The Lepidopterists' Society

60th Annual Meeting

Yale University
New Haven, Connecticut, USA
23-26 June 2011

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Local Arrangements Committee:

Chair:	Larry Gall
Conference Services:	Zelma Brunson, Melissa DePaolo, Sara Machowski
Registration Website:	Zelma Brunson
Program:	Larry Gall, Bonnie Mahmood, Nicole Palffy-Muhoray, Sharon Rodriguez
AV & Technical Support:	Trevor Williams
Session Moderators:	Astrid Caldas, Rick Cech, April Dinwiddie, Chuck Harp, Hugh McGuiness, Antonia Monteiro, Jane O'Donnell, Harry Zirlin
Judging & Door Prizes:	Charles Covell
Field Trip Leaders:	Lenny Brown, Victor Demasi, Hugh McGuiness, Dave Wagner, Harry Zirlin
West Campus Tours:	Lynn Jones
Student Assistants:	Madeline Miguel, Nicole Palffy-Muhoray, Alex Terrell, Trevor Williams
Group Photograph:	Jerry Domian
Meeting Logo:	Antonia Monteiro & Lab
Campus Housing:	Loramarie Muratore
Catering:	Susan Hainsworth & Seaflour Foods

Institutional Sponsors:

Peabody Museum of Natural History, Yale University
Connecticut Butterfly Association

The Lepidopterists' Society

60th Annual Meeting, Schedule of Events
23-26 June 2011

Wednesday, 22 June

10:00 am	Field trip: Pound Ridge, NY
10:00 am	Field trip: West Rock, CT
10:00 am - 2:00 pm	Campus housing check-in (JE / Swing dorms)

Thursday, 23 June

10:00 am	Field Trip: West Redding, CT
9:00 am - 4:30 pm	Executive Council (Peabody Marsh Room)
10:00 am - 4:30 pm	Entomology Collection open (Env. Sci. Center)
1:00 pm - 5:00 pm	Campus housing check-in (JE / Swing dorms)
5:30 pm - 7:30 pm	Registration (Peabody Great Hall)
5:30 pm - 8:00 pm	Opening Reception (Peabody Great Hall)

Friday, 24 June

7:45 am - 10:45 am	Registration (Osborn Lab)
8:30 am - 8:55 am	Welcome & Opening Remarks (Osborn Lab)
8:55 am - 9:05 am	Local Arrangements (Osborn Lab)
9:05 am - 9:15 am	Lepidopterology at Peabody (Osborn Lab)
9:15 am - 10:15 am	Paper Session (Osborn Lab) "*Climate Change & Conservation (part 1)"*
10:15 am - 10:45 am	Break
10:45 am - 11:30 am	Paper Session (Osborn Lab) "*Destinations (part 1)"*
11:30 am - 11:45 am	Group Photograph (Osborn Lab)
11:45 am - 1:00 pm	Lunch
1:00 pm - 1:35 pm	Travel to West Campus (depart Osborn Lab)
1:45 pm - 2:45 pm	Paper Session (WC B25) *"Deep History"*
2:45 pm - 3:15 pm	Break
3:15 pm - 4:00 pm	Paper Session (WC B25) *"Sex & Sequelae (part 1)"*
4:00 pm - 5:30 pm	West Campus Collections Tours (WC A21)
5:30 pm - 7:30 pm	Barbecue (WC B25)
7:30 pm - 8:00 pm	Travel to Main Campus (depart WC B25)
7:30 pm - late	Field Trip: Brooksvale Park, CT

Saturday, 25 June

8:30 am - 10:00 am	Registration (Osborn Lab)
9:10 am - 9:15 am	Local Arrangements (Osborn Lab)
9:15 am - 10:15 am	Paper Session (Osborn Lab) *"Climate Change & Conservation (part 2)"*
10:15 am - 10:45 am	Break
10:45 am - 11:45 am	Paper Session (Osborn Lab) *"Crawlers & Greenery"*
11:45 am - 1:15 pm	Lunch
1:15 pm - 2:15 pm	Paper Session (Osborn Lab) *"Sex & Sequelae (part 2)"*
2:15 pm - 2:45 pm	Break
2:45 pm - 3:45 pm	Paper Session (Osborn Lab) *"Destinations (part 2)"*
4:00 pm - 5:30 pm	Entomology Collection open (Env. Sci. Center)
5:30 pm - 6:15 pm	Banquet Reception (Peabody Great Hall)
6:15 pm - 7:15 pm	Banquet (Peabody Great Hall)
7:15 pm - 8:45 pm	Banquet Program (Peabody Great Hall)
	Officiating: John Shuey, President
	Clench Award; Klots Award; Presidential Address; Jordan Medal Award & Address; Preview of 2012 Meeting; Door Prizes

Sunday, 26 June

9:00 am - 9:30 am	Registration (Osborn Lab)
9:25 am - 9:30 am	Local Arrangements (Osborn Lab)
9:30 am - 11:00 am	Annual Business Meeting (Osborn Lab)
11:00 am	Adjournment
11:30 am - 5:00 pm	Entomology Collection open (Env. Sci. Center)
11:30 am - late	Field Trip: Killingly, CT

