

2016 Curriculum Vitae



NAME: Bryan Nicholas Danforth
DEPARTMENT/UNIT: Entomology
TITLE: Professor
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TRAINING: BS zoology, Duke University, Durham, NC, 1983.
MS entomology, University of Kansas, Lawrence, KS, 1987. Advisor:
C.D. Michener.
PhD entomology, University of Kansas, Lawrence, KS, May, 1991.
Advisor: C.D. Michener.

FIELD OF SPECIALIZATION:

Research/Teaching: Insect phylogeny, social evolution, behavioral ecology, systematics, pollination biology. Specialization: phylogeny, ecology, and social evolution of bees.

PROFESSIONAL EXPERIENCE:

1982 Teaching assistant, Department of Zoology, Duke University, Durham, NC
(Animal Diversity)
1985 Teaching assistant, Department of Entomology, University of Kansas, Lawrence,
KS (Introductory Biology).
1985-1986 Teaching assistant, Department of Entomology, University of Kansas, Lawrence,
KS (Introductory Entomology).
1987-1989 Research assistant, Department of Entomology, University of Kansas, Lawrence,
KS. Supervisor: C.D. Michener.
1989-1991 Pre-doctoral Fellow. Department of Entomology, Smithsonian Institution.
Supervisor: Ronald J. McGinley.
1991-1992 Research Assistant, Department of Entomology, Smithsonian Institution.
Supervisor: Ronald J. McGinley.
1992 Post-doc, Department of Entomology, University of California, Riverside.
Advisor: P. Kirk Visscher
1993-1995 Post-doc, Department of Entomology, Cornell University, Ithaca, NY. Advisor:
G.C. Eickwort.
1993 Lecturer, Genome Variation Analysis Facility, Cornell University, Ithaca, NY;
Analysis of Genomic Variation (Instructor: Bernie May)

1995 Lecturer, Insect Morphology, Cornell University, Ithaca, NY
1996-2002 Assistant Professor, Cornell University, Ithaca, NY
2002-2008 Associate Professor, Cornell University, Ithaca, NY
2008- Professor, Cornell University, Ithaca, NY

PROFESSIONAL AWARDS

Cum Laude, Duke University, 1983.
Fulbright Scholarship Finalist, 1983.
H.B. Hungerford Award for an outstanding thesis, University of Kansas, 1987.
United States Department of Agriculture, Unit Award for Superior Service, 1993.
Thomas Say Award, Entomological Society of America, 2014

PROFESSIONAL ACITIVITIES (1990 to present)

A. Professional societies

American Association for the Advancement of Science
Entomological Society of America
Journal of the Kansas Entomological Society
Pan-Pacific Entomological Society
Society of Systematic Biologists
Society for the Study of Evolution
Society for Molecular Biology and Evolution

B. Professional Assignments

Reviewer for the following journals:

American Museum Novitates
American Naturalist
Animal Behaviour
Annals of the Entomological Society of America
Annals of the South African Museum
Apidologie
Behavioral Ecology
Behavioral Ecology and Sociobiology
Biological Journal of the Linnean Society
Canadian Entomologist
Canadian Journal of Zoology
Cladistics
Current Biology
Ecology
Ecological Entomology
Environmental Entomology

Entomological News
Entomological Society of Washington
Ethology
Evolutionary Biology
Gene
Heredity
Insectes Sociaux
Journal of Animal Ecology
Journal of Apicultural Research
Journal of Applied Ecology
Journal of Biogeography
Journal of Insect Behavior
Journal of the Kansas Entomological Society
Journal of Zoology
Molecular Ecology
Molecular Phylogenetics and Evolution
Oecologia
Pan-Pacific Entomologist
Proceedings Royal Society of London
Proceedings of the National Academy of Sciences (PNAS)
Science (AAAS)
Systematic Biology
Systematic Entomology
Zoologica Scripta

Grant reviewer for:

Australian National Research Council
National Geographic Society
National Science Foundation (USA)
National Sciences and Engineering Research Council (Canada)

C. Invited Lectures/Seminars

University of Illinois, Urbana-Champaign, Apr. 17, 2006
Harvard University, Cambridge, MA, Oct. 5, 2006
Dresden meeting on insect phylogeny September 21-23, 2007
International Pollination Symposium June 24-28, 2007
Evolution Joint Annual Meeting, July 1-3, 2008
XXIII International Congress of Entomology, July 6-12, 2008
Society for Integrative and Comparative Biology, January 3-7, 2009
56th Annual Systematics Symposium, Missouri Botanical Garden, October 9-11, 2009
Department of Entomology, Cornell Experiment Station, Geneva, NY, November 2, 2009
UC Davis Entomology, Davis, CA, September 20, 2012, *AThe new view of bee phylogeny@*
Rutgers University, Rutgers, NJ, November 29, 2012, *AThe new view of bee phylogeny@*

Easter Branch, Entomological Society of America, "*How molecular data have altered our understanding of bee phylogeny and evolution*", Lancaster, PA, March 16-19, 2013

Pennsylvania State University, State College, PA, February 27, 2014, *The new view of bee phylogeny*

University of Rochester, Rochester, NY, November 7, 2014, *The new view of bee phylogeny*

University of Kansas, Lawrence, KS, February 9, 2015, *The new view of bee phylogeny*

D. Invited Symposia

International IUSSI meeting; Symposium on Bee Phylogeny, Aug. 2006

Dresden meeting on insect phylogeny, 21 September 2007

ESA Symposium on fossil-calibrated phylogenies. 15 December, 2010

E. University, College, and Departmental Committees

Faculty Representative to the Career Development Office (1998-2002)

Cornell University Insect Collection Committee/Bradley Committee (1996-present)

Department of Entomology representative to the CALS Faculty Senate (1998-2000)

Chair, Department of Entomology Curriculum Committee (2005-2011)

CALS Curriculum Committee representative for Entomology (2005-2011)

Department of Entomology Graduate Admissions Committee (1998-2002)

