and assistance in the field which helped lead to the discovery of this life history. Thanks especially to Eric Quinter and Jane O'Donnell for reviewing the manuscript and offering several helpful suggestions.

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Figure 3. A. Late ultimate instar *Papaipema marginidens* larva boring in *Dioscorea villosa*. **B.** Several intertwined *D. villosa* vines. The four browned and curled leaves in the center and right parts of the image represent a single vine, its root below tenanted by a *P. marginidens* larva.

Announcements:
Call for Season Summary Records

The Season Summary database is on the Lepidopterists' Society home page (http://www.flmnh.ufl.edu/lepsoc/). The value of the online database increases as your data gets added each year. Please take the time to consider your 2020 field season and report range extensions, seasonal flight shifts, and life history observations to the appropriate Zone Coordinator. They and their contact information appears on the inside back cover of the "News". The states covered by each zone are in the (most recent) Season Summary. Some Coordinators have changed, and some are in the process of changing, so look closely in this issue. If you are in Zones 6, 7 and 8, you will currently send your records to Brian Scholtens, but new Coordinators should be in place for at least Zones 7 & 8 by the next News. Please have your data to the Zone Coordinator(s) no later than **December 31, 2020**.

Most records are important. Reports of the same species from the same location provides a history. However, do not report repeated sightings of common species. Report migratory species, especially the direction of flight and an estimated number of individuals. Again, all of these records may be useful in the future. BE AWARE that some of these types of records will go IN THE DATABASE, but may NOT appear in the printed Season Summary.

Season Summary Spread Sheet and Spread Sheet Instructions

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.** The Zone Coordinators use the Season Summary Spread Sheet to compile their zone reports. Please follow the instructions carefully and provide as much detail as possible. Send your completed Season Summary Spread Sheet to the Zone Coordinator for each state, province or territory where you collected or photographed the species contained in your report.

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 and Jeff Pippens, Co-Chief Coordinators for the Season Summary. (see contact information inside back cover).

Searching The Lepidopterists' Society Season Summary on SCAN

Brian Scholtens and Jeff Pippen

The Season Summary coordinators, Brian Scholtens and Jeff Pippen, want to thank everyone who made our first effort at producing the Season Summary a success. We particularly thank all the Zone Coordinators, who put up with lots of instructions about how to format and submit records, and who all successfully sent records so that we could produce the summary.

Part of what we are now doing as a society is contributing all our Season Summary records to SCAN (Symbiota Collections of Arthropods Network), a larger effort to assemble and make available occurrence records of insects and other arthropods to the greater scientific community and the public in general. Each year we now upload all of the submitted Season Summary records to this site. In addition, several years of back records are also hosted here, and we hope to continue adding past years as that is possible.

Now that our Season Summary is available online, we thought it best to provide a simple set of instructions about how to use the SCAN database to search our available records. This process is easy, but not immediately obvious when you start exploring the site. To get started you can go directly to the SCAN site using the link below, or you can access the site through the Lepidopterists' Society webpage using the link under Season Summary. Then just follow the set of instructions below to access, search and download any data from the Season Summary. The first two instructions set up the search feature to search only the Lepidopterists' Society records. If you would like to include other databases, you can select them in addition to our database. Have fun and explore a bit. There are lots of interesting datasets on the site, including quite a few from major and minor collections as well as some important personal collections. Have fun exploring our data and those in the other databases.

1) Go to: **https://scan-bugs.org/portal/collections/index.php**
2) Click on Select/Deselect All to deselect all databases
3) Scroll to near the bottom of the list and select Lepidopterists' Society Season Summary
4) Go back to the top and click on Search
5) Choose whatever criteria you would like and tell to complete search
6) Records will be displayed
7) Click on the icon in the upper right if you would like to download records
8) Click on appropriate choices – this will download comma separated or tab separated data, which can be compressed or not
9) Click Download Data

2019 (and 2017) Season Summary

The 2019 Season Summary is coming, but will ship with the 2020 Winter issue of the News. Please see the call for submitting your 2020 Season Summary records on the previous page.

2020 Annual Meeting at Western Carolina University Rescheduled for 2021

The annual meeting of the Lepidopterists' Society has been rescheduled for the 2020 location, Western Carolina University, next year (2021) at the same time of year, during mid-June. Be looking for more information in the coming months. We look forward to hosting you next year.

Brian Scholtens and Jim Costa, meeting coordinators.

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

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

Lep Soc Statement on Collecting

The Lepidopterists' stance on collecting is discussed fully in The Lepidopterists' Society Statement on Collecting Lepidoptera. This is available online at: **https://www.lepsoc.org/content/statement-collecting**

Journal of the Lep Soc page charges reduced

Due to the ongoing financial hardship created by the COVID-19 pandemic, The Journal of the Lepidopterists' Society will be dropping pages charges for members to $25 USD per page. This policy will remain in effect for the duration of Fiscal Year 2021 (July 1, 2020 – June 30, 2021) and will be revisited at the annual meeting of The Lepidopterists' Society in June 2021. If you are an author and/or a member that has a paper already in layout, or has a paper that has been accepted but not-yet-published, the Editor will automatically update your page charge assessment to reflect this shift in policy. Questions regarding this new approach to reducing financial burden for members should be sent to the Editor directly at **KSummerville@drake.edu.**

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!

The Ron Leuschner Memorial Fund for Research

The 2021 cycle of the Ron Leuschner Memorial Fund for Research on the Lepidoptera is now open for applications. Each year, the Society will fund up to 3(+) grants for up to $500 each to undergraduate or graduate students depending on merit. Applicants must be members of the Lepidopterists' Society. Applications are due January 15, 2021. The application must include submission of the application form, which will be posted later this year to the Lep Soc 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. Additional information about the research fund or a copy of the application can also be obtained by writing to Dr. Shannon Murphy (see immediately below). 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.

This year the Lepidopterists' Society gave three students awards from the Ron Leuschner Memorial Fund for Research on the Lepidoptera. The three awardees were: 1) Christopher Cosma, a PhD student from the University of California, Riverside for his proposal entitled "Linking plant-plant and plant-pollinator interactions along an elevational gradient", 2) Gabriela Montejo-Kovacevich, a PhD student from University of Cambridge for her proposal entitled "Evolution of toxicity in *Heliconius* butterflies recently introduced to the Cook Islands (New Zealand)" and 3) Yuecheng Zhao, an undergraduate student from Emory University for the proposal entitled "Effects of male body size on the mating behavior of monarch butterflies (*Danaus plexippus*)". Each student received $500 to support their research project.

Increase in Late subscription fees

Notice of increase in late-fees. Due to ever increasing postage costs, international late-fees are increasing. The US will remain the same at $10, Canada and Mexico will **increase to $15**, and the rest of the world **increases to $40**. This change will take place for the upcoming subscription year, and will be reflected on the upcoming dues notice mailing.

The Southern Lepidopterists' Society invites you to join

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

Please write to me, Marc C. Minno, Membership Coordinator, at **marc.minno@gmail.com** if you have any questions. Dues may be sent to Jeffrey R. Slotten, Treasurer, 5421 NW 69th Lane, Gainesville, FL 32653.

Society of Kentucky Lepidopterists

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

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

The Association for Tropical Lepidoptera

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

The Wedge Entomological Research Foundation Revises Categories of Financial Support

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

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

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

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

Mix Family Award for Contributions in Lepidoptera

In honor of Nancy, John, Lin, and Joe Mix, the Lepidopterists' Society is pleased to announce the establishment of the "Mix Family Award for Contributions in Lepidoptera." This award will be used to honor an amateur lepidopterist (someone not professionally employed as an entomologist) who has contributed the most to the field of Lepidoptera in the view of the Awards Committee. Outstanding short-term or long-term accomplishments will be considered, and may include contributions to outreach and education, collaboration with colleagues, novel research and discoveries, building an accessible research collection, or leadership within the Society. Nominations are allowed from any member of the Lepidopterists' Society and the nominee must also be a member of the Society in good standing.

This annual award is funded by a very generous monetary donation from Steve Mix that is designated specifically for this award. Award recipients will receive a check for $1,000 and a plaque that will be presented at the banquet at the Annual Meeting of the Lepidopterists' Society. The award will be presented to a single recipient, and any person who receives the award is not eligible to be nominated again for at least 5 years. It is estimated that the initial donation will be sufficient to sustain this award for at least 20 years. In the event that the award fund is reduced to the point where the award cannot be sustained, the Executive Council will determine if the award will continue.

Insights into the publication of Butterflies of California by John Adams Comstock

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Fig. 1. John Adams Comstock, c.1920.

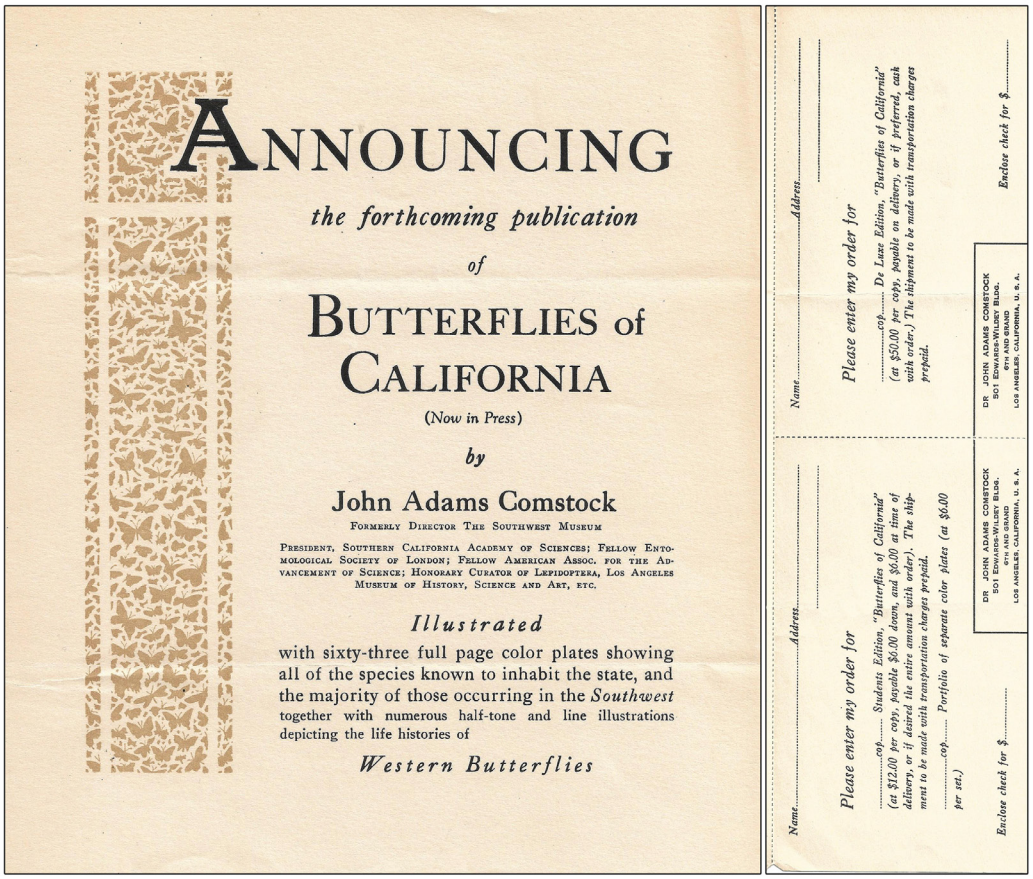
Born into a wealthy family in Evanston, Illinois, John Adams Comstock (1882-1970) (Fig. 1) became interested in Lepidoptera when he was 12 years old (Anonymous 1917, Van Doren 1983). In 1908, he moved to California, where he opened an arts and crafts shop with his sister before attending medical college in 1912. He became a licensed physician in 1915, specializing in osteopathy. By the age of 21, Comstock had assembled a Lepidoptera collection of 3,000 specimens (Anonymous 1909), which swelled to include 10,000 specimens 14 years later (Anonymous 1917). He served as assistant director and director of the Southwest Museum in Los Angeles from 1919 to 1926, after which he briefly returned to his medical practice, located in Suite 501 of the Edwards-Wildey Building, 600 South Grand Avenue (corner of 6th St. and Grand Ave.) in downtown Los Angeles (Martin 1972, Van Doren 1983). He again withdrew from medicine in 1928 to accept a position at the Los Angeles County Museum (now the Natural History Museum of Los Angeles County; NHMLAC). Lester D. Crain (1901-1953) took over Comstock's medical practice in January 1929 (letter dated 24 Dec. 1928, J. Calhoun library). Comstock served as director of sciences and chief curator of science at the Los Angeles County Museum from 1939 until his retirement in 1948. After permanently relocating to Del Mar, California, he became closely associated with the San Diego Natural History Museum. Between 1902 and 1969, Comstock authored 236 scientific papers, mostly on Lepidoptera (Birnie & Smith 1972). Known to his friends as "Doc," he was fondly remembered as "outgoing, friendly, generous with his knowledge, a spell-binding speaker and his appearance was one to be greatly revered and respected" (Van Doren 1983). To recognize outstanding students and pioneer lepidopterists in the west, the John Adams Comstock Award was established in 1978 by the Pacific Slope Section of the Lepidopterists' Society.

