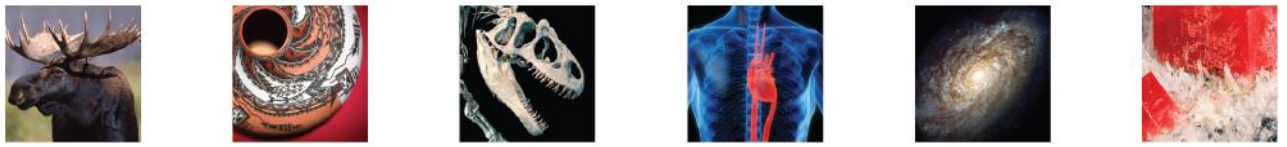
DENVER MUSEUM OF NATURE & SCIENCE



Technical Report 2012 - 6

Frank-Thorsten Krell, David Bettman &
Todd Gilligan (Eds.)

Program and Proceedings of the International Lepidopterists' Conference, Denver, July 23–29, 2012

Combined Annual Meeting of the Lepidopterists' Society and the Societas Europaea Lepidopterologica

Denver – July 2012

DENVER MUSEUM OF NATURE & SCIENCE

DENVER MUSEUM OF NATURE & SCIENCE

Technical Report 2012 - 6

Frank-Thorsten Krell, David Bettman & Todd Gilligan (Eds.)

Program and Proceedings of the International Lepidopterists' Conference, Denver, July 23–29, 2012

Combined Annual Meeting of the Lepidopterists' Society and the Societas Europaea Lepidopterologica

Organizing Committee

Frank-T. Krell, DMNS (host and chair)
Kizra Sullivan, DMNS (local organizer)
Todd Gilligan, CSU (program chair)
Paul Opler, CSU, and Evi Buckner-Opler (communications)
Chuck Harp, DMNS (field trips)
Janet Chu, CSU (field trips, T-shirts)
Joaquin Baixeras, SEL (SEL liaison)
Deane Bowers, CU Boulder (CU liaison)
Mary Ann Hamilton, Butterfly Pavilion (Butterfly Pavilion liaison)

Denver, July 2012

Conference sponsors:

Gold sponsor:

BioQuip Products
2321 Gladwick Street, Rancho Dominguez, CA 90220, USA
Phone: (310) 667-8800, Fax: (310)667-8808
bqinfo@bioquip.com

Bronze sponsors:

Leptraps LLC
3000 Fairway Court, Georgetown, KY 40324, USA
Tel: 502-370-4259, Cell: 502-542-7091
leptraps@aol.com

Wiley-Blackwell | John Wiley & Sons, Ltd. | 9600 Garsington Road | Oxford OX4 2DQ

Contents

Check in/registration hours for the conference:

Tuesday, July 24: 10:00 am–2:00 pm (Red Lion Hotel Denver Central)
Wednesday, July 25: 7:30 am–1:00 pm (Denver Museum of Nature & Science)
Thursday, July 26: 8:00 am–1:00 pm (Denver Museum of Nature & Science)
After hours: approach conference organizers/staff

Bus transfer between Red Lion Denver Central and Denver Museum of Nature & Science:

Wednesday, July 25: 7:15 am–5:30 pm (5:00-6:00 pm transport from Hotel to Butterfly Pavilion)
Thursday, July 26: 8:00 am–9:00 pm
Friday, July 27: 8:00 am–10:00 pm
Saturday, July 28: 8:00 am–10:00 pm

Conference Schedule

Monday, July 23

Satellite Symposium: Tortricid2012: An International Meeting of Tortricid Systematics (9:00 am–4:30 pm; Harry T. Lewis Room)

Organized field trip to Mt. Evans (watching, no collecting), led by Jan CHU and Larry CROWLEY

Organized field trip to Roxborough State Park (watching, no collecting), led by Gordon REVEY and Ellen SHANNON

Organized collecting trip to Loveland Pass, led by Mike FISHER

Organized collecting trip to Berthoud Pass, led by Steve SPOMER

Organized collecting trip to North Fork, South Platte River, Deckers, led by Boyce DRUMMOND

Organized moth collecting and watching trip Chatfield State Park and Lockheed-Martin Pavillion, led by Chuck HARP

Tuesday, July 24

Organized field trip to Rocky Mountain National Park (watching, no collecting), led by Steve FRATELLO.

Organized field trip to Golden Gate State Park, Mt. Lindo, Tiny Town (watching, no collecting), led by Gordon REVEY

Organized field trip to Plains Conservation Center (watching, no collecting), led by Susan SMITH and Mike SIPES

Organized collecting trip to Loveland Pass, Mike FISHER

Organized collecting trip to Berthoud Pass, led by Paul OPLER

Organized collecting trip to North Fork, South Platte River, Deckers, led by Boyce DRUMMOND

9:00 am–5:00 pm	Executive Council and committee meetings (Lepidopterists' Society) (Harry T. Lewis Room)
5:00 pm	Vendors setting up (Schlessman Family Lobby; **vendors will be open Wednesday – Friday, 8:00 am–5:00 pm**)
5:00 pm	Start poster set-up (Schlessman Family Lobby); posters will be exhibited until Saturday evening)
6:00–9:00 pm	**Welcome reception at the Red Lion Hotel Denver Central** (sponsored by BioQuip)

Wednesday, July 25

8:30–9:00 am	Welcome (George SPARKS, President and CEO, Denver Museum of Nature & Science; Frank KRELL, DMNS Curator of Entomology, conference host)

Student Competition

9:00–9:15 am	Heather CUMMINS & Susan Weller: **A review of *Euchaetes* Harris (Erebidae: Arctiinae)**
9:15–9:30 am	Maria HEIKKILÄ et al.: **Another challenge for systematists – the evolutionary history of Gelechioidea**

9:30–9:45 am	Christi JAEGER et al.: **The *Phaneta tarandana* species complex (Lepidoptera: Tortricidae): testing a morphological perspective**
9:45–10:00 am	Mari KEKKONEN et al.: **Six ways to delimit species – results from three lepidopteran subfamilies**
10:00–10:15 am	Mark LAMMERS et al.: **Dating *Spodoptera* Guenée, 1852 (Lepidoptera: Noctuidae) clades using fossil and non-fossil evidence**
10:15–10:45 am	**Break**
10:45–11:00 am	David PLOTKIN: **Analysis of morphology of Neotropical Geometrinae (Lepidoptera: Geometridae) using exo- and endoskeletal characters**
11:00–11:15 am	Andersonn PRESTES & Dan Rubinoff: **Systematics and diversification of the endemic Hawaiian genus *Haliophyle* (Lepidoptera: Noctuidae)**
11:15–11:30 am	Akito KAWAHARA et al.: **Stridulating genital valves: the evolutionary origins of anti-bat ultrasound production in hawkmoths**
11:30–11:45 am	Cassandra ROMERO et al.: **The piercing spines of hawkmoth legs: how much do they vary, and how did they evolve?**
11:45–12:00 am	Sangmi LEE et al.: **The Hasbrouck Insect Collection at Arizona State University – past, present and future**
12:00–1:30 pm	**Lunch**
Special Session: Lepidoptera-Plant Interactions (moderator: Deane BOWERS)	
1:30–1:50 pm	Caitlin KELLY: **Chemical mediation of *Penstemon*-herbivore interactions: a comparison of specialist and generalist caterpillars**
1:50–2:10 pm	Katrina LOEWY & Shannon Murphy: **Trade-offs in host choice by an herbivorous insect based on parasitism and host plant quality**
2:10–2:30 pm	MacKenzie KJELDGAARD et al.: **Local variation in host plant quality affects spatial distribution of fall webworms (*Hyphantria cunea*)**
2:30–2:50 pm	Paul OPLER: **California oaks and allies as evolutionary and ecological islands for leaf-mining Lepidoptera: host individuals and species populations**
2:50–3:10 pm	Deane BOWERS: **Chemical defense in *Eucaterva variaria* (Geometridae) and its host plant, desert willow (*Chilopsis linearis*, Bignoniaceae)**
3:10–3:30 pm	**Break**
Contributed Papers	
3:30–3:45 pm	Bob PATTERSON: **Moth Photographers Group – current and future projects**
3:45–4:00 pm	William HAINES et al.: **Carcass scavengers and snail hunters: evolution of carnivory in Hawaiian fancy-cased caterpillars**
4:00–4:15 pm	Dan RUBINOFF & Patrick Schmitz: **Timing explosive diversification in Hawaii's fancy case caterpillars (*Hyposmocoma*)**
4:15–4:30 pm	Marc EPSTEIN: **I got your back: the evolution of defense in slug and nettle caterpillars (Limacodidae)**
4:30–4:45 pm	Shannon MURPHY et al.: **Guild-specific parasitism of forest caterpillars: size matters**
6:00–8:00 pm	**Evening event at the Butterfly Pavilion**

Organized moth collecting and watching trip Kenosha Pass, Pike National Forest, led by Chuck HARP

Thursday, July 26

8:30–8:45 am	Announcements
Contributed Papers	
8:45–9:00 am	Ray STANFORD: **The nearly 200 year history of butterfly (and some moth) collecting and study in Colorado**
9:00–9:15 am	Robert ROBBINS et al.: **Loss of male secondary sexual structures in allopatry in the Neotropical butterfly genus *Arcas* (Lycaenidae)**
9:15–9:30 am	David JAMES: **Population biology of the imperiled Leona's little blue butterfly, *Philotiella leona* (Lepidoptera: Lycaenidae)**
9:30–9:45 am	Piotr NOWICKI et al.: **Selection against dispersal in isolated metapopulations of large blue butterflies**
9:45–10:00 am	Carlos CORDERO & Nubia Caballero: **Male mating costs in butterflies producing relatively small ejaculates**
10:00–10:30 am	**Break**
10:30–10:45 am	Michael POGUE & Charles Harp: **A revision of the *Schinia volupia* (Fitch) species complex (Lepidoptera: Noctuidae: Heliothinae)**
10:45–11:00 am	Kim MITTER et al.: **A well-resolved phylogeny of the corn earworm complex (Noctuidae: Heliothinae: Helicoverpa spp.) based on amplified fragment length polymorphisms (AFLP) and morphology**
11:00–11:15 am	Zdenek FRIC et al.: **Holarctic distribution of butterflies – what do we know?**
Special Session: Holarctic Lepidoptera	
11:15–12:00 am	Don LAFONTAINE: **Holarctic Lepidoptera: the Beringian connection**
12:00–1:30 pm	**Lunch**
Symposium: Lepidoptera Inventorying and Monitoring (moderator: Rich BRAY)	
1:30–1:50 pm	Richard BRAY & Jan Kilgore: **Fifteen years of butterfly monitoring at Rocky Mountain National Park**
1:50–2:10 pm	Dale RHODA et al.: **Apples to apples – statistical adjustments and imputation to facilitate meaningful comparisons in butterfly monitoring data**
2:10–2:30 pm	Janet CHU: **Ten-year inventory of butterfly species and populations in Boulder County Open Space properties, Colorado – 2007–2011 analyses**
2:30–2:50 pm	James ADAMS: **The very latest lep updates from Georgia and Kansas!**
2:50–3:10 pm	Terry Harrison & May BERENBAUM: **Light trap inventory of moths in biofuel crops and native prairie in central Illinois**
3:10–3:30 pm	**Break**
3:30–3:50 pm	Raymond MORANZ et al.: **Monitoring butterflies in America's heartland: new techniques help reveal increasing populations of prairie-dependent species**
3:50–4:10 pm	Steve MUELLER: **Benefits and limitations of three inventory methods**
4:10–4:30 pm	Karen WILSON & Doug Taron: **Twenty-five years and still counting – The science of citizen collected data**
7:00–8:30 pm	Robert M. PYLE: **Butterflies: the bright wings of summer** (Public Talk; IMAX)

Organized moth collecting trip Roggen sandhills, Weld County, led by Chuck HARP

Friday, July 27

8:30–8:45 am Announcements

Contributed Papers

8:45–9:00 am Jerome Regier, Charles MITTER, et al.: **The Leptree "backbone" molecular phylogeny estimate**

9:00–9:15 am Jurate DE PRINS et al.: **Will Africa play the key role in the taxonomy of Lepidoptera in the 21st century? Yes!**

9:15–9:30 am Robert HOARE: **Marvels, mysteries and challenges in the New Zealand Lepidoptera fauna**

9:30–9:45 am Eric METZLER: **Endemism in moths (Lepidoptera) at White Sands National Monument, New Mexico, USA**

9:45–10:00 am John CALHOUN: **John Abbot's butterflies: science and commerce in early Georgia**

10:00–11:45 am Book signings

11:45–12:00 am Group photo

12:00–1:30 pm Lunch

Symposium: Global Change and Lepidoptera Conservation (moderator: Astrid CALDAS)

1:30–1:40 pm Introduction

1:40–2:05 pm Felix SPERLING & Ben Proshek: **Taxonomy and conservation of *Apodemia mormo* (Lepidoptera: Riodinidae) in North America**

2:05–2:30 pm Heidi MACLEAN et al.: **Thermoregulation and the ecological and evolutionary responses of Rocky Mountain *Colias* to climate change**

2:30–2:55 pm Robert CARUANA et al.: **Site selection of potential prime butterfly areas: the case of an impoverished butterfly fauna in a Mediterranean island state**

2:55–3:20 pm Paul OPLER: **Conservation status of Colorado moths: selected taxa**

3:20–3:30 pm Conclusions

3:30–3:40 pm Break

Special Session: Current Developments in Zoological Nomenclature

3:40–4:40 pm Frank-T. KRELL: **Electronic publication, ZooBank and the new edition of the Code** (report and discussion)

6:00–8:30 pm Barbecue (Anschutz Sky Terrace and Southeast Atrium)

Saturday, July 28

Contributed Papers

8:30–8:40 am Announcements

8:40–8:55 am Mesfin WONDAFRASH: **Life-cycle parameters of African bollworm, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) affected by Neem, *Azadirachta indica* (A. Juss) extracts**

8:00–9:10 am Alma SOLIS et al.: **A molecular phylogeny for the Pyraloidea (Lepidoptera: Pyraloidea)**

9:10–9:25 am	Alma SOLIS: **Recent discoveries about pyraloids with aquatic immatures (Acentropinae: Crambidae)**
9:25–9:40 am	James HAYDEN: **Larvae of *Penestola* and *Sufetula* in Florida (Crambidae)**
9:40–9:55 am	Richard MALLY et al.: **Testing monophyly of megadiverse Spilomelinae (Pyraloidea: Crambidae)**
9:55–10:15 am	**Break**
10:15–10:30 am	Kevin TUCK: **Industrial-scale digitization of Lepidoptera collections using SatScan**
10:30–10:45 am	Knud LARSEN: **The genus *Clavigesta* Obraztsov, 1946: a zoogeografical interesting genus with origins in the Mediterranean basin, and discovery of relict populations in Europe**
10:45–11:00 am	Deborah MATTHEWS et al.: **Inventory of the lepidopteran fauna of the Guantanamo Bay Naval Base, Cuba**
11:00–11:15 am	Erik van NIEUKERKEN: **Leafmining Nepticulidae and Heliozelidae in North America: fieldwork and DNA barcoding reveal overlooked biodiversity**
11:15–11:30 am	Jean-François LANDRY et al.: **Taxonomic review of North American taxa formerly or presently included in *Yponomeuta* (Lepidoptera: Yponomeutidae)**
11:30–11:45 am	Richard BROWN & Michael Giddens: **The SilverCollection Web Portal in the Mississippi Entomological Museum**
11:45–12:00 am	Richard PEIGLER: **Diverse evidence that *Antheraea pernyi* is entirely of sericultural origin**
12:00–1:30 pm	**Lunch**
1:30–4:30 pm	Business meetings Pacific Slope meeting **Poster session** (Spratlen Lounge)
6:00–9:00 pm	**Banquet** (Southeast Atrium) Andy WARREN (President LepSoc): **Collections and collecting: we are running out of time!** Gerhard TARMANN (President SEL): **Societas Europaea Lepidopterologica SEL – the European Society for Lepidopterists** Jackie MILLER (McGuire Center): **LepSoc 2013 Meeting in Gainsville** Andy WARREN **- Awards** **Harry K. Clench Award for the best student presentation** **Alexander B. Klots Award for the best student poster** Charlie COVELL: **Trivia contest**

Sunday, July 29

Organized field trip to Walker Ranch, Boulder County Open Space (watching, no collecting), led by Jan CHU, Larry CROWLEY, Jean MORGAN, and Venice KELLY

Organized field trip to Loveland Pass (watching, no collecting), led by Christian NUNES

Organized field trip to Cottonwood Pass, Chaffee/Gunnison Counties (watching, no collecting), led by Steve FRATELLO

Organized collecting trip to Berthoud Pass, led by Steve CARY

Organized collecting trip to Cottonwood Pass, Chaffee/Gunnison Counties, 12 mi W Buena Vista, led by Paul OPLER

Organized moth collecting and watching trip Cottonwood Pass, Chaffee/Gunnison Counties, 12 m W Buena Vista, led by Chuck HARP

Abstracts of Talks and Posters

The effect of soybean induced responses on soybean loopers (*Chrysodeix includens*)

Accamando, Amanda K. (presenter) & James T. Cronin

202 Life Sciences Building, Department of Biological Sciences, Louisiana State University, Baton Rouge, LA 70803 USA. (jcronin@lsu.edu)

Abstract: Herbivorous insects are known to negatively impact plant fitness, such that plants have evolved defense strategies to reduce herbivory. An induced defense strategy is one in which defense traits are expressed only upon herbivory. We examined the effect that jasmonic-acid induced responses by soybean (*Glycine max*) had on preference and performance of soybean loopers (*Chrysodeix includens*) (Lepidoptera: Noctuidae), an economically important soybean pest in the southern United States. In a choice experiment soybean loopers exhibited a significantly greater preference for control plants, consuming 62% more tissue than from induced plants. Soybean loopers that fed on induced plants matured at the same rate and to the same size as soybean loopers that fed on control plants. However, at high conspecific density, soybean looper survivorship was reduced by 44% on induced relative to control plants. Our findings highlight the importance of considering the environmental context in studies of induced plant responses against lepidopteran pests. **(Poster)**

The very latest lep updates from Georgia and Kansas!

Adams, James K.