CALS Committee on Teaching and Learning (2008-2011)

Department of Entomology Griswold Committee Chair (2011-2012)

CUIC Collections Manager Search Committee (Fall 2011)

CUIC Collections Committee (2000-present)

University Faculty Senate, Entomology representative (Fall, 2012-present)

F. Outside activities (and extension)

Research Associate, Division of Invertebrate Biology, American Museum of Natural History, Central Park west @ 79th St., New York, NY

Editor, Special Issue of *Apidologie* [vol. 39(1)], *Insights into Bee Evolution: A tribute to Charles D. Michener* (co-editor: Eduardo Almeida)

International Scientific Board of *Apidologie* (January 2012-December 2015). INRA Centre PACA/ Dept SPE, 400 route des Chappes, 06903 Sophia-Antipolis Cedex, FRANCE [http://www.apidologie.org/]

The Bee Course

"The Bee Course" has been taught annually for the past ten years and will be offered

again this year (August, 2012). The course is organized by Jerome G. Rozen, Jr. and Ronald J. McGinley and is taught at the Southwestern Research Station, Portal, AZ for ten days in August or September. The course is limited to 20 students and has been over-subscribed for the past two years. The course provides instruction in bee identification (to the generic level) for all genera collected in North and Central America (using the following text book: Michener, C.D., R.J. McGinley & B.N. Danforth.1994. The Bee Genera of North and Central America (Hymenoptera: Apoidea). Smithsonian Institution Press, Washington, DC. vii+209pp.).

More information can be obtained from the web site:

<http://research.amnh.org/invertzoo/beecourse/>

Invited public lectures

Tompkins County Beekeepers Association, 19 Nov., 2006 [Public lecture on bees]
Jupiter Island Club, West Palm Beach, FL 19 Jan., 2008 [Public lecture on bees]
Taft School, Watertown, CT 16 Nov., 2012 [Lecture to AP Biology class]
Finger Lakes Beekeeping club, 21 April, 2013 [Public lecture on apple pollination]
Tompkins County Environmental Management Council, 12 March, 2015 [Public lecture entitled
AHoney bees, colony collapse disorder, and the importance of wild bees in crop
pollination@]
Science Cabaret, 21 April, 2015 [Public lecture on the importance of wild bees for crop
pollination]

Extension talks to apple growers:

Fruit EXPO, Syracuse, NY, Jan. 22, 2014, *AHoneybees, CCD, and the importance of wild
pollinators for orchard pollination@* [extension talk]
NY State IPM advisory council meeting, Syracuse, NY, Feb. 25, 2014, *AHoneybees, CCD, and
the importance of wild pollinators for orchard pollination@* [extension talk]
Lake Ontario Winter Fruit School, Lockport, NY, Feb. 1, 2016. *APollinator Management: The
Importance of Wild Bees@*. [extension talk]
Lake Ontario Winter Fruit School, Newark, NY, Feb. 2, 2016. *APollinator Management: The
Importance of Wild Bees@*. [extension talk]
Red Tomato Annual Growers Meeting, The Henry A. Wallace Center at the FDR Presidential
Library and Home, Hyde Park, NY, March 15, 2016. *AWild pollinator diversity and
ecology in NY orchards@*. [extension talk]

Current grant funding:

USDA-AFRI grant: (\$495,925) (Feb. 1, 2011 to January 31, 2016). Title: Quantifying and
enhancing pollination services provided by native bees for sustainable apple production.

USDA-Specialty Crop Research Initiative (SCRI) grant: (\$129,488) (Jan. 2, 2012 to Dec. 31,
2016). Title: Pollination and Security for Fruit and Vegetable crops in the Northeast.
Lead PI: Anne Averill, Umass, Amherst. Cornell subcontract. \$2M grant

Apple Research and Development Program (ARDP), New York Farm and Markets grant: (\$54,686) (March 1, 2015 - Feb. 28, 2016). Title: Mason bees as pesticide biomonitors in apple orchard habitats. Co-PIs: Katja Poveda, Brian Eitzer

New York Farm Viability Institute (NYFVI): (\$100,000) (April 1, 2015 to March 31, 2017). Title: Northeast Pollinator Partnership: developing cost-effective pollinator management for New York apple growers

National Science Foundation (DEB: Systematic Biology): (\$850,500) (Jan. 5, 2016 to Jan. 4, 2019). Title: title: Phylogeny and diversification of the stinging Hymenoptera (Aculeata) using targeted enrichment of ultra-conserved elements. Lead PI: Bryan Danforth (Sean Brady, James Pitts, Robert Ross, co-PIs)

USDA Hatch grant: (\$88,500) (Oct. 1, 2015 to Sept 30, 2018). Title: The interacting effects of pesticides, pathogens, and symbionts on the squash bee: *Peponapis pruinosa*.

Pending grant funding:

USDA-AFRI Foundational Program: (\$494,829) (Jan. 1, 2015 to Dec. 31, 2018). Title: Osmia bees as bioindicators of solitary bee health in agroecosystems. Lead PI: Bryan Danforth (Katja Poveda, co-PI)

Northeast Sustainable Agriculture, Research and Extension (NE-SARE): (\$186,580) (Jan. 15, 2015 to Jan. 14, 2018). Title: Northeast Pollinator Partnership: developing cost-effective pollinator management for New York apple growers

Past grant funding (in reverse chronological order):

Atkinson Center for a Sustainable Future (Cornell University): (\$99,581) (Sept. 1, 2012 to August 31, 2013) Title: Impacts of Pathogens and Pesticides on Wild Pollinators in Eastern Apple Orchards. Collaborators: Motoko Mukai (VTPMD), Eric Nelson (PLPA), and Andre Kessler (EEB)

USDA Hatch Grant: (\$85,200) (Oct. 1, 2012 to Sept. 30 2015). Title: Pesticide and Pathogen Screening of the Alternative Pollinator *Osmia cornifrons*. Collaborators: EJ Blitzer, Shannon Hedtke.

