

LEPSOC+SEL 2018

COMBINED ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY AND
SOCIETAS EUROPAEA LEPIDOPTEROLOGICA
JULY 10-15, 2018
CARLETON UNIVERSITY, OTTAWA, ONTARIO, CANADA

CO-CHAIRS:	Vazrick Nazari, Chris Schmidt
ORGANIZING COMMITTEE:	Peter Hall, Don Lafontaine, Christi Jaeger
MEETING WEBSITE:	Ella Gilligan, Todd Gilligan
PROGRAMME:	Vazrick Nazari
MICROLEP MEETING:	David Bettman, Todd Gilligan
SYMPOSIA:	Erin Campbell, Federico Riva
JUDGING AND DOOR PRIZES:	Charlie Covell
FIELD TRIP LEADERS:	Chris Schmidt, Peter Hall, Rick Cavašin
PRE-CONFERENCE TRIP:	Maxim Larrivée
MOTHING EVENTS:	Jason Dombroskie, Ashley Cole-Wick
CNC ACCESS:	Owen Lonsdale, Michelle Locke, Jocelyn Gill
REGISTRATION DESK:	Sonia Gagnon, Mariah Fleck
MEETING & GROUP PHOTOS:	Ranger Steve Muller
LOGO AND T-SHIRT DESIGN:	Vazrick Nazari, Chris Schmidt
VENDORS:	Atelier Jean-Paquet

Cover illustration: The first published image of the Canadian Swallowtail, *Papilio canadensis* (Rothschild & Jordan, 1906), by Philip Henry Gosse, 1840, *The Canadian Naturalist*: 183.

LEPSOC+SEL 2018

SCHEDULE OF EVENTS

JULY 10-15, 2018

Tuesday, July 10th

8:00 am — 4:30 pm	Carleton University campus housing check-in	
8:30 am — 4:30 pm	Microlepidopterists' Meeting (Salon A, K.W. Neatby Building) <i>moderators:</i> Vazrick Nazari & Christi Jaeger	
8:30 am — 10:15 am (In no particular order)		Opening remarks
	Byun	A review of the tribe Cochylini (Lepidoptera, Tortricidae) in Korea
	Charpentier	Collecting in rural Quebec: Highlights from the last seasons
	Eiseman	Leafminers of the Southwestern United States
	Hayden	Three gelechioid pests in Florida
	B. Landry	Pyraloidea research in Nicaragua; preliminary results based on two field trips
	J.-F. Landry	<i>Crasimorpha</i> vs <i>Oestomorpha</i> (Gelechiidae) for the bio-control of the Brazilian Pepper Tree (<i>Schinus terebinthifolia</i>): is it a matter of controlling gelechiid nomenclature as well?
10:15 am — 10:45 am	Coffee break and Poster mingle	
10:45 am — 12:00 am (In no particular order)	Matthews	Plume moths of The Bahamas
	Nazari	An update on the taxonomy of the Andean Potato Tuber Moth, <i>Symmetrischema tangolias</i> (Gelechiidae: Gnorimoschemini)
	Nieukerken	An invasive Asian leafminer on Siberian elm is spreading through eastern North America (Nepticulidae)
	Pinkaw	One century of research on Olethreutinae (Tortricidae) in Thailand
	Sperling	Genus delimitation, biogeography and diversification of <i>Choristoneura</i> Lederer (Tortricidae) based on molecular evidence
12:00 pm — 1:30 pm	Lunch break	
1:30 pm — 4:30 pm	Workshops	
4:30 pm — 6:30 pm	Visit to CNC	
7:00 pm — 10:00 pm	Group dinner	

Wednesday, July 11th

8:00 am – 4:30 pm	Carleton University campus housing check-in
9:00 am – 12:00 pm	Moth Photographers Group meeting, Salon C, K.W. Neatby Building, 960 Carling Ave.
9:00 am – 4:30 pm	Executive Council Meeting, boardroom RB2211, second floor, Richcraft Hall (RB)
1:30 - 8:00 pm	Registration, Foyer, Richcraft Hall (RB)
1:30 - 8:00 pm	Poster set up, Foyer, Richcraft Hall (RB)
5:00 p.m – 8:00 pm	Welcome reception, River Building, atrium and balcony
8:00 pm until late	Field trip for moth collectors (optional) <i>Leaders:</i> Jason Dombroskie, Ashley Cole-Wick <i>Meet at:</i> P18 Parking Lot

Thursday, July 12th

8:00 am – 4:30 pm	Carleton University campus housing check-in	
8:00 - 12:00 pm	Registration, Foyer, Richcraft Hall (RB)	
morning session I	<i>moderator:</i> Vazrick Nazari	
8:00 am – 8:30 pm		Opening remarks
8:30 am – 9:30 am (60 minutes)	Yack	Caterpillars chatter and butterflies listen: Sound strategies for survival
9:30 am – 9:45 am	Yadav	Mechanisms mediating sociality in caterpillars: Vibroacoustics to sociogenomics
9:45 am – 10:00 am	Agassiz	Yponomeutidae and ultrasound
10:00 am – 10:30 am	Coffee break and Poster mingle	
morning session II	<i>moderator:</i> Jason Dombroskie	
10:30 am – 10:45 am	Adamski	A detailed study of a gynandromorph Lep-Leviathan (Saturniidae)
10:45 am – 11:00 am	Miller	The discovery of the male of <i>Synpalamides estherae</i> Miller, 1976 (Lepidoptera: Castniidae), comparative discussion of the taxonomy and bionomics of related species
11:00 am – 11:15 am	Aiello	Notodontids can be beautiful
11:15 am – 11:30 am	Gilligan	Identification of heliothine larvae intercepted at U.S. ports of entry from the New World (Lepidoptera: Noctuidae)
11:30 am – 11:45 am	Kim	Evolutionary hypothesis of family Oecophoridae (Lepidoptera: Gelechioidea)
11:45 am – 12:00 pm	Eiseman	Leafminers of Nantucket and beyond
12:00 pm – 1:30 pm	Lunch break	

Programme and Abstracts

afternoon session I	Symposium: Patterns in butterfly biodiversity (I) <i>moderator: Federico Riva</i>	
1:30 pm — 1:45 pm	Marcus	The Chronicles of <i>Junonia</i> : Reciprocally illuminating adventures in taxonomy and molecules
1:45 pm — 2:00 pm	Zaspel	A deeper meaning for shallow-scale phylogenomic studies: nested anchored hybrid enrichment offers great promise for resolving the tiger moth tree of life (Insecta: Lepidoptera: Erebidae)
2:00 pm — 2:15 pm	Zacca	An overview of the Euptychiina diversity in Brazil
2:15 pm — 2:30 pm	Lucas	Temporal and spatial patterns of genetic diversity in the alpine butterfly <i>Parnassius smintheus</i>
2:30 pm — 2:45 pm	Sperling	Genomic data indicate ubiquitous evolutionary distinctness among populations of western North American metalmark butterflies
2:45 pm — 3:15 pm	Coffee break and Poster mingle	
afternoon session II	Symposium: Patterns in butterfly biodiversity (I) <i>moderator: Erin Campbell</i>	
3:15 pm — 3:30 pm	Brattstrom	Mycalesina in morphospace: How developmental bias shape evolutionary diversification in butterflies
3:30 pm — 3:45 pm	Walker	Rhopalocera of Mabira Forest, Uganda – 2008-2018
3:45 pm — 4:00 pm	Linton	Recovery of the endangered Mottled Duskywing (Hesperiidae: <i>Erynnis martialis</i>) In Ontario
4:00 pm — 4:15 pm	Riva	Effects of forest disturbance from in situ oil sands and wildfires on butterfly diversity
4:15 pm — 4:30 pm	Fric	Cross-continental movements & the ice-ages - The case of holarctic butterflies
5:00 pm — 8:00 pm	Visit to CNC. <i>Meet at: P18 Parking Lot entrance to carpool</i>	
8:00 pm until late	Field trip for moth collectors (optional) <i>Leaders: Don Lafontaine / Chris Schmidt</i> <i>Meet at: CNC visitors Parking Lot</i>	

Friday, July 13th

morning session I	Pyraloidea Symposium <i>moderator: Ana Paula Carvalho</i>	
8:00 am — 8:15 pm	Mally	The phylogenetic systematics of Spilomelinae (Pyraloidea: Crambidae)
8:15 am — 8:30 am	Hayden	Tribal classification of Spilomelinae (Pyraloidea: Crambidae): implications for the New World fauna
8:30 am — 8:45 am	Léger	Phylogeny, character evolution and tribal classification in Crambinae and Scopariinae (Lepidoptera, Pyraloidea)

Students Symposium I (moderator: Ana Paula Carvalho)		
8:45 am — 9:00 am	St Laurent	The first phylogeny of Mimallonidae, and a revised classification of the family
9:00 am — 9:15 am	Campbell	Out of (species) bounds: genome-wide SNPs uncover phylogenetic inconsistencies in the genus <i>Speyeria</i> (Lepidoptera: Nymphalide)
9:15 am — 9:30 am	Martinez	Tracking down the neotropics' other jaguars
9:30 am — 9:45 am	Keegan	What Is That? Further Digging in the Noctuid Junk Drawer Amphipyriinae
9:45 am — 10:15 am	Coffee break/Poster mingle	
morning session II	Students Symposium II (moderator: Richard Mally)	
10:15 am — 10:30 am	Saadain	The curious incident of the moths at light-time: A study testing the attractiveness of different street lamps for Lepidoptera
10:30 am — 10:45 am	Conlin	Lepidoptera Diversity of the Trent Nature Areas
10:45 am — 11:00 am	Leone	To graze or to burn: how management affects butterflies in Minnesota remnant prairies
11:00 am — 11:15 am	Riva	Local and Landscape Determinants of the Rare Cranberry Blue Butterfly (<i>Plebejus optilete</i>): What Matters?
11:15 am — 11:30 am	Dookie	What Makes a Caterpillar Tick? Acoustic Defences are Size and Instar Dependent in Bombycoidea Larvae
11:30 am — 11:45 am	Scallion	Sonic defences of caterpillars: The how and the why of signal variation
11:45 am — 12:00 pm	Baranowski	How does fear of predation affect luna moth larvae?
12:00 pm — 1:30 pm	Lunch break	
afternoon session I	Students Symposium III (moderator: Julia Leone)	
1:30 pm — 1:45 pm	Hernandez	Larval Performance of a Multivoltine Generalist Herbivore: Effects of Diet and Time
1:45 pm — 2:00 pm	Sun	Butterflies use Inflated Wing Veins as “Hearing Aids”
2:00 pm — 2:15 pm	Carvalho	The diversity of the sphragis in butterflies and the impact of this modified mating plug on male-female interactions
2:15 pm — 2:30 pm	Royals	Revision of <i>Paralobesia</i> (Tortricidae: Olethreutinae)
2:30 pm — 2:45 pm	Choi	Review of the genus <i>Archips</i> Hübner (Lepidoptera: Tortricidae) in Korea
2:45 pm — 3:15 pm	Coffee break/Poster mingle	

Programme and Abstracts

<i>afternoon session II</i>	Students Symposium III (<i>moderator: Théo Léger</i>)	
3:15 pm — 3:30 pm	McCarthy	Effects of <i>Ophryocystis elektroscirrha</i> (OE) on the Painted Lady Butterfly (<i>Vanessa cardui</i>) (Lepidoptera: Nymphalidae)
3:30 pm — 3:45 pm	Brack	Conserved and Novel Genes Underlie Expansion of Red Pigmentation Patterns in Butterflies
3:45 pm — 4:00 pm	Peng	Uncovering the genes behind melanin in butterfly wings
(end of Student symposia)		
4:00 pm — 4:30 pm (30 minutes)	Reed	How to make a butterfly wing pattern
5:00 pm	Buses departure to LoneStar Ranch	
5:30 pm - 1:00 am	BBQ at LoneStar Ranch	
9:00 pm	buses return to Carleton Campus. Guests with their own cars can stay until 1:00 am and collect moths.	

Saturday, July 14th

<i>morning session I</i>	Symposium: Digitization, imaging and cataloging Lepidoptera <i>moderator: Jennifer Zaspel</i>	
8:00 am — 8:15 pm	Rivieres	Capturing high-resolution images of live moths in the field
8:15 am — 8:30 am	Caywood	Developing Digitization at the Milwaukee Public Museum
8:30 am — 8:45 am	Colby	Lepidoptera Collections of the Milwaukee Public Museum
8:45 am — 9:00 am	Macnaughton	New developments in butterfly and moth atlases
9:00 am — 9:15 am	Cole-Wick	PollardBase & Beyond: Counting Butterflies Across North America
9:15 am — 9:30 am	Schmidt	The state of North American macro-moth taxonomy: how much do we really know?
9:30 am — 9:45 am	Pohl	Lepidoptera range changes in western Canada
9:45 am — 10:15 am	Coffee break/Poster mingle	
<i>morning session II</i>	Symposium: Biochemistry, phylogenetics, and conservation of Lepidoptera (<i>moderator: Felix Sperling</i>)	
10:15 am—10:30 am	Dowdy	Behavioral and chemoecology on the pin: utilizing museum collections to better understand the bat-moth arms race
10:30 am—10:45 am	Tamaru	Making Use Of Geometrid Phylogenies: Comparative Analyses In Evolutionary Ecology

10:45 am — 11:00 am	Simonsen	Ghosts in the Outback: towards a phylogenetic and biogeographic framework for Australian Hepialidae
11:00 am — 11:15 am	Zahiri	Global phylogeography of the Gypsy Moth
11:15 am — 11:30 am	Rubinoff	Phylogenomics reveals localized, sporadic, and incongruous ecological specialization across <i>Hemileuca maia</i> (Saturniidae)
11:30 am — 11:45 am	Haines	Attempts to reintroduce the Kamehameha butterfly (Nymphalidae: <i>Vanessa tameamea</i>) to restored habitat on O'ahu, Hawai'i
11:45 am — 12:00 pm	Adams	A short update on Dinumma deponens (Erebidae; Scoliopteryginae)
12:00 pm — 1:30 pm	Lunch break	
afternoon session	<i>moderator:</i> Thamara Zacca	
1:30 pm — 2:15 pm (45 minute talk)	Rajaei	A lepidopterist in the hottest spot on the planet earth
2:15 pm — 2:45 pm	Covell	Memories: a selection of images of past meetings from the Society archives
2:45 pm — 3:00 pm	Coffee break	
3:00 pm — 3:15 pm		posters take-down
3:15 pm — 5:00 pm		Business meeting, RB3201 Richcraft Hall
5:00 pm — 9:00 pm	Banquet Reception	
	Scholtens	Presidential address: Brian Scholtens
	Nieuwerkerken	Presidential address: Erik van Nieuwerkerken
	Surakov	In Memoriam: Tom Emmel
		Preview of 2019 LepSoc meeting
	LepSoc EC	Presentation of Student Awards
	Covell	Door Prizes
10:00 pm until late	Field trip for moth collectors (optional) <i>Leaders:</i> Don Lafontaine / Chris Schmidt <i>Meet at:</i> CNC visitors Parking Lot	

Sunday, July 15th

Field Trips

8:00 am	<i>Leaders:</i> Chris Schmidt, Peter Hall, Rick Cavasin <i>Meet at:</i> Entrance to the P18 Parking Lot to assemble carpool groups. Sites to visit will be determined then. There will be three collecting and one photography groups, each with approximately 15 members. Each group will visit two different sites (morning and afternoon).
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Abstracts: Contributed Papers

Microlepidopterists' meeting, Tuesday July 10th

In alphabetical order of presenters' last name

Collecting in rural Quebec: Highlights from the last seasons

Alain Charpentier

14865, rue Maricourt, St-Hyacinthe, Québec J2S 3S5 Canada (unaffiliated)

Abstract: In this presentation, I will share my most remarkable records of microlepidoptera from the past few years. Since 2013, I have collected intensively in Gaspé peninsula (especially in Chaleurs Bay) and in St-Hyacinthe, about 45 km East of Montréal. The specimens were obtained by rearing larvae on host plants as well as night collecting, and their identification was confirmed with dissections and DNA sequences. Some are new records for Québec and Canada and sometimes present a great range extension for the species. The presentation will cover some Tineidae, Gracillaridae and Tortricidae.