For over 25 years, Comstock gathered information on California butterflies with the idea of authoring a book on the subject. He achieved his goal with the publication of his magnum opus, *Butterflies of California* (Comstock 1927). The book was very popular, and it is still recognized as a valuable contribution to the study of North American butterflies. Drummond (1990) claimed that *Butterflies of California* was issued in 1927 in two editions: a "Regular Edition" bound in green leatherette that sold for $9.00, and a leather-bound "De Luxe Edition" priced at $15. Upon further investigation, I discovered that this assessment is inaccurate, and the true history of *Butterflies of California* is much more complicated.

The following analysis is based on 136 copies of *Butterflies of California*, as well as related correspondence and other documents. I personally examined 19 copies of the book: six in my personal library, one in the library of the Division of Plant Industry (Florida Dept. of Agriculture and Consumer Services, Gainesville, Florida), and twelve in the library and staff offices of the McGuire Center for Lepidoptera and Biodiversity (Florida Museum of Natural History, Gainesville, Florida). Photographs of eight copies were received from other entomologists and booksellers. Images and descriptions of 22 copies were found online and in book sales catalogs. The majority of copies were tracked down via the online bibliographic database OCLC WorldCat, resulting in photos and scans of 85 copies, received from 77 libraries and museums in the United States, Canada, Australia, and the Netherlands. At least 25 additional copies were located, but they could not be examined due to the institutional closures associated with the COVID-19 pandemic.

Conception. In 1920, Comstock announced that he would begin issuing color illustrations of the butterflies of California in the Bulletin of the Southern California Academy of Sciences. They would be "executed in the three-color copper-plate process," representing the "highest expression of this form of reproductive art" (Comstock 1920). Between 1920 and 1926, Comstock published 17

of these color plates in the Bulletin as promised, but he printed many others with a greater idea in mind. In 1925, he distributed sets of plates, numbered 2-37, "as a matter of scientific record prior to the publication of the complete volume." He presented sets to members of the Lorquin Entomological Club (Gunder 1925), and sold them through the Dawson Book Shop in Los Angeles (Anonymous 1926a, 1926b). A surviving set of plates, presented by Comstock to a member of the Lorquin Entomological Club, includes a typewritten note indicating that Plate 2 was printed "about April, 1920, and Plate 37 was "printed about May 1st 1925" (J. Wiker library). The note also includes a statement that "These plates have been distributed, as printed, to lepidopterists of the Lorquin Natural History Club, and to all students of the group who made inquiry for them. About 60 plates will be required to finish the work." These sets all lacked Plate 1, which was originally prepared only for publication in the Bulletin of the Southern California Academy of Sciences. Comstock (1926) cited figures on Plates 32-37, noting that these plates were "published and distributed some time ago." The issuance of these plates was Comstock's first step in fulfilling his desire to author a definitive manual on the butterflies of California.


ANNOUNCING

the forthcoming publication

of

BUTTERFLIES of CALIFORNIA

(*Now in Press*)

by

John Adams Comstock

FORMERLY DIRECTOR THE SOUTHWEST MUSEUM

PRESIDENT, SOUTHERN CALIFORNIA ACADEMY OF SCIENCES; FELLOW ENTOMOLOGICAL SOCIETY OF LONDON; FELLOW AMERICAN ASSOC. FOR THE ADVANCEMENT OF SCIENCE; HONORARY CURATOR OF LEPIDOPTERA, LOS ANGELES MUSEUM OF HISTORY, SCIENCE AND ART, ETC.

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.....cop..... Portfolio of separate color plates (at $6.00 per set.)

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Enclose check for $.....

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Fig. 2. First page of circular announcing *Butterflies of California*, 1926. At right are order slips.

Announcement. In 1926, Comstock formally declared that he would soon publish a book titled *Butterflies of California*, which would include "over sixty full page colored plates and numerous half tone figures" (Anonymous 1926a, 1926b). He placed advertisements in various periodicals, and mailed to prospective buyers a two-page circular announcing the forthcoming book (Fig. 2). Measuring 7 x 10.5 inches, the circular advertised that the book would be "arranged in popular form, enabling the beginner to identify every California butterfly at a glance, by comparison with the colored figures." The circular described two editions of the book, and included detachable order slips for each (Fig. 2, right). These editions, published and sold by Comstock himself, were described as follows:

Students Edition, page 7 ¾ x 10 ½", bound in durable art fabrikoid. This edition will be sold under two separate plans:

1. By advance subscription, $12.00, payable $6.00 with order, and $6.00 at time of delivery.
2. By advance order, $15.00, payable in full at time of delivery, with transportation prepaid.

The price of the work after it is off the press will be $15.00 plus transportation.

De Luxe Edition, limited to 200 copies, numbered, autographed, illuminated title page and initials, bound in full crushed levant. Price on delivery . . . $50.00.

Book production. A copy of *Butterflies of California* in my library includes four letters and a postcard (dated 1926-1928) from Comstock to the original buyer, Frank Harrold Sellars (1864-1938), a wealthy financier and philanthropist from Chicago who moved to Pasadena, California, in 1919. Among his many interests, Sellers studied science and nature (White 1941). These documents, as well as Comstock's personal papers (NHMLAC) and a letter from Comstock to the American lepidopterist Cyril F. dos Passos (Wittenberg University, Springfield, OH), include valuable information about the production of this book.

The highlight of *Butterflies of California* is the impressive series of 63 full page color illustrations, or plates, bound at the rear of the volume. All but the last plate figure adult butterflies, reproduced from photographs of 62 Riker mounts of specimens that Comstock arranged.

Two years after the publication of the book, Comstock donated these Riker mounts to NHMLAC (Martin & Truxal 1955), where they remain mostly as he left them, though some type specimens were subsequently relocated to other parts of the museum's collection (J. P. Donahue pers. comm.). The last illustration in the book, Plate 63, portrays color drawings of larvae and pupae by the San Francisco artist and lepidopterist Robert F. Sternitzky (1891-1980). The copper printing plates used to produce the color illustrations for the book were prepared by the Southern Engraving and Colortype Company of Los Angeles, who ensured "faithfulness of color rendering and accuracy of line" (Comstock 1927). The prints themselves were produced by the Chicago Color Printing Company, which, despite its name, was also located in Los Angeles. Although Comstock (1920) initially stated that they would be printed using a "three-color copper-plate process," a higher quality, four color process was ultimately employed.

A single original copper printing plate for *Butterflies of California* was recently rediscovered among the possessions of the Shaw family, who were neighbors of Comstock when he lived at 1373 Crest Road in Del Mar, California. Measuring 5.6 x 7.4 inches, the plate is accompanied by a note from Comstock, which was probably written during the 1960s. Typewritten and signed in ink by Comstock, it reads, "The copper plate of Butterflies is a part of the four color halftone process of plates used in my 'Butterflies of California'. This process is becoming obsolete – perhaps a dying art – as a result of cheaper, but we think less satisfactory, methods. Also with each copper plate is the finished four-color printing. The book is out of print now, so these records are all that are left of the work." Comstock's comments suggest that additional materials were once part of this collection. This copper plate (Fig. 3) was used to print Plate 53, and is thought to be the only surviving example from the production of *Butterflies of California* (a wire hanger on the back implies that it was once a wall decoration). An imprint along the bottom edge reads "YELLOW," indicating that this plate was used to apply the color yellow, while three other copper plates were used to print red, blue, and black; one pigment applied on top of the other. Each sheet passed through the press four times to achieve the final result (Hackleman 1924). The illustrations for the celebrated *Butterfly Book* by Holland (1898) were produced using a three color process, which lacked the application of black ink. The addition of black greatly enhanced detail, but increased cost and production time. The historical use of printing plates is the reason why illustrations are still known as "plates" when they are printed separately from the text.

Fig. 3. Copper printing plate used to apply the color yellow for Plate 53 of *Butterflies of California*.

Butterflies of California was still being proof-read and indexed by Comstock in November 1926. The printer, McBride Printing Company of Los Angeles, would not consider producing the book without a large subsidy from Comstock, and strongly advised that a limited number of copies be printed (Cockerell 1944). Comstock was confident that the book would perform well and ordered 2000 copies. Although the plates were already printed, they required additional finishing work, as explained by Comstock on 12 February 1927: "The time element in the printing of this book was greatly underestimated. All of the finished page proofs have been in the hands of the printer for some time, and the work is being run as fast as the presses can handle it. The overprinting of the plate numbers and copyright imprint on the colored sheets requires 252000 impressions with a continual running time of over a month. This has just been started, and will be the chief cause of the continued delay. I hope, however, that the book will be through the bindery early in March" (J. Calhoun library). According to copyright records, *Butterflies of California* was officially published on 14 April 1927. He dedicated it to his mother, Cornelia "Nellie" H. Comstock (1857-1940), who "encouraged always the pursuit of truth in the sunlit places." Comstock promoted the book as "a fairly complete work for the territory west of the Rockies" (letter dated 11 Nov. 1928, NHMLAC). Although he ultimately issued three editions of the book, their text blocks were printed in 1927; only the bindings differ in age.

Used copies of *Butterflies of California* are scarce, and they often sell for hundreds of dollars. This prompted the publication of a facsimile edition in 1989, which was edited by the lepidopterists Thomas C. Emmel and John F. Emmel (Comstock 1989). Although this edition reproduced the color plates in black-and-white, it was reasonably priced at

$24.50. Despite its positive reception, the facsimile lacks the grandeur of Comstock's original editions.

Students Edition. Copies of this edition are bound in full cloth, which is coated with a water resistant artificial leather called fabrikoid. Manufactured by DuPont, fabrikoid was very popular during the early twentieth century for bookbinding and upholstery (Hackleman 1924, Meikle 1995). The binding of this edition is dark brown or black, and the front cover has an embossed title and image of a western tiger swallowtail (*Papilio rutulus*) (Figs. 4-6). These copies are sometimes called the "large paper edition," as they are larger than those identified as the "Regular Edition" by Drummond (1990) (see below). The endpapers are plain or (more rarely) marbled. The descriptive page for each plate is glued onto the verso of the previous plate. Although Comstock boasted that this edition is "handstitched in a very durable binding," most surviving copies have spit hinges or detached spines, mostly due to the heavy weight of the coated paper used. As a result, copies often have evidence of spine repair or are fully rebound. Of the 103 copies of the Students Edition examined during this study, 25 were rebound.

After 15 January 1927, the standard price of this edition was $15, which is equivalent to about $220 in today's economy — a rather hefty expense for a student. Each copy cost $14 to produce (letter dated 17 Dec. 1926, NHMLAC), and Comstock sought no profit from its sale. He offered a ten percent discount to schools and colleges, and a discount of 33 1/3 percent to booksellers. He sold copies through local shops and department stores, including the former J. W. Robinson Company, which was located two blocks from Comstock's medical practice in Los Angeles. Copies of the Students Edition were also advertised in book sales catalogs, such as those issued by the prominent bookseller John D. Sherman, Jr., of Mt. Vernon, New York.

Comstock offered the Students Edition for many years, and in two very different binding designs. The initial design (D1) is black or dark brown, with yellow highlighting added to the cover butterfly and spine titles (Figs. 4, 5). The later design (D2) is glossy black with gilt titles, and no yellow coloration on the cover butterfly (Fig. 6). It is difficult to know precisely when each design was produced, but dated signatures by Comstock, as well as dated ownership inscriptions, offer valuable clues. Copies were evidently bound in batches, perhaps as few as 50-100 at a time. D1 bindings were employed for copies sold from 1927 until at least the mid-1940s. The earliest copies generally have the darkest bindings (Fig. 4). Later D1 copies are browner, with more extensive yellow embellishments (Fig. 5). Beginning around 1945, Comstock produced copies with the more vibrant D2 binding, and these were sold into the 1960s. Dust jackets (Fig. 11, right) were issued with at least some copies of the Students Edition, but they are now very rare. They served mostly to advertise the book and included an order slip on the back flap. The D1 binding design is much more common. Of the 78 copies of the Students Edition that I examined with original bindings (whole or in part), only eleven were found to have the D2 binding. The majority of copies in libraries are of the D1 design, probably because they were acquired prior to the production of D2 copies, or were received with older private libraries.