National Science Foundation Improvements to Biological Research Collections (NSF-BRC) Program: (\$150,314) (May 1, 2010 to April 30, 2014). Title: Collaborative databasing of North American bee collections within a global informatics network. Collaborative grant with John Ascher and Jerome Rozen (AMNH) and Douglas Yanega (UC Riverside). \$3M grant

NSF (Systematics Program): (\$370,000) [DEB-0742998] (February 15, 2008 to May 31, 2013). Title: REVSYS: Phylogeny and systematics of megachilid bees. *Collaborative grant with Dr. Terry Griswold, USDA Bee Biology and Systematics Laboratory, Logan Utah*

NSF (Systematics Program): (\$393,736 + \$7,500 REU supplement) [DEB-0814544] (September 1, 2008 to August 30, 2012). Title: Phylogeny of Apidae (Hymenoptera) with an emphasis on the evolution and antiquity of eusociality

USDA Hatch Grant: (\$57,900) (Oct. 1, 2008 to Sept. 30 2011). Title: Diversity and Pollination Biology of Native and Managed Bees in Apple Orchards in New York

National Geographic Society (Fideliini) (\$10,000). (Oct. 1, 2008 to Oct. 14, 2009) Title: Phylogeny, historical biogeography, and host-plant evolution of the Fideliini (Hymenoptera: Apoidea).

NSF (Doctoral Dissertation Improvement Grant Program): (\$11,992) [DEB-0709956] (July 1, 2007 to June 30, 2008). Title: DISSERTATION RESEARCH: Evolution of cleptoparasitism in apid bees (Hymenoptera: Apidae).

NSF (Systematics Program): (\$286,681) [DEB-0412176] (September 1, 2004 to August 31, 2008). Title: Phylogeny and historical biogeography of the primitive bee family Colletidae.

NSF (Systematics Program): (\$185,745) [DEB-0211701] (July 15, 2002 to June 30, 2005) Title: Collaborative Research: Reconstructing the early evolution of the bees and the history of bee/angiosperm relationships.

Publications

Refereed publications (in reverse chronological order; n=86):

86. López-Uribe, M. J. Cane, R. Minckley, **B.N. Danforth** (2016). Crop domestication facilitated rapid geographic expansion of a specialist pollinator, the squash bee *Peponapis pruinosa*. Proc. Royal Soc. Lond. (B) [*in press*].

85. Litman, J.R., T. Griswold, **B.N. Danforth** (2016). Phylogenetic systematics and a revised generic classification of anthidiine bees (Hymenoptera: Megachilidae). Molecular Phylogenetics and Evolution 100: 183-198. [DOI: 10.1016/j.ympev.2016.03.018]

84. Blitzer, E.J., J. Gibbs, M.G. Park, **B.N. Danforth** (2016). Pollination services for apple

depend on functionally diverse wild bee communities. *Agriculture, Ecosystems, and Environment* 221: 1-7

83. Park, M.G., R.A. Raguso, J.E. Losey, **B.N. Danforth** (2016). Per-visit pollinator performance and regional importance of wild *Bombus* and *Andrena* (*Melandrena*) compared to the managed honey bee in New York apple orchards. *Apidologie* 47:145B160 [*published online 25 August 2015, 10.1007/s13592-015-0383-9*]
82. Russo, L., M.G. Park, J. Gibbs, **B.N. Danforth** (2015). The challenge of accurately documenting bee species richness in agroecosystems: bee diversity in eastern apple orchards. *Ecology and Evolution* 5(17): 3531B3540 [*published online 5 August 2015, doi: 10.1002/ece3.1582*]
81. Hedtke S.M., E.J. Blitzer, G.A. Montgomery, **B.N. Danforth** (2015). Introduction of non-native pollinators can lead to trans-continental movement of bee-associated fungi. *PLoS ONE* 10(6): e0130560 [*published online 23 June 2015, doi:10.1371/journal.pone.0130560*]
80. Kleijn, D., R. Winfree, I. Bartomeus, L. Cavalheiro, et al. (2015). Managing for pollinators or pollination: conflicts between biodiversity conservation and ecosystem service delivery. *Nature Communications* 6:7414 [*published online 16 June, 2015, DOI: 10.1038/ncomms8414*]
79. Park, M.G., E.J. Blitzer, J. Gibbs, J.E. Losey, **B.N. Danforth** (2015). Combined effect of pesticides and landscape simplification compromises wild pollinators. *Proc. Royal Soc. Lond. (B)* 282: 20150299 [*published online 3 June 2015, DOI: 10.1098/rspb.2015.0299*]
78. López-Uribe, M.M., S.J. Morreale, C.K. Santiago, **B.N. Danforth** (2015) Nest suitability, fine-scale population structure and male-mediated dispersal of a solitary ground nesting bee in an urban landscape. *PLoS ONE* 10(5): e0125719. doi:10.1371/journal.pone.0125719
77. López-Uribe, M.M., K.R. Zamudio, C.F. Cardoso and **B.N. Danforth** (2014). Climate, physiological tolerance, and sex-biased dispersal shape genetic structure of Neotropical orchid bees. *Molecular Ecology* 23(7): 1874-1890 [*published online 7 February, 2014, DOI: 10.1111/mec.12689*]
76. Bartomeus, I., M.G. Park, J. Gibbs, **B.N. Danforth**, A.N. Lakso, & R. Winfree (2013). Biodiversity as insurance against plant-pollinator phenological asynchrony. *Ecology Letters* 16:1331-1338 [*published online 23 August, 2013, doi: 10.1111/ele.12170*]
75. Hedtke, S., S. Patiny, **B.N. Danforth** (2013). Resolving the Bee Tree of Life : bioinformatic approaches to apoid phylogeny. *BMC Evolutionary Biology* 13:138 <http://www.biomedcentral.com/1471-2148/13/138>
74. Gibbs, J., L. Packer, S. Dumesh, and **B.N. Danforth** (2013). Revision and reclassification of

