North American Black Fly Association

15th Annual Meeting Program Agenda

March 1-3, 2017

Pennsylvania Department of Environmental Protection
Bureau of Laboratories Building
2575 Interstate Drive, Harrisburg PA 17110

WEDNESDAY, MARCH 1ST

2:00 PM – 5:00 PM **FIELD AND LABORATORY TOURS**
Tour of PA DEP labs and field visits to 3 waterways; Susquehanna River, Juniata River and Sherman's Creek

6:30 PM **WELCOME MIXER** (FOOD PROVIDED)
Hospitality Room at Hampton Inn, 30 Capital Drive, Harrisburg, PA 17110

THURSDAY, MARCH 2ND

8:00 AM – 8:20 AM Introductions and Dr. Kenneth Pruess remembered
John Walz, Metropolitan Mosquito Control District (MMCD), St. Paul, MN

8:20 AM – 8:30 AM Welcome to Pennsylvania!
Doug Orr, PA Department of Environmental Protection, Harrisburg, PA

8:30 AM – 9:00 AM PA Black Fly Suppression Program update
Doug Orr, PA Department of Environmental Protection, Harrisburg, PA

9:00 AM – 9:30 AM The *Simulium arcticum* complex in Central Idaho
Gerald F. Shields[1] and John P. Shields[2]
[1]Life and Environmental Sciences, Carroll College, Helena, MT
[2]Dept. of Biology, Eastern Washington University, Cheney, WA

9:30 AM – 10:00 AM Variability in diatom consumption across larval instars of *Simulium jenningsi* (Diptera: Simuliidae)
Keith J. Price[1], Rebecca A. Eckert[2], Andrew M. Scanlan[3], David Hurley[1], Douglas Orr[1]
[1]PA Department of Environmental Protection, Harrisburg, PA
[2]University of Maryland, College Park, MD
[3]Saint Francis University, Loretto, PA

10:00 AM – 10:30 AM **BREAK**

10:30 AM – 11:00 AM A bit of a bummer – actually!
Doug Craig, Department of Biological Sciences, University of Alberta, Edmonton, Alberta, CANADA

11:00 AM – 11:30 AM Bullhead City Pest Abatement: A new program in Arizona AND University of Georgia (for Elmer) update
Joseph Iburg, City of Bullhead City and Bullhead City Pest Abatement District, Bullhead City, AZ

THURSDAY, MARCH 2ND (CONTINUED)

11:30 AM – 12:00 PM — The diversity and evolution of the Baltic amber black flies (Diptera: Simuliidae)
Douglas C. Currie[1,2], Mateus Pepinelli[1,2]
[1]Department of Natural History, Royal Ontario Museum, Toronto, ON, CANADA
[2]Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, ON, CANADA

12:00 PM – 1:00 PM — **LUNCH** (PROVIDED AT PA DEP)

START - STUDENT PRESENTATIONS

1:00 PM – 1:30 PM — The effect of micro-topography on the settlement of *Simulium tribulatum* larvae
Rene Clark and Jonathan Fingerut, St. Joseph's University, Philadelphia, PA

1:30 PM – 2:00 PM — Distribution patterns of *Simulium jenningsi* in Maryland: Recent progress and future plans
Rebecca C. Wilson and William O. Lamp, University of Maryland, College Park, MD

END - STUDENT PRESENTATIONS

2:00 PM – 2:30 PM — The evolution of blood-feeding behavior in black flies (Diptera: Simuliidae): new insights from Mesozoic- and Eocene-aged fossils
Mateus Pepinelli[1,2] and Douglas C. Currie[1,2]
[1]Department of Natural History, Royal Ontario Museum, Toronto, ON, CANADA
[2]Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, ON, CANADA

2:30 PM – 3:00 PM — **BREAK**

3:00 PM – 3:30 PM — The effects of ontogeny, density, and flow on the spatial distribution of larval black flies on a single bed element
Christy R. Violin[1], Jonathan T. Fingerut[1], James R. Thomson[2], David D. Hart[3]
[1]Department of Biology, Saint Joseph's University, Philadelphia, PA, USA
[2]Monash University, Melbourne, Victoria, Australia
[3]Mitchell Center for Sustainability Solutions, University of Maine, Orono, ME, USA

