

Annual Report for Period:09/2007 - 08/2008**Submitted on:** 06/16/2008**Principal Investigator:** Wiegmann, Brian M.**Award ID:** 0731528**Organization:** North Carolina State U**Submitted By:**

Wiegmann, Brian - Principal Investigator

Title:

Taxonomic, Phylogenetic, and Evolutionary Studies of Horse flies (Diptera:Tabanidae): An Integrated Approach to Systematics Training

Project Participants**Senior Personnel****Name:** Wiegmann, Brian**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Yeates, David**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Morita, Shelah**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Kampmeier, Gail**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Graduate Student****Name:** Bayless, Keith**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Keith Bayless is a project graduate student in the Department of Entomology, North Carolina State University. Keith's project will be a taxonomic revision of the genus *Dasychela* and phylogenetic analysis of the Diachlorini. Project funds support the a graduate research assistantship and research costs.

Undergraduate Student**Name:** Carnavale, Daniela**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Daniela Carnavale is an undergraduate summer scholarship student working on Australia with David Yeates.

Technician, Programmer**Name:** Cassel, Brian**Worked for more than 160 Hours:** Yes**Contribution to Project:**

DNA sequencing and database support for the project.

Other Participant**Research Experience for Undergraduates****Organizational Partners****ARS/ Systematic Entomology Laboratory****Other Collaborators or Contacts**

John Burger, University of New Hampshire, Horse fly taxonomy and systematics
 Jon Chainey, The Natural History Museum, Horse fly taxonomy and systematics
 Terry Erwin, Smithsonian Institution, Neotropical horse fly specimens
 Christian Gonzalez, Universidad Metropolitana, Santiago Chile, horse fly taxonomy and systematics
 Michael E. Irwin, UIUC and Arizona-Sonora Desert Museum, Tabanidae collecting and specimens
 Chris Manchester, Australian National Insect Collection, LUCID interactive keys
 Katja Schultz, Florida State University, Morphbank processes and submission
 David Spratt, CSIRO consultant, horse fly taxonomy and systematics
 Gary Steck, Florida Collection of Arthropods, Horse fly diversity and collections
 John Stoffolano, University of Massachusetts, horse fly physiology and behavior
 Bruce Sutton, horse fly collecting, taxonomy and systematics
 F. C. Thompson, Systematic Entomology Lab, USDA, National Museum of Natural History - Biodiversity informatics, Diptera Nomenclature and Taxonomy
 Shaun Winterton, Queensland DPI, horse fly collecting and brachyceran systematics
 Donald Webb, INHS, horse fly taxonomy and collecting

Activities and Findings**Research and Education Activities:**

Co-PI and postdoctoral associate Shelah Morita conducted Bayesian and maximum likelihood analyses on combined molecular datasets for *Philoliche* (Tabanidae: Pangoniinae). These data were used to map changes in mouthpart morphology and pollination ecology across the species ranges of these taxa in South Africa and to assess species limits and divergence times of South African *Philoliche*. Manuscripts were prepared on systematics of *Philoliche* and the evolution of flower-associated characters. Morita began work on a comprehensive world-wide taxonomic and phylogenetic revision of the genus *Philoliche*.

Graduate student Keith Bayless began revisionary taxonomic research on the genus *Dasychela*. He developed a research plan, obtained specimens from major collections, and began to enter specimen-level information in the project database (MANDALA).

Bayless and Morita visited the US National Insect Collection at the Smithsonian Institution and examined specimens, sorted material, and obtained loans. Key taxa for revisionary and phylogenetic analyses were sorted from Terry Erwin's Ecuadoran and Peruvian canopy fogging samples. Bayless and Morita traveled to UMASS to consult with horse fly behavioral physiologist, John Stoffolano. Bayless and Morita traveled to University of New Hampshire to consult with horse fly taxonomist, John Burger, and examine specimens in the UNH research collection.

Morita visited the Florida State Collection of Arthropods to examine specimens and consult with collaborators Gary Steck and Bruce Sutton.