Poster Presentations

Available for viewing throughout meeting opposite Osborn Lab lecture hall

Meeting Name Tag

Allows free admission to the Peabody Museum throughout meeting

ABSTRACTS

Friday, 24 June

"Climate Change & Conservation (part 1)"
Moderator: Astrid Caldas

9:15-9:30
Lepidoptera conservation under a changing climate
Astrid Caldas (Defenders of Wildlife, DC; acaldas@defenders.org)

People may disagree that human activities are the primary driver of climate change, but the fact that the earth is under a warming trend is undeniable. In turn, climate change can have widespread effects, many of which we are already seeing. Butterflies and moths provide important services at the ecosystem level, not to mention that they are aesthetically pleasing and widely used as indicators of environmental quality. Habitat loss, sea level rise, and phenological changes are only some of the climate-driven effects that can contribute to changes in Lepidopteran populations. As Lepidopterists, we must start paying more attention to climate. I will present a brief review of studies dealing with climate and Lepidoptera, and discuss possible paths and policies for Lepidoptera conservation and adaptation under a changing climate.

9:30-9:45
Microclimatic benefits of the high elevation oyamel fir forest for overwintering monarch butterflies
Lincoln P. Brower & Ernest H. Williams (Hamilton College, NY; ewilliam@hamilton.edu)

Overwintering monarch butterflies benefit from several microclimatic features provided by the high elevation oyamel fir forest they occupy on the mountains of central Mexico. The forest canopy prevents night-time temperatures from dipping below freezing and provides umbrella-like protection from freezing due to wetting. Our recent studies have showed that the temperature is moderated within the dense clusters formed on fir boughs and that tree trunks provide additional significant thermal buffering. We also found that intermediate heights in the forest experience less temperature fluctuation than either the ground or canopy; the last result helps explain the vertical distribution of overwintering clusters. These

microclimatic factors confirm that the fir forest ecosystem is key to the survival of the monarch butterfly migratory and overwintering phenomenon.

9:45-10:00
Grassland restoration and management for the reintroduction of the Regal Fritillary, *Speyeria idalia*
Virginia P. Tilden (Penn State University - Fort Indiantown Gap, PA; c-vtilden@state.pa.us)

A habitat restoration and future Regal Fritillary butterfly reintroduction project has been initiated at Gettysburg National Military Park, PA. The goal of this study was to examine experimental treatment effect (solarization, scarification, control) on violets, nectar plants, and vegetation cover classes while restoring grasslands at the study site. Lepidopteran and vegetation surveys were conducted from 2008-2010. Slightly changing the management regime increased butterflies and created positive vegetation responses (increases in larval and adult host plants.) There were no significant differences in treatment effect on violet density or nectar transplant survivorship. Solarization was the most effective at increasing bareground and decreasing thatch, but it decreased cover of target warm-season grass. Overall the site at Gettysburg is more suitable for a future reintroduction of this rare species.

10:00-10:15
Population dynamics of the federally threatened Pawnee Montane Skipper Butterfly
Boyce A. Drummond (Colorado College, CO; bdrummond3@msn.com)

An eleven-year monitoring study of the Pawnee Montane skipper (*Hesperia leonardus montana*) shows that adult populations fluctuate dramatically with changes in growing season precipitation, which affects the abundance of prairie gayfeather plants (*Liatris punctata*) upon which the skipper depends for both nectar and mate location. USFS thinning of Ponderosa pine forests in the skipper's restricted range in central Colorado has increased skipper abundance by improving habitat for both prairie gayfeather plants and Pawnee Montane skipper butterflies. Mean skipper densities measured on permanent transects during this study ranged from a low of 0.3 to a high of 2.5 per acre. The higher densities (on thinned sites in wetter

years) compare favorably with those reported from baseline population assessments (2.1-3.6/acre) conducted between 1986-1988.

10:15-10:45, Break

"Destinations (part 1)"
Moderator: Rick Cech

10:45-11:00
Travel to French Guiana
Victor Demasi (Peabody Museum, CT; victormonarch@yahoo.com)

French Guiana offers excellent Neotropical collecting opportunities. A trip was taken to the Amazon Lodge by several Yale Peabody Museum entomologists for seven days in October 2010. Easy access, comfortable accommodations, knowledgeable guides, and permits supplied by the host maximized field time. Numerous bait traps and impressive night collecting apparati were also provided by the Lodge. Transportation to a variety of primary and late secondary forest habitats was possible. The diversity of *Morpho*s and phenomenal black lighting were memorable, exceeding anything this experienced tropical veteran has encountered. *Agrias narcissus* and the extremely rare *Morpho eugenia* were collected. This crepuscular *Morpho* flies predictably between 6:00-6:30 am in forest gaps, and was attracted with blue flags but only secured through desperate swings of the net.

11:00-11:15
The Butterflies of America website: review of progress to date and future goals
Andrew D. Warren (McGuire Center for Lepidoptera, FL; hesperioidea@yahoo.com), *Kim Davis, Nick V. Grishin, Mike E. Stangeland & Jonathan P. Pelham*

We review the contents of the Butterflies of America website, and describe our future goals. Currently, the website treats all species, subspecies and undescribed geographic segregates occurring from the American Arctic through Panama, and the Caribbean. For each of about 5,100 taxa in the area, we provide images of pinned and/or live adults, and when possible, photographs of habitats, illustrations of genitalia, a rough description of distribution, and literature references. We currently feature over 100,000 images on the site, and have focused in recent months on adding images of primary type

specimens, from many institutions, as well as adding images from over 275 photo contributors. We recently added an Illustrated Checklist of Neotropical Butterflies, based on Lamas' (2004) publication, featuring Lamas' collection of Neotropical butterfly type specimens. This is the first step towards expanding the list to include all of South America.