De Luxe Edition. This edition is fundamentally like the Students Edition, but with striking enhancements. Instead of a fabrikoid binding, copies of the De Luxe Edition are bound in full, dark brown Morocco leather (crushed levant, made from goat skin), with gilt titles and marbled endpapers (Fig. 7). The D2 binding design of the Students Edition (Fig. 6) appears to have been based on the design of the De Luxe Edition. The front matter of the De Luxe Edition includes a signed and numbered edition page (Fig. 8), indicating that it was limited to 200 copies. The most obvious feature of this edition is the illumination (hand-coloring) of many elements, including the dedication, half-title, title, drop caps, and text line drawings scattered throughout the book (Fig. 9). Designed and applied by Comstock himself, some of these embellishments include bits of gold leaf.

The De Luxe Edition is very rare. I located only five copies during my study: No. 4, dated 20 July 1927, originally owned by Jean D. Gunder (1888-1948) and C. F. dos Passos (1887-1986) (Wittenberg University); No. 6, dated 25 July 1927, of unknown provenance (University of Michigan, Ann Arbor, MI); No. 8, dated 1 August 1927, originally owned by the California philanthropist Ellen B. Scripps (1836-1932) (San Diego Natural History Museum, San Diego, CA) (see Van Doren 1983); No. 9, undated, Comstock's personal copy (NHMALC); and No. 22, undated, originally owned by the entomologist Elwood C. Zimmerman (1912-2004) (Black Mountain Library, Canberra, ACT, Australia). Although Comstock intended to issue up to 200 copies of this edition, the actual quantity produced was much lower. In his personal copy at NHMLAC is an undated note by Comstock that reads "Of this edition there were, as a matter of fact, less than 20 copies issued." He obviously produced several additional copies after writing this note, but the very poor hand-coloring of No. 22 suggests that he had little interest in upholding their quality. The $50 price of the De Luxe Edition is equivalent to about $750 in today's economy, placing it far beyond the reach of most potential customers during the Great Depression. The time and expense required to create the De Luxe Edition may explain why he gave his son, John Sterling Comstock (1907-1983), a Students Edition (Cullman Library, Smithsonian Institution).

Several copies of the Students Edition that I examined include an uncolored De Luxe Edition page, which is not signed or numbered by Comstock. These copies also lack the hand-coloring and leather binding associated with the De Luxe Edition. The most notable example, deposited at the Central Library of Santa Rosa (California), was donated in 1932 by Comstock's mother (Anonymous 1933). The most logical explanation for this discrepancy is that

Comstock had originally prepared these copies for the De Luxe Edition, but the poor demand for that edition led him to bind them as Students Editions. Prior to doing so, he simply forgot to remove the edition page.

Field-Book Edition. In the 1950s, a "limited edition" of *Butterflies of California* was offered. Measuring 7 x 10 inches, these copies are smaller than the Students and De Luxe editions, and are bound in shades of green cloth,

Figs. 4-12. Editions of *Butterflies of California.* **4,** Students Edition, earlier D1 binding (1927). **5,** Students Edition, later D1 binding (c.1935). **6,** Students Edition, D2 binding (c.1945). **7,** De Luxe Edition binding (1927). **8,** De Luxe Edition, edition page design. **9,** De Luxe Edition hand-colored elements, including title page decoration. **10,** Field-Book Edition (c.1950) (note crushed spine). **11,** Field-Book Edition binding variants (with dust jacket at right) (c.1950-1955). **12, "**Lundberg Edition" (c.1967).

with gilt spine titles and either plain or floral endpapers. Binding colors include olive green, forest green, and teal (Figs. 10, 11). Unlike the other editions, the descriptive page for each color plate is not attached to the verso of the previous plate. Drummond (1990) called these copies the "Regular Edition" and mistakenly believed they were issued in 1927.

In a letter to C. F. dos Passos, dated 29 September 1952 (Wittenberg Univ.), Comstock wrote, "I have about 425 unbound but assembled copies which I am having bound in small lots from time to time. The binding of these is of an ordinary commercial type, and the books are trimmed to a smaller size, to make up what I call the field-book edition. There is no difference in the text and plates. The 'field-book' can be sold at a considerably reduced price which places it within reach of the young amateur collectors." The text and plates were originally produced at a larger size in 1927, thus the binder had to recut them for the Field-Book Edition. This edition was priced at $9, which is equivalent to nearly $100 in todays' economy.

Fig. 13. Plate set portfolio, clockwise from upper left: cover, partially opened, fully opened showing individual plates.

The 1927 publication date of these copies is misleading, as this edition was first offered for sale around 1950. It is unknown how long Comstock issued new copies, which were sold in bookstores and gift shops (Anonymous 1955). One of the copies I consulted was originally purchased for $9 in 1954, and an advertisement mentions this edition the following year (Anonymous 1955). Because copies were bound in batches at irregular intervals, they show variation in binding color and spine printing. Most copies of this edition have crushed or damaged spines (Figs. 10, 11). Those with spine titles written in all upper case letters have stronger spines, suggesting they were bound later with better materials. At least some copies of this edition have dust jackets like those used for the Students Edition, which were trimmed down to fit the smaller-sized volumes (Fig. 11, right). I examined 25 copies of the Field-Book Edition, including two in my own library.

"Lundberg Edition." I found three copies of *Butterflies of California* with a binding design that is radically different from those issued by Comstock. A notation in one copy records that it was purchased in 1967 from "Lundberg." The two other copies were acquired c.1967-1970. All three copies are bound in sturdy beige cloth, with a red title block and gilt letters on the spine (Fig. 12). The bookseller and publisher Eric B. Lundberg (1908-1984) began selling books in 1927 and established his own business a decade later. Specializing in botanical and zoological works, he operated from several states over many years, including Maryland, New York, New Hampshire, West Virginia, and Vermont. Because Lundberg occasionally reissued new editions of older books (Nemeyer 1972), it is conceivable that he purchased the remaining unbound copies of *Butterflies of California* from Comstock and had them bound in an exclusive design.

Plate sets. Comstock also sold unbound sets of color plates, which he began advertising in his printed circular of 1926 (Fig. 2). He described them as "A few sets of the color plates only, unbound, in portfolio . . . $6.00. These are suitable for Nature Study classes, and for display in Biology Classrooms, Libraries, etc."

These sets include all 63 color plates, which are the same as those used for the book. The loose plates are enclosed in a cardstock, fabrikoid-coated portfolio (Fig. 13), with a cover that is similar to the D1 binding design of the Students Edition of the book. Unfortunately, the portfolio material is very flimsy and most surviving copies are in poor condition. I examined six plate sets during this study, including two in my library.

Final sales. By 1944, it was reported that few copies of *Butterflies of California* remained, and that Comstock had recovered the original cost of its production (Cockerell 1944). In September 1952, Comstock still possessed 75 bound copies, as well as about 425 unbound copies and 60 sets of plates. He was using the unbound copies to issue the Field-Book Edition, but by that time had probably ceased

production of the Students Edition (though he was still selling the remaining inventory). As late as 1968, Comstock was offering sets of plates for $8, but the book was no longer available (Comstock 1968). Many of the remaining plates were given away after his death (Drummond 1990).

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The Zigzag Flat, *Odina decoratus*. Kaeng Krachan National Park Thailand. 2018. Photo by Antonio Giudici.

Digital Collecting:

Butterflies of Yunnan and Sichuan Provinces, China

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Just before leaving for this trip, I closed my store, Berthet Jewelers, for a month. The sign left on the door told it all – "Gone to China, photographing butterflies."

This article is based on visiting numerous Chinese attractions, sometimes photographing butterflies at certain sites May 11 – 21, 2012, arranged by **tours@travelchinaguide.com.** Travel consultants were Lydia Meng and Linda Fang, who arranged private guides and drivers. The butterfly photographing holiday was after that, from May 22 to June 09, with trip Co-ordinator Jason M.W. Lees from **www.haiweitrails.com,** and trip leader Andrew Neild with some assistance from Vadim Tshikolovets.

Comparing all the other butterfly holidays I have participated in, China's history, archaeological sites, geography, people, culture, cuisine, flora, fauna biodiversity, and others were by far the most interesting, but not the best lepping.

We left JFK on Air China for the 13 ½ hour trip to Beijing. I was a bit surprised when "Frank" my Chinese guide stood towering over everyone else at 6 feet five inches tall! Yunnan is the most southwestern province in China, with the Tropic of Cancer running through its southern part bordering Myanmar, Laos, and Vietnam. The northern part of the province forms part of the Yunnan-Guizhou Plateau, bordering Guangxi and Guizhou in the east, Sichuan in the North, and the Tibet Autonomous Region in the Northwest. China features 22 provinces, 5 autonomous regions, 4 municipalities, 2 special administrative regions (Hong Kong and Macau) and one claimed province (Taiwan). Over 100 cities have a million or more people.

The morning after arrival our driver dropped Frank and myself off at the 109 acre Tiananmen Square (that over 250,000 people pass through most days) flanked by the Great Hall of People, The National Museum of China, and the always crowded Chairman Mao's glass sarcophagus. Entering the Forbidden City leads you to The Hall of Supreme Harmony, Palace of Heavenly Beauty, Palace of Peace and Longevity, and the Imperial gardens. There is a dizzying array of things to look at. My favorite was a fifteen foot tall richly decorated carved wood clock in the Hall of Clocks. Many of the mechanical timepieces are from China, England, and Switzerland.

In the evening our table carver carefully sliced a crispy Beijing Peking Duck into 118 pieces, served on 3 separate plates with crepes and various sliced vegetables and plum sauce.

Left: Entrance to the Forbidden City; right: clock in the Hall of Clocks.

Great Wall of China, Mutianyu entrance

Traffic is wild and crazy, every man for himself. There are pedestrians, taxis, motorized and human driven rickshaws, bicycles, motorized bicycles, motor-scooters, motorcycles, and cars by the hundreds and hundreds. We finally arrived at the Temple of Heaven that symbolized interaction between heaven and mankind. A neat spot was the Echo wall famous for acoustics and sounds transmitted along its length with remarkable clarity. Clapping your hands would create a single echo on the 1st tier, double echo on the 2nd tier, and a triple echo on the third tier.

Early the next morning we took the 60 mile trip to the Mutianyu entrance of the Great Wall of China. I worked the flower filled forested areas below the wall for butterflies but saw none.

We then flew to Luoyang in Henan Province. We counted one apartment complex that had forty-seven, twenty-five story buildings, with underground parking on the way to the hotel. At 5:15 am the next morning I awakened to the sound of huge pile drivers shaking the hotel. We headed to the Shaolin Temple and Pagoda Forest, guarded by two *Ginko biloba* trees planted around 1500 years ago. The two trees show finger holes used for practice in martial arts. The temple was built in the 5th century AD, but has been burned down several times. Deep impressions in the stone floor serve as reminders of tough combat exercises.

1500 year-old Gingko biloba tree, with finger holes. These were used to help with accuracy during martial arts practice.

We visited the surrounded areas and the Stupka forest where many monks are buried, to photograph butterflies. Several butterflies were observed, but we did not get any clicks. The highlight was seeing a monk holding a piece of glass, with another holding a balloon behind the glass, while a third monk was holding a needle. He twirled around hit the glass with the needle, creating a small hole in the glass without it breaking, as it popped the balloon.

The next morning I was again awakened at 5:15 a.m. by the huge pile drivers. We headed to Longman Caves (grottoes) with over 100,000 Buddhist carved stone statues ranging from one inch to 57 feet high. One small cave has over 10,000 stone carvings, each measuring around one inch in size.

In the morning the bullet train took us, with speeds up to 185 mph, to Xian in Shaanxi Province. It felt like floating on air. The next morning I was excited to visit the Terracotta Army, a collection of terracotta sculptures depicting the armies of Qin Shi Huang, the first emperor of China. Discovered in 1974 by peasants digging a well, the Army's purpose was to provide protection for the emperor in his afterlife. The army is enclosed in a huge structure measuring around 211 feet by 990 feet, containing around 8000 warriors in varying degrees of degradation. Many are crumbling and being put back together on site.