Department of Natural Sciences, Dalton State College, Dalton, GA 30720 USA. (jadams@daltonstate.edu)

Abstract: As we investigate different areas in Georgia, and sample at different times of the year, our knowledge of the lep fauna of Georgia becomes more complete. Inventories have been completed for some locations over the course of several years and we are now beginning to be able to see some trends in abundance of some species as well. Kansas is a remarkably rich state from a lepidopterological standpoint. It stands at the "crossroads" between east and west, north and south. And contrary to popular belief, it is NOT completely flat! Although I have not been involved as long in seriously surveying Kansas as I have Georgia, there are many more people involved in the survey which has given us ample sampling from most parts of the state. Come and see some of the coolest and unusual lep species that have been recently encountered in the states of Georgia and Kansas. **(Thursday, 2:30)**

Chemical defense in *Eucaterva variaria* (Geometridae) and its host plant, desert willow (*Chilopsis linearis*, Bignoniaceae)

Bowers, M. Deane

Museum of Natural History and Department of Ecology and Evolutionary Biology, University of Colorado, UCB 334, Boulder, CO 80309 USA. (deane.bowers@colorado.edu)

Abstract: *Eucaterva variaria* Grote (Geometridae) is a specialist on Desert Willow, *Chilopsis linearis* (Bignoniaceae). Larvae apparently feed exclusively on this plant. Eggs are laid in masses and young larvae feed gregariously. Late instar larvae are longitudinally striped black, white and orange, suggesting warning coloration and that they might be chemically defended. Preliminary data suggested that Desert Willow contains iridoid glycosides, a group of bitter compounds that are sequestered by other specialist caterpillars, rendering them unpalatable to predators. Samples of this plant were collected from three populations in southern Arizona and found to contain iridoid glycosides. *Eucaterva variaria* were then reared on Desert Willow from these populations and different life stages analyzed for the presence of iridoid glycosides. Larvae, pupae, silken cocoons spun by the larvae, adults, and eggs were all found to contain iridoid glycosides. Amounts were relatively high in larvae and pupae and lower in adults, eggs, and silken cocoons. **(Wednesday, 2:50)**

Non-target Lepidoptera from targeted early-detection surveys in Florida

Brambila, Julieta

USDA-APHIS-PPQ, P.O. Box 147100, Gainesville, FL 32614 USA. (Julieta.Brambila@aphis.usda.gov)

Abstract: Early-detection surveys for potentially invasive Lepidoptera species are currently taking place in Florida, USA. In these targeted surveys for non-native moths various traps are used with pheromones specific for each 'target' species. However, these pheromones usually attract some native species, sometimes in large numbers, complicating early detection efforts. Surprisingly, some of the native species are not closely related to the intended target. In some cases, the catch includes rarely collected or previous undescribed species. This work presents the native species most often caught in several of these surveys, in part aiming to facilitate the processing of samples. **(Poster)**

Fifteen years of butterfly monitoring at Rocky Mountain National Park

Bray, Richard (presenter) & Jan Kilgore

Rocky Mountain National Park Butterfly Project, P.O. Box 1260, Estes Park, CO 80517 USA. (MtLep@earthlink.net)

Abstract: Long-term monitoring is of value to public lands. This citizen science inventory and monitoring project has over fifteen years of butterfly data for Rocky Mountain National Park. The species list grew from 94 to 141 confirmed species. Volunteers created a database with 78,765 butterfly sightings from 3,796 transect surveys. They also created a database with over 20 years of daily weather data from the National Weather Service Station, Estes Park 1SSE. Analysis is underway. If we had stopped

after eight years, trends in the butterfly communities would have led to the hypothesis that chemical deposition, elk, drought, or all three have affected the communities' long term health. With fifteen years of data, the natural cycles of butterflies in the high elevation environment begin to be revealed. Even with relatively long-term monitoring, there is indeed danger of jumping to conclusions. **(Thursday, 1:30)**

The SilverCollection Web Portal in the Mississippi Entomological Museum

Brown, Richard L.[1] (presenter) & Michael Giddens[2]

[1]Mississippi Entomological Museum, Mississippi State, MS 39762 USA; [2]SilverBiology LLD, 16950 Strain Rd., Baton Rouge, LA 70816 USA. (RBrown@entomology.msstate.edu)

Abstract: The Mississippi Entomological Museum uses the SilverCollection web portal to provide research and visualization tools for specimen data. This application uses various filters to allow easy access, searching, browsing, reporting, and downloading of data. Data for more than 65,000 specimens of moths have been converted from a Comma Separated Value (CSV) file into a Darwin Core Archive with data provided to GBIF. The standardized DwC-A format is then imported into SilverCollection software on the Mississippi State University server. Details of the use of digitized data associated with SilverCollection will be presented. **(Saturday, 11:30)**

Species traits and the prediction of phenological responses to climate change in Lepidoptera

Caldas, Astrid

Defenders of Wildlife, 1130 17th St. NW, Washington, DC 20036 USA. (acaldas@defenders.org)

Abstract: In many ways, known and unknown, climate change will affect species' distributions, life cycles, phenologies, and ultimately survival. Lepidoptera are among the organisms that have been shown to be most impacted by climate change, and their conservation presents challenges that are both unique and unprecedented. Various studies have sought to determine what ecological and life traits of Lepidoptera influence their response to climate change, and in this study I review the relevant results at the level of assemblages and communities, and summarize the common responses. Larval diet breadth and composition, overwintering stage, and adult activity period appear to be consistent predictors of changes in flight phenology in studies from Europe and North America. I present a framework of responses based on those traits, which can be used in conservation planning at various levels. **(Poster)**

The North American Butterfly Monitoring Network: promoting participation in butterfly research, scientific discovery and education

Caldas, Astrid[1] (presenter), Leslie Ries[2], Doug Taron[3], Nathan Brockman[4], Jaret Daniels[5], Karen Oberhauser[6], Karen Wilson[3], Paul Allen[7], Greg Breed[8], Jeff Glassberg[9], Mikaela Howie[10], Joseph Jaja[11], Kelly Lotts[12], Steve McGaffin[13], Sarah Moore[14], Lea Morgan[15], Thomas Naberhaus[12], Cyndy Parr[16], Guy Pe'er[17], Rick Ruggles[18], Matt Scott[19], Lori Scott[20], Jane Scott[9], Mike Smorul[21], Jim Springer[9], Sharon Stichter[9], Dave Waetjen[22] & Jerome Wiedmann[18]

[1]Defenders of Wildlife, 1130 17th St. NW, Washington, DC 20036 USA; [2]Department of Biology, University of Maryland and the National Socio-environmental Synthesis Center; [3]Peggy Notebaert Nature Museum / Chicago Academy of Sciences; [4]Rieman Gardens, Iowa State University; [5]University of Florida; [6]Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota; [7]Cornell Lab of Ornithology; [8]Harvard Forest; [9]North American Butterfly Association; [10]Kalamazoo Nature Center; [11]Department of Computer Sciences and Electrical Engineering, University of Maryland and the National Socio-environmental Synthesis Center; [12]Butterflies and Moths of North America; [13]Knoxville Zoo; [14]Pacific Science Center; [15]Boston Museum of Science; [16]Encyclopedia of Life; [17]UFZ-Helmholtz Centre for Environmental Research, Leipzig; [18]Ohio Lepidopterists Society; [19]Red-Shift Technologies; [20]NatureServe; [21]The National Socio-environmental Synthesis Center; [22]University of California-Davis. (acaldas@defenders.org)

Abstract: Citizen-scientists throughout North America perform thousands of surveys each year but, unlike their European counterparts, the data from these monitoring programs are little known and less used. A recent workshop brought together North American butterfly data producers with representatives from the scientific and technology communities with the goal to develop systems to promote and support expanding public participation in and use of butterfly data and knowledge. This workshop resulted in the formation of a network of data providers and includes butterfly monitoring groups that currently collect several types of data. Our goals were to 1) increase recruitment and ease participation in monitoring programs, 2) standardize protocols, data, and taxonomic standards as much as possible, and 3) develop systems for data management, sharing, and visualization. Based on this new network, we look forward to much greater visibility, participation, and use of butterfly monitoring data for scientific research and education. **(Poster)**

John Abbot's butterflies: science and commerce in early Georgia

Calhoun, John V.

977 Wicks Dr., Palm Harbor, FL 34684 USA. (bretcal1@verizon.net)

Abstract: During his long residency in Georgia, the English naturalist-artist John Abbot (1751-ca.1840) produced thousands of watercolor drawings of natural history subjects, including butterflies. Through his drawings and accompanying manuscripts, Abbot painstakingly documented the early stages and food plants of many species, which remains a valuable source of scientific information. Abbot also gathered thousands of specimens, many of which are still preserved in institutional collections. These activities provided a livelihood for himself and his family. To produce multiple illustrations

for sale, he often duplicated compositions and shared individual figures between drawings. In the process, he sometimes portrayed erroneous figures of early stages and food plants, presumably for aesthetic purposes. In the interest of business, Abbot often employed such "artistic license." **(Friday, 9:45)**

Site selection of potential prime butterfly areas: the case of an impoverished butterfly fauna in a Mediterranean island state

Caruana, Robert (presenter), Louis F. Cassar & Elisabeth Conrad

Institute of Earth Systems, University of Malta, Tal-Qroqq, Msida, Malta. (robert.caruana@um.edu.mt)

Abstract: Centrally located within the Mediterranean, the Maltese Islands provide an ecological linkage that bridges the African and European continents. The impoverished butterfly fauna that characterizes these islands is the product of both natural as well as anthropogenic root causes. Moreover, global warming may possibly be exacerbating pressures, further altering butterfly microhabitat conditions and consequently species behaviour and distribution. Although none of the butterfly species of the Maltese Islands satisfy the pre-determined selection criteria applied in Europe to identify Prime Butterfly Areas (PBAs), there is scope for the setting up of a conservation management strategy to better safeguard local Lepidoptera. This study outlines a novel methodology for determining core butterfly conservation habitats within this central Mediterranean archipelago's landscapes. The methodology has been designed to be applicable to the local context, and is based upon the evaluation of a site's physical and ecological attributes, with a view to identifying and suitably safeguarding/managing Prime Butterfly Areas. **(Friday, 2:30)**

Regal fritillary (*Speyeria idalia*) population trends at Rowe Sanctuary, Gibbon, NE

Cavallaro, Michael C.[1] (presenter), Neil Dankert[2] & W. Wyatt Hoback[2]

[1]University of Nebraska at Kearney, 51 Sherwood Forest Drive, Andover, NJ 07821 USA; [2]University of Nebraska at Kearney, 905 West 25th Street, Kearney, NE 68849 USA. (cavallaromc@lopers.unk.edu)

Abstract: Since the initiation of the Xerces Society 4th of July (4J) butterfly counts, Rowe Sanctuary in south central Nebraska has annually reported the greatest 4J regal fritillary numbers in the country. Regal Fritillaries emerge in late June to early July making 4J counts an accurate means to monitor populations. Tall grass prairies are crucial to healthy regal fritillary populations; Rowe Sanctuary maintains restored tall grass prairie habitat in partnership with conservation groups and agencies to preserve migratory bird habitat. This program has indirectly supported regal fritillary populations. A number of variables have been documented to affect regal fritillary numbers such as precipitation, prescribed burnings, and grazing. Here we discuss over 30 years of data collected from the Rowe Sanctuary's 4J counts. **(Poster)**

Ten-year inventory of butterfly species and populations in Boulder County Open Space properties, Colorado – 2007-2011 analyses

Chu, Janet

964 Ravenwood Road, Boulder, CO 80303 USA; Museum Associate, C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, CO 80523 USA. (chuhouse@hotmail.com)

Abstract: Butterflies were inventoried in several habitats in ten county parks. A "meander-survey" method was performed on the trails and near waterways instead of the traditional scientific transect method. Butterflies were observed weekly during April through August a) on the wing; b) by capture and release; and c) by digital photographs. Field records were made of numbers of individuals and species during 'Research Hours', the date, time, temperature and useful behavioral notes. Of the known 201 Boulder County species, 123 were recorded in ten years of surveying. Total numbers of individuals per research hour were highest in 2007 (112) with 2010 and 2011 showing the lowest numbers (62 and 61 respectively); the average number of Individuals for the recent five-years was 86 individuals per research hour. The average number of species per research hour was determined to be 4.4 in 2007, higher than the five-year average of 3.4 and higher than the totals in 2009 and 2011 (3.2 and 2.7 number of Species per Research Hour respectively). We are measuring both fewer individuals and species recently. This research is sponsored by Boulder County Parks and Open Space, Boulder, Colorado and Boulder County Nature Association, Boulder, Colorado. **(Thursday, 2:10)**

Male mating costs in butterflies producing relatively small ejaculates

Cordero, Carlos[1] (presenter) & Nubia Caballero[2]

[1]Departamento de Ecología Evolutiva, Instituto de Ecología, Universidad Nacional Autónoma de México; [2]Posgrado en Ciencias Biomédicas and Departamento de Ecología Evolutiva, Instituto de Ecología, Universidad Nacional Autónoma de México. (cordero@ecologia.unam.mx)

Abstract: Male butterflies generally invest substantial amounts of resources in mating, and evidence indicates that multiple mating reduces male longevity. These survival costs have been observed in butterflies that produce large ejaculates. We studied the effect of multiple mating on male longevity in *Callophrys xami* (Lycaenidae) and *Leptophobia aripa* (Pieridae), two species with relatively small investment of resources in ejaculates (first ejaculates are equivalent to 1.45% and 0.82% of male weight, respectively). In both species, virgin males lived significantly longer than multiply mated males and this effect was stronger when males suffered food restrictions during the last larval instar. Since ecological costs of mating were excluded in the experiments, our results indicate that diminished male longevity was a product of physiological costs of sexual interactions. Our results also imply that even in species producing relatively small ejaculates selection could favor post-copulatory male choice. (Financial support provided by PAPIIT/UNAM IN213011.) **(Thursday, 9:45)**

A review of *Euchaetes* Harris (Erebidae: Arctiinae)

Cummins, Heather M. (presenter) & Susan J. Weller

University of Minnesota , Department of Entomology, 1980 Folwell Ave., 219 Hodson Hall, St. Paul, MN 55108 USA. (hmariecummins@gmail.com)

Abstract: *Euchaetes* Harris, members of the subfamily Arctiinae, are endemic to the New World, with their diversity spanning the Neotropical and Nearctic regions. The most complete checklist includes 21 species in the genus sensu lato, but *Euchaetes* is not currently convincingly monophyletic. Several species of *Euchaetes* are not well described. A taxonomic revision based on morphology is needed initially to address the systematic issues of the genus. The results from this revision will inform a companion study testing the monophyly of *Euchaetes* and the relationship of *Euchaetes* to other arctiines. Initial work has revealed additional character systems and confirmed the existence of new species. **(Wednesday, 9:00 [student presentation])**

Will Africa play the key role in the taxonomy of Lepidoptera in the 21st century? Yes!

De Prins, Jurate[1] (presenter), Geoff Martin[2] & Laurent Nsenga Ndjike[3]

[1]Entomology Section, Royal Museum for Central Africa, Tervuren, Belgium; [2]Department of Entomology, Natural History Museum, London, UK; [3]World Wildlife Foundation, Democratic Republic of the Congo. (jurate.de.prins@africamuseum.be)

Abstract: The biodiversity of Lepidoptera is largely understudied in tropical ecosystems in general and sub-Saharan Africa in particular. This phenomenon, known as the "Taxonomic Impediment", implies incomplete information on taxonomy and distribution. This is especially true for lepidopteran species that are small in size, cryptically coloured, and morphologically similar, often with closely resembling forewing patterns occurring in numerous species. Our recent field work (12-27 May, 2012) in the Yangambi Biosphere Reserve, province Orientale, Democratic Republic of the Congo, yielded an enormous richness of new species of the Old World. Many of them belong to small, obscure genera which are up to now considered as monotypic. We promote inter-institutional but targeted team studies which are conducted with the necessary methodological precision and an integrative approach. The enormously rich, dynamic, constantly evolving and complex African lepidopteran fauna is not only a challenge for taxonomists of the 21st century but in many cases offers the key to solve the phylogenetic relationships of higher taxa and also assists to answer the question of how the Lepidoptera colonized the world. **(Friday, 9:00)**

I got your back: the evolution of defense in slug and nettle caterpillars (Limacodidae)

Epstein, Marc

California Dept. of Food & Agriculture, Plant Pest Diagnostic Laboratory, 3294 Meadowview Road, Sacramento, CA 95832 USA. (marc.epstein@cdfa.ca.gov)

Abstract: Caterpillars of the Limacodidae (Zygaenoidea) are known for their diverse forms, ranging from the highly cryptic "gelatines" to the dazzling colors and patterns of the "nettles." This talk

explores the ontogeny of these forms from early to late instars in the context of the latest phylogenetic analyses using both morphological and molecular techniques. It also reviews how certain views, such as going from hairy to smooth, may have biased our understanding of the evolution of these jewels of the caterpillar world. **(Wednesday, 4:15)**

Holarctic distribution of butterflies – what do we know?

Fric, Zdenek F.[1] (presenter), Irena Slámová[2] & Martin Česanek[3]

[1]Biology Centre CAS, Institute of Entomology, Branisovská 31, CZ-37005 České Budějovice, Czech Republic; [2]University of South Bohemia, Branisovská 31, CZ-37005 České Budějovice, Czech Republic; [3]Bodrocká 30, SK-82107 Bratislava, Slovakia. (zdfric@gmail.com)

Abstract: Many butterfly genera and for several species show Holarctic distribution. While reviewing the published papers, we found that the most common pattern is an origin in the Palaearctic region and then the dispersal to North America via Beringia. On the infraspecific level the frequent pattern is a deep divergence between Palaearctic and Nearctic species. On the ultraspecific level, none or a weak divergence is found especially in Arctic taxa (for instance *Euchloe creusa*, *Parnassius phoebus*). On the other hand, the majority of the studies were done using only a limited amount of material. We enlarge the dataset of some of the taxa on both he infra- and ultraspecific levels. We found several dispersal events from PA to NA on the infra-specific level and a deep divergence between NA and PA on the ultraspecific level with successional differences from East to West. (The study was supported by the Grant Agency of the Czech Republic (P505/10/2248). **(Thursday, 11:00)**

Ecological impacts of habitat fragmentation on moth communities in an urban ecosystem

Grenis, Kylee (presenter) & Shannon Murphy

Department of Biological Sciences, University of Denver, 2101 E. Wesley Ave., Denver, CO 80208 USA. (kgrenis@gmail.com)

Abstract: As human populations continue to grow and spread across the landscape, we partition remaining native ecosystems into small patches surrounded by human influence. Many studies focus on species living within a landscape fragmented by agriculture, but in Colorado, there is a unique focus on preserving patches of native ecosystem within the surrounding urban/suburban landscape. Our study focuses on moths, which may respond differently to habitat fragmentation than their diurnal counterparts, butterflies. While butterflies generally lose species richness as habitat size decreases, moths do not respond to habitat loss as predictably. Instead, moth distribution has been attributed to vegetation composition but in urban/suburban systems, moths may also be affected by surrounding light from the matrix. The purpose of our study is to understand the drivers of moth community structure in urban/suburban systems by investigating the roles of patch size, vegetation composition, and light pollution on the species abundance and richness of moth communities. **(Student poster)**

Carcass scavengers and snail hunters: evolution of carnivory in Hawaiian fancy-cased caterpillars

Haines, William[1] (presenter), Zachary Williams[2], Akito Kawahara[3], Patrick Schmitz[1] & Daniel Rubinoff[1]

[1]University of Hawaii at Manoa, Department of Plant and Environmental Protection Sciences, 3050 Maile Way, Gilmore 310, Honolulu, HI 96822 USA; [2]University of Hawaii at Manoa, Tree Snail Conservation Lab, 3050 Maile Way, Gilmore 408, Honolulu, HI 96822 USA; [3]McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Powell Hall, 3215 Hull Road, Gainesville, FL 32611 USA. (whaines@hawaii.edu)

Abstract: The genus *Hyposmocoma* (Cosmopterigidae), endemic to the Hawaiian Islands, includes a spectacular diversity of caterpillars that fashion elaborate portable cases. While most *Hyposmocoma* feed on plant material, algae, or lichens, one group (15+ spp.) is carnivorous, with representatives on most of the main Hawaiian Islands. Some are generalist scavengers, eating dead insects, while others exhibit highly specialized behavior, hunting snails, tying them down with silk, and consuming them alive. We reconstructed a phylogeny of carnivorous taxa using three genes (COI, EF1α and CAD), and explored phylogeography and the evolution of feeding strategy (when known). Most of the species diversity in this group appears to have evolved on the oldest island of Kauai (7+ spp.), with multiple colonizations to younger islands. Surprisingly, specialization on snails does not appear to be a highly derived state within this group. Laboratory studies of the feeding behavior of carnivorous *Hyposmocoma* are ongoing. **(Wednesday, 3:45)**

Light trap inventory of moths in biofuel crops and native prairie in central Illinois

Harrison, Terry & May Berenbaum (presenter)

Department of Entomology, 320 Morrill Hall, University of Illinois, Urbana, IL 61801 USA. (maybe@illinois.edu)

Abstract: Increasing demand for biofuel feedstock for alternative energy may lead to large-scale conversion of land for monoculture production of biofuel crops, with concomitant adverse impacts on biodiversity. Because moths generally display dietary specificity, landscape conversion to biofuel feedstock production has the potential to eliminate habitat and hostplants for many moth species, particularly microlepidoptera. Over three years, we compared moth diversity in light-trap samples from corn, miscanthus, switchgrass, and native prairie at the University of Illinois Energy Biosciences Institute Energy Farm. Moths were identified by sight or with the aid of genital dissection. Alpha diversity of moths was calculated using the Shannon-Wiener index; Sorenson's index was used to determine beta diversity, the rate of change between communities. Approximately 5400 moths, representing 252 species in 25 families, were collected over the course of this study. Alpha diversity was highest in prairie and was higher in switchgrass than in the other two biofuel crops. Beta diversity generally was low among the biofuel crops, and prairie shared lower beta diversity with switchgrass than with corn or miscanthus. Overall, our findings are consistent with those of those of previous studies, in that ranking of moth diversity and abundance was prairie>switchgrass>corn/miscanthus. **(Thursday, 2:50)**

Larvae of *Penestola* and *Sufetula* in Florida (Crambidae)

Hayden, James E.