- Lasioglossum (Evylaeus)*, *L. (Hemihalictus)* and *L. (Sphecodogastra)* in eastern North America (Hymenoptera: Apoidea: Halictidae). *Zootaxa* 3672 (1): 1-117
73. Litman, J.R., C.J. Praz, T.L. Griswold, **B.N. Danforth**, S.C. Cardinal (2013). Origins, evolution, and diversification of cleptoparasitic lineages in long-tongued bees. *Evolution* 67(10): 2982-2998 [*published online 7 June, 2013, DOI: 10.1111/evo.12161*]
72. Cardinal, S. & **B.N. Danforth** (2013). Bees diversified in the age of eudicots. *Proc. Royal Soc. Lond (B)* 280: 1-9 [*available online 30 January, 2013*]
71. Kennedy, C.M., E. Lonsdorf, M.C. Neel, **et al.** (2013). A global quantitative synthesis of local and landscape effects on native bee pollinators in agroecosystems. *Ecology Letters* 16(5): 584-599 [*published online 11 Mar. 2013, DOI: 10.1111/ele.12082*]
70. Bartomeus, I., J.S. Ascher, J. Gibbs, **B.N. Danforth**, D.L. Wagner, S.M. Hedtke, and R. Winfree (2013). Historical changes in northeastern United States bee pollinators related to shared ecological traits. *Proc. Natl. Acad. Sci. (USA)* 110(12): 4656-4660 [*published online 4 Mar. 2013, DOI: 10.1073/pnas.1218503110*]
69. Danforth, B.N., S.C. Cardinal, C. Praz, E. Almeida, D. Michez (2013). Impact of molecular data on our understanding of bee phylogeny and evolution. *Ann. Rev. Entomology* 58: 57-78 [*http://www.annualreviews.org/toc/ento/forthcoming*]
68. López-Urbe, C.K. Santiago, S.M. Bogdanowicz, **B.N. Danforth** (2012). Discovery and characterization of microsatellites for the solitary bee *Colletes inaequalis* using Sanger and 454 pyrosequencing. *Apidologie* 44(2): 163-172. *DOI: 10.1007/s13592-012-0168-3* [*published online 26 October, 2012*]
67. Gibbs, J., S. Brady, K. Kanda, & **B.N. Danforth** (2012). Phylogeny of halictine bees supports a shared origin of eusociality for *Halictus* and *Lasioglossum* (Apoidea: Anthophila: Halictidae). *Mol. Phylogen. Evol.* 65: 926-939.
66. Debevec, A.H., S. Cardinal, & **B.N. Danforth** (2012). Identifying the sister group to the bees: a molecular phylogeny of aculeata with an emphasis on the superfamily Apoidea. *Zoologica Scripta* 41: 527-535 [*published ahead of print 14 June 2012, DOI: 10.1111/j.1463-6409.2012.00549.x*]
65. Gonzalez, V.H., T. Griswold, C.J. Praz, & **B.N. Danforth** (2012). Phylogeny of the bee family Megachilidae (Hymenoptera: Apoidea) based on adult morphology. *Systematic Entomology* 37: 261-286
64. De Meulemeester, T., D. Michez, A.M. Aytakin & **B.N. Danforth** (2012). Taxonomic affinity of halictid bee fossils (Hymenoptera: Anthophila) based on geometric morphometrics analyses of wing shape. *J. Syst. Paleo.* DOI:10.1080/14772019.2011.628701

63. Almeida, E.A.B., M.R. Pie, S.G. Brady, & **B.N. Danforth** (2012). Biogeography and diversification of colletid bees (Hymenoptera: Colletidae): emerging patterns from the southern end of the World. *J. Biogeography* 39(3): 526B544 [published ahead of print December 6, 2011, DOI: 10.1111/j.1365-2699.2011.02624.x]
62. Bartomeus, I., J.S. Ascher, D. Wagner, **B.N. Danforth**, S.R. Colla, S. Kornbluth, & R. Winfree (2011). Climate-associated phenological advances in bee pollinators and bee-pollinated plants. *Proc. Natl. Acad. Sci., USA* 108(51): 20645-20649 [published ahead of print December 5, 2011, doi:10.1073/pnas.1115559108]
61. Litman, J.R., **B.N. Danforth**, C.D. Eardley, & C.J. Praz (2011). Why do leafcutter bees cut leaves? New insights into the early evolution of bees. *Proc. Royal Society of London (B)* 278: 3593-3600
60. Cardinal, S.C. & **B.N. Danforth** (2011). The antiquity and evolutionary history of social behavior in bees. *PLoS ONE* 6(6): e21086. doi:10.1371/journal.pone.0021086.
59. Brady, S.G., J.R. Litman, & **B.N. Danforth** (2011). Rooting phylogenies using gene duplications: An empirical example from the bees (Apoidea). *Mol. Phylogen. Evol.* 60: 295B304.
58. Danforth, B.N. & G.O. Poinar (2011) Morphology, classification, and antiquity of *Melittosphex burmensis* (Apoidea: Melittosphecidae) and implications for early bee evolution. *J. Paleontology* 85(5): 882B891.
57. Martinson, V., **B.N. Danforth**, R. Minckley, O. Rueppell, S. Tingek, & N. Moran (2011). A simple and distinctive microbiota exclusively associated with honey bees and bumble bees. *Molecular Ecology*, 20: 619B628.
56. Cardinal, S., J. Straka, & **B.N. Danforth** (2010). Comprehensive phylogeny of apid bees reveals the evolutionary origins and antiquity of cleptoparasitism. *Proc. Natl. Acad. Sci. (USA)* 107(37): 16207B16211. *Open access*:
<http://www.pnas.org/content/107/37/16207.full.pdf+html?sid=5fc14c42-749f-479a-b872-8bf3344481f7>
55. Michez, D., C.D. Eardley, K. Timmermann & **B.N. Danforth** (2010). Unexpected polylecty in the bee genus *Meganomia* (Hymenoptera, Apoidea, Melittidae). *J. Kansas Entomological Society* 83(3): 221B230.
54. López-Urbe, M.M., A.N. Green, S. Ramírez, S.M. Bogdanowicz, and **B.N. Danforth** (2010). Isolation and cross-species characterization of polymorphic microsatellites for the orchid bee *Eulaema meriana* (Hymenoptera: Apidae: Euglossini). *Conservation Genet Resources* DOI 10.1007/s12686-010-9271-9
53. Bradley, T.J., Briscoe, A.D., Brady, S.G., Contreras, H.L., **Danforth, B.N.**, Dudley, R., Grimaldi, D., Harrison, J.F., Kaiser, A., Merlin, C., Reppert, S.M., Vandenbrooks, J.M.,

