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Front Cover:

Eupackardia calleta larva, Santa Cruz. Co., AZ. In the late 1950s Robert Weast was the first to propose that this species was aposematic and chemically protected. At the time few others had reared *calleta*. See related article by Collins, page 92.

Conservation Matters: Contributions from the Conservation Committee

Eight practical actions to save insects from global declines

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Insects comprise the vast majority of known animal species and are ubiquitous across terrestrial ecosystems, playing key ecological roles. As prey, they are critical to the survival of countless other species, including the majority of bats, birds, and freshwater fishes (1). As herbivores, parasites, and predators, they are major determinants of the distribution and abundance of innumerable plants as well as animals, including many that are pest species. A majority of flowering plants, the dominant component of most terrestrial ecosystems, depend on insects for pollination and hence reproduction. As consumers of waste products, insects are essential to the recycling of nutrients. Humans and their agriculture rely heavily on such "ecosystem services" provided by insects, which together have at least an annual value of ~$70 billion (2020 valuation) in the U.S. (2). Insects also provide us with honey, silk, wax, dyes, and in many cultures, food. Insects have become essential subjects in medical and basic biological research. And, they are one of the most easily accessible forms of wildlife, with a diversity of morphology, life history, and behavior that seems ready-made for inspiring appreciation of nature and its conservation.

This benign characterization of insects seems self-evident now, but its emergence is historically recent, especially in the U.S. In the mostly agricultural 19th century U.S., political pressure generated by increasing crop losses to insects led to creation of a government-supported corps of professional entomologists. Great advances in fundamental knowledge resulted, but entomology became closely tied to the chemical/pesticide industry, which increasingly adopted a strident insects-as-enemy dialogue, broadened to include disease vectors (3). The 1962 publication of Silent Spring (4) marked a dramatic turn toward a more balanced view, but the transition has been slow, not least because the challenges of crop pest and disease vector management remain enormous.

Ironically, even as insects gain recognition as essential members of ecosystems, a concern has arisen that their diversity and abundance may be in global decline, owing to habitat degradation and loss, climate change, pollution, and other causes (e.g., 5-8). Although the evidence is as yet fragmentary and controversial (9, 10, and articles in this issue), there is every reason to suspect that such forces, combined with human population growth and urbanization, are leading to declines among insects and many other organismal groups (e.g., 11). There is thus abundant justification for trying to slow or mitigate potential ecological catastrophes triggered by biodiversity losses. Multiple proposals exist. For example, Forister *et al.* (12) called for immediate conservation actions at the levels of nations, states, provinces, and cities; working lands; natural areas; and gardens, homes, and other personal property. Others have proposed intermediate and long-term action plans for insect conservation and recovery (e.g., 13, 14). Implementing these plans and actions, especially those that require approval of governments or nations, can take time. Fortunately, at an individual level, people can play an important role with immediate local impacts. In light of the negative trends in insect abundance and diversity that have been shown in numerous recent studies, and how essential insects are to human existence, it is vital that people learn how they can take action.

To help individuals broaden participation in the conservation of insects and to promote the adoption of behaviors and habits expected to mitigate insect declines, we propose eight simple actions, most with immediate impact, that many people can undertake on their own, regardless of background, occupation, or geographic location. The first five of these are aimed at creating more and better insect-friendly habitats, the loss of which is likely a leading cause of insect declines. The remaining three are aimed at adjusting public attitudes toward insects and increasing

appreciation of insects, and hence increasing support for conservation actions.

The Eight Action items

Create insect-friendly habitats:

1. *Convert lawns into diverse natural habitats.* Traditional European or western lawns are biodiversity deserts (15). There are over 40 million acres of lawns or turf grass in the U.S. alone (16) and these groomed/mowed monocultures support few insects or other wildlife. With increasing global fragmentation of natural habitats, insects will need quality habitat to be preserved and restored, including travel corridors and stepping stones between habitats to allow movement across the landscape (5, 7, 17). Because many insects need little space to survive, even partial conversion of lawns to minimally disturbed natural vegetation – say 10% – could significantly aid insect conservation, while simultaneously lowering the cost of lawn maintenance including watering, as well as requisite herbicide, fertilizer, and pesticide applications. If every home, school, and local park in the U.S. converted 10% of their lawn space into natural habitat, this would increase usable habitat for insects by more than 4 million acres. Converting lawns into natural habitat is relatively easy, and if preexisting turf grass is needed to be removed beforehand, this can be done with a sod cutter or through solarization before seeding. Fallen leaves, twigs, and fruit, in this space should be left in place, and vegetation should be minimally trimmed or not trimmed at all, as many insects depend on new growth and complex plant structure. A model effort is the "Thousands of Gardens – Thousands of Species" project in Germany, funded by 2.5 million euros from the German Federal Ministry for the Environment (18).

2. *Grow native plants.* Although there are exceptions, there is increasing evidence that growing native plants provides more benefits to native insects, on average, than growing non-native ornamental species. Native insects share evolutionary and ecological relationships with native plants and many different kinds of insects use these plants as a food source or nesting sites. These insects are in turn prey for birds and other wildlife, thus native plants indirectly attract many vertebrates. For example, almost all songbirds (~96%) feed insects to their young (19), and declines in suburban backyard birds have been linked to an increased number of non-native plants that do not provide food for as many insects (20). Native plants, being adapted to local climates and rainfall regimes, can also be easier to maintain. If native plants are unavailable, growing a diversity of non-natives, especially species that produce nectar, can still benefit insects. For homes that lack yards, native plants can be added to balconies, roofs, or between the curb and sidewalk in cities. There are many books on the native flora of particular regions, and additional information on native plants can be obtained from local and mail-order plant nurseries, native plant societies, conservation organizations, and university extension programs. We argue that the beauty of one's yard should not be determined by how well a lawn is maintained or how uniformly its hedges are trimmed, but instead by the diversity of its native plants.

3. *Reduce pesticide and herbicide use.* Pesticides often harm non-target, natural insect populations (reviewed in 5, 7), while reduction of their use fosters beneficial arthropods (e.g., 21). Pesticides have been found far from their application source (22), and in some regions, are more prevalent in urban streams than in those near agricultural lands (23). Much pesticide use is cosmetic, that is, aimed only at improving the appearance of non-agricultural green spaces such as lawns, gardens, or parks. Reduction or elimination of cosmetic pesticide use, already legislatively mandated in Nova Scotia and Ontario (24), could greatly benefit both terrestrial and aquatic insect communities.

Mosquito suppression is another frequent motivation for home use of pesticides. Pesticide barrier treatments (PBTs), in which pest control companies regularly apply chemicals to vegetation surrounding a home, harm beneficial insects (25), and are thought to promote the development of pesticide resistance in mosquitoes (26). Simple alternative control measures can greatly reduce the need for these chemicals, though judicious use of insecticides is sometimes essential for combating mosquitoes that vector diseases. Non-chemical measures include wearing long sleeves when mosquitoes are active, keeping window screens in good repair, and most importantly, identifying and removing standing water in containers (e.g., buckets, pots, birdbaths, gutters, and old tires), which serve as habitat for the larvae of some mosquito species. In residential areas, water-holding, human-made containers are primary larval habitats for *Aedes aegypti* and *A. albopictus* mosquitoes, two of the most important pathogen vectors and pest species globally. Although not all mosquito species use containers as larval habitats, eliminating standing water in the yard is a free, easy, and ecologically sound method for a homeowner to reduce the abundance the mosquitoes on their property.

4. *Limit use of exterior lighting.* Since the 1990s, nighttime light pollution has increased sharply, even doubling in some of the world's most biodiverse areas (27, 28). The majority of nocturnal insects are attracted to artificial lights and these lights are powerful sensory traps that can indirectly kill insects via exhaustion or result in predation before sunrise (29). In Europe, nocturnal moths are declining more quickly than moths and butterflies that fly during the day, and this trend is likely due to light pollution (30). Artificial light has also been shown to reduce reproductive success in fireflies because they use light to attract mates (31). To reduce harm to insects, people should turn off unneeded lights, dim necessary light sources, use motion-activated lighting, shield bulbs, and switch to bulbs that produce amber- or red-colored light, which produce

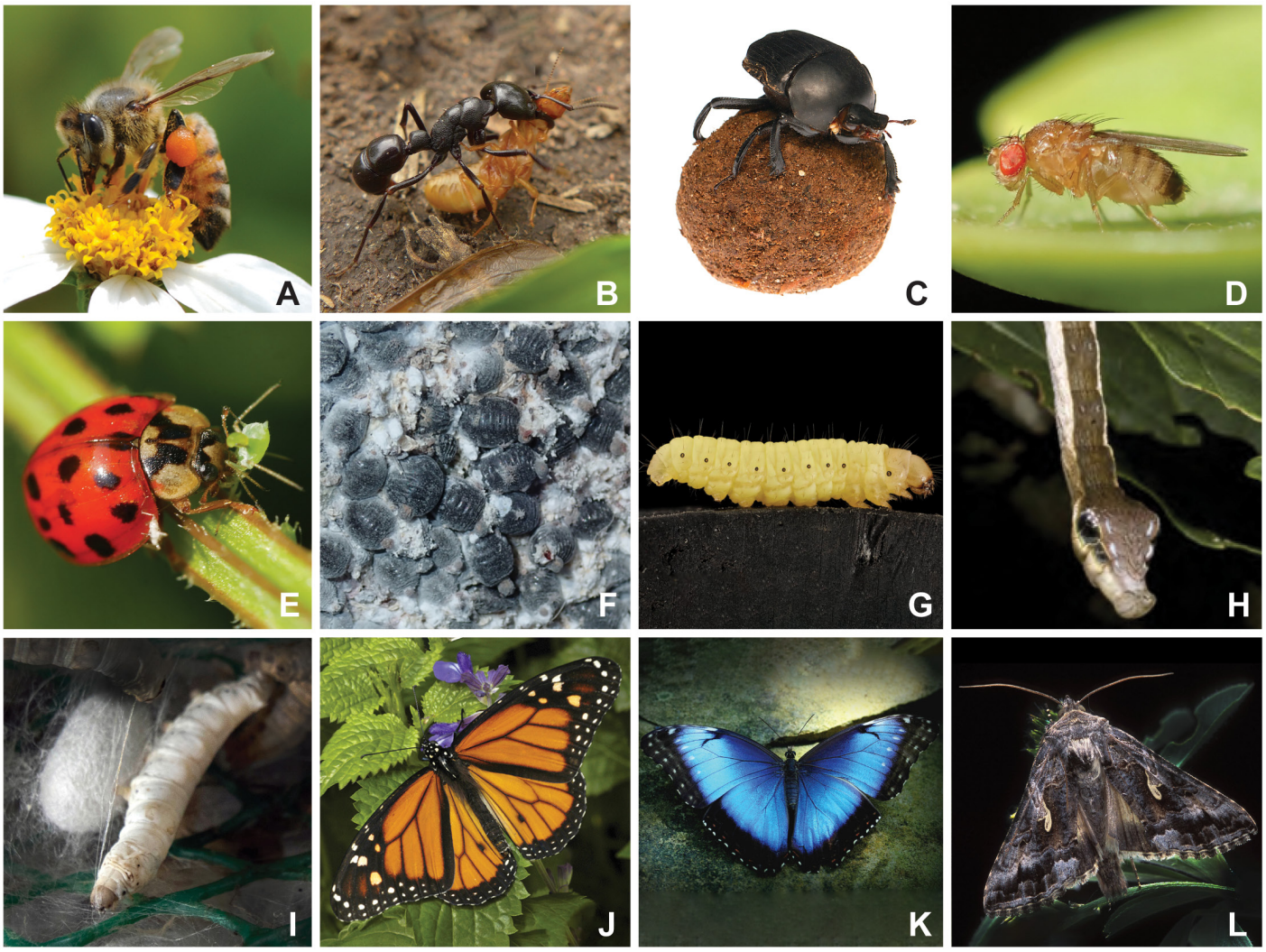

Figure 1: Beneficial and amazing insects and Lepidoptera. **A.** Pollinator: Honeybee (Hymenoptera: Apidae: *Apis mellifera*). The honeybee is one of the world's most important insects for pollination of crops such as apple, avocado, blueberry, broccoli, cabbage, cherry, coffee, cranberry, cucumber, grape, melon, onion, and orange. They also provide honey, and beeswax. Maryland, USA (M. Raupp). **B.** Ecosystem service: Ants (Hymenoptera: Formicidae). With their enormous diversity and abundance, ants have immense ecological importance as seed dispersers, soil and nutrient movers, prey for some species, predators of others, and decomposers. Imaged: *Plectroctena mandibularis*. Kasanka National Park, Zambia (J. Fahr). **C.** Decomposer: Dung beetle (Coleoptera: Scarabaeidae). Dung beetles are important to decomposition and nutrient cycling in both natural and agricultural systems. Kalimantan Tengah, Indonesian Borneo (L. Reeves). **D.** Human benefit: Research: Fruit fly (Diptera: Drosophilidae: *Drosophila melanogaster*). The fruit fly is among the most important model organisms in scientific research, and has been used to study genetics, physiology, development, neuroscience, and evolution, among many others. Eight Nobel Prizes have been awarded to research involving this fly. Berlin, Germany (A. Orion). **E.** Biocontrol: Ladybird beetles (*Harmonia* sp.) are predatory, feeding primarily on plant pests such as aphids and scale insects. Hart District, England (J. Spooner). **F.** Human benefit: Dye production: Cochineal scale insect (Hemiptera: Dactylopiidae: *Dactylopius coccus*). Cochineal scale insects are the primary source of the red dye, carmine. Caniço, Portugal (A. Sprungk). **G.** Decomposer: Wax moth (Lepidoptera: Pyralidae: *Galleria mellonella*). Larvae of the wax moth can feed on and decompose the wax produced by honeybees, and possibly decompose plastics (USGS Bee Inventory and Monitoring Lab). **H.** Visual defense: Hawkmoth caterpillar (Lepidoptera: Sphingidae: *Hemeroplanes triptolemus*) flips its body over and inflates its thorax when agitated, having a striking resemblance to a venomous snake, scaring off potential predators. Brazil (A. Freitas). **I.** Human benefit: Silk production: Larvae of the silkmoth (Lepidoptera: Bombycidae: *Bombyx mori*) has been cultivated by humans for their silk for the past 5,000 years. Bago City, Negros Occidental, Philippines (L. Reeves). **J.** Migration: Monarch butterflies (Lepidoptera: Nymphalidae: *Danaus plexippus*) migrate thousands of kilometers across North America to a small patch of forest in Mexico and to sites along the California coast where they congregate and overwinter. Florida, USA (J. Gage). **K.** Iridescence: Morpho butterflies (Lepidoptera: Nymphalidae: *Morpho* sp.) are considered some of the most beautiful insects, and have extraordinary wings that are iridescent blue (TexasEagle). **L.** Human benefit: Vaccine development: Alfalfa looper moth (Lepidoptera: Noctuidae: *Autographa californica*). Several species of moths, including the alfalfa looper moth and the fall armyworm (*Spodoptera frugiperda*) are used for development of proteins used as vaccines against human viruses. The *S. frugiperda* SF9 insect cell baculovirus system is being used to develop a vaccine against COVID-19. Georgia, USA (P. Greb).

wavelengths that are less attractive to insects (32). UV-blacklight "bug zappers" with a purported function to attract pests such as biting flies, mainly kill harmless, non-target insects (33). Insect populations will benefit from conservation efforts to protect dark night skies.

5. *Lessen soap runoff from washing vehicles, building exteriors, and reduce use of driveway sealants, and de-icing salts.* The use of soaps to wash cars, motorbikes, other vehicles or the exteriors of building often produces significant quantities of pollutants including ammonia, heavy metals, nitrogen, petroleum hydrocarbons, phosphorus, and surfactants that drain directly into local water systems (34). Natural waterways contain a diversity of aquatic insects, including some of the most threatened animals on Earth (5). As water levels in aquifers precipitously decline globally, we recommend reducing cosmetic and recreational water use and using reclaimed water when possible. Domestic soap usage can be made more environmentally friendly by using biodegradable soaps.

Coal-tar based sealants such as polycyclic aromatic hydrocarbons (PAHs), often used on driveway asphalt, are released as runoff into the soil and the atmosphere, harming both terrestrial and aquatic ecosystems (35). Some states and municipalities have banned their use (36). Alternative, soy-based sealants are less toxic. In cold climates, rock salt (halite) is often applied to pavement, including driveways and sidewalks, to prevent icing. Rock salt is only effective at temperatures above 15°F, and the melted salt can reduce plant growth, cause gastrointestinal disorders in pets, and interfere with insect development, reproduction, and behavior, while damaging concrete (37). Snow blowers, electric snow/ice melt mats, and sand are less harmful, as are salt-free, ice melting chemical formulations such as SafePaw® (safepaw.com).

Increase public awareness and appreciation of insects:

6. *Counter negative perceptions of insects.* People rarely protect what they do not know and appreciate (38). In many countries, the public is largely unaware of the benefits and services that insects provide, and negative perceptions of insects are widespread (14). Such perceptions can reflect cultural beliefs not grounded in scientific evidence (38), and can be amplified by media sensationalism such as films depicting large, scary insects, or the use of dramatized and misleading headlines.