11:15-11:30
Moths of White Sands National Monument and Carlsbad Caverns National Park, New Mexico
Eric H. Metzler (Alamogordo, NM; metzlere@msu.edu)

In 2006, I began a study of the moths at Carlsbad Caverns National Park. In 2007, I and my colleague Gregory Forbes, started a study at White Sands National Monument. I collected 182 samples on 46 nights in the two locations. Every moth was identified to species. Five hundred fifty species are recorded from Carlsbad Caverns National Park, and 430 species are recorded from White Sands National Monument. Five new species were found at Carlsbad Caverns National Park, and 14 new species were found at White Sands National Monument. Two new species from White Sands were published, two more from White Sands and one from Carlsbad Caverns were submitted for publication. We are working on the other descriptions. The studies are planned to last for 10 years.

11:30-11:45, Group Photograph

11:45-1:00, Lunch

1:00-1:35, Travel to West Campus

"*Deep History*"
Moderator: April Dinwiddie

1:45-2:00
The original colors of fossil moths
Maria E. McNamara (Yale University, CT; maria.mcnamara@yale.edu), *Derek E.G. Briggs, Patrick J. Orr, Sonja Wedmann, Heeso Noh & Hui Cao*

Structural colors, the brightest in nature, are most complex in butterflies and moths, where they function primarily in communication. The evolution of structural colors and their functions, however, is poorly understood. Here we report the preservation of structural colors in moths from the 47-million-year old Messel oil shales. The original colors were altered during fossilization but are reconstructed based upon ultrastructural detail in the scales. The dorsal surface of the forewings was a bright yellow-green color that probably served as a visual warning signal. This signal was enhanced by reducing iridescence (change in hue with viewing angle) via two separate optical mechanisms: extensive perforation, and concave distortion, of a multilayer reflector. Complex optical mechanisms for interspecific signaling clearly evolved in lepidopteran scales by the mid-Eocene.

2:00-2:15

Lepidopteran fossil record: an overview of the known fossils and recent discoveries

Jae-Cheon Sohn (University of Maryland, MD; jsohn@umd.edu), *Conrad Labandeira, Donald Davis & Charles Mitter*

Recent increased interest in molecular dating studies has highlighted the importance of fossils whose taxonomic position and age are well-defined. The availability of such fossils is strongly taxon-dependent. The Lepidoptera is the only one of the five major insect clades that has a fossil record poorer than what its modern diversity would suggest (Labandeira & Sepkoski, 2003). This depauperate record is attributed to the fragility and buoyancy of the body and wings. It is estimated that only about 600-700 total specimens of fossil Lepidoptera are known (Kristensen & Skalski, 1998), and few of these have rigorously established systematic positions. To maximize the use of fossils for the reconstruction and dating of lepidopteran phylogeny, a complete catalogue of the known fossil species of Lepidoptera is being made. A total of 651 records have been compiled so far. Our data show that compression/impression body fossils, amber inclusions and plant associations are the three major types of lepidopteran fossils. The age distribution of these fossils is extremely biased toward the middle Eocene. Jurassic Lepidoptera prove to be more diverse than expected, consisting of several lineages. We summarize our discovery of new fossils and how they affect our current knowledge of Lepidoptera evolution. New lepidopteran fossils discovered from the late Middle Jurassic of the Jiulongshan Formation in China suggest that early Lepidoptera already may have been ecologically diverse. Examination of

unstudied material from Baltic and Bitterfeld amber, of more recent, middle Eocene age, revealed new insights for character evolution in some lepidopteran lineages.

2:15-2:30
The multifunctional proboscis and the diversification of Lepidoptera
D. Monaenkova, M. Lehnert (Clemson University, SC; mlehner@clemson.edu), *T. Andrukh, C. Beard, B. Rubin, A. Tokarev, W. Lee, P. Adler & K. Kornev*

For more than 30 years the lepidopteran proboscis has been assumed to function like a drinking straw. The drinking-straw model, however, assumes that Lepidoptera feed from pools of liquid; the ability to feed from porous materials, such as rotting fruit, has not been explained until now. Using scanning electron microscopy and a series of experiments involving X-ray phase-contrast imaging, we discovered that the proboscis acquires fluid from porous substrates in a two-step process: capillarity forms liquid bridges in the food canal, which are then transported to the gut by the sucking pump. The dual functionality of the proboscis represents a key innovation for exploiting a wide range of nutritional sources that might have facilitated the radiation of the Lepidoptera, including exploitation of the angiosperm radiation.