Florida State Collection of Arthropods, FDACS, Division of Plant Industry, 1911 SW 34th St., Gainesville, FL 32608 USA; and McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida. (james.hayden@freshfromflorida.com)

Abstract: The larval morphology and ecology of *Penestola bufalis* (Guenée) and *Sufetula* Walker sp. in Florida are described. As predicted by systematic relationships and distributional data, *Penestola* larvae were found inhabiting and feeding on intertidal leaf litter in a mangrove swamp. Diagnostic differences are given from *Duponchelia fovealis* Zeller, a related invasive pest with similar behavior. The two endemic *Sufetula* species are associated with roots of palms, and regulatory information indicates that both are occasional pests of ornamentals. Adults are attracted to fermenting beer/fruit bait. Unusual larval characters include absence of stemmata, numerous extrapinacula, and bisetose A8 SV group. **(Saturday, 9:25)**

Another challenge for systematists – the evolutionary history of Gelechioidea

Heikkilä, Maria[1] (presenter), Marko Mutanen[2], Mari Kekkonen[1] & Lauri Kaila[1]

[1]Finnish Museum of Natural History, University of Helsinki, P.O. Box 17, Helsinki 00014, Finland; [2]Zoological Museum, Department of Biology, University of Oulu, P.O. Box 3000, Oulu 90014, Finland. (maria.heikkila@helsinki.fi)

Abstract: Gelechioidea are one of the largest and most diverse but also least known superfamilies within Lepidoptera. Their outstanding diversity, resulting from the very broad range of life modes and feeding strategies they exhibit, has posed challenges for resolving their evolutionary history. In the series of studies with the objective to obtain resolution to the nebulous classification of Gelechioidea, our phylogenetic study comprises thus far the most extensive taxon sampling and largest morphological and molecular character dataset. These datasets are analyzed in combination using parsimony and maximum likelihood methods. Although many challenges remain to be overcome, our results are a contribution towards a more stable classification of Gelechioidea by reinforcing several inter-familial relationships and justifying status assignments for several groupings, not forgetting nomenclatural issues that come with these. **(Wednesday, 9:15 [student presentation])**

Marvels, mysteries and challenges in the New Zealand Lepidoptera fauna

Hoare, Robert J. B.

New Zealand Arthropod Collection, Landcare Research, Private Bag 92170, Auckland, New Zealand. (HoareR@landcareresearch.co.nz)

Abstract: New Zealand has approximately 1750 known species of Lepidoptera; there are many known undescribed taxa and the true fauna is likely to exceed 2000 species. Levels of endemism are extremely high, with nearly 90% of species restricted to New Zealand. Some groups (e.g., Incurvarioidea, Papilionoidea) are notably depauperate, while others (e.g., Oecophorinae, Scopariinae) are exceptionally diverse. Mnesarchaeidae is the only family currently considered endemic to New

Zealand, but some enigmatic unplaced genera (e.g., *Cadmogenes*, *Titanomis*) may eventually require their own families. Biogeographically, the fauna is considered to be a mixture of 'primitive' relicts from the ancient fauna of the Gondwanan supercontinent (e.g., Micropterigidae) with more recent elements derived, principally from Australia, by dispersal. Most groups of moths, including almost all 'Macrolepidoptera', have not been taxonomically revised since the 1920's: there are no more than 10 active lepidopterists in the country, and there is vast scope for new systematic work. **(Friday, 9:15)**

The *Phaneta tarandana* species complex (Lepidoptera: Tortricidae): testing a morphological perspective

Jaeger, Christi[1] (presenter), Jason Dombroskie[2] & Felix A.H. Sperling[1]

[1]CW403 Biological Sciences Building, Department of Biological Sciences, University of Alberta, Edmonton, Alta., Canada T6G 2E9; [2]Comstock Hall, Department of Entomology, Cornell University Ithaca, NY 14853 USA. (christi@ualberta.ca)

Abstract: Moths of the *Phaneta tarandana* (Möschler, 1874) complex have challenged entomologists for the last century. We investigated the relationship between *P. tarandana* and a close congener, *P. montanana* (Walsingham, 1884), using morphological and molecular characters. We focused on characters that allowed tests of the prior taxonomic arrangement and found that male genitalic characters previously used to diagnose these groups were unreliable with a high degree of intra-specific variation. A new character in *Phaneta*, apical wing scale detail, provided evidence supporting the hypothesis that these are two evolutionarily distinct lineages. Likelihood analysis of 631 bp mtDNA in COI placed *P. montanana* as a monophyletic clade within *P. tarandana*. However, there was strong support (>95%) for the monophyly of both groups using maximum parsimony and bootstrap analysis. ITS2 sequences gave one informative character, a 1 bp insertion in *P. montanana*. Our results reveal substantial support for the current taxonomic arrangement. **(Wednesday, 9:30 [student presentation])**

Population biology of the imperiled Leona's little blue butterfly, *Philotiella leona* (Lepidoptera: Lycaenidae)

James, David G.

Department of Entomology, Washington State University, 24106 North Bunn Road, Prosser, WA 99350 USA. (david_james@wsu.edu)

Abstract: Populations of *Philotiella leona* were surveyed in the known occupied area of the Antelope Desert, Klamath County, Oregon during June-July in 2011 and 2012. Adults eclosed soon after mid June with greatest numbers recorded during late June-early July. Females represented 35.3% of butterflies seen with mating and oviposition commonly observed. The sex ratio was relatively balanced during the remainder of the flight period. Numbers of butterflies dropped slightly during July 6-8 with a further slow decline during the rest of July. Mark, release and recapture (MRR) was conducted at one 0.39 ha site with 214 individuals marked in 2011. Ten individuals were recaptured after intervals of 2-14 days and population estimates indicated a population of 200-300 individuals. MRR data for 2012 will also be presented. **(Thursday, 9:15)**

Stridulating genital valves: the evolutionary origins of anti-bat ultrasound production in hawkmoths

Kawahara, Akito Y.[1] (presenter), Jesse Barber[2], Cassandra Romero[1] & Ian J. Kitching[3]

[1]McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Powell Hall, 3215 Hull Road, Gainesville, FL 32611 USA; [2]Department of Biology, Boise State University, Boise, ID 83725 USA; [3]Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD, U.K. (kawahara@flmnh.ufl.edu)

Abstract: Bat-insect interactions date back millions of years, and the shared evolutionary history between echolocating bats and nocturnal insects have resulted in a suite of unique defensive strategies. Anti-bat ultrasound production may be linked to multiple behavioral strategies, including cross-family acoustic mimicry, advertisement of physical defenses and/or evasive flight, and mating behavior. We demonstrate that hawkmoths produce ultrasound in response to bat attack and show that multiple types of stridulatory organs exist. We examine how these stridulatory organs have evolved on a new, fossil-calibrated sphingid phylogeny. **(Wednesday, 11:15)**

Six ways to delimit species – results from three lepidopteran subfamilies

Kekkonen, Mari[1] (presenter), Lauri Kaila[1], Marko Mutanen[2] & Paul Hebert[3]

[1]Finnish Museum of Natural History, University of Helsinki, P.O. Box 17, FI-00014 Helsinki, Finland; [2]Zoological Museum, Department of Biology, University of Oulu, P.O. Box 3000, FI-90014 Oulu, Finland; [3]Biodiversity Institute of Ontario, University of Guelph, 50 Stone Road East, Guelph, ON, Canada. (mari.kekkonen@helsinki.fi)

Abstract: Taxonomists have used a variety of different types of characters to establish the boundaries between species. Traditionally, characters have been derived from morphological structures, but the use of molecular characters has increased rapidly in recent years and will accelerate in the future. The results of applying different methods for species delimitation have been compared, but few prior studies have examined several larger groups with varying evolutionary histories. Here, we compare the results obtained by using six methods for species delimitation on three lepidopteran subfamilies (Elachistinae, Gelechiinae and Hypertrophinae). Two morphological methods were used: sorting based on male and female genitalia. Molecular character-based delimitation was based on the sequence data for the barcode region of the mitochondrial COI gene using four analytical approaches (Barcode Index Numbers [BINs], Automated Barcode Gap Discovery [ABGD], parsimony networks and general mixed Yule coalescent model [GMYC]). In addition, we have ecological information for elachistines and gelechiines. **(Wednesday, 9:45 [student presentation])**

Chemical mediation of *Penstemon*-herbivore interactions: a comparison of specialist and generalist caterpillars

Kelly, Caitlin

University of Colorado, Department of Ecology and Evolutionary Biology, Campus Box 334, Boulder, CO 80309 USA. (caitlin.a.kelly@colorado.edu)

Abstract: Variation in plant quality is one of the driving factors in structuring communities of herbivores. Especially for insect herbivores, host plant suitability is often determined by the amounts and kinds of secondary plant metabolites. My research addresses how chemical variation among plants of the genus *Penstemon* (Plantaginaceae), which are native to Colorado, influences interactions with insect herbivores. Chemical analyses from two species, *Penstemon glaber* and *Penstemon virgatus,* show large differences in their iridoid glycosides (IG) content. Iridoid glycosides are bitter compounds that can be used by plants for defense against herbivory, yet some insect herbivores can specialize on plants containing IGs and sequester these compounds for their own defense. Though *P. glaber* and *P. virgatus* belong to the same genus, their vastly different IG content indicates that they may have different relationships with native herbivores. I compare the host plant preferences of IG specialist insects (feeding on only one plant family) and generalist insects (feeding on multiple plant families) between these two plant species. Using results from laboratory, garden and field experiments, I discuss the implications of the surprising host plant preferences demonstrated by specialist and generalist herbivores. **(Wednesday, 1:30)**

Local variation in host plant quality affects spatial distribution of fall webworms (*Hyphantria cunea*)

Kjeldgaard, MacKenzie (presenter), Katrina Loewy & Shannon Murphy

Department of Biological Sciences, University of Denver, 2101 E. Wesley Ave., Denver, CO 80208 USA. (Shannon.M.Murphy@du.edu)

Abstract: The fall webworm (*Hyphantria cunea*) is a generalist moth species, but populations appear to be specialized in Colorado. One host plant in Colorado is plains cottonwood (*Populus deltoides*). Fall webworm larvae are not as likely to feed on plains cottonwood located in canyons in the foothills of Colorado as they are to feed on plains cottonwood located on the adjacent plains. Furthermore, plains cottonwood is never as commonly used as a host as its congener, narrowleaf cottonwood (*Populus angustifolia*), which is a relatively high-quality host for fall webworm in Colorado. Using a split-brood design, we reared fall webworm larvae on plains cottonwood from canyons and plains and narrowleaf cottonwood to determine the relative performance of larvae on these host plants. Our measures of larval performance demonstrated that plains cottonwood from the plains is a superior host to plains cottonwood from the canyons for fall webworms in Colorado. **(Wednesday, 2:10 [student presentation])**

Electronic publication, ZooBank and the new edition of the Code

Krell, Frank-Thorsten

Commissioner, International Commission on Zoological Nomenclature (ICZN); c/o Department of Zoology, Denver Museum of Nature & Science, 2001 Colorado Blvd., Denver, CO 80205 USA. (frank.krell@dmns.org)

Abstract: Three new developments will adapt zoological nomenclature to the requirements of the 21st century. 1. An Amendment to the current Code will allow electronically published nomenclatural acts. The publishing industry, in line with changing user behavior and the effects of library budgetary constraints, is increasingly transitioning from paper to electronic formats. Nomenclatural acts already are published in electronic-only format (hence being unavailable) but are generally used as if they were available. This situation needs to be regulated by the nomenclatural rules. 2. Registration of e-only publications in ZooBank, the official online registry of the ICZN, will be mandatory. Registration of paper publications and nomenclatural information therein remains voluntary. A new, user-friendly and robust version of ZooBank is currently being tested and will be released soon. The Amendment will be ratified as soon as this version of ZooBank is considered ready for general use. 3. A new edition of the Code is in preparation. Currently, we are considering whether restructuring the Code will make it easier to use and whether adding more examples will clarify some of the more complex Articles. We are also considering whether many shortcomings of the current Code could be solved by mandating the registration of nomenclatural information in ZooBank. Input from the zoological community on these matters will be crucial if we are to successfully overhaul the 4th edition of the Code. **(Friday, 3:40)**

Holarctic Lepidoptera: the Beringian connection

Lafontaine, Don

Canadian National Collection of Insects, Arachnids, and Nematodes (CNC), Ottawa, Ontario K1A 0C6, Canada. (lafontained@agr.gc.ca)

Abstract: 36 species of butterflies and 223 species of moths are currently believed to have naturally occurring Holarctic distributions. Introduced species and cosmopolitan species, the latter also probably aided by man or ships, are only briefly mentioned. In spite of observations by Alfred Wallace in 1876 on a trans-Beringian faunal connection, and compelling geological evidence in 1894 for a dry-land connection 1000 miles wide connecting Asia and North America with extensive ice-free areas in Alaska and Yukon, the importance of possible Amphi-Atlantic connections continued into the 1950's. Other topics included are taxonomic difficulties, typical larval host plants, geographical distribution patterns, and the effects of Pleistocene glaciations on northern biomes, especially in the Beringian area, are reviewed. The recent role of DNA Barcoding as a taxonomic tool in comparing the Nearctic and Palearctic faunas and in determining if a species is naturally Holarctic or introduced are also discussed. The greatest barrier to studies on Holarctic distributions is the lack of moth collecting and access to fresh material from Russian Beringia. **(Thursday, 11:15)**

Dating *Spodoptera* Guenée, 1852 (Lepidoptera: Noctuidae) clades using fossil and non-fossil evidence

Lammers, Mark[1] (presenter), Marja van der Straten[2] & Freek T. Bakker[1]

[1]Biosystematics Group, Wageningen University, The Netherlands; [2]Plant Protection Service, National Reference Centre, Wageningen, The Netherlands. (mark.lammers@wur.nl)

Abstract: Various species within *Spodoptera* Guenée, 1852 (Lepidoptera: Noctuidae) are known to be important crop pests, causing great economic damage in most continents. In order to better understand their origin and persistence as pests, knowledge of the phylogenetic relationships and age of *Spodoptera* clades concerned is instrumental. Using both previously-published and newly-generated mitochondrial (COI) and nuclear (EF1a, CAD, GAPDH and IDH) encoded gene sequences we first established monophyly of *Spodoptera* and assigned it as sister to *Galgula* Guenée, 1852 in the noctuid phylogeny. We then conducted dating analyses of the noctuid phylogenetic trees, using both a notodontid fossil as calibration, as well as the assumption that the emergence of noctuoid tympanal organs is linked with the emergence of bat echo-location, the latter dated at 62±4 Mya. As both approaches give consistent results we feel that, in concert, they provide valuable calibration and conclude that the main *Spodoptera* pest clades emerged in the late Paleogene. **(Wednesday, 10:00 [student presentation])**

Taxonomic review of North American taxa formerly or presently included in *Yponomeuta* (Lepidoptera: Yponomeutidae)

Landry, Jean-François[1] (presenter), Steven Passoa[2], Jae-Cheon Sohn[3], Terry L. Harrison[4] & Eric LaGasa[5]

[1]Canadian National Collection of Insects, Arachnids, and Nematodes (CNC), Ottawa, Ontario K1A 0C6, Canada; [2]USDA-APHIS-PPQ, U.S. Forest Service Northern Research Station and The Ohio State University, Columbus, Ohio 43212 USA; [3]Department of Entomology, University of Maryland, College Park, Maryland 20742 USA; [4]Department of Entomology, University of Illinois, 320 Morrill Hall, 505 South Goodwin Ave, Urbana, Illinois 61801 USA; [5]Pest Program / Plant Protection Division, Washington State Department of Agriculture, P.O. Box 42560, Olympia, Washington 98504 USA. (jean-francois.landry@agr.gc.ca)

Abstract: The North American *Yponomeuta* fauna is composed of a single native species, *multipunctella* Clemens, and four introduced species, *cagnagella* Hübner, *malinellus* Zeller, *padella* (L.), and *plumbella* (D. & S.). *Yponomeuta multipunctella* ranges broadly in the East (feeds on native *Euonymus*); *cagnagella* occurs in the East (feeds on ornamental *Euonymus*); *malinellus* and *padella* occur in the Pacific Northwest and are pests of apple and cherry, respectively; *plumbella* appears restricted to coastal Massachusetts and feeds on *Euonymus*. *Yponomeuta atomocella* Dyar on *Ptelea* is transferred to *Prays* (Praydidae). We also report the introduced *P. fraxinella* (hostplant *Fraxinus*) from Newfoundland and British Columbia, and *P. hualapai* sp.n. from Arizona. *Tinea martinella* Walker, previously in *Yponomeuta*, is transferred to *Kessleria*, with *Tinea afflictella* Walker as synonym. *Yponomeuta wakarusa* Gaumer, a synonym of *multipunctella*, has been omitted from the literature for over 100 years despite being an available name. *Yponomeuta calcarata* Meyrick, originally described from Bermuda and recorded from Florida in the 1990s is placed in the genus *Teinoptila*. Morphological features and life history of each species will be presented. **(Saturday, 11:15)**

The genus *Clavigesta* Obraztsov, 1946: a zoogeografical interesting genus with origins in the Mediterranean basin, and discovery of relict populations in Europe

Larsen, Knud

Rontoftevej 33, Dyssegaard 2870DK, and Zoological Museum of Copenhagen, Denmark. (knud.torts@gmail.com)

Abstract: This paper deals with the genus *Clavigesta* Obraztsov, 1946. The material of the author's collection and some additional material has been examined. Together with the two already known species in this genus, two new species are described and figured: *Clavigesta gerti* sp. n. and *Clavigesta tokei* sp. n. The distribution of all four species is described in detail and it is detected that all four species occur in the Mediterranean region and that the genus may have originally evolved in the pine forests of this region. *C. purdeyi* from the central Mediterranean area is slightly different in appearance from the populations in North-West Europe, indicating a long time separation of the populations. **(Saturday, 10:30)**

Larval feeding preference of the dancing moth, *Dryadaula terpsichorella* (Tineidae: Dryadaulinae)

Lee, Ga-Eun[1] (presenter), James E. Hayden[2] & Akito Y. Kawahara[1]

[1]McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Powell Hall, 3215 Hull Road, Gainesville, FL 32611 USA; [2]Florida State Collection of Arthropods, FDACS, Division of Plant Industry, Gainesville, FL 32608 USA. (kawahara@flmnh.ufl.edu)

Abstract: The dancing moth, *Dryadaula terpsichorella*, is a tineid that has recently been discovered in large numbers in California and Florida. The moth is known for its rapid circling adult behavior, but little is known about its life history. This moth can occur in large numbers and might be a pest, as its larva is reported to be associated with the leaves of banana and pineapple. Other reports suggest the moth may feed on lichens, ferns, or fungi on damp wood, but none of these reports have been confirmed. We conducted feeding choice tests in which larvae were offered fresh and wilted leaves of: banana (*Musa* sp.), alligator flag (*Thalia geniculata*), willow (*Salix* sp.), sweet gum (*Liquidambar styraciflua*), *Canna* sp., fern, lichen, and decayed wood. While larvae favored wilted leaves of banana the most (34%), this moth probably is not a threat to horticulture as it is small and tends to feed on parts of the plant that are not photosynthetic. **(Student poster)**

The Hasbrouck Insect Collection at Arizona State University – past, present and future

Lee, Sangmi (presenter), Nico Franz & Stephanie Varelas

School of Life Sciences, Box 874501, Arizona State University, Tempe, AZ 82587 USA. (microlepi@hotmail.com)

Abstract: The Frank F. Hasbrouck Insect Collection at Arizona State University (ASUHIC) has recently received a series of significant upgrades including the hiring of a new curator, collection manager, renovations, and other collection infrastructure improvements. ASUHIC contains approximately 700,000

well curated specimens representing more than 12,000 species, and primarily covering the southwestern United States and adjacent Sonora, Mexico. The collection had previously seen its greatest activity during the period of 1960-1990, due in large part to the efforts of ASU entomologists Frank Hasbrouck and Mont Cazier. Hasbrouck in particular specialized in the taxonomy of Microlepidoptera, having completed his doctoral thesis on the family Acrolophidae. He took immense care in curating the specimens which remain in excellent condition. The collection is now once more fully functional and welcomes interactions with scientists and the general public. Efforts to database and image the specimen holdings can be tracked through the following websites: http://franz.lab.asu.edu/collection.html and http://hasbrouck.asu.edu/symbiota/portal/index.php. **(Wednesday, 11:45)**

Trade-offs in host choice by an herbivorous insect based on parasitism and host plant quality

Loewy, Katrina J. (presenter) & Shannon Murphy

Department of Biological Sciences, University of Denver, 2101 E. Wesley Ave., Denver, CO 80208 USA. (Shannon.M.Murphy@du.edu)

Abstract: Natural enemies and host plant quality have both been invoked to explain the evolution of host choice in herbivorous insects. In this study, we quantified both selection pressures for a polyphagous moth species, fall webworm (*Hyphantria cunea* Drury). The gregarious larvae spin extensive webs for protection and thermoregulation, and have been recorded on dozens of plant families worldwide. In Colorado, we have recorded them on ~17 host species. We quantified host plant quality and parasitism pressure for multiple host plant species in Colorado by rearing wild-caught larvae. Based on results from our observational study, we selected four host plants of high and low host plant quality for a manipulative split-brood experiment. We found a positive correlation between mortality from parasitism and host plant quality, which suggests a fitness trade-off in which low-quality host plants may provide a refuge from natural enemies. **(Wednesday, 1:50 [student presentation])**