A concerted effort is needed to counter negative perceptions towards insects. It is critical to know the benefits that insects bring to humankind. These benefits can be easily remembered as the "5Ps": insects are 1) *pollinators*, 2) *prey*, 3) *physical* decomposers, they 4) help *progress* in science and technology, and 5) provide *pleasure*. Writing regular blogs, such as on the "bug of the week" (bugoftheweek.com) and taking photos of insects and writing about them on social media are ways to increase appreciation. Smartphone images can magnify insects and make them more meaningful (14), especially if the images are high quality and draw attention. If one's insect pictures are not high quality, spectacular insect macro photos can be found online (e.g., flickr.com, bugshot.net; images taken by others must be credited appropriately). Insect photos can be deposited in web-based biodiversity portals, such as iNaturalist (39), an app that allows participants to document and share their natural history observations in a common social network. The app is an effective outreach tool that can get people quickly interested in nature and counter their negative perception of insects. While it helps to know the insect species' name when uploading images to iNaturalist, it is not required; unidentified species will be subsequently identified by experts. iNaturalist and other community science networks have the potential to generate a wealth of baseline to understand global insect diversity patterns; iNaturalist has effectively informed many scientific studies on species monitoring, biodiversity patterns, and assessing conservation planning (e.g., 40). Another way to encourage positive messages about insects is to support and participate in insect-focused public activities. Educational events such as insect fairs, butterfly houses, and live insect zoos exist in Asia, Europe, and North America and they provide opportunities for participants to handle, learn, observe, and purchase insects (41). Spectacular insect phenomena, such as glowworms in the caves of Australia and New Zealand, migrating monarch butterflies in Mexico, and synchronous fireflies in Malaysia and the U.S., all attract thousands of annual visitors (42). Community science (also called citizen science) efforts that contribute to the monitoring of insects include "Bumble Bee Watch" in North America (bumblebeewatch.org), the "Big Butterfly Count" in Europe (bigbutterflycount.org), and "National Moth Week" worldwide (nationalmothweek.org), which are just a few examples of ways professionals and amateurs can observe, learn, and contribute to insect conservation.

Insect appreciation can be also increased through developing mechanisms that promote insects in culture. An example of a country with prevalent appreciation for insects is Japan. There, insects appear frequently in popular media, animated films, and celebrity quiz shows, and are often portrayed as interesting and beneficial to humans and nature (43). Many Japanese insects have approachable common names, and they appear in anime films and cartoons, often with anthropomorphic traits. Insect enthusiasts should make efforts to advocate for common names with positive connotations, such as the damselfly "violet dancer" (*Argia fumipennis*) or the orthopteran "rainbow grasshopper" (*Dactylotum bicolor*). There should also be concerted efforts to standardize common names of species that appear often in the media (e.g., Asian giant hornet, *Vespa mandarinia*) and move away from common names with a negative undertone such as "murder hornet". Japan could serve as a model for elevating insect appreciation through celebrity nature advocacy, animation films, and the use of creative common names, as means of improving attitudes toward insects.

7. *Become an educator, ambassador, and advocate for insect conservation.* Personal outreach to others, through formal and informal teaching, discussion, etc., is a powerful means for increasing awareness and appreciation of insects, especially when the audience is children (44). The first wild animal a child encounters is likely to be an insect in their immediate surroundings. Positive early experiences can be crucial for the development of an appreciation for nature, given the decreasing time that children now typically spend outdoors (45, 46). The age range of 6 to 12, when emotional connection to animals typically peaks (45), is an especially good time for natural history education. Professional scientists can contribute by volunteering to provide interactive insect-themed walks or outdoor activities in schools or through churches, scouts, and other programs serving children. Scientists can also teach from afar through "Skype a Scientist" (skypeascientist.com). There are multiple funding sources for K-12 insect education initiatives, such as the Chrysalis Fund from the Entomological Society of America (www.entsoc.org/chrysalis-fund). Entomological societies across the world should create similar opportunities. Fostering an appreciation of insects, nature, and the outdoors to children is especially impactful, as they will become the stewards of the natural world.

It is also important to talk to adults about insect conservation and an excellent place to do so is during outdoor group walks and hikes that allow for hands-on, positive interactions with insects. Engage participants by introducing insects through story-telling and personal experiences that can improve retention and interest, for example by including explanations of how they are beneficial. Facts, such as that >90% of temperate bird species feed on insects (47), or that the majority of freshwater fish, including popular gamefish species, rely on insects (48) are examples of messages that will inform the public about the positive benefits that insects provide.

8. *Get involved in local politics, support science, and vote.* Insect-friendly environmental policies at any level of government will only be adopted if insects are recognized as important. Political advocacy, especially at the local level, can significantly advance insect conservation. For example, landscaping requirements of many homeowners' associations in the U.S. have led to overuse of pesticides that harm native insects, birds, and other animals. Members of such associations should advocate to make those rules more environmentally friendly, and promote neighborhood interest in conservation (action items 1-5) through discussion with their board and the use of yard signage. Citizens can also interact with local parks departments, planning commissions, city councils, and other governing bodies to advocate for evidence-based policies and practices that help insects. Participating in the design and conservation planning of urban landscapes can have an immediate "bottom-up" effect on local politics and species conservation. For example, residents in the U.S. succeeded in advocating for the Miami blue butterfly to be listed under the U.S. Endangered Species Act (naba.org/miamiblue.html). Public advocacy focusing on issues that directly and indirectly impact insects and the environment more broadly can contribute to positive changes at the local and national levels. People should attend events that support increased reliance on science in policy-making, such as the "March for Science" (www.marchforscience.org), and advocate for larger-scale insect- and conservation-friendly changes, such as banning pesticides in towns, and large environmental initiatives, such as the Paris Climate Agreement (unfccc.int/process-and-meetings/the-paris-agreement), and the Convention on Biological Diversity (www.cbd.int/). Becoming locally active and voting for evidence-based science can have long-term global impacts to protect insects. Public opinion is a powerful tool for conservation and can compel decision makers to act (14).

Concluding remarks

We propose simple action items that are focused on creating insect-friendly environments and raising public awareness. Preservation and restoration of habitats that support insect diversity, as well as wildlife more broadly, is a critical element in ensuring their conservation. At the individual level, any or all of these actions can be adopted to slow insect declines. We encourage people to start by picking one of the eight action items discussed above, before adding others. Being able to recite the 5Ps will help to educate the public about the benefits that insects provide.

It is also important to be mindful of the impacts of our daily actions and decisions. Avoiding some behaviors or adopting others will contribute both directly and indirectly to insect conservation. Further, taking actions that address issues such as climate change can synergistically promote insect diversity. Climate change is increasingly recognized as a primary factor driving local and regional plant and animal extinctions (49), and therefore actions that contribute to reducing one's carbon footprint are critical. The combined impact of millions contributing in direct and indirect ways is necessary to confront the global issues related to insect declines.

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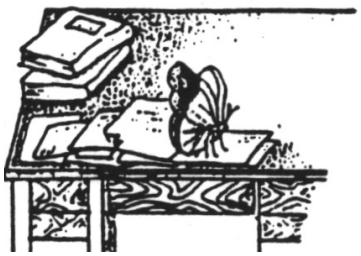


From the Editor's Desk

James K. Adams

I have an interesting problem, which I have not faced previously. I had JUST enough article contributions to fill this issue, and I have NOTHING in the Fall issue folder at the moment. In other words, I NEED YOUR CONTRIBUTIONS!

I even ended up filling a page with a teaser for the talk (see page 86) I am planning on giving at this Summer's virtual meeting (see announcement next page). I certainly don't mind producing my own content, but I usually am not in that situation.

Remember, articles do not have to be particularly scientific. Backyard observations, interesting rearing anecdotes, and anything else Lepidoptera-wise that interests you, from any part of the world, is acceptable. So send me your articles!!

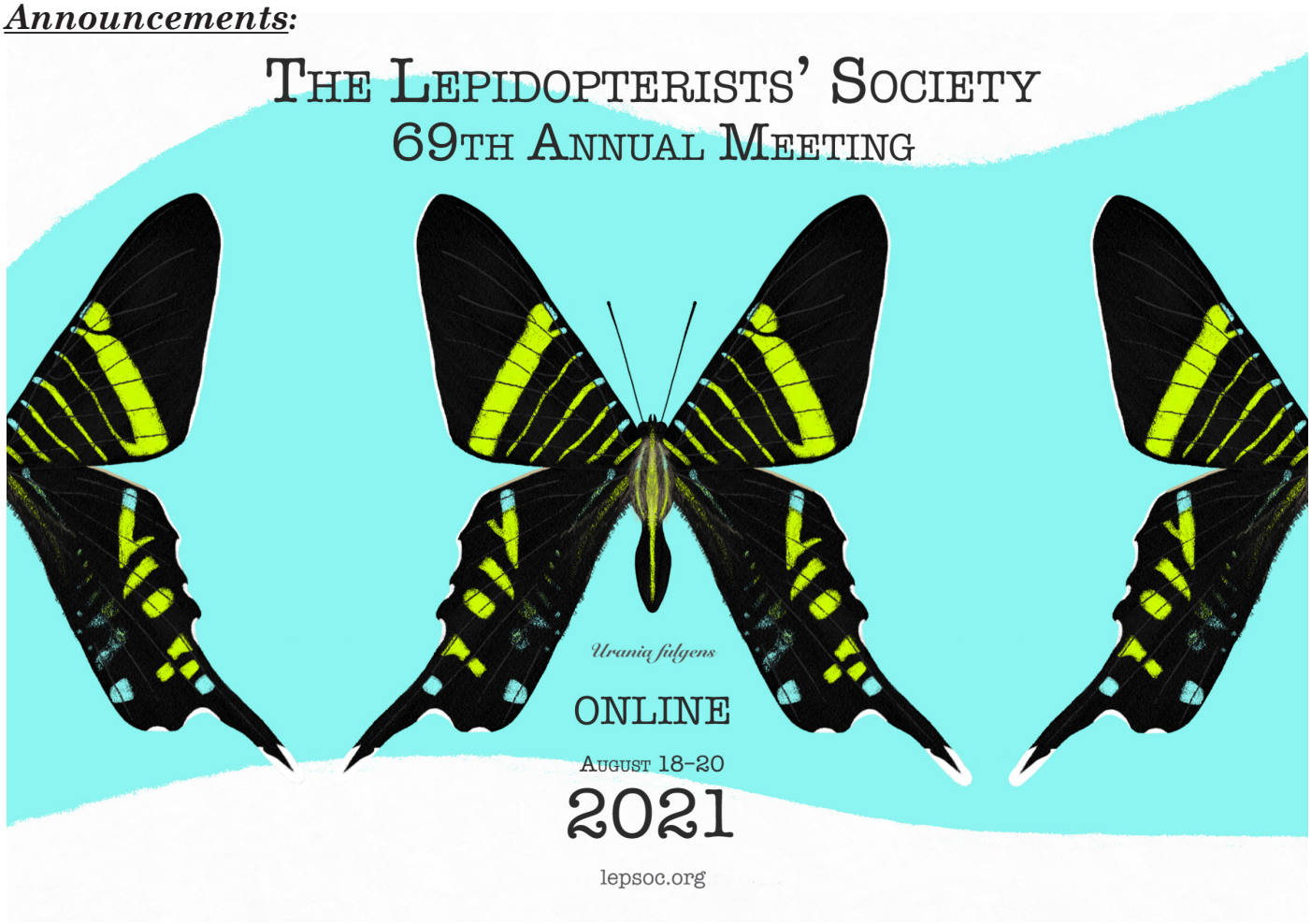
Most MONA Fascicles Now Available as Freely Downloadable PDFs!

The Wedge Entomological Research Foundation (WERF) recently completed a project to make digitally available all published *Moths of America North of Mexico* as PDFs with full text search capability, and is pleased to offer these for download on its website at:

http://wedgefoundation.org/publications_paypal.asp

Fascicles published prior to 2015 were physically scanned since "born digital" high resolution copies were unavailable; those fascicles are free. Born digital PDFs were available for the four most recently published fascicles (9.4 *Eucosma*, 2015; 9.5 *Pelochrista*, 2017; 22.1A Notodontidae, 2018; 25.4 Noctuidae, 2020). These four PDFs can be purchased and downloaded at a sliding discount compared to the corresponding print versions, based on the number of years since publication. For additional information please contact WERF's Managing Director, Kelly Richers (kerichers@wuesd.org).

Announcements:



Call for Contributed Papers

VIRTUAL ANNUAL MEETING OF

The Lepidopterists' Society, *Southern Lepidopterists' Society*, *Association for Tropical Lepidoptera* and *Societas Europaea Lepidopterologica*

18–20 August 2021

Due to the Covid-19 pandemic the 2021 Annual Meeting will be held in a virtual online format. The tentative schedule will include prerecorded 12-minute Zoom presentations followed by live question and answer sessions. Posters will be viewable pdf files with a scheduled session of 2 minute "elevator pitches" and question and answers. Awards will be given for outstanding student posters and oral presentations. Please visit **www.lepsoc.org** to register and view the full schedule of activities, including featured speakers, online social events, and iNaturalist field identification projects.

Presenters may screenshare using PowerPoint or other software in order to prerecord Zoom presentations. Instructions for recording and uploading presentations and preparing pdf posters will be available at **www.lepsoc.org**.

Titles and abstracts **must be received by 16 July 2021** in order to be considered for inclusion in the program. Please fill out the pdf form available at **www.lepsoc.org** and email to **meeting@lepsoc.org**. A Word file including author(s), address, phone, email, presentation title, and abstract may be sent in lieu of the form. Please limit abstracts to 125 words or less, indicate poster or oral presentation, and if you are a student presenter.

Corrections to Summer 2020/Spring 2021 issues of the News

Two book reviews -- "The Witt Catalogue: Volume 10 . . .", Summer 2020, pp. 96-97 and back cover and "Notodontidae of the Indonesian Archipelago (Lepidoptera): Volume 1" by Schintlmeister, Spring 2021, pp. 21-23 -- are both by Eric H. Metzler. There is a reference to him on the back cover in the Summer 2020 issue, but none to him in the Spring 2021 review. I (the editor) apologize for this oversight, but will say that Eric didn't include his name with the reviews so it isn't entirely my fault -- still, as editor, I should have caught this. Eric has promised to remind me in his future reviews that they are from him!

Also, the captions to Figures 4a through 4e in the article on ghost moth larvae from Isla Grande de Chiloé, Chile by Grehan and Gargiulo, Spring 2021, pp. 6-9, were a bit mangled, though I believe still understandable. The figure captions SHOULD have referred to larva 1 through larva 5 sequentially. The caption for 4b was a repeat of the caption for 4a, and for 4c-4e the larvae were referred to as they appeared in Figure 2, namely 2c through 2e. I apologize for any confusion.

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 2021 annual meeting of the Lep Soc. If you are an author and/or a member that has a paper already in lay-out, 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.**

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and https://www.
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Searching The Lepidopterists' Society Season Summary on SCAN

Brian Scholtens and Jeff Pippen

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 provide below 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 it through The Lep Soc 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

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!

National Moth Week Marks 10th year, July 17-25, 2021

Calling Young People around the world to learn about and observe moths

National Moth Week (NMW) is marking its 10th year July 17 through 25 with a call to young people around the world to learn about and observe moths in their local habitats.

Each year since 2012, National Moth Week has shone a light on often unheralded moths, calling attention to their beauty, extraordinary diversity and essential role in the natural world as pollinators and a food source for other creatures.

As a worldwide citizen science project, NMW encourages "moth-ers" of all ages and abilities to turn on a light wherever they are and observe and document what they see through photography and data collection. Finding day-flying moths and moth caterpillars can be done in daylight.

Individuals and organizations are invited to register private and public mothing and educational events for free on the NMW website. Due to the pandemic, participants are advised to follow health guidelines and regulations for gatherings in their area. Participants receive a beautiful certificate designed by NMW team member and graphic artist Belen Mena.

This year, the NMW team is encouraging kids and teens to discover and learn about moths in their own backyards and communities, or even while on vacation. Kid-friendly content and tips for beginners, from book lists to light setups and "moth bait" recipes are featured on the NMW website.

"Observing moths is as easy as turning on a porch light and seeing what's flying," said Jacob Gorneau, who became the youngest member of the NMW team when he was 15 and is now a graduate student in entomology. "Because they are so diverse, moths are a great starter insect for kids, who will never tire of the amazing shapes, colors, and sizes that exist. An interest in moths instills a greater appreciation for the natural world and why we need to preserve it. Wherever you may be with your child, even checking out brightly lit places at night or early morning where lights were on all night, you are sure to see some moths. Lastly, get outside. Some of my most memorable experiences finding moths were the ones I found serendipitously, without searching. You may soon be known as the local moth person and people will start bringing moths to you!"

NMW participants are invited to contribute their photos and data to NMW partner websites, as well as the NMW Flickr group, which now has over 100,000 moth photos from around the world.

"Documenting the numbers and locations where moth species are flying can help scientists determine what impacts, if any, climate change, pollution and other threats are having on native populations," said Liti Haramaty, who co-founded NMW with David Moskowitz, Ph.D.

Since 2012, NMW has inspired thousands of public and private moth-watching and educational events in over 80 countries and all 50 U.S. states. Sites have included National Parks and Monuments, museums and local recreation areas, private backyards and front porches – wherever there's a light and a place for them to land.

National Moth Week is a project of the Friends of the East Brunswick (N.J.) Environmental Commission, a nonprofit organization dedicated to environmental education and conservation. It is now one of the most widespread citizen science projects in the world. It is coordinated by volunteers on the NMW team and country coordinators around the world. It is held annually for nine days during the last full week and two weekends of July.

For more information about National Moth Week, visit nationalmothweek.org, or write to info@nationalmothweek.org. Also, find National Moth Week on Facebook, Twitter (@moth_week) and Instagram (mothweek). Hashtags: #Nationalmothweek #mothweek

Why study moths?

- Part of the Lepidoptera order of insects, moths are among the most diverse and successful organisms on earth.
- Moths are important pollinators for crops and flowers, and serve as a food source for birds, bats and other animals.
- Scientists estimate there are 150,000 to as many as 500,000 moth species.
- Their colors and patterns are either dazzling or so cryptic that they define camouflage. Shapes and sizes span the gamut from as small as a pinhead to as large as an adult's hand.
- Most moths are nocturnal, and need to be sought at night to be seen – others fly like butterflies during the day.
- Finding moths can be as simple as leaving a porch light on and checking it after dark. Serious moth aficionados use special lights and baits to attract them.

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

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. Be looking for information in the next SKL Newsletter about this year's meeting as virus protocols may require a different format, as it did last year. Also, follow the Society's facebook page (https://www.facebook.com/societykentuckylep/) for announcements of this and potential 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 has updated its categories of financial support. As of January 2021 the Foundation has introduced the following 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.

The category of Patron has been closed, and all Patrons are now 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.