Résumé: Dans cette présentation, je veux partager mes mentions les plus remarquables des dernières années parmi le groupe des micro-lépidoptères. Depuis 2013, j'ai concentré mes efforts en Gaspésie (surtout dans la baie des Chaleurs) et à St-Hyacinthe, à environ 45 km à l'est de Montréal. Les spécimens ont été obtenus en élevant des larves sur des plantes hôtes et par des chasses de nuit, et leur identification a été confirmée par des dissections et des séquences d'ADN. Certains sont de nouveaux ajouts pour le Québec et le Canada et présentent parfois une grande extension de l'aire de répartition de l'espèce. La présentation couvrira quelques Tinéidés, Gracillaridés et Tortricidés.

Leafminers of the Southwestern United States

Charles S. Eiseman¹ and Julia A. Blyth²

¹Northfield, MA, USA (unaffiliated); ²Maria Mitchell Association, Nantucket, MA, USA

Abstract: In March 2017 we took a short road trip through the southwestern United States to enhance the coverage of that region in a guide to North American leafminers. Although winter / early spring in an arid region might seem unlikely to be productive, we found mines of Acanthopteroctetidae, Batrachedridae, Bucculatricidae, Coleophoridae, Cosmopterigidae, Elachistidae, Gelechiidae, Gracillariidae, Heliodinidae, Heliozelidae, Nepticulidae, Pterophoridae, Tischeriidae, and Tortricidae, and we were able to rear adults from each of these groups. A substantial proportion of them represented undescribed species, and we obtained new (in some cases first) host records for several of the described ones. Clearly, southwestern leafminers deserve some more attention.

Three gelechioid pests in Florida

James E. Hayden

Florida Department of Agriculture and Consumer Services - Division of Plant Industry, Gainesville, FL, USA

Abstract: I discuss three pest taxa in Florida: *Homaledra* (Pterolonchidae), *Calliprora* (Gelechiidae: Thiotrichinae), and *Pectinophora gossypiella* (Gelechiidae: Apatretrinae). The first two include undescribed species that respectively infest palms and *Leucaena*, and the third is the target of surveys of cotton and okra in Florida. Cosmopterigidae is a

secondary theme, as species of *Melanocinclis*, *Siskiwitia*, and *Anatrachyntis* are associated with the same hosts.

Evolutionary hypothesis of family Oecophoridae (Lepidoptera: Gelechioidea)

Sora Kim¹, Lauri Kaila² and Seunghwan Lee¹

¹Research Institute of Agriculture and Life Sciences, Seoul National University, Seoul 151-742, Republic of Korea;

²Finnish Museum of Natural History, Zoology Unit, University of Helsinki, Helsinki FI-00014, Finland

Abstract: Trophic associations of lepidopteran larvae have been formed from a long period of evolution. The larva of Oecophoridae can keep being concealed with several strategies. They may be sheltered within a web or hidden under bark or dead wood, or inside leaves rolled by them. Sometimes they bore stem or trunk or burrow under bark or hide in soil. In addition, they can also be found in very diverse and specialized microhabitats. This study was to assess the ancestral character state of microhabitat and larva sheltering strategy within the phylogenetic relationship of Oecophoridae to understand their evolutionary transition and the adaptation of larva to microhabitats using sheltering strategies.

Pyraloidea research in Nicaragua; preliminary results based on two field trips

Bernard Landry

Muséum d'histoire naturelle, Route de Malagnou 1, 1208 Genève, Suisse/ Switzerland

Abstract: I visited Nicaragua at the end, and at the onset, of the rainy season in 2015 and 2017, respectively, to support ongoing phylogenetic and taxonomic work on the Crambinae (Pyralidae s.l.) of the New World. Each trip lasted three weeks and three habitats were targeted: a dry deciduous forest at 150 m elev., a mountain forest at 1300 m elev., and a rain forest at 50 m elev. Seasonality proved to be very influential to the overall results, with 352 species collected in 2017 and 290 in 2015. However, at the dry deciduous forest site, the reverse trend was observed, with 70 species found in December and 58 in June, presumably because the rains in May 2017 triggered the normal mass emergences, with the adult moths disappearing quickly thereafter. Each collecting site will be briefly characterized regarding the Crambinae fauna encountered.

Crasimorpha vs *Oestomorpha* (Gelechiidae) for the bio-control of the Brazilian Pepper Tree (*Schinus terebinthifolia*): is it a matter of controlling gelechiid nomenclature as well?

Jean-François Landry¹, Mark Metz², Gregory Wheeler³ and Fernando Mckay⁴

¹Agriculture & Agri-Food Canada, Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada; ²USDA, ARS, Systematic Entomology Laboratory, Beltsville, Maryland, USA; ³Invasive Plant Research Laboratory, USDA-ARS, 3225 College Avenue, Ft. Lauderdale, Florida, USA; ⁴Fundación para el Estudio de Especies Invasivas, Buenos Aires, Argentina

Abstract: The stem-boring, gall-inducing, black-colored *Crasimorpha infuscata*, a gelechiid targeted for the biocontrol of invasive *Schinus* trees, have two different species in Brazil: the southern black *infuscata* Hodges, 1966, and a northern grey one with slenderer galls, likely undescribed. They differ in DNA barcodes, gall shape, and female genitalia. Placement of *infuscata* in *Crasimorpha* by Hodges was based on similarities with a male from Panama tentatively considered conspecific with the type species *peragrata* Meyrick, 1923, itself known from a single female from French Guiana. The sex association remains unverified. A complex of 11 similar species was discovered in the USNM protom material, all superficially similar to the putative male *peragrata* studied by

Hodges. One of them is *Oestomorpha alloea* Walsingham, 1911, originally described from Mexico but widespread in Central and northern South America. All these species appear to be congeneric based on genitalia similarities and barcode analysis. The implication is that *Crasimorpha* would be a junior synonym of *Oestomorpha*.

Plume moths of The Bahamas

Deborah L. Matthews and Jacqueline Y. Miller

McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, P.O. Box 112710, Gainesville, FL 32611-2710 USA

Abstract: The Caribbean plume moth fauna is poorly known, with few species recorded, for example, from Cuba (14) and Puerto Rico (21), compared to the neighboring mainland fauna of Florida (43). In the Bahamas, only five species of Pterophoridae were recorded (1980s). Our efforts to sample the total moth fauna of the Bahamas since 2011 resulted in 11 species reported after surveys on North Andros that year. Since then, 13 major islands in the Bahamas archipelago have been sampled, with the number of plume moth species now more than doubled to at least 23. An overview of the fauna and host associations will be given along with discussion of unknowns and potential new taxa.

An update on the taxonomy of the Andean Potato Tuber Moth, *Symmetrischema tangolias* (Gelechiidae: Gnorimoschemini)

Vazrick Nazari

Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa Research and Development Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada

Abstract: The recent and unexpected discovery of the two 'lost' syntypes of the Andean Potato Tuber moth *Trichotaphe tangolias*, described by Dutch entomologist Klunder van Gyen at the Museo Nacional de Historia Natural in Santiago, Chile, and the subsequent examination of these specimens has shed some new light on the taxonomic complex to which this moth belongs. In this talk I will give an update on an on-going research project that aims to review the complicated taxonomy of this important global pest of potato.

An invasive Asian leafminer on Siberian elm is spreading through eastern North America (Nepticulidae)

Erik J. van Nieukerken¹, Daniel Owen Gilrein² and Charles S. Eiseman³

¹Naturalis Biodiversity Center, PO Box 9557, NL-2300 RA Leiden, The Netherlands; ²Cornell Cooperative Extension of Suffolk County, Entomology, Riverhead, NY, USA; ³276 Old Wendell Rd., Northfield, MA 01360, USA

Abstract: *Stigmella multispicata* Rocienè & Stonis, previously known from the Holotype from Russia, Primorye, is reported as a new invasive species mining leaves of Siberian elm, *Ulmus pumila*, in eastern North America. Adults and leafmines have been reported from many sites as unidentified Nepticulidae since 2010. A match of the DNA barcode of a single larva collected on *U. pumila* in Beijing with adults from North America helped to speed up the identification. *Stigmella multispicata* is closely related to the European *S. ulmivora*, but differs in details. In North America *S. multispicata* is the only *Ulmus*-feeding nepticulid with green larvae. Currently the species is known from USA: Illinois, Indiana, Iowa, Maryland, Minnesota, New York, Ohio, Tennessee, Wisconsin and Canada: Ontario. In some places larvae have been reported to occur in masses on Siberian elms. Online photographs in observation sites have been important in determining the distribution.

One century of research on Olethreutinae (Tortricidae) in Thailand

Nantasak Pinkaew

Department of Entomology, Faculty of Agriculture at Kamphaengsaen, Kasetsart University, Kamphaengsaen campus, Nakhon Pathom, 73140, Thailand

Abstract: Olethreutinae moths were studied and reported from Thailand about one century ago since 1907 to present. There are many Lepidopterists from many countries have been visited, collected, reported or described the moths specimens in subfamily Olethreutinae from Thailand. The research of these moths can be divided into major four periods depend on main lepidopterist. Edward Meyrick was the beginner who firstly used one specimen from Siam (the former name of Thailand) as one of type series of *Temnolopha mosaica* that was described in 1907. The second period was in 1971-1973 that some species were reported and described by Alexi Diakonoff, who contributed his knowledge on tortricid moths to Southeast Asia fauna. The third period was in 1981-1995 that was the major period of olethreutinae moths study in Thailand. Many new species and new records were reported by Atsushi Kawabe from Japan. And the fourth period was started since 2001 to present by Nantasak Pinkaew and team, the local Thai researcher. Recently, 255 species from 97 genera are known from Thailand.

Genus delimitation, biogeography and diversification of *Choristoneura* Lederer (Tortricidae) based on molecular evidence

Giovanny Fagua^{1,2}, Fabien Condamine^{1,3}, Jason Dombroskie⁴, Bong-Kyu Byun⁵, Jurate DePrins⁶, Thomas Simonsen⁷, Marcos Baez⁸, Bryan Brunet¹ and Felix Sperling¹

¹Department of Biological Sciences, University of Alberta, Canada; ²Pontificia Universidad Javeriana, Colombia; ³CNRS, Université de Montpellier, France; ⁴Cornell University, USA; ⁵Hannam University, South Korea; ⁶Royal Belgian Institute, Belgium; ⁷Natural History Museum Aarhus, Denmark; ⁸Universidad de la Laguna, Spain

Abstract: *Choristoneura* species are well known as temperate forest pests, but delimitation of the genus has remained unresolved. Taxonomic confusion increased when *Archips occidentalis* (Walsingham) was transferred to *Choristoneura*, creating a homonym with *Choristoneura occidentalis* Freeman. We reconstructed a phylogeny using DNA for mitochondrial COI and nuclear 28S genes, and generated a time-calibrated tree using fossil and secondary calibrations. Our analysis recovered the genus as polyphyletic, with *Archips occidentalis*, *Choristoneura simonyi* and *Choristoneura evanidana* excluded from the main clade, and we restrict *Choristoneura* primarily to species with a northern hemisphere distribution. We found support for a Holarctic origin of *Choristoneura* about 23 Ma, followed by early divergence in the Palearctic region. The main divergence occurred at 16 Ma, with one clade in the Nearctic and another in the Palearctic. Subsequent independent specialization of conifer feeders in each clade temporally matched the expansion of boreal forest during the Miocene.

**Annual meeting
Thursday, July 12**

Morning Session (I) (Moderator: Vazrick Nazari)

Thursday, 8:00-8:30 **Opening remarks**

Thursday, 8:30-9:30 **Keynote speech**

Caterpillars chatter and butterflies listen: Sound strategies for survival

Jayne E. Yack

Department of Biology, Carleton University, Ottawa, ON, Canada

Abstract: Most people are familiar with insect sounds, particularly those used for advertisement over long distances, such as the familiar chirps of crickets or buzzing of cicadas. What many do not realize is that insects generate and detect an extraordinary diversity of acoustic (sound and vibration) signals that extend far beyond human sensory capabilities. I will discuss new research on acoustic communication in butterflies and caterpillars- insects whose acoustic sensory capabilities are poorly understood. Although once considered to be mostly deaf and mute, we now have abundant evidence that these creatures employ a wide range of sounds and vibrations in their daily activities. I will discuss among other things, how caterpillars engage in rap battles, how butterflies use hearing aids, and why silk and hawk moth caterpillars might rank amongst the 'noisiest' of insects. The complex acoustic landscape of many insects, including Lepidoptera, remains uncharted territory ripe for further exploration.

Thursday, 9:30-9:45

Mechanisms mediating sociality in caterpillars: Vibroacoustics to sociogenomics

Chanchal Yadav and Jayne E. Yack

Department of Biology, Carleton University, Ottawa, ON, K1S5B6 Canada

Abstract: Group living is widespread in larval Lepidoptera but the mechanisms mediating social interactions are poorly understood. We take a pioneering approach to exploring such mechanisms by testing hypotheses on the roles of vibroacoustics and genomics, using the masked birch caterpillar, *Drepana arcuata* (Lepidoptera: Drepanoidea). Like many lepidopterans, *D. arcuata* caterpillars transition from gregarious to solitary living during development. Our results show that (a) social early instars employ complex vibratory signals to recruit conspecifics, whereas solitary late instars employ vibrations to defend territories and; (b) there is a remarkable shift in the transcriptome coinciding with shift from social early to solitary late instars. Transcriptome assembly and analysis revealed ~ 3,000 genes, including candidate "social" genes, to be differentially expressed between social and solitary instars that we further biologically validated using qPCR. Our study provides unprecedented evidence that vibratory communication and differential gene expression mediate social living in caterpillars.