Thermoregulation and the ecological and evolutionary responses of Rocky Mountain *Colias* to climate change

MacLean, Heidi J. (presenter), Jessica K. Higgins, Joel G. Kingsolver & Lauren B. Buckley

Department of Biology, University of North Carolina at Chapel Hill, Coker Hall, CB #3280, 120 South Road, Chapel Hill, NC 27599 USA. (heidi.maclean@gmail.com)

Abstract: *Colias* butterflies have long been a model system for understanding thermoregulatory behavior and local adaptation to climate. What are the behavioral, ecological and evolutionary responses of *Colias* to recent climate changes in the Rocky Mountains? *Colias* use behavioral postures to maintain body temperatures required for flight (30-40°C) and to avoid overheating, and adapt to local climate conditions via differences in melanin on the ventral hind wings and the thickness of thoracic setae ('fur'). Our recent reciprocal transplants with high-elevation *Colias meadii* and lower-elevation *Colias eriphyle* show that butterflies from higher elevations with darker wings and thicker setae tend to initiate morning flight sooner regardless of location. Ongoing work is investigating whether the high-elevation phenotype experiences more frequent overheating and the consequences thereof. Preliminary research examining natural history specimens is addressing whether phenotypes have evolved to alleviate overheating associated with climate change. **(Friday, 2:05 [student presentation])**

Testing monophyly of megadiverse Spilomelinae (Pyraloidea: Crambidae)

Mally, Richard[1] (presenter), Christoph Neinhuis[2] & Matthias Nuss[1]

[1]Senckenberg Natural History Collections, Museum of Zoology, Königsbrücker Landstraße 159, D-01109 Dresden, Germany; [2]Technical University Dresden, Chair of Botany, D-01062 Dresden, Germany. (richard.mally@senckenberg.de)

Abstract: Spilomelinae represent one quarter of the 16,000 described species of Pyraloidea, making it the most speciose subgroup of the snout moths. Spilomelinae have a worldwide distribution with highest diversity in the tropics. They contain many species of economic importance, including invasive pests like the box tree moth *Cydalima perspectalis*. So far, Spilomelinae are exclusively defined by typological means and have repeatedly been claimed to be polyphyletic (Minet 1982, Solis & Maes 2003). A morphology-based cladistic analysis (Solis & Maes 2003) failed to find autapomorphies for the group. As an initial step towards a stable, phylogenetically justified nomenclature, we present first results of our test on the monophyly of Spilomelinae. Our taxon sampling comprises representatives of most of the 15 genus groups treated by Munroe (1995), 25 of the 29 spilomeline genera occurring in Europe and representatives from the Afrotropical and Oriental regions as well as 11 Pyraustinae taxa. We compiled molecular data of mitochondrial COI gene and nuclear genes EF1a, GAPDH, IDH and analyzed them phylogenetically using MrBayes. Our preliminary results indicate a sister-group relationship of Spilomelinae and Pyraustinae. Spilomelinae only form a natural group with the inclusion of Wurthiinae, confirming the results of Mitter et al. (in press). None of the investigated genus groups with exception of the *Samea* group appear monophyletic. The *Udea* s.l. group (Mally & Nuss 2011) appears to be a key group at the base of the Spilomelinae-Pyraustinae clade. However, several enigmatic taxa (e.g. *Euclasta*) and genus group representatives are still missing from the sampling and may provide further insights, once they are included. **(Saturday, 9:40)**

Inventory of the lepidopteran fauna of the Guantanamo Bay Naval Base, Cuba

Matthews, Deborah L.[1] (presenter), Jacqueline Y. Miller[1], Terry A. Lott[2], Roger W. Portell[2] & James K. Toomey[2]

[1]McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, P.O. Box 112710, Gainesville, FL 32611 USA; [2]Dickinson Hall, Florida Museum of Natural History, University of Florida, P. O. Box 117800, Gainesville, FL 32611 USA. (mothnut@hotmail.com)

Abstract: The Guantanamo Bay Naval Base covers a 120 km^2 area at the southeastern shore of Cuba. The bay area is surrounded by several mountain ranges with the resulting rain shadow limiting annual precipitation to less than 24 inches. The unique dry tropical sub-montane to marsh habitats preserved on the base are home to a variety of endemic and widespread lowland wildlife species. A project to inventory Lepidoptera currently on the base and assemble records from previous collectors is in progress. Initial fieldwork was conducted in January 2012. Preliminary observations and examples of taxa collected will be presented. **(Saturday, 10:45)**

Endemism in moths (Lepidoptera) at White Sands National Monument, New Mexico, USA

Metzler, Eric H.

Michigan State University Adjunct Curator of Lepidoptera, U.S.N.M. Natural History Research Collaborator, P.O. Box 45, Alamogordo, NM 88311 USA. (metzlere@msu.edu)

Abstract: White Sands National Monument preserves 297.85 km^2 (40%) of the world's largest snow-white gypsum dunes. The adaptations of Squamata, Rodentia, and Orthoptera prompts the National Park Service to call White Sands the Galapagos of North America. The National Park Service invited Metzler to undertake a study of moths at White Sands NM. Along a transect ≈ 2.4 km long through the dunes, 450 species of moths were recorded during 2007-2010. Metzler discovered at least 14 previously unknown species of moths in five families. All, except two, occur wholly within the dunes, and several are "white species." Other widespread species of moths have white phenotypes in the dunes. Many plants in the dunes have chemical signatures and associated microbes that are different from the same plant species outside the dunes. Larvae within the dunes are ingesting different chemicals and microbes than larvae outside the dunes, thus they inhabit an ideal place for speciation. **(Friday, 9:30)**

A well-resolved phylogeny of the corn earworm complex (Noctuidae: Heliothinae: *Helicoverpa* spp.) based on amplified fragment length polymorphisms (AFLP) and morphology

Mitter, Kim[1] (presenter), Robert Poole[2] & Charles Mitter[1]

[1]University of Maryland, Department of Entomology, 4112 Plant Sciences Building, College Park, MD 20742 USA; [2]722 Owens Street, Rockville, MD 20850 USA. (kim.mitter@verizon.net)

Abstract: The circum-global genus *Helicoverpa* contains 18 species including several highly destructive agricultural pests. Previous studies of protein-coding nuclear gene sequences (Cho et al., 2008) had left the phylogeny of *Helicoverpa* species only partly resolved. We collected AFLP data (1895 fragments) on 84 specimens representing ten *Helicoverpa* species and two species of its sister genus, *Australothis*. Phylogenetic analyses support monophyly for all species, usually with very strong bootstrap support. The first lineage to diverge contains two Hawaiian island endemics. The remaining species comprise two sister clades. One groups the Australian *H. punctigera* with the South American *H. gelotopoeon* and *H. atacamae*. The other divides basally into a lineage uniting *H. fletcheri* (Africa) with *H. assulta* (Asia/Australia), and a lineage consisting of *H. zea* (North America), *H. hardwicki* (Australia), and *H. armigera* (the Old World budworm). These groupings conflict only slightly with a phylogeny for all 18 species based on morphology. **(Thursday, 10:45)**

Monitoring butterflies in America's heartland: new techniques help reveal increasing populations of prairie-dependent species

Moranz, Raymond A.[1] (presenter), Diane M. Debinski[1], John Delaney[1], David M. Engle[2] & James R. Miller[3]

[1]Department of Ecology, Evolution, and Organismal Biology, Iowa State University, 253 Bessey Hall, Ames, IA 50011 USA; [2]Department of Natural Resource Ecology and Management, Oklahoma State University, 008C Agricultural Hall, Stillwater, OK 74078 USA; [3]Department of Natural Resources and Environmental Sciences, University of Illinois, N407 Turner Hall, Urbana, IL 61801 USA. (raymoranz@yahoo.com)

Abstract: Each summer since 2007, we have monitored butterfly populations at 12 sites in southern Iowa/northern Missouri as part of an experiment to assess the effects of prescribed fire and cattle grazing on grassland butterflies. These sites are in the Grand River Grasslands, a 90,000 acre region that is one of the largest grassland landscapes remaining in the tallgrass prairie zone. Though initially we only used Pollard Walk sampling, since 2008 we have used line-transect distance sampling to generate estimates of butterfly density, correct for differences in butterfly detectability, and attain higher sampling efficiency. We will compare and contrast these two sampling techniques, and reveal the effects of fire and grazing management on butterfly populations. Some of our sites had a history of intensive cattle grazing; since relaxation of that grazing, some prairie-dependent butterfly species (and the habitat elements they require) appear to be increasing. **(Thursday, 3:30)**

Benefits and limitations of three inventory methods

Mueller, Steve

Ody Brook Enterprises, 13010 Northland Dr., Cedar Springs, MI 49319 USA. (Odybrook@chartermi.net)

Abstract: Three different inventory methodologies used in our survey practices have advantages and limitations that can be mitigated. The 1995-2000 Michigan Butterfly Survey depended heavily on citizen science observations with minimal photographic or specimen collection review. It fundamentally duplicated 150 years of specimen collection data in six years and provided a current species status. The Michigan Butterfly Monitoring Network began in 2011 using the Illinois model with "Pollard transect" walks by citizen scientists. The Karner Blue Butterfly distance sampling transect walks are the most rigorous method we are using to gather the most statistically useful data for population assessment. Advantages and limitations of methods are discussed, with mitigation recommendations. **(Thursday, 3:50)**

Guild-specific parasitism of forest caterpillars: size matters

Murphy, Shannon[1] (presenter), Kylee Grenis[1], Teresa M. Stoepler[2] & John T. Lill[2]

[1]Department of Biological Sciences, University of Denver, 2101 E. Wesley Ave., Denver, CO 80208 USA; [2]Department of Biological Sciences, The George Washington University, 2023 G St. NW, Washington, DC 20052 USA. (Shannon.M.Murphy@du.edu)

Abstract: Slug caterpillars (Limacodidae) are known for their unusual morphologies and are attacked by a variety of predators and parasitoids. To test whether parasitoids partition limacodid hosts based

on caterpillar size, we conducted a manipulative experiment in which we paired small and large limacodids in the field and recorded which size classes were preferentially attacked by parasitoid species at different times during the field season. We found that initial length of the limacodid caterpillar was not a significant predictor of whether they were likely to be parasitized; small and big caterpillars were equally likely to be parasitized. However, we found that small caterpillars were more likely to be parasitized by wasps than were big caterpillars. Furthermore, big caterpillars were more likely to be parasitized by flies than were small caterpillars. The results from our manipulative experiment suggest that fly and wasp parasitoids partition the community of limacodid caterpillar hosts by size. **(Wednesday, 4:30)**

Leafmining Nepticulidae and Heliozelidae in North America: fieldwork and DNA barcoding reveal overlooked biodiversity

Nieukerken, Erik J. van

Naturalis Biodiversity Center, PO Box 9517, 2300 RA Leiden, the Netherlands. (Nieukerken@naturalis.nl)

Abstract: Fieldwork in the eastern USA and DNA barcoding have provided much new data on the biology and diversity of leafmining Nepticulidae and Heliozelidae. A new *Antispila* species feeding on *Vitis*, that invaded Europe, was described when almost all previously named Vitaceae miners appeared to consist of at least two species, some of which feed both on *Vitis* and *Parthenocissus*. Diversity of Nepticulidae is also higher in many groups; *Ectoedemia* material collected from resp. *Nyssa*, *Carya*, *Corylus* and *Quercus*, revealed two species for each host, where only one was known. Whereas polyphagy for *Stigmella corylifoliella* on Betulaceae, Myricaceae and Ericaceae (possibly Rosaceae) could be corroborated by DNA barcoding, polyphagy for other species in the *S. betulicola* group has to be rejected and separate species are known to feed on *Carya* (2 species), *Ostrya*, *Juglans* and *Myrica* (in the SW states). *S. ostryaefoliella* is a completely misinterpreted species. Three new European introductions were recorded from the eastern USA thanks to barcode data. **(Saturday, 11:00)**

Selection against dispersal in isolated metapopulations of large blue butterflies

Nowicki, Piotr[1] (presenter), Simona Bonelli[2] & Vladimir Vrabec[3]

[1]Institute of Environmental Sciences, Jagiellonian University, Gronostajowa 7, 30–387 Kraków, Poland; [2]Department of Animal and Human Biology, University of Turin, Via Accademia Albertina 13, I – 10123 Torino, Italy; [3]Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Kamýcká 129, Prague 6 – Suchdol, CZ – 165 21, Czech Republic. (piotr.nowicki@uj.edu.pl)

Abstract: Isolation makes dispersal more costly and therefore it may be expected to act as a selection force against dispersive individuals. We tested the prediction by comparing dispersal parameters derived with the Virtual Migration model for isolated and non-isolated metapopulations of two species of large blue *Maculinea* (*Phengaris*) butterflies, surveyed with intensive mark-recapture. The model estimates indicated significantly reduced average dispersal distances in isolated metapopulations (avg. d = 155 m in *M. arion* and 74 m in *M. teleius* vs. respectively 575 m and 146 m in non-isolated metapopulations), with the effect being particularly strong in females. Isolation also resulted in lower propensity of individuals to emigrate from their natal habitat patches. Finally, dispersal mortality was

2–5 times higher in isolated metapopulations than in non-isolated ones. All the results obtained imply considerable dispersal depression in isolated butterfly metapopulations. **(Thursday, 9:30)**

Conservation status of Colorado moths: selected taxa

Opler, Paul A.

C. P. Gillette Museum of Arthropod Diversity, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523 USA. (paulopler@comcast.net)

Abstract: Although no Colorado moths are considered federally endangered or threatened and no species receive protection at the state level, there are a number of moths listed by NatureServe in their categories 1 and 2 at the Global, U.S. national, or state level. These species are primarily in the families Saturniidae, Sphingidae, Notodontidae, and Erebidae (Arctiinae). There are estimated to be between four and five thousand Lepidoptera species native to or at least occasional immigrants to the state. On the basis of current knowledge, certainly many hundreds of these would be known from 10 or fewer populations and would therefore receive NatureServe ranks 1 or 2. I will consider only species that have global or national ranks of 1 of 2. Additional groups to those monitored by NatureServe will be considered. These include Geometridae and selected Noctuidae. **(Friday, 2:55)**

California oaks and allies as evolutionary and ecological islands for leaf-mining Lepidoptera: host individuals and species populations

Opler, Paul A.

C. P. Gillette Museum of Arthropod Diversity, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523 USA. (paulopler@comcast.net)

Abstract: California oaks and allies have been shown by earlier studies to act as evolutionary islands for leaf-mining Lepidoptera in the sense of Island Biogeography (MacArthur & Wilson, 1973). This information will be reviewed together with new data that also shows that host individuals of *Quercus agrifolia* and species populations within the *Quercus agrifolia-wislizenii* complex also act as islands in current ecological time. A brief study of leaf-miner communities specific to *Quercus durata* did not result in significant correlations. This scrubby oak is endemic to serpentine rock outcrops in westside California. Poor sampling design was probably the cause of that exceptional result. **(Wednesday, 2:30)**

Moth Photographers Group - current and future projects

Patterson, Bob

12601 Buckingham Drive, Bowie, MD 20715 USA. (BPatter789@aol.com)

Abstract: Bob Patterson will talk about usage of the Moth Photographers Group (MPG) website, contributions of data needed to enhance the distribution maps recently added to all species pages, and work in progress to place the North American Checklist, with complete synonymies, online, and to keep it current with future revisions and publications. Visit MPG at:
http://mothphotographersgroup.msstate.edu/MainMenu.shtml **(Wednesday, 3:30)**

Diverse evidence that *Antheraea pernyi* is entirely of sericultural origin

Peigler, Richard S.

University of the Incarnate Word, 4301 Broadway, San Antonio, TX 78209 USA. (peigler@uiwtx.edu)

Abstract: Used in laboratories worldwide for research, the Chinese oak silkmoth is generally considered to be a wild species that is mass-reared for tussah silk in China and neighboring countries. However, there is a preponderance of evidence that this "species" only exists in captivity, with no wild populations. Cytologically *A. pernyi* is a trivalent, whereas its relatives are normal bivalents. Traits reflecting 3000 years of cultivation include ease of rearing, disease resistance, and cocoons with ample silk. More than 130 varieties are maintained in China. Wild collected specimens of *A. pernyi* are rare and here viewed as escapees from captive colonies or misidentifications of its wild ancestor, the Himalayan *A. roylei*. Presumed hybrids known as *A. proylei* (*pernyi* × *roylei*), the basis of the temperate tasar silk industry in India, were fully fertile from the onset in the 1970s and are now indistinguishable from *A. pernyi*. **(Saturday, 11:45)**

Analysis of morphology of Neotropical Geometrinae (Lepidoptera: Geometridae) using exo- and endoskeletal characters

Plotkin, David

Mississippi State University, Mississippi Entomological Museum, Box 9775, Mississippi State, MS 39762 USA. (dmp215@msstate.edu)

Abstract: The Geometrinae are commonly distinguished from other subfamilies of Geometridae using genitalic characters, wing venation, and scale patterns. However, removing scales from whole bodies of Geometrinae enables observation of further morphological variation of exoskeletal and endoskeletal characters. Using the method of Lee & Brown (2006), whole body mounts of descaled specimens of Neotropical Geometrinae were prepared. These were compared with whole body mounts of representatives from four other subfamilies of Geometridae. Variation of characters on the descaled head, thoracic segments, and tegulae was observed between subfamilies, indicating that these characters may be of diagnostic value. Further morphological variation was observed within Geometrinae, at the generic level. One character in particular, the length of the foretibial epiphysis AKA antennal comb, appears to be directly correlated with the length of antennal pectination, implying functional variation. **(Wednesday, 10:45 [student presentation])**

A revision of the *Schinia volupia* (Fitch) species complex (Lepidoptera: Noctuidae: Heliothinae)

Pogue, Michael G.[1] (presenter) & Charles E. Harp[2]

[1]USDA, Agricultural Research Service, Systematic Entomology Lab, c/o Smithsonian Institution, P.O. Box 37012, NMNH, MRC-168, Washington, DC 20013 USA; [2]Research Associate, C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Ft. Collins, CO 80523 USA. (Michael.Pogue@ars.usda.gov)

Abstract: DNA barcode analysis of cytochrome oxidase I (COI) could not differentiate between the species of the *Schinia volupia* (Fitch) complex, *S. miniana* (Grote), and *S. biforma* Smith. Genitalic

characters could only differentiate *S. miniana* and *S. biforma* from the *S. volupia* complex. Based on forewing color and pattern, larval host plant utilization, and geographic distribution, *S. volupia* and *S. fulleri* (McElvare) were recognized as valid species and *S. masoni* Smith and *S. sanrafaeli* Opler are considered new synonyms. A variety of adult images are presented to show the incredible range in variation among these species. Host plant utilization is discussed and illustrated. **(Thursday, 10:30)**

Preliminary molecular phylogeny of *Eumorpha* hawkmoths (Sphingidae: Macroglossinae: Philampelini)

Ponce, Francesca V. (presenter) and Akito Y. Kawahara

McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Powell Hall, 3215 Hull Road, Gainesville, FL 32611 USA. (francescavponce@ufl.edu)

Abstract: The hawkmoth genus *Eumorpha* includes 25 strikingly colored large species that are restricted in distribution to the New World. While they are often perceived as staples of Neotropical hawkmoths, little is known of their phylogenetic relationships. We constructed a preliminary molecular phylogeny with three genes (CAD, EF1-alpha and CO1) totaling 2155 base pairs for 14 taxa. Maximum Likelihood (ML) analyses were conducted using GARLI, and Bayesian analyses in MrBayes. Analyses were performed on individual genes and on the concatenated three-gene dataset. Preliminary analyses revealed strong branch support for several key groups within the genus. **(Student poster)**

Systematics and diversification of the endemic Hawaiian genus *Haliophyle* (Lepidoptera: Noctuidae)

Prestes, Andersonn (presenter) & Dan Rubinoff

Department of Plant and Environmental Protection Sciences, University of Hawaii, 3050 Maile Way, Gilmore 310, Honolulu, HI 96822 USA. (aprestes@hawaii.edu)

Abstract: Islands biotas have always been prominently featured in the study of evolution. In this study I inferred the relationships among 47 specimens of *Haliophyle* from the six main Hawaiian Islands with molecular data from the mitochondrial gene cytochrome oxidase I (COI), and the nuclear gene elongation factor-1a. As analytical tools, I used Bayesian Inference and Maximum Likelihood. The results suggest 12 evolutionary significant units across the islands, all of which are single island endemics except one. Although the clades show some adherence to the progression rule (basal lineages on older islands), this pattern is not strictly followed. As strong flyers, it is possible that they have flown back and forth along the archipelago. The group is genetically homogeneous, presenting an overall COI genetic distance less than 5.5%. It seems that *Haliophyle* is an explosive and ongoing radiation, including some very interesting patterns involving sympatric populations from the Big Island. **(Wednesday, 11:00 [student presentation])**