CT scanning as a promising tool for studying Lepidoptera immatures

Andrei Sourakov, Amanda Markee and Edward L. Stanley

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CT scanning is a technique that is now used widely not only for diagnosing human disease, but also for natural history research. The Florida Museum of Natural History at the University of Florida is one of the leaders in using this technology for museum collection studies. The micro-CT scanner located at the Nanoscale Research Facility has been used to image anything from tiny bark beetles to frogs and lizards. CT (Computer Tomography) combines numerous X-ray images (taken as cross-sections) into a three-dimensional image.

Recently, we attempted to explore the possibilities that the micro-CT scanning can offer for studying immature stages of Lepidoptera. Compared to the traditional studies of anatomy using dissections and histology, CT scanning allows for analyzing separate, frequently very delicate internal organs without damaging them. Also, as an additional benefit, the method is non-destructive, so the valuable specimens remain intact for future studies.

External and internal organs made of chitin are dense, so exoskeleton and trachea can be readily seen on a CT-scan without additional preparation. To see other tissues such as the gut, Malpighian tubes, and silk glands, the contrast must be enhanced by soaking a specimen in iodine solution for several days. The specimens of the imaged Imperial Moth (*Eacles imperialis*) were previously fixed and stored in Kahle's fluid (solution containing formalin, acetic acid, ethanol and water). Preliminary computer renderings, showing sectioning of some of the organs in a mature caterpillar and the tracheal system in a four-day-old pupa are featured in figures 1 and 2.

The scans were made using a Phoenix V|Tome|X M dual-tube nano-CT system, with a post processing using 3D editing software VGStudioMax 3.3 Volume Graphics software.

Future directions

The possibilities of this technique for studying Lepidoptera development and comparative anatomy are virtually limitless. For example, one of us (AM) plans to conduct a study as part of her Master's Thesis, which will involve analyzing CT scans of silk-producing organs of Lepidoptera larvae. Silk is among the strongest and most versatile biomaterials on Earth, plays an important role both economically and culturally, and Lepidoptera larvae use silk for a wide range of purposes, from cocoon construction to adhering to substrates. Despite the diversity of silk usage across Lepidoptera, research has been limited to a few model organisms, such as the domesticated silkworm moth (*Bombyx mori*). While this particular model species is well studied, much less is known about the genetics of wild silk and how silk gland morphology varies between life stages and species.

As for the silk gland development, it has been hypothesized that unique silk fibers are produced at different larval stages of Lepidoptera, but this has not been adequately tested in Saturniidae. Lepidoptera silk genes are known for their tissue-specific expression: fibroin proteins, which are responsible for the silk fiber strength, are produced in the posterior region of the silk gland; sericin proteins responsible for silk adhesiveness, are produced in the median region. As larvae develop, the shape and size of the silk gland changes depending on which silk genes are expressed. Isolating silk glands using dissections can be time-consuming, so CT scanning may prove to be useful for characterizing and describing silk gland morphology as caterpillars develop, and for comparing such development across Lepidoptera.

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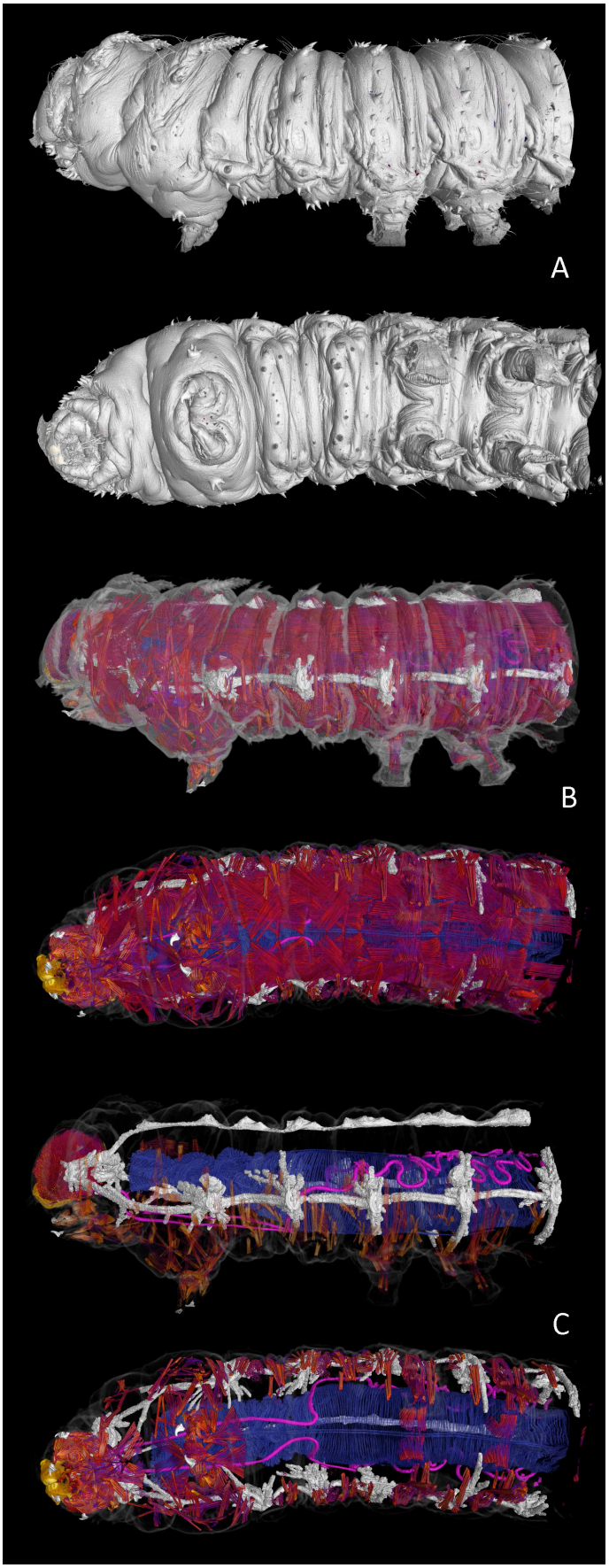

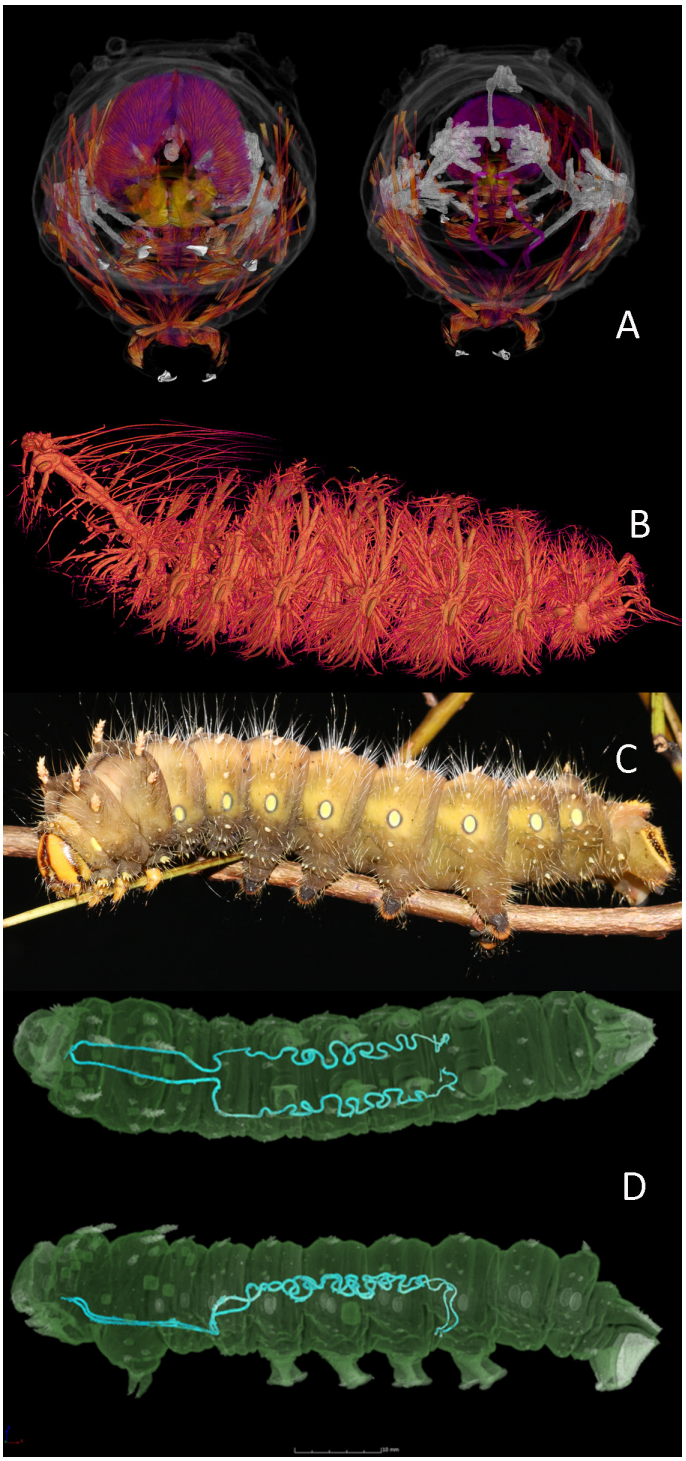

Fig. 1 (left). CT scan of the mature Imperial Moth (*Eacles imperialis*) larva. (A) Surface reconstruction, (B) and (C) Reconstruction of musculature (red), trachea and dorsal vessel (white), gut (blue), and silk glands (pink).

Fig. 2 (above). The Imperial Moth (*Eacles imperialis*): (A) CT scan of the head region, (B) CT scan, 4-day-old pupa, reconstruction of the tracheal system; (C) Mature larva; (D) Silk glands, renderings based on a CT-scan.

Digital Collecting:

Butterflies of Río Negro, Neuquén, and Misiones provinces, Argentina

Bill Berthet

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This article is based on a Butterfly photography holiday in Argentina from January 13 to February 5, 2020, just before Covid was getting a foothold on the world. This tour was organized by David Geale (mariposabutterflytours.com) and also led by David (from Canada), as well as Kim Garwood (from Texas).

Map of Argentina

David is an excellent guide, being an expert in butterflies and birds in the Neotropics. On these trips, David will mix up rotting fish, urine, and water for butterfly bait, and get out on the trail, usually before we begin our butterfly "treasure" hunt. He also alerts us when he runs across a "blue ribbon" species. He is most helpful, taking whatever time is necessary in the afternoon and evening to ID your butterfly images and generally enjoyable to be around.

The diversity of Lepidoptera in Argentina is quite high, with a total of around 518 genera, and ≈1300 species of butterflies, with 40 or so being endemic due to diverse climates and altitudes that include tropical, subtropical, temperate and cold regions. A majority of South American countries have a larger number of butterfly species, especially swallowtails, due to large areas of tropical habitats.

Butterflies are useful as environmental indicators. The adults play a fundamental role as pollinators, and their caterpillars help control the vegetation biomass, while both are consumed by many other animal species.

Our international group met up at the Hotel Plaza Central Canning in Buenos Aires before our flight to Bariloche in Río Negro Province the next morning. Río Negro is one of 6 provinces making up the Patagonia region in south central Argentina. The landscapes feature the Altoandino with perpetual snow above 1650 meters (including the soaring dormant volcano Mount Tronador), the Andino-Patagonico, the hilly lower reaches, and the Patagonian steppe, that spans from snow-capped Andes Mountains to the west and the Atlantic Ocean to the east.

The lakeside city of Bariloche (893m), set in the Andean foothills in Nahuel Huapi National Park, is the largest city in Río Negro Province. Bariloche, known for its Swiss alpine-style architecture, is a major tourism center with skiing, trekking, and mountaineering. In addition, it has numerous restaurants, cafés, locally made chocolate, gift shops, and was a haven for Nazi refugees.

Nahuel Huapi National Park, established in 1934, is the oldest National Park in Argentina, surrounding the large glacial lake Nahuel Huapi.

The snow-capped dormant volcano Mount Tronador

The first morning, after we enjoyed breakfast at the Hotel La Malinka, we drove for several days to explore around the Bariloche area, but very few butterflies were observed.The best spot was a sloped, dry, sandy, small rock filled wash, bordered by flowers, shrubs, thickets, and small trees, near a small river, with a closed canopy of trees and bamboo on either side, leading to an open area where the shallow river becomes much wider. The most common species was *Argyrophorus chiliensis*, very skittish, and a real challenge to get close enough for a good click. Others included the small skippers, *Butleria bissexguttatus* and *B. quilla*, *Hylephila signata*; satyrs *Neomaenas fractifascia* and *N. humilis*; the brightly yellow colored *Colias vauthierii*; and the Fritillary *Yramea cytheris*.

Even though there were not many butterflies the scenery was outstanding, with crystal clear azure blue lakes, evergreen tree covered multi-tiered land masses, with barren and snow covered mountain peaks in the background.

At our hotel I had breakfast several times with a couple of fly fishermen from Ohio. I was salivating as they showed me pictures of recently caught Brown Trout up to 20 pounds! I had a flashback of fly fishing with Uncle Reggie on the Au Sable (the Holy Waters) River when I was 12 years old near Grayling, Michigan. Around dusk I would walk along the river listening for the slurping sounds created by a trout feeding on floating insects being carried downstream. With waders on I slowly walked upstream near where the trout was feeding, casting a "match the hatch" dry fly, landing it gently above the area he was feeding, hoping the fly would follow the same path as the ones he was eating. If you were lucky and skilled, many casts later might produce one Brown trout between 14 to 17 inches, but certainly not 20 pounds!

Argentinians like to have a late dinner. Usually the restaurants opened at 8:30 p.m. David was able to get one restaurant to open at 8:00 p.m. that we ate at several times. We did find one other restaurant that specialized in various cuts of steaks that was excellent. We all waddled out of this place with smiles on our faces after having dulce de leche for dessert.

We spend a day at Cerro Catedral Ski Resort a short drive from Bariloche that is open from June to October featuring

Left, top to bottom: *Argyrophorus chiliensis*, *Neomaenas fractifascia, N. humilis.* Center, top to bottom: *Butleria bissexguttatus, B. quilla*, *Hylephila signata.* Right, top to bottom: *Colias vauthierii, Yramea cytheris.*

different snow filled activities. One end of the parking lot area had flowers in bloom attracting several species of butterflies that for me were impossible to photograph due to their skittish nature and windy conditions. We all walked up a nearby hill looking for other bugs, but few were seen.

After another early breakfast, we headed northwest from Río Negro to Neuquén Province for the 4 hour drive to San Martin de los Andes located near Lanin National Park. The scenery ranged from the Patagonian steppe that is the 8th largest desert in the world by area, dominated by shrubby and herbaceous plants, to crystal clear lakes, and a dormant volcano. Some of the small conical shaped hills had perfectly formed huge Christmas tree shaped evergreens that looked like they had been placed there by hand, with barren to snowcapped mountains in the distance.

We turned left at a flat, sandy, scrubby area at the junction of RN 40 West at RN 237 in Chimehuin Valley (730m) and were mesmerized by very bright silver colored reflections from dozens of non-stopping Silver Satyrs (*Argyrophorus argenteus*) zipping by almost faster that the eye could follow. We came to a sudden halt, rushing out to try to capture an image of this butterfly. *A. argenteus* had a habit of briefly landing on the ground next to discarded green bottles, strewn about the field, sometimes attracting up to five in a single spot. Getting close enough for a decent click was nearly impossible, as this was one of the most skittish butterflies I have observed. I laid on my belly about 10 feet away waiting patiently for one to stay long enough for a shot, but had no luck. David figured out the best opportunity for a decent photograph was to wait near a patch of flowers that they would occasionally visit to nectar. It was a real challenge to get a good click, but because of the intense silver scales none of my images where very good.

Mother Nature can sure put on a show! This area also gave us *Cosmosatyrus leptoneuroides*, and the seldom observed *Tetraphlebia germainii argentina*. Down the road we stopped at some promising flowering vegetation at around 925m, photographing *Butleria fruticolens.*

Top row: *Argyrophorus argenteus* habitat, *A. argenteus* upperside. Middle row: *A. argenteus* male, *A. argenteus* female, *Cosmosatyrus leptoneuroides*. Bottom row: *Tetraphlebia germainii argentina, Butleria fruticolens* (upperside and underside).

In the late afternoon we crashed at Hotel y Cabanas Le Village in San Martin de los Andes.

David drove around Lanin National Park for several days but we experienced very little butterfly activity. One day, after a 20 minute drive from San Martin de los Andes we arrived at the fantastic ski and snowboarding Resort Cerro Chapelco (1250-1970m) open from June to October that receives 20-30 feet of snow a season. Several of us took the chairlift to the first stop. There was lots of sand and small rocks. Several slopes were bordered by trees but were fenced off, and there was very little vegetation, with just a flower or two. I waited over ½ hour for a particular Satyr to nectar on one of the flowers, but because of the wind and being so skittish failed in any attempt for a click. Exhausted, we all met up for a very good late lunch and a yummy chocolate cake for dessert. I got my workout for the year!!

Auca coctei

Heading to the airport for our flight to Buenes Aires we came across a great spot filled with butterflies on private property. The agitated owner immediately came out and told us to get the hell off his land. Later we found a small productive spot bordering a dirt road filled with Silver Satyrs darting about along with the low flying *Auca coctei* that likes to nectar on yellow flowers.

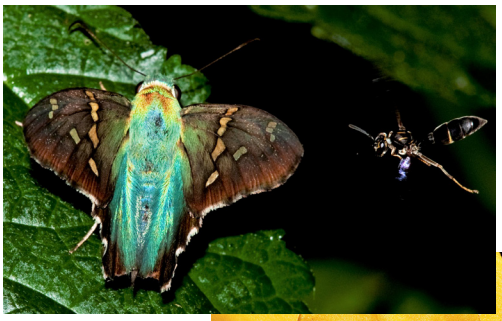
We flew from San Martin de los Andes with a stop at Buenes Aires continuing on to Iguazu Airport in Misiones Province. We rented a van, and David drove in the rain to the hotel Complejo Americano near Iguazu Falls.