3:30 PM – 4:00 PM — Twin Falls County Pest Abatement District program update
Kirk Tubbs, Twin Falls County Pest Abatement District, Twin Falls, ID

4:00 PM – 4:30 PM — PA West Nile Virus Control Program and PA's response to Zika
Matt Helwig, Vector Management, PA Department of Environmental Protection, Harrisburg, PA

THURSDAY, MARCH 2ND (CONTINUED)

4:30 PM – 5:00 PM — Atypical mechanical transmission of *Mycobacterium ulcerans* in the spread of Buruli ulcer: implications for other biting/stinging arthropods
John R. Wallace, Department of Biology, Millersville University, PA

6:00 PM – 9:00 PM — EVENING AT **THE NATIONAL CIVIL WAR MUSEUM**

DINNER BUFFET	6:15 PM – 7:45 PM
SPEAKER, **WAYNE MOTTS**	7:00 PM – 8:00 PM

"Fathers, Sons, Husbands and Brothers: Union and Confederate Soldiers at The Battle of Gettysburg"

MUSEUM TOUR*	8:00 PM – 9:00 PM

Wayne E. Motts is the chief executive officer of the National Civil War Museum located in Harrisburg. He has been a licensed battlefield guide at Gettysburg National Military Park for three decades.

*Attendees will also receive a ticket for free entry on Friday the 3rd should anyone want to return to the museum.

FRIDAY, MARCH 3RD

8:00 AM – 8:30 AM — History of the PA Black Fly Suppression Program
Andy Kyle, PA Department of Environmental Protection, Harrisburg, PA

8:30 AM – 9:00 AM — Observations and questions concerning Cecidomyiidae and Mycetophilidae caught in dry ice baited EVS traps during 2016
Robin Gray, Seven Valleys LLC Winnemucca, NV

9:00 AM – 9:30 AM — Pennsylvania tick and tick-borne pathogen surveillance
Mike Hutchinson, PA Department of Environmental Protection, Harrisburg, PA

9:30 AM – 10:00 AM — Determining causal factors of diversity within the *S. arcticum* complex
Gerald F. Shields, Life and Environmental Sciences, Carroll College, Helena, MT

10:00 AM – 10:30 AM — **BREAK**

10:30 AM – 11:00 AM — Towards a phylogenetic framework for *Simulium sensu lato*: inferences from elongation complex protein 1 (ECP1)
John K. Moulton, University of Tennessee, Knoxville, TN

11:00 AM – 11:30 AM — History and current challenges associated with black fly problems in Hunterdon County and northwestern New Jersey
Tadhgh Rainey, Hunterdon County Health Department, Milford, NJ

11:30 AM – 12:00 PM — MMCD Black Fly Control Program update
Scott Grant, Metropolitan Mosquito Control District (MMCD), St. Paul, MN

12:00 PM — 2018 MEETING PLANNING AND LUNCH (PROVIDED AT DEP)

Meeting dedicated to long time NABFA participant, Dr. Kenneth Pruess, who passed away December 11, 2016.

A special thanks to Valent BioSciences and the Pennsylvania Vector Control Association (PVCA) for their generous support of the meeting.

North American Black Fly Association would like to recognize, and thank the Pennsylvania Department of Environmental Protection for providing the host amenities this year.

PRESIDENT: JOHN WALZ
HOST SITE COORDINATOR: DOUG ORR
PROGRAM EDITOR: CAREY LAMERE
T-SHIRT DESIGN: MOLLY NEE

www.nabfa-blackfly.org

15TH ANNUAL NABFA MEETING ABSTRACTS

MARCH 1–3, 2017

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
HARRISBURG, PENNSYLVANIA

(Alphabetical order by last name of presenter)

THE EFFECT OF MICRO-TOPOGRAPHY ON THE SETTLEMENT OF *SIMULIUM TRIBULATUM* LARVAE

Rene Clark and Jonathan Fingerut, St. Joseph's University, Philadelphia, PA

This study investigates how distributions of black fly larvae may be affected by bed-element surface micro-topography. Specifically, whether surface roughness can explain patterns of heterogeneous inter-element settlement patterns. By 3D printing tiles with different, but spatially homogenous, levels of roughness and placing them in a recirculating flume we are able to vary both surface texture and flow independently to determine how *Simulium tribulatum* larvae respond to each of these factors. Though still a work in progress, early results show a significant difference in larval emigration among different surface treatments that may be due to changes in the level of near-bed turbulence (and not changes in velocity) attributable to the different surface textures.