Thursday, 9:45-10:00

Yponomeutidae and ultrasound

David Agassiz^{1,2} and Liam O'Reilly³

¹Garden House, Stafford Place, Weston-super-Mare BS23 2QZ UK; ²Scientific Associate, Dept. of Life Sciences, Natural History Museum, London SW7 5BD; ³School of Biological Sciences, Bristol University, UK

Abstract: A hindwing structure raised the question "Do small ermine moths sing?"

... when do they sing?

... why do they sing?

... how do they sing?

... are there other species doing the same?

... application to taxonomy.

Thursday, 10:00-10:30 **Coffee break and poster mingle**

Morning Session (II) (*Moderator:* Jason Dombroskie)

Thursday, 10:30-10:45

A detailed study of a gynandromorph Lep-Leviathan (Saturniidae)

David Adamski¹ and Diana Marques²

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Abstract: A cross between two Lep-Leviathans, *Citheronia regalis* and *C. splendens*, produced several F1 hybrid progeny and a single gynandromorph specimen. The gynandromorphy was recognized during the last instar as significant bilateral differences were observed, including color; length, and numbers of barbules on the scoli; and setal positions on the head capsule and anal plate. No differences in size, shape, or numbers of crochets were observed on any adjacent prolegs. Pupal differences included comparative sizes of antennae and two gonopores on the eighth abdominal sternum. The adult exhibits a much larger female "*regalis*" side compared to a smaller male "*splendens*" side. Gynandromorphic differences from all life-stages, except the egg, are documented using photography, colorized chaetotaxal maps, scanning electron micrographs, and ZBrush 3-D sculpting software. Gynandromorphic features are sex-linked due to an irregular distribution of genes from both sexes during early mitotic division.

Thursday, 10:45-11:00

The discovery of the male of *Synpalamides estherae* Miller, 1976 (Lepidoptera: Castniidae), comparative discussion of the taxonomy and bionomics of related species
Jacqueline Y. Miller¹, Jorge M. Gonzalez², Bernardo Lopez G.³, Ignacio Zaragoza³ and Fernando Hernandez-Ba³

¹McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, P. O. Box 112710, Gainesville, Florida, USA; ²California State University, Fresno, Department of Plant Science, Fresno, California, USA; ³Facultad de Biología-Xalapa, Universidad Veracruzana, Zona Universitaria, Circuito Gonzalo Aguirre Beltrán, s/n, C.P. 91000, Xalapa, Veracruz, México

Abstract: There are 14 species of the Castniinae known from Mexico of which eight appear to be endemic (Miller 2000; González 2008; González et al. 2008; Niño Maldonado 2013). Of these, *Synpalamides escalantei* (= *Castnia escalantei* Miller 1976) is widely

distributed throughout Mexico including localities in Chihuahua, Guerrero, and Morelos. *Synpalamides chelone* (Hopffer 1857) was originally described from Mineral del monte, Hidalgo. Miller (1976) also described another species, *Synpalamides estherae*, (= *Castnia estherae* Miller 1976) which was based on a single female specimen collected in Purua, Michoacan. As far as we can tell no additional specimens of this latter species have been observed until recently. We will provide a description of the male of *S. estherae*, a comparative discussion of the closely related *S. chelone* and *S. escalantei* and insight into their life history and bionomics, and a description of a new genus, *Escalantiana*, to which the above species are then assigned.

Thursday, 11:00-11:15

Notodontids can be beautiful

Annette Aiello

Smithsonian Tropical Research Institute, 9100 Panama City Place, Washington, D.C. 20521-9100 USA

Abstract: Unlike most adult Notodontidae, which tend to be drab, the caterpillars of many species are quite colorful, and in the subfamily Dioprinae, even the adults are colorful. The life history of *Ephialtias draconis* (Notodontidae: Dioprinae) is described and interaction with its host plant, *Turnera panamensis* (Turneraceae) is explored.

Thursday, 11:15-11:30

Identification of heliothine larvae intercepted at U.S. ports of entry from the New World (Lepidoptera: Noctuidae)

Todd M. Gilligan¹, Paul Z. Goldstein² and Alicia E. Timm³

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²Systematic Entomology Laboratory, USDA, Smithsonian Institution, NMNH, E-502, P.O. Box 37012, MRC 168, Washington, DC 20013, USA;

³Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, Colorado 80523, USA

Abstract: Heliothine larvae, especially early instars, are difficult to identify, often requiring the use of origin and host data to produce a reliable species-level identification. The introduction of *H. armigera* into the New World has altered the ability to identify intercepted *Helicoverpa* larvae by their host and origin, and suspect Heliothinae/*Helicoverpa* larvae are now screened for *H. armigera* and *H. zea* using molecular methods, but non-targets are not identified to species. Here we identify 317 Heliothinae/*Helicoverpa* larvae using DNA barcoding that were screened as non-targets. A total of nine species were identified, with *Chloridea virescens* making up the bulk of interception records. The majority of Heliothinae/*Helicoverpa* suspects originate from Mexico and Peru on pigeon pea, chickpea, tomatillo, pea, and corn. *Chloridea virescens* is recorded from every country where interceptions were identified for this study and is found on multiple hosts. Identification issues and specific host/origin associations are discussed in detail. North of the sunset: tropical butterflies and biodiversity.

Thursday, 11:30-11:45 Break

Evolutionary hypothesis of family Oecophoridae (Lepidoptera: Gelechioidea)

Sora Kim¹, Lauri Kaila² and Seunghwan Lee¹

¹Research Institute of Agriculture and Life Sciences, Seoul National University, Seoul 151-742, Republic of Korea;

²Finnish Museum of Natural History, Zoology Unit, University of Helsinki, Helsinki FI-00014, Finland

Abstract: Trophic associations of lepidopteran larvae have been formed from a long period of evolution. The larva of Oecophoridae can keep being concealed with several strategies. They may be sheltered within a web or hidden under bark or dead wood, or inside leaves rolled by them. Sometimes they bore stem or trunk or burrow under bark or hide in soil. In addition, they can also be found in very diverse and specialized microhabitats. This study was to assess the ancestral character state of microhabitat and larva sheltering strategy within the phylogenetic relationship of Oecophoridae to understand their evolutionary transition and the adaptation of larva to microhabitats using sheltering strategies.

Thursday, 11:45-12:00

Leafminers of Nantucket and beyond

Charles S. Eiseman¹ and Julia A. Blyth²

¹Northfield, MA, USA (unaffiliated); ²Maria Mitchell Association, Nantucket, MA, USA

Abstract: Microlepidoptera are often underrepresented in biodiversity surveys because they are missed by typical collecting techniques or because adults are small and difficult to identify. Leafminers, which include about 10% of described Nearctic Lepidoptera, are best surveyed by searching vegetation for signs of larval feeding (mines). Most are highly host-specific and produce persistent, conspicuous patterns that are often sufficiently distinctive to identify the species. Others may only be identifiable to genus but larvae can be reared to adults without much difficulty. By searching the island of Nantucket (Massachusetts, USA) for leaf mines, we have found about 100 moth species, most of them not previously reported from the island and some of them new to science. Similar plant-focused surveys conducted throughout the continent would greatly improve our knowledge of these moths.

Thursday, 12:00-1:30 **Lunch break**

Symposium: Patterns in butterfly biodiversity (I)

(Moderator: Federico Riva)

Thursday, 1:30-1:45

The Chronicles of *Junonia*: Reciprocally illuminating adventures in taxonomy and molecules

Jeffrey M. Marcus

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Abstract: *Junonia* butterflies (Lepidoptera: Nymphalidae) have been important models for the study of colour pattern development and evolution, larval host plant adaptation, and insect physiology. Yet, the taxonomy of the New World *Junonia* has been difficult and controversial. Obstructions to achieving the goal of taxonomic clarity include the high degree of resemblance between some *Junonia* forms, as well as individual, geographic, and seasonal variability within forms. This challenging taxonomy has become an impediment to unambiguous scientific communication. Projects such as the Barcode of Life Initiative and the Caterpillar Host Plants Database have been compromised for this genus because of poor taxonomy and specimen misidentification. My laboratory has

developed molecular tools, some of which reliably yield genotypes from pinned specimens up to 150 years old, to clarify *Junonia* taxonomy, identify cryptic species, and reconstruct the invasion of and adaptation to Florida by Caribbean *Junonia zonalis*, a process that began in the 1930's.

Thursday, 1:45-2:00

A deeper meaning for shallow-scale phylogenomic studies: nested anchored hybrid enrichment offers great promise for resolving the tiger moth tree of life (Insecta: Lepidoptera: Erebidae)

Jennifer M. Zaspel^{1,2}, Nicolas J. Dowdy^{1,2}, Shannon Keating³, Alan Lemmon⁴, Emily Lemmon⁴, William E. Conner⁵, Clare H. Scott Chivavlo⁶, Timothy Anderson², Susan J. Weller⁷, Rebecca B. Simmons⁸, Melissa Sisson⁸

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Abstract: Tiger moths are a diverse clade comprised of at least 11,000 described species worldwide. They are well known for their bright coloration, mimicry and unique defensive strategies. Moths in this lineage are known to feed on toxic plants and lichens as larvae (and in some cases adults) in order to gain chemical protection against vertebrate predators (i.e., pharmacophagy). Some species sequester these toxic compounds and use them to defend themselves during the adult stage and also attract and protect their mates. Despite the important role of tiger moths in chemical ecology studies, few robust molecular phylogenies for the subfamily exist, hindering our understanding of the role these traits may have played in shaping tiger moth diversity. We generated phylogenetic hypothesis of Arctiinae using anchored hybrid enrichment. We obtained DNA sequence data from over 750 genes for 70+ taxa. Our results suggest anchored hybrid enrichment offers great promise for resolving the tiger moth tree of life. Here, we provide the first strongly-supported phylogenetic framework for the tiger moth radiation and subtribes therein. We also discuss patterns of chemical defense and complex host associations in tiger moths in the context of their evolutionary history.

Thursday, 2:00-2:15

An overview of the Euptychiina diversity in Brazil

Thamara Zacca, Eduardo P. Barbosa, Mário Marín and André V. L. Freitas

Laboratório de Ecologia e Sistemática de Borboletas, Departamento de Biologia Animal, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil

Abstract: With 48 genera and more than 400 described species, Euptychiina is one of the most diverse subtribe of Satyrinae, recognized by its ventral ocelli and brownish wings background, although some species are remarkable by its bluish, lilac or white wings. The group is mostly distributed in the Neotropics even though a few species occur in the Nearctic region and a single species in the Palearctic region. Since 2013, a broader collaborative effort to revise the systematics of the subtribe has been underway resulting in approximately 40 papers published on this group, with 19 species (40%) and 4 genera

(50%) described to Brazil which is home to 52% of the described species of Euptychiina. Here we present an overview of the main advances on the systematics of the Brazilian Euptychiina, especially ongoing descriptions of new taxa, and synthesized the challenges and perspectives of this group for the next years.

Thursday, 2:15-2:30

Temporal and spatial patterns of genetic diversity in the alpine butterfly *Parnassius smintheus*

Melissa Lucas¹, Maryam Jangoo¹, Stephen Matter², Jens Roland³ and Nusha Keyghobadi¹

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Abstract: Few butterfly populations inhabit a homogeneous landscape. Resources are frequently patchily distributed, and habitat quality changes temporally in both predictable (e.g. seasonal) and less predictable (e.g. extreme weather events) ways. Such landscape variation affects patterns of genetic diversity within and between populations. Western Alberta populations of the alpine butterfly *Parnassius smintheus* experience both spatial and temporal variation in habitat quality, making them an ideal candidate to study the effects of habitat variability on genetic diversity. Their alpine meadow habitat is distributed patchily in a forest matrix, and several population collapses attributed to periodic poor overwintering conditions have been documented in this system. Across spatial scales, habitat connectivity and extent are associated with greater genetic similarity between populations. At a fine scale, population collapses result in temporarily decreased genetic diversity, while recovery from these collapses occurs within several generations and is associated with habitat connectivity.

Thursday, 2:30-2:45

Genomic data indicate ubiquitous evolutionary distinctness among populations of western North American metalmark butterflies

Felix Spertling¹, Julian Dupuis², Jeffrey Oliver³, Bryan Brunet¹, Travis Longcore⁴ and Jana Johnson⁵

¹Department Biological Sciences, University of Alberta, Canada; ²University of Hawaii at Manoa, USA; ³University of Arizona, USA; ⁴University of Southern California, USA; ⁵Moorpark College, California, USA

Abstract: Conservation geneticists have argued that Evolutionarily Significant Units (ESUs) must be both genetically distinct and adaptively significant to be recognized for conservation protection. High-throughput DNA approaches can greatly increase the power to identify genetic distinctiveness, even if inferring adaptive significance remains a challenge. Here we present the first genomic evaluation of Lange's metalmark, *Apodemia mormo langei* (Lepidoptera: Riodinidae), a U.S. federally endangered subspecies restricted to sand dune habitats in a National Wildlife Refuge in California. Previous work based on very few genetic markers detected little genetic distinction for Lange's metalmark. We use several thousand genome-wide single nucleotide polymorphisms to characterize the population structure of the *A. mormo* complex across California and determine if Lange's metalmark qualifies as an ESU. We found that Lange's metalmark is genetically identifiable, but is no more distinct than many other isolated populations across the study area. It remains unclear whether this genetic variation is adaptive.

Thursday, 2:45-3:15 Coffee break and poster mingle

Symposium: Patterns in butterfly biodiversity (II)

(Moderator: Erin Campbell)

Thursday, 3:15-3:30

Mycalesina in morphospace: How developmental bias shape evolutionary diversification in butterflies

Oskar Brattstrom¹, Kwaku Aduse-Poku², Erik van Bergen³, Vernon French⁴ and Paul Brakefield⁴

¹Department of Zoology, University of Cambridge, Cambridge, UK; ²City College of New York, USA; ³Instituto Gulbenikan de Ciência, Lisbon, Portugal; ⁴University of Edinburgh, UK

Abstract: We study how developmental bias shape diversification in butterflies. Experimental evolution using *Bicyclus anynana* revealed that developmental bias can constrain the evolution of repeated elements such as wing eyespots. Whereas the relative size of eyespots behaves in an unbiased manner, the colour composition of different eyespots shows strongly biased responses to selection. Focusing on the relative size of eyespot colour elements, we have analysed diversification of eyespot patterns throughout the subtribe Mycalesina (300+ species), including *B. anynana*. Most species of the genus *Heteropsis* on Madagascar show a highly enlarged yellow ring element in a single eyespot, such that this genus occupies a unique area of morphospace. Transplantation experiments in pupae reveal how this novel phenotype develops through modified responses in the wing epidermis to unaltered inductive signals. This reveals that developmental bias through shared development can contribute to shaping diversification, but on a macro-evolutionary scale such bias can be broken.