Misiones is the second smallest province in Argentina that is completely different from Patagonia, located in the Northeastern corner of Argentina. It is surrounded by Paraguay and Brazil, embraced by the Parana, Uraguay, and Iguazu rivers helping to create the spectacular Iguazu waterfalls. This province has a humid subtropical climate with a lack of a dry season and abundant rainfall throughout the year. January can be hot during the day and warm at night. The A/C got a lot of use after each day of digital collecting.

After breakfast, with ominous looking skies, we headed to Iguazu Falls. It was overrun with crowds of tourists, but has spectacular scenery and can have lots of butterflies. We were not allowed to bait. Unfortunately, it started raining and did so for hours. We visited various spots to observe the falls without much butterfly activity. On the way out of the park we got clicks of *Tithorea harmonia pseudethra.*

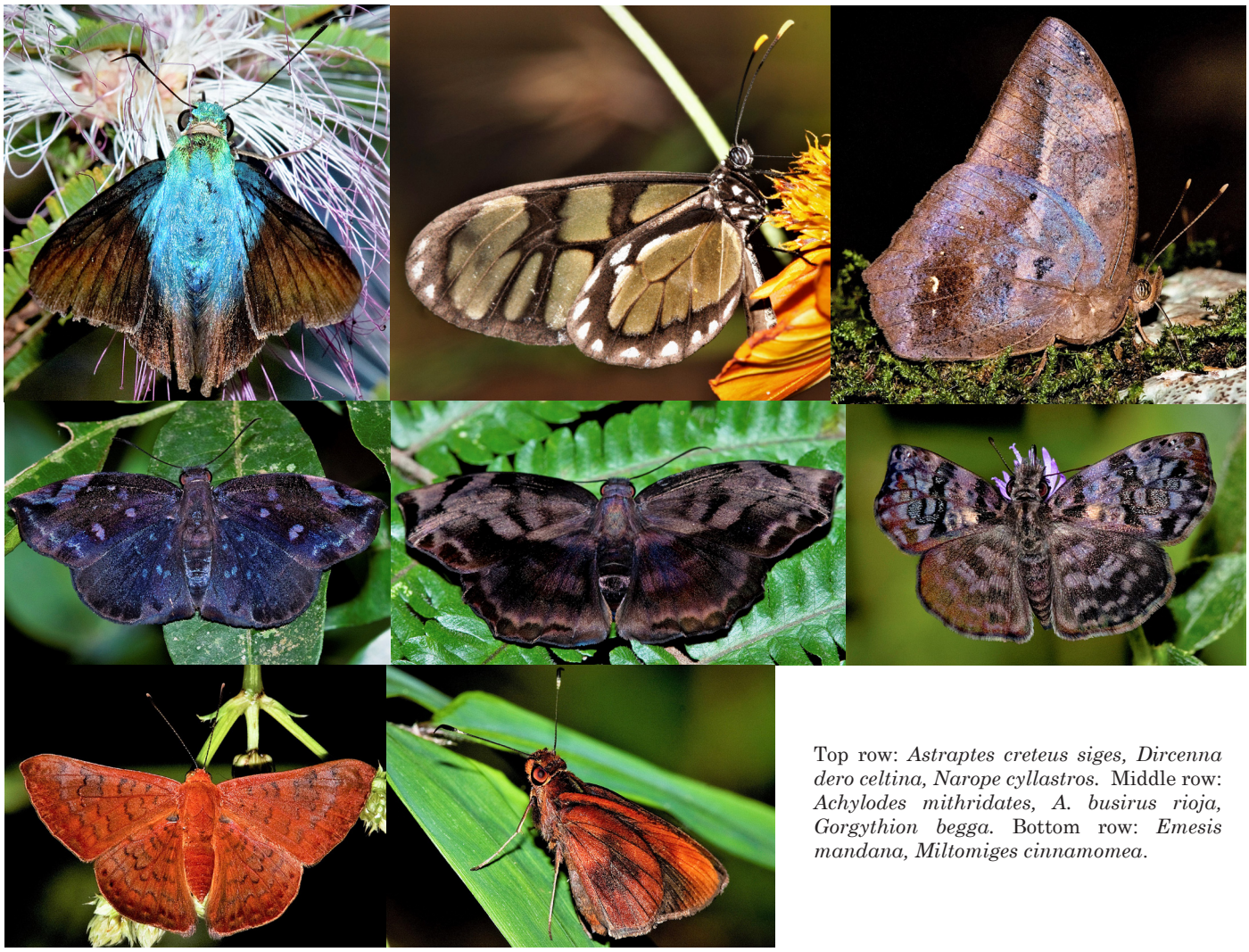
Tithorea harmonia pseudethra

The next day the weather was still not cooperating so we drove 3 1/2 hours to Obera then another 19 kilometers for a 3 night stay at the 25 hectare farm Chacra Mariposa, located in the central mountain range. For over a decade the owners Lucia and Horatio have been working in environmental education, promoting activities for the conservation of the local flora and fauna, helping preserve species in their natural environments. The couple built a garden next to the office filled with butterfly friendly flowering vines, bushes, and plants, bordered by larger trees that attract all kinds of pollinators, including *Urbanus pronta*, *Pyrrhopygopsis socrates* and *Naevolus orius* sharing a



Urbanus pronta (missing tails), with wasp friend

Pyrrhopygopsis socrates and *Naevolus orius*, sharing a yellow flower



Top row: *Astraptes creteus siges, Dircenna dero celtina, Narope cyllastros.* Middle row: *Achylodes mithridates, A. busirus rioja, Gorgythion begga.* Bottom row: *Emesis mandana, Miltomiges cinnamomea.*

yellow flower, *Astraptes creteus siges*, and the large black veined clearwing *Dircenna dero celtina.* With good weather, butterflying, lodging, food and conversation, we explored the trails and small river areas for the next couple of days.

A short distance from the lodge stood a cluster of tall flowers being visited for nectar by the flat wing skippers *Achlyodes mithridates*, *Achlyodes busirus rioja*, *Gorgythion begga*, and the riodinid *Emesis mandana.* One trail ended at a small river that was constantly visited by swallowtails including *Heraclides thoas*, and *H. astyalus* (see back cover) mineralizing on the sandy moist areas along the river bank. Crossing a small swinging bridge, I enjoyed watching the beautiful umber brown skipper *Miltomiges cinnamomea* nectaring on small flowers, and a very skittish *Narope cyllastros* imbibing fluids on a fern covered rock. This butterfly is often attracted to lights at night.

I was walking along a sloped, very narrow trail (that if you slipped you would end up in the river) and I came across "her" and said to myself "Please, Please, Please let me get this click!!" She was slowly fluttering around with legs outstretched, trying to locate a plant or tree leaf to deposit her egg. In the meantime, while balancing myself along an uneven riverbank, I changed my camera settings to a faster shutter speed and greater light exposure to eliminate wing blur. Locating a suitable spot, she stops fluttering her wings, arches her abdomen to lay a single egg. I get a click off, check the rear screen . . . oh no! Too dark, I forgot to change the settings back! Hoping she does not take off, I quickly changed back to the correct settings and fired off two clicks, and then the melanistic form *Heraclides hectorides* was gone. Checking the rear screen again, the clicks looked okay. Happy and satisfying feelings flooded throughout my body. All this took place within 11 seconds.

Later that day using rotting fish and urine, we baited a large flat rock next to the bridge around 6:00 pm. We came back around 7:00 p.m. and waited patiently for *Dyscophellus ramusis* to stop "buzzing" around and land on the bait. It was very skittish, but I finally got the click.

One trail along the river ended with a dirt path, leading to a large wood platform overhanging the river, and then descended along a narrow very short trail to a small moist

Top: *Heraclides hectorides,* female melanistic form. Bottom: *Dyscophellus ramusis.*

sandy area that was hopping with butterflies, including *Paulogramma pygas thamyras*, *Diaethria candrena*, and *Dynamine postverta*. Parts of this trail had a closed shady canopy that attracted *Taygetis tripunctata*, *T. yphthima*, and *Memphis moruus*. Our group was very satisfied with the numbers and diversity of butterflies during these three days.

Late afternoon and night time ID sessions were made possible with the large 328 paged Butterflies of Argentina identification guide published in 2018, The Butterflies of America Website, and additional keys for the identification of butterflies by William Harry Evans.

In the morning we drove 3 plus hours to the beautiful Mocona Virgin Lodge by Don (200m), immersed within the Yabotí Biosphere Reserve. Set in great habitat, we were on-site the whole time with excellent breakfast, lunch, and dinner at the lodge. This place is most accommodating, letting you come for lunch at your own time instead of their prescribed time. Yabotí Biosphere Reserve is home to the largest biodiversity in Argentina. Its subtropical forests, with trees, bushes and bamboos are a habitat for jaguars, tapirs and collared peccaries, among other endangered species.

Top row: *Paulogramma pygas thamyrus.* Second row: *Dynamine postverta.* Third row: *Diaethria candrena, Taygetis ypthima.* Bottom Row: *Memphis moruus, Taygetis tripunctata.*

After getting our rooms and luggage transferred I hoofed it down to the river hoping to find the fancy tailed metalmark *Barbacornis basilis*.

Recent rains had made the river much higher than normal. The beach area was underwater, a real bummer. Using my trusty 15 year old Eagle Optics Platinum Ranger Binoculars I located one small, moist, sandy area about 200 feet away with a *Barbacornis* mineralizing. Now in stealth

Above: *Barbacornis basilis*. Right: *Morpho epistrophus titei*.

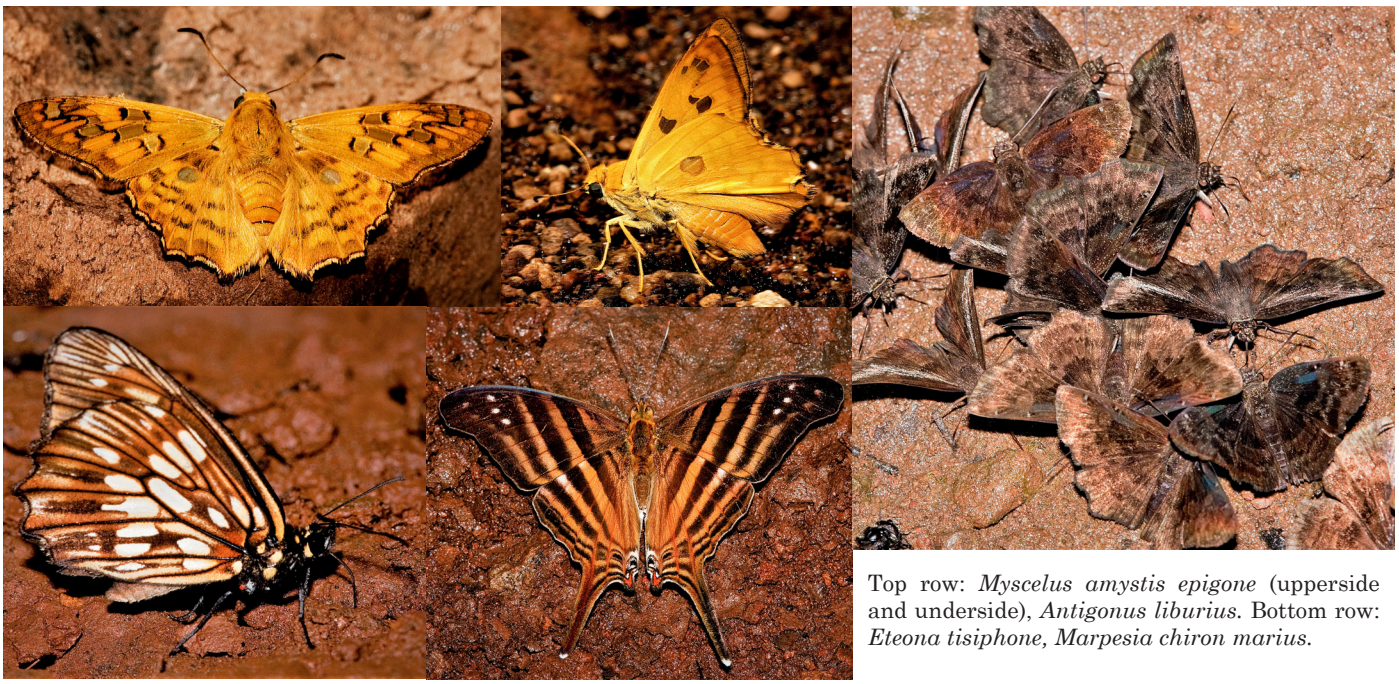
mode, I got about 10 feet away when he took off not to be seen again. But that got the adrenalin flowing, so I decided to go boulder hopping along the river. About a hundred yards away I snagged my first *basilis,* but it was a ragged specimen, so I continue looking. And then bam, right in front of me between two boulders was a *Barbacornis* in very good condition. After many clicks, I looked up into the sky, thanking Mother Nature for this exciting moment.

Tired and hot, in high humidity, I was nevertheless very satisfied. The trail going back to the room was steep, so I rested a bit and then enjoyed a very good dinner with a nice cold beer, and good conversation.

The next day we tried a new trail that David baited with rotting fish mixed with urine and water. At the junction of this trail and the main trail was a gully with flowing water and thick vegetation on either side. On a leaf next to the gully was another heart stopping moment. The majestic white *Morpho epistrophus titei* was locked on David's bait allowing many clicks from different angles.

One of the best spots included multiple moist sandy areas not flooded out by the river that were being visited by numerous puddle parties of spread-wing skippers, various species of swallowtails, along with white and yellow pierids. Hunting along the river, dodging drift wood large mud puddles, overhanging branches, various bugs, and boulders was a blast, keeping us busy for hours.

Some of the goodies here included *Myscelus amystis epigone*, *Antigonus liburius*, *Thespieus ethemides*, *Eteona tisiphone*, *Marpesia chiron marius*, *Paulogramma pyracmon*, and the swallowtail *Protesilaus stenodesmus*.



Top row: *Myscelus amystis epigone* (upperside and underside), *Antigonus liburius*. Bottom row: *Eteona tisiphone, Marpesia chiron marius*.

Top: *Thespieus ethemides, Paulogramma pyracmon*. Left: *Protesilaus stenodemus.*

Along the partly shady to full-canopied trails, we found the energetic skipper *Proteides mercurius*, as well as *Callicore hydaspes*, *Doxocopa laurentia*, *Temenis laothoe meridionalis*, *Smyrna blomfildia*, and the satyr *Splendeuptychia libitina*.

We left the following morning with full bellies and drove for around 7 hours. This included a stop at a bus depot to wait for one of the owners to take us to the four-roomed Surucuá Reserve & Ecolodge located in the Parana rainforest. David got the fifth bed, located in the loft above the library/bar area. As we got out of the van we observed a number of butterflies imbibing minerals from pants, socks, underwear, and shirts, hanging from the clothes line. We figured this was going to be a great spot. The owners Laura and Adrian went out of their way to take care of us, specializing in handmade, fresh local ingredient cuisine.

Surucuá Reserve and Ecolodge. Walkway through the surrounding habitat.

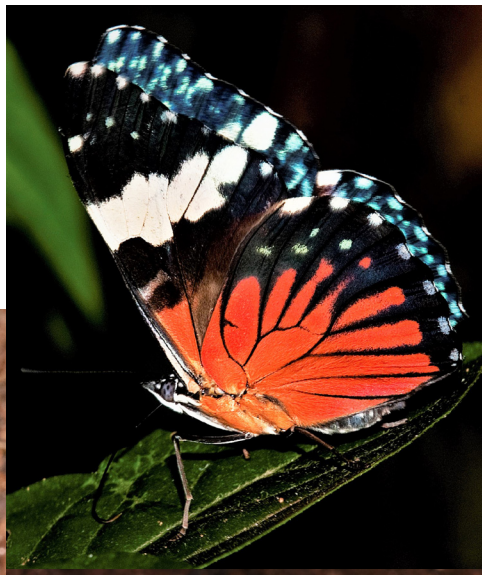
Top row: *Callicore hydaspes, Temeneis laothoe meridionalis, Splendeuptychia libitina.* Bottom row: *Proteides mercurius, Smyrna blomfildia, Doxocopa laurentia.*

Upper left: *Thespieus dalma*. Above: *Historis odius dious*. Lower left: Giant African Snail (*Lissachatina fulica*).

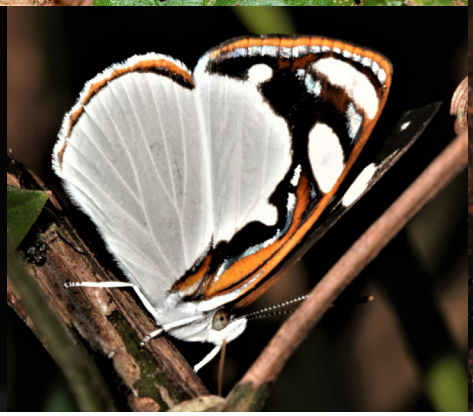
Part of the habitat was lowland jungle that had a raised wooden walkway over a very small stream leading to the rooms. There was a *Thespieus dalma* buzzing around the swimming pool area. The owners were building another house nearby with freshly poured concrete that was a magnet for butterflies including the large and striking *Historis odius dious*.

Wandering around on a rainy day with umbrella in hand, we ran across a Giant African Snail. First observed in Argentina in 2010, it is a significant cause of pest issues and one of the top 100 invasive species in the world. Many countries, including the U.S. in southern Florida, are making an effort to eradicate this pest.

David drove the van on the full-canopied mature forest road, with monkeys sometimes swinging from tree to tree. We stopped near an elevated wooden walkway through a wet area filled with mosquitoes that ended at the Iguazu River. The area attracted scads of butterflies, especially around the ash filled fire pit. Some of the goodies included *Rhetus periander arthuriana*, *Melanis aegates*, *Hamadryas amphinome*, *Dynamine artemisia*, *Dynamine coenus*, and *Zaretis strigosus*.



Below top row: *Melanis aegates, Rhetus periander*. Below bottom row: *Dynamine artemisia, D. coenus*. Right top: *Hamadryas amphinome*. Right bottom: *Zaretis strigosus*.