Horse fly specimens were obtained from collaborators conducting research in Thailand (B. Brown), Fiji (Evenhuis), Central Europe (Foldvari), Chile and Southwest US (Irwin) and Madagascar (B. Fisher).

Bayless, Morita, and Wiegmann initiated work on the higher-level phylogeny of Tabanidae based on nucleotide sequence data. DNA extraction, PCR amplification and sequencing were carried out on approximately 75 species of Tabanidae from all subfamilies, and outgroups. Amplicons were obtained from regions of the nuclear protein coding genes CAD and AATS, a 1 kb fragment of 28S rDNA, and from mitochondrial *cox1*.

Digital images from multiple views and structures on tabanid research specimens were made and submitted to Morphbank.

Graduate student, Keith Bayless initiated work on creating a digital image library of all tabanid genera and began work on updated tabanid pages for the Tree of Life Web project (tolweb.org). He completed TOLweb pages for Stratiomyiidae and Richardiidae, and improved pages for all of Diptera. He also worked on completion of taxonomic papers describing new species in Asilidae and Richardiidae.

Collecting expeditions for horse fly specimens were conducted in North Carolina (Sept. - Nov. 07, Apr-May 08), California (Dec 07), South Africa and Kenya (Jan 08, July 08).

Project participants, Wiegmann, Yeates, Morita, Kampmeier, Thompson, and Bayless met in Coweeta Field Station in North Carolina, Nov. 2007 during the FLYTREE meetings and discussed project goals and plans, and database development initiatives. In collaboration with Thompson, plans were generated to complete a World Catalog of Tabanidae for publication in MYIA and for inclusion in the Biosystematic Database of World Diptera.

During the FLYTREE meeting in November 2007 at Coweeta, NC, Kampmeier collaborated with co-PI Shelah Morita on adding the ability to track progress on molecular activities (extractions, PCR, primers, sequences) to the Mandala database system (<http://www.inhs.uiuc.edu/research/mandala/>). This functionality has been added to Mandala 8, a new version of Mandala that collapses the number of files from 23 to 3 but increases the number of tables in the database system to accommodate the tracking of molecular data attached to specimens. These improvements will be used for both the Tabanid PEET and the FLYTREE projects. Mandala 8 is currently in beta test with a release target in the summer of 2008. The Mandala 8 database system requires FileMaker 8 or above and will be available to prospective users upon request through the Mandala website.

At the Biodiversity Information Standards meeting in Bratislava in September 2007, Gail Kampmeier was introduced to the EDIT (European Distributed Institute of Taxonomy) project, a collaborative online environment (using a Drupal-based content management system) for the systematics community. Upon returning to Illinois, she began to collaborate with Irina Brake (Natural History Museum, London) to start a Diptera portal <http://diptera.myspecies.info/>. Gail is a manager for the site and has subsequently created a presence for the Tabanidae and the FLYTREE (Diptera Tree of Life) projects, which were written up in the FlyTimes (<http://www.nadsdiptera.org/News/FlyTimes/issue40.pdf>).

Co-PI David Yeates and collaborator Dave Spratt have just submitted a large revision of Australian *Cydistomyia* species to Zootaxa. The manuscript treats 40 species, 17 of which are new. The manuscript was modified and developed from one written by Dr Ian

Mackerras and Dr Spratt in the 1970's.

CSIRO Summer Scholarship student Daniela Carnovale, working in Australia with David Yeates, started in December 2007. She focussed on the biting ecology of tabanids in the Australian Alpine zone. A total of 10 species were recorded biting humans, with the dominant genus being *Scaptia*. Biting frequencies were very high, with up to 60 bites per minute recorded on sunny calm days. Daniela is currently preparing a poster and educational material for use by the Alpine National parks and Wildlife Service.

Mr Chris Manchester, technical Officer in the Australian National Insect Collection, has prepared an interactive key to the genera and subfamilies of Australian Tabanidae in Lucid 3.4. This will be deployed on the web once final proofreading and testing has been completed.