Thursday, 3:30-3:45

Rhopalocera of Mabira Forest, Uganda - 2008-2018

Mark Walker

5062 Nighthawk Way, Oceanside, CA 92056 USA

Abstract: In 2008 I had the distinct pleasure of visiting Uganda - primarily for adoption proceedings. During the months of waiting and queuing and waiting, I managed to offload some frustration by making multiple visits to a remnant old growth forest between Kampala and Jinja Mabira Forest, which has continued to be impacted by development over the past 10 years, remains an interesting and diverse habitat for many species of Rhopalocera. More recent visits to the area have expanded the data collection. This talk will provide species details, anecdotes, and current status of the Lepidopteron ecology of this fascinating part of the planet.

Thursday, 3:45-4:00

Recovery of the endangered Mottled Duskywing (Hesperiidae: *Erynnis martialis*) in Ontario

Jessica Linton¹, Gard Otis² and Adrienne Brewster³

¹Natural Resource Solutions Inc. 225 Labrador Drive, Waterloo, ON N2K4M8 Canada; ²University of Guelph; Guelph, ON, Canada; ³Cambridge Butterfly Conservatory, Cambridge, ON, Canada

Abstract: *E. martialis* is extant in Canada (MB, ON), occurring in small, isolated metapopulations where its larval food plant occurs. It has always been observed in small numbers and is rarely considered abundant, with the exception of one known subpopulation. There are currently no data available on fecundity, survival rates of juvenile life stages, or optimal conditions for successful captive breeding or

overwintering. Filling in these knowledge gaps is critical to implementing a successful recovery program in Canada. Our current work focuses on identifying the feasibility of reintroducing the species to formally occupied sites through ongoing habitat restoration, collaborative research projects, captive rearing experiments, and coordinating a recovery and implementation team.

Thursday, 4:00-4:15

Effects of forest disturbance from in situ oil sands and wildfires on butterfly diversity

Federico Riva¹, Jaime Pinzon², John H. Acorn³ and Scott E. Nielsen⁴

¹Department of Renewable Resources and Land Reclamation International Graduate School, University of Alberta, Edmonton, Alberta, T6G 2H1 Canada; ²Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, T6H 3S5 Canada; ³Department of Renewable Resources, University of Alberta, Edmonton, Alberta, T6G 2H1 Canada; ⁴Department of Renewable Resources and Land Reclamation, International Graduate School, University of Alberta, Edmonton, Alberta, T6G 2H1 Canada

Abstract: Natural and anthropogenic disturbance of habitat is increasing worldwide. Since these different sources of change in habitat interact in influencing species occurrence, their understanding became a primary focus of biodiversity conservation. In Alberta the boreal biome is subject to widespread extraction of oil sands, which requires extensive networks of cleared seismic line corridors, and frequent wildfires, that are a fundamental component of this system. We investigated how butterflies respond to the individual and interactive effects of in situ oil sands developments and wildfires. Corridors as narrow as 9 m double butterfly richness in comparison to reference undisturbed forests, and provide wildfire refugia where butterflies persist in severely-burned forests. Thus, despite their localized scale, seismic lines condition butterfly diversity and affect the natural dynamics associated with the wildfire regime. Responses in butterflies suggest that the effects of this anthropogenic footprint on invertebrates are widespread and multifaceted, deserving further attention.

Thursday, 4:15-4:30

Cross-continental movements & the ice-ages - The case of Holarctic butterflies

Zdenek Faltýnek Fric¹ and Jana Maresova²

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Abstract: About 50 butterfly species occur both in Eurasia and North America. It is believed that this pattern is caused by repeated connections of the two continents by the Beringian land bridge. To fill gaps in our knowledge of history of cold-adapted insects, we present a comparative phylogeographical study of ten butterfly species specialized to different habitats (from temperate grasslands to Arctic tundra). Based on both molecular analyses and species distribution modeling, our results provide a better view how species from different habitats reacted to climate change. Some species show a deep divergence between North American and Eurasian populations, several species share the same haplotypes in eastern parts of Asia as well as in North America. However, the Beringia was important for post-glacial formation of butterfly fauna of North America. The study was supported by the Grant agency of the University of South Bohemia (152/2016/P; 087/2017/P) and Czech Science Foundation (14-36098G).

Thursday, 5:00-8:00 Visit to CNC.

Friday, July 13th

Pyraloidea Symposium (*Moderator: Ana Paula Carvalho*)

Friday, 8:00-8:15

The phylogenetic systematics of Spilomelinae (Pyraloidea: Crambidae)

Richard Mally¹ and James E. Hayden²

¹University Museum of Bergen, Natural History Collections, Realfagbygget, Allégaten 41, 5007 Bergen, Norway; ²Florida Department of Agriculture and Consumer Services - Division of Plant Industry, Gainesville, FL, USA

Abstract: Spilomelinae is the most species-rich subfamily in the crambid snout moths, but the morphologically heterogeneous group has not been broadly accepted as a natural group due to the lack of convincing apomorphies. In order to test the monophyly of Spilomelinae, we conducted a phylogenetic analysis based on six molecular markers and 114 morphological characters. I discuss the general results of the study and present the proposed tribal classification.

Friday, 8:15-8:30

Tribal classification of Spilomelinae (Pyraloidea: Crambidae): implications for the New World fauna

James E. Hayden¹ and Richard Mally²

¹Florida Department of Agriculture and Consumer Services - Division of Plant Industry, Gainesville, FL, USA; ²University Museum of Bergen, Natural History Collections, Realfagbygget, Allégaten 41, 5007 Bergen, Norway

Abstract: Although Spilomelinae is the largest subfamily of Crambidae, it has no currently accepted classification above the level of genus. A newly proposed tribal classification helps identification and prediction. I discuss three tribes (Agroterini Acloque, Nomophilini Kuznetsov & Stekolnikov, and one based on the *Psara* Group of Munroe 1995), their diagnoses, nomenclatural changes for Nearctic species, and generalizations about host plant associations.

Friday, 8:30-8:45

Friday, 8:30-8:45

Phylogeny, character evolution and tribal classification in Crambinae and Scopariinae (Lepidoptera, Pyraloidea)

Théo Léger¹, Bernard Landry² and Matthias Nuss¹

¹Senckenberg Museum fuer Tierkunde, Koenigsbruecker Landstrasse 159, 01109 Dresden, Germany; ²Muséum d'histoire naturelle (MHNG), Département d'Entomologie, route de Malagnou 1, 1208 Genève, Switzerland

Abstract: The Crambinae (2047 sp.) and the Scopariinae (577 sp.) are two major lineages of pyraloid moths with a worldwide distribution. Their larvae feed predominantly on Cyperaceae, Poaceae and Bryophyta, with a number of crop pests of economic importance. We present here the first molecular phylogeny of both groups based on five nuclear and one mitochondrial gene totaling 4713 bp. 58 Crambinae species representing 56 genera and all tribes, as well as 33 Scopariinae species representing 12 genera were selected along with several other Crambidae lineages. The Crambinae are found sister to Erupa, with Scopariinae as possible sister-group to Crambinae + Erupa. Tribal classification of the Crambinae is revised, with synonymization of two tribes, as well as four scopariine and two crambine genera. Wing venation provides synapomorphies for previously unsuspected clades in the Crambinae. Evolution of non-adhesive eggs, larval life habits and host plants are discussed in the light of our results.

Student Symposium (I) (Moderator: Ana Paula Carvalho)

Friday, 8:45-9:00

The first phylogeny of Mimallonidae, and a revised classification of the family

Ryan St Laurent^{1,2}, Chris A. Hamilton¹ and Akito Y. Kawahara^{1,2}

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Abstract: Mimallonidae, the sack-bearer moths, are a relatively small family of predominantly Neotropical moths. Mimallonidae feed on over 40 host plant families and are found in a variety of environments, but phylogenetic relationships of species within the family have never been investigated. We sequenced 515 loci using anchored hybrid enrichment target capture from 47 species, representing 32 of the 36 mimallonid genera described at the time of this research. Maximum likelihood and multi-species coalescent analyses provide robust support for the recognition of six higher-level groups within Mimallonidae, which we designate as subfamilies. We also revise the classification of the entire family using morphology (for taxa not molecularly sampled) and the framework of the molecular phylogenomic study to aid in a satisfactory classification scheme. The culmination of this research presents numerous taxonomic changes, most importantly six new genera and over 60 new combinations.

Friday, 9:00-9:15

Out of (species) bounds: genome-wide SNPs uncover phylogenetic inconsistencies in the genus *Speyeria* (Lepidoptera: Nymphalide)

Erin Campbell, Ed Gage, Randy Gage and Felix Sperling

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Abstract: Species delimitation in the North American genus *Speyeria* has been complicated by high variability in wing patterning within species, close evolutionary relationships between species, and the use of only a few molecular markers to infer phylogenetic relationships. Genome-wide SNPs have been useful for elucidating relationships in similarly difficult-to-characterize systems and thus represent a promising approach for clarifying species dynamics within *Speyeria*. We present a phylogenetic comparison between DNA barcoding and genomic SNPs to evaluate incongruities between markers. Our results reveal a history of complex interactions likely marked by incomplete lineage sorting, secondary contact and introgression, each of which has implications for species delimitation in this group.

Friday, 9:15-9:30

Tracking down the neotropics' other jaguars

Jose I. Martinez¹, Jaqueline Y. Miller¹ and B. Christian Schmidt²

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Abstract: Jaguar moths (Noctuidae: Pantheinae) comprise three different genera (*Lichnoptera*, *Gaujonia* and *Bathyra*) with about 21 poorly studied species from the Americas, which are characterized by the wing patterns resembling the jaguar stains. An extensive study of jaguar moths has not been carried out since their discovery almost two

centuries ago, and their evolutionary history, behavior and conservation status are still unknown. Therefore, the primary project goal is to explore the evolutionary history and behaviour of this amazing group of moths, employing novel molecular and chemical techniques. Our preliminary morphological and molecular results have shown that the genera *Lichnoptera* and *Gaujonia* are not monophyletic, and also that they contain several new species. In addition, *Gaujonia* and *Lichnoptera* species produce a highly alkaline defensive secretion. Finally, we found that some endemic species are specialists on at-risk plants or restricted to small areas and thus are in need of targeted conservation efforts.

Friday, 9:30-9:45

What Is That? Further Digging in the Noctuid Junk Drawer Amphipyridae

Kevin Keegan and David Wagner

University of Connecticut, Ecology and Evolutionary Biology, 75 N. Eagleville Road, Unit 3043 Storrs, CT 06269-3043 USA

Abstract: Our previous molecular phylogenetic study of Amphipyridae revealed the subfamily to contain genera that belong in 10 sub-family level taxa spread across Noctuidae. We continue to sample amphipyridine genera, both Nearctic and Palearctic, and reveal even more interlopers belonging to already identified and newly identified subfamilies. What's more we sample noctuid genera beyond Amphipyridae with dynamic taxonomic histories (e.g. *Phosphila*, *Magusa*, and *Stilbia*) to shed light on noctuid subfamilial classification as a whole.

Friday, 9:45-10:15 Coffee break and poster mingle

Student Symposium (II) (Moderator: Richard Mally)

Friday, 10:15-10:30

The curious incident of the moths at light-time: A study testing the attractiveness of different street lamps for Lepidoptera

Sarah Saadain

Department of Integrative Zoology, University of Vienna, Althanstraße 14, 1090 Vienna, Austria

Abstract: The term „light pollution” describes the excessive or misdirected use of artificial light. It can have a serious impact on wildlife, especially on orientation of nocturnal species. Over the last decades, light pollution has increased as a consequence of urbanization. During a period of several weeks, different types of commercial street lights were tested in relation to insect attraction. The lamps were incorporated in special light traps and placed along a street in a montane region in Austria. With more than 20,000 insects from 13 different orders, special emphasis was placed on nocturnal Lepidoptera. The study shows a high difference between LED and gas discharge lamps. By choosing the right lamp type, the relative attraction can be decreased up to 96%. The results point out the high influence of streetlights on Lepidoptera activity and show that the negative impact of light pollution can be minimized by using the appropriate lamp type.

Friday, 10:30-10:45

Lepidoptera diversity of the Trent nature areas

Basil Conlin

Trent University, 650 Armour rd., Peterborough, Ontario K9H 1Z4 Canada

Abstract: Trent University is unique in Ontario because its campus mostly consists of natural areas. This provides many unique learning opportunities for students interested in the natural world. For the last seven years, I have been surveying moths on the Trent campus and have compiled a list of over 700 species that occur here. This list is significant because it includes many rare records of uncommon species. Many of these nature areas are threatened by development on campus. My hope is that the school and the public can realize the true potential and worth of their nature areas by witnessing the diversity of insects that are able to live there.

Friday, 10:45-11:00

To graze or to burn: how management affects butterflies in Minnesota remnant prairies

Julia B. Leone¹, Patrick Pennarola², Diane Larson³, Susan Galatowitsch³, Jen Larson⁴ and Karen Oberhauser³

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Abstract: Land managers seek to conserve endangered prairie ecosystems by reinstating natural, pre-settlement disturbances such as fire and grazing. The Minnesota tallgrass prairie is home to many butterfly species that are sensitive to disturbance. Although the effects of fire on prairie ecosystems are well documented, much less is known about the effects of conservation grazing, a knowledge gap we examined by documenting direct and indirect effects of fire vs. grazing on tallgrass-prairie butterflies. Butterfly surveys were conducted at 20 remnant prairies in Minnesota during the summers of 2016 and 2017. One quarter of observed species were associated with only one management type. Nine of 40 species observed were prairie specialists. Two of these prairie-specialist species were observed only at grazed sites, and one only at burned sites. Traits of butterfly species as well as vegetation explain some of these observations and can be used to develop conservation plans.

Friday, 11:00-11:15

Local and landscape determinants of the rare Cranberry Blue Butterfly (*Plebejus optilete*): What matters?

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Abstract: In Alberta, Canada, the cranberry blue butterfly (*Plebejus optilete*) is considered imperiled with <15 occurrences known, generally in treed peatlands. There is concern that this species will be negatively affected by anthropogenic disturbances associated with seismic assessments of underground oil sands reserves. Here, we investigated how variation in patterns in natural and anthropogenic forest characteristics affect the occurrence of cranberry blue butterflies. We sampled cranberry blues along 250-m transects across 40 sites, and modeled the species occurrence based on forest

disturbance (wildfire and oil sands developments), forest structure, and soil wetness. We discovered 14 new populations across a 2,500-km² region of northeast Alberta. Cranberry blues preferred open treed peatlands and were sensitive to disturbance. Although local characteristics are the primary determinant of species occurrence, amount of surrounding treed peatland conditioned the local presence of cranberry blues, confirming that the landscape can fulfill important roles in moderating ecological processes.