The Terracotta Army of soldiers

After several days of sightseeing, I flew to Kunming in Yunnan Province to visit the stone forest 78 miles S.E. of Kunming. These are bizarre shaped limestone karsts peering out of the forest, some over 100 feet high. Bai women wearing hats were the guides. Two wings on the hat showed a woman was single, one wing on the hat, she was engaged, and no wings on the hat she was married. Six miles to the north we visited the Naigo Black Forest, spending the afternoon photographing butterflies in the surrounding meadows and pond areas. The shot of the day was Papilio bianor.

Stone forest near Shiling -- bizarre shaped limestone karsts, some over 100 feet high.

That night I attended the grand original native song and dance melody "Dynamic Yunnan" that travels all over the world including Broadway, it was the best show I have ever seen.

The next morning we visited the World Butterfly Eco Center, a terrible facility that is poorly designed and maintained for butterflies, but has flowering gardens loaded with butterflies to photograph. Up the street was the Dwarf Empire or Kingdom of the little people, a fantasy theme park with around 100 little people that live and work entertaining guests with song and dance routines. I met and talked with Bennie from Pittsburg, a Harvard grad student working on a documentary of the little people.

The next day I flew from Kunming to Chengdu (500m) in Sichuan Province to meet up with the butterfly group. We stayed at Tianfu Sunshine Hotel with a soft bed, complete with gas masks. It was raining heavily, but I still wanted to visit the Chengdu Research Base of Giant Panda breeding. It is fortunate to have this many Giant Pandas in one place. Dozens of people were in front of me taking pictures, so I decided to crawl my way through many legs, popping up in front to get a good picture. There is a very good butterfly and insect collection on the second floor where I ran into Paul a cardiologist who would be with me on this trip. We had lunch and drove to the Dujiangyan Irrigation Project of China on the Min River, built by Li Bing between 306 and 251 B.C., an incredible feat of engineering.

We transferred to Wenjun Mansion House, where I had dinner with 2 more participants on the butterfly trip, Larry and Nancy from Gilbert, Arizona. After dinner, we snagged a perfect front row seat eating peanuts and sipping tea at the Shu Feng Ya Yun Tea House, for the Sichuan Opera. Acts included a stick puppet and hand shadow show, along with quick change faces, and a comedic show featuring an argumentative couple reminding me of the Bickersons. One of the changing face characters had a mustache. I twirled the end of mine, he smiled, looked at me, moved his hand across his face and his mustache disappeared, really cool!

On May 22 our 11 person international group met for a fairly good buffet. Our tour leader Andrew Neild reviewed a few details then handed us a checklist of around 210 species and subspecies of butterflies put together by Vadim Tshikolovets, the author of many butterfly books in this part of the world. Transportation consisted of three Toyota Land Cruisers with Tibetan drivers. I lucked out and got to hang with Andrew, Vadim, and Tony Hoare in the lead vehicle for the entire trip.

Our journey took us to the Eastern limits of the Tibetan plateau in western Sichuan Province to the north, and western Yunnan to the south. Subtropical plains around Ya'an, through deep and lushly-forested temperate valleys, carved out by the Yangtze and Mekong rivers and its tributaries, to alpine meadows and high passes, where many peaks are above 6,000m with the tallest (Gonga Shan) exceeding 7,500 meters in height.

The Chinese Peacock swallowtail, Papilio bianor

We were in Sichuan Province on road G5 heading about 80 miles S.E to Ya'an (580m) (The Raining Town) observing numerous white and yellow butterflies flying across the expressway. Overcast skies greeted us on a gravel road following along a stream near a manufacturing plant. We saw several locals including an ancient looking man with a very long white goatee who smoked a pipe

Clockwise from upper left: *Aglais urticae chinensis, Pseudergolis wedah, Neptis yerburii, Neptis anata*, and *Limenitis populi*.

smiling and giggling as he watched us photograph around 18 species of butterflies. Our good clicks included *Aglais urticae chinensis, Limenitis populi, Pseudergolis wedah*, and several *Neptis*. Later that afternoon we arrived at the Ku Mu Hotel in Ya'an.

Heading west on road G318, a cloudy morning greeted us on our way to a nearby meadow, where we photographed 5 species of butterflies. Later we crossed a narrow single lane bridge to the hamlet of Yuan Yang-ba (1415m).

Flower in the genus *Rhipsalis*.

Working the beach and scrub habitat along the river, we photographed an additional eight species of butterflies including several blues. Elaine and I walked up the hill to a three tiered area with a small stream and a narrow forested canopy for 3 more clicks. I had to crawl on my hands and knees in the mud to try to get a good shot of a *Neope*. No luck, but I came across a beautiful purplish red flower in the genus *Rhipsalis*.

Later that afternoon we arrived at the Gesar Hotel in Kanding (2590m) After butterfly IDs, I paid around $16.00 for an incredible 90 minute foot to head massage including tea, snacks and oranges. On the wall was a sign that said "no hanky panky".

Almost all habitats on this exploration trip were discovered along the way. This day was the exception. We visited a very well-known collecting spot (1758m) near Kanding that greeted us with a partly cloudy day. The habitat had a fairly steep winding trail bordered by a stream on one side, and a forested area on the other. We were excited to observe *Bhutanitis thaidina* floating in the air down the gully, finally landing on a flat muddy area on the bottom, and watching *Troides helena* flying high overhead for the first time. Our group is not alone on this day, as there are several collectors catching butterflies to sell on Ebay. While having lunch I noticed the yellow tongued *Hestina assimilis* imbibing minerals on top of a can of paint that I got a good click of. And, of course, the best of the day was *Bhutanitis thaidina*. Their caterpillars use varies species of host plants in the genus *Aristolochia*.

The collecting spot near Kanding in Sichuan Province

Top row: *Bhutatnitis thaidana* (left and center), *Hestina assimilis*. Bottom row: *Papilio xuthus, Araschnia davidis*, and a pair of *Tongeia filicaudis*.

Additional bugs included the rapid flying *Papilio xuthus, Araschnia davidis,* a pair of *Tongeia filicaudis*, along with 15 other species. That evening I took a walk through a very crowded downtown to the market, and ended up spinning a bank of prayer rolls along the river.

Leaving Kanding, the next day was high elevation butterfly day, heading on road G318 over Zhedua Pass (4306m). The habitat was tundra with lots of heather like blue flowers in bloom, and poppy fields. Butterflies were scarce with few photos that day. We crossed over the Gaoersi Mountain pass (4412m) on a very bumpy, muddy, messy road, without guard rails to prevent vehicles from straying into the deep gorges that are cut out by the Yalong River, a tributary of the mighty Yangtze River. We had to stop outside the city for a passport check that took over 1 hour, but we finally arrived at Yalong Way Hotel in Yajiang (2600m).

The top of each pass has thousands of Tibetan prayer flags attached to ropes and wires. These flags, steeped in Buddist traditions, are arranged in a special order, blue representing the sky, white the air, red symbolizing fire, green the water, and yellow the earth. All 5 flags together signify balance. A stop along the way had a dead Yak covered with hundreds of flies near a group of yellow flowers that the large blue *Caerulea coeligena* was nectaring on -- it was a real challenge to get a good click on this one.

After dinner, while playing pool with several friendly locals, I got the feeling they had not seen an American from Florida before. Several gals were giving me the "let's play hanky panky" look.

The three Land Cruisers revved up the next morning and continued on road G318 for a 130km drive under partly cloudy skies. We crossed over the 4718m high Kazila Pass. After a rice lunch, balanced delicately on about a 20 foot long, 12 inch wide log crossing over a stream, we then hiked up a very steep hill to a meadow. This area was the greatest challenge to get good clicks on this trip. Shots of the day included the striking hairstreak *Lycaena pang*, and then after waiting patiently for about ½ hour, I got a good image of *Anthocharis bieti* when it finally landed.

Clockwise from upper left: *Caerulea coeligena, Lycaena pang (the Chinese Copper)*, and *Anthocharis bieti*.

Bill Berthet, expressing himself at high elevation.

The nunnery

An elevation of 11,220 ft. takes a toll on your energy level, especially if you're a 60 year old guy living at sea level in Florida. We stayed that night at the Potola Inn in the city of Litang (4014m). During the next morning's drive, several participants stood on top of a rock for fun high elevation photos. The day's drive took us over three Tibet prayer flag filled passes ranging from over 14,000 to 15,500 feet. Without any luck, I tried to photograph a timid very rapid flying high elevation pretty skipper darting around a yellow and red poppy field near 4300m in elevation. Off in the distance, I observed a pair of very large white eared pheasants landing. The scenery was stunning, filled with *Rhododendron phaeochrysum* shrubs and multi-colored primroses in the genus *Primulas* dotting the mountainside.

We took G318 further west, driving at elevations from 3100 to 4300m. We stopped at a stream near a small flat area, where we ran across another dead Yak, this one with many more flies than the one mentioned earlier. We spent lots of energy with very little reward, but we did find the killer copper *Lycaena li*.

Our group ended up at a dumpy hotel in Weng Shu with no bathrooms or decent food, and bugs crawling on me at night. To this point, we weren't really getting our money's worth, but many of the participants, though clearly restless, were largely good sports about it. The next day we stopped at several steep drops, some with water and low vegetation with lots of rocks, leading to more exhausting work with little return, but the scenery was magnificent. One puddling area had the bug of the day, *Lethe yunnana*, and later we saw *Aporia goutellei* and *Sinia lanty*.

We spent the night at a very good hotel in Xianggelila or Shangri-la City, in the fictional land of Shangri-la created by the 1933 James Hilton novel **Last Horizon**, in an effort to promote tourism in the area. Dinner was enjoyed at a good Indian Restaurant.

Still following road G318 we were stopped by a landslide that was impossible to drive around. Many of these areas have a high road (G318) and a low road paralleling the high road. The problem is the connection between the two is steep with many extremely sharp switchbacks. At that point we had to backtrack to find a very steep narrow zigzag road that connects with the low road hoping that it is not covered by a landslide. Luckily the low road is cleared for passage. Ending our journey on G318 we turned south on G214.

We stopped at a nunnery, watching nuns cleaning vessels, making wax candles, and other clay objects. They allowed us to briefly enter their warm temple, decorated with colorfully designed silk banners, while listening to

Clockwise from upper left: *Lycaena li, Lethe yunnana, Aporia goutellei*, and *Sinia lanty*.

Mei Li Snow Mountain Glacier

chanting in the background. Outside areas had lots of wood for fires. It was too windy and cold for butterflies that day, but the Rhododendrons and other flowers helped us pass the time. Later that day we stayed at the Guan Jing Tian Tang Hotel in Deqen (3480m).

Waking up to a very foggy morning, I decided to take the day off, sleep in, and worked 6 hours on the computer, while enjoying the view of Mei Li Snow Mountain Glacier across from my hotel room. The group had very few butterflies that day so I did not miss much.

After breakfast the next morning, we spent the day in a national park above the Mekong River, one valley over from the glacier. There was light drizzle in the afternoon but we got good clicks of *Papilio bootes*, and *Satryium oenone* feeding on my shoe lace. Then back to our hotel.

The following morning followed road G214 through the steep valleys, waterfalls and streams feeding the Mekong River, with lots of rocks blocking part of the road from erosion. It was spooky driving a dangerous road in very foggy conditions, and finally arriving at Watts Inn with no toilets in the room in Cizhong (1980m). But at least the food was good!

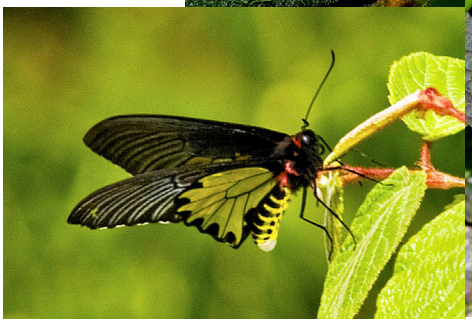
Catholic French missionaries came to this region in the 1800s and brought with them rose honey grapes for communion. Those grapes were wiped out in France by blight in 1860. It was not until the 1990s when a French sommelier rediscovered the world's last acre of rose honey grapes on the grounds of the Cizhong Catholic Church. During this time the villagers built a thriving local wine industry. Several years ago a dam was constructed near Cizhong wiping out most of the grape producing areas. Our group drank some of this wine while sharing stories during dinner. Later that night, some had to deal with a mooing cow that lived below the rooms we stayed in.