20 identified Australian species of *Dasybasis*, *Cydistomyia*, *Scaptia* and *Tabanus* have been preserved in 100% ethanol for molecular systematics.

A national and international search was conducted for a project graduate student assistantship. The successful candidate, Daniela Ramirez, has been enrolled in the graduate program in Entomology at NCSU beginning August 1, 2008.

Findings:

Higher-level phylogenetic analyses of nucleotide and morphological evidence reveal the need for revision of the subfamilial classification of Tabanidae. Chrysopsinae, the deer flies, long considered a highly derived group, are placed as sister group to all higher Tabanidae (Tabaninae). Likelihood and Bayesian phylogenetic analysis of newly collected data corroborate this finding and supports the monophyly of Pangoninae and Tabaninae. Diachlorinae is paraphyletic in all preliminary trees and will be a major focus of phylogenetic research conducted by project graduate students. Nuclear genes CAD and Aats contain phylogenetically informative variation for higher level relationships. These genes provide significant resolution and support for the major clades of Tabanidae.

Based on recently collected material accessed to the Australian National Insect Collection (ANIC), David Yeates has identified a new species of *Scaptia* biting humans from the Nhulunbuy Peninsula in eastern Arnhem Land, the Northern Territory, and a number of new species of *Tabanus* from the Pilbara OF Western Australia.

Ongoing research on the phylogeny and evolution of S. African *Philoliche* reveals that floral associated characters are phylogenetically derived and evolutionarily labile across closely related species. These features are significantly correlated with flower morphology and floral communities, especially in the *P. aethiopica* complex. Taxonomic work on *Philoliche* clarified species identities and type specimen associations using corroborating evidence from molecular phylogenetics and morphological character surveys.

Morita is currently describing the first larval record for *Philoliche*.

Training and Development:

During the first year of the project, graduate student Keith Bayless has been trained in taxonomic database development and data management, digital imaging methods and SEM, systematic methods and phylogenetic analysis, DNA extraction, amplification and sequencing, nucleotide data editing, contig assembly, and divergence times estimation.

Bayless was teaching assistant in undergraduate General Entomology course in the Entomology Dept. NCSU (fall 08)

CSIRO Summer Scholarship student Daniela Carnovale received training in tabanid field work and behavioral ecology. Her work is leading to scientific presentations and development of educational materials.

The Tabanid PEET PIs joined collaborators from Australia, Canada, Denmark, Singapore, and the US in a team meeting for the Diptera Tree of Life (aka FLYTREE <http://www.inhs.uiuc.edu/research/FLYTREE/>) at the Coweeta Research Station and in Raleigh, NC 15-19 November 2007. The group shared progress and ideas for the future, set goals, and collaborated on new initiatives. It was also the first opportunity for the PEET group to meet.

Shelah Morita participated in the Phyloinformatics Workshop at NESCent (July 07).

Wiegmann co-organized and participated in a one-day work shop on the use of BEAST for Bayesian Divergence Time estimation conducted by BEAST author, Dr. Alexei Drummond (May 2008).

Outreach Activities:

Wiegmann developed and co-presented a workshop on systematics and phylogeny in the classroom for the PAEMST biology teacher awardees at NSF, April 2008.

Wiegmann participated in the AAAS/AIBS Education Summit and in the NSF Natl. Education Conversation at AAAS, May 2008.

Wiegmann, along with colleagues at NESCent, co-organized and moderated the Evolution Symposium at the annual National Association of Biology Teachers Meeting, in Atlanta GA. Nov 2007.

Wiegmann presented Horse Fly Facts to the public at BugFest at the NC Museum of Natural Sciences in Raleigh NC. Aug 2007.