- and Yanoviak, S.P. (2009) Episodes in insect evolution. *Integrative and Comparative Biology* 49: 590-606
52. Michez, D., S. Patiny & **B.N. Danforth** (2009). Phylogeny of the bee family Melittidae (Hymenoptera: Anthophila) based on combined molecular and morphological data. *Syst. Entom.* 34: 574-597
51. Almeida, E.A.B. & **B.N. Danforth** (2009). Phylogeny of colletid bees (Hymenoptera: Apoidea: Colletidae) inferred from four nuclear genes. *Molecular Phylo. Evol.* 50(2): 290-309.
50. Praz, C.J., A. Muller, **B.N. Danforth**, T.L. Griswold, A. Widmer, & S. Dorn (2008). Phylogeny and biogeography of bees of the tribe Osmiini (Hymenoptera: Megachilidae). *Molecular Phylo. Evol.* 49(1): 185-197.
49. Almeida, E.A.B, L. Packer & **B.N. Danforth** (2008). Phylogeny of the Xeromelissinae (Hymenoptera: Colletidae) based upon morphology and molecules. *Apidologie* 39:75-85
48. Danforth, B.N., C. Eardley, L. Packer, K. Walker, A. Pauly, & F. Randrianambinintsoa (2008). Phylogeny of Halictidae with an emphasis on the endemic African Halictinae. *Apidologie* 39:86-101
47. Patiny, S., D. Michez, & **B.N. Danforth** (2007). Phylogenetic relationships and host-plant associations within the basal clade of Halictidae (Hymenoptera: Apoidea). *Cladistics* online: 8-Nov-2007 doi: 10.1111/j.1096-0031.2007.00182.x
46. Danforth, B.N. (2007). Bees - a primer. *Current Biology* 17(5): R156-R161.
45. Magnacca, K.N. & **B.N. Danforth** (2007) Low nuclear DNA variation supports a recent origin of Hawaiian *Hylaeus* bees (Hymenoptera: Colletidae). *Mol. Phylogenet. Evol.* 43(3): 908-915.
44. Magnacca, K.N. & **B.N. Danforth** (2006). Evolution and biogeography of native Hawaiian *Hylaeus* bees (Hymenoptera: Colletidae). *Cladistics* 22: 393-411
43. Poinar, G.O., Jr. & **B.N. Danforth** (2006). A fossil bee from Early Cretaceous Burmese amber. *Science* 314: 614.
See news story: <http://sciencenow.sciencemag.org/cgi/content/full/2006/1025/1>
42. Schwarz, M.P., M.H. Richards & **B.N. Danforth** (2006) Changing paradigms in insect social evolution: insights from halictine and allodapine bees. *Annual Review of Entomology* 52:127-150.
41. Danforth, B.N., S.D. Sipes, J. Fang, & S.G. Brady (2006). The history of early bee diversification based on five genes plus morphology. *Proc. Natl. Acad. Sci. (USA)* 103(41): 15118-15123. *Open access:*
<http://www.pnas.org/content/103/41/15118.full.pdf+html?sid=5fc14c42-749f-479a-b872->

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40. Danforth, B.N., J. Fang, & S.D. Sipes (2006). Analysis of family-level relationships in bees (Hymenoptera: Apiformes) using 28S and two previously unexplored nuclear genes: CAD and RNA polymerase II. *Mol. Phylogenet. Evol.* 39 (2): 358-372.
39. Brady, S.G., S.D. Sipes, A. Pearson, **B.N. Danforth** (2006). Recent and simultaneous origins of eusociality in halictid bees. *Proc. Royal Soc. London, Series B (Biological Sciences)* 273:1643-1649.
- See news story: <http://www.news.cornell.edu/stories/March06/social.bees.evolution.ssl.html>

Abstracts, Posters and Presented Papers (in reverse chronological order):

- Brochu, K.* & **B.N. Danforth** (2016). Microbial ecology of the bee brood cell. Entomological Society of America and International Congress of Entomology, Miami, FL (Sept 25-30, 2016)
- Centrella, M., K. Poveda, **B.N. Danforth** (2016). Landscape effects on mason bee fitness mediated by diet diversity and pesticide exposure. Entomological Society of America and International Congress of Entomology, Miami, FL (Sept 25-30, 2016)
- Grab, H., J. Brokaw, **B.N. Danforth**, J. Gibbs, A. Hutchinson, R. Isaacs, K. Poveda, M. Renauld, and G.M. Loeb (2016). Landscape simplification constrains adult body size in native bees. Entomological Society of America and International Congress of Entomology, Miami, FL (Sept 25-30, 2016)
- Brokaw, J.N., M.G. Park, **B.N. Danforth** (2016). The dirt on apple pollinators: incorporating soil survey data to predict ground-nesting bee distributions in central New York orchards. Entomological Society of America and International Congress of Entomology, Miami, FL (Sept 25-30, 2016) [poster]
- vanDyke, M. & **B.N. Danforth** (2016). The Northeast Pollinator Partnership. International Conference on Pollinator Biology, Health and Policy, Pennsylvania State University, State College, PA (July 18-20, 2016)
- Russo, L., M. Park, J. Gibbs, E.J. Blitzer, **B.N. Danforth*** (2015). A novel approach to quantifying the importance of wild bees in apple pollination. Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)
- Centrella, M.*, **B.N. Danforth**, K. Poveda, E.J. Blitzer (2015). You are what you eat: the effects of pesticides and diet diversity on mason bees in apple. Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)
- Park, M.*, N.K. Joshi, E. Rajotte, D.J. Biddinger, J. Losey, & **B.N. Danforth** (2015). A regional assessment of eastern apple grower knowledge, perceptions, and attitudes of alternative pollinators. Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)