A BIT OF A BUMMER – ACTUALLY!

Doug Craig, Department of Biological Sciences, University of Alberta, Edmonton, Alberta, CANADA

Black fly larvae have to deal with a surrounding medium that is 1,000 times more dense than air and, when flowing, creates considerable drag forces. Failing to deal with this is a quick trip to extinction. The presentation will deal briefly with morphological adaptations by simuliid larvae for dealing with a variety of habitats – *e.g.*, slow flow, waterfalls and thin films of water. The majority of the adaptations concern the posterior abdomen, the first part of the body to meet the flow.

THE DIVERSITY AND EVOLUTION OF THE BALTIC AMBER BLACK FLIES (DIPTERA: SIMULIIDAE)

Douglas C. Currie[1,2], Mateus Pepinelli[1,2]
[1]Department of Natural History, Royal Ontario Museum, Toronto, Ontario, Canada
[2]Department of Ecology and Evolutionary Biology, University of Toronto, Ontario, Canada

Examination of 249 recently acquired inclusions reveals important new insights about the diversity and evolution of Eocene-aged Baltic amber simuliids. Cutting edge tools including large-scale digital microscopy, 3D images derived from micro CT scanning and geometric morphometric analyses revealed difficult-to-observe character stages — prerequisite for establishing species status and evolutionary relationships of black flies. Our analyses reveal that the Baltic amber simuliid fauna is more diverse than previously known at the tribal, generic and species levels. The biotic and evolutionary implications of our findings are discussed.

OBSERVATIONS AND QUESTIONS CONCERNING CECIDOMYIIDAE AND MYCETOPHILIDAE CAUGHT IN DRY ICE BAITED EVS TRAPS DURING 2016

Robin Gray, Seven Valleys LLC Winnemucca, Nevada

During 2016 dry ice baited EVS traps were run on a weekly basis in 16 locations in Northern Nevada for the purpose of sampling mosquitoes and black flies as part of an abatement program. Cecidomyiids and Mycetophilids were regularly taken in these traps. The largest numbers of Cecidomyiids were taken in riparian areas with two significant exceptions. The most Mycetophilids by a wide margin were taken at the Winnemucca

Sewage Treatment Plant. Both groups had a peak abundance from June to August; Mycetophilids had a second peak at the end of October. Many questions were raised in examining these catches.

THE EVOLUTION OF BLOOD-FEEDING BEHAVIOR IN BLACK FLIES (DIPTERA: SIMULIIDAE): NEW INSIGHTS FROM MESOZOIC- AND EOCENE-AGED FOSSILS

Mateus Pepinelli[1,2], Douglas C. Currie[1,2]
[1]Department of Natural History, Royal Ontario Museum, Toronto, Ontario, Canada
[2]Department of Ecology and Evolutionary Biology, University of Toronto, Ontario, Canada

Analysis of remarkably well-preserved Mesozoic- and Eocene aged fossils provides new insights about the evolution of bloodsucking behavior in black flies. There have so far been few efforts to interpret the bloodfeeding habits of fossil simuliids, the most notable being the earliest example of ornithophily as expressed by the Upper Cretaceous species *Archicnephia ornithoraptor*. Morphological analyses of the head (including mouthparts), thorax and legs reveal that host preferences among the earliest lineages of black flies was more complex than currently expressed by the extant fauna (i.e., ornithophilic versus mammalophilic species). A novel form of bloodsucking habit is proposed, and evolutionary transformations of haematophagy are optimized on a phylogeny of fossil and extant black flies.