Kampmeier worked to get the Entomological Society of America as a participant in COPUSÆs (Coalition on the Public Understanding of Science) Year of Science, 2009. <http://www.copusproject.org/>

Kampmeier co-organized with librarian, Susan Braxton, an INHS Discussion Group meeting around the topic of sensitive data. Using a workshop report written by Arthur Chapman for the Global Biodiversity Information Facility (GBIF) as a backdrop, we discussed how our biodiversity data are managed at INHS. See <http://www.inhs.uiuc.edu/~gkamp/downloads/SensitiveData20VII07.pdf>. Shared the

results of this discussion with the DIGIT (Digitisation of Natural History Collections) Science Subcommittee of GBIF

Kampmeier is a member of the program committee for 2008 Biodiversity Information Standards meeting, Fremantle (Perth), Australia <http://www.tdwg.org/conference2008/>. She is organizing a symposium "Bridging the Gap between Bench Taxonomists and Database Geeks" at the meeting and leading the follow-up discussion.

Kampmeier represented the Illinois Natural History Survey (INHS), an institutional member, at the Biodiversity Information Standards (TDWG) annual meeting in Bratislava, Slovakia 16-22 September 2007 and spoke in the Communication, Education, and Outreach symposium on 'Mapping biodiversity specimen data: Opportunities for collaboration,' a talk co-authored by John Pickering (Univ. of Georgia; Discover Life.org).

Journal Publications

Morita S. I., "A revision of the *Philoliche aethiopica* species complex", *African Invertebrates*, p. 129, vol. 49, (2008). Published,

Morita S. I., "A phylogeny of long-tongued horse flies (*Philoliche*, Diptera: Tabanidae) with the first cladistic evaluation of higher relationships within the family", *Invertebrate Systematics*, p. , vol. 22, (2008). Accepted,

Spratt, D., Mackerras I., Yeates, D, "A review of Australasian species of the horse fly genus *Cydistomyia* (Diptera: Tabanidae)", *Zootaxa*, p. , vol. , (2008). Accepted,

Yeates, DK; Wiegmann, BM; Courtney, GW; Meier, R; Lambkin, C; Pape, T, "Phylogeny and systematics of Diptera: Two decades of progress and prospects", *ZOOTAXA*, p. 565, vol. , (2007). Published,

Brake, I., G. Kampmeier, & F. C. Thompson, "The *new* Diptera Site", *Fly Times*, p. 6, vol. 40, (2008). Published,

Kampmeier, G., & Pickering, J., "Mapping biodiversity specimen data: Opportunities for collaboration", *Proceedings of TDWG*, p. , vol. , (2007). Published,

Kampmeier G. E., "Sharing biodiversity data: opportunities for collaboration", *Illinois Natural History Survey Reports*, p. 2, vol. 394, (2008). Published,

Morita S I, "Notes from the field: A new species of redheaded Nemestrinidae from South Africa may shake up some botanical names", *Fly Times*, p. 17, vol. 40, (2008). Published,

Books or Other One-time Publications

Web/Internet Site

URL(s):

<http://www.inhs.uiuc.edu/research/tabamid/>,
<http://diptera.myspecies.info/content/tabanidae>

Description:

This is the project website. It is used for dissemination of project products, communication among project participants and organization of systematic and biodiversity resources pertaining to Tabanidae.

The EDIT Tabanidae scratchpad is a community-level workspace for disseminating information on horse fly biodiversity, creating species pages and coordinating taxonomic initiatives.

Other Specific Products

Product Type:

Data or databases

Product Description:

Mandala 8.0 is major upgrade to a database system begun in 1995 for a therevid PEET project (DEB 95-21925 and 99-77958) to document taxonomic name history and the taxon-associated literature, and tracking of specimen information. Its use was broadened with the NSF Fiji Arthropod Survey (DEB 04-25790) in 2004 for biodiversity studies that need to track samples that have been sorted and sent to specialists for identification. Databases have been available for public online searching for these projects using PHP (see links to specific projects from Mandala's home page at <http://www.inhs.uiuc.edu/research/mandala/>). The therevid taxonomic name and specimen data are being served and mapped through DiscoverLife <http://www.discoverlife.org/mp/20q?search=Therevidae> as the tabanid data will be as it begins to accumulate.