2:30-2:45
A year in the life of a young lepidopterist: Theodore L. Mead's journal of 1871
John V. Calhoun (Palm Harbor, FL; bretcal1@verizon.net)

A fortunate series of events has led to the discovery of the previously unknown 1871 journal of Theodore L. Mead (1852-1936). In 1871, Mead explored Colorado as part of the Wheeler Survey. The butterfly specimens that he collected during this expedition contributed to the description of many new species by W. H. Edwards. During his trip to Colorado, Mead recorded modes of transportation, arrival and departure times, and mileage between destinations. He mentioned some butterflies by their Latin names and pressed a few plants between the pages. Some portions of Mead's itinerary have remained vague, but this discovery promises to eliminate much of this uncertainty. Mead later settled in Florida, where he spent the remainder of his life researching and hybridizing various plants.

2:45-3:15, Break

"Sex & Sequelae (part 1)"
Moderator: Antonia Monteiro

3:15-3:30
Premating experience changes mating patterns in a butterfly
Erica Westerman (Yale University, CT; erica.westerman@yale.edu) *& A. Monteiro*

Lepidopterans are remarkable for their high biodiversity and spectacular variety of distinct, species-specific wing patterns. In vertebrates, a high rate of signal diversity evolution is associated with sexual imprinting, but this behavior has never been observed in butterflies or moths. Here we demonstrate that pre-mating experience can alter mating patterns in a butterfly, *Bicyclus anynana*. Naïve *B. anynana* females mated preferentially with the wild type male phenotype (2 dorsal forewing UV-reflective spots) over manipulated males with more spots (4 UV-reflective spots). However, females briefly exposed to 4 spot males mated preferentially with 4 spotted males during later mate choice trials. These results demonstrate that butterflies can learn a mate preference, and suggest that both genetics and social experience shape mating patterns in butterflies.

3:30-3:45
Sexual selection and the evolution of genital traits in Lepidoptera
Carlos Cordero (Instituto de Ecologia, UNAM, Mexico; signa_cornuti@yahoo.com.mx)

Many genital traits evolve rapidly and divergently in Lepidoptera. The main hypotheses to explain this pattern are: (a) the "lock-and-key" hypothesis, according to which species-specific genital traits evolved to prevent hybridization; and (b) the "sexual selection" hypothesis, that proposes that divergent genital traits are adaptations produced by different types of post-copula sexual selection. I discuss specific post-copula sexual selection hypotheses to explain the evolution of two genital traits widely distributed among the Lepidoptera: the signa of the female corpus bursae and the cornuti of the male endophallus. I present comparative data supporting sexually antagonistic selection as the main force behind the evolution of signa,

and preliminary results regarding the role of sperm competition and cryptic choice in the evolution of cornuti.

3:45-4:00
Sex chromosome mosaicism and hybrid speciation among Tiger Swallowtail butterflies
Krushnamegh Kunte (Harvard University, MA; kkunte@cgr.harvard.edu), *Cristina Shea, Matthew Aardema, J. Mark Scriber, Thomas Juenger, Lawrence Gilbert & Marcus Kronforst*

Hybrid species, formed as a result of hybridization between two parental species, are rare in animals and the factors responsible for their origin and maintenance are largely unknown. Here I show that the North American *Papilio appalachiensis* is a hybrid species, with genomic admixture from *P. glaucus* and *P. canadensis*, that originated and is maintained by natural selection. *Papilio appalachiensis* inherited Z-linked genes associated with a cold thermal habitat from *canadensis*, whereas it inherited a W-linked mimicry gene and mitochondrial DNA from *glaucus*. This species provides rare evidence for the importance of sex-linked traits in the origin and maintenance of hybrid species; in this case ecological barriers associated with a steep thermal cline maintain three, rather than two, species in partial sympatry.

Saturday, 25 June

"Climate Change & Conservation (part 2)"
Moderator: Jane O'Donnell

9:15-9:30
Status of arboreal and understory macrolepidoptera in northwestern New Jersey (USA) forests
Dale Schweitzer (The Nature Conservancy, NJ; dschweitzer@tnc.org), *Joseph Garris, Joseph Smith & Anthony McBride*

Macrolepidoptera were sampled at lights and in the daytime from 2005-2010 in northwestern New Jersey, mostly at two sites, except that forb feeders were sought more widely. For canopy, subcanopy, lowbush blueberry, and litter-feeding species, 94-100% of the expected macrolepidoipteran species were found, but only 23 of 37 other understory shrub specialists were found. In the herb layer, 16

of 27 understory forb specialists and 8 of 8 fern specialists were found. We failed to even locate several recently "frequent" to "common" shrubs and forbs. Deer are strongly suspected as the main reason for declines of understory Lepidoptera that were collected regularly in the 1970s or 1980s. Results were independent of phylogeny, except that four of five Ceratocampinae and two of five *Sphinx* were very rare or undetected.

9:30-9:45
Awareness, education and conservation of butterflies in India
Manjula Channamadhavni (Osmania University, India; manjula_craju@yahoo.com), *Shailaja Gandhari, Priya Kumari Dasari & Sabitaraja Sangam*

Butterflies, along with moths, constitute one of the major insect groups in India. Due to their attractiveness butterflies are often referred to as "nature's jewels," "flagships" and/or "honorary birds." Butterflies are good indicators of environmental quality as they are sensitive to changes in the environment, and their immense value as pollinators make them indispensable to successful farming; decline in their populations therefore directly affect agricultural industry. Butterflies are also of high aesthetic value and historically have been used as motifs in visual and literary arts. Threats to butterflies in India largely arise from human exploitation of forestry, agriculture and other resources. Conservation of butterflies can be brought about by protecting their habitat and by regulating collecting. Endangered and rare species can be suitably cultured and released back into the environment through butterfly farming and butterfly ranching.