Friday, 11:15-11:30

What makes a caterpillar tick? Acoustic defences are size and instar dependent in Bombycoidea larvae

Amanda L. Dookie¹, Akito Y. Kawahara² and Jayne E. Yack³

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Abstract: Defence sounds in insects are taxonomically widespread and acoustically diverse. Yet, hypotheses explaining their functions and evolutionary origins are understudied. Bombycoidea caterpillars are excellent models to test such hypotheses because many species produce antipredator sounds. We first tested the hypothesis that sound production is size-dependent by following the ontogeny of defence sounds in four species. In all species, sounds first occurred in third instars when individuals were of similar size (\bar{x} = 26.27 mm long). We also sought to explain why small caterpillars lacked sound production. Of sound producing individuals, there were few significant relationships between body size and sound characteristics. We conclude that once a caterpillar begins to produce sound, the sounds are sufficiently loud and long enough to be effective against predators. These interesting results support the hypothesis that sonic defences are size dependent, and that they ‘switch on’ when caterpillars reach a critical size. Research was supported by an NSERC Discovery Grant, Ontario Innovation Trust, Canadian Foundation for Innovation, and an Early Researcher Award to JEY.

Friday, 11:30-11:45

Sonic defences of caterpillars: The how and the why of signal variation

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Abstract: Among caterpillars, Bombycoidea are unique for their ability to produce antipredator defence sounds. These sounds occur in 36% of species tested to date with four distinct mechanisms: clicking, chirping, whistling and vocalizing. The sounds vary in their signal characteristics, but which characteristics they vary by the most, and why, is unknown. We tested the hypothesis that signal variation reflects the communication of alternate functions, such as aposematism or deimatism, by studying how this variation relates to chemical defences. Using a principal components analysis, we found that “unit shortness” (PC1: unit duration, pulses-per-unit, pulse rate) accounted for 42% of the variation between sounds. Shorter sounds correlated significantly to higher chemical defence levels (PGLS correlation coefficient -0.621, $p < 0.05$), providing evidence that short sounds may be aposematic. The results suggest that signal variation may have evolved to convey different messages to predators, and we will further test this hypothesis empirically using live predators.

Friday, 11:45-12:00

How does fear of predation affect luna moth larvae?

Alex Baranowski and Evan Preisser

Department of Biological Sciences, University of Rhode Island, USA

Abstract: We reared *Actias luna* larvae in the presence of nonlethal predatory wasps. Compared to the control (no insect) and harmless fly (to factor for flying insect disturbance) groups, wasp group larvae had a higher mortality rate. Time to and weight at pupation was not affected by treatment, although weight at death of larvae that died was.

Friday, 12:00-1:30 Lunch break

Student Symposium (III) (Moderator: Julia Leone)

Friday, 1:30-1:45

Larval performance of a multivoltine generalist herbivore: Effects of diet and time

Katherine Hernandez¹ and Deane Bowers^{1,2}

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Abstract: An important challenge in ecology and evolutionary biology is understanding the evolution of diet breadth in herbivorous insects. This may be especially important for multi-voltine, generalist species in which host plant availability and suitability may change over generations. This project compared the effects of diets composed of a single plant species versus a mixed diet containing all species on performance of larvae of the generalist butterfly, *Vanessa cardui* (Nymphalidae), the painted lady, and how performance might change over multiple generations. Host plants used in this experiment were: silvery lupine mallow, narrowleaf plantain, and dandelion. The objectives were to: 1) compare larval performance (growth rate, pupal weight, survival, immune response) when fed on a single host plant or a mixed diet of all species, and 2) assess larval performance over four generations. Results showed that all measures of larval performance were lowest on dandelion and silvery lupine across all generations.

Friday, 1:45-2:00

Butterflies use inflated wing veins as “hearing aids”

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Abstract: Insects have evolved a diversity of hearing organs, each specialized to detect sounds critical to survival. We report on a unique structure on butterfly wings that enhances hearing. The Satyrini are a diverse group of butterflies, occurring throughout the world. One of their distinguishing features is a conspicuous swelling of their forewing subcostal vein, but the functional significance of this structure is unknown. We show, for the Common Wood-Nymph, *Cercyonis pegala*, that wing vein inflations function in hearing. These butterflies have ears on their forewings that are mechanically most sensitive to low frequency sounds (<5 kHz). Swollen wing veins are hollow and are connected to the ears. Finally, when subcostal vein swellings are cut, low frequency

hearing is impaired. We propose that modified wing-veins serve as miniature 'hearing aids', contributing to low frequency hearing by impedance matching or as Helmholtz resonators. The adaptive significance of hearing in butterflies is discussed.

Friday, 2:00-2:15

The diversity of the sphragis in butterflies and the impact of this modified mating plug on male-female interactions

Ana Paula S. Carvalho¹, Albert G. Orr² and Akito Y. Kawahara³

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Abstract: Males of many species have developed strategies to prevent female re-mating and ensure paternity of the offspring. In some butterflies, males have evolved the ability to produce externalized, often enormous mating plugs, known as sphragis. After searching in the literature and insect collections, we have built a comprehensive list of the occurrence and morphological diversity of the sphragis in butterflies. A sphragis, or related structure, was recorded in 278 species so far, distributed in the families Papilionidae and Nymphalidae. A true sphragis seems to have evolved independently in at least five butterfly subfamilies. The sphragis could be a good example to illustrate mate conflict and sexually antagonistic coevolution. Investigating the biology involved in the development of sphragides as well as the evolution of this structure across butterflies should help us deepen our understanding of the selective processes affecting the 'arms race' between males and females.

Friday, 2:15-2:30

Revision of *Paralobesia* (Tortricidae: Olethreutinae)

Hanna Royals¹ and Todd Gilligan²

¹Colorado State University, 2301 Research Blvd., Fort Collins, Colorado 80526 USA; ²USDA-APHIS-PPQ, 2301 Research Blvd. Fort Collins, Colorado 80526 USA

Abstract: The genus *Paralobesia* currently consists of 19 described and several undescribed species. The taxonomic history of Nearctic *Paralobesia* is confusing due to the unresolved question of monophagy in the genus, misuse of names in previous literature, the similarities in wing pattern between congeneric species and those in the closely related genus *Lobesia*, and numerous undescribed species. Here we complete the first comprehensive systematic revision of *Paralobesia*. We combine information from morphology, DNA barcodes, and host data to provide diagnoses for all species in the genus. We re-examine the morphological characters that define the genus, test monophyly of the genus using DNA data, and provide evidence that *Paralobesia* is indeed separate from *Lobesia*. We describe 12 new species and provide detailed re-descriptions of the other 18 species. In addition, we provide several examples of species that can be differentiated using morphology but cannot be separated using traditional DNA barcodes.

Friday, 2:30-2:45

Review of the genus *Archips* Hübner (Lepidoptera: Tortricidae) in Korea

Hae-Ryun Choi and Bong-Kyu Byun

Department of Biological Science & Biotechnology, Hannam University, Yuseong-Gu, Daejeon 34054, Korea

Abstract: The genus *Archips* is one of the large groups among the family Tortricidae,

which includes 102 described species in the world. In Korea, totally 17 species of the genus *Archips* have been known to date. The members of the genus are somewhat difficult to identify exactly especially between the sexes due to the sexual dimorphism. Also, there are some species among the genus, which has been changed their taxonomic position recently, including *Archips occidentalis* to *Cacoecimorpha* and *Choristoneura evanidana* to *Archips* respectively. Thus, it need to conducted the taxonomic study in Korea not only extracting the DNA barcodes, but also examining the morphological characters critically, especially on the female adult. In this study, we provide a list of the genus *Archips* in Korea for understanding the faunistic characteristics of the Korean peninsula. Also, historical review of the genus in Korea is presented. This study is aimed to clarify the faunal inventory of the genus including the synonymic list, host plants and distributional ranges was arranged for the further study of the genus *Archips* in Korea. And all available materials were examined for adult and genitalic characters with known information, including DNA barcoding. Also, the further study for the Korean *Archips* is discussed.

Friday, 2:45-3:15 Coffee break and poster mingle

Student Symposium (IV) (Moderator: Théo Léger)

Friday, 3:15-3:30

Effects of Ophryocystis Elektrosirrha (OE) on the Painted Lady butterfly (*Vanessa cardui*) (Lepidoptera: Nymphalidae)

Joseph McCarthy

SUNY Oswego, 26 NW 9th Street, Oswego, NY 13123 USA

Abstract: The protozoan parasite *Ophryocystis elektrosirrha* (OE) is known to infect three species of butterflies, monarchs (*Danaus plexippus*), queens (*D. gilippus*), and lesser wanderers (*D. petilia*). There are no documented cases of other butterfly species hosting OE, and no research has been done on its effects on other species, although horizontal transmission is possible and likely in areas of high rates of parasitism. In the three *Danaus* hosts, OE infections can lead to shorter lifespans, reduced flight ability, lower fecundity rates, and an overall reduction in body sizes. I studied the effects of OE on a non-host species, the painted lady butterfly (*Vanessa cardui*), to determine if OE could complete its life cycle or impact the development of the painted ladies. Cross infections found that OE exposure lead to a reduction in adult and pupal body mass and an increase in amount of time between larval and pupal eclosion.

Friday, 3:30-3:45

Conserved and novel genes underlie expansion of red pigmentation patterns in butterflies

Benjamin Brack

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Abstract: While wing coloration plays a vital role in the evolution of butterflies, the genetic mechanisms underlying butterfly coloration have only recently started to be discovered. The genetic basis of ommochromes, a family of red pigments, remains poorly understood in butterflies. Using CRISPR/Cas9 genome editing, we have deleted several candidate genes likely involved in the formation of red pigments in *Vanessa cardui*. Deletions in genes from two novel families of transporter molecules demonstrate local

reduction or complete loss of red pigment. Additionally, the deletion of some genes known to be involved in ommochrome synthesis in the fruit fly, *Drosophila melanogaster*, also resulted in loss of red coloration. Collectively, these results indicate the complexity of butterfly ommochrome synthesis and demonstrate that expansion of the red and orange color pattern palette in butterflies is due not only to the conservation of ancestral genes but also to the cooption of novel transporter genes.

Friday, 3:45-4:00

Uncovering the genes behind melanin in butterfly wings

Ceili Peng^{1,2}

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Abstract: Lepidopteran scales and the color patterns that they compose have important roles in flight, thermodynamics, mating, and predator deterrence, among others. Despite the crucial functions of these scales and patterns, there are gaps in our knowledge as to the genetic mechanisms responsible for their patterning, development, and coloration. Here, I discuss recent research using CRISPR/Cas9 gene editing technology to uncover the genetic basis of melanin in the pigmentation of *Vanessa cardui* butterflies. Of special interest were functional knockout tests of the gene *laccase 2*, which resulted in reduction of melanin pigmentation, but also produced more dramatic mutant phenotypes including scale reduction and wing malformation. This work provides further support for the growing list of genes which play dual roles in melanization and scale formation and provides new insight into the evolution of lepidopteran wing coloration.

(End of student symposia)

Friday, 4:00-4:30 (*30 minute talk)

How to make a butterfly wing pattern

Robert D. Reed

Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, USA

Abstract: In 1924 the Russian entomologist Boris Schwanwitsch proposed the first model of the butterfly wing pattern groundplan. The basic premise of this model was that a simple ancestral system of spot and stripe elements has evolved over time to produce the diversity of color patterns we now see in nature. Over the years a body of research has developed that applies this groundplan model to interpret color pattern homologies between disparate groups. Until recently, however, we have had only a limited understanding of the developmental genetic basis of color pattern development. In this talk I will describe recent advances we have made using gene expression comparisons, genetic mapping, and gene editing to better understand the wing pattern groundplan. Thus far our results largely confirm Schwanwitsch's model of color pattern modularity, but go further by allowing us to settle some contentious debates about color pattern homologies in butterflies with highly derived wing patterns. Furthermore, by connecting specific genes to specific color patterns we can now begin to address a new generation of questions about the genetic origins of lepidopteran color patterns themselves.

Friday, 5:30-1:00 am **Barbecue at Lone Star Ranch**

Saturday, July 14th

Symposium: Digitization, imaging and cataloging Lepidoptera

(Moderator: Jennifer Zaspel)

Saturday, 8:00-8:15

Capturing high-resolution images of live moths in the field

Jim des Rivieres

4B-144 Clarence Street, Ottawa, ON K1N 5P8, Canada

Abstract: Several artists have photographed moths and other insects with the aim of producing large-scale archival inkjet prints for display and sale. The digital image capture technology varies: Scheer uses a flatbed scanner, as does the author; Biss uses a digital camera and stacking software. All work with dried specimens, usually with their wings spread. All produce large prints (over a meter across) of individual moths. Gowin has photographed live moths in the field, showing the beauty of moths with wings in their natural resting positions. Gowin also produces large prints of 5x5 arrays of small moth portraits. This paper discusses recent developments that allow the capture of high-resolution portraits of live moths using digital camera, custom-built camera stand, and LED lightbox. The setup was designed to be used in the field alongside a collecting sheet or trap, and folds up to fit into airline carry-on luggage.

Saturday, 8:15-8:30

Developing digitization at the Milwaukee Public Museum

Alyssa Caywood

Milwaukee Public Museum, 800 W Wells St., Milwaukee, WI 53233 USA

Abstract: Since 2015, Milwaukee Public Museum has developed their collections digitization projects with the goal of producing workflows and procedures applicable to multiple collection types. In addition to an overview of the development of institutional digitization infrastructure and volunteer-supported production, I will discuss how we are applying what we have learned through our pilot projects to current LepNet and future grant projects.

Saturday, 8:30-8:45

Lepidoptera collections of the Milwaukee Public Museum

Julia Colby

Milwaukee Public Museum, 800 West Wells Street, Milwaukee, WI 53233 USA

Abstract: The Milwaukee Public Museum had its origin in 1883 with a group of collections presented to the City of Milwaukee by the Natural History Society of Wisconsin. The invertebrate collections are approximately 800,000 specimens (70% insects, 30% other invertebrate groups) over 52 zoological classes and include wet and dry material. A brief overview of of the insect collections, notable past collectors, current staff, and ongoing projects will be given, with a focus on the lepidoptera holdings.

Saturday, 8:45-9:00

New developments in butterfly and moth atlases

Alan Macnaughton

Toronto Entomologists' Association; 49 Northforest Trail, Kitchener, Ontario N2N 2Y7 Canada

Abstract: Data-submission websites such as eButterfly, BAMONA, iNaturalist, and BugGuide collect visual observations and both photograph and specimen data. However, there is a need to have the data displayed and analyzed in maps, charts and statistics, which is a relatively low priority for these websites. Also, groups of people interested in a particular geographic area will wish to collect data from all data-submission websites - which is possible since all of the data-submission websites have, or are working on, data download facilities accessible to such groups. Butterfly and moth atlas websites can achieve both of these goals. This talk will discuss the state of the art in such atlases, including how atlas websites can allow user interaction such as zooming in by using website developer tools such as Google Fusion Tables (Macnaughton, Lep. Soc. News, 2012) and the Google Maps API. The Ontario Butterfly Atlas will be discussed as an example.