VARIABILITY IN DIATOM CONSUMPTION ACROSS LARVAL INSTARS OF *SIMULIUM JENNINGSI* (DIPTERA: SIMULIIDAE)

Keith J. Price[1], Rebecca A. Eckert[2], Andrew M. Scanlan[3], David Hurley[1], Douglas Orr[1]
[1]PA Department of Environmental Protection, Harrisburg, PA
[2]University of Maryland, College Park, MD
[3]Saint Francis University, Loretto, PA

Pestiferous adult black fly (Diptera: Simuliidae) populations are suppressed by controlling the larvae with *Bacillus thuringiensis* subsp. *israelensis* (*Bti*). However, larval diet, particularly diatoms, has been linked to impaired control effectiveness, and differential instar susceptibility to *Bti* has been identified. Larval gut-content data across instars is thus important in order to understand ontogenetic diet shifts as well as advance sustainable management efforts. Therefore, we examined gut diatom community composition, density, biovolume, diversity, morphology, and ecological guilds across larval instars of *Simulium jenningsi*. Larvae were collected from lotic systems across the state (n= 14), measured, statistically assigned to instar (size) categories, and subjected (intact) to a chemical digestion procedure yielding 'cleaned' diatoms. A minimum of 300 diatom valves were identified to species and enumerated for each sample (n= 42). A total of 132 diatom sp. were recovered from *Simulium* gut analyses. No significant differences in Shannon diversity and evenness indices were found across the instars. Similarly, the proportion of morphologically distinct diatoms were not significantly different ($p \geq 0.572$), suggesting that early instar larvae are capable competitors and possess strong assimilatory abilities for diverse stream microbes. Significant differences were, however, found across instars for diatom biovolume (μm^3) per gut length (mm) ($F_{2,38}= 9.67$, $p < 0.001$), suggesting differential gut filling capacities. We present a practical technique for detailed examination of *Simulium* larval gut contents across instars and examine variability in diatom consumption which offers insight into a potentially important variable affecting *Bti* efficacy and population management of black flies in Pennsylvania.

THE *SIMULIUM ARCTICUM* COMPLEX IN CENTRAL IDAHO

Gerald F. Shields, Life and Environmental Sciences, Carroll College, Helena, Montana
John P. Shields, Dept. of Biology, Eastern Washington University, Cheney, Washington

The *S. arcticum* complex is one of the most diverse groups of black flies, second only world-wide to the *S. damnosum* complex in Africa, the vector of African River Blindness. Nine sibling species and an additional 22 cytotypes have been described for the *S. arcticum* complex in Alaska, western Canada, eastern Washington, northern Idaho and western Montana. In an effort to determine chromosome diversity of the *S. arcticum* group

in central Idaho, an unstudied area, we made 19 collections at 15 sites at the major rivers (Clearwater, Lochsa, Salmon, Selway, Snake) and their tributaries and found *S. arcticum* at seven locations. *S. saxosum* was the most abundant type in the region confirming previous studies to the west. We found combinational types of *S. arcticum* s. s and *S. saxosum* at two sites thus increasing the range at which sex chromosomes of these types have been found in the same individuals. At two sites we also found *S. arcticum* IIL-79 which had previously been found at only two sites to the north. Finally, we discovered a taxon new to science, *S. arcticum* IIL-80 at the Tucannon River, a tributary of the Snake. Additional collection and analyses of larvae at these sites is planned for the spring of 2017.

DETERMINING CAUSAL FACTORS OF DIVERSITY WITHIN THE *S. ARCTICUM* COMPLEX

Gerald F. Shields, Life and Environmental Sciences, Carroll College, Helena Montana

We have suggested (Shields and Hokit, 2016) that river corridor affects chromosome diversity within the *S. arcticum* complex. That is, larvae in the same river corridor have chromosomes that are more similar than larvae in different river corridors even when the latter are closer in Euclidian distance. However, what may be occurring at the landscape level may not be occurring at the microhabitat level. Accordingly, I analyzed the polytene chromosomes of *S. arcticum* larvae at new sites in six different river drainages and compared them to those of nearby previously analyzed sites. Larvae at 12 of the 14 paired comparisons had different chromosomes, suggesting that gravid females may be using certain unknown physical and ecological cues to lay eggs at locations which are favorable to the survival of their offspring. Our future studies will include comparisons of a suite of environmental variables (water temperature, rate of stream flow, stream width, etc.) and larval chromosomes to determine if environmental variables correlate with the presence or absence of chromosome types.