The Leptree "backbone" molecular phylogeny estimate

Regier, Jerome[1], Charles Mitter[1] (presenter), Michael Cummings[1], Don Davis[2], Cyndy Parr[2], Susan Weller[3], Akito Kawahara[4], Jae Cheon Sohn[1], John Brown[5], Joaquin Baixeras[6], Andreas Zwick[7] & Adam Bazinet[1]

[1]University of Maryland, Department of Entomology, 4112 Plant Sciences Building, College Park, MD 20742 USA; [2]Smithsonian Institution; [3]University of Minnesota; [4]University of Florida; [5]U.S. Department of Agriculture; [6]University of Valencia; [7]State Museum of Natural History, Stuttgart. (cmitter@umd.edu)

Abstract: With enormous help from the Lep Soc community, the Leptree project has sequenced up to five genes (6.6 kb) in about 900 species plus an additional 14 genes (8193 kb) in about half of these. Our estimate of the "backbone" phylogeny of Lepidoptera is based on 483 exemplars sequenced for up to 19 genes (14.8 kb), and representing 115 families and 303 subfamilies, about 90% of the total for each. We are also conducting separate analyses on each major superfamily or set of superfamilies, using all sequenced species (both 5 & 19 genes), and publishing these in collaboration with group experts. The backbone study includes analyses of the effects of phylogenetic signal source and "rogue" taxa on branch support. Support is generally strong within superfamilies, and along the backbone up to the base of Apoditrysia. In contrast, with notable exceptions, backbone node support is generally weak throughout Apoditrysia. **(Friday, 8:45)**

Leptree project progress report

Regier, Jerome[1], Charles Mitter[1] (presenter), Michael Cummings[1], Don Davis[2], Cyndy Parr[2], Susan Weller[3], Akito Kawahara[4], Jae Cheon Sohn[1], John Brown[5], Joaquin Baixeras[6], Andreas Zwick[7] & Adam Bazinet[1]

[1]University of Maryland, Department of Entomology, 4112 Plant Sciences Building, College Park, MD 20742 USA; [2]Smithsonian Institution; [3]University of Minnesota; [4]University of Florida; [5]U.S. Department of Agriculture; [6]University of Valencia; [7]State Museum of Natural History, Stuttgart. (cmitter@umd.edu)

Abstract: This poster will summarize progress on the Leptree Project (Lepidoptera ATOL), and include some slides from the talk on the "backbone" phylogeny so that people can inspect these at their leisure. **(Poster)**

Apples to apples - statistical adjustments and imputation to facilitate meaningful comparisons in butterfly monitoring data

Rhoda, Dale A.[1] (presenter), Richard O. Bray[2] & Jan Kilgore[2]

[1]Battelle Memorial Institute, 303 Blandford Drive, Worthington, OH 43085 USA; [2]Rocky Mountain National Park Butterfly Project, P.O. Box 1260, Estes Park, CO 80517 USA. (RhodaD@battelle.org)

Abstract: One goal of butterfly monitoring projects is to make meaningful comparisons of abundance, either on the same transect from year to year, or between transects. The Rocky Mountain National Park (RMNP) Butterfly Project attempted to survey each transect at least once a week during the monitoring season at times when the weather met the project's protocol criteria. Some weeks, however, volunteers conducted surveys outside protocol parameters (OPP) (i.e., on days colder or cloudier than

the protocol allows) and some weeks they did not conduct a survey at all due to lack of manpower or adverse weather conditions. Before comparing annual abundance indices, it may be desirable to adjust counts made OPP and to impute reasonable estimates for counts that are missing. This talk documents the frequency and pattern of missing and OPP surveys in the 15-year RMNP dataset and describes statistical techniques being explored to facilitate meaningful comparisons. **(Thursday, 1:50)**

Loss of male secondary sexual structures in allopatry in the Neotropical butterfly genus *Arcas* (Lycaenidae)

Robbins, Robert K. (presenter)[1], Ananda Regina P. Martins[2], Robert C. Busby[3] & Marcelo Duarte[4]

[1]Smithsonian Institution, PO Box 37012, NHB Stop 105(E-514), Washington, DC 20013 USA; [2]Departamento de Biologia, Universidade Federal do Maranhão, Avenida dos Portugueses s/n, Bacanga 65085-580, São Luís, MA, Brazil; [3]7 Countryside Way, Andover, MA 01810 USA; [4]Museu de Zoologia, Universidade de São Paulo, Avenida Nazaré 481, Ipiranga, 04263-000, São Paulo, SP, Brazil. (ROBBINSR@si.edu)

Abstract: Male secondary sexual characters may be present or absent in species that otherwise appear to be closely related, an observation that has led to differences of opinion over the taxonomic usefulness of these structures above the species level. An evolutionary issue raised by this debate is whether male secondary sexual characters can be 'switched on and off' by genes that regulate development. A second evolutionary issue is the conditions under which male secondary sexual characters might be lost or gained evolutionarily. We show that variation in the occurrence of male secondary sexual characters in the Neotropical genus *Arcas* is the result of losses only. Further, these losses occur only in allopatry. For taxonomy, this study provides a rationale for the evolutionary loss of male secondary sexual structures and suggests that their absence, by itself, does not indicate a lack of relationship above the species level. **(Thursday, 9:00)**

The piercing spines of hawkmoth legs: how much do they vary, and how did they evolve?

Romero, Cassandra[1] (presenter), Akito Y. Kawahara[1], Jesse Barber[2] & Ian J. Kitching[3]

[1]McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Powell Hall, 3215 Hull Road, Gainesville, FL 32611 USA; [2]Department of Biology, Boise State University, Boise, ID 83725 USA; [3]Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD, U.K. (clromero@ufl.edu)

Abstract: Hawkmoths have some of the longest tibial spurs among Lepidoptera. While the function of these spurs remains largely unknown, they may serve as a defense mechanism against predatory bats. These spurs vary greatly in length between species, and we measured the tibial spurs of males and females of 108 species. Spur length was controlled for body size and mapped onto a phylogeny of hawkmoths to determine whether long spurs are correlated with specific hawkmoth lineages. **(Wednesday, 11:30 [student presentation])**

Timing explosive diversification in Hawaii's fancy case caterpillars (*Hyposmocoma*)

Rubinoff, Dan (presenter) & Patrick Schmitz

310 Gilmore Hall, 3050 Maile Way, Department of Plant and Environmental Protection Sciences, The University of Hawaii, Honolulu, HI 96822 USA. (rubinoff@hawaii.edu)

Abstract: The fancy case caterpillars (*Hyposmocoma*: Cosmopterigidae) are the most ecologically diverse radiation in the Hawaiian Islands, representing nearly 400 described species, including caterpillars which hunt snails and others which dive underwater for extended periods. All species are single-island endemics, and most are even more restricted to single volcanoes. Unlike most Hawaiian lineages, fancy case caterpillar species occur on the ancient Northwest Islands, up to 20 million years old, offering the possibility of estimating the age of the radiation and the patterns of diversification. Results indicate complex patterns of ancient diversification that do not concur with most extant Hawaiian lineages. **(Wednesday, 4:00)**

A molecular phylogeny for the Pyraloidea (Lepidoptera: Pyraloidea)

Solis, Alma M.[1] (presenter), Jerome C. Regier[2], Charles Mitter[3], James E. Hayden[4], Bernard Landry[5], Matthias Nuss[6], Thomas J. Simonsen[7], Shen-Horn Yen[8], Andreas Zwick[9] & Michael P. Cummings[10]

[1]SEL, USDA, Smithsonian Institution, P.O. Box 37012, National Museum Natural History, E-517, MRC 168, Washington, DC 20013 USA; [2]Center for Biosystems Research, University of Maryland Biotechnology Institute, College Park, Maryland, USA; [3]Department of Entomology, University of Maryland, College Park, Maryland, USA; [4]Florida State Collection of Arthropods, Gainesville, FL, USA; [5]Muséum d'histoire naturelle, Geneva, Switzerland; [6]Senckenberg Naturhistorische Sammlungen Dresden, Museum für Tierkunde Königsbrücker Landstr., Dresden, Germany; [7]Department of Entomology, The Natural History Museum, Cromwell Road, London, UK; [8]Department of Biological Sciences, National Sun Yat-Sen University, Kaohsiung Taiwan; [9]Department of Entomology, State Museum of Natural History Stuttgart, Stuttgart, Germany; [10]Laboratory of Molecular Evolution, Center for Bioinformatics and Computational Biology, University of Maryland, College Park, MD, USA. (Alma.solis@ars.usda.gov)

Abstract: The first detailed molecular estimate of relationships across the subfamilies of Pyraloidea is presented. Up to five nuclear genes were sequenced in each of 42 pyraloids spanning both families and 18 of the 22 subfamilies, plus up to 14 additional genes in 22 of those pyraloids plus all 24 outgroups. Its concordance with previous morphology-based hypotheses is assessed. Subfamily relationships within Pyralidae, all very strongly supported, differ only slightly from a previous morphological analysis, and can be summarized as Galleriinae + Chrysauginae (Phycitinae (Pyralinae + Epipaschiinae)). In Crambidae the molecular phylogeny is also strongly supported, but conflicts with most previous hypotheses. **(Saturday, 8:55)**

Recent discoveries about pyraloids with aquatic immatures (Acentropinae: Crambidae)

Solis, Alma M.

SEL, USDA, Smithsonian Institution, P.O. Box 37012, National Museum Natural History, E-517, MRC 168, Washington, DC 20013 USA. (Alma.solis@ars.usda.gov)

Abstract: Recent studies about Acentropinae, with many species whose immatures live in water, have resulted in new discoveries. The discovery of the aquatic immature of *Petrophila avernalis* from Valles Caldera Natural Preserve, New Mexico, is discussed and a movie is presented. New findings on the identity of the "supposed *Oxyelophila* immature" from Texas are discussed with both morphological and molecular data. The surprising biology of *Aulacodes* from Costa Rica is discussed. **(Saturday, 9:10)**

Taxonomy and conservation of *Apodemia mormo* (Lepidoptera: Riodinidae) in North America

Sperling, Felix (presenter) & Ben Proshek

Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9, Canada. (felix.sperling@ualberta.ca)

Abstract: The Mormon Metalmark, *Apodemia mormo* (Lepidoptera: Riodinidae), is a widespread and geographically variable North American butterfly. Three populations have received formal conservation ranking: two Canadian populations in British Columbia and Saskatchewan ("endangered" and "threatened," respectively), and one subspecies, *A. m. langei*, in central California ("endangered"). Using 1498 base pairs of mtDNA (COI) gene sequence data, a suite of six novel microsatellite loci, and 11 dorsal wing characters, we tested the assumptions implicit in those conservation rankings: 1) that the two Canadian populations are distinct and one is more at risk than the other, and 2) that *A. m. langei* is a valid subspecies and qualifies as an evolutionarily significant unit. We conclude that the first assumption is corroborated but the second is tenuous, on the basis of the range□wide genetic diversity of the species. These findings have important ramifications for the conservation prioritization and management of these populations. **(Friday, 1:40)**

The nearly 200 year history of butterfly (and some moth) collecting and study in Colorado

Stanford, Ray E.

1430 Village Center Drive, Medford, OR 97504 USA. (ray.stanford@stanfordalumni.org)

Abstract: The known study of Colorado Lepidoptera began in 1819, when Thomas Say, a biologist from England, was part of the Long Expedition to Colorado. The earlier explorations westward, notably the famous travels of Lewis and Clark, did not enter what is now Colorado, or Utah, Nevada, or California. Say collected specimens from west of Denver, south to the mountains west of Pueblo, when these cities were wilderness (see F. M. Brown, Historical Preface, in Ferris and Brown, *Butterflies of the Rocky Mountain States*, 1981). The DMNS entered the publication parade on Colorado butterflies with the publication in July 1937 of *Butterflies of Colorado* by Frank Cross, a checklist with some B/W pho-

tos. Then in 1956, after the chapters had been issued by the Museum as fascicles, the Museum published the final result as a book by F. M. Brown, J. D. Eff, and B. Rotger, *Colorado Butterflies*. Now, M. S. Fisher is publishing a similar series of fascicles through the Gillette Museum at CSU, *The Butterflies of Colorado*, which is projected to be published in book form in the near future. **(Thursday, 8:45)**

Industrial-scale digitization of Lepidoptera collections using SatScan

Tuck, Kevin R.

Curator – Microlepidoptera, Terrestrial Invertebrates Division (DC2 - 2N), Natural History Museum, Cromwell Road, London SW7 5BD. (K.Tuck@nhm.ac.uk)

Abstract: How long will it take for the dream of the major museums' collections of Lepidoptera being available online to become a reality? SatScan and some ancillary software developed by the BMNH, London, provides the genuine possibility to make images of very large collections of dry-mounted insects such as Lepidoptera accessible and searchable online on an industrial scale. This talk will provide a brief summary of what SatScan looks like and what it can do, and points to some exciting possibilities for the future. **(Saturday, 10:15)**

Twenty-five years and still counting-The science of citizen collected data

Wilson, Karen K. (presenter) & Doug Taron

The Chicago Academy of Sciences and its Peggy Notebaert Nature Museum, 2430 North Cannon Drive, Chicago, IL USA. (kwilson@naturemuseum.org)

Abstract: The Illinois Butterfly Monitoring Network has a twenty-five year history of citizen science with very few changes in protocol and focus. It was initially instituted by The Nature Conservancy in the Chicago region, with the goal of understanding responses of invertebrate populations to land management practices. Collaborations with volunteers and land managers remain the backbone of the program. The longevity, consistency, and scope of the project provide a unique opportunity for analysis of the data generated from both a quantitative and qualitative perspective. While the Pollard method utilized could be considered moderately rigorous it may not be appropriate for all monitoring scenarios, such as those where one sensitive species is the sole focus. An undeniable strength is its ability to be replicated and the adjustments for effort that are possible. Basic protocol, training methods, data vetting, and some key regional comparisons of data and methods with related networks will be discussed. With the recent increase in "Citizen Science" programs, one with such a long history can provide valuable insights about the strengths and limitations of such efforts, in addition to the butterfly population dynamics it is designed to capture. **(Thursday, 4:10)**

Life-cycle parameters of African bollworm, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) affected by Neem, *Azadirachta indica* (A. Juss) extracts

Wondafrash, Mesfin

Department of Biology, Ghent University, Ledeganckstraat 35, 9000 Ghent, Belgium; and School of Plant Sciences, Haramaya University, P. O. Box 138, Dire Dawa, Ethiopia.
(mesfinwondafrash@gmail.com)

Abstract: The effects of Nimbecidine 0.03% Aza and water extracts of neem seed and leaf each at three concentration levels were studied on various developmental stages of *Helicoverpa armigera* under laboratory conditions. Square dip and larval immersion experiments were conducted in Completely Randomized Design in three replications. All concentration levels of water extracts of neem seed and leaf resulted in extended larval development period of 30-35 days in those larvae fed on dipped squares. In larval immersion experiment, 2.5% NSE, 10% NSE, 10% NLE and NH_2 extended the larval development period from 21-25 days in the control group to 26-30 days in treated larvae. Permanent larvae and larval-pupal intermediates were also seen from some of the larvae treated with Nimbecidine and water extracts of neem seed and leaf. A relatively lower number of larvae fed on squares dipped in various concentration levels of water extracts of neem seed and leaf were able to reach the adult stage. Furthermore, some abnormalities were observed in adults developed from treated larvae. Significantly lower mean adult longevities of 1.83, 1.97, 3.07 and 3.42 days were recorded from larvae fed on squares dipped in 10% NLE, 2.5% NLE, NH_2 & NM, respectively as compared to 7.98 days in control adults. The fecundity of adults developed from larvae fed on squares dipped in 2.5% NSE, 2.5% NLE, 5% NLE, NM and NH_2 and adults developed from larvae dipped in 5% NSE, 5% NLE, NH_1 and NH_2 was by far reduced as compared to those of control adults. The majority of eggs deposited by these adults were also found to be infertile. In summary, the result of our study indicated that neem has multitudes of effects on various developmental stages of *Helicoverpa armigera*, which will be used as a valuable component for the control of this pest. **(Saturday, 8:40)**

The Entomology Collection at the Denver Museum of Nature & Science

Frank-Thorsten Krell
Curator of Entomology
Department of Zoology, Denver Museum of Nature & Science
2001 Colorado Blvd, Denver CO 80205-5798, USA
E-mail: frank.krell@dmns.org

Jeffrey T. Stephenson
Zoology Collections Manager
Department of Zoology, Denver Museum of Nature & Science
2001 Colorado Blvd, Denver CO 80205-5798, USA
E-mail: jeff.stephenson@dmns.org

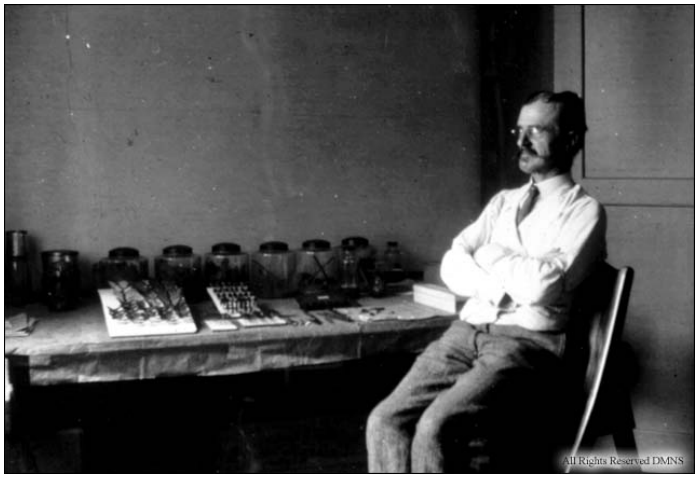
Overview of the Entomology Collection

The DMNS entomology collection consists of 803,000 specimens (Jan. 2012). At its current growth rate (~2.2% per year), we are adding an average of 20,000 specimens per year. The unprepared backlog is being processed at a rate of 20-30,000 specimens per year. The collection spans 1880-present. Holdings are worldwide in coverage and comprise all major insect orders, with a particular focus on Coleoptera (86%) and Lepidoptera (12%). Only 0.4% of specimens are currently cataloged in a paper catalog and none are presently databased.

The collection's primary strength is its worldwide focus (65% of specimens from Africa, 20% regional, 15% from other regions), which distinguishes the DMNS entomology collection from other large insect collections in the region with mainly regional holdings. Nevertheless, the DMNS regional holdings are also strong, particularly in the Lepidoptera and in several families of Coleoptera (e.g., Scarabaeidae and Tenebrionidae). In 2008, Curator of Entomology Frank Krell initiated the creation of a Colorado State Reference Collection for Coleoptera, initially based on local holdings and then further developed with an aggressive collecting program across the state. Since its inception the reference collection has quadrupled in size, but is still in need of thorough curation.

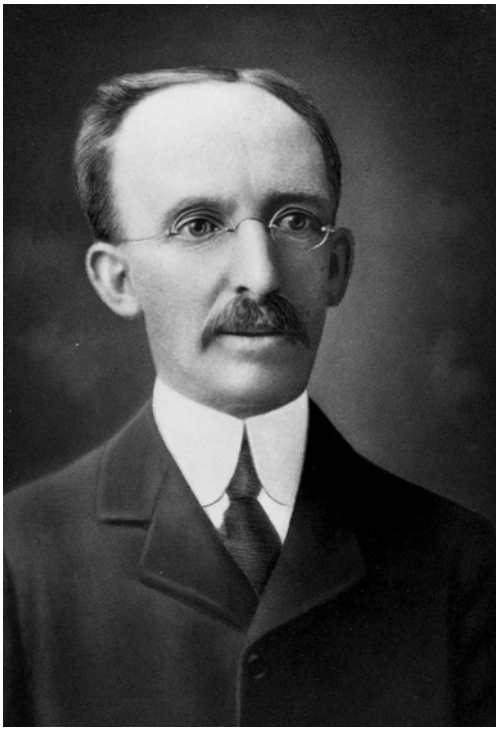
The entomology collection includes at least 13 name-bearing types and 152 paratypes described by museum staff and external researchers between 1882 and 2010 (Grote 1882; Aaron & Aaron 1885; French 1884; Cockerell 1905, 1906; Cross 1937a, b; Nonveiller 1960; Peigler 1992; and Peigler & Kendall 1993, for holo- or syntypes). An illustrated catalogue of the type specimens in the entomology collection is in preparation. The Lepidoptera holdings are summarized by Bettman in this volume (Bettman 2012).