Saturday, 9:00-9:15

PollardBase & beyond: Counting butterflies across North America

Ashley A. Cole-Wick¹ and Jeffrey S. Pippen²

¹Kalamazoo Nature Center, MI, USA; ²Georgetown University, Washington D.C., USA

Abstract: Citizen science is a growing force and powerful tool for bio-inventory work and biological population monitoring. Many regional and statewide monitoring programs use citizen science to gather data on butterfly populations and these data can be combined to investigate myriad ecological questions. Used for decades in both Europe and the United States, "Pollard Walk" protocols provide a fairly consistent methodology for gathering local data and comparing butterfly population trends at multiple scales. We have developed an online, international database (PollardBase) to provide support to various butterfly monitoring programs across the continent. In this talk we will introduce PollardBase, described the Michigan Butterfly Network, and discuss butterfly monitoring efforts at the MPG Ranch in the Bitterroot Valley from 2014-2016 using Pollard Walks. PollardBase is growing and we welcome questions from those who wish to start a state or regional monitoring program using our resources.

Saturday, 9:15-9:30

The state of North American macro-moth taxonomy: how much do we really know?

Chris Schmidt

Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-food Canada, 960 Carling Ave., Ottawa, ON K1A 0C6 Canada

Abstract: The last two decades have ushered in a new age of taxonomic discovery of the North American macro-moth fauna, which has yielded many surprises. Using the Noctuoidea as an example, an overview is presented of the nature and pattern of recent cryptic-species discoveries, existing knowledge gaps, and future prospects for improved taxonomic resolution.

Saturday, 9:30-9:45

Lepidoptera range changes in western Canada

Gregory Pohl¹ and John Acorn²

¹Natural Resources Canada, Canadian Forest Service, Edmonton, AB Canada; ²Faculty of Agricultural Life and Environmental Sciences, University of Alberta, Edmonton, AB Canada

Abstract: Several butterflies and moths have been expanding their ranges in western Canada. We review the major patterns, and give examples of several species. Introduced general-feeders with good dispersal abilities and expanding their ranges broadly into the region. Other species have followed their host ornamental plants westwards. Several Aspen Parkland species, primarily grass-feeders, have been expanding naturally westwards, contrary to expectation of northwards dispersal with a warming climate. A possible mechanism for the latter group is explored.

Saturday, 9:45-10:15 **Coffee break and poster mingle**

Symposium: Biochemistry, phylogenetics, and conservation of Lepidoptera

(Moderator: Felix Sperling)

Saturday, 10:15-10:30

Behavioral and chemoeology on the pin: utilizing museum collections to better understand the bat-moth arms race

Nicolas J. Dowdy¹, Alan Lemmon², Emily Lemmon³, William E. Conner⁴ and Jennifer M. Zaspel⁵

¹Milwaukee Public Museum, 800 W Wells St, Milwaukee, WI 53233, USA, ²Dept. of Scientific Computing, The Florida State University, 400 Dirac Science Library, Tallahassee, FL 32306-4120, USA; ³Department of Biology, Florida State University, 319 Stadium Drive, P.O. Box 3064295, Tallahassee, FL 32306-4295, USA; ⁴Biology Department, Wake Forest University, 1834 Wake Forest Road, Winston-Salem, NC 27106, USA; ⁵Zoology Department, Milwaukee Public Museum, 800 W Wells St, Milwaukee, WI 53233 USA

Abstract: The tiger moths (Lepidoptera: Erebidae: Arctiinae; >11,000 species) are a diverse group of insects well-known for sequestering noxious chemicals from host plants and for producing ultrasonic clicks which aposematically signal their unpalatability to bat predators and/or disrupt bat echolocation. Assessing the behavioral strategies for a large number of species is costly and time consuming and traditional molecular markers have failed to robustly resolve many relationships within the subfamily. We have developed new tools capable of leveraging museum collections to address these two impediments and tackle long-standing questions about the evolution of these unique anti-predator defenses. We detail our methods and present preliminary data derived from this suite of new tools. These include methods for utilizing preserved specimens to predict important aspects of their acoustic behaviors and chemoeology as well as an anchored hybrid enrichment probe set (>550 loci) capable of resolving evolutionary relationships within the Arctiine radiation.

Saturday, 10:30-10:45

Making use Of Geometrid phylogenies: Comparative analyses In evolutionary ecology

Toomas Tammaru, Robert B. Davis, Erki Üunap, Sille Holm, Juhan Javoš

Department of Zoology, University of Tartu, Vanemuise 46, EE-51014 Tartu, Estonia

Abstract: The availability of reliable phylogenies has opened the road for the application of phylogenetic comparative analyses. We can now use among-species variation in trait values to explicitly test for adaptive hypotheses. However, the vast potential of insects as objects of phylogenetic comparative studies has still received limited attention. I will present our original research which uses phylogenetic and ecological data on the family Geometridae. In particular, we have confirmed the link between body size and the degree of polyphagy. Egg size was found to strongly depend on adult size, with little evidence of ecological effects. The same applies to adult longevity measured in laboratory conditions. The gradation from income to capital breeding (= the importance of adult feeding in egg production) was confirmed to serve as an axis usable for ordinating lepidopteran life histories. Our most recent results concern small size of day-flying geometrids, and cognitive capacity of adults.

Saturday, 10:45-11:00

Ghosts in the Outback: towards a phylogenetic and biogeographic framework for Australian Hepialidae

Thomas J. Simonsen¹ and Niklas Wahlberg²

¹Natural History Museum Aarhus, Wilhelm Meyers Allé 10, DK-8000 Aarhus, Denmark; ²Lund University, Sölvegatan 37, SE-223 62 Lund, Sweden

Abstract: Australia is home to a particular rich fauna of Hepialidae s. str. with more than 150 species in 8 genera, as well as the primitive genera *Anomoses*, *Palaeoses* and *Fraus*. The Australian Hepialidae s. str. can be divided into two main 'working groups' based on wing venation: the oxycanine and the hepialine hepialids. The oxycanine hepialids are a homogenous, but systematically poorly known group; the hepialine hepialids are evolutionary and ecologically heterogeneous, but better understood, comprising 70 known species in five genera of which two are monobasic. The three remaining genera are widespread in most habitats, and represent the three main feeding-strategies employed by hepialid larvae: Oncopera (13 spp.) being leaf- and herb-feeders; Aenetus (18 spp.) being internal stem-borers; and Abantiades (37 spp.) being root-feeders. We here present preliminary phylogenetic analyses of the three genera based on DNA and morphology, and explore biogeographic and evolutionary consequences of the obtained phylogenies.

Saturday, 11:00-11:15

Global phylogeography of the Gypsy Moth

Reza Zahiri¹, B. Christian Schmidt², Alexander Schintlmeister³, Roman V. Yakovlev⁴, Michal Rindos⁵

¹Canadian Food Inspection Agency, Ottawa Plant Laboratory, Entomology Laboratory, Bldg. 18, 960 Carling Ave., Ottawa, Ontario, K1A 0C6 Canada; ²Agriculture and Agri-Food Canada, Biodiversity Program, Canadian National Collection of Insects, Arachnids, and Nematodes, K.W. Neatby Bldg., 960 Carling Ave., Ottawa, Ontario, K1A 0C6 Canada; ³Museum Witt München, Tengstr. 33, D-80796 Munich, Germany; ⁴Altai State University, Lenina 61, Barnaul, 656049, Russia; ⁵University of South Bohemia, Faculty of Science, Branišovská 31, CZ-370 05 České Budějovice, Czech Republic

Abstract: We examined the global phylogeography of *L. dispar* using molecular data based on two mitochondrial genes and three nuclear genes. All known populations of *L. dispar* from every biogeographic region were sampled to fully document intraspecific variation and to identify potential cryptic species, as well as clarifying the relationships among major phylogeographic lineages. The circumscription and taxonomy of *L. dispar*

subspecies is revised. Our study corroborates that the endemic Hokkaido taxon previously identified as *Lymantria umbrosa* (Butler) is the sister group to all other *L. dispar* populations, but this species is correctly called *L. hokkaidoensis* Goldschmidt. Discovery of a cryptic, highly distinctive genetic lineage from Transcaucasia is described as a new subspecies. We redefine the intraspecific variation of *L. dispar* as consisting of three strongly supported and genetically distinctive lineages. The enigmatic east-central Asian populations that exhibit characters of both European and Asian *L. dispar* confidently place with nominate *L. dispar dispar* in our multi-gene phylogeny, including topotypical *asiatica* Vnukowskij, which is accordingly synonymized under the latter. Neotypes are designated for *Lymantria dispar hokkaidoensis* Goldschmidt and *Lymantria dispar bocharae* Goldschmidt.

Saturday, 11:15-11:30

Phylogenomics reveals localized, sporadic, and incongruous ecological specialization across *Hemileuca maia* (Saturniidae)

Daniel Rubinoff¹, Julian Dupuis^{2,3}, Richard S. Peigler⁴ and Scott M. Geib³

¹Department of PEPs, Entomology Section, The University of Hawaii, 310 Gilmore Hall, 3050 Maile Way, Honolulu, HI 96822, USA; ²Department of Plant and Environmental Protection Services, University of Hawai'i at Mānoa, Honolulu, HI 96822, USA; ³U.S. Department of Agriculture-Agricultural Research Service, Daniel K. Inouye U.S. Pacific Basin Agricultural Research Center, Hilo, HI 96720, USA; ⁴Department of Biology, University of the Incarnate Word, San Antonio, TX 78209, USA

Abstract: The *Hemileuca maia* species complex provides an ideal model for investigating the utility of phylogenomics to reveal fine scale patterns of local adaptation. This group consists of large, diurnal, moths that occur across eastern North America from southern Canada to Florida, and west to California. At least nine different taxonomic names have been used to recognize species or populations in the group exhibiting varying levels of divergent morphology or host plant use. We used thousands of loci from a DDRAD sequencing to assess population structure and genomic relationships between members of the *H. maia* species complex. Results are generally counterintuitive and suggest some changes in how we view this group are needed.

Saturday, 11:30-11:45

Attempts to reintroduce the Kamehameha butterfly (Nymphalidae: *Vanessa tameamea*) to restored habitat on O'ahu, Hawai'i

William P. Haines, Katrina R. Scheiner, Layla K. Rohde and Cynthia B. King

Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, 1151 Punchbowl St. Rm. 325, Honolulu, HI 96813 USA

Abstract: The Kamehameha butterfly (Nymphalidae: *Vanessa tameamea*), endemic to Hawai'i, has been extirpated from parts of its range, presumably due to predation by nonnative birds and ants and displacement of host plants by invasive weeds. We are attempting to reestablish populations through captive rearing and release at five sites in the southern Ko'olau range on O'ahu where the butterfly's urticaceous host plants have been restored and invasive ants have been managed. Two rounds of releases were conducted in 2017, with a total of 3146 butterflies released. After releases, sites were surveyed weekly for caterpillars or feeding damage. Caterpillars were found at all sites, but the number observed was low considering the large number of butterflies released, suggesting that only a small proportion of butterflies successfully reproduced. There was

no evidence of long term establishment. A third round of releases is planned for July 2018, with some modifications to the release strategy.

Saturday, 11:45-12:00

A short update on *Dinumma deponens* (Erebidae; Scoliopteryginae)

James K. Adams

Department of Natural Sciences, Dalton State College, 650 College Dr., Dalton, GA 30720 USA

Abstract: I presented a talk at Park City, Utah in 2014, about the expanding range of *Dinumma deponens* in the U.S., first found in northern Georgia and Alabama in 2012. With nearly four years of data since then, the moth has expanded into eleven states, with the northern edge of the expansion currently sitting at the northern edge of the range of the foodplant, Silktree ("Mimosa"), *Albizia julibrissin*. Oddly, the moth has barely moved to the south, and not much westward, either.

Saturday, 12:00-1:30 **Lunch break**

Afternoon Session (Moderator: Thamara Zacca)

Saturday, 1:30-2:15 (45 minute talk)

A lepidopterist in the hottest spot on the planet earth

Hossein Rajaei

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Abstract: The poorly known Lut desert is located in South-eastern Iran. Since 2005, NASA's Aqua satellite has repeatedly reported this desert as hottest spot of the planet earth with maximum ground temperatures of up to 70.7°C (159.3°F)!. The harsh climatic conditions had convinced the early researchers to regard this desert as a dead area deprived of any life forms. However, many local people and occasion tourists reported the presence of different living organisms in the desert. To study its ecology and biodiversity, a team of researchers from different disciplines made two excursions to Lut, 10 days each, in November 2016 and March 2017. The extraordinary difficulties of these excursions, exciting observations and interesting tales about these expeditions will be narrated.

Saturday, 2:15-2:45 (30 minute talk)

Memories: a selection of images of past meetings from the Society archives

Charlie Covell

The McGuire Center for Lepidoptera and Biodiversity, 207 NE 9th Ave., Gainesville, FL 32601-4378 USA

Abstract: A series of powerpoint images will be presented from our archives to help recall memories of past meetings.

Saturday, 2:45-3:15 **Coffee break**

Saturday, 3:30-5:00 **Business meeting** (room RB3201, Richcraft Hall)

Saturday, 5:00-9:00 **Banquet Reception**

Abstracts: Posters

In alphabetical order of presenters' last name

*=Student posters

RNA-Seq of the *Hyles euphorbiae* transcriptome reveals strong expression of phorbol ester detoxification and cold hardiness genes*

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Abstract: The hawkmoth, *Hyles euphorbiae* (within the *H. euphorbiae* complex, HEC), has been studied as model to determine genetic mechanisms underlying two adaptive trait candidates for species delimitation within the HEC: Phorbol ester 12-tetradecanoyl-phorbol-13-acetate detoxification and seasonal cold acclimation. The first transcriptome of *H. euphorbiae* (and the Sphingidae subfamily Macroglossinae) was sequenced. Differential gene expression of TPA fed larvae and cooled pupae compared to controls were assessed by mapping 26bp RNA tag libraries (DeepSuperSAGE) to the transcriptome. In total, 389 and 605 differentially expressed transcripts were identified for detoxification and cold hardiness. The majority of detox transcripts referring to drug metabolism were up-regulated. Cold treatment is marked by metabolic down-regulation and shifts in carbohydrate metabolism towards cryoprotectant production. Glycerol, a supercooling point lowering osmolyte, appears to be the predominant cryoprotectant in *H. euphorbiae* diapause pupae. A majority of differently expressed transcripts unique for either detoxification or cold hardiness indicates specialized adaptation.

A review of the tribe Cochylini (Lepidoptera, Tortricidae) in Korea

Bong-Kyu Byun

Department of Biological Science & Biotechnology, Hannam University, 1646 Yuseong-Daero, Yuseong-gu, Daejeon 34054, Korea

A total of 43 species belonging to 9 genera of the tribe Cochylini including two recently described species (Byun et al., 2017) are recognized from Korea and their wing patterns, male and female genitalic structures are described and illustrated. Also, five additional species are described as new to sciences in this study. In the present study, the historical review including the taxonomic position of some genera *Pseudargyrotoza* Obraztsov and *Eulia* Hübner which has been treated under the tribes Cochylini in Korea are noted. Keys are given for the genera respectively. Known host plants and life histories reported until recently were reviewed and presented. Seasonal occurrence of the adults, especially occurring period and number of individuals was surveyed. Biogeographical characteristics of the tribe Cochylini was treated and discussed. The number of known species of the Korean peninsula with her adjacent countries were compared and discussed. Domestic localities and distribution maps in this country were also provided for each species.