THE EFFECTS OF ONTOGENY, DENSITY, AND FLOW ON THE SPATIAL DISTRIBUTION OF LARVAL BLACK FLIES ON A SINGLE BED ELEMENT

Christy R. Violin[1], Jonathan T. Fingerut[1], James R. Thomson[2], David D. Hart[3]
[1]Department of Biology, Saint Joseph's University, Philadelphia, PA, USA
[2]Monash University, Melbourne, Victoria, Australia
[3]Mitchell Center for Sustainability Solutions, University of Maine, Orono, ME, USA

This study investigated the individual and integrated effects of ontogenetic stage (larval size), density (individuals vs. aggregations) and flow (both bulk and small spatial variations), on larval movement on a single bed element for larvae of the black fly *Simulium tribulatum*. We found significant effects of all three factors on larval responses to small scale flow conditions. Late instar larvae were more likely to move to higher flow regions when they initially attached to the experimental bed element in areas of lower flow, and this behavior was modified by both bulk flow velocity and population density. Neonate larvae did not similarly respond to local flow conditions. Understanding these effects will fill significant gaps in our knowledge of, and increase our ability to predict, population-level distributions of these organisms and similar filter-feeding macrobenthic organisms which are important for stream ecosystems.

ATYPICAL MECHANICAL TRANSMISSION OF *MYCOBACTERIUM ULCERANS* IN THE SPREAD OF BURULI ULCER: IMPLICATIONS FOR OTHER BITING/STINGING ARTHROPODS

John R. Wallace, Department of Biology, Millersville University, PA, USA

Addressing the transmission enigma of the neglected disease Buruli ulcer (BU) is a World Health Organization priority. In Australia, we have observed an association between mosquitoes harboring the causative agent, *Mycobacterium ulcerans*, and BU. Here we tested a contaminated skin model of BU transmission by dipping the tails from healthy mice in cultures of the causative agent, *Mycobacterium ulcerans*. Tails were exposed to mosquito (*Aedes notoscriptus* and *Aedes aegypti*) blood feeding or punctured with sterile needles. Two of 11 of mice with *M. ulcerans* contaminated tails exposed to feeding *A. notoscriptus* mosquitoes developed BU.

Eighteen of 20 mice subjected to contaminated tail needle puncture developed BU. Mouse tails coated only in bacteria did not develop disease. We observed a low infectious dose-50 of four colony-forming units and a median incubation time of 12 weeks, consistent with data from human infections. We have uncovered a highly efficient and biologically plausible atypical transmission mode of BU via natural or anthropogenic skin punctures.

MMCD BLACK FLY CONTROL PROGRAM UPDATE

John Walz, Carey LaMere and Scott Grant, Metropolitan Mosquito Control District (MMCD), St. Paul, MN

The goal of the Metropolitan Mosquito Control District's (MMCD) Black Fly Control Program is to reduce pest populations of black flies within the MMCD to tolerable levels. The MMCD monitors 168 small stream sites and 28 large river sites in the 7-county metropolitan area surrounding Minneapolis-St. Paul. The program uses a yearly average of 3,000 gallons of *Bti*; the majority applied to the Minnesota and Mississippi rivers. In 2016, a bulk *Bti* treatment system was tested on the Minnesota River with the goal to reduce the number of 2.5 gallon plastic jugs and staff hours.

DISTRIBUTION PATTERNS OF *SIMULIUM JENNINGSI* IN MARYLAND: RECENT PROGRESS AND FUTURE PLANS

Rebecca C. Wilson and William O. Lamp, University of Maryland, College Park, MD

Since 2013 residents in western Maryland have pushed for state management efforts for *Simulium jenningsi* populations, which form severe summer nuisance swarms within some regions of the state. Our lab began investigating the distribution patterns of *S. jenningsi* adults and larvae near the areas of resident complaints that year, our primary objectives being to determine the spatial, environmental, and societal factors associated with the seemingly localized nuisance swarms. Adult flies were collected from 250 sampling locations throughout the region of interest over two years. *S. jenningsi* was present to some degree throughout the region, but large numbers were encountered in regional "hot-spots." Land cover was correlated to nuisance severity, with fewer flies in urban areas. *S. jenningsi* larvae were found in large densities on artificial substrates within the Potomac River, the spatial variability of which is under analysis. Reports of *S. jenningsi* nuisance from counties in central and northern Maryland also reached our lab within the past year, helped in part by the spreading news of a black fly management bill passing in the state senate.