History of the Entomology Collection



Ernest J. Oslar

The Denver Museum of Nature & Science has gone by several names in its history: first called the Colorado Museum and Library Association (1897–1900), then the Colorado Museum of Natural History (1900–1947), the Denver Museum of Natural History (1948–2000), and currently the Denver Museum of Nature & Science. The growth of the entomology collection began soon after the incorporation of the Museum in 1900 with the activity of the first entomology curator, **Ernest J. Oslar** (1908-1911). Oslar was a professional insect collector who collected around 10,000 specimens of mainly regional Lepidoptera for the Museum. Some material from Africa was also donated during his tenure. There appears to have been a disagreement with Museum leadership when Oslar presented an invoice for these specimens, and this led to his departure. Only a few Oslar specimens have been identified in the collections to date. A decade later, in 1918, **John T. Mason**, an avid collector with a wealth of contacts in the lepidopterist community and Museum manager from 1900-1910, donated a worldwide collection of 20,000 butterflies and moths to the Museum (Webb & Peigler 1990). His donation contained important historical material, type specimens, and many tropical species rare in collections. Specimens from the Mason collection first went on display in the Museum from 1929 to 1938. A more extensive exhibit was then constructed and the Colorado Butterflies and Moths Exhibit opened in 1940, funded by Mrs. Dora Porter Mason and presented in a hall named after this benefactress. This exhibit closed in 1986 during Museum expansion.



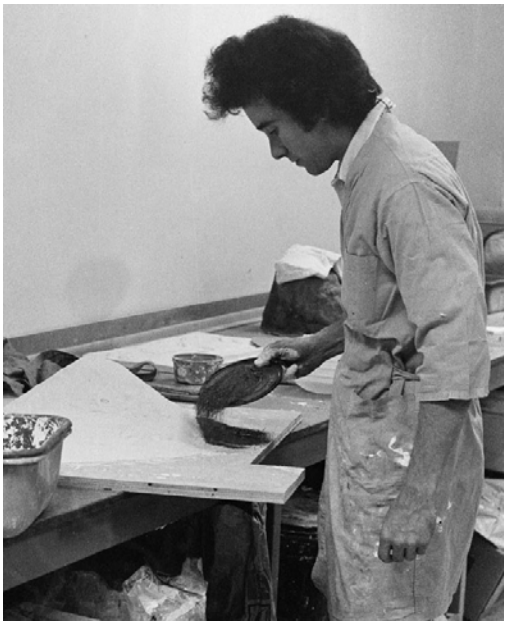
John T. Mason

Mr. **Frank Howland**, Curator of Minerals and Geology, served as caretaker of the entomology collection from the late 1920s through 1935. From 1936-1938, **Frank Clay Cross** became the Honorary Curator of Entomology. Together with his assistants, **Robert Potts** and **Charles W. Dawson**, he reorganized the collection and rediscovered several type specimens (Webb & Peigler 1990). **Walker Van Riper** served as Curator of Insects and Spiders from 1943 to 1959, with **W.H. Tyeryar**

Marc E. Epstein at Red Rocks

serving as Associate Curator in 1958. This period of moderate growth was followed by more than a decade of stagnation.

From 1972 to 1977, **Marc E. Epstein** was on contract, extensively collecting and curating butterflies. Epstein was at the Smithsonian for 15 years and is now a systematist at the California Department of Food and Agriculture. **Michael G. Pogue**, currently at the USDA/Smithsonian, was employed as Curatorial Assistant from 1975-1979, having been responsible for the curation of birds and insects. He donated his personal collection of butterflies, mostly from Colorado, when he left. Marc and Michael, with the help of volunteers, upgraded the collection significantly, particularly by transferring the Mason collection from cork-bottomed drawers to modern Cornell drawers. During the following decade, the insect collection again entered a stagnant period.



Michael G. Pogue

From 1990-1997, lepidopterist **Richard S. Peigler** worked at the Museum, first as Collections Manager, then as Curator of Entomology. The insect collection resumed moderate growth during his tenure. Peigler's rearing and hybridization experiments on wild silkmoths are well documented in the collection. Also during this period, many improvements were made to collection storage conditions and protocols that positively impacted the entomology collection. These included improvement of collections care by increased environmental monitoring and implementation of an Integrated Pest Management program in 1988.

Richard S. Peigler

From 1998-2006, arachnologist **Paula Cushing** was the curator responsible for the entomology collection. Her extensive Colorado Spider Survey resulted in thousands of non-target insects being collected in pitfall traps all over the Rocky Mountains and the western Great Plains. Cushing also accepted a donation of extraordinarily beautiful specimens (with collection data) collected over a century ago by **Clarence Riker** (inventor of the "Riker mount", a glass covered shallow box commonly used for displaying insects) and stored in Riker's original hand-made cabinet mounts. The Riker collection was accepted for its historical value as well as its outreach value for behind-the-scenes tours, art projects, and exhibits.

In January 2007, **Frank Krell** was hired as the Curator of Entomology responsible for both the entomology collection and the small herbarium. Krell has significantly increased the activity level of the entomology collection by hiring and training a substantial volunteer corps and starting regional collecting activities such as the Colorado Scarab Survey and the Colorado Beetle Reference Collection, hosting scientific meetings such as the 20th High Country Lepidopterists' meeting in 2009 (Krell 2009) and the current Combined Annual Meeting of the Lepidopterists' Society and the Societas Europaea Lepidopterologica. Approximately 700,000 newly accessioned insect specimens have been added over the last five years. This recent growth was achieved through intensified regional collecting (10-15,000 specimens/yr), accessioning unprocessed backlog material from 1990-2006, donation-funded projects, and large donated or transferred collections (e.g., **B. Bartell**, **D. Bettman**, **E. Cano**, **T. Cekalovic**, **D.M. Fanara**, **M. Fisher**, **C. Harp**, **S.A. Johnson**, **F.-T. Krell** [225,000 specimens collected between 1977 and 2000, mainly Scarabaeoidea], **A. Mudge**, **P. Moretto**, **S.M. Nelson**, **G. Opie**, **P. Tates**, **B. Vogel**, **I. Winkler**, **F.N. Zeiner**, etc.).

Concurrent with this rapid growth, Krell has also instituted rigorous curatorial procedures; developed an entomology collections manual; developed focused accession policies; established a high-throughput team of trained volunteers that processes about 20-30,000 specimens per year from the unmounted backlog; and attracted a team of department and research associates skilled in Lepidoptera taxonomy, namely **Barbara Bartell**, **David Bettman**, **Chuck Harp**, and **Paul Opler**, who are recurating the extensive butterfly and moth collection. The success with two grants funded by the National Science Foundation in 2012 will help to transform the entomology collection into a modern, accessible collection. The collection became a part of the Southwest Collections of Arthropods Network (SCAN), which will digitize the museum's regional holdings of soil arthropods. A collections improvement grant (CSBR) will provide new cabinetry for the collection's move into a new, state-of-the-art collections preservation facility (currently under construction, completion expected in 2014). Additionally, the CSBR grant provided funding for the hire of **David Bettman** as a Curatorial Assistant in June 2012.

Despite its worldwide holdings containing rare material of high scientific value from both remote tropical areas and from local ecoregions, the collection has remained underutilized by scientific and professional communities during most of its history. Based on loan and data queries, there is a growing interest in the use of DMNS material, but without online publication of the specimen data the visibility and use of the collection would likely remain limited. We therefore plan to disseminate this specimen data on the Museum's webpage via our newly implemented collections management system KE Emu, and through

GBIF and further portals we will increase accessibility and extend the use and value of the collection significantly.

Acknowledgments

We thank David Bettman, Curatorial Assistant, for additions and suggestions that substantially improved this manuscript.

References

Aaron, E.M. & Aaron, S.F. 1885. List of a collection of diurnal Lepidoptera from southern Texas. *Papilio* **4**: 172–182.

Bettman, D. 2012. The Lepidoptera Collection at the Denver Museum of Nature & Science, Denver, Colorado: Description and Holdings. Pp. 45–49 in: Krell, F.-T., Bettman, D., & Gilligan, T. (Eds.): Program and Proceedings of the International Lepidopterists' Conference, Denver, July 23–29, 2012 *Denver Museum of Nature & Science Technical Report* **2012-6**: 65 pp.

Cockerell, T.D.A. 1905. Miscellaneous notes. *Canadian Entomologist* **37**: 361-362.

Cockerell, T.D.A. 1906. *Pseudorthosia variabilis* var. *pallidior* n. var. *Entomological News* **17**: 204.

Cross, F.C. 1937a. A new race of *Plebeius scudderii*. *Pan-Pacific Entomologist* **13**: 88.

Cross, F.C. 1937b. Butterflies of Colorado. *Proceedings of the Colorado Museum of Natural History* **16**: 1–28.

French, G.H. 1884. A new zygaenid. *Triprocris Martenii*. n. sp. *Papilio* **3**: 191–192.

Grote, A.R. 1882. New moths. *Canadian Entomologist* **14**: 181–188.

Krell, F.-T. (ed.) 2009. Program and Abstracts, High Country Lepidopterists, 20th Annual Meeting, October 23 and 24, 2009, Denver Museum of Nature & Science. *Denver Museum of Nature & Science Technical Report* **2009-8**: 11 pp.

Nonveiller, G. 1960. Speziation bei den Rhizotroginae als Folge tageszeitlicher Sonderung. *Verhandlungen, XI. Internationaler Kongress für EntomologieWien* **1**: 88–91.

Peigler, R.S. 1992. A new species of *Syntherata* from the Trobriand Islands (Lepidoptera: Saturniidae). *Tropical Lepidoptera* **3**: 105–108.

Peigler, R.S. & Kendall, R.O. 1993. A review of the genus *Agapema* (Lepidoptera: Saturniidae). *Proceedings of the Denver Museum of Natural History (Series 3)* **3**: 1–22.

Webb, E.A. & Peigler, R.S. 1990. The John T. Mason collection at the Denver Museum of Natural History. *Journal of the Lepidopterists' Society* **44**: 194–198.

The Lepidoptera Collection at the Denver Museum of Nature & Science, Denver, Colorado: Description and Holdings

David J. Bettman
Curatorial Assistant in Entomology
Department of Zoology, Denver Museum of Nature & Science
2001 Colorado Blvd, Denver CO 80205-5798, USA
E-mail: david.bettman@dmns.org

Overview of the Lepidoptera Collection

The Lepidoptera collection at DMNS consists of approximately 100,000 specimens, of which 87,000 are pinned, 9,000 are papered, and 4,000 are in Riker mounts or plastic Renk mounts. The pinned material and plastic Renk mounts are housed in 25- or 34-drawer Cornell cabinets, while the papered material and Riker mounts are housed in a steel holding cabinet. We are currently adding 1,500-2,000 specimens per year to the collection, mostly of regional moths. The collection contains at least nine primary types and 81 paratypes, as well as specimens from at least three extinct taxa; these specimens are housed separately from the main collection.

Truly worldwide in scope, we have substantial holdings from all major zoogegraphic regions. Many donations over the years have significantly increased the global diversity of our collection; in addition to those mentioned in Krell & Stephenson (2012), we have received important and substantial material from **R.J. Jae**, **R.S. Peigler** and **Brother J. Renk**. Our regional holdings have also benefited from many donations beyond those mentioned in Krell & Stephenson (2012), the most significant including **C. Burkhart**, **R.J. Jae**, **J.E. Michael**, **P.A. Opler**, **R.S. Peigler** and **W.W. Steinmetz**. We are grateful to **M.S. Fisher**, **J.A. Scott** and **A.D. Warren** for donations of type specimens. As we continue to research the history of earlier donations to the collection, other important contributors will no doubt come to light.

Many talented volunteers and Associates have worked on the collection in recent decades. **Charles Slater** (deceased) curated major portions of the butterfly collection. **Ray Stanford**, co-author of *Butterflies of the Rocky Mountain States* and noted authority on Colorado butterflies, selected and identified all the butterfly and skipper specimens currently on display in the Colorado Lepidoptera exhibit (Webb & Peigler 1990), as well as assisting in curation of the butterflies and skippers. **Andrew Warren**, a world authority on skippers, curated much of our skipper material and rediscovered several missing butterfly type specimens (Webb & Peigler 1990). **Fran Haas** helped to reorganize our noctuoid holdings. **Barbara Bartell**, DMNS Zoology Department Associate, unshingled all of our pinned butterfly specimens, began a paper catalog of pinned butterfly specimens, reorganized and rehoused our papered material and incorporated several major donations (Burkhart, Renk, Vogel, Zeiner) into the collection. In 2009, Barb initiated an ongoing Gilpin County, Colorado

moth survey, and has donated approximately 1,000 pinned specimens per year to the museum from that survey. **Chuck Harp**, a noctuid expert and DMNS Research Associate, has recently begun curating our noctuoid holdings. He has donated a number of specimens over the years including three specimens of *Schinia zuni*, which had not been seen in 60 years and which he recently rediscovered. **Paul Opler**, Assistant Director of the C.P. Gillette Museum of Entomology at Colorado State University, co-author of *Moths of Western North America* and the *Peterson Field Guide to Western Butterflies* and DMNS Research Associate, has recently begun curating our notodontids and geometrids. **Clifford Ferris**, co-author of *Butterflies of the Rocky Mountain States*, has dissected and identified a number of our geometrids, mostly in the genus *Eupithecia*. The names of some additional workers may have inadvertently been omitted, but we are extremely grateful to all for the hard work they have put into improving the collection.

Holdings

The following inventory of our holdings is listed by number of drawers or portion thereof, and is current as of June 2012. Note that while our collection is actively being curated, many of our moth families have not yet received adequate attention and some families are intermixed within drawers; some of these counts are necessarily approximate as a result. These counts do not include any of our papered material, material in Riker mounts, or material currently out on exhibit in the museum. Families for which we do not have material are not listed. Phylogenetic arrangement of families is based primarily on Regier et al. (2009), Mutanen et al. (2010), and van Nieukerken et al. (2011). Arrangement of families within Bombycoidea follows Zwick et al. (2011), within Geometroidea Sihvonen et al. (2011), and within Noctuoidea Zahiri et al. (2012).

Order Lepidoptera
Suborder Glossata
Clade Myoglossata
Clade Neolepidoptera
Infraorder Exoporia
Hepialoidea
Hepialidae – 1 drawer, partly curated
Infraorder Heteroneura (all following)
Clade Eulepidoptera (all following)
Clade Incurvariina
Adeloidea
Adelidae – $^{1}/_{32}$ drawer, curated
Prodoxidae – ¼ drawer, partly curated
Clade Ditrysia (all following)
Tineoidea
Psychidae – ¾ drawer, partly curated
Tineidae (incl. Acrolophinae) – ½ drawer, partly curated
Gracillarioidea
Bucculatricidae – $^{1}/_{32}$ drawer, mostly uncurated

- Yponomeutoidea
  - Yponomeutidae – 1/32 drawer, curated
  - Argyresthiidae – 1/32 drawer, curated
  - Attevidae – 3/16 drawer, partly curated
  - Heliodinidae – 1/32 drawer, curated
- Clade Apoditrysia (all following)
  - Tortricoidea
    - Tortricidae – 1¾ drawers, partly curated
  - Alucitoidea
    - Alucitidae – 1/16 drawer, uncurated
  - Pterophoroidea
    - Pterophoridae – ⅝ drawer, mostly uncurated
  - Choreutoidea
    - Choreutidae – 1/32 drawer, curated
  - Cossoidea (incl. Sesioidea)
    - Cossidae – 1 drawer, partly curated
    - Castniidae – ¼ drawer, partly curated
    - Sesiidae – ¾ drawer, partly curated
  - Zygaenoidea
    - Limacodidae – ½ drawer, partly curated
    - Megalopygidae – ½ drawer, partly curated
    - Dalceridae – ⅛ drawer, partly curated
    - Zygaenidae – 1 1/16 drawers, partly curated
  - Gelechioidea
    - Blastobasidae – 1/32 drawer, uncurated
    - Chimabachidae – 1/32 drawer, curated
    - Elachistidae (incl. Depressariinae, Ethmiinae, Stenomatinae) – ⅜ drawer, mostly uncurated
    - Momphidae – 1/16 drawer, partly curated
    - Cosmopterigidae – 3/32 drawer, partly curated
    - Gelechiidae – 3/16 drawer, partly curated

Misc. "micros" – 4 drawers, mostly uncurated

- Clade Obtectomera (all following)
  - Thyridoidea
    - Thyrididae – ⅛ drawer, partly curated
  - Papilionoidea
    - Papilionidae – 76 drawers, partly curated
    - Hesperiidae – 22½ drawers, partly curated
    - Pieridae – 64 drawers, partly curated
    - Nymphalidae – 174½ drawers, partly curated
    - Riodinidae – 2⅜ drawers, partly curated
    - Lycaenidae – 34¾ drawers, partly curated
  - Pyraloidea – 4⅜ drawers, partly curated
    - Pyralidae (see under Pyraloidea)
    - Crambidae (see under Pyraloidea)
  - Mimallonoidea
    - Mimallonidae – ⅛ drawer, partly curated

Clade Macroheterocera (all following)
- Drepanoidea
  - Doidae – ⅛ drawer, curated
  - Drepanidae (incl. Thyatirinae) – 1 drawer, partly curated
- Lasiocampoidea
  - Lasiocampidae – 6½ drawers, partly curated
- Bombycoidea
  - Apatelodidae – ⅝ drawer, partly curated
  - Eupterotidae – ½ drawer, partly curated
  - Brahmaeidae (incl. Lemoniinae) – 1⅛ drawers, mostly curated
  - Endromidae (incl. Prismostictinae) – ⅛ drawer, curated
  - Anthelidae – $^1/_{16}$ drawer, uncurated
  - Sphingidae – 21½ drawers, partly curated
  - Bombycidae – ¾ drawer, mostly curated
  - Saturniidae – 155½ drawers, partly curated
- Geometroidea
  - Uraniidae (incl. Epipleminae) – 1 drawer, partly curated
  - Sematuridae – ½ drawer, uncurated
  - Geometridae – 17¾ drawers, partly curated
- Noctuoidea
  - Notodontidae – 6⅛ drawers, partly curated
  - Euteliidae – ⅛ drawer, mostly uncurated
  - Noctuidae – 40¼ drawers, partly curated
  - Erebidae (incl. Arctiinae, Lymantriinae) – 36¼ drawers, partly curated
  - Misc. noctuoids – 13½ drawers, mostly uncurated

Misc. "macros" – 2 drawers, uncurated

References

Krell, F.-T. & Stephenson, J.T. 2012. The entomology collection at the Denver Museum of Nature & Science. Pp. 40–44 in: Krell, F.-T., Bettman, D. & Gilligan, T. (Eds.): Program and Proceedings of the International Lepidopterists' Conference, Denver, July 23-29, 2012. *Denver Museum of Nature & Science Technical Report* **2012-6**: 65 pp.