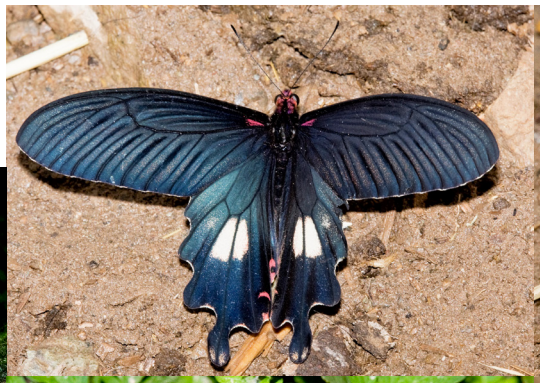
Over the next couple of days, we worked a steep trail finding about 10 butterfly species, and one large flowering tree, with four species of swallowtails nectaring on the flowers. The bully of the group was *Troides aeacus* that was chasing the others away. After many tries, I got a shot of the golden colored hairstreak *Gonerilia thespias*.

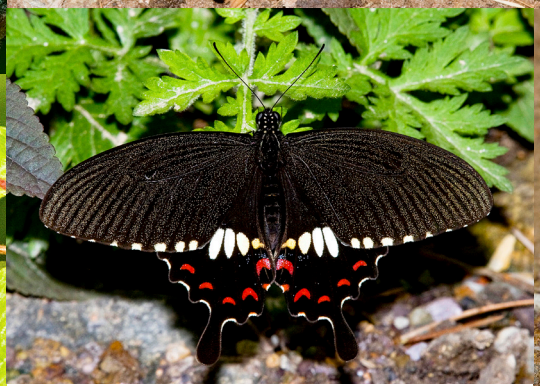
Recovering the next morning from a bit of wine, we made our way over the very bumpy G214 road along the Mekong River towards Weixi. Randomly (this is an exploratory adventure) we took a side road following a stream to a huge gravel pit area. Jackpot!!!! The weather was sometimes

Top row: *Satyrium oenone, Gonerilia thespis*, and The Tailed Redbreast, *Papilio bootes.*

Bottom row: *Troides aeacus,* and The Common Mormon, *Papilio polytes.*







Top row: *Papilio protenor*; *Limenitis elwesi*. Second row: The Yunnan Peacock, *Papilio syfanius*; *Limenitis sydni*. Third row: Common Windmill, *Atrophaneura polyeuctes*; *Limenitis sydni*. Fourth row: *Epicopeia hainesii*; *Delias sanaca*. Fifth row: Chinese Windmill, *Byasa plutonius*; *Calinaga davidis*.

Left: *Abisara neophron*; right: the transit of Venus across the sun's disk.

The windy and cloudy, with intermittent drizzle but that day and the next we discovered around 35-40 species of butterflies, including 7 species of swallowtails. Goodies included *Papilio's bootes, polytes, protenor,* and *syfanius*, *Atrophaneura polyeuctes*, as well as *Limenitis elwesi* and *sydni*. We also found the moth *Epicopeia hainesii, Delias sanaca, Byasa plutonius*, and a trio of *Calinaga davidis*.

The most challenging to photograph was the riodinid *Abisara neophron*, that was constantly twisting and turning using a series of jerky movements. Accommodations during this time were at the Jiquan Hui hotel in Weixi (2350m)

A spectacular lunar event, the transit of Venus, occurred the morning of June 5th. Elaine, an astrophysicist and engineer, had a piece of welder's glass that she hooked up to a pair of binoculars that transmitted the image onto a flap of a cardboard box lying on the sidewalk outside the entrance to the hotel. After several minutes, the local Chinese realized what was happening and mobbed the spot to get a look.

We had a very good Chinese dinner, then ate ice cream cones on the way back to the hotel, which was followed with an ID session in Vadim's room

Everyone is very happy as we continued in Yunnan Province following the Mekong River valley road G214 to Lijiang (2375m). This is the most important place of the ancient Southern Silk road that started in Burma (Myanmar) crossing Shangri-la County, Tibet, Iran, and ultimately to the Mediterranean Sea.

The Naxi Ochestra

In the morning we explored the Jade Snow Mountain areas. I walked long distances to find *Graphium cloanthus, Limenitis cattini*, and the unusual looking *Patsuia sinensium*.

Top row: *Graphium cloanthus, Patsuia sinensium*; bottom row: *Limenitis cattini*.

The last night of the trip we celebrated with dinner at Kentucky Fried Chicken. Andrew and I had a separate dinner, sharing stories and other memories. Afterwards I walked to Old Town, and listened to the world famous Naxi Orchestra, consisting of five young women and 25 men between 65 to 88 years old. Some of the instruments were 200 years old; some had to be buried to avoid being destroyed during Mao's Cultural Revolution during the 1960's. The next day we flew from Lijiang to Chengdu, spent the night, then flew from Chengdu to Beijing where we said our good byes for our flights back home.

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The Marketplace

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

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For more information visit: **www.leptraps.com**, or contact Leroy C. Koehn, Leptraps LLC, 126 Greenbriar Drive, Aurora, OH 44202; Tel: 502-542-7091, e-mail: **leptraps@aol.com**. indefinite

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

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

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

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

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

Leroy C. Koehn, Leptraps LLC, 126 Greenbriar Drive, Aurora, OH 44202; Tel: 502-542-7091, e-mail: **leptraps@aol.com** indefinite

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

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

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

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

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

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

Publications

Butterflies of the Sierra Nevada was published in mid-March as Lepidoptera of North America 16 in the Contributions of the C.P. Gillette Museum of Arthropod Diversity at Colorado State University, Fort Collins.

The work by Ken Davenport is based on 50+ years of experience with the Sierra Nevadan butterfly fauna, particularly that of the southern Sierra Nevada in Kern and Tulare counties. It is available at the following link: **https://hdl.handle.net/10217/203548.**

This publication covers the butterfly fauna of the Sierra Nevada in eastern California and a small area of the Carson Spur in western Nevada. The Sierra Nevada occupies 28,000 square miles and runs 400 miles from the Feather River drainage in the north south to the Piute and Greenhorn mountains.

All 192 species, 104 subspecies and 15 segregates known to have occurred within the range at least twice are treated. An additional 5 butterfly species that have been recorded at least once in the Sierra Nevada are mentioned but not discussed in detail.

This publication covers distributions of these butterflies within the Sierra Nevada and three National Parks, their habitats, flight periods and taxonomic issues based on current knowledge. This is the first-ever comprehensive treatment of the Sierra Nevada butterfly fauna! Ken›s updated discussion of the taxonomy of the southern California butterfly fauna was published in 2018 in the same series and is also available as a downloadable pdf.

This publication and others in this series are open access and may be accessed and downloaded at no cost at **https://hdl.handle.net/10217/195576.**

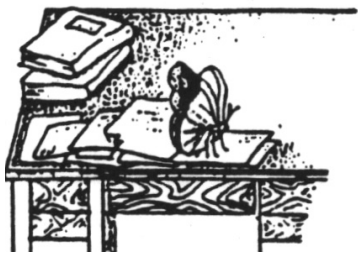
Hard copies are not available from the author or the university, but may be printed from downloadable pdfs from the web site. 622

Southern Lepidopterists' Society Special Issue

The *Southern Lepidopterists' Society* has recently published a separate Supplement to its Volume 42, summer issue of *News* titled "Louisiana's Avery Island and its Enigmatic Butterflies," authored by Gary Noel Ross. The special issue contains 95 pages including 201 photographs. (NOTE: Avery Island is an ancient coastal salt dome that is renowned worldwide as home to Tabasco Brand pepper sauce, Jungle Gardens, and Bird City -- the latter being the nation's first successful attempt at conserving large wading birds such as egrets and herons.) Copies of this illustrated and easy-to-read work can be secured for the price of $27.00/copy (including shipping). Make check payable to Gary Noel Ross and mail to 6095 Stratford Ave., Baton Rouge, LA. 70808. Electronic correspondence can be addressed to: **GNRoss40@yahoo.com**. 623

Research

I am very interested in North American Cossidae, especially from the southwestern region: California, Utah, Texas, Arizona, etc. I am especially interested in: *Fania, Toronia, Hamilcara*, and *Pomeria* (=*Inguromorpha*). Any specimens you can send are very important to me for DNA investigations. I offer in exchange butterflies and moths from Russia, Kazakhstan, Tajikistan, and Mongolia. You can contact me directly at yakovlevcossidae@gmail.com or through Eric H. Metzler, erichmetzler@tds.net Thank you. Dr. Roman V. Yakovlev, docent of Ecology Department, Altai State University, Lenina 61, Barnaul, RUS-656049, Russia. 623



From the Editor's Desk

James K. Adams

This has been a very different type of year for all of us. I missed having the Lep Soc meetings, and therefore missed the opportunity to see many of you. I also missed having a chance to travel on a longer trip, which I do almost every summer, seeking butterflies and moths in other parts of the country. I assume that many of you have missed out in similar ways.

On the flip side, I ended up doing a LOT more mothing near home, and it has been a remarkable summer in NW Georgia for Underwing Moths (*Catocala*), especially on Taylor's Ridge, northwest of my home in Calhoun, GA. I have light-trapped 31 species of *Catocala* from the ridge (with more fall species to come). The absolute best species have included *miranda* (4), *judith* (lots), *serena* (second time ever in Georgia for me), *insolabilis* (lots, uncommon in NW GA), *cerogama* (many, only the second time for me in NW GA), *retecta* (uncommon in NW GA), *ulalume* (so many I quit spreading them), one *sappho*, and my first Georgia *habilis* ever. I more than doubled my collection's representation for *serena, judith, miranda* and *insolabilis*. One spectacular night (July 11-12) I had over 400 *Catocala* in five traps (with *epione* representing about half). There was even one rag *epione* still flying last weekend (the species has been out for over two months). I hope some of you have taken advantage of the situation in a similar fashion.

Conservation Matters: Contributions from the Conservation Committee

Big lessons and questions from a little butterfly: the Northern Metalmark

David L. Wagner[1] and Weston Henry[2]

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Northern metalmark butterfly (*Calephelis borealis*). Photos courtesy Michael C. Thomas.

The northern metalmark (*Calephelis borealis*) is a winsome insect, especially when the details of its markings are viewed with binoculars or otherwise enlarged. The silver filigree on the wing undersides is especially handsome, and the raison d'être for the English common name given to metalmarks (Riodinidae) worldwide. The northern metalmark is local and seldom encountered across its global range, which extends from Connecticut southwestward into northwestern Arkansas and northeastern Oklahoma, and down the Appalachians to southern Virginia (NatureServe 2020). Its current global NatureServe rank of G3 indicates that it is regarded as globally vulnerable; if its present range-wide population trends continue, its status will soon be bumped to G2 (globally imperiled). It is listed as S1 (critically imperiled) in six of the twelve states in which it is ranked (Fig. 2). In two states where it is listed as an S2 (imperiled: Kentucky) or S3 (vulnerable: New Jersey), the butterfly should be re-ranked as S1; New Jersey is presently doing this. The only populations regarded as secure are found in southwestern Ohio and shale regions of western Virginia. In Connecticut, where we have been working with the species for 15 years, the northern metalmark is listed as a State Endangered species with only three remaining populations, two of which are exceedingly small—that yield just a few dozen adults in a given year.

The butterfly's vulnerability is rooted in its specialized ecology: it is a hostplant specialist whose larvae feed on a single species of ragwort: roundleaf groundsel (*Packera obovata*), a low-growing composite of shale, limestone, and otherwise rocky soils. It appears to be a poor competitor, soon shaded out by overtopping vegetation, often doing best in situations disfavored by other plants, such as in the needle-strewn shade beneath eastern redcedars (*Juniperus virginiana*) (Henry et al. submitted). Further information on the insect's relationship with the host plant, as well as its global range, biology, and conservation status, is given in Schweitzer et al. (2011).