- Branstetter, M., **B.N. Danforth**, J.P. Pitts, & S. Brady* (2015). Phylogeny of the stinging Hymenoptera (Aculeata) using targeted enrichment of ultra-conserved elements. Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)
- Connelly, H.*, N. Amon, **B.N. Danforth**, K. Poveda, & G.M. Loeb (2015). Does landscape mediate wild bee health and phylodiversity? Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)
- Brochu, K*, A. Kessler, **B.N. Danforth** (2015). Chemical and microbial ecology of the bee brood cell: insights from the hoary squash bee, *Peponapis pruinosa* (Eucerini, Apidae). Entomological Society of America, Minneapolis, MN (Nov. 15-18, 2015)
- Burand, J.P., S. Zheng, **B.N. Danforth** (2015). Virus prevalence in bee populations in apple orchards in New York, USA. Society of Invertebrate Pathology, Vancouver, BC, Canada (August 9-13, 2015).
- Branstetter, M., B. Faircloth, **B.N. Danforth**, J. Pitts, & S. Brady (2014). Ultraconserved elements provide new insights into the phylogeny and evolution of Hymenoptera. ESA meeting, Portland, OR (November 16-19, 2014)
- Park, M.G., R.A. Raguso, E.J. Blitzer, J. Gibbs, J. Losey, & **B.N. Danforth** (2014). Filling the pollination gap: Assessing the potential for wild bees to maintain adequate apple pollination as honey bee colonies decline. Ecological Society of America meeting, Sacramento CA, Aug. 10-15, 2014
- Russo, L., M.G., Park, **B.N. Danforth** (2014). Host specialization in a wild bee community: Variation in the composition of pollen collected by apple pollinators. Ecological Society of America meeting, Sacramento CA, Aug. 10-15, 2014
- Park, M.G., R. Raguso, J.E. Losey, & **B.N. Danforth**. Effectiveness and importance of wild bees for apple pollination. ESA meeting, Austin, TX (November 10-14, 2013)
- Hedtke, S., S. Patiny, & **B.N. Danforth**. The bee tree of life: Insights from a supermatrix approach to apoid phylogeny. ESA meeting, Austin, TX (November 10-14, 2013) [*Invited symposium*]
- López-Uribe, M. & **B.N. Danforth**. The successful biological invasion of the specialist bee *Peponapis pruinosa*. ESA meeting, Austin, TX (November 10-14, 2013) [*Invited symposium*]
- Park, M.G., E.J. Blitzer, J. Gibbs, J. Losey, and **B.N. Danforth**. Natural areas buffer the impact of pesticides on wild pollinators of a perennial crop, International Student Conference on Conservation Science, New York, NY (October 9-11, 2013).
- Margarita M. López-Uribe & **B.N. Danforth**. Integrative taxonomy of orchid bee species in the genus *Eulaema* (Apidae: Euglossini). VIII Congreso Mesoamericano de abejas nativas,

San José, Costa Rica (Aug 30-31, 2013).

Park, M.G., E.J. Blitzer, J. Gibbs, J. Losey, & **B.N. Danforth**. Natural areas buffer impact of pesticides on wild pollinators of a perennial crop. International Conference on Pollinator Biology, Health and Policy, State College, PA (July 11-14, 2013)

Hedtke, S.H. & **B.N. Danforth**. The pleasures and pitfalls of bee phylogenetics. Evolution meeting, Snowbird, UT (June 21-25, 2013).

Debevec, A., S.C. Cardinal, **B.N. Danforth**, & J.W. Whitfield. Investigating outgroup taxon sampling: empirical examples from Noctuoidea (Lepidoptera) and bees (Hymenoptera: Apoidea). North Central Branch ESA meeting, Rapid City, South Dakota (June 16-19, 2013).

Blitzer, E.J., M.G. Park, **B.N. Danforth**. Native and managed bees of New York apple orchards: Connecting biodiversity, pollination services, and production. Eastern Branch ESA meeting, Lancaster, PA (March 16-19, 2013).

Danforth, B.N. How molecular data have altered our understanding of bee phylogeny and evolution. Eastern Branch ESA meeting, Lancaster, PA (March 16-19, 2013). [*Invited symposium: Natural History and Diversity of Arthropods*]

Blitzer, E.J., M.G. Park, **B.N. Danforth**. Connecting native and managed pollinators to apple production in New York orchards. ESA meeting, Knoxville, TN (November 11-14, 2012). [*Invited symposium*]

Park, M.G., **B.N. Danforth**. Effects of landscape and farm management on wild pollinators of eastern apple orchards. ESA meeting, Knoxville, TN (November 11-14, 2012).

Soro A, M. Bönn, **B.N. Danforth**, J. Field, I. Grosse, I. Lemnian, M. Lopez-Urbe, R.J. Paxton. The genetic basis of the solitary-eusocial transition in a socially polymorphic sweat bee. 5th European Conference of Apidology, Halle an der Saale, Germany (September 3-7, 2012).