One old growth, full-canopied, humid, moist area along the wooden walkway was especially productive, including the brilliant orange Metalmark *Mesene epalia*, that I only saw briefly one time, getting off 2 clicks before it bolted back high up into the canopy. I also saw *Eresia lansdorfi*, and the beautiful male hairstreak *Theritas hemon*. Skippers were also buzzing and zipping around and presented a real challenge to get a good click. Some that did pose for a shot were *Paracarystus hypargyra*, *Naevolus orius*, *Nascus phocus*, and *Tirynthia conflua*.

While walking along another trail near the river I roused up a large moth that flew into a very large spider web above the trail. The spider felt the vibration and immediately went to capture the moth. Luckily, *Phaloe cruenta* was able to free itself, flying to a nearby tree, where I was able to get several clicks before it disappeared into the canopy. This location concluded our Argentina escapade and I returned to Jacksonville, Florida.

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Butterflies of America Website

Top Row: *Mesene epalia, Eresia lansdorfi, Theritas hemon.* Middle Row: *Paracarystus hypargyra, Naevolus orius, Tirynthia conflua.* Upper left: *Nascus phocus.* Lower left and above: *Phaloe cruenta* and *Nephila* spider.

Mystery of the silk purser moths (Lepidoptera: Hepialidae)

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Southern Africa is home to several soil inhabiting genera of Hepialidae. Most species belong to just two genera: *Eudalaca* (37 species) and *Gorgopis* (32 species). The few remaining species belong to *Afrotheora* (7 species), *Antihepialus* (4 species), *Metahepialus* (12 species), and *Leto* and *Neoleto* (1 species each). The biology of most species is unknown. Nearly all species appear to have subterranean larvae that feed on roots or ground foliage, the only known exception being the stem borer *Leto venus* (Grehan *et al.* 2018, 2019, Grehan & Ralson 2018).

Of the subterranean species, *Gorgopis libania* (Cramer, 1781) is recorded feeding on grass roots (Pinhey 1975, Scoble 1986) and reported damaging pasture in Tanzania where larvae were observed to occupy silk lined tunnels (McCrae 1975). Subterranean habits are also noted for *Gorgopis crudeni* (Janse, 1942), *G. ptiloscelis* (Meyrick, 1919) and *G. troglodytis* (Janse, 1919) (Cruden 1917, Janse 1919, 1942). The only detailed account on larval biology known to us is Joubert's (1975) study of *Eudalaca rufescens* (Hampson, 1910). This species is responsible for significant impacts on lawns, greens, golf courses and pasture. Larvae feed primarily on grasses and live within a web of cut grass and fecal pellets on the ground surface and construct a vertical burrow within the soil. Soil moisture is critical for first instar development and later instars are unable to survive under arid conditions. The first five instars feed on dead, dry leaves and stalks of grasses while later instars include live leaves. Leaves and stalks of the host plant are cut and dragged through feeder tunnels of silk and debris to the central web where they are consumed or cut into shorter segments and left within the web where they are presumably consumed at a later time.

Hepialidae with ground dwelling larvae generally attract little attention, other than in situations where they may have an economic impact on crops or pastures. In contrast to the low visiblity of most larval activities, some species in southern Africa have feeding webs that are quite prominent due to their being constructed above ground level at the base of their host plants – usually species of the family Restionaceae, a group of monocotyledonous plants with photosynthetic stems, and leaves reduced to sheaths. Larval webs usually take the form of a reddish brown 'mound' of silk and closely packed fecal pellets (Fig. 1a) or a vertical expanding bag (Fig. 1b). The latter shape lends itself to the common name of 'silk purser' as the web has the appearance of a 'silk purse' (Fig. 1c). These webs may be scattered and seen individually, or they may be concentrated in clusters (Fig. 1d). When an actively occupied web is opened, there are often a number of cuttings stored within by the larva (Fig. 1e), a behavior described for the grassland species *E. rufescens* by Joubert (1975).

The web and larvae observed by TR were observed in the fynbos biome, a fire-prone grass and shrubland habitat with a Mediterranean climate in the Western Cape and Eastern Cape provinces. Fynbos is a shrubland or restioland with more than 5% comprising Restionaceae and usually containing species of Proteaceae and Ericaceae or other ericoid shrubs. The biome is subject to periodic fires, usually at intervals of 10–30 years, but sometimes 5–50 years. The fires are fuelled by the fine-leaved shrubs and especially by the Restionaceae. Fynbos occurs mainly on nutrient-poor sandy soils, and less often on limestone, leached clay soils derived from shale and granite, and gravelly soils derived from duricrust outcrops and alluvial sediments (Rebelo *et al.* 2006, van Wilgen 2013).

The species responsible for the silk purse feeding webs is unknown. They may be constructed by any one or a number of the southern African genera other than *Leto,* and presumably *Neoleto* that is known only from a single locality the eastern coast (Eitschberger & Ströhle 2021). Silk purser larvae may be found in the webs during the day and were observed to leave the web when this structure was disturbed by handling or digging out the host plant (Fig. 1f). Larvae are typical of Hepialidae. An example from Klipbokkop Mountain Reserve (Figs. 1g, h) has a lightly greyish-brown pigmented abdomen with small pinnacula

Fig. 1: Webs and larvae of silk pursers (Hepialidae) inhabiting species of Restionaceae in South Africa: (a) web close to the ground, Kromme River (**www.inaturalist.org/observations/6714422**), (b) web elevated from ground level, Briers Louw nature reserve (11136093), (c) purse-like shape of web, Lucerne Akkedisberg (10865614), (d) cluster of webs at the base of host plants (yellow arrows), Hawkewas Plateau, south of New Years Peak (71448502), (e) opened web revealing host plant cuttings, Klipbokkop Mountain Reserve (10831906), (f) larvae protruding from web after disturbance, Middagsberg (69106983), (g) lateral view of larvae, Klipbokkop Mountain Reserve (10831906), (h) Anterior lateral view of larvae showing the presence of sensory pits at the base of SD1 and SD2, Klipbokkop Mountain Reserve (10831906).


a
b
c
d
e
f
g
h
SD1
SD2

(sclerotized plates) and sparse setae (typical of Hepialidae, although not unique). The thorax is robustly developed with large pinnacula, particularly the prothorax that is reddish brown in this specimen (and frequently in other Hepialidae). The head is strongly sclerotized, dark brown to black, and as is typical of Hepialidae after the first instar, has the form of a blunt tear drop with an orthognathous projection where the mouthparts are ventrally oriented. Anterior and slightly above the spiracle of the lateral prothorax, the subdorsal setae SD_1 and SD_2 each have a shallow depression or 'pit' covered with microtrichia (Fig. 1h). With the only known exception of *Leto venus*, all hepialid larvae have a microtrichiated pit at the base of the prothoracic subdorsal setae, either individually or in combination, and in some cases also including D2 (Grehan 1981).

Part of the 'mystery' is solved – the silk pursers are ghost moth larvae. The more challenging question remains: identification of the genus or genera and species responsible. This will require being present at the time of emergence (probably in the late afternoon or just before dusk as is often the case with other Hepialidae), or rearing a larva or pupa. Maintaining a pupa is most likely the least difficult option, although moisture will have to be sufficient, and material should be present that would allow the emergent moth to climb and spread its wings. Rearing larvae would most likely be feasible only by maintaining a host plant along with the larva. Hopefully in the future one or more of these options will prove feasible, and we will start to have a better understanding of the southern African fynbos ghost moth fauna.

Acknowledgement

We are grateful to Eric Metzler (Arizona) for useful critique of the draft manuscript.

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Spindasis syama peguanus - The Club Silverline; Sri Lanna National park - Chiang Mai, Thailand, 450 mt, 8 Feb. 2020. Image by Antonio Giudici.

Alma outside the lab at Rancho del Cielo Biological Station during her Master's research (Spring 1980).

President's Letter: a postscript

The Lepidopterists' Society, 2019-2021

Alma Solis

A letter from me to the membership was published in the Winter 2020 (62:169-172) issue of the News of the Lepidopterists' Society. This letter prompted an invitation to contribute to a blog with some follow-up questions for the University of Texas Biodiversity Center website on March 15, 2021 [**https://biodiversity.utexas.edu/news/entry/meet-lepidopterist-alma-solis**]. I thought I would share some of these answers and an additional photo.

(2.) Your field, broadly speaking, is on the biodiversity of moths. A lot of people don't think about moths the same way as they might butterflies. Why should that change?

There is more interest in butterflies because people can see them during the day. This should change because there are more moth species on the planet than butterflies (there are about 140,000 species of moths and only about 19,000 species of butterflies), but both are significant organisms in ecological webs. Every life stage, eggs, caterpillars, and pupae (or chrysalis), provides food for other organisms such as birds, bats, reptiles, and other arthropods. Caterpillars decompose leaves on trees for our soil by feeding on them.

Adult moths can be general pollinators, usually at dusk, although the ones that have been studied have very intimate relationships with the plants they pollinate, such as the senita moth and the senita cactus. They also provide food for bats and other night flying animals. The most successful groups of moths have developed tympanal organs or ears to "hear the bats" and evade them.

But moth caterpillars can have a direct impact on humans because they are so successful as pests of crops that humans eat, like corn or wheat (and why I work for the US Department of Agriculture). The caterpillars in my group can be direct pests of stored food in people's homes, such as flour, or seeds, such as nuts, in pantries. On the plus side, some species in my group can control plants that have become invasive in different parts of their native habitat, for example, fern-feeding moths to control the Old World Climbing Fern in the Everglades. Some moth caterpillars are a double-edged sword, like the cactus moth for the control of cacti in many parts of the world, but most recently became an invasive species in the United States and found in Texas.

(3.) You spent a few months completely alone in the cloud forest of Rancho del Cielo, researching leaf mining moths and their host plants. Why did you choose this spot for research?

I am from south Texas where I was most acquainted with fields of crops, such as tomatoes, melons, or grapefruits. I was introduced to Rancho del Cielo (see photo, previous page), a cloud forest in northeastern Mexico just 260 miles southwest of where I grew up in Brownsville, Texas, during my freshman year at Texas Southmost College. This was not just a forest, but a cloud forest where the clouds came in, and left every leaf glistening. I could feel my face tingling with the minute droplets of water. I had never seen such tall trees, over 100 feet tall, or bromeliads, or fern in such abundance. This is where my interest in the biological world evolved. Even after I transferred to UT Austin, I would go back as a volunteer. I felt comfortable and safe. I knew all the trails and how the buildings functioned. So later when I was looking for a location to conduct fieldwork, this seemed very natural.

(4.) How was the experience of being alone there for you? What were the challenges? Any amazing memories you wish to share?

The first three days [in the Spring of 1980] were tough. Every noise was something. I couldn't sleep and I slept during the day. I couldn't go on like this and decided to do something about it. After the 3rd day I went outside the cabin where I was sleeping and found every little noise-making structure, a branch hitting the roof, a loose piece of aluminum, squirrels running across the roof, acorns dropping on the roof, etc. Some of the sounds were bats living in the roof between the aluminum and the wood of the cabin.

There are two ways to collect moths at night. One is to put out a trap before it gets dark and then pick it up in the morning. The other is to set out white sheets with special lights to attract the moths. You learn to dodge the bats and eventually you forget about them. Some of the larger moths, such as the Black Witch moth, have spurs on their legs that can be painful when they attach to you. For my research, I mainly used traps, but the sheet collecting was more interesting because you can see the wide variety of moths that come to the lights, you can pick and choose which ones are of interest. One of the most terrible things that happened was that a moth found its way into my ear canal. There was no one else around to use a forceps to pull it out. I couldn't poke at it myself for fear of puncturing my eardrum. I had to let it live, but the sound of a flapping moth in your ear canal is horrible. I had to kill it by putting alcohol in my ear. It stopped moving, but then I had to wait for the moth to decompose and come out in pieces.

One of the more amazing events was when the vehicles left the compound in the first day, many of the usually difficult birds to see, flocked into plain sight. There were Blue crowned mot-mots, Mountain trogons, and woodcreepers, for example, perching within a few feet of me until they realized I was there.

Speyeria atlantis and *S. hesperis* species boundaries

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Hammond et al. (2020) still cling to the old idea that eastern North America *Speyeria atlantis atlantis* (including ssp. *canadensis*) is conspecific with *S. hesperis*, despite overwhelming evidence of genetic, larval, habitat, and adult traits that they are separate species. They also raise the names *hollandi* and *sorocko* to species status, without any evidence. Then Zhang et al. (2020) split *S. hesperis* into three "species". Corrections are needed.

Nine studies provide relevant DNA evidence:

1. Dunford (2007). Once Dunford's misidentifications of some specimens were corrected by us and others, using photos of each, his results demonstrate that (a) *S. atlantis* and *S. hesperis* are separate species, with the mtDNA of *S. hesperis cottlei=dodgei* being somewhat different; and (b) the mtDNA of *S. a. sorocko* from Wyoming is the same as ssp. *atlantis* mtDNA from West Virginia, Ontario and Vermont. Specimens misidentified by P. Hammond that are relevant here [see p. 155] are one "*hesperis*" that is actually *sorocko* from Albany Co. Wyo. [#87529|655]; two "*atlantis*" that are actually ssp. *hesperis* from Washakie Co. Wyo. [#71048|627 and #52267|656]; and two "*atlantis*" that are actually *S. aphrodite* from Renfrew Co. Ontario [#15053|627 and #90700|656]. Dunford treated *canadensis* as a synonym of *atlantis*, as Scott et al. (1998) wrote.

2. McHugh et al. (2013) clearly showed that *S. atlantis* (represented by spp. *hollandi* and *sorocko*) are extremely similar in mtDNA/nuclear genes and are genetically very distinct from the *S. hesperis* group (represented by ssp. *hesperis*, *cottlei=dodgei*, and "*cornelia*" {=*electa*, which has priority}).

3. De Moya (2016) showed that *S. atlantis* ssp. *atlantis* and *hollandi* have extremely similar mtDNA/four nuclear genes, whereas *S. hesperis* (represented by ssp. *irene* and *cottlei=dodgei*) are different genetically.

4. Thompson et al. (2019) demonstrated high similarity of *S. a. atlantis* to *S. a. sorocko* in RADseq genes, and showed that *S. hesperis* differed considerably although is considered a sister species.

5. Campbell et al. (2019) showed that *S. a. hollandi* is not mtDNA/nuclear genetically distinct from *S. a. atlantis* & =*canadensis*, and stated that "Our studies support *S. atlantis* as a distinct genetic entity that does not appear to hybridize or otherwise mix with *S. hesperis* in regions where both taxa co-occur".

6. A September 2020 phenogram (BOLD TaxonID Tree) of "barcode" COI gene mtDNA structure obtained by Guppy of 537 *Speyeria* specimens, demonstrates that *S. atlantis atlantis* from West Virginia, Quebec, and Ontario have very similar mtDNA structure as *canadensis* from Newfoundland, Nova Scotia, and New Brunswick, and *S. atlantis hollandi* from BC and Alberta, and one *S. atlantis sorocko* from Wyoming; they all have the same mtDNA. In contrast, *S. hesperis* ssp. from Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, South Dakota, Colorado, Idaho, Wyoming, New Mexico, Arizona, and Manitoba have a much-different cluster of mtDNA. A third type of mtDNA occurs in *S. hesperis cottlei=dodgei* and *S. h. irene* from Oregon-California (one *S. h.* near-*beani* from Alaska is similar).

7. Riva et al. (2019) studied mtDNA and habitat and eye color etc. of *S. atlantis hollandi*, *S. aphrodite manitoba* and *S. hesperis beani* in Alberta, and showed that *S. a. hollandi* differs greatly from the other two.

8. Zhang et al. (2020) (they replaced genus *Speyeria* with *Argynnis*) found using autosomal and Z-chromosome DNA that *S. atlantis atlantis* from Maine, West Virginia, New York, and Ontario, plus *S. a. "canadensis"* from Newfoundland, *S. a. hollandi* from Manitoba and Montana, *S. a. pahasapa* from South Dakota, *S. a. sorocko* from Colorado, were all mixed randomly together in one tight *S. atlantis* branch, not containing *S. hesperis*, because they have very similar distinctive DNA; *S. atlantis* has 28% unique DNA polymorphisms.

9. Campbell et al. (2020) produced two trees, using nuclear SNPs and mtDNA, which clustered "*canadensis*", *hollandi*, and *sorocko* in one compact group.

S. hesperis cottlei=dodgei and *S. h. irene* have DNA somewhat different from the other *S. hesperis* ssp. (the BOLD phenogram, McHugh et al. 2013, and Dunford 2007), but seem to be ssp. of *S. hesperis* because *cottlei* is similar to *viola*, which intergrades with *tetonia* which intergrades with ssp. *hesperis*. An Alaska *S. hesperis* near-*beani* specimen in the BOLD barcode data has mtDNA similar to *cottlei=dodgei* suggesting *cottlei* may be *S. hesperis* (central Alaska has adults with red-brown disc

which can be called near-*beani* and may be an unnamed variety/ssp. with somewhat-blacker ups wing bases). *S. hesperis* definitely occurs as far west as Alaska [and in Dawson, Yukon], whereas *S. atlantis hollandi* just reaches as far west as the Liard River watershed (roughly the town of Watson Lake, Yukon).