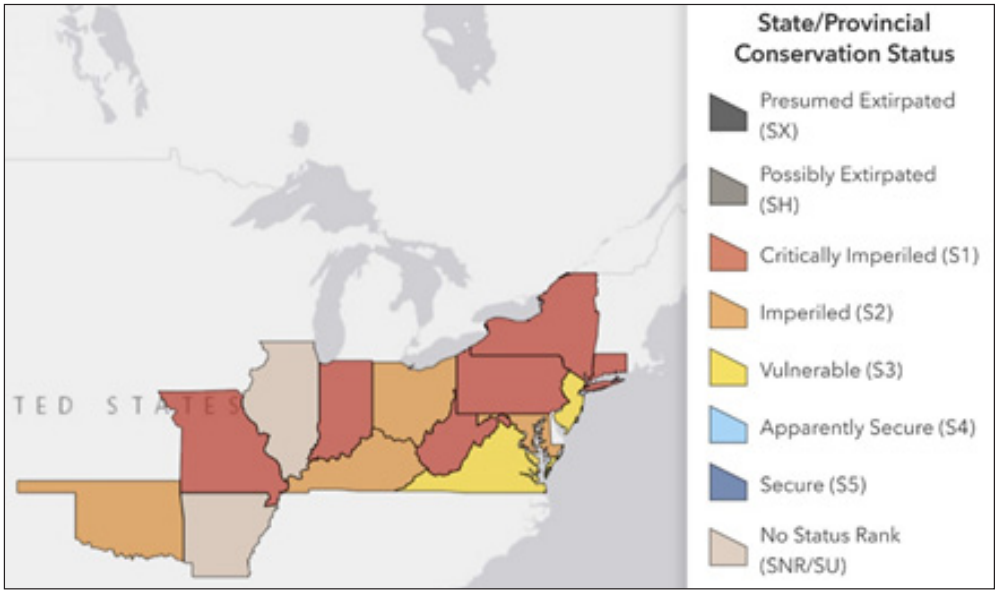

Fig. 2. NatureServe (2020) status map for *Calephelis borealis* (https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.107560/Calephelis_borealis.

An Ecotonal Species. The northern metalmark is a difficult conservation target because it doesn't have a single critical habitat, but rather two. Its larval foodplant is shade tolerant; or at least that's where one can find large patches of roundleaf groundsel, especially under the allopathic redcedar. Adults by contrast, are highly dependent on nectar resources, and spend most of day nectaring on or perched on flowers: especially black-eyed Susan, New Jersey tea, butterfly milkweed, and woodland sunflower, none of which tolerate full shade. We have visited a dozen metalmark colonies in the Northeastern USA: all are in open woodlands, forest glades, or anthropogenic equivalents such as utility corridors cut through cedar stands—habitats that provide enough shade for the larval hostplant to thrive, but that are open and sunny enough to support summer nectar sources. Closed-canopy woodlands where roundleaf groundsel occurs and open meadows with extensive nectar resources are shunned by the butterfly, unless both occur in close proximity. In Connecticut, remaining colonies require management: either forest thinning or the creation of glades, as well as routine invasive plant control measures. To what extent limestone outcrops with thin soils might have served as the historical habitat for the species in Connecticut will remain a mystery, as the candidate locales are now active limestone quarries (but see discussion of genetic data below).

Restoration Efforts. When DLW first moved to the state in the late 1980s there were five colonies, two of which (Bethel and Kent) had a metapopulation structure, i.e., they included subpopulations—both of these are still extant. Since then, Connecticut's largest colony in Canaan has been all but lost to quarrying; two small colonies blinked out; and, three of the seven subpopulations at Kent, all on national park lands, succumbed to forest succession and invasive plant encroachment.

David Norris initiated restoration in 1989, spending many hours each summer girdling canopy trees, pulling invasive plants, and augmenting in-colony nectar sources. In 2006, we inherited stewardship for the butterfly from Dave. His blueprint for management was simple: shoot for 40% open canopy and make sure there are in-colony nectar resources at the time the adults are flying. Of course, this was more easily said than done, as none of the extant colonies were on public land, and killing trees is not a popular request to make to landowners. The butterfly also had another unexpected competitor: white-tailed deer were quite fond of New Jersey tea and woodland sunflower. Despite these challenges, we persevered and Norris's formula proved golden—it allowed us to bring the colony back at Kent from the brink of extirpation to a thriving colony with a 2019 population estimate--based on our mark-recapture data--in the hundreds. While it took us longer than it should have to learn, one of the most important lessons that we have come to understand is that the availability of in-habitat, summer nectar is more limiting than presence of the larval foodplant, which occurs in abundance at many sites where the butterfly is absent.

While the northern metalmark was the focus of our management strategy at Kent for the first decade of our efforts, other taxa were protected. Stated differently, the geology, edaphic conditions, and ecological history of a site that has proven to be critical for the survival of one rare species is likely to have conditions favorable to other plants and animals. At Kent, six state-listed plants benefited from our effort to keep the canopy open and hold invasives at bay: New England blazing star (*Liatris novae-angliae*), Seneca snakeroot (*Polygala senega*), stiff goldenrod (*Oligoneuron rigidum*), Virginia snakeroot (*Aristolochia serpentaria*), wallrue (*Asplenium ruta-muraria*), and the only known population of wild Job's tears (*Onosmodium virginianum*) remaining in New England.

Metapopulation Structure. The importance of metapopulation dynamics for butterfly conservation have been best documented in a European butterfly, the Glanville fritillary (*Melitaea cinxia*). Over four decades of study, Ilkka Hanski and his students have shown that the fritillary's long-term persistence is dependent on local networks of interconnected, but discrete, subpopulations. In metapopulations, a given population is broken up into subpopulations that are more or less isolated by unsuitable habitat: the subpopulations are close enough to be connected by dispersal (gene flow) but isolated enough to experience different biotic and abiotic pressures within and across seasons. This means different subpopulations enjoy (or suffer) different fates, forming a system of sources and sinks: dispersing individuals from the former rescue the latter. Across years, different subpopulations are the winners (sources), such that no single subpopulation can ensure long-term survival of the entire metapopulation. The essence of metapopulation structuring has since been reported from an array of other animal systems and is especially common among insects.

We imagined that metapopulation dynamics were most easily explained by the presence and absence of natural enemies. Whenever a satellite or subpopulation crashed, so would its local set of parasitic flies, wasps, and other would-be enemies. A gravid female fritillary that subsequently returned to the site would be expected to enjoy enhanced reproductive success due to the temporarily diminished natural enemy complex there.

Metapopulation structure can be advantageous for other reasons. In 2017, we girdled and felled trees that were shading out critical habitat of the butterfly at one of its four subpopulations in Kent—this, on a south-facing slope. The following summer, proved to be dry, hot, and droughty. Our opening of the canopy seemed ill timed: the site baked. After many successive years of increasing population numbers at this focal site, adult numbers crashed in 2018. The three other subpopulations at Kent remained stable. However, a reversal of fortune would soon follow—2019 was a year of good rainfall. The site, now two years removed from the tree thinning, saw the larval foodplant flourish and the canopy openings boom with nectar plants. Metalmark numbers

tripled in a single year and reached their high for the 14 years that we had count data for the butterfly (Henry et al. submitted). As surprisingly, the other three subcolonies at Kent had diminished numbers, in part due to canopy closure. Another lesson learned: abiotic factors can drive metapopulation dynamics. At Kent and almost certainly elsewhere, differences in rainfall across years, greatly affect which subpopulations will wax and which will wane.

Genetic Puzzle. Given that the northern metalmark's range appears to be disjunct with the Arkansas, Oklahoma, and Missouri (Ozark) colonies being well separated from those in Kentucky, Indiana, and other eastern states (Fig. 3, BAMONA 2020, **https://www.butterfliesandmoths.org/species/Calephelis-borealis**), we decided to sequence the 658 base-pair region of the mitochondrial gene (CO1) from fifteen butterflies from across the insect's range to test for genetic differences across the butterfly's range. Our results surprised us: all fifteen butterflies had identical barcodes (no detectable genetic diversity), which suggested that the current range of the butterfly was recently derived (Henry et al. submitted). We can only speculate as to why this might be so and are still casting around for explanations. One possibility is that the species expanded its range (or at least enjoyed more gene flow across its range) as a consequence of fires set by indigenous Americans to improve hunting, and later, as a consequence of forest conversion into agriculture by colonists. Perhaps the metalmark was able to disperse through much of eastern North America during the region's agricultural peak from 1800 to 1940 or so? Redcedar is one of the most successful and widespread colonizers of abandoned farmlands and pastures. The edges of cedar groves and glades therein would have provided suitable habitat for this butterfly across the eastern United States.

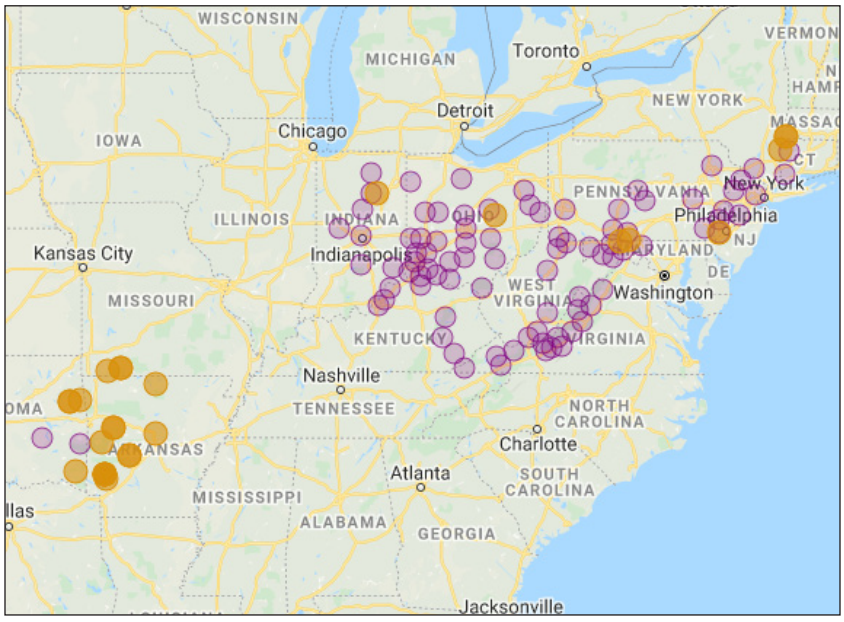

Fig. 3 Butterflies of North America range map (https://www.butterfliesandmoths.org/): orange circles denote detailed record; purple records denote historical records.

However, with the post-World War II industrialization and modernization of agriculture, and the wider range of occupational possibilities in industrial societies, farming has been on the decline across the butterfly's range. The agricultural landscapes of the last two centuries that seemingly would have been favorable to the species, have and are still being lost to afforestation and development.

Conservation Dollars and the Agony of Choice. Given limited dollars for conservation practitioners, funders and policymakers are faced with the decision of how conservation dollars are best spent. In the early 2000s, the Uncompahgre fritillary (*Boloria acrocnema*), a denizen of two mountain tops in southwestern Colorado, was at the center of a debate focused on what dollars should be spent on species and ecosystems whose existence was (and is) dependent on a paleoclimate that no longer exists. As a glacial relict, what is our responsibility to this species? Likewise, what is our responsibility to other relict biotas, such as those of southerly black spruce bogs or the spruce-fir associations of southeast Arizona's sky islands? An analogous quandary might be how much effort and money should be spent on taxa that are dependent on human landscapes that are now historical. What are we to do for the taxa that thrived in the early successional habitats created by indigenous Americans and European colonists when they burned or logged forests and replaced these with forest openings, croplands, and pastures? Many butterflies were favored by the sunny, agricultural landscapes that were, for more than two centuries, part of the ecosystem matrix of eastern North America. Pastures, untilled wet meadows, and anthropogenic grasslands favored greater and lesser fritillaries, checkerspots (including the Baltimore), the common wood nymph, coppers, many grass skippers, and others. Presumably, abandoned farmlands, in intermediate stages of succession, provide habitat for the northern metalmark, pearly-eyes, and some woodland skippers that disappear from mature, closed-canopy forests. Western Europe has had to face this matter, as most of their present-day communities and ecosystems have been shaped by two thousand years of human occupation. We have no answer to this conundrum. Given limited dollars for conservation, we must think critically about how dollars and efforts are best spent, especially now that we have landed ourselves in a biodiversity crisis, and sit in the chute of the Anthropocene, which promises to be Mother Earth's sixth greatest period of biotic extinction, and her most lamentable one as this one is self-induced and preventable.

What to do? Our genetic findings for the northern metalmark instill doubt about our future conservation efforts. Does the lack of genetic diversity indicate that the species is a recent colonist, at the periphery of its global range, and as such, might our efforts be better

focused elsewhere? Conversely, does its lack of genetic diversity, suggest that it, like the cheetah, make it more imperiled because it is largely devoid of the underlying genetic variation that organisms require to respond to changing environments and other selective pressures? Given the certainty of warming planetary climates, are the populations at the northern edge of the species's range, i.e., those in Connecticut for the northern metalmark, the most likely to persist as global temperatures rise, and serve as the stepping stones for colonizing new regions to the north? Without active management, Connecticut's colonies will soon be lost, and with them, the rare plants that have benefited from many years of site management—for the near term, the plan will be to continue efforts to keep the canopy open and control the invasive plants.