Gibbs, J., Brady, S., Kanda, K., and **Danforth, B.N.** Phylogeny and social evolution of the Halictidae. International Congress of Entomology, Daegu, South Korea (August 24, 2012). [*Invited speaker*]

Hedtke, S., S. Patiny, S., **B.N. Danforth**. A supermatrix approach to resolving bee family-level phylogeny. X Encontro Sobre Abelhas, Ribeirão Preto, Brazil (July 25-28, 2012). [*Invited speaker*]

López-Urbe, C.K. & **B.N. Danforth**. Genetic diversity and population declines in solitary bees: Is there a pattern? X Encontro Sobre Abelhas, Ribeirão Preto, Brazil (July 25-28, 2012). [*Invited speaker*]

- López-Urbe, C.K., K. Zamudio, C. Cardoso, & **B.N. Danforth**. Assessing the impact of climatic changes on neotropical pollinators: Comparative multi-locus phylogeography of three orchid bee species. X Encontro Sobre Abelhas, Ribeirão Preto, Brazil (July 25-28, 2012). [*Invited speaker*]
- Debevec, A., S. Cardinal, B.N. Danforth. Identifying the sister group to the bees: a molecular phylogeny of Aculeata with an emphasis on Apoidea. Evolution meeting, Ottawa, Ontario (July 6-10, 2012)
- Cardinal, S. & B.N. Danforth. Dating the antiquity of bees (poster). Evolution meeting, Ottawa, Ontario (July 6-10, 2012)
- Blitzer, E.J., M.G. Park, **B.N. Danforth**. Are New York apples pollen limited? ESA meeting, Reno, NV (November 13-16, 2011).
- Danforth, B.N. M.G. Park, E.J. Blitzer, J. Gibbs, M. Orr. Patterns of bee biodiversity across commercial New York apple orchards. ESA meeting, Reno, NV (November 13-16, 2011).
- Bartolomeus, I., R. Winfree, J.S. Ascher, S.R. Colla, D.L. Wagner, **B.N. Danforth**, S. Kornbluth. Climate-associated phenological advances in bee pollinators and bee-pollinated plants. ESA meeting, Reno, NV (November 13-16, 2011).
- Gibbs, J., S. Brady, K. Kanda, M. López-Urbe, S. Cardinal, & **B.N. Danforth**. Phylogeny and social evolution of the bee-tribe Halictini (Hymenoptera: Halictidae). ESA meeting, Reno, NV (November 13-16, 2011).
- Park, M.G., J.E. Losey, & **B.N. Danforth**. Importance of wild bees in apple pollination. Ecological Society of America Annual Meeting, Austin, TX (August 8, 2011).
- Park, M.G., J.E. Losey, & **B.N. Danforth**. Per-visit effectiveness of native bees in apple pollination. ESA meeting, San Diego, CA (December 13-16, 2010).
- Litman, J.R., C. Praz, & **B.N. Danforth**. Phylogeny and relaxed-clock dating of the bee family Megachilidae. ESA meeting, San Diego, CA (December 12-15, 2010). [*Invited speaker*]
- Cardinal, S.C. & **B.N. Danforth**. Dating the antiquity of bees using multiple nuclear genes and relaxed-clock methods. ESA meeting, San Diego, CA (December 12-15, 2010). [*Invited speaker*]
- Park, M.G., J.E. Losey, & **B.N. Danforth**. Discovering New York's Forgotten Apple Pollinators. Student Conference on Conservation Science, New York, NY (November 3, 2010)
- Minckley, R.M. & **B.N. Danforth**. The impact of ecological and historical factors on patterns of bee diversity. ESA meeting, Indianapolis, IN (December 13-16, 2009)

- Park, M.G., J.E. Losey, & **B.N. Danforth**. Per-visit effectiveness of native bees in apple pollination. International Conference on Pollinator Biology, Health and Policy, State College, PA (July 11, 2010).
- Cardinal, S.C. & **B.N. Danforth**. Phylogeny and temporal diversification of bees & some implications for plants. 56th Annual Systematics Symposium, Missouri Botanical Garden, St. Louis, MO (October 9-11, 2009) [*Invited speaker*]
- Brady, S.G., P. S. Ward, B. L. Fisher, T. R. Schultz, & **B. N. Danforth**. Integrating fossils and phylogeny in ants and bees. Entomological Society of America, Eastern Branch Annual Meeting, Harrisburg, PA (March 20-23, 2009). [*Invited speaker*]
- Brady, S.G. & **B.N. Danforth**. Evolution of eusociality in insects: comparison of origins and losses in ants and bees. Society for Integrative and Comparative Biology, Boston, MA (January 3-7, 2009). [*Invited speaker*]
- Cardinal, S., J. Straka, and **B.N. Danforth**. Evolution of cleptoparasitism, eusocial behavior and shifts in diversification rates in apid bees (Hymenoptera: Apidae). Evolution Joint Annual Meeting, University of Minnesota, Minneapolis, Minnesota (July 1-3, 2008)
- Cardinal, S., J. Straka, and **B.N. Danforth**. Evolution of cleptoparasitism and social behavior in apid bees. XXIII International Congress of Entomology, Durban, South Africa (July 6-12, 2008) [*Invited speaker*]
- Cardinal, S., A. Kawakita, and **B.N. Danforth**. Phylogeny and antiquity of the bees based on combined molecular, morphological and paleontological datasets. XXIII International Congress of Entomology, Durban, South Africa (July 6-12, 2008) [*Invited speaker*]
- Brady, S.G. & **B.N. Danforth**. Reconstructing social evolution in halictine bees. International Congress of Entomology, Durban, South Africa (July 6-12, 2008). [*Invited speaker*]
- Danforth, B.N., S. Sipes, & S. Brady. Phylogeny of the bees based on single-copy nuclear gene data provides new insights into early bee diversification. Dresden meeting on insect phylogeny (September 21-23, 2007; <http://www.snsd.de/insectphyl2005/>). [*invited presentation*].
- Danforth, B.N., S. Sipes, S. Patiny & D. Michez. Phylogenetic studies of bees provide insights into the evolution of host-plant specialization and evolution. International Pollination Symposium (June 24-28, 2007; <http://www.uca.iastate.edu/mnet/plantbee/home.html>) [*invited presentation*].
- Danforth, B.N., S. Sipes, S. Cardinal, & S. Brady (poster). A phylogeny of the bees based on nuclear genes provides insights into the evolution and antiquity of eusociality in Apidae. Cold Spring Harbor Workshop on Honeybee Genomics and Biology, May 6-8, 2007; <http://meetings.cshl.edu/meetings/honeyb07.shtml>)

Danforth, B.N. & S. Brady. Evolution of sociality in halictine bees. International Union for the Study of Social Insects, Washington, DC (July 31-Aug. 4, 2006). [*Symposium organizer*]

Almeida, E.A.B. & **B.N. Danforth** (2006). Systematics, evolution, and historical biogeography of the bee family Colletidae (Hymenoptera: Apoidea). VII Encontro Sobre Abelhas, Ribeirao Preto, Brazil (12 July, 2006).