Zhang et al. (2020) treated *S. hesperis* as three species, *S. nausicaa* (with *dorothea*, *capitanensis*, *schellbachi*, *chitone*, *wasatchia*, *tetonia*, *electa*, *greyi*, *elko*, *viola*), *S. irene* (with *cottlei=dodgei*, *hanseni*), and *S. hesperis* (with *beani*, *brico*, *hutchinsi*, *lurana*, *dennisi*, *ratonensis*), which form nearby branches of the tree. They examined very few specimens (half types, and sequenced no *elko* or *chitone*, and one of their "*hutchinsi*" from The Pas, Manitoba is actually ssp. *beani*). The branching pattern using autosomal and Z-chromosomal genes differed, and they noted that *irene* and *hesperis* may be conspecific based on the Z chromosome. Scott cannot accept those as three separate species. Published studies of the phenotype of 100,000 specimens using the Paul Grey method of comparing adjacent populations across the continent (see Scott et al. 1998) actually demonstrates intergradation between those three "species", including the following: There is a "Paul Grey" cline from *beani* through "*hutchinsi*" (which is an intergrade zone of *beani* with *tetonia*) which becomes mostly-unsilvered *tetonia* southward, then in sequence becomes *wasatchia*, then *chitone*, then *schellbachi*, then *nausicaa*. Southeastward, *hutchinsi* near-*tetonia* becomes *lurana* (the Bighorn Mts. seem to have a mixture of some *beani* and much more *lurana* genes) and *hesperis* (*tetonia* forms are even found in Colorado *hesperis*), then *hesperis* intergrades with *electa* along the top of the Front Range of Colorado and especially along the Sangre de Cristo Mts., then in New Mexico *electa* becomes *dorothea* then *capitanensis* and *nausicaa*. Ssp. *greyi* resembles *dennisi* and intergrades with *tetonia* in Cassia Co. Idaho, and *tetonia* intergrades with *viola* in eastern Idaho (Targhee National Forest, Arthur Moeck), and *viola* actually resembles *cottlei=dodgei* (round unsilvered spots on reddish disc with extensive tan, etc.), and *elko* is almost identical to "*S. irene*" ssp., thus "*S. nausicaa*" and "*S. irene*" are conspecific. Ssp. *ratonensis* and *dennisi* are very similar to *greyi* (and occasional paler near-*ratonensis* variants occur in nearby *electa* suggesting gene flow), yet they are misplaced into separate species *S. hesperis* and "*S. nausicaa*" by Zhang et al. (*greyi* may share some ancestry with *beani* through *hutchinsi*/*tetonia*). Ssp. *nausicaa*, *capitanensis*, *dorothea*, and *schellbachi* and SE Utah *electa* have much thicker yellow heart-bands on larvae, but the other ssp. misplaced into "*S. nausicaa*" do not. Also, *electa*, *greyi*, and *tetonia* larvae are melanic like *hesperis* and *lurana* and "*S. irene*" *dodgei*, whereas *nausicaa*, *capitanensis*, *dorothea*, and *schellbachi* are not. Those color forms suggest some gene exchange not matching the three "species". Paul Grey and modern experts including Scott et al. (1998) successfully charted the intergradation of *S. hesperis* ssp. across the whole range, and those three "species" have no areas of sympatry without interbreeding. Thus adults and larvae prove that *S. hesperis* includes "*S. irene*" and "*S. nausicaa*" (Scott et al. 1998).

Campbell et al. (2020) produced a nuclear-DNA tree with two *S. hesperis* groups perhaps "species": one "northern" *hesperis* branch (containing Zhang's *S. hesperis* taxa), and a "southern" *hesperis* branch containing many of Zhang's *S.nausicaa* [but *schellbachi*, *greyi*, *elko*, and *wasatchia* were not sequenced]). However they placed *irene* into the northern *hesperis* group, not as a distinct species. And their mtDNA tree was grossly different, as the northern and southern *hesperis* taxa were randomly and thoroughly mixed together on just one branch of the tree, as their mtDNA is very similar. Furthermore, both of their trees placed *Speyeria zerene* ssp. (*picta*, *platina*, *gunderi*, *zerene*) into their trees near *S. atlantis* and *S. hesperis*, despite the fact those *S. zerene* ssp. are sympatric and reproductively isolated from *S. atlantis* and *S. hesperis*. {*S. zerene* seems to easily exchange genes, thus what was *S. adiaste atossa* may have exchanged genes to become ~*S. zerene atossa*, and what was *S. zerene carolae* may have exchanged genes to become ~*S. coronis carolae*, Zhang et al. 2020}. We conclude that modern DNA trees cannot be used to determine reproductively-isolated taxa, and the trees produce greatly different results depending on the choice of DNA to sequence, and introgression has occurred, at least into/out of *S. zerene*. If geneticists could sequence the genes that make pheromones, perhaps their results could be used to better define reproductively-isolated species. Currently the Paul Grey method works best.

Hammond et al. (2020) claim that *hollandi* and *sorocko* are separate species from *S. atlantis*, which is ridiculous based on the DNA data noted above. In addition, we and numerous others report that *S. atlantis* ssp. (including *hollandi*, *pahasapa*, *sorocko*) fly in moister cooler habitats, whereas *S. hesperis* ssp. usually fly in dryer areas such as open aspen-rich woods. The older larvae of *S. atlantis atlantis*, *S. a. hollandi*, and *S. a. sorocko* are distinctively paler with crocodile-skin body pattern, while *S. hesperis* larvae are much different in markings and most northern ssp. are melanic (ssp. *hesperis, greyi*, *tetonia*, and *dodgei* etc. are very black, ssp. *beani* in BC is dark). Those *S. atlantis* ssp. have various adult traits uniting them, including dark ups margins, a dark-brown ventral hindwing disc with a narrow submarginal pale band, darker ups margins, and always-silvered spots.

Hammond et al. (2020) claim that *S. atlantis atlantis* intergrades with *S. hesperis dennisi* in Roseau Co. Minnesota (near Lake-of-the-Woods) (the highly-variable adults are shown on their fig. 6), and based on that speculation they claim that all *S. hesperis* ssp. are therefore ssp. of *S. atlantis*. Most of their paper involves crosses between *Speyeria* species in the lab, proving that nearly all species hybridize in the lab (they usually remain distinct in nature presumably because of different sex-pheromones, a statement that J. Scott agrees with), so we

need not be surprised to find occasional hybrids in nature. Riva et al. (2019) found a possible hybrid *S. aphrodite manitoba* X *S. atlantis hollandi* in Alberta.

However, there is a simpler explanation for the phenotype and great variation of the Roseau Co. butterflies. Klassen et al. (1989) map and list both *S. hesperis* evidently near *dennisi* (as *electa*) (preferring drier more open habitats in Manitoba) and *S. atlantis atlantis* (preferring cool moist forested habitats) in extreme SE Manitoba next to Roseau Co. And N. Kondla examined specimens of *S. hesperis* from SW Ont. adjacent to Manitoba in the CNC collection (Lake-of-the-Woods is in the SW tip of Ont. and on the edge of Roseau Co.). Therefore it is reasonable to suppose that some *S. a. atlantis* fly in moister sites in Roseau Co. (the individual collection sites or habitats were not listed for any specimens), reproductively isolated from *hesperis* by sex pheromones. There are identification problems. Most of the adults figured resemble variable *S. hesperis* (especially *ssp. dennisi*) and some are like *S. atlantis atlantis*.

But there is a problem with their fig. 6, because all the Roseau Co. photos display the reddish-brown ventral hindwing of *S. hesperis* (including those labeled just "*atlantis*" on the second row of fig. 6)- which is the key trait continent-wide for the recognition of *S. hesperis*. The holotypes of *atlantis* and *canadensis* (a synonym to J. Scott) and *hollandi* (all figured in color by Dunford 2009) are darker on dorsal borders and ventral hindwing than any of the Roseau Co. specimen photos (the disc on those types is dark-reddish-brown on *atlantis*, darker reddish-brown on *canadensis*, and blackish on *hollandi*), however old specimens often darken with time as the reddish disc darkens on photos taken at different times. Most experts say fig. 6 is too reddish, even though the backgrounds appear colorless gray suggesting most of the specimens are actually tinted reddish-brown, and #14 is definitely very reddish. The simplest explanation is that their standard camera setting makes colors too reddish, which is done by camera manufacturers even Nikon because most people prefer redder colors (no-longer-sold Fuji film was made too reddish also). {And computer monitors often display *Speyeria* less reddish.} Anyway, even though the figure is too reddish, we still identify the specimens shown as mostly *S. hesperis* and some *S. atlantis*, and we mostly agree on the identification of the "various intermediates" (13, 15, 21, 25 are *S. atlantis atlantis*, 9, 11, 17, 19, 23, 27 are *S. hesperis*, though 11, 23, 27 are more difficult to identify). Some *S. atlantis atlantis* do have a reddish-brown disc (for instance some from Maine) but most have a dark-brown disc (for instance one from Norland, Ontario NNE of Toronto has slightly redder dark-brown disc). Most ssp. of *atlantis* have some pale-tan or grayish patches in the disc, which appear to be just tan on the adults in Fig. 6, evidently also because fig. 6 is too reddish. (A book on *Colias* butterflies by Paul Hammond also has many photos too orangish.)

The method of scoring the specimens in Hammond et al. (2020)—just as *dennisi* or *atlantis* for each trait—is too simplistic because it badly treats continuous variation.

Now, which *S. hesperis* ssp. applies? There are two similar *S. hesperis* ssp.--*S. h. dennisi* and *S. h. beani*--based on phenotypes at their type localities some distance away from Roseau Co. The figured Roseau Co. *S. hesperis* seem best named ***S. hesperis* near-*dennisi*** athough some such as #19 have a disc more typical of **ssp. *beani***. None are as pale as "pure" *dennisi* (shown from Turtle Mts. North Dakota on Hammond 2020 fig. 6 #1-4), but most adults are similar to the paler to darker individuals of *dennisi* from nearer the type locality of Beulah in SW Manitoba (Duck Mtn. Prov. Park, Onanole, International Peace Garden, etc.). Ssp. *dennisi* is mapped from southern Alberta, southern Saskatchewan, southern Manitoba, North Dakota, and the Sweetgrass Hills of Toole Co. in north-central Montana, and are similar to the *dennisi* from S Alberta (the Neutral Hills in SE Alberta [far SE of Edmonton] and Rimbey and Hoadley) north to Edmonton (and northward as far as Redwater); ssp. *dennisi* varies there from mostly pale- to sometimes dark-reddish-brown disc with tan areas on the disc, like Roseau Co. *S. hesperis* adults, and like the paler holotype of *helena* and its associated homonym *lais* (both from TL Edmonton Alta., by priority a synonym of *dennisi*). Ssp. *dennisi* occurs in aspen parkland habitat (or boreal forest such as Duck Mtn, once in tall shrubery in a ravine at Wintering Hills Alta.)

The other ssp. is the darker *S. h. beani*, which ranges mostly farther from the Great Plains, from the Rocky Mountains of NW Montana and southeastern British Columbia, and southwest Alberta including west of Calgary (TL Banff, where adults vary from mostly darker-reddish-brown to sometimes pale-reddish-brown disc with some paler areas on the disc), and NW of Hinton near Jasper Park; also Alta. *beani* from Castle Mtn., Frank, Fir Creek, & Baril Crk. in N. Kondla coll. are the same although few such as one from Whitecourt, Alberta have a darker-reddish-brown disc with no tan areas. Ssp. *beani* occurs northward in Alberta and Saskatchewan, the Cypress Hills of Saskatchewan-Alberta, and much of Manitoba including The Pas and Pikwitonei in north-central Manitoba (many similar to the *beani* holotype). (Hammond et al. 2020 used the name *brico* instead of *beani* for Canada taiga butterflies, but *brico* has dark-red-brown ventral hindwing and evidently does not occur east of BC.) (An adult from Pine Pass in NE BC has dark-reddish-brown disc like some *beani* and all BC *brico*). Far northern Alberta (Fort Vermilion, 59°N) and NWT may have near-*beani* (Pink Mtn. in N Alta. has near-*beani*, a few have uniform redder ventral hindwing, and some have darker dorsal wing bases). Ssp. near-*beani* with darker ups wing bases may occur in NW BC [Cassiar Mts., Atlin], Yukon, and Alaska. Some Roseau Co. *S. hesperis* resemble the *beani* holotype (figured in color by Dunford 2009) with ventral hindwing disc medium-reddish-brown with tan areas. Ssp. *beani* occurs in boreal forest, mostly drier than *S. atlantis* habitat, though both species may occur where habitats meet or are intermediate dry/wet forest.

Riva et al. (2019) studied identification traits of *S. h.* "*beani*" and *S. a. hollandi* and *S. aphrodite manitoba* in Alberta, confirmed by mtDNA, and found that variation occurs which makes identification more difficult - "no single character distinguishes *beani* [many from central Alta. which may be *dennisi*] from *hollandi*", and "Distinguishing between *S. hesperis beani* and *S. atlantis hollandi* remains complex even after detailed analysis" (they both have gray eyes, whereas *S. aphrodite manitoba* has brown eyes). They found that the dark-chocolate ventral hindwing specimens are mostly *hollandi*, whereas *beani* are usually redder-brown. {Criticism: They examined few *S. hesperis* [most were *S. hesperis dennisi*, few were Alta. Mts. ssp. *beani*] and N. Kondla notes that fresh Alta. *S. hesperis* are generally easily identified. And their late July specimens from Devon Alta. may be *aphrodite*. And Canadian *aphrodite* mostly lack their "halo" character.} But N. Kondla and S. Spomer have found occasional adults in *beani* populations that are dark, similar to *hollandi*, variation indicating that occasional Roseau Co. *S. h.* near *dennisi* look more like ssp. *atlantis* and are harder to identify (and ssp. *atlantis* has some variation from dark-reddish-brown to dark-brown discs, with some even from Maine being reddish-brown, most darker). Many *hollandi* are slightly-reddish dark-brown. In summary, Roseau Co. *S. hesperis* are nearer *dennisi* than *beani*. Thus some Roseau Co. adults are *S. a. atlantis* along with commoner *S. h.* near-*dennisi* (although the bad plate 6 casts some doubt as to how common *S. atlantis* is there). **The "intergradation" speculated to occur in Roseau Co. is just difficulty in identification**, a problem frequently experienced in *Speyeria*, a problem that ruins parts of some DNA studies.

Hammond et al. (2020) failed to sequence DNA of any Roseau Co. specimens, even though mtDNA apparently would clearly identify individuals as *S. hesperis* , *S. atlantis* or hypothesized hybrids. And they failed to lab-hybridize *S. hesperis* with *S. atlantis* (*S. hydaspe* is no substitute for *S. hesperis* in hybrid studies). A lab hybrid of *S. atlantis pahasapa* female with a fully-silvered male of *S. hesperis lurana* by W. Evans produced only 80 infertile eggs (Scott et al. 1998). And they failed to examine older larvae from Roseau Co., which would greatly help identification, because northern *S. hesperis* ssp. have weaker twin heart-lines and are darker (SE British Columbia *beani* have darker larvae, and *dennisi* X *beani* have an intermediate look [S. Spomer pers. comm.], *dennisi* might be paler, and *brico* from BC is probably darker). Also numerous photos prove that all true *S. atlantis* ssp. have paler larvae with crocodile-skin body pattern and twin bright cream heart-lines while lacking the black larvae that occur geographically in half-a-dozen *Speyeria* species including *S. hesperis*.

To conclude, there is zero evidence—DNA or adult phenotype or habitat or larval coloration, etc.—that ssp. *atlantis* is conspecific with any ssp. of *S. hesperis*, and there is much DNA and other evidence that *S. atlantis* includes only ssp. *atlantis*, "*canadensis*", *hollandi*, *sorocko*, and Black Hills ssp. *pahasapa*. And *S. hesperis* is just one species at least based on study of intergrading phenotypes.

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(*The problem with several of these papers (McHugh, Dunford) was that Paul Hammond did all the IDs for specimens they used, so there was some question as to the actual identity of some of the specimens used.*)

The *Catocala* of (northwest) Georgia -- a teaser

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Last year, as we all know, was a very different year for all of us. I normally travel out of state every year, for some significant part of a month during the summer, usually associated with the Lepidopterists' Society Meeting. For obvious reasons, that didn't happen last year. All travel for me was restricted to Georgia, and most was local. I used the opportunity to really concentrate on collecting at some favorite spots locally, including Taylor's Ridge in Walker Co. (very northwest Georgia), which is northwest of my home in Calhoun and almost directly west of Dalton State College. As it turns out, the location has an amazing diversity of *Catocala*, with 36 species being taken (all at light), a number of which are quite rare in northwest Georgia. I've taken five other species there before, so the total number of species from this location exceeds 40. I will be giving a talk on this at this Summer's virtual Lep Soc meeting. I provide a bit of a teaser here of some of the species encountered -- hopefully this will entice you to "tune in" to the meeting (see back cover as well).

Top: *Catocala sappho* (7/23). Bottom: *C. ulalume* (8/15); from Taylor's Ridge, Walker Co., Georgia.

Top: *Catocala robinsonii*, unlined and lined forms (9/12). Bottom: *C. residua*, dark-fringed and white-fringed forms (8/23); from Taylor's Ridge, Walker Co., Georgia.

Metamorphosis

James (Jim) des Rivières (1953 – 2019)

Jim was a computer scientist by profession, working for IBM in Ottawa for many years. But in the entomology world he was best known for creating high-resolution images of moths that could be appreciated as art. His 36" by 48" prints were displayed at the 2018 Lep Soc meeting in Ottawa and as a touring display in museums, including the Canadian Museum of Nature, the American Museum of Natural History in New York, and the Sam Noble Museum at the University of Oklahoma. Perhaps Jim's favourite, though, was his display of postcard-sized images in a converted telephone booth in the UK.

Jim collected butterflies as a boy, but then put that aside. At about age 40 he and his wife, visual artist Kathryn Finter, were using a flatbed scanner to create digital images of flowers, butterflies and anything else that caught their eye. Jim tried some scans of moths, liked the results, and just kept going, and going, and going.

Jim's goal was to allow people to see moths as they really are, not as uniformly drab brown-and-grey dull blobs but as objects of interest. As Jim said: "My aim is to bring moths out into good light and magnify them so that we can all see them. People will be astonished at how exquisite moths truly are."

Jim worked mostly with an Epson flatbed scanner because, at the time, its resolution far exceeded that available from a camera. But that required that specimens be killed, spread and dried. As camera technology advanced, Jim moved to taking pictures of live moths in the field with a Nikon D850 camera and focus stacking: fifty 45-megapixel shots were taken in fifty seconds, with different parts of the moth in focus with each shot. Software then assembled all of the shots into a single image with amazing depth of field. Jim, the "moth whisperer," was remarkably successful at transferring the live moths from the blacklight sheet to his photo stand and then getting them to stay put for the length of their photo shoot. See, for example, the three images of the Asian moth *Scopelodes unicolor* (Limacodidae): one of the whole moth, one of the head, foreleg and antenna, and one of the edges of the forewings.