Mutanen, M., Wahlberg, N. & Kaila, L. 2010. Comprehensive gene and taxon coverage elucidates radiation patterns in moths and butterflies. *Proceedings of the Royal Society B* **277** (1695): 2839-2848. doi:10.1098/rspb.2010.0392

Nieukerken, E.J. van, Kaila, L., Kitching, I.J., Kristensen, N.P., Lees, D.C., Minet, J., Mitter, C., Mutanen, M., Regier, J.C., Simonsen, T.J., Wahlberg, N., Yen, S.-H., Zahiri, R., Adamski, D., Baixeras, J., Bartsch, D., Bengtsson, B.Å., Brown, J.W., Bucheli, S.R., Davis, D.R., De Prins, J., De Prins, W., Epstein, M.E., Gentili-Poole, P., Gielis, C., Hättenschwiler, P., Hausmann, A., Holloway, J.D., Kallies, A., Karsholt, O., Kawahara, A.Y., Koster, S. (J.C.), Kozlov, M.V., Lafontaine, J.D., Lamas, G., Landry, J.-F., Lee, S., Nuss, M., Park, K.-T., Penz, C., Rota, J., Schintlmeister, A., Schmidt, B.C., Sohn, J.-C., Solis, M.A., Tarmann, G.M., Warren, A.D., Weller, S., Yakovlev, R.V., Zolotuhin, V.V. & Zwick, A. 2011. Order Lepidoptera Linnaeus, 1758. *In:* Zhang, Z.-Q. (Ed.) *Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness*. *Zootaxa* **3148**: 212-221. http://www.mapress.com/zootaxa/2011/f/zt03148p221.pdf

Regier, J.C., Zwick, A., Cummings, M.P., Kawahara, A.Y., Cho, S., Weller, S., Roe, A., Baixeras, J., Brown, J.W., Parr, C., Davis, D.R., Epstein, M., Hallwachs, W., Hausmann, A., Janzen, D.H., Kitching, I.J., Solis, M.A., Yen, S.-H., Bazinet, A.L. & Mitter, C. 2009. Toward reconstructing the evolution of advanced moths and butterflies (Lepidoptera: Ditrysia): an initial molecular study. *BMC Evolutionary Biology* **9**: 280. doi:10.1186/1471-2148-9-280

Sihvonen, P., Mutanen, M., Kaila, L., Brehm, G., Hausmann, A. & Staude, H.S. 2011. Comprehensive molecular sampling yields a robust phylogeny for geometrid moths (Lepidoptera: Geometridae). *PLoS ONE* **6** (6): e20356. doi:10.1371/journal.pone.0020356

Webb, E.A. & Peigler, R.S. 1990. The John T. Mason collection at the Denver Museum of Natural History. *Journal of the Lepidopterists' Society* **44** (3): 194-198. http://peabody.research.yale.edu/jls/pdfs/1990s/1990/1990-44(3)194-Webb.pdf

Zahiri, R., Holloway, J.D., Kitching, I.J., Lafontaine, J.D., Mutanen, M. & Wahlberg, N. 2012. Molecular phylogenetics of Erebidae (Lepidoptera, Noctuoidea). *Systematic Entomology* **37** (1): 102-124. doi:10.1111/j.1365-3113.2011.00607.x

Zwick, A., Regier, J.C., Mitter, C. & Cummings, M.P. 2011. Increased gene sampling yields robust support for higher-level clades within Bombycoidea (Lepidoptera). *Systematic Entomology* **36** (1): 31-43. doi:10.1111/j.1365-3113.2010.00543.x

Lepidoptera Housed in the Entomology Section, University of Colorado Museum of Natural History, Boulder, Colorado: Description and Holdings

M. Deane Bowers
Curator, Museum and Department of Ecology and Evolutionary Biology
University of Colorado
Boulder, CO 80309
deane.bowers@colorado.edu

Virginia L. Scott
Collection Manager, Entomology Section, University Museum
University of Colorado
Boulder, CO 80309
virginia.scott@colorado.edu

The Insect and Arachnid Collection

The University of Colorado at Boulder insect and arachnid collection is housed on the third floor of the Museum Collections Building (MCOL; also called the Bruce Curtis Building) on the University of Colorado, Boulder, campus. The collection includes approximately 700,000 specimens of insects and arachnids representing over 17,000 species. The collection contains 124 holotypes, 14 allotypes and 32 specimens labeled as "type". These specimens are databased and housed in a separate cabinet from the main collection. Paratypes and cotypes are housed in the main collection. Additional information about the collection can be found online at: http://cumuseum.colorado.edu/Research/Entomology/index.html. The collection is staffed with Curator, **Deane Bowers**, Collection Manager, **Virginia Scott**, Graduate Assistant, **Caitlin Kelly**, and Curator Adjoint, **Cesar Nufio**.

The collection was begun by **T.D.A. Cockerell**, one of the Museum's founders. Early contributors to the collection also included **Hugo Rodeck**, a former Museum Director, and **W.N. Burdick**. The first Curator of the collection was **Url Lanham**, who was there from 1961 to 1989. The present Curator, **Deane Bowers**, took over in 1989.

The collection contains several groups with historically important material, including collections made by **T.D.A. Cockerell** (all insects, especially Hymenoptera); **Hugo Rodeck**, (Hymenoptera); **M.T. James** (Diptera); **C.J. McCoy** (western Colorado insects); **B. Vogel** (Hymenoptera and spiders), and **Url Lanham** (Hymenoptera). There are several important collections that have been donated or deposited in the Entomology Collection. These include collections by **G. Alexander** (Orthoptera; see http://ghopclimate.colorado.edu); **F.M. Brown** (Lepidoptera, Diptera and Hymenoptera); **W.N. Burdick** (Lepidoptera); **D. Eff** (Lepidoptera); **C.H. Hicks** (Hymenoptera); **T. Kincaid** (Hymenoptera and other insects of the Pacific northwest); **B. Rotger** (Coleoptera and Lepidoptera), and **F.K. Smith** (Coleoptera).

The Lepidoptera Collection

The University of Colorado Museum's Lepidoptera collection contains approximately 105,000 specimens; 80,000 of these are mounted on pins in Cornell drawers, 5,000 are in Riker mounts, and 20,000 are papered and unsorted. The pinned collection is housed in 25-drawer Cornell cabinets. The collection contains approximately 4,300 species of Lepidoptera ($^1/_3$ moths and $^2/_3$ butterflies and skippers). The collection houses 8 primary Lepidoptera types and several paratypes are located within the main collection.

The **Burdick** collection of Lepidoptera is from the early part of the 20th century (1930's to 1950's) and is composed of approximately 10,000 papered specimens, primarily butterflies and several thousand specimens in Riker mounts. The material is mostly North American, with a concentration on the Rocky Mountain Region, including National Park lands, but there are also hundreds of specimens from Mexico. The **Rotger** material is composed primarily of papered specimens, many not yet incorporated into the main collection. All specimens from this 100 year old material have good collection and locality information.

More recently (in the last 25 years) there have been several significant additions to the collection. The **D. Eff** collection came to the section in 1989 and was composed of over 16,500 specimens (all butterflies). In addition, **R. Watkins** donated 4,888 specimens of both butterflies (585 species) and moths (671 species) in 2005. Of these 1,256 donated species, 626 were new to our collection. In 2010, **J. Odor** donated his moth collection of 1030 specimens of over 220 species. Of these, 99 species are new to our holdings. Many other collectors have contributed to the collection over the years, both in specimens and expertise, for which we are extremely grateful.

Current research on the Lepidoptera includes work by Curator **Bowers** focused on the chemical ecology of butterflies and moths, lepidopteran ecology and evolution, and Lepidoptera-plant-natural enemy interactions. Graduate student research involving Lepidoptera has included work on the effects of habitat fragmentation on butterfly communities, response of butterfly communities to drought, chemical ecology of unpalatability in a variety of lepidopteran species, genetics of unpalatability, and effects of introduced plants on lepidopteran ecology and behavior. Five graduate students have completed Ph.D.s focused on some aspect of lepidopteran biology (Dyer, Camara, Barton, Jamieson, Quintero); five have completed Masters (Park, Armstead, Bettman, Vargas, Robinson) and two are currently working on Ph.D.s focused on lepidopteran biology (Robinson, Kelly).

Holdings of the Lepidoptera Collection

This inventory of our holdings is by number of drawers or portion thereof, as of June 2012. Taxa for which we do not have material are not listed. Uncurated or unidentified material is not included.

Glossata, Homoneura Clade
Eriocraniidae – ⅛ drawer (2 species)

Exoporia Clade
Hepialoidea
Hepialidae – $^1/_{16}$ drawer (1 species)

Heteroneura, Monotrysia Clade
- Opostegidae –1/32drawer (1 species)
- Incurvariidae – 1/32 drawer (1 species)
- Prodoxidae – ¼ drawer (4 species)
- Tischeriidae – 1/32 drawer (1 species)

Ditrysia Clade
- Tineoidea
  - Tineidae – ⅜ drawer (5 species)
  - Acrolophidae – 1/16 drawers (3 species)
  - Psychidae – ⅛ drawer (3 species)
- Gracillarioidea
  - Gracillariidae – ¾ drawer (20 species)
  - Bucculatricidae – ⅛ drawer (3 species)
- Gelechioidea
  - Oecophorid lineage
    - Blastobasidae – 1/32 drawer (1 species)
    - Oecophoridae – ½ drawer (20 species)
  - Elachistid lineage
    - Ethmiidae – ¾ drawer (8 species)
  - Gelechiid lineage
    - Coleophoridae – ¼ drawer (2 species)
    - Momphidae – ¼ drawer (2 species)
    - Scythrididae – 1/32 drawer (1 species)
    - Cosmopterigidae – ⅛ drawer (4 species)
    - Gelechiidae – ¾ drawer (17 species)
- Yponomeutoidea
  - Yponomeutidae – ⅛ drawer (5 species)
  - Plutellidae – ⅛ drawer (1 species)
  - Glyphipterigidae – 1/32 drawer (1 species)

Apoditrysia Clade
- Epermenioidea
  - Epermeniidae – 1/32 drawer (1 species)
- Pterophoroidea
  - Pterophoridae – ¼ drawer (3 species)
- Choreutoidea
  - Choreutidae – 1/32 drawer (1 species)
- Sesioidea
  - Sesiidae – ⅞ drawer (15 species)
- Cossoidea
  - Cossidae – ⅜ drawers (4 species)
- Tortricoidea
  - Tortricidae – ⅝ drawer (17 species)
- Zygaenoidea
  - Zygaenidae – ¼ drawer (3 species)
  - Epipyropidae – 1/32 drawer (1 species)
  - Limacodidae – ⅞ drawer (23 species)

Megalopygidae – ½ drawer (4 species)
"Unsorted Microlepidoptera" – ⅛ drawer

Unspecialized Obtectomera
Thyridoidea
Thyrididae – ⅛ drawer (3 species)

Obtectomera Clade
Pyraloidea
Crambidae + Pyralidae – 4 ½ drawers (86 species)

Macrolepidoptera Clade
Papilionoidea
Papilionidae – 127 drawers (312 species)
Pieridae – 111 drawers (337 species)
Lycaenidae – 57 drawers (328 species)
Riodinidae – 5 drawers (62 species)
Nymphalidae (including Libytheidae) – 362 drawers (1307 species)
Hesperioidea
Hesperiidae – 28 drawers (232 species)
Drepanoidea
Drepanidae –⅛ drawer (4 species)
Geometroidea
Uraniidae – ¾ drawer (2 species)
Geometridae – 18 drawers (324 species)
Mimallonoidea
Mimallonidae – $^{1}/_{32}$ drawer (1 species)
Lasiocampoidea
Lasiocampidae – 1 drawer (10 species)
Epiplemidae – ¼ drawer (4 species)
Bombycoidea
Bombycidae – ⅛ drawer (3 species)
Apatelodidae – ⅛ drawer (3 species)
Brahmaeidae – $^{1}/_{32}$ drawer (1 species)
Saturniidae – 18 drawers (87 species)
Sphingidae – 18 drawers (97 species)
Noctuoidea
Notodontidae – 21 drawers (48 species)
Noctuidae – 33 drawers (416 species)
Arctiidae – 10 drawers (162 species)
Lymantriidae – 1 drawer (12 species)

Miscellaneous (unidentified/unsorted) Macrolepidoptera – 10 drawers

Lepidoptera at the C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Ft. Collins: Description and Holdings

Paul A. Opler
C.P. Gillette Museum of Arthropod Diversity
Department of Bioagricultural Sciences and Pest Management
Colorado State University
Ft. Collins, CO 80523-1177
E-mail: paulopler@comcast.net

The C. P. Gillette Museum of Arthropod Diversity

The internationally renowned homopterist, **Dr. C.P. Gillette** founded the C.P. Gillette Museum of Arthropod Diversity in 1870. The collection includes approximately 3 million specimens representing about 60,000 species. Fifty primary types and 1,000 secondary types are included. As the largest, most comprehensive, and best-curated holding of arthropods, predominately insects, in the Southern Rocky Mountain Region (Montana, Wyoming, Colorado, and New Mexico), it is a major resource for regional and national biodiversity investigations. Much of the material has been identified by specialists to the specific level. Examples of the unique quality of museum material include the aphids, other Homoptera, Coleoptera, Diptera, Hymenoptera, Lepidoptera, and all aquatic orders. Additionally, it houses the Natural Resource Ecology Laboratory Soil Arthropod Collection, which is derived from the International Biological Program's Pawnee Site Arthropod Reference Collection, Konza Prairie Research Natural Area LTER Reference Collection and the Jornada LTER Reference Collection. It also serves as the repository for comprehensive arthropod inventories of Canyonlands National Park, Great Sand Dunes National Park, Mesa Verde National Park, Rocky Mountain National Park, Dinosaur National Monument, Yucca House National Monument, and Colorado National Monument. Additionally, the museum is a repository for comprehensive surveys of military lands such as Fort Sill, Oklahoma, and Camp Guernsey, Wyoming. More than 100,000 specimens are added to the collection each year. The Gillette Museum collection has been valued at $6 million.

Certain segments of the collection are so significant that they have been named for past curators or significant donors. At present these include the Howard E. Evans Hymenoptera Collection, the Miriam Palmer Aphid collection, and the Ray E. Stanford Butterfly Collection.

Bob Stevens curated the Lepidoptera for many years after his retirement from the U.S. Forest Service. **Paul Opler** has curated the Lepidoptera collection since 1987. Graduate students completing theses on Lepidoptera topics include **Matthew Garhart**, **Sara Simonson**, and **Amy Seidl**. **Todd Gilligan** is near completion of his doctoral research.

A number of Lepidopterists have made significant contributions to the collection in terms of lending their expertise, donations of collections, or financial contributions. Many of these are C.P. Gillette Museum Associates and are listed below. The names of some individu-

als may have been omitted accidentally, but all are gratefully thanked for their kind contributions.

Valeriu Albu, Fresno, California, collaborates on research dealing with argyresthiid moths and is author of a Gillette series publication. **Barbara Bartell**, Gilpin County, Colorado, conducts ecological and natural history studies of selected butterflies and assists the museum in specimen preparation. She has donated a large number of spread, labeled moths from Gilpin County. **Donald Bowman**, Pueblo West, donated several thousand rare Lepidoptera to the museum and provides specimens for photography. Don has accompanied Paul on three expeditions to Mexico. **Janet Chu**, Boulder, Colorado, retired Boulder County science teacher, conducts butterfly inventories and contributes assistance to the museum. Star donor. Jan has published two reports on Boulder County butterflies in the Gillette series. **Ken Davenport**, Bakersfield, California, collaborates on DNA research and contributes significant material to the butterfly collection. Ken has published his Kern-Tulare County butterflies in the Gillette series. **Scott D. Ellis**, La Porte, Colorado, is an expert on western plants and selected insect groups. He has donated a large collection of papered butterflies and moths to the museum. **Clifford D. Ferris**, emeritus professor, University of Wyoming, co-author of *Butterflies of the Rocky Mountain States*, identifies many moths for the museum. Cliff has donated large numbers of southwestern moths. **Mike Fisher**, Littleton, Colorado, CSU graduate, author of several scientific papers, donated several hundred butterflies to the collection. **Chuck Harp**, Littleton, Colorado, collaborates on research on the genus *Schinia* (Lepidoptera: Noctuidae) and donates specimens of Lepidoptera to the collection. **Richard Holland**, Albuquerque, New Mexico, has contributed a large collection of Southwestern butterflies and moths. Dick has published two reports on New Mexican butterflies in the Gillette series. **Dr. John A. Hyatt**, Kingsport, Tennessee, collaborates on DNA butterfly research, spreads material for the museum, and has donated butterfly specimens. **Sam Johnson**, Colorado Springs, Colorado, engages in scientific collection and sampling of Colorado Lepidoptera. **George O. Krizek**, Washington, D.C., is a co-author of *Butterflies East of the Great Plains* and an internationally renowned butterfly photographer. **Robert L. Langston**, Kensington, California, has donated a large collection of papered butterflies to our museum. **John Moore**, Grand Junction, retired high school biology teacher, has run light traps at Colorado National Monument for four years. He has also collected several new species and Colorado state records. **John Nordin**, University of Wyoming, Laramie, has donated thousands of specimens of Lepidoptera and Trichoptera. **John W. Peacock**, Marion, Ohio, has donated many valuable specimens and additionally has collaborated on research of the genus *Catocala* (Erebidae), and has donated several rare species of that genus. **James A. Scott**, Lakewood, Colorado, author of *Butterflies of North America*, has donated many insect and papered moth specimens to the museum. **Charles Putnam Slater** (deceased), Lakewood, Colorado, contributed his personal collection of Lepidoptera and alpine insects. Charles also was a volunteer who curated major portions of the butterfly collections. His notes and electronic files are available on request. **Ray E. Stanford**, Medford, Oregon, co-author of *Butterflies of the Rocky Mountain States*, donated his personal collection, the Ray E. Stanford Butterfly Collection, including more than 100,000 butterflies. **J. Bolling Sullivan III**, Beaufort, North Carolina, has contributed extensive material from the southeastern states and identifies selected taxa. **Andrew D. Warren**, Gainesville, Florida, studies the higher classification of world Hesperioidea. He is an expert on Colorado and tropical Lepidoptera and has donated valuable material to the collection and publishes in the museum series. **David Wikle**, Pasadena, California, studies the distribution and classification of stiriine noctuid

moths. In addition, partly in cooperation with Dr. Opler, he carries out faunistic studies of Lepidoptera of the California deserts, Utah, southern Arizona and northwestern Mexico, including Baja California. Dave has also contributed many valuable specimens.

The museum's Lepidoptera are housed in 12- or 25-drawer Cornell cabinets, not including several hundred boxes of labeled uncurated material. This inventory of our holdings is by number of drawers or portion thereof as of January 2012.

Lepidoptera holdings

Zeugloptera Clade
- Micropterigoidea
  - Micropterigidae – $^1/_{16}$ drawer, curated (4 species)

Glossata, Homoneura Clade
- Eriocranioidea
  - Eriocraniidae – ⅛ drawer, curated (6 species)
  - Acanthopteroctetidae – $^1/_{32}$ drawer, curated (1 species)

Exoporia Clade
- Hepialoidea
  - Hepialidae – ¾ drawer, curated (21 species); ⅜ drawer, misc.

Heteroneura, Monotrysia Clade
- Nepticuloidea
  - Nepticulidae – $^1/_{32}$ drawer, misc. (2 species)
  - Opostegidae – $^1/_{32}$ drawer, curated (1 species)
- Adeloidea
  - Heliozelidae – $^1/_{16}$ drawers, curated (2 species)
  - Incurvariidae – $^1/_{32}$ drawer, curated (1 species)
  - Adelidae – ⅜ drawer, curated in part (12 species)
  - Prodoxidae – 1 drawer, partly curated (29 species) [loan to Davis]
- Tischerioidea
  - Tischeriidae – $^1/_{16}$ drawer, curated (3 species)

Ditrysia Clade
- Tineoidea
  - Tineidae – ⅜ drawer, partly curated (6 species)
  - Acrolophidae – 1½ drawers, partly curated (27 species)
  - Psychidae – ½ drawer, partly curated
- Gracillarioidea
  - Gracillariidae – ⅝ drawer, partly curated
  - Phyllocnistidae – none
  - Bucculatricidae – $^1/_{16}$ drawer, curated
  - Douglasiidae – $^1/_{32}$ drawer
- Gelechioidea
  - Oecophorid lineage
    - Symmocidae – ⅛ drawer, curated

Xylorictidae – none
Blastobasidae – ¼ drawer, partly curated [loan to Adamski]
Oecophoridae (s. str.) – $^{1}/_{16}$ drawer, curated
Elachistid lineage
Stenomatidae + misc. – ⅝ drawer, partly curated
Depressariidae – 1 drawer, curated
Ethmiidae – 2¼ drawers, mostly curated
Elachistidae – none?
Gelechiid lineage
Deoclonidae – none
Coleophoridae – ½ drawer, mostly uncurated
Momphidae – ½ drawer, partly curated
Scythrididae – ⅛ drawer, mostly curated
Cosmopterigidae – ⅜ drawer, mostly curated
Gelechiidae – 12¾ drawers, mostly uncurated
Yponomeutoidea
Yponomeutidae – $^{1}/_{16}$ drawer, misc.
Argyresthiidae – ⅜ drawer, partly curated
Ypsolophidae – 1¼ drawer, partly curated
Plutellidae – ¾+ drawer, mostly curated
Acrolepiidae – none
Glyphipterigidae – ¼ drawer, mostly uncurated
Heliodinidae – ⅛ drawer, uncurated
Bedelliidae – none

Clade Apoditrysia
Schreckensteinioidea
Schreckensteiniidae – $^{1}/_{32}$ drawer
Epermenioidea
Epermeniidae – $^{1}/_{32}$ drawer, mostly uncurated
Alucitoidea
Alucitidae – ⅛ drawer, curated
Pterophoroidea
Pterophoridae – 4 drawers, partly curated
Choreutoidea
Choreutidae – ¼ drawer, curated [most on loan to Heppner]
Sesioidea
Sesiidae – 5⅛ drawers, mostly curated
Castniidae – ¼ drawer, uncurated
Cossoidea
Cossidae – 3 drawers, mostly curated
Tortricoidea
Tortricidae – 37 drawers, mostly curated
Zygaenoidea
Zygaenidae – ⅝ drawer, mostly curated
Epipyropidae – none?
Limacodidae – ½ drawer, mostly curated [Epstein loan]
Dalceridae – $^{1}/_{32}$ drawer, mostly uncurated

Megalopygidae – ½ drawer, mostly curated
"Unsorted Microlepidoptera" – 12 drawers, misc.