While important questions remain about what our long-term steps are to be with the northern metalmark, there is little doubt that the most important matters for those that value planetary biodiversity are to slow and mitigate climate change and the loss of tropical forests. These are the most urgent threats to butterflies and other wildlife. We must dial back our use of fossils fuels, while simultaneously ramping up green energy technology and solutions, and do more to protect tropical forests.

With regard to conservation spending, an emerging message from climate scientists and conservation biologists, is that more dollars need to be placed on the acquisition and preservation of lands with topographic (altitudinal) complexity, especially in tropical arenas, that will allow species to shift their ranges to accommodate the earth's rapidly changing climate. Likewise, in aridlands, communities with hydrological resources will become increasingly important for the survival of plants and animals, challenged by an increasingly droughty future.

As a Society with members with a penchant for Lepidoptera, most of us enjoy acting locally to study and protect biodiversity: i.e., making yard, trip, and state lists; engaging in local butterfly counts; collecting specimens or photographic images; contributing to iNaturalist projects; volunteering for nearby conservation efforts; tending to our butterfly (and moth) gardens; or for the moth-ers, running a light near the house. But if ever there were a time to act globally it is now, as we begin our plunge into the Anthropocene. Mother Earth's troves abound in tropical forests—there you will find more than 80% of her butterfly and moth treasures.

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Sandra Schachat wins ESA Student Activity Award

Sandra Schachat, Stanford Univ. was just awarded the prestigious ESA Student Activity Award. Her publication record is outstanding (see below). The award is $5000.00 and a certificate. Sponsored by Bayer, this award is presented annually to recognize a student for outstanding contributions to the Society, his/her academic department, and the community, while maintaining academic excellence.

Sandra Schachat serves on ESA's Student Affairs Committee (SAC), SysEB Leadership Council, and Diversity & Inclusion (D&I) Committee. As a member of the SAC, she has cohosted two "Know Before You Go" webinars and has written three posts for ESA's "Entomology Today" blog, and she will host an upcoming webinar this fall. She is a founding member of the D&I Committee's Best Practices Subcommittee. She has published in three ESA journals and has reviewed manuscripts for two more. Her articles about art history in American Entomologist have explored changing public attitudes toward insects and entomology. She has been among the first students to publish in ESA's newest journal, Insect Systematics and Diversity.

She is one of two students at her university who serve in a volunteer leadership role in Graduate Pathways to STEM, an annual conference for undergraduates from under-represented backgrounds. She represents the School of Earth in her university's Graduate Student Council, where she also serves as one of two co-chairs of the Diversity & Advocacy Committee.

She has published 19 first- and sole-authored scientific papers in refereed journals. Her M.S. thesis won the Snodgrass Award from SysEB. Her published papers range from the feeding habits of ancestral hemipteroids, to the comparative morphology of moth wings, to the amount of oxygen in the atmosphere 350 million years ago and whether this impacted insect evolution, to novel statistical techniques for quantifying insect herbivory, to parasitoids' impact on overall insect diversity.

Sandra won two Clench awards for student presentations at Lep Soc meetings, 1st place in 2013, and 2nd in 2014.

The mirror cloth silk moth

Tor Hansen

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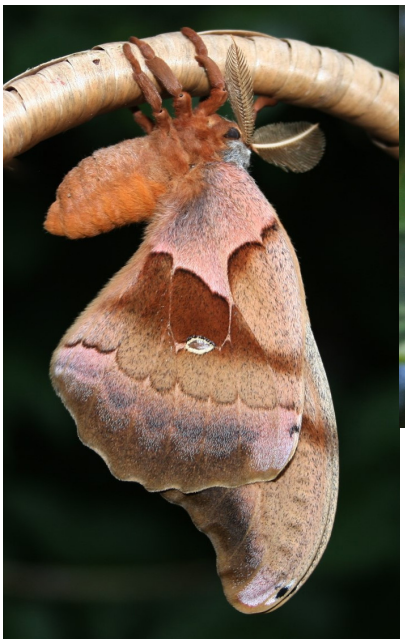


A freshly emerged male Polyphemus moth, similar to the one I first encountered while playing ball in my childhood in Englewood, New Jersey; a final instar Polyphemus larva, which I thrilled finding as a child on maples and various other trees in my neighborhood.

My first encounter with a living Polyphemus moth came about after school (I was then in fourth grade) when playing sand lot baseball with the neighborhood boys on South Dwight Place in Englewood New Jersey. Butch Cook delivered a blazing pitch to Doug Peters, and a foul ball cleared a chain link fence over first base. Playing first base, I ran through the gate to retrieve the foul and found next to the hard ball, one freshly emerged male polyphemus moth with wings closed clinging to a day flower. What a moment for opulent elation. Back in the game I resolved to widen my search for poly cocoons, and found quite a few from extended walks over the years along the railroad tracks that stretched south from Englewood to Ridgefield.

Walking to and from Roosevelt School, at age 7, in early autumn, I found many more poly cocoons on Audubon Road between parked cars, some squashed thin as a cracker. I loved to search the base of the silver maple trees that grew along the streets, and within a radius of one foot, I detected several silvery cocoons wrapped in cut grass from adjacent lawns. Other larval host plants included norway maple, horse chestnut, privet hedges,viburnum, and even sharp thorny barberry hedges! Another day I found a stunning emerald green poly larva climbing down the same maple trunk and upon capture I fed it maple leaves. It never spun a cocoon, being killed by some parasitic insect within. That fired up more interest to study metamorphosis in depth, and still remains a keystone in my gateway photography of silk moths.

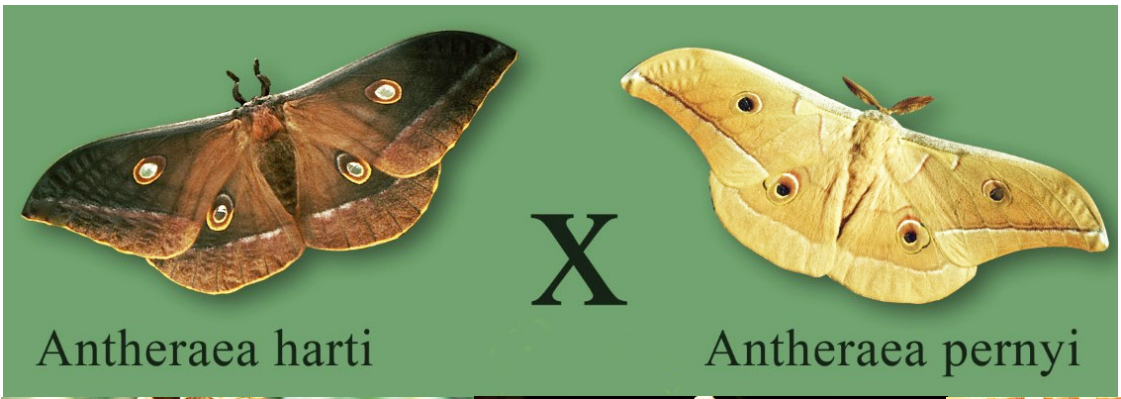
Searching "The Market Place" in "The Lepidopterists' Society Newsletter", the pages for purchase or exchange of "livestock" as we call it, I found an offer to buy eggs from a Chinese dealer, P.T. Chang. He listed eggs of *Antheraea pernyi*, another flamboyant moth known also as the Evergreen Oak Silk Moth. These giants are not commercial silk producers like *Bombyx mori*, but rather experimental producers of a coarse silk, known as tussah or tussore silk, grown today in Southeast Asia, India, Pakistan and China. The larvae are farmed out on oak tree orchards, and tending guards will fire shot guns to force birds to flee before devouring the tasty larvae! The large stunning emerald green larvae are known to be easy to propagate on oak leaves (4 oak species red, black, white, and scrub on Cape Cod). It belongs to the same genus as our own North American *A. polyphemus*. Within this widespread Asian genus there are species with striking similarities in wing shape & color, yet obvious differences between moths separated by wide geographical distances, including *A. paphia, mylitta, roylei*, and the Japanese *yamamai*. Artificial breeding has confused the pedigree of some species, muddling the genetics of some of the well known subspecies.

The title "Mirror Cloth Silk Moth" was chosen to draw attention to the forms, shapes, & colors, around the cloth's mirrored circles, and in the moth the hyaline clear circles (one per hindwing; see image, next page). Perhaps the cloth maker was inspired so much by the beautiful moth, that she chose the same colors echoed in the mirror cloth! This coincidence speaks to cultural anthropology as well. Comparing caterpillars and moths of both species as they as they grow, they become distinctly different, as their genes promote divergent phenotypes. It seemed like a worthy challenge to start what would result in rearing subsequent generations through their life cycles. I was soon introduced to Gareth King in England who provided eggs of another species (*A. harti*…also from southeast Asia and China) that would be of keen genetic interest when crossbred with *A. pernyi*.

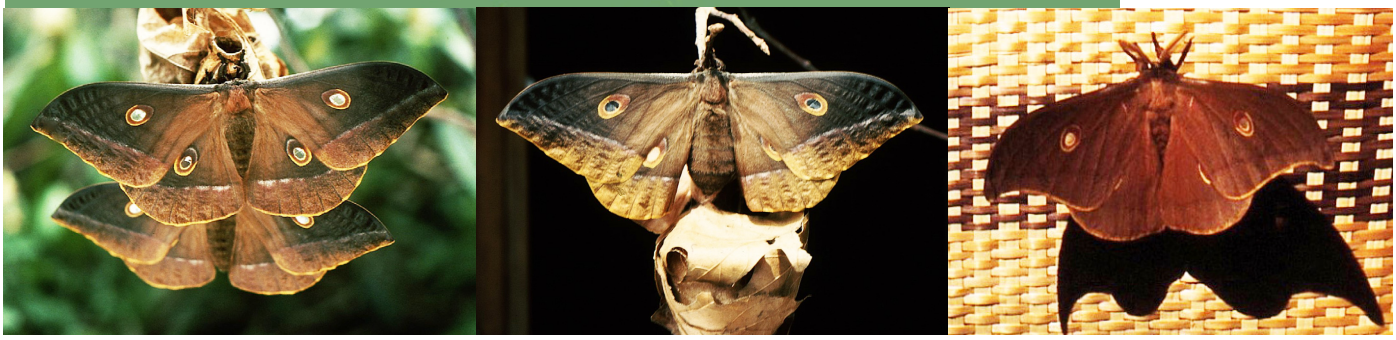
I thought about the way continents drift apart, and how the distinct species evolved separately as the continents diverged. Beginning in 1985 and over the next five years, I would study related species and compare their different phenotypes. I enjoyed comparing dominant gene

Anteraea pernyi. Upper left: mating pair (hiding). Lower left: young larvae. Upper right: mature larvae. Lower right: adult on the woven "Mirror Cloth"; some of the patterns in this cloth are reminiscent of the mirror like spots in the wings of the adult moth.

expression to recessive forms and any and all heterozygous forms to follow. As it turned out, it was like comparing the offspring of vanilla & chocolate, with several distinct intergrades. *Antheraea pernyi* in ground color of wing scales is imbued with soft tan to straw yellow wing scales (vanilla), whereas *A. harti* in ground color of wing scales is deep brown (like dark chocolate)! Imagine seeing the result of cross-breeding these two species, in several F1 and F2 generations. Behold sumptuous heterozygous "ice cream swirls" and assorted shades of brown wings edged in gold leaf, and pink post-median lines, and intricate combinations of color ex-pressed by crossing them. Yes, the outcome across the spectrum produced several intergrades or heterozygous forms, indeed indicative of remarkable wonders of gene pooling.



Examples of adults from crosses between *Antheraea pernyi* and *A. harti*.



With assistance with dramatic lighting from brother Erik, we were able to highlight the molting larva with bright strobes and a hint of backlighting. Notice the ease of exuvia extraction; the old skin rides off smoothly, usually complete (at least 95%). The white "suspenders " for lack of a better word no doubt arise to facilitate integument removal before it dries in place. These white stripes appear elastic and elevate the old skin, enabling the integument to slide off evenly spaced, so to prevent a tangled pile-up. However, in *A. pernyi* here, these stripes exude from all spiracles, unlike the lesser number of spiracles as found in molting *Hyalophora cecropia* larvae (from first true leg segments to eighth proleg segment).