9:45-10:00
Biodiversity and butterflies of the Deccan Plateau
Suryakala Illendula (Osmania University, India; dr.suryakala@gmail.com), *Manjula Channamadhavni & Tejkumar Shetty*

The Deccan Plateau lies to the south of the Indo-Gangetic plain of the Indian peninsula and is endowed with dry tropical vegetation - dry, deciduous and thorny forests. There are about 115 species of butterflies in this area. Notable among these are Papilionidae (Crimson Rose, Common Rose, Common Mormon, Tailed Jay, Common Jay, Banded Peacocks), Pieridae (Common Emigrant, Mottled Emigrant, Common Jezebel, Common Wanderer, Orange Tip, Crimson Tip), and Nymphalidae (Black Rajah, Baronet).

Butterflies play a very important role in our ecosystem and their existence is threatened due to destruction and pollution of habitat, and climatic changes. Loss of habitat could lead to large scale extinction of numerous other insects, and conservation of butterflies, and the habitats that sustain them, is therefore important.

10:00-10:15
Within and between year variation in chemical defense of two Checkerspot butterflies
Deane Bowers (University of Colorado, CO; deane.bowers@colorado.edu), *Alex Hill, Frances Drachenberg & Carolina Quintero*

For insects that protect themselves by the production or sequestration of defensive chemicals, individuals may vary substantially in the amounts they contain. Certain checkerspot butterflies have the ability to sequester iridoid glycosides from their host plants and are therefore unpalatable. *Euphydryas anicia* and *Poladryas arachne* (Nymphalidae) co-occur at Crescent Meadows, Boulder County, Colorado. Females oviposit on two species of *Penstemon*, *P. virgatus* and *P. glaber* (Plantaginaceae). We sampled individuals of these species from 1998 to 2009 and found that iridoid glycosides in these butterflies varied significantly by year (with means ranging from 2.5 to 6% dry weight) and that the two species differed in the amounts of iridoid glycosides they contained. Thus palatability of individuals may vary substantially from one year to the next.

10:15-10:45, Break

"Crawlers & Greenery"
Moderator: Harry Zirlin

10:45-11:00
Lepidoptera associated with *Melanthera* in northern Honduras
Deborah L. Matthews (McGuire Center for Lepidoptera, FL; mothnut@hotmail.com) *& Jacqueline Y. Miller*

During the course of our surveys of the biodiversity of the Lepidoptera of Honduras, we have observed and collected several species of moths and butterflies associated with squarestem, *Melanthera* Rohr (Asteraceae). These composites thrive in disturbed sites such as the edges of roads and trails, as well as areas cleared for

farming. They are a common source of nectar for several butterfly species as well as a larval host plant for two butterfly species and several moths. Larvae and pupae of various species have been collected in both the flower heads and on leaves. We present images and results on species obtained thus far including Hesperiidae, Nymphalidae, Geometridae, Pyraloidea, and Pterophoridae.

11:00-11:15

Mapeta xanthomelas* Walker, 1863 (Pyralidae): an unusual and aposematic pyralid guest of *Aristolochia

Giovanny Fagua (Pontificia Universidad Javeriana, Colombia; fagua@javeriana.edu.co), *Juliana Duran, Jorge Robles & Elizabeth Gil*

Mapaeta xanthomellas (Pyralidae: Pyralinae) is an unusually colored moth associated with *Aristolochia* vines, its host plant; these plants are used by other specific but aposematic herbivorous species of *Parides* and *Battus* genera. Because this moth has a light orange color we tested the moth for its host plant preferences, and for the presence of Aristolochic acid in both plants and moth. The preference of *M. xanthomellas* for different *Aristolochia* was examined by feeding groups of caterpillars leaves of different species of *Aristolochia*; the rate of leaf area consumed was measured, and we found a preference for some of the plant species. In a second test, groups of caterpillars were fed leaves of just one *Aristolochia* species (from eight different plant species); in this experiment differences were detected in the rate of development time and caterpillar survival rate. These results were consistent with the preferences found in the first experiment. We detected Aristolochic acid in *M. xanthomellas* and *Aristolochia pilosa*, one of the hosts.

11:15-11:30

An evolutionary exploration of polyphenism in lepidopteran caterpillars

David L. Wagner (University of Connecticut, CT; david.wagner@uconn.edu)

I briefly review the phenomenon of larval polyphenism in Lepidoptera, noting examples of diet-, heat-, light-, and crowding-induced examples of phenotypic plasticity. Of special interest is the largely unheralded green-to-black polyphenism that occurs in many Lepidoptera prone to population outbreaks. We were able to induce green to black color changes in both directions by manipulating larval

densities in the lab and field. The core of the presentation will examine the phylogenetic distribution of the green-to-black polyphenism in the Geometridae and Noctuidae and consider adaptive explanations for this widespread color transformation.