Family Gracillariidae of Korea*

Da-Som Kim^{1,2} and Bong-Kyu Byun¹

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Abstract: The family Gracillariidae known as leafminers, comprising 1,966 described species of 106 genera in the world. They mine into the leaf on larval stages, and the pattern and shape of mines are various in each genus. Gracillariidae generally distributed throughout the world except for Antarctic, and many other species are pests of agricultural and ornamental plants feeding on 106 different hostplant families. In Korea, the family Gracillariidae is known as 3 subfamily, 14 genera of 58 described species. It is rather low records comparing with the number of described species in Japan, and seems to be possible to report more newly species in Korea. This study was conducted to present an annotated check list of the family Gracillariidae in Korea with some new species and newly recorded species. All the available information including their host plants, synonym list and distributional range is provided.

Nepticulidae (Lepidoptera: Nepticuloidea) of Korea*

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Abstract. The family Nepticulidae is a small sized group consisting of 22 genera and 880 species in the world. Nepticulidae have been placed in the superfamily Nepticuloidea, with Opostegidae as phylogenetically allied groups. Most species of Nepticulidae are small moth, which gives rise to their common name, pigmy moth or midget moth. They are leafminer moth, usually make various shapes of mine in larval stages. In East Asia, in total 105 species, including 67 species occurring in the Russian Far East and 53 in Japan. However, very little is known in Korea. In this study, Morphological character of adults and genitalia are illustrated. Also, a checklist of the family Nepticulidae from Korea is provided.

Psychidae (Lepidoptera: Tineoidea) of Korea*

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Abstract: The family Psychidae is a medium-sized family of moths consisting of 241 genera and 1,350 species in the world. Since the species of the family Psychidae builds characteristic of various shapes at different larval stages, their common name is bagworms. In addition, males have wings and can fly, whereas females cannot fly as their wings have been reduced during the evolutionary process. In this study, a total of 16 species of the family Psychidae were recognised from Korea with a new species. Adults and genitalia are illustrated. Also, a checklist of the family Psychidae from Korea is provided.

Leafminers of North America

Charles S. Eiseman

Northfield, Massachusetts, USA (unaffiliated)

Abstract: Leafminers are insects whose larvae live and feed between the epidermal layers of leaves for part or all of their development. In North America they include 1200+ moth species, plus another 1000+ flies, beetles, and sawflies. Most are specific to one or a few related plant genera, and each produces a characteristic pattern (mine) in the leaves of its hostplant. Since 2011 I have conducted a thorough literature review and

traveled throughout the US to photograph, collect, and rear leafminers. I have now constructed dichotomous keys to the known mines on every plant genus in North America, which I am self-publishing as an e-book in monthly installments. The result is not only an identification guide, but a guide to discovering new natural history information and new species. I hope that others across the continent will use this guide to focus collection and rearing efforts on adding to scientific knowledge.

Guide des papillons du Québec - Volume II - Microlépidoptères

Daniel Handfield¹ and Louis Handfield²

¹355 des grands Côteaux, St-Mathieu de Beloeil, Québec, J3G 2C9 Canada; ²845 Fontainebleau Mont-St-Hilaire, Québec J3H 4J2 Canada

Abstract: Présentation de l'avancement des travaux du volume II des papillons du Québec après 10 ans de travail. Le guide présente l'aire de distribution, l'habitat, les plantes hôtes et plus encore ... sur plus de 1600 espèces de microlépidoptères. Nous présenterons les 1100 pages de textes et 90 pages de planches réalisées jusqu'à maintenant.

Taxonomic study of Thiotrichinae (Lepidoptera: Gelechiidae) from China

Houhun Li and Ga-Eun Lee

College of Life Sciences, Nankai University, Tianjin 300071, P.R. China

Abstract: The Thiotrichinae Karsholt et al., 2013 is a subfamily of Gelechiidae that comprises approximately 170 described species within four genera, *Macrenches*, *Palumbina*, *Polyhymno* and *Thiotricha*. The present study was primarily focused on review of the Chinese Thiotrichinae based on morphological and molecular analysis. For the molecular analysis, one mitochondrial gene (COI) and five nuclear genes were sampled from 43 exemplar taxa including three thiotrichine and three related genera. Based on the Maximum Likelihood analysis, the monophyly of Thiotrichinae was re-confirmed in this study. All members of the subfamily were clustered with high bootstrap value, and the result reinforced the Karsholt et al. (2013)'s proposal of the subfamily Thiotrichinae. Prior to this study three *Palumbina* species and fifteen *Thiotricha* species had been recorded in China. After present study, approximately 150 thiotrichine species have been confirmed to occur in China.

Ultrasonic courtship songs in the Hooktip Moth (*Drepana arcuata*): A novel way of communication for Drepanoidea*

Mairelys Naranjo¹, Thenuwan Kandedgedara¹, Ryo Nakano² and Jayne E. Yack¹

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Abstract: Ultrasound production has been widely described in moths, primarily in the context of defense against insectivorous bats. Nevertheless, some moths employ acoustic communication in courtship behaviour. Here we report on sound production in an adult hooktip moth, *Drepana arcuata*. Using overnight video and ultrasonic audio recordings obtained from mating pairs we report ultrasonic clicks during courtship. The sounds are distinct from flight sounds and have characteristics of communication signals produced by tymbals. The dominant frequency of the produced sound matches the hearing range of adult moths. This is the first example for sound production shown for the Lepidoptera superfamily Drepanoidea. Hearing in Drepanoidea has been previously assumed to

function in bat detection, but as yet there is no direct evidence for this function. Further research is required to better understand the mechanisms, taxonomic distribution and functions of sound production in the Drepanoidea.

Discovery of interesting genera of Olethreutinae (Tortricidae) from Thailand

Nantasak Pinkaew

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Abstract: Thailand is the important part of hotspot of biodiversity in southeast Asia. There are two mains of zoogeography subregion are Indo-Malayan subregion (south Thailand) and Indo-Chinese subregion (remainder area), that effected to the high diverse of insect especially moths in Thailand. Along a century of olethreutine moths study in Thailand total of 255 species from 97 genera in 5 tribes were known. First interesting is concerned about distribution of some genera that have not been reported from oriental region, i.e., genus *Pternidora* Meyrick, 1911 and genus *Hiroshiinoueana* Kawabe, 1978 that usually distributed in Australian and Palaearctic region respectively but they were surprisingly found in Thailand. The second interesting is concerned about day-flying olethreutine moths genera that were observed and took photographed in natural habitats, i.e., genus *Ancylis*, *Eucosmogastra* and *Loboschiza* in tribe *Enarmoniini*, genus *Lobesia*, *Ophiorrhabda*, *Sorolopha*, *Statherotis*, *Sycacantha*, *Theorica* and *Thymioptila*. Information of distribution and habit of olethreutine moths are necessary data to add up for the genus or species describing.

Confusing syntypes - appearing issues during investigation and its solution

Hossein Rajaei and **Dominic Wanke**

Department of Entomology, State Museum of Natural History Stuttgart, Rosenstein 1, D-70191, Stuttgart, Germany

Abstract: An important step during the description of new species is the investigation of type material. Designated holotypes are essential to validate identity of species, their systematic status and comparison with potentially new species. However, in former times, the holotype designation was not a common taxonomic act and instead a series of specimens (often) from different localities were regarded as syntypes. Different cases of complication and confusion in interpretation of syntype series may happen (e. g. when more than one species is present in the syntype series). A case of difficulty was observed during the investigation of syntype series of *Triphosa toachata* Lederer, 1870. The specimens loaned from collection Staudinger (deposited in Museum für Naturkunde Berlin), which externally are *Triphosa*, were dissected. Two (out of four) dissected specimens show no *Triphosa* genitalia, but *Hydria (Rheumaptera)* Hübner, 1822. Both of these specimens were secondarily clued and repaired, and it seems that the abdomen belong to other specimens. Thereby it is also not clear if the other type specimens remained untouched, although they show no sign of preparation. Potential solutions to this problem are discussed and further advices is given on this special issue.

A case of gynandromorphy in the family Geometridae

Hossein Rajaei and **Chantal Holzhaue**

Department of Entomology, State Museum of Natural History Stuttgart, Rosenstein 1, D-70191, Stuttgart, Germany

Abstract: Gynandromorphism is a phenomenon in which one individual shows characteristics of both male and female sexes. Gynandromorphism is generally

categorized in two different kinds: a) *bilateral gynandromorphism*, b) *mosaic gynandromorphism*. Whether an individual is a bilateral or mosaic gynandromorph depends on in which state of zygote cell division a non-disjunction appears. The very first divisions of the zygote determine the bilateral body, an occurrence of a non-disjunction in this phase would lead to a half male and half female individual. A non-disjunction in later cell division phases lead to a mosaic gynandromorph. An exact rate of gynandromorphism is unknown. Many insects don't develop a sexual dimorphism, so it is difficult to see externally whether an individual contains both sexes. In this talk, a recently discovered case of gynandromorphism in an individual of the species *Aplocera annexata* Freyer, 1830 in the collection of the SMNS will be presented. Photos of different character combinations will be depicted. In this specimen, wings, antennae and legs appear just like a normal male individual, but genital structure reveals a combination of genitalia of both sexes. Even though both genitalia are almost fully developed, the whole apparatus seems to be non- functional.

Molecular phylogeography of *Lymantria monacha* (Lepidoptera: Erebiidae: Lymantriinae) - preliminary results

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Abstract: The Black Arches (or Nun Moth) is considered as a serious economic pest of different coniferous (e.g. *Pinus*, *Picea*, *Abies*, *Pseudotsuga*, etc.) and also of many deciduous (e.g. *Acer*, *Fagus*, *Malus*, *Prunus*, etc.) plants. The species forms a morphologically unit subgenus *Lymantria* sensu stricto and it is distributed throughout the Palearctic Region. Its larvae feed on needles or leaves and may cause serious defoliations. The aim of this study is to investigate phylogeographic patterns of *Lymantria monacha* across the whole species range. We conducted analyses of genetic parameters of studied populations, together with the ecological niche modeling as a predictor of potential distribution. We present first results of this study, revealing the existence of a main haplotype with a wide range of distribution and larger amount of unique geographically distinct haplotypes occurring mostly in the Europe and East Asia.

Analyzing digitization procedures in the Lepidoptera of North America Network (LepNet)*

Kathryn Sullivan, Laura Carter and Jennifer Zaspel
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Abstract: With up to 15 million specimens, Lepidoptera is one of the most abundant groups of insects in museum collections in North America, but fewer than 5% are digitized. The Lepidoptera of North America Network (LepNet) currently comprises 27 research collections that are digitizing 1.7 million specimen records and integrating these with over 1 million existing records. After approximately a year and a half into the project, the Milwaukee Public Museum's collection is more than halfway to the goal of 51,133 specimen records transcribed through Emu and 4,563 images of Lepidoptera. Throughout the project period, task analyses were established and refined, which will be useful in continuing digitization in the institution's other collections in the future. The

data generated from the LepNet project are essential for continued research in the collection and will inform future efforts to share large digitized datasets across institutions.

“Hearing aids” in butterflies: A comparative study*

Penghui (Carrie) Sun¹, Jayne E. Yack¹ and Akito Y. Kawahara²

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Abstract: Many butterfly species, particularly nymphalid butterflies within the subfamily Satyrinae, have been reported to possess a conspicuous “inflated” or “swollen” subcostal vein on each forewing. However, the function and phylogenetic diversity of these structures is unknown. We use comparative methods to test hypotheses that these structures function in hearing, and that they are most prominent in smaller species. Species among various subfamilies within Nymphalidae were sampled, including 51 Satyrinae species, representing all tribes and a variety of body sizes. Our results show that all species with inflated veins possess ears, but not all species with ears possess inflated veins. Further, inflated veins are best developed in smaller species, and are most prominent in the tribe Satyrini. Small insects face physical challenges in hearing low frequency sounds, and we propose that inflated veins in butterflies function as hearing aids to enhance sensitivity to low frequency sounds produced by predators.

Ontogeny of social behaviour in the masked birch caterpillar, *Drepana arcuata* (Lepidoptera: Drepanidae)*

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Abstract: Group-living is widespread in larval Lepidoptera but the mechanisms for mediating social behaviour are poorly understood. The masked birch caterpillar, *D. arcuata*, provides an excellent opportunity to study such mechanisms. This species is reported to change its social behaviour throughout development, and is being used as a model to explore the roles of vibroacoustics and genetic influences on social living. To explore mechanisms mediating sociality it is pertinent to carefully document ontogenetic changes in the morphology and behaviour in this species. Results show that instars I and II seek each other out and build communal silken shelters, whereas instars IV and V live solitarily. Interestingly, third instars transition between group and solitary living as they age. We also report changes in vibratory signalling that corresponds with ontogenetic changes. These results provide essential information that will aid in future investigations of the proximate mechanisms mediating sociality in larval Lepidoptera.

Possible cases of ovoviviparity in Neotropical butterflies*

Thamara Zacca and André V. L. Freitas

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Abstract: In Lepidoptera, ovoviviparity has been mainly observed in moths, with records varying between 1 and >10 larvae inside the female abdomen. In butterflies, this reproductive strategy is known to some Palearctic species of Papilionidae, Pieridae and Nymphalidae with a single larva inside the female observed during genital dissections. We report possible cases of ovoviviparity in 13 species of Satyrinae and 1 species of Ithomiini

based on first instar larvae found inside the female abdomen. Some butterflies have the ability in maintaining the fertilized eggs on its oviduct that would allow the larvae hatching on its interior prior the female be collected. However, larviposition has been observed in *Ypthimoides mimula* in laboratory, suggesting the ovoviviparity might be facultative in some species since it probably increases the larval survival rate by eliminating external incubation in a stressful environment. Studies on female laying behavior are essential to support the larviposition phenome in butterflies.