If the cocoon is spun too tightly, the surging moth cannot escape the confines, and will die in silk prison. I observed this in a cross between *H. cecropia* & European *Saturnia pyri*. When witnessing the moths emerging from cocoons, listen for stirrings and scraping noises coming from silvery or golden wiggling ovals wrapped in oak leaves (figs. 22 - 33). Gray and tan moths push out with surprising strength and soon golden antennae and shriveled wings appear. Their body "fur" and wing scales suggest a forthcoming sylvan king of the realm already dressed for a coronation. Watch how the gangly heavy body reveals hairless green intersegmental grooves that with successive body contractions congeal into a trim compact moth suggesting

Molting *A. pernyi* larvae. The image in the middle right shows two freshly molted larvae (note the light colored head capsules).

Antheraea pernyi. Upper left: prepupal larva spinning a cocoon. Upper right: new pupa inside cocoon. Set of three on left: moth emerging from pupa. Above center and right: adult moth expanding wings.

a flower, fruit, or a meditative prayer medallion. Finding a suitable 4-6 foot hold, the heart inside pumps hemolymph into the wings and over 60 minutes the wing membranes become fully stretched and sturdy enough to promote a maiden flight. They can resemble surrounding dead oak leaves. That first night mates find each other by pheromone attraction and detection. With sharp scissors or a razor blade, one can cut open a cocoon and see the moth eclosing from its confining sepulcher. Follow an astounding event by cutting open the new cocoon before pupation happens, to find the molting instar 5 larvae changing and congealing into its raw pupa with adult preformed appendages still unsealed (see previous page).

While observing the freshly cut oak leaves stemmed in water bottles (red, white, black, & scrub oaks), I noticed inside one cocoon under construction two caterpillars spinning up together, next to each other. So I decided to keep an eye on this atypical behavior that I call cluster cocooning (first couple of figures, previous page). And would this double occupancy happen to be a male and a female, somehow "knowing" in the larval stages, so designed to facilitate quick mating? As it turns out male and female cats look alike and both moths were male.

What caused me to stop future cross breeding was to raise enough money to go to Costa Rica and work to learn and soon teach Rain Forest Ecology under the mantra "Ayuda el Bosque". This familiar call is echoed by the author of "The Natural History of Costa Rica", Dan Janzen PhD., for the mission through reforestation and connecting floral corridors to extend the message "Help Save the Rainforest". So I sold my caterpillar livestock, all 100 cats at $1.00/each to Ron Boender at Butterfly World in Coconut Creek Florida. When I passed through "Butterfly World", to fly out of Miami to Costa Rica, the moths so chocolate and vanilla were emerging from cocoons spun in North Truro Cape Cod, and readily on display for our public to gain the awareness that only living moths and butterflies can give.

If you wish to document life histories like this, you may want a heavier camera (such as a Minolta X-9 film camera) to reduce hand shake, and certainly a supporting tripod.

Membership Updates

Chris Grinter

Includes ALL CHANGES received by August 17, 2020. 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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Phenotypic variability in the Tropical Tasar Silkworm, *Antheraea mylitta*

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Antheraea mylitta D. (Lepidoptera: Saturniidae) is a polyphagous sericigenous insect endemic to India. A total of 44 locally adopted eco-races of *A. mylitta*, distributed in the tropical region in India (12-31°N LAT and 72-96°E LONG) have been reported from India (Jolly et al. 1974). Among the eco-races, only DABA Bivoltine (BV) and DABA Trivoltine (TV) are being reared extensively on *Terminalia tomentosa* and *T. arjuna* for the production of commercial silk cocoons by the tribal, women groups and rural populace in central India as a livelihood (Rathore et al. 2018). Diverse income sources through the production of cocoons, disease free laying (dfl), silk reeling, weaving, designing, marketing, etc. entice rural youth towards tasar sericulture (Dewangan 2018).

The DABA BV and TV are mainly of green larval types. The parental stock of DABA BV and TV, which are currently exploited in India for commercial rearing, have been derived way back in the 1960s from wild populations through selection and multiplication processes. Since *A. mylitta* is polyphagous, a striking color variation is evident in the larval stages, which may relate to mimicry or crypsis against predators (Endler 1978). The larval color polymorphism in *A. mylitta* is governed by dominant and recessive genes (*YYbb*-yellow, *yyBB*-blue, *YYBB*-green and *yybb*-almond) and follow the mendelian theory of inheritance (Jolly et al. 1969). Due to the exercise rearing larvae under outdoor conditions, the fitness may vary relatively in comparison to natural selection. Strict selection imposed for economic characters at larval, cocoon and moth stages during rearing and egg production might have led to changing allelic frequencies, which needs to be studied. Human alteration of traits through directional selection may have altered the species fitness and reduced the domesticated strains ability to survive in the wild.

Field surveys were conducted to record phenotypic (color) variation at larval stage both in domesticated (BDR-10 and DABA BV races) and wild *A. mylitta* during 2019. Selected silkworm rearing fields were visited during August and November 2019 in and around Bilaspur (Chhattisgarh), which is situated at 22.0796 °N, 82.1391 °E (264 m AMSL). The climate is sub-tropical, semi-arid and monsoon dependent. Nearly 100 to 150 fifth instar larvae of silkworms cultured on *T. arjuna* in the forest patch were selected for each observation and five such observations were conducted in each field. Silkworm rearing was carried out following the "normal" practiced procedure for tropical tasar silkworm. Observations like number of larvae with a different color in the total population and their

Fig. 1: Different larval color types of *A. mylitta* (A,B&C - BDR-10 race, D,E&F - Wild *A. mylitta* & G,H,I&J – DABA BV).

phenotypes were recorded. The data sets were pooled for each treatment and converted into percentage. The data in percentage were subjected to arc-sine transformation and analyzed by Anova: Single Factor. Observations were also made during moth emergence in the months of June-July and October, 2019 to analyze color pattern in male and female moths from different BV cocoon stock obtained from different rearing locations near Bilaspur, Chhattisgarh.

Since BDR-10 (Fig. 1 A,B&C) stock involves the selection of yellow larval type of DABA-BV, their offspring are usually yellow in the larval stage. In the present study, we report significant variation in phenotype such as dark yellow (15 %) (Fig. 1A), greenish-yellow (80%) (Fig. 1B), green (4%) and intermediate types (off-type) (1%) ($F=232.87$, $df=3,19$, $P<0.01$). Intermediate types (Fig. 1C) were recorded in the field, where leaves of host plants were dusted with mud particles due to road construction in the nearby rearing field. A total of seven sets of wild *A. mylitta* larvae distributed contiguously in 17.1 ha of *T. arjuna* were analyzed at an isolated plantation at Kargi Kota, Bilaspur (22.1022° N, 82.14685° E 330 m AMSL) (Fig. 1 D,E&F). The average larval numbers in each group were 6.14±2.03 (Mean±SD) and larval color varied from dark to pale green (Fig. 1 D,E&F) ($P>0.05$). In the DABA-BV race (Fig 1G, H, I, J & K), major color types -- green (99 %), yellow (0.9 %), blue (0.05 %) and almond (0.05%), and intermediate types -- almond-green (0.01 %) and yellow-green (0.01 %) have been recorded ($F=2054.9$; $df=5,35$; $P<0.01$).

Different color morphs have also been recorded during the adult stage both in male and female *A. mylitta* (Fig. 2). Numbers of each color pattern was varied significantly ($P<0.05$) across the cocoon stocks. Phenotypically male and female moths are brown and yellow in appearence, respectively. Female color morphs (Fig. 2: 1-8) recorded in this study include apricot with a light yellow tinge subapically and cream marginally (1), atomic tangerine (2), citron with postmedian gold metallic shading (3), dark gray wings with a basal and postbasal abalone patch and harbor gray marginally (4), yellow with postmedian brown shading (5), yellow (6), gray with a subapical dark patch (7), and dark gray color markings on both the forewing and hindwing (8). Similar variations have also been recorded in the male moths, which includes crimson red with a bit of dark carmine postmedian coloration (9), dark brown with subapical yellow patches and cream marginally (10), golden brown with a subapical yellow tinge and dark postmedian shading (11), khaki color (12), syrup brown color with khaki color marginally (13), gray color with basal brown patches and postmedian brown shading, a subapical yellow tinge, and additional dark lining along major wing veins (14), brownish yellow (15) and flaxen color with yellow and dark tinges (16).

In this communication, we are reporting variable larval color types and color morhs in the adult stage of *A. mylitta* for the first time in India. The polymorphism in the larval stage is well known in *A. mylitta* (Jolly et al. 1969). Relative allele frequencies do not seem to change over successive generation precisely following Hardy-Weinberg expectations. But deviation in phenotypic ratio under natural conditions might be related to segregation, predation pressure, host-associated mimicry and environment (Mallet and Joron 1999). Further, coloration is also linked to body temperature regulation and intraspecific communication (Brakefield 1985). The significance of the yellow color in relation to disease resistance and thermo-tolerance properties under different climatic conditions needs to be studied for confirmation. Variability in the adult stage may be

Fig. 2 Different color pattern recorded in the DABA-BV female (1-8) and male (9-16) *A. mylitta*.

related to defensive mechanisms against unstable environments, predators, and the like. Discrete phenotypes arising from a single genotype due to environmental factors is refered as polyphenism (Woodward and Murray 1993). Since *A. mylitta* is distributed in the tropical part of India, it experiences extreme high temperature, cool winters, predation pressure, etc. In addition to these, food quality and management practices determines stability and persistence of stock. Stability of parental stock is a prerequisite in tropical tasar silkworm egg production, and yet the species is exposed to outdoor rearing conditions that are potentially changing. As such, greater phenotypic variability may also be related to population fitness (Forsman et al. 2015). So the variability seen may help in overcoming various abiotic pressures during adult stages. But, ecological relevance of color types, effects of predation pressure and climate change on fitness are all researchable issues for the conservation and economic welfare of the rural populace involved in the tropical tasar sericulture.

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Are squirrels involved in moth evolution?

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What's the connection between these two photos? This squirrel is a part of the squirrel squad that lives in (or rather above) my yard on live oak trees and comes down to raid bird feeders. The Imperial moth forewing is all that was left after a squirrel was observed eating a live specimen in my yard at 7 am on 12th of August 2020. I am now looking for additional records of such behavior and so far have found one cellphone video online involving another live Imperial moth being eaten by a squirrel in natural settings.

Camouflage in moths is mostly attributed to bird predation. For example, Kettlewell popularized it by conducting studies involving chickens and Peppered moths in Britain. And while most naturalists know that moths are food for a variety of vertebrates, including bats, lizards, frogs, grizzly bears, and even an opportunistic cat or dog around the black light, none of these, with the exception of birds, can be seriously considered as agents of selective pressure that would affect the evolution of moth wing pattern.

The situation is different with squirrels, however. Curious, fast-learning, crepuscular/diurnal and equipped with excellent vision, they are perfect predators for large resting saturniids and sphingids. They also share the habitat with the latter when climbing up and down tree trunks. The Eastern grey squirrel is described as omnivorous, and while mostly vegetarian, it does not shy away from an occasional insect, lizard, or nestling bird. According to Callahan (1993) squirrels are known to stalk and take down larger prey occasionally. How prevalent are large moths in their diet? If hunting for moths is a commonplace but largely unnoticed occurrence, this may be a driving force for evolving those eyespots on, say, the Io or the Polyphemus moth's hindwings, or the camouflage of their forewings.

If you have any observations of squirrels eating moths and of birds predating on saturniids or sphingids, please send them to **Sourakov@ufl.edu**.

Callahan, J.R., 1993. Squirrels as predators. *The Great Basin Naturalist*, pp.137-144.

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** ($30.00 outside North America)	15.00

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
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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:

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Journal of The Lepidopterists' Society

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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):

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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 upcoming volumes must reach the Editor by the dates below:

Issue		Date Due
62	4 Winter	November 15, 2020
63	1 Spring	February 12, 2021
	2 Summer	May 12, 2021
	3 Fall	August 15, 2021

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

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

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Top row: *Parantica sita*, near Ya'an, Sichuan Province, May 22. Second row: *Papilio* (*Chilasa*) *agestor*, The Tawny Mime Gravel Pit near Weixi, Diqing Prefecture, Yunnan province, June 4; Popinjay, *Stibochiona nicea*, near Ya'an, Sichuan Province, May 22. Third row: Mandarin Swallowtail, *Graphium mandarinus*, June 5; *Apatura laverna*, June 4; *Caliagra polyphemus*, June 5; data for all three same as *P. agestor*. Fourth row: *Polyura eudamippus*, June 4, data as for *P. agestor*; Riley's Constable, *Dichorragia nesseus rileyi*, Sichuan Province. All photos by Bill Berthet, taken in China; see related article page 123.