11:30-11:45
North American metalmark food plants
Gordon F. Pratt (University of California Riverside, CA; euphilotes@aol.com) *& Gary D. Bernard*

Visual pigments of North American metalmarks allow them to see into the far red. This ability may aid in distinguishing wings of conspecifics or food plants from non food plants. The metalmarks use larval food plants in nine plant families: Asteraceae, Fabaceae, Fagaceae, Krameriaceae, Polygonaceae, Ranunculaceae, Rhamnaceae, Rosaceae, and Ulmaceae. The seven metalmarks in the genus *Calephelis* all feed upon members of the Asteraceae, while the seven *Apodemia* species whose food plants are known feed upon members of six plant families in the Polygonaceae, Krameriaceae, Fabaceae, Ranunculaceae, Rhamnaceae, and Rosaceae. We plan to determine whether differences in visual pigments correspond to differences in food plants, and use experimental approaches that determine whether metalmarks use these pigments to distinguish food plants from non food plants.

11:45-1:15, Lunch

"Sex & Sequelae (part 2)"
Moderator: Hugh McGuiness

1:15-1:30
Far-red vision of Metalmark butterflies
Gary D. Bernard (University of Washington, WA; garydbernard@comcast.net) *& Gordon F. Pratt*

Metalmarks can see far-red wavelengths. Two potential functions for their unique vision are to detect: (a) wings of conspecifics which exhibit high far-red reflectance, and (b) larval food plants which exhibit high far-red reflectance. Eyeshine measurements reveal four rhodopsins, maximally sensitive in the UV, Blue, Green, and Red (@600nm), respectively. Light converts rhodopsin R600 to

photoproduct M505, measurable as an eyeshine difference spectrum. R600 photoreceptors enable metalmarks to see far-red 700nm-750nm, where most animals are blind. Results are presented for *Apodemia duryi*, *A. mejicanus*, *A. mormo*, *A. palmeri*, and *A. virgulti*; *Calephelis nemesis* and *C. virginiensis*; *Emesis ares* and *E. zela*. Wings of metalmarks and leaves of *Eriogonum* buckwheat have bright markings in the far-red, as demonstrated with spectrally filtered video and measured reflectance spectra.

1:30-1:45

New stories from old friends: phylogeography and species boundaries in *Hyalophora* (Saturniidae)

Michael M. Collins (Carnegie Museum of Natural History, PA; mmcoll@sbcglobal.net), *James W. Fetzner & John E. Rawlins*

The eastern cecropia moth has long been a familiar icon for teaching insect life history in schools and has served science in developmental hormone research (Williams; Truman & Riddiford, U. Washington) and population biology (Waldbauer & Sternburg, U. Ill.). Sweadner's classic work (Carnegie Museum) on natural hybridization among the western species inspired Collins' studies of hybrid zones and species boundaries, using morphometrics, experimental hybridization, and allozymes. Three broad and inter-related questions form the structure of our current work: a phylogeographic study of genetic variation among recognized taxa; a detailed genetic analysis of hybrid zones and species integrity in *Hyalophora*; and a phylogeny of *Hyalophora* within world-wide attacine Saturniidae. In this paper we emphasize phylogeographic studies by reviewing previous work, posing testable hypotheses of species relationships, and presenting new results from sequencing mtDNA markers. A better understanding of hybridization and species boundaries must await our planned development of appropriate microsatellite and nuclear DNA markers.

1:45-2:00

Butterfly eyespots and the evolution of serial humility

Jeffrey C. Oliver (Yale University, CT; jeffrey.oliver@yale.edu), *& Antonia Monteiro*

The diversity of butterfly wing patterns defines the charismatic family Nymphalidae. The eyespot is one of the most conspicuous patterns in butterflies and considerable attention has been devoted to understanding the processes leading to eyespot formation. Numerous genes have been implicated in eyespot development in model

butterfly species, including transcription factors, hox genes, and receptor proteins. We investigated expression of five candidate genes in 19 nymphalid species, encompassing a diversity of wing patterns. We found considerable variation in the degree of expression conservation among the genes: some genes were expressed in only a few closely-related species, while others were nearly ubiquitous, expressed across all taxa. Thus some developmental mechanisms of eyespot formation are labile, while others have likely been conserved since the origin of Nymphalidae.

2:00-2:15
Some like it hot: butterfly sex role reversals result from differences in larval rearing temperature
Kathleen Prudic (Yale University, CT; kathleen.prudic@yale.edu) *& Antonia Monteiro*

Perhaps the famed entomologist Alfred Kinsey would have done well to investigate butterfly sexual behavior. Some butterfly species reverse their sexual roles depending on the external temperature they experience during larval development. When *Bicyclus anynana* caterpillars are raised in warm environments mimicking natural wet season conditions, they grow into what some would consider traditional roles - males pursuing females and females choosing the better male. However, when temperatures during larval development are dropped to levels mimicking dry season conditions, the females become the flirtatious adults while the males choose particular females. This sexual role reversal corresponds to a change in nuptial gift quality. Mating with a cool temperature male increases female longevity and fecundity regardless of the temperature at which she was raised.