Top: *Scopelodes unicolor*, adult. Middle: *Head, antenna and foreleg of S. unicolor.* Bottom: *edges of wings, showing fringe.*

Jim's work lives on through the website he created (**www.moths.ca**) and (soon) the website of the Toronto Entomologists' Association (**www.ontarioinsects.org**).

[contributed by Alan Macnaughton]

The Marketplace

IMPORTANT NOTICE to ADVERTISERS: If the number following your ad is "631" then you must renew your ad before the next issue if you wish to keep it in the Marketplace!

Equipment

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

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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.

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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.

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

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

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

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

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

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

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

Publications, Books

New publication: *Butterflies of the Central Arizona Highlands* by Philip McNally. 299 pages. This book addresses a unique and often ignored biological community with remarkable floral and faunal diversity including over 180 butterfly species. The Central Arizona Highlands is a biological crossroads for species from Latin America, the Rocky Mountains, and California. This book includes over 500 photographs of the upper side and underside of all species including some rare images captured in nature, key diagnostic features, hosts, activity period, distribution maps, specific recorded sites, and summaries of current biological and biogeographical studies. $24.95. Available at centralarizonabutterflies.com. 634

Butterflies of Morocco (in English)

Finally in English! Michel Tarrier's celebrated work on the Rhopalocera of Morocco in five captivating volumes, finally available in a full English translation.

THE PAPILIONIDAE OF MOROCCO
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A set of updated and annotated monographs summarizing thirty years of fieldwork throughout all Moroccan regions. New taxa, new unpublished data, detailed compilation of hundreds of localities. Collectively over 770 pages,1150 illustrations, in-depth cartography of complex genera. Promotional price: from 11€ to 21€ for the E-books; private URL/PDF. Contact to buy: **micheltarrier@gmail.com** 632

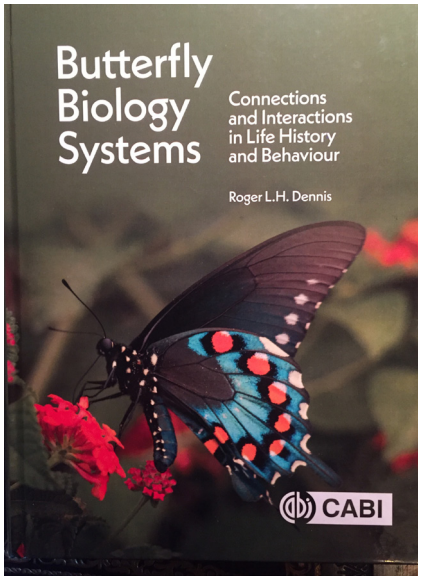
Research

Eric Metzler is looking for any persons who collected moths in the Ouachita Mountains or knows of moths collected in the Ouachita Mountains, a mountain range in western Arkansas and southeastern Oklahoma. Together with the Ozark Plateaus, the Ouachitas form the U.S. Interior Highlands. The highest natural point is Mount Magazine, in Arkansas, at 2,753 feet. If you can help with information about moths collected in the Ouachita Mountains please contact Eric Metzler at: ehmetzler@metzler.app or PO Box 45, Alamogordo NM 88311-0045. Thank you. 634

Book Reviews

Butterfly Biology 76 years after Ford.

BUTTERFLY BIOLOGY SYSTEMS. Connections and Interactions in Life History and Behaviour. By Roger L.H. Dennis. 2020. Wallingford,UK and Boston, MA: CABI. 478 pp. Sterling 150.--/$210 US (lower prices are available from vendors on-line). ISBN 978-1-78924-357-4.



Butterflies were central to many aspects of Victorian biology, but it can be argued that it was the publication of "Butterflies" by E.B. Ford in 1945 that sold researchers worldwide on using them as experimental systems. Fittingly, the publication of "The Biology of Butterflies" as a *Festschrift* in his honor in 1984 reinforced their status, as did "Butterflies: Ecology and Evolution Taking Flight" (2013) and a series of geographically-focused works, one of which, "The Ecology of Butterflies in Britain" (1992), set in motion the project that became this book.

Butterfly biology—or rather the study of it—has changed dramatically since 1945. Then, butterfly study remained much as it had been in Victorian times, insightful projects by individual investigators, often working on a shoestring. That was true of organismal biology in general, not so long ago. The team research model was already well-entrenched by mid-Century in the biomedical sciences and some aspects of physical science, such as astrophysics and particle physics. Why? Because they were heavily dependent on expensive instrumentation and thus required an institutional base. The US-IBP (International Biological Programme) of the 1960s was a daring attempt to translate the team-research model to ecology and environmental biology. It had little impact on butterfly research, but things were about to change profoundly. When I came out of grad school in 1970 the professional reward system in academe still privileged single-author papers. One of the first glimmers of change came when Lewontin and Hubby demonstrated that enzyme electrophoresis could be used to reveal a hitherto-unsuspected wealth of genetic variation in populations. One of the first applications of the technique, which was cutting-edge at the time, to wild populations was by John Burns, working with agricultural *Colias*. From that time forward, hitherto-arcane methods intruded on butterfly research at an accelerating pace. My late colleague Tim Prout used to ask Ph.D. candidates at their orals: "When DNA sequencing costs $5 a pop, will anyone learn morphology any more? And if so, why?" Pretty soon a surfer dude named Kary Mullis invented the polymerase chain reaction—and Tim's question was no longer hypothetical.

Now DNA technology was integral to almost any butterfly study—be it polymorphism, polyphenism, coevolution with host plants, speciation, biogeography…and that

meant collaboration! Who besides Ward Watt was capable of working on the same system simultaneously from the community to the molecular level? And who could finance such research without grant support?

That said, the consequences for using "the literature" were profound. Despite the seeming ease of on-line searching, it became nearly or quite impossible to remain *au courant*. It seems impossible that only 50 years ago Peter Bellinger tried to maintain a running global survey of Lepidoptera research in the pages of the *News,* and later the *Journal*. Even 20 years ago it was still possible for Neal Smith at the Smithsonian Tropical Research Institute to run his own private bibliographical service.

This book represents a truly daring attempt to organize a butterfly literature that has grown beyond all bounds and that fragments and anastomoses simultaneously even as we watch. Dennis has read many thousands of publications and has accumulated 5400 of them as pdfs. (That's roughly twice the number I have, and I have to keep shifting them to Google Drive to keep enough space open for emplacing software updates.) I am in awe of his achievement. After a 50-year career I found myself encountering an average of 3 citations per page (in a 478-page book) that were new to me. Not a few of them proved quite important, forcing me to wonder how I could have missed *that*. Dennis: "It is becoming impossible for any of us to keep up with the progress over the entire subject"—I might add, even if one had no other demands on one's time. The proliferation of "open access" journals, many of which exercise no quality control, has further complicated the task: there's that much more chaff to winnow.

How to proceed, then? Dennis firmly believes that everything is connected to everything else and the "big picture" is essential. His solution to the problem is "systems analysis." Not the sense in which "systems biology" is being used today in cognitive science/neurobiology, but the classical approach pioneered by Bertalanffy at midcentury and aggressively promoted by Ramon Margalef and my late colleague K.E.F. Watt. The vogue for this method passed, leaving behind a legacy of flow charts on all of our PowerPoint shows. The history of the approach parallels that of phenetics in systematics; the zeal went out of it long ago but the useful techniques are here to stay. Dennis argues that systems approaches are the most effective way to organize and communicate about intrinsically complicated matters. He uses them consistently through the book. He acknowledges that few of his readers will be tempted to immerse themselves in the methods as he has, though he provides a basic tutorial in that direction. He correctly surmises that we will all be eager to reap their benefits.

Not even Dennis can read everything. The printed bibliography occupies 119 pages. I noticed right off the extreme rarity of non-English-language titles. I did a haphazard (not rigorously random!) sample of 40 pages and found only 6 with any non-English titles (none had more than one). Some of these were hoary classics. English is the acknowledged *lingua franca* of modern scientific communication, but to what extent can such linguistic parochialism be justified? Dennis misses a few other things too, such as the refutation by Mueller et al. in 2008 of the notion that Pierid larvae sequester glucosinolates for their own defense. His excellent discussion of the ecology and evolution of mimicry misses two fine papers by my former student Elizabeth Long. But enough; the number of works I know that Dennis missed is far smaller than the number I first encountered in his pages.

This is an expensive limited-edition book. But if you fancy yourself a butterfly biologist, you *need* it. It provides road maps (flow charts are very like road maps!) to attacking the many problems that Dennis' and my generation are bequeathing to our younger successors, and on which careers and reputations will be built.

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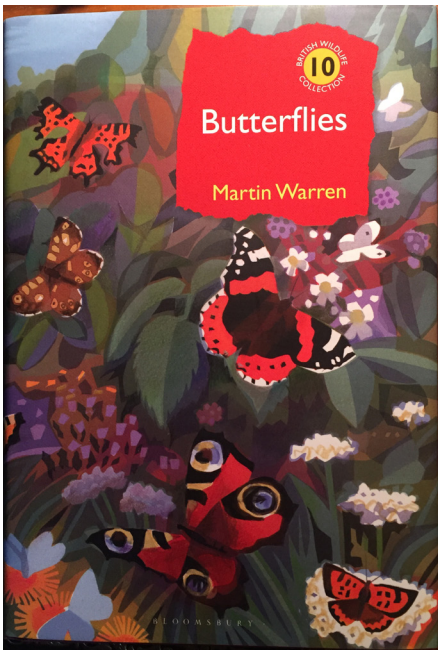
BUTTERFLIES. A Natural History. By Martin Warren. 2021, Bloomsbury Wildlife, London and Dublin. 384 pp. Sterling 29.99/(US price not yet available). ISBN 978-1-4729-7525-6.

The publication of E.B. Ford's "Butterflies" in the New Naturalist series in 1945 was a major stimulus to butterfly study not only in the UK but world-wide. Now, 76 years later, a replacement has appeared—this time as volume 10 in the British Wildlife Collection published by Bloomsbury. These are sumptuously-produced volumes, richly illustrated with color photographs and astonishingly up-to-date. Despite its British focus it, like Ford's book, will resonate globally and demands careful reading by butterfly enthusiasts



everywhere and especially by those specially concerned with conservation and the alarming declines of butterflies nearly everywhere.

Martin Warren recently retired as head of Butterfly Conservation (UK) and then became Head of Development for Butterfly Conservation Europe. In 2007 he won the Marsh Award for Insect Conservation from the Royal Entomological Society and in 2017 received the Order of the British Empire for his conservation work. He is superbly qualified to write this book. It is intended as an introduction to butterfly biology for the sophisticated and concerned layman; it never "talks down." For me the high point is the detailed discussion of butterfly monitoring and the tracking of butterfly populations in time and space in the context of a rapidly-changing planet. Of course, this enterprise began with the British Butterfly Monitoring Scheme about a half-century ago, and has now spread worldwide. But it is still the case that no butterfly fauna has been more thoroughly and lovingly studied than the British. It helps that Britain is an island nation and has a relatively small fauna, but the "national character" has played no little role in that history.

I got my copy of Ford's book in 1960, when I was 14. I still have it and I re-read chunks of it from time to time. This book now lives next to it. May it have a comparable shelf-life, and may the fauna it so lovingly documents be healthy another 75 years down the line!

(I am getting tired of pointing out that Mueller et al. demonstrated in 2003 that *Pieris rapae* and *P. brassicae* larvae do not sequester host glucosinolates and use them for their own defense, as frequently claimed. That is the only error I found in this wonderful book.)

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Membership Updates

Chris Grinter

Includes ALL CHANGES received by May 10, 2021. 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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Meg O'Connor: [red. by req.] (megoconnor13@gmail.com)
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Yi-Kai Tea: Unit 28/2-4 Wrights Avenue, Sydney, NSW 2204 AUSTRALIA (teayk1@gmail.com)

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Leslie M. McClair: 3169 Highway 14, Mill Section, Nova Scotia B0N 2T0 CANADA (lesandiris@gmail.com)
Gordon F. Pratt: 58650 Nickerson Rd., Anza, CA 92539

Robert D. Weast -- a remembrance

Michael M. Collins

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The 1949 movie version of the classic children's book, *The Secret Garden* (MGM, F. M. Wilcox, dir.), was shot in black and white up until the children discover the 'secret garden' behind a reluctant and rusty gate. At this point the movie dramatically switches to Technicolor. I still remember the delighted outburst from the audience. The lush growth and beautiful flower colors transform the troubled lives of the children, even curing a psychosomatic paralysis of the boy. No subtle symbolism here!

Here is a metaphor for many of us in the Society - the childhood discovery of the secret world of Lepidoptera within the greater sphere of nature. As we collected and reared various species all was new and exciting. We were secure in being able to enter this secret world more-or-less at will, one largely apart from the outside world of home, school and everyday life.

Bob Weast and I realized we independently shared this kind of experience. He once wrote to me:

"My life with the saturniids has always been one of inquiry and discovery, such as finding a [*Citheronia*] *splendens* on wild cotton in Brown Canyon, to taking a male [*Rothschildia*] *cincta* in that canyon, to collecting a series of [*Hyalophora*] *gloveri* in Madera Canyon. Each of these was a thrill, - - - as were the boyhood discoveries of the first *luna* at a fruit stand and the first mating of a reared *cecropia* to a wild male [in Wisconsin]."

Bob was born in 1929 in Waukesha, Wisconsin. He was a self-taught trumpet player, and by age 15 helped to support his family by playing in speakeasies and dancehalls in the area. At that time he also developed an intense fascination with saturniid moths; throughout his life he devoted a joyous energy to both ventures. A professor of music for 36 years at Drake University in Des Moines, he became famous as a teacher and performer, and published numerous articles and books on techniques and theory in brass instruments.

After earning a degree from the University of Wisconsin (Madison), Bob moved to Tucson to earn a second music degree, during which he met his wife-to-be, Janice. Bob was among the first post-WW II collectors to record saturniid life history in Arizona and Texas, and was a contemporary of Lloyd Martin (later a prominent member of the Lepidopterist community at the L.A. Co. Museum) when Bob was an undergraduate at the University of Arizona in Tucson.

The spectacular larva of *Eupackardia calleta* (see front cover), which Bob knew from both coastal Texas and from S.E. Arizona, was among his favorites and he was the first to propose that this was a chemically protected aposematic species. His chemical assay consisted of tasting the very bitter liquid emitted by the brilliant blue scoli.

After moving to Des Moines, Bob and Janice eventually purchased a home in lightly wooded property north of Des Moines, overlooking – at that time – agricultural land. It was here that they raised their two daughters Karen and Janine. I remember Janice filling their lovely home with music as she rehearsed classical piano and the liturgical pieces she regularly played in Sunday church services.

The mid-1980s were probably the peak of the Menagerie Era for the Weast property. In the house were various song birds, in outdoor enclosures were exotic pheasants and various hybrid quail, and even a donkey in a corral. Rearing sleeves festooned the branches of wild cherry and other trees and shrubs. Bob was also a devoted beekeeper, even publishing articles on the craft in apiculture journals. During one visit my search image "software" spied a larva of *Hyles lineata* on purslane in the garden, at the edge of a walkway. Bob had never thought to look for wild larvae this close to home and mockingly accused me of conjuring the caterpillar from thin air. I just considered it part of the menagerie.

I have recently written a homage (Collins 2021) to Bob; it was in press when he passed away. Nevertheless, I would like to say again how important his view of natural history was to me as my interest in saturniids developed. He saw each species, not as a discrete taxonomic unit with fixed habits and appearance, but rather as a series of populations, locally adapted to select host plants and environments, surviving in various ways in the face of natural enemies and seasonal weather. Over the years we often wondered how many of the species could persist at what seemed such low population levels. Some of these ideas are expressed in our 'little green book' (Collins & Weast 1961), and others in his privately published booklet (Weast 1989), where he describes attempts to colonize Des Moines, Iowa with *Samia cynthia, Callosamia promethea,* and *Automeris io,* and to monitor their survival. The time and energy he put into this work was worthy of a Master's degree, raising countless larvae and then releasing adults (or sometimes cocoons in the fall) in carefully selected and prescribed areas.

Bob never maintained a collection, and in fact I don't think he owned a spreading board. His passion was rearing and

he always had some new species in hand and a new venture in mind to study its life history. This could be a messy and exciting proposition. Once when I visited him in Green Valley, AZ (near to Madera Canyon) he had his stock – cocoons, bare pupae of 'burrowing' species, live adults – all confined in an open cardboard box. Emerging adults were crawling up the sides of the carton, many finding their way to drapes and curtains looking for a venue to expand their wings. Fellow visitor Bill Harding and I laughed in amazement as we helped to capture the escapees.

Bob and Janice bought a lot in Harlingen, Texas in 1994 and built a winter home there. Discouraged earlier by the price of homes in Tucson, Bob enjoyed returning to the Rio Grande Valley where he and Janice had earlier lived, and he looked forward to devoting time to study the local saturniids. As usual, he shared his joy with others: "The director of the Santa Ana [National Wildlife] Refuge and staff were profuse in their compliments on my presentation: mounted local specimens in a case, two large posters with huge photos by Leroy Simon, the first called "Caterpillar Gems of the Rio Grande Valley" - - the other I captioned "Survival Strategies of Spectacular Silk Moths." He also set up for public viewing along trails emergence cages stocked with cocoons. (Jim Tuttle describes below his memorable visits with Bob in Harlingen.)

And, of course, he gave the community his music as well: "I have a big band concert Feb. 1 [1998] with 18 players, four vocalists; we raise money for the Reynosa MX orphanage. - - - We pack Tropic Star RV Park Ballroom with winter Texans who love the old big band music."