Sharing Information:

The database is web-accessible for project personnel and a web interface will allow public search access.

Contributions

Contributions within Discipline:

Phylogenetic and revisionary taxonomic studies, database development and web products are contributing to the development of accurate and widely accessible biodiversity information on Tabanidae. An interactive key to the genera and subfamilies of Australian Tabanidae in Lucid 3.4 is in development.

Tests of phylogenetic utility of nuclear genes in Tabanidae allow the use of project genes in other studies.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Wiegmann is Associate Director of Education and Outreach at the National Evolutionary Synthesis Center. In this position, Wiegmann participates in programs to enhance opportunities for expanding the opportunities for underrepresented groups in evolutionary biology. Wiegmann attends meetings and workshops, works with teams to develop curricula, and contributes to efforts to recruit students into evolutionary biology.

Wiegmann along with Scott Edwards, and NESCent EOG staff, is co-organizer and participant in the Minority Undergraduate Scholarship program at the Evolution Meetings in Minneapolis June 2008.

Gail Kampmeier was elected to the Governing Board (GB) of the Entomological Society of America (ESA) to represent the Section on Plant-Insect Ecosystems, a newly formed discipline-based Section that officially came into being with the Society's new Bylaws on

12 December 2007. She met with the new Section's Governing Council (GC), which joined the three other new sections, for an intensive two-day planning session in Indianapolis, IN 18-19 October 2007. In December she was re-elected to the ESA GB Executive Committee in an annual election by members of the Governing Board for two at large positions. She also serves as a member of the Entomological Foundation in her capacity as an ESA Exec. Committee member, and is the GB liaison to the ESA Standing Committee on Membership. She worked with the committee on a plan to attract more early career entomologists to the Society and to retain those transitioning from student status to regular membership by lengthening the subsidy of their membership by an additional year. She has also co-organized a network for Women in Entomology and co-organized a breakfast at the ESA Annual Meeting in December 2007 in San Diego.

Kampmeier was asked to continue for second term on GBIF's DIGIT (Digitisation of Natural History Collections) Science Subcommittee (2008-2010). Reviewer of seed funding proposals, which were recently funded <http://www.gbif.org/Stories/STORY1207138000>.

Kampmeier attended the FileMaker Developer's Conference, Orlando, FL August 2008, focusing on sessions dealing with sharing databases via the web using PHP. As a member of FileMaker's Technet program, she also has taken the opportunity to participate in webinars on FileMaker server technologies and with FMWebSchool's webinars on FileMaker web technologies.

Contributions to Resources for Research and Education:

Wiegmann contributed to workshops for the EVAC working group at NESCent, Evolution Across the Curriculum and TREE .. Tree Thinking in Evolutionary Education.

Wiegmann was an external reviewer and panel member for multiple NSF programs.

Kampmeier was an external reviewer for a NSF Biological Research Collections grant

Kampmeier represented the Illinois Natural History Survey (INHS), an institutional member, at the Biodiversity Information Standards (TDWG) annual meeting in Bratislava, Slovakia 16-22 September 2007

Kampmeier is chair of the Information Technology Committee at INHS, an advisory and advocacy committee to promote sustainable IT infrastructure at the Survey. As committee chair, she also is also a member of the University of Illinois's CCSP (Campus Computer Support Personnel) group, attending its semi-annual conferences. Kampmeier is also a member of the INHS WebTeam and is helping to coordinate and encourage contributions particularly of insect-related content http://www.inhs.uiuc.edu/animals_plants/insect/. She also worked to create a PHP-based searchable interface to the FileMaker-based INHS Historical Image Collection (<http://ant.inhs.uiuc.edu:16080/INHSphotos/archive/index.php>). She is teaching librarian Susan Braxton how to use the FMStudio webtools for continued development of website.

Contributions Beyond Science and Engineering:

Research on biting frequency, distribution, and intensity of biting and blood feeding for Australian *Scaptia* is used to inform public and local medical workers about severity and impact of biting flies.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Book

Contributions: To Any Other Disciplines