2:15-2:45, Break

"Destinations (part 2)"
Moderator: Chuck Harp

2:45-3:00
Recent work on the South Carolina butterfly fauna
Brian Scholtens (College of Charleston, SC; scholtensb@cofc.edu)

Historically, only a handful of individuals have done work on South Carolina butterflies and the number of specimens in major collections

is relatively limited. We are compiling the known records from these individuals and collections into a database, to develop a guide to South Carolina butterflies. We currently have documented records of 160 species, from over 12,000 individual specimen records. We are doing extensive new surveying to re-document as many species as possible from the state. Our recent survey work has resulted in valuable information about rare or potentially extirpated species, significant range extensions, the occurrence of vagrants in the state, and has produced at least 4 new species records for the state.

3:00-3:15
Trends and stats for live Lepidoptera exhibits in the United States
Wayne Wehling (USDA APHIS PPQ, DC; wayne.f.wehling@aphis.usda.gov)

Exhibits displaying live Lepidoptera have flourished in the United States for more than 3 decades. This talk will discuss facts and details accumulated by the USDA for these highly varied exhibits and the Lepidoptera they display.

3:15-3:30
A Report of a Lepidoptera survey visit to the Cosnipata Valley, Cusco, Peru in October 2010
Charles V. Covell (McGuire Center for Lepidoptera, FL; covell@louisville.edu)

For several years the Cosnipata Valley of Peru, between Cusco and Puerto Maldonado, has been surveyed for butterflies. It is possibly the most speciose area of its kind in the world. Further new butterfly records, plus interesting moths, were collected by a team of lepidopterists in October, 2010. Some of these interesting Lepidoptera and some of the team's adventures are presented here.

3:30-3:45
Butterflies of Panama
Kim Garwood (NeotropicalButterflies.com, TX; kimgrwd@sbcglobal.net)

In this talk, I present a photographic tour of some of Panama's spectacular lepidopteran species in their varied habitats.

POSTERS

The effect of climate change on the flight times of Lycaenid butterflies in Massachusetts

Caroline Polgar (Boston University, MA; carolinepolgar@gmail.com), *Richard Primack, Ernest Williams, Sharon Stichter & Colleen Hitchcock*

We examined the effect of climate change on the adult flight period of 11 species of Lycaenid butterflies - five species of *Callophrys*, five *Satyrium* species, and *Lycaena epixanthe* - in Massachusetts using thousands of records obtained from museum specimens, and contemporary records from the Massachusetts Butterfly Club. Species do not show obvious changes over recent decades in flight times. Nine out of eleven species were sighted significantly earlier in warmer years. Different climatic zones of Massachusetts showed differences in flight times; for example *Callophrys* were generally seen earlier on Cape Cod than in other regions. The successful use of museum specimens combined with contemporary data shows promise as a tool for future climate change studies.

The over-expression of Ultrabithorax in *Bicyclus anynana*

Xiaoling Tong (Yale University, CT; xiaoling.tong@yale.edu)

The homeotic complex (Hox) genes have long been thought to play an important role in the diversification of arthropod appendages. In insects, the morphological diversity of limbs and wings is regulated by the Hox gene Ultrabithorax (Ubx). Ubx is required to specify the metathoracic (T3), and prevent mesothoracic (T2) segment fate. In this manner ectopic expression of Ubx has the potential to produce homeotic transformation phenotypes. To test this idea, we produced an ubx over-expression transgenic line in *Bicyclus anynana*. Here we report the effect of ubx over-expression, which was derived by hsp70 promoter under heat shock control, during different development stages. In the embryonic stage, the ectopic ubx gives rise to striking transformations in the thoracic segment. No similar extensive transformations occurred in the adult. However, the ectopic expressed ubx affects the size and color composite of the eyespot on the wing. The laser heat-shock produced enlarged eyespots, ectopic black

scales and long hair in the Ubx over-expression line. In addition, we found that the co-expression of Ubx and Antp on the hindwing, and some genes in the wing developmental pathway, are regulated by Ubx. Compared with previous work \on *P. coenia*, our results suggest that the ubx might not be the single evolutionary switch in the determination of wing morphogenesis.

Assessing conservation priorities for rare, endangered and legally protected butterfly species in Sikkim, Eastern Himalaya, India
Krushnamegh Kunte (Harvard University, MA; kkunte@cgr.harvard.edu)

Sikkim is unusually important for diversity, endemism and conservation of Indian butterflies. It hosts approximately 25% of the butterfly species and subspecies known from India, and a third of the endemics and other butterfly taxa protected under India's Wild Life (Protection) Act. However, little is known about current populations, distributions and conservation priorities for rare, endangered and legally protected butterfly species in Sikkim Himalaya. I have initiated intensive surveys throughout Sikkim to generate baseline information on butterfly populations across seasonal, altitudinal and habitat gradients. The highlight of my work so far is the rediscovery of the federally protected Scarce Jester butterfly (*Symbrenthia silana*, Nymphalidae), which was spotted in Sikkim in 2008 after a 90 year absence. It became Sikkim's Centennial Butterfly at the Forest Centenary in December 2009.