Unspecialized Obtectomera
Copromorphoidea
Copromorphidae – none
Carposinidae – ¼ drawer, partly curated
Thyridoidea
Thyrididae – ⅛ drawer, mostly curated

Obtectomera Clade
Pyraloidea – 35 drawers, partly curated
Crambidae (see under Pyraloidea)
Pyralidae (see under Pyraloidea)

Clade Macrolepidoptera
Papilionoidea
Papilionidae – 49 drawers, mostly curated
Pieridae – 73 drawers, mostly curated
Lycaenidae – 88 drawers, mostly curated
Riodinidae – 8 drawers, partly curated
Nymphalidae – 209 drawers, mostly curated
Hesperioidea
Hesperiidae – 58 drawers, mostly curated
Hedyloidea
Hedylidae – $^{1}/_{16}$ drawer, uncurated
Drepanoidea
Drepanidae – 1¼ drawer, mostly curated
Geometroidea
Sematuridae – none
Uraniidae – ¼ drawer, uncurated
Geometridae – 116 drawers, mostly curated
Mimallonoidea
Mimallonidae – none?
Lasiocampoidea
Lasiocampidae – 10 drawers, mostly curated
Bombycoidea
Bombycidae – none?
Endromidae – none?
Brahmaeidae – none?
Saturniidae – 51 drawers, mostly curated
Sphingidae – 47 drawers, mostly curated
Noctuoidea
Doidae – $^{1}/_{16}$ drawer, curated
Notodontidae – 21 drawers, mostly curated
Erebidae – 113 drawers, mostly curated
Noctuidae – 235 drawers, mostly curated
Misc. Macrolepidoptera – 23 drawers

Butterflies of Rocky Mountain National Park

Paul A. Opler
C.P. Gillette Museum of Arthropod Diversity
Department of Bioagricultural Sciences and Pest Management
Colorado State University
Ft. Collins, CO 80523-1177

Richard O. Bray
Volunteer, Rocky Mountain National Park
Estes Park, CO 80511

Sara Simonson
Natural Resource Ecology Laboratory
Colorado State University
Ft. Collins, CO 80523-1177

As of June 9, 2012, a total of 141 species of butterflies have been recorded from Rocky Mountain National Park, reflecting recent taxonomic changes. With a few exceptions, scientific names follow Pelham (2008). Common names follow Opler (1999).

SKIPPER FAMILY (Hesperiidae)

Silver-spotted Skipper (*Epargyreus clarus* (Cramer))
Mexican Cloudywing (*Thorybes mexicanus* (Herrich-Schäffer))
Common Sootywing (*Pholisora catullus* (Fabricius))
Dreamy Duskywing (*Erynnis icelus* (Scudder & Burgess))
Pacuvius Duskywing (*Erynnis pacuvius* (Lintner))
Funereal Duskywing (*Erynnis funeralis* (Scudder & Burgess))
Persius Duskywing (*Erynnis persius* (Scudder))
Grizzled Skipper (*Pyrgus centaureae* (Rambur)), odd years
Two-banded Checkered-Skipper (*Pyrgus ruralis* (Boisduval))
Common Checkered-Skipper (*Pyrgus communis* (Grote))
Russet Skipperling (*Piruna pirus* (W.H. Edwards))
Garita Skipperling (*Oarisma garita* (Reakirt))
Bronze Roadside-Skipper (*Amblyscirtes aenus* W.H Edwards)
Common Roadside-Skipper (*Amblyscirtes vialis* (W.H. Edwards))
Uncas Skipper (*Hesperia uncas* W.H. Edwards)
Juba Skipper (*Hesperia juba* (Scudder))
Western Branded Skipper (*Hesperia colorado* (Scudder))
Nevada Skipper (*Hesperia nevada* (Scudder))
Draco Skipper (*Polites draco* (W.H. Edwards))
Tawny-edged Skipper (*Polites themistocles* (Latreille))

Long Dash (*Polites mystic* (W.H. Edwards))
Sonoran Skipper (*Polites sonora* (Scudder))
Sachem (*Atalopedes campestris* (Boisduval))
Taxiles Skipper (*Poanes taxiles* (W.H. Edwards))
Woodland Skipper (*Ochlodes sylvanoides* (Boisduval))
Morrison's Skipper (*Stinga morrisoni* (W.H. Edwards))
Snow's Skipper (*Paratrytone snowi* (W.H. Edwards))
Dun Skipper (*Euphyes vestris* (Boisduval))

SWALLOWTAIL FAMILY (Papilionidae)

Rocky Mountain Parnassian (*Parnassius smintheus* Doubleday)
*Old World Swallowtail (*Papilio machaon bairdii* W.H. Edwards)
Eastern Black Swallowtail (*Papilio polyxenes asterius* Stoll)
Anise Swallowtail (*Papilio zelicaon* Lucas)
Western Tiger Swallowtail (*Papilio rutulus* Lucas)
Pale Swallowtail (*Papilio eurymedon* Lucas)
Two-tailed Swallowtail (*Papilio multicaudata* W.F. Kirby)

WHITE AND SULPHUR FAMILY (Pieridae)

Dainty Sulphur (*Nathalis iole* Boisduval)
Mexican Yellow (*Eurema mexicana* (Boisduval))
Sleepy Orange (*Abaeis nicippe* (Cramer))
Clouded Sulphur (*Colias philodice* Godart)
Orange Sulphur (*Colias eurytheme* Boisduval)
Alexandra's Sulphur (*Colias alexandra* W.H. Edwards)
Mead's Sulphur (*Colias meadii* W.H. Edwards)
Scudder's Sulphur (*Colias scudderii* Reakirt)
Southern Dogface (*Zerene cesonia* (Stoll))
Western Cordilleran Orange-tip (*Anthocharis julia* W.H. Edwards)
Large Marble (*Euchloe ausonides* (Lucas))
Olympia Marble (*Euchloe olympia* (W.H. Edwards))
Pine White (*Neophasia menapia* (C. & R. Felder))
Margined White (*Pieris marginalis* Scudder)
Cabbage White (*Pieris rapae* (Linnaeus))
Becker's White (*Pontia beckerii* (W.H. Edwards))
Checkered White (*Pontia protodice* (Boisduval & Le Conte))
Western White (*Pontia occidentalis* (Reakirt))
Spring White (*Pontia sisymbrii* (Boisduval))

GOSSAMER WING FAMILY (Lycaenidae)

Lustrous Copper (*Lycaena cupreus snowi* (W.H. Edwards))
Ruddy Copper (*Lycaena rubidus* (Behr))

Blue Copper (*Lycaena heteronea* Boisduval)
Purplish Copper (*Lycaena helloides* (Boisduval))
Behr's Hairstreak (*Satyrium behrii* (W.H. Edwards))
California Hairstreak (*Satyrium californica* (W.H. Edwards))
Coral Hairstreak (*Satyrium titus* (Fabricius))
Western Green Hairstreak (*Callophrys affinis* (W.H. Edwards))
Sheridan's Hairstreak (*Callophrys sheridanii* (W.H. Edwards))
Juniper Hairstreak (*Callophrys gryneus* (Hübner))
Thicket Hairstreak (*Callophrys spinetorum* (Hewitson))
Brown Elfin (*Callophrys augustinus* (Westwood))
Moss' Elfin (*Callophrys mossii* (Henry Edwards))
Hoary Elfin (*Callophrys polios* (Cook & Watson))
Western Pine Elfin (*Callophrys eryphon* (Boisduval))
Gray Hairstreak (*Strymon melinus* Hübner)
Marine Blue (*Leptotes marina* (Reakirt))
Eastern Tailed-Blue (*Cupido comyntas* (Godart))
Western Tailed-Blue (*Cupido amyntula* (Boisduval))
Northern Azure (*Celastrina lucia* (W. Kirby))
Rocky Mountain Echo Azure (*Celastrina echo sidara* (Clench))
Rocky Mountain Dotted-Blue (*Euphilotes ancilla* (Barnes & McDunnough))
Arrowhead Blue (*Glaucopsyche piasus* (Boisduval))
Silvery Blue (*Glaucopsyche lygdamus* (Doubleday))
Reakirt's Blue (*Echinargus isola* (Reakirt))
Melissa Blue (*Plebejus melissa* (W.H. Edwards))
Greenish Blue (*Plebejus saepiolus* (Boisduval))
Mountain Blue (*Plebejus icarioides* (Boisduval))
Shasta Blue (*Plebejus shasta* (W.H. Edwards))
Timberline Blue (*Plebejus cotundra* J. Scott & M. Fisher)
Lupine Blue (*Plebejus lupini lutzi* dos Passos)
Southwestern Blue (*Plebejus 'lupini' texanus* (Goodpasture))
Arctic Blue (*Plebejus glandon* (de Prunner))

BRUSHFOOT FAMILY (Nymphalidae)

Monarch (*Danaus plexippus* (Linnaeus))
Queen (*Danaus gilippus* (Cramer))
Weidemeyer's Admiral (*Limenitis weidemeyerii* W.H. Edwards)
Gulf Fritillary (*Agraulis vanillae* (Linnaeus))
Variegated Fritillary (*Euptoieta claudia* (Cramer))
Bog Fritillary (*Boloria eunomia* (Esper))
Silver-bordered Fritillary (*Boloria selene* ([Denis & Schiffermüller]))
Meadow Fritillary (*Boloria bellona* (Fabricius))
Frigga Fritillary (*Boloria frigga* (Thunberg))
Freija Fritillary (*Boloria freija* (Thunberg))
Arctic Fritillary (*Boloria chariclea* (Schneider))
Aphrodite Fritillary (*Speyeria aphrodite* (Fabricius))
Edwards' Fritillary (*Speyeria edwardsii* (Reakirt))

Coronis Fritillary (*Speyeria coronis* (Behr))
Zerene Fritillary (*Speyeria zerene* (Boisduval))
Callippe Fritillary (*Speyeria callippe* (Boisduval))
**Great Basin Fritillary (*Speyeria egleis secreta* dos Passos & Grey)
Atlantis Fritillary (*Speyeria atlantis* (W.H. Edwards))
Northwestern Fritillary (*Speyeria hesperis* (W.H. Edwards))
Mormon Fritillary (*Speyeria mormonia* (Boisduval))
American Lady (*Vanessa virginiensis* (Drury))
Painted Lady (*Vanessa cardui* (Linnaeus))
West Coast Lady (*Vanessa annabella* (Field))
Red Admiral (*Vanessa atalanta* (Linnaeus))
Milbert's Tortoiseshell (*Aglais milberti* (Godart))
***California Tortoiseshell (*Nymphalis californica* (Boisduval))
Mourning Cloak (*Nymphalis antiopa* (Linnaeus))
Satyr Comma (*Polygonia satyrus* (W.H. Edwards))
Oreas Comma (*Polygonia oreas* (W.H. Edwards))
Hoary Comma (*Polygonia gracilis* (Grote & Robinson))
Green Comma (*Polygonia faunus* (W.H. Edwards))
Common Buckeye (*Junonia coenia* Hübner)
Anicia Checkerspot (*Euphydryas anicia* (E. Doubleday)) complex
Dotted Checkerspot (*Poladryas arachne* (W.H. Edwards))
Silvery Checkerspot (*Chlosyne nycteis* (Doubleday))
Gorgone Checkerspot (*Chlosyne gorgone* (Hübner))
Northern Checkerspot (*Chlosyne palla* (Boisduval))
Rockslide Checkerspot (*Chlosyne damoetas* (Skinner))
Pale Crescent (*Phyciodes pallida* (W.H. Edwards))
Northern Crescent (*Phyciodes cocyta* (Cramer))
West Slope Bates' Crescent (*Phyciodes batesii anasazi* J. Scott)
Field Crescent (*Phyciodes pulchella* (Boisduval))
Ochre Ringlet (*Coenonympha tullia ochracea* W.H. Edwards)
Canyonland Satyr (*Cyllopsis pertepida* (Dyar))
Common Wood-Nymph (*Cercyonis pegala* (Fabricius))
Small Wood-Nymph (*Cercyonis oetus* (Boisduval))
Magdalena Alpine (*Erebia magdalena* Strecker)
Common Alpine (*Erebia epipsodea* Butler)
Callias Alpine (*Erebia callias* W.H. Edwards)
Ridings' Satyr (*Neominois ridingsii wyomingo* (J. Scott))
Jutta Arctic (*Oeneis jutta* (Hübner))
Melissa Arctic (*Oeneis melissa* (Fabricius))
Chryxus Arctic (*Oeneis chryxus* (Doubleday))
Uhler's Arctic (*Oeneis uhleri* (Reakirt))

The following butterflies were not confirmed in RMNP by the Rocky Mountain Butterfly Project during the period 1996-2012:

*Old World Swallowtail (*Papilio machaon bairdii* W.H. Edwards) – Recorded by John and Grace Sperry in Rocky Mountain National Park (1929-1931), but specimen not seen;

possibly in the American Museum of Natural History or the Los Angeles County Museum of Natural History.

**Great Basin Fritillary (*Speyeria egleis secreta* dos Passos & Grey) – Type locality purportedly in the park, but probably erroneous. Male and female types are in the American Museum of Natural History.

***California Tortoiseshell (*Nymphalis californica* (Boisduval)) – Recorded by Phillip C. Ritterbush in Rocky Mountain National Park (1955-1956), but specimen not seen.

Butterfly species not yet documented in RMNP but which might occur

Northern Cloudywing (*Thorybes pylades* (Scudder))
Martial Duskywing (*Erynnis martialis* (Scudder))
Afranius Duskywing (*Erynnis afranius* (Lintner))
European Skipper (*Thymelicus lineola* (Ochsenheimer))
Pahaska Skipper (*Hesperia pahaska* Leussler)
Oslar's Roadside Skipper (*Amblyscirtes oslari* (Skinner))
Indra Swallowtail (*Papilio indra* Reakirt)
Cloudless Sulphur (*Phoebis sennae* (Linnaeus))
Lilac-edged Copper (*Lycaena nivalis* (Boisduval))
Edith's Copper (*Lycaena editha* (Mead))
Bronze Copper (*Lycaena hyllus* (Cramer))
Striped Hairstreak (*Satyrium liparops* (Le Conte))
Sylvan Hairstreak (*Satyrium sylvinus* (Boisduval))
Sagebrush Sooty Hairstreak (*Satyrium semiluna* Klots), formerly *S. fuliginosum* of authors, not (W.H. Edwards))
Great-spangled Fritillary (*Speyeria cybele* (Fabricius))
Regal Fritillary (*Speyeria idalia* (Drury))
Hydaspe Fritillary (*Speyeria hydaspe* (Boisduval))
Sagebrush Checkerspot (*Chlosyne acastus* (W.H. Edwards))
Edith's Checkerspot (*Euphydryas editha* (Boisduval))
Compton Tortoiseshell (*Nymphalis vaualbum* ([Denis & Schiffermüller]))
Viceroy (*Limenitis archippus* (Cramer))
Pawlowski's Alpine (*Erebia pawloskii* Ménétriés) formerly *E. theano* of authors, not (Tauscher))

Reported erroneously from the park

Vesta crescent (*Phyciodes graphica* (R. Felder))
White-veined Arctic (*Oeneis bore* (Esper))

Acknowledgments

We thank the personnel of Rocky Mountain National Park who made this study possible by their interest, collecting permits, and guidance. We thank the over 50 Volunteers to the Rocky Mountain Butterfly Project. Evi Buckner-Opler and the late Sandra Opler assisted Paul in the field and in teaching classes for the Rocky Mountain Nature Association, where some park butterfly species were first encoun-

tered. We thank Robert Michael Pyle for sharing his knowledge and the locations of specific Park butterflies. His help teaching Bray the pronunciation of scientific names was invaluable. Present mispronunciations are Bray's alone. Museum specimens mentioned are property of the National Park Service on permanent loan to the C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Ft. Collins.

References

Bagdonas, K. 1982. Butterflies and Moths of Rocky Mountain National Park and Vicinity. Unpublished manuscript submitted to RMNP.

Bray, R.O. 1996. 1996 Season Summary, Rocky Mountain Butterfly Project. Unpublished report to RMNP.

Bray, R.O. 1997. 1997 Season Summary, Rocky Mountain Butterfly Project. Unpublished report to RMNP.

Bray, R.O. 1998. 1998 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 1999. 1999 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2000. 2000 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2001. 2001 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2002. 2002 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2003. 2003 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2004. 2004 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2005. 2005 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2006. 2006 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2007. 2007 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2008. 2008 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2009. 2009 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2010. 2010 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Bray, R.O. 2011. 2011 Season Summary, Rocky Mountain Butterfly Project. Unpublished Report to RMNP.

Cary, M.M. 1928. List of Butterflies Caught in the Long's Peak Region, July 20-26, 1928. Unpublished report to RMNP.

Glassberg, J., editor. 1995. *Checklist and English Names of North American Butterflies.* Morristown, NJ: North American Butterfly Association.

Opler, P.A. 1999. *Field Guide to Western Butterflies*. Boston: Houghton Mifflin Co.

Opler, P.A. 2012. Lepidoptera of Rocky Mountain National Park, 1991-2001, unpublished list and data. Fort Collins: Department of Bioagricultural Sciences and Pest Management, Colorado State University.

Opler, P.A. & Warren, A.D. 2002. *Butterflies of North America. 2. Scientific Names List for Butterfly Species of North America, north of Mexico.* Fort Collins: C. P. Gillette Museum of Arthropod Diversity, Colorado State University.

Pelham, J.P. 2008. A Catalogue of the Butterflies of the United States and Canada with a Complete Bibliography of the Descriptive and Systematic Literature. *Journal of Research on the Lepidoptera* **40**: I–XIV, 1–652.

Ritterbush, P.C. 1972. Butterflies of Rocky Mountain National Park, Colorado, Checklist and Summary, 1955 and 1956. *The Mid-Continent Lepidoptera Series* **4 (50)**: 1–12.

Simonson, S. 1998. Rapid Assessment of Butterfly Diversity: A Method for Landscape Evaluation. Master's Thesis, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Ft. Collins.

Sperry, G.H. & Sperry, J.L. 1931. A Checklist of the Butterflies of Rocky Mountain National Park, Colorado--1929, 1930, 1931. Unpublished Report to RMNP.

Satellite Symposium:

Tortricid2012: An International Meeting of Tortricid Systematists

Monday, July 23 (Denver Museum of Nature & Science, Harry T. Lewis Room)

8:00 am	Meet in the lobby of the Red Lion Hotel if you need a ride to the Denver Museum of Nature & Science
8:30–9:00 am	Arrival and check-in at DMNS
9:00–9:10 am	Welcome
9:10–9:40 am	Eric METZKER: **Cochylini of North America**
9:40–10:15 am	Todd GILLIGAN & Don WRIGHT: ***Phaneta* as not a North American genus (Eucosmini)**
10:15–10:35 am	Peter OBOYSKI: **Phylogeography of Pacific Islands Grapholitini**
10:35–10:50 am	**Break**
10:50–11:15 am	Jerry POWELL: **Sparganothini, history, current status, recent advancements, and future research needs**
11:15–11:45 am	Richard BROWN: **Phylogenetic relationships of Olethreutinae based on endo– and exoskeletal characters**
11:45–12:00 am	Christi JAEGER: **The *Phaneta tarandana* species complex**
12:00–1:15 pm	**Lunch at DMNS restaurant**
1:15–1:45 pm	Todd GILLIGAN: **A molecular phylogeny for the Tortricidae**
1:45–2:05 pm	Ximo BAIXERAS: **Form and function of the bursa copulatrix in Tortricidae**
2:05–2:25 pm	Knud LARSEN: **Research on African Tortricidae**
2:25–2:40 pm	Jason DOMBROSKIE: **Update on the phylogeny of the Archipini**
2:45–3:00 pm	Kevin TUCK: **Worth a closer look – a possible new tribe or subtribe of Tortricinae**
3:00–3:15 pm	**Break**
3:15–3:30 pm	Jean-François LANDRY: **Barcoding Tortricidae**
3:30–4:00 pm	Todd GILLIGAN/Ximo BAIXERAS/everyone: **T@RTS Catalogue updates/discussion**
4:00–4:30 pm	Todd GILLIGAN/Richard BROWN/everyone: **Research proposal discussion**
4:30 pm	**Return to hotel**
5:00 pm–Late	Tortricid collecting

copy deadline: July 5, 2012