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Pubs and restaurants near Carleton campus

1. Oliver's Pub and Patio

Main floor, University Center building (UC on Campus map)

2. Mike's Place Bar

2nd floor, University Center building (UC on Campus map)

3. Tim Horton's, Starbucks, Second Cup

University Center food court (UC on Campus map)

4. Subway

University Center food court (UC on Campus map),
Carleton Athletics building (AC on Campus map)

5. Milano Pizzeria

44 Seneca Street (10 minute walk)

6. Chez Anh (Vietnamese)

435 Sunnyside Ave (10 minute walk)

7. Patty's Pub

1186 Bank Street (20 minute walk)

8. The Senate Tavern

1159 Bank Street (20 minute walk)

9. Belmont Restaurant

1169 Bank Street (20 minute walk)

10. Quinn's Pub

1070 bank Street (25 minute walk)

11. Barley Mow

1060 Bank Street (25 minute walk)

Checklist of Butterflies of the Ottawa region

Hesperiidae	Silver-spotted Skipper Northern Cloudwing Wild Indigo Duskywing Columbine Duskywing Least Skipper European Skipper Peck's Skipper Tawny-edged Skipper Crossline Skipper Long Dash Skipper Northern Broken-Dash Little Glasswing Delaware Skipper Mulberry Wing Hobomok Skipper Broad-winged Skipper Dion Skipper Two-spotted Skipper Dun Skipper	<i>Epargyreus clarus</i> <i>Thorybes pylades</i> <i>Erynnis baptisiae</i> <i>Erynnis lucilius</i> <i>Ancyloxypha lineola</i> <i>Thymelicus lineola</i> <i>Polites peckius</i> <i>Polites themistocles</i> <i>Polites origenes</i> <i>Polites mystic</i> <i>Wallengrenia egeremet</i> <i>Pompeius verna</i> <i>Anatrytone logan</i> <i>Poanes massasoit</i> <i>Poanes hobomok</i> <i>Poanes viator</i> <i>Euphyes dion</i> <i>Euphyes bimaculata</i> <i>Euphyes vestris</i>
Papilionidae	Black Swallowtail Tiger Swallowtail hybrid Giant Swallowtail	<i>Papilio polyxenes</i> <i>Papilio canadensis/glaucus</i> <i>Papilio cresphontes</i>
Pieridae	Mustard White Cabbage White Orange Sulphur Clouded Sulphur Pink-edged Sulphur	<i>Pieris oleracea</i> <i>Pieris rapae</i> <i>Colias euytheme</i> <i>Colias protodice</i> <i>Colias interior</i>
Lycaenidae	Harvester American Copper Bronze Copper Bog Copper Acadian Hairstreak Coral Hairstreak Edwards' Hairstreak Hickory Hairstreak Banded Hairstreak Striped Hairstreak Grey Hairstreak Eastern Tailed Blue Northern Spring Azure	<i>Fenisea tarquinius</i> <i>Lycaena phlaeas</i> <i>Lycaena hyllus</i> <i>Lycaena epixanthe</i> <i>Satyrrium acadicum</i> <i>Satyrrium titus</i> <i>Satyrrium edwardsii</i> <i>Satyrrium caryaevorum</i> <i>Satyrrium calanus</i> <i>Satyrrium liparops</i> <i>Strymon melinus</i> <i>Everes comyntas</i> <i>Celastrina lucia</i>
Nymphalidae	Great Spangled Fritillary Aphrodite Fritillary Atlantis Fritillary Hackberry Emperor Silver-bordered Fritillary Meadow Fritillary Silvery Checkerspot Pearl Crescent Northern Crescent Baltimore Checkerspot Question Mark Eastern Comma Satyr Comma Green Comma Grey Comma Compton Tortoiseshell Mourning Cloak Milbert's Tortoiseshell American Lady Painted Lady Red Admiral White Admiral Viceroy Northern Pearly-Eye Eyed Brown Appalachian Brown Little Wood-Satyr Common Ringlet Common Wood-Nymph Monarch	<i>Speyeria cybele</i> <i>Speyeria aphrodite</i> <i>Speyeria atlantis</i> <i>Asterocampa celtis</i> <i>Boloria selene</i> <i>Boloria bellona</i> <i>Chlosyne nycteis</i> <i>Phyciodes tharos</i> <i>Phyciodes cocyta</i> <i>Euphydryas phaeton</i> <i>Polygonia interrogationis</i> <i>Polygonia comma</i> <i>Polygonia satyrus</i> <i>Polygonia faunus</i> <i>Polygonia pragne</i> <i>Nymphalis vaualbum</i> <i>Nymphalis antiopa</i> <i>Nymphalis milberti</i> <i>Vanessa virginiensis</i> <i>Vanessa cardui</i> <i>Vanessa atalanta</i> <i>Limenitis arthemis</i> <i>Limenitis archippus</i> <i>Enodia anthedon</i> <i>Enodia eurydice</i> <i>Enodia appalachia</i> <i>Megisto cymela</i> <i>Coenonympha tullia</i> <i>Cercyonis pegala</i> <i>Danaus plexippus</i>

Butterfly sites around Ottawa (Field trips and other locations)

Here are a few sites in the Ottawa region that you might consider visiting for collecting or photography. GPS co-ordinates included. Some of the butterflies that may be encountered in each area are given *in Italics*.

General cautions: Deer Ticks (which carry Lyme Disease) are likely present in most areas listed. Poison Ivy present in many areas, ESPECIALLY on Alvars. Biting insects, especially Deer Flies, could be abundant on many trails.

Non-protected areas - Collecting should be OK (caveat emptor):

C1: Marlborough Forest E3/E4/E5 Trails (45.06576, -75.83107): Mixed Cedar Swamp (ATVs used here) - *Anglewings* (possible ATVs on all trails except E3)

C2: Lowe Road Extension (45.2078, -76.07456): Mixed, wet meadow, scrub etc. - *Greater/Lesser Fritillaries, Acadian Hairstreak, and various Skippers*

C3: Howie Road Extension (45.26014, -76.0459): Mixed Hardwood, Cedar Swamp (ATVs) - *Greater Fritillaries, Hairstreaks, Baltimore Checkerspot, Harvester*

C4: Panmure Alvar (45.31007, -76.22576): Wooded Alvar (ATVs?) - *various species*

C5: Burnt Lands NW outside park (45.28068, -76.20803): Wooded/Open Alvar (ATVs) - *Columbine Duskywing, Aphrodite Fritillary, Skippers* (note that one can walk several KM along 12 concession road allowance before reaching the provincial park boundary which is normally marked, but collectors should familiarize themselves with the park boundary)

C6: Larose Forest (45.37807, -75.19935): Ditches along gravel road through forest/marshes - *Anglewings, Sedge Skippers (Dion, Broad-winged, Mulberry, Two-spotted), Baltimore Checkerspot*

C7: Stony Swamp (45.29467, -75.83537): trails through mixed forest - *Anglewings, Little Glassywing, possibly Mustard White*

C8: K&P Trail - park at Flower Station (45.15800, -76.68707): trail through woods and marsh - *Anglewings, Skippers, Harvester, Hairstreaks, Fritillaries*

C9: Rideau Lakes - Opinicon Road start at Chaffey's Locks (44.57931, -76.32054): through woods and meadows - *Hairstreaks, Fritillaries, Skippers, Tiger Swallowtail hybrids*

Protected Areas - Photography only

P1: Reveller Conservation Area (45.20508, -75.22333): Grassy Scrub with Oaks and Hickory - *Satyrnum Hairstreaks, Milbert's Tortoiseshell, Lesser Fritillaries*

P2: Burnt Lands Provincial Park - off Burnt Lands Rd (45.26126, -76.14233): Open Alvar - *Aphrodite Fritillary, Meadow Fritillary, Coral Hairstreak*

P3: Gatineau Park - Champlain Lookout (45.50923, -75.9111): Wide trails through Mixed Forest - *Greater Fritillaries, Anglewings, Banded/Striped Hairstreaks, Mustard White, Skippers*

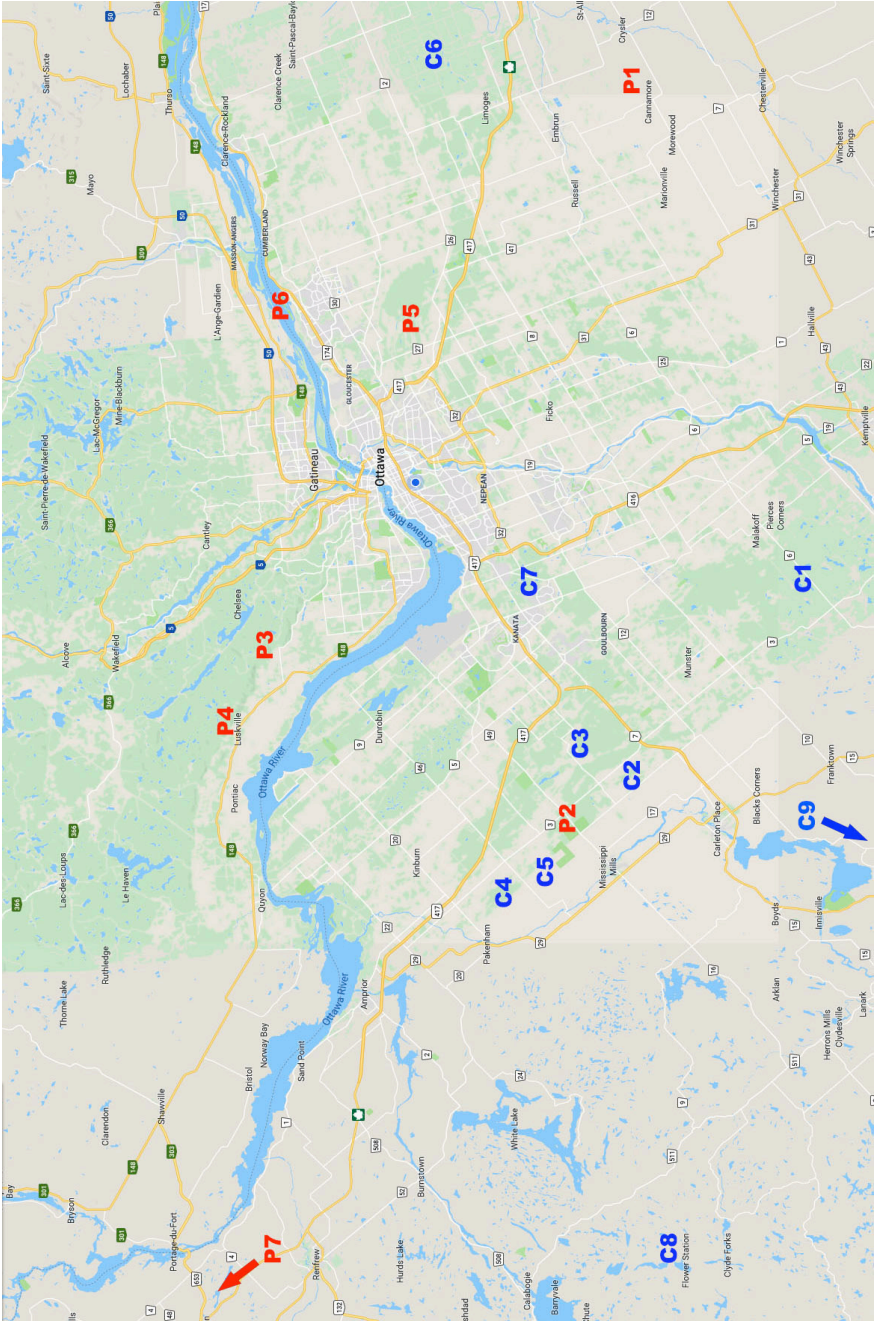
P4: Gatineau Park: Luskville (45.53007, -75.98451): open fields, woods - *Hairstreaks, Fritillaries, Sedge and other Skippers, Baltimore Checkerspot*

P5: Mer Bleu Bog (45.39459, -75.51291): Boardwalk on bog, trails on sand ridge - *Bog Copper, American Copper, Harvester*

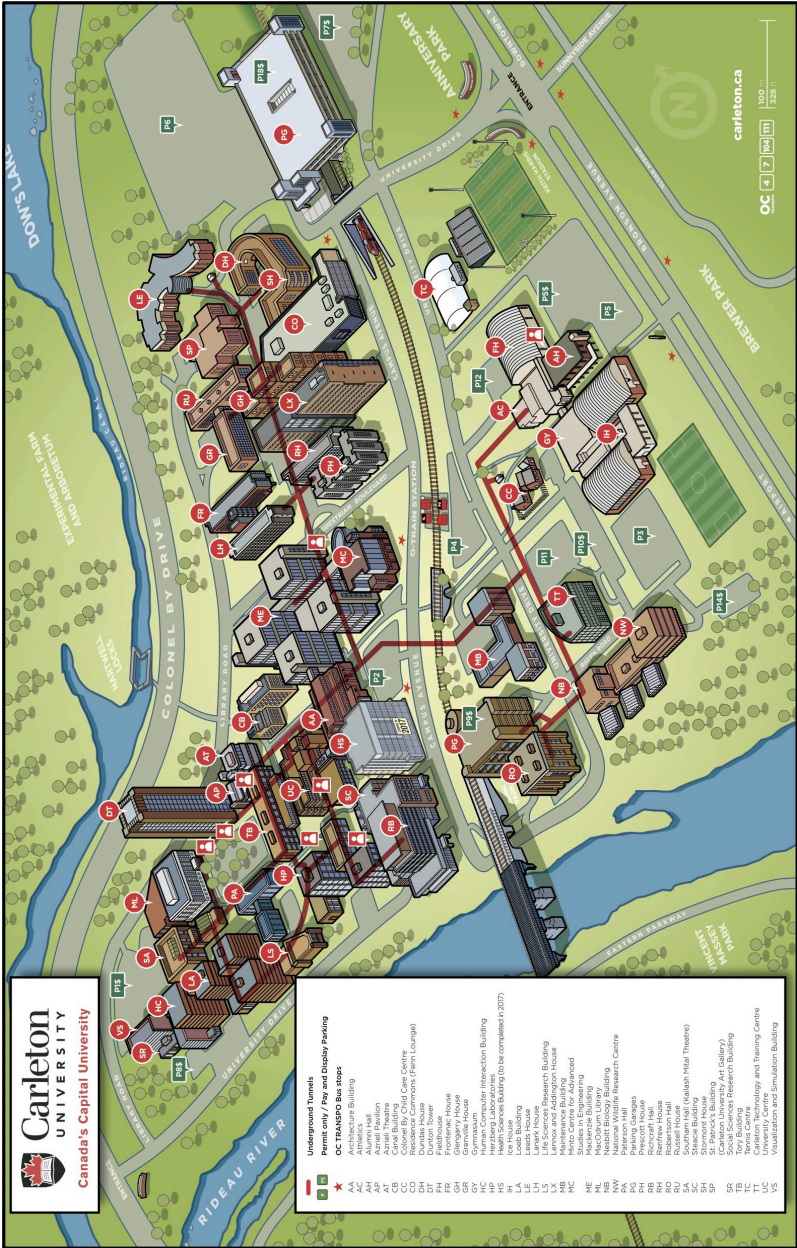
P6: Petrie Island (45.50383, -75.49488) \$\$parking - beach, trail through forest, marshes - *Hackberry Emperor, Hickory Hairstreak, Delaware Skipper, Bronze Copper*

P7: Algonquin Provincial Park - Barron Canyon Road (\$\$ admission) (45.89042, -77.6408) - Gravel roads through Forest - *Anglewings, Greater Fritillaries, Two-spotted Skipper*

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Notes