A role for the ecdysone receptor in controlling wing pattern plasticity in *Bicyclus anynana*
Carole Bastianelli (Yale University, CT; carole.bastianelli@ens-lyon.fr)

The African butterfly *Bicyclus anynana* (Satyrinae) has two distinct seasonal forms. The wet season form (WSF) emerges when larvae experience warm temperatures, and the dry season form (DSF) emerges when the larvae experience cool temperatures. This plastic response to rearing temperature leads to conspicuously different wing patterns. The WSF displays very large eyespots and a conspicuous transverse white band, whereas the DSF have less ornamented wings with reduced eyespots and a more discrete band. We are interested in investigating the proximate factors that lead to this wing pattern plasticity. We started by asking whether ecdysteroid signaling is involved in translating environmental rearing temperature and

regulating the expression of wing patterning genes. Here, we show that one component of that signaling, the Ecdysone Receptor, is differentially expressed in developing larval and pupal wings in dry and wet seasonal forms. We argue that while some of these changes may be functional relative to wing patterns, others may represent compensatory changes for fluctuating ecdysteroid titers and involved in maintaining homeostatic wing development.

Spot on - the genetic basis of eyespot number variation in butterfly wings

Bethany R. Wasik (Yale University, CT; bethany.wasik@gmail.com), *Jeffrey C. Oliver, Waldan Kwong & Antonia Monteiro*

Modularity and serial homology are widespread in nature and in part account for the dramatic diversity in animal body plans. However, the genetic mechanisms underlying the process of diversification of serial homologues are not well understood. Here we are focusing on uncovering the genetic basis of eyespot number variation in the nymphalid butterfly *Bicyclus anynana*. Eyespots are serially homologous, modular structures that vary in number across and within species. In *Bicyclus anynana*, the number of eyespots varies between wildtype (Wt) and Spotty, a mutation that doubles the number of forewing eyespots. Gene expression data has shown that several eyespot patterning genes have similar patterns of expression between Wt and Spotty fore wings until the middle of the fifth larval instar, but then four differentiated eyespot foci remain in Spotty wings compared to two foci in Wt wings. We are currently mapping the Spotty locus and using comparative transcriptome analyses both before and after eyespot initiation to identify gene expression affected by the Spotty mutation. Our results will describe how individual serially-repeated modules can differentiate from their serial homologues, and will provide insight into the types of genetic changes that affect eyespot number diversity in nymphalid butterflies.

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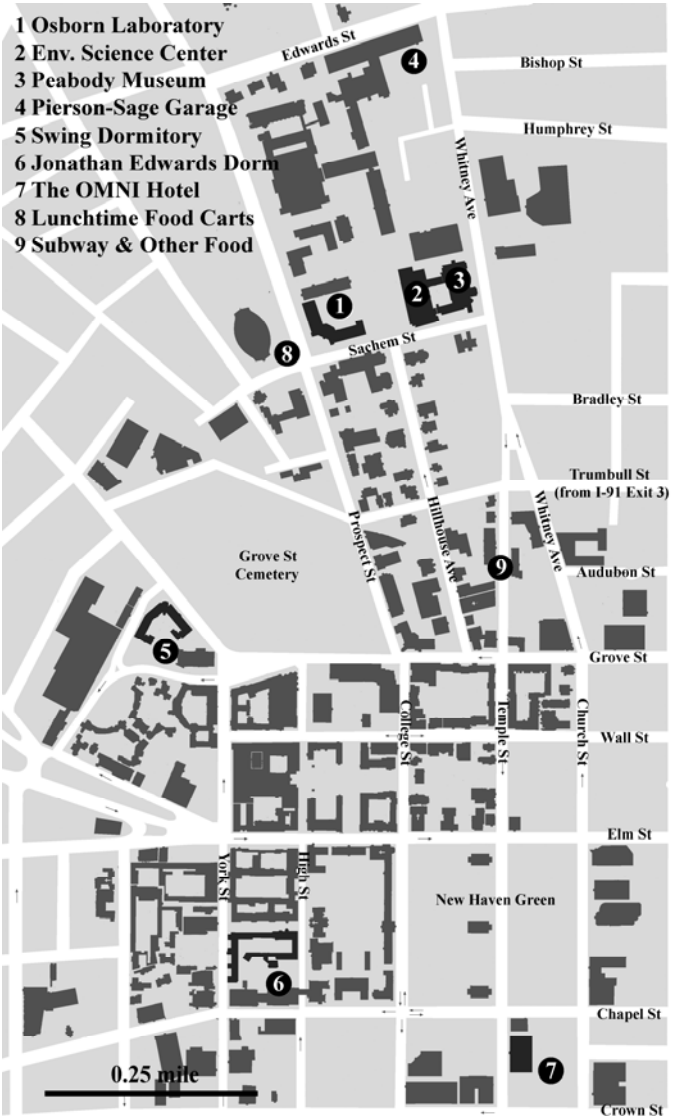
(presenters in boldface)

NOTES:


1 Osborn Laboratory
2 Env. Science Center
3 Peabody Museum
4 Pierson-Sage Garage
5 Swing Dormitory
6 Jonathan Edwards Dorm
7 The OMNI Hotel
8 Lunchtime Food Carts
9 Subway & Other Food
Edwards St
Bishop St
Humphrey St
Whitney Ave
Sachem St
Bradley St
Trumbull St
(from I-91 Exit 3)
Prospect St
Hillhouse Ave
Whitney Ave
Grove St
Cemetery
Audubon St
Grove St
College St
Temple St
Church St
Wall St
Elm St
York St
High St
New Haven Green
Chapel St
Crown St
0.25 mile