After Janice passed away in 2018, Bob moved to a retirement community in Arizona. He quickly inventoried the place for potential host plants and began stocking up on various species (*E. calleta* to rear on ornamental *Tecoma stans*, and so on). In his last email to me he wrote: "I have ordered several atlas cocoons - - - to show the residents what a giant moth looks like. - - - so you see, I still dabble in our favorite past time – started in 5th grade – and am still intrigued by our behemoth friends." He later told his daughter Janine how he had strolled through the central meeting room, giant atlas moth resting on a finger, variously thrilling and frightening his fellow residents! With the onset of the pandemic, Bob moved in with his daughter Karen. He died at the age of 91, November 18, 2020.

I'll hold closely the image of Bob holding the atlas moth, so representative of him in many ways, and I will miss him greatly.

Michael Collins

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Bob and I knew each other for many years entirely through e-mail writings. Still, we had a close relationship perhaps due in part to having been 'cut from the same cloth'; both with a love of Lepidoptera and Apiculture. Now I wish we had found a way to talk more of this. I took pride in being able to provide some small assistance to his many efforts, mostly by providing Sat cocoons from time to time for which he would always give me credit. I will miss him.

Don Adams

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My father's fascination with moths never wavered and my earliest childhood memories up to the final months of his life involved his enduring love for these nocturnal wonders. My mother and sister accepted my father's passion for moths, but I was the one who assisted him throughout the years. My father loved to tell stories about his life, and many of his favorite moth experiences are included in his personal memoirs [Weast, 1989]. Anything that I can add will not do him justice - his knowledge and experiences are far beyond my understanding. But his life-long devotion to Saturniidae was a significant part of my life. My father was a rare and very special soul and I count myself blessed for having had such uniquely wonderful experiences with him.

I cannot recall a time when there wasn't a designated produce drawer in our refrigerator for cocoons, pupae (exposed to determine gender) and sometimes unfortunate female moths that hatched too soon, legs scrambling as their wings were flattened together in the frayed blue-turned-gray dictionary my father used for prolonging life until males would emerge.

Every summer our dining room table, kitchen desk and my father's bedroom dresser came alive with the fluttering of egg-laying females in brown paper grocery bags held together with clothes pins. Sleeves of mosquito netting – a friend said that they looked like ghosts - were draped over branches of wild cherry, lilac, weeping willow, hickory and other host plants from the back of the house down the hill past the bee hives to the barn which, through the years, held an assortment of animals including pheasants, exotic chickens, peacocks, Sicilian donkeys and horses – a vibrant and loud kaleidoscope of living creatures.

Trips in the family car during the winter and early spring months involved treasure hunts for the coveted silken encasements that dangled from branches or, as with Cecropia, were camouflaged within the bark. On our annual trips to Waukesha, Wisconsin, to visit my father's relatives, we took the "scenic route"- out of the way country roads lined with bushes and small trees alongside rows of planted fields. We trudged through ditches to reach Promethea moth cocoons. Too often we met disappointment when the contents of the cocoons were loose when shaken, a small hole revealing a life cycle interrupted. But the jackpot, the cocoon with weight, and the "tik, tik" sound when shaken was confirmation of life and our prize was placed with others in the glove compartment until we reached our destination.

My father many times lifted me above his head, my feet on his shoulders teetering as I struggled to grasp and then pull cocoons from branches beyond his reach – and mine too sometimes. In 1966, when my father was on sabbatical in Paris, France, I remember my embarrassment as people in a stopped city bus stared at our awkward acrobatics in the pouring rain as I tried with all my might to pull a Cynthia cocoon from a branch that reached over the sidewalk.

Tying female moths always bothered me. My father said that it didn't hurt them a bit but my young mind saw this as being cruel. He later used traps with the females placed in screen covered cans at the top of a funnel with a modified wood and screen bee shipping container below to hold the males as they slipped through the funnel.

My father's walk-in moth cage was an ambitious project. Built in the style of a chicken coop, the screened wooden frame had compartments from floor to ceiling which housed one of his largest and most diverse collections of live silk moths. He never followed any sort of plans when he built things and the end result tended to have structural issues or unanticipated problems. But I loved this set-up as it provided me with the opportunity to examine the moths up close. I also remember my father's tremendous excitement when he discovered an unintended mating of two unrelated moths [*S. cynthia* X *C. promethea* (Weast, 1989)] that had escaped from their compartments. The cage itself was used for only a summer or two. The entrapped flying moths attracted predators and the screen was no match for birds or mice. After it stood empty for a couple of years, my father tore it down and, as he did with all unsuccessful endeavors, never looked back.

In 1984, on a very early Sunday morning, my husband Tom and I met my father at a local mall to determine the speed at which moths travel. My father wanted to take advantage of the large empty parking lot - my husband driving our red Toyota Corolla while I made note of the speedometer. After releasing the moth, my father shouted out directions while my husband attempted to follow it by holding his head outside the car window. My husband was determined in his pursuit and after sudden starts and stops, squealing tires, donuts and skid marks, we watched the elusive moth disappear into the sky. My father insisted that we keep trying, and in the middle of the third attempt, Tom finally had enough, stopped the car and told my father that this was crazy. Conclusion: Moths do not fly in straight lines nor maintain speed. *If only drones had been available at the time.*

Changing moth nets in a hot and muggy Iowa summer has its own set of challenges. A murky neighborhood pond within eyeshot of my parents' home provided perfect conditions for terrible mosquito infestations. My father, an equally enthusiastic apiarist, learned that his bee attire, veil and all, was the perfect answer to the blood-sucking mob.

My father's entire life involved some aspect of his interest in moths. His yard was filled with a variety of host plants, many that he purposely planted to raise his broods. He owned a home in Harlingen, Texas, the location chosen due the presence of Calleta and other moths specific to the area. He visited his grandchildren's schools sharing stories and showing them living specimens, even talking with kindergarten students via Zoom last fall, students of Kristie Kellerman, his granddaughter. He co-authored *Wild Silk Moths of the United States* with Michael Collins, his friend since 1956, and continued to write numerous articles for other publications for many years. The Des Moines Register published several articles about the "moth man" with one reporter asking him, "Why do you raise moths?" My father's response, "Why do people bowl?"

After my father passed, I sporadically checked his email and discovered a message from Don Adams, a fellow moth enthusiast from Massachusetts, who had promised to send him some Cecropia cocoons, my father having requested them months previously. As it was my father's wish to raise Cecropia moths this year, I contacted Don and asked if he could instead send them to me. Within a week, I received a box of several large cocoons, and with great anticipation, I await their emergence. I cannot think of a better way to honor my father than to fulfill his desire to raise yet another batch of these beautiful treasures.

Janine Weast Searcy

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Quite often the paths that our interests follow are driven by serendipity. A chance encounter in 1968 with a used copy of the little green book, "Wild Silk Moths of the United States" was such an event for me. Although it was far removed from the rigid formatting and style expected today, I was enthralled by the black and white images that addressed life histories, parasitoids, and ecology. It caused me to reach out to Bob Weast, who was encouraging, gracious, and supportive. He also put me in touch with his young co-author, Michael Collins, who subsequently has been a frequent sounding board for various musings on saturniid issues and a frequent co-author.

Never one to let a thousand miles or so stand in the way, I visited Bob on two occasions at his winter home in the lower Rio Grande Valley of Texas. We talked for hours about a number of saturniid issues, including seasonality in *Callosamia promethea* and, of a more local interest, if *Agapema solita* [= *galbina* in revision] still existed in south Texas. Bob and I plotted out potential *solita* search sites, and although we found the condalia hosts at those sites, we failed in our extensive search for the moth. On a more positive note, Bob accompanied me to sites in the Harlingen area, where we found *Rothschildia lebeau forbesi* cocoons on willow and citrus. In addition, we collected larvae of *Eupackardia calleta* on cenizia. During the 1993 visit

and accompanied by Michael Smith, we visited Bob and shared our experiences rearing *Sphingicampa albolineata* and *S. heiligbrodti* at the Sabal Palm Sanctuary south of Brownsville.

Bob was not a collector, *per se*, but rather a careful collector of observations that he would selflessly share. While a few of his field observations served as building blocks for some of the species that Tuskes et al. (1996) treated, it was his willingness to openly share information that I regard as his greatest lesson and personal gift to me.

Jim Tuttle

– – – – –

Bob Weast in Arizona, near Tucson, in 1955. This is the only photo I have seen of him with a collecting net! He did not maintain a collection. Courtesy Janine Weast Searcy.

List of Publications by Robert D. Weast, and Select References:

Collins, M.M. 2021. Searching for Cincta: a fascination with a hauntingly beautiful desert dweller. News of the Lepidopterists' Society. 62(4):162-169.

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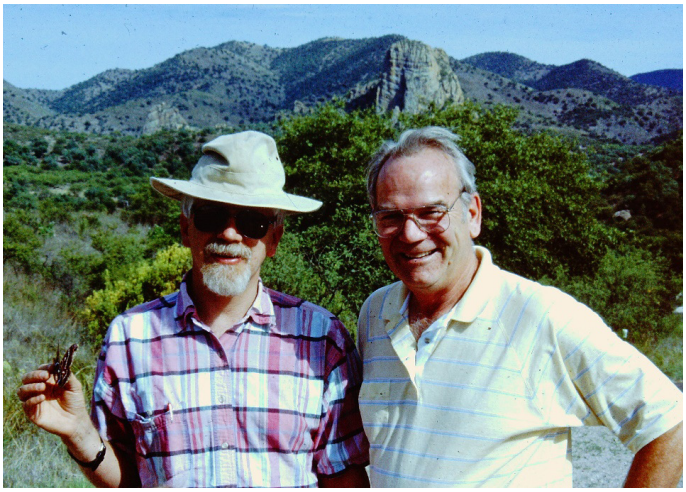
_____. 2014. Hope and Promise: remembering and restoring Iowa's natural heritage. Iowa History Journal. May/June. pp. 28-30.

_____. 2014. Apiculture Pioneers. American Bee Journal. May pp. 577-579.

_____. 2017. Things ain't what they used to be: How Drake University got into the jazz groove. Iowa History Journal, January – February: 8-11.

2013, MMC and Weast signing a copy of their 1961 silk moth book, the only such occasion.

Near Lake Peña Blanca, AZ, July 1993. A fresh male *Hyalophora gloveri* mating with a battered *cecropia* female, which had started laying infertile ova.



Victorious moth hunters with male *gloveri* in hand (see above).

With Bob and Janice at their home in Des Moines, 2009.

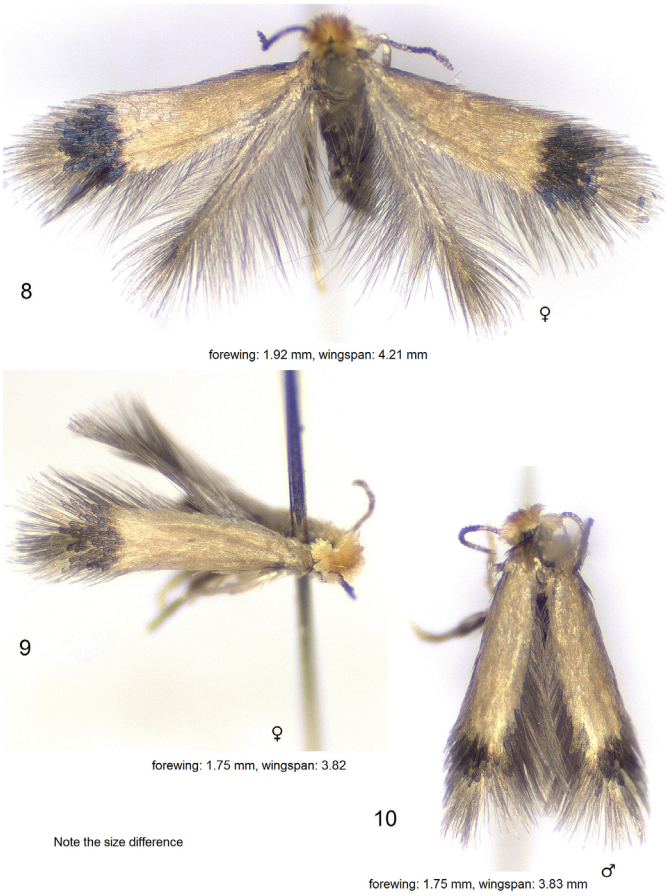
(*Continued from next page*)

Stonis et al. (2021), published in March, attracted great interest from other entomologists and others interested in nature. A copy has been placed at the international research portal ResearchGate.net and is now freely available at: **https://www.researchgate.net/publication/350019216_What_are_the_smallest_moths_Lepidoptera_in_the_world**.

References

Simonsen, T. J. & N. P. Kristensen. 2003. Scale length/wing length correlation in Lepidoptera (Insecta). Journal of Natural History. 37(6): 673-679.

Stonis, J. R., A. Remeikis, A. Diskus, S. Baryshnikova, & M. A. Solis. 2021. What are the smallest moths (Lepidoptera) in the world? Zootaxa. 4942(20): 269-289.



Stigmella incaica Diškus & Stonis

In pursuit of the smallest Lepidoptera in the world

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People often talk about the world's largest Lepidoptera, such as the magnificent *Ornithoptera alexandrae* in Papua New Guinea or the giant *Thysania agrippina* in Central and South America. The species can reach almost 28-30 centimeters in wingspan. **But what about the smallest Lepidoptera in the world?** We recently published an article to answer this question by examining the world's smallest Lepidoptera and discussing the complexity of measuring extremely small moths (Stonis et al., 2021). We measured about 2,800 individuals belonging to 650 of the smallest species of moths and reviewed measurement data published by other authors. We noted that at least eight different families have some of the smallest moths, but two families of moths, Gracillariidae or leaf blotch moths, and especially the Nepticulidae or pygmy moths, stand out from other lepidopteran families because of their extremely small size.

The length of the forewing of the smallest moth species is only about 1.2–1.3 millimeters, and the width of extended wings is about 2.6–2.8 millimeters. Among the Nepticulidae, five of the world's smallest species are now recognized from various regions: *Johanssoniella acetosae* in Europe, *Stigmella diniensis* and *Parafomoria liguricella* in the Mediterranean, *Stigmella maya* and *Simplimorpha* in Central and South America. In the Gracillariidae, the smallest species are *Porphyrosela alternata* in Southeast Asia and *Porphyrosela desmodivora* found in Central Africa. They are all small-size world record holders.

In nature, when these tiny moths perch and are very still, only the very observant notice them. Even when these tiny moths rise to fly and flutter their wings, human eyes usually do not notice them. However, these tiny moths are almost everywhere: in every wilderness, meadow, or forest, and even in our gardens. They are one of the natural wonders of our world, not only because of their size, but because of their beauty. Included in Stonis et al. (2021) is a new species of pygmy moth, *Stigmella incaica* Diškus & Stonis, which was discovered in the South American Andes in 2018. To the naked eye, the allure of this little moth is baffling, but, when a specimen is magnified under the microscope, its beauty comes into full focus (See figures 8-10 from Stonis et al., 2021). Although *S. incaica* is not one of the small-size record holders, it perfectly illustrates the extraordinary beauty of the world's smallest moths.

However, nothing is ever simple in biology. Although the family Nepticulidae is famous for its smallest moths, not all species in this family are extremely small. Some species are real "monsters" compared to small-size record holders. For example, some individual species of the genus *Ectoedemia*, common in North America, have wing spans greater than 8-10 mm. Some species with a wing width of less than 4 mm and a forewing length of less than 1.8 mm make up about 12 % of the world fauna of Nepticulidae. There is variation within species, and species size depends on the sample size or number of moths measured. For example, when measuring about 50 individuals of *Johanssoniella acetosae* collected in one area, the length of the forewing varied from 1.13 mm to 1.90 mm. There has previously been speculation that the smallest moth species were found in the tropics. However, we have found no significant differences between the boreal (northern) and tropical faunas. There can be correlations between the wings and other structures. For example, Danish scientists Thomas Simonsen and Niels Kristensen (2003) found a positive correlation between the length of the wing and the size of the scales covering the wing: the smallest length moth scales (40 μm) were found in the family Nepticulidae and the largest (about 500 μm) in the family Castniidae. The authors found that the size of lepidopteran scales depends on the size of the trichogen cell, or epidermal cell, that secretes the scale.

Nepticulid larvae live and feed inside the leaf of the food plant and, except for very rare cases, cannot leave the leaf and move on to another leaf, regardless of whether food resources are insufficient. Therefore, it has been speculated that the extremely small size of the adult moths may be related to the food plant: if the leaves of the plant are small, then food resources are poor, resulting in smaller individual moths. However, our observations show that larvae of many of the smallest species of Nepticulidae and Tischeriidae (trumpet moths) during their entire feeding period consume only about 4-6% of the food resources available to them. Be that as it may, families of moths whose species are characterized by very small sizes are plant miners. Their larvae live in green tissues of plants, usually in leaves under the epidermis. It is understood that such an ecological adaptation, when living and feeding where space is limited, is only possible for organisms of extremely small size.

(*Continued on previous page*)

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The Lepidopterists' Society is open to membership for 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:

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

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Submission Guidelines for the News

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

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

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

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

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

Submission Deadlines

Material for upcoming volumes must reach the Editor by the dates below:

Issue		Date Due
63	3 Fall	August 15, 2021
	4 Winter	November 15, 2021
64	1 Spring	February 12, 2022
	2 Summer	May 12, 2022

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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Above. All specimens from 2020, and Taylor's Ridge, Walker Co., GA, unless otherwise indicated. Top Row: *Catocala miranda* (6/4), *C. judith* (6/4), *C. serena* (7/12). Middle Row: *C. coccinata* (6/4), *C. coccinata* with reduced lines (a southern form), Sapelo Island, McIntosh Co. (5/17), *C. innubens*, Calhoun, Gordon Co. (6/18). Bottom Row: *C.delilah* and *C. muliercula*, Sapelo Island, McIntosh Co. (5/17), *C. illecta*, Salacoa Creek, SE of Fairmount, Bartow Co. (6/12). See related article page 86.

Left and Below. These swallotail images are from near the Chacra Mariposa Lodge, Obera, Misiones Province, Argentina. Images by Bill Berthet; see related article page 68. Left: puddle club of *Heraclides astyalus*, Jan. 26, 2020. Lower left: *Heraclides astyalus*, Jan. 23, 2020. Lower Right: *Heraclides thoas*, Jan. 23, 2020.