Letters:

Danforth, B.N. (2013). Social insects: Are ants just wingless bees? *Current Biology* 23(22): R1011-R1012.

Book chapters (in reverse chronological order):

Brady, S.G., L. Larkin & B.N. Danforth (2009). Bees, ants and stinging wasps (Aculeata). Pp. 264-269 in *The Timetree of Life*, S.B. Hedges and S. Kumar, eds. (Oxford University Press, 2009).

Extension publications and web sites:

Park, M.G., M.C. Orr, & **B.N. Danforth** (2010). The role of native bees in apple pollination. *New York State Fruit Quarterly* 18(1): 21-25.

Park, M., **B.N. Danforth**, J. Losey, D. Biddinger, Mace Vaughan, J. Dollar, E. Rajotte, & A. Agnello (2012). Wild Pollinators of Eastern Apple Orchards and How to Conserve Them. Cornell University, Penn State University, and The Xerces Society. URL: <http://www.northeastipm.org/park2012>

Danforth, B.N. & Maria van Dyke (2015). The wild bees of New York: our insurance policy against honey bee decline. *New York Fruit Quarterly* 23(4): 17-22.

Mentoring:

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Current:

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Mary Centrella
Silas Bossert

Past:

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Undergraduate students

Undergraduate research students:

Current:

Nolan Amon (Entomology, 2015)
Peter Lannoo (Biology, 2017)
Erin Krichilsky (Entomology, 2017)

Past:

Alex Swanson (Biology, 2006[1 years])
Allison Meisner (Entomology, 2006[1 years])
Kojun Kanda (Entomology, 2007[2 years])
Neha Botapati (Biology, 2009[1 semester])
Chris Castorena (Engineering, 2009 [1 semester])
Michael Orr (Entomology, 2009 [2 years])
Andrew Debevec (Entomology, 2011 [2 years; Hughes Undergraduate Research Scholars Program])
Jamer Bellis (Biology, 2011[1 semester])
Yang Zhang (Biology, 2011 [1 year])
Lori Moshmann (Plant Biology, 2012 [4 years])
Kyle Rossner (Continuing Education, 2012 [1 year])
Isa Betancourt (Entomology, 2013 [1 year])
Patrick Brown (Entomology, 2013 [1 year])
Christine Santiago (Human Ecology, 2013 [3 years; Undergraduate Minority Student Fellowship])
Michelle Jennifer Rogals (Biology, 2014 [1 year])
Corey Jack Keane (Biology, 2014 [1 year])
Christina Harden (Biology, 2015 [1 year])
Julia Brokaw (Natural Resources, 2013 [3 year])
Graham Montgomery (Entomology, 2015 [2 years])

Undergraduate advisees:

Phil Torres (Entomology; 2008)
Taro Eldredge (Entomology; 2009)
Keith Ciccaglione (Entomology; 2011)
Lori Moshmann (Entomology; 2012)
Patrick Brown (Entomology; 2013)
Dan Pearlstein (Entomology; 2013)
Leah Buchmann (Entomology; 2016)

Clifton Stacy (Entomology; 2017)

Undergraduate publications (2006 to present):

Papers with undergraduate co-authors (in **bold**) are listed below.

Danforth, B.N., S.G. Brady, S.D. Sipes & **A. Pearson** (2004). Single copy nuclear genes recover Cretaceous age divergences in bees. *Syst. Biol.* 53(2): 309-326.

Brady, S.G., S.D. Sipes, **A. Pearson**, B.N. Danforth (2006). Recent and simultaneous origins of eusociality in halictid bees. *Proc. Royal Soc. London, Series B (Biological Sciences)* 273:1643-1649.

Debevec, A.H., S. Cardinal, & B.N. Danforth (2012). Identifying the sister group to the bees: a molecular phylogeny of aculeata with an emphasis on the superfamily Apoidea. *Zoologica Scripta* [*published ahead of print 14 June 2012, DOI: 10.1111/j.1463-6409.2012.00549.x*]

Gibbs, J., S. Brady, **K. Kanda**, & B.N. Danforth (2012). Phylogeny of halictine bees supports a shared origin of eusociality for *Halictus* and *Lasioglossum* (Apoidea: Anthophila: Halictidae). *Mol. Phylogen. Evol.* 65: 926-939.

López-Uribe, **C.K. Santiago**, S.M. Bogdanowicz, B.N. Danforth (2012). Discovery and characterization of microsatellites for the solitary bee *Colletes inaequalis* using Sanger and 454 pyrosequencing. *Apidologie* 44(2): 163-172.

Hedtke S.M., E.J. Blitzer, **G.A. Montgomery**, B.N. Danforth (2015). Introduction of non-native pollinators can lead to trans-continental movement of bee-associated fungi. *PLoS ONE* 10(6): e0130560

Teaching

a. Accomplishments

Over the past fourteen years I have taught 19 courses (Entom 2010 [*Alien Empire: Bizarre Biology of Bugs*], Entom 3220 [*Insect Comparative Morphology*], Entom. 3310/3311 [*Insect Phylogeny and Evolution*], and Entom. 6350 [*Insect Molecular Systematics*] to a total of 863 students. Course evaluations for all these classes were high (4.0 or above on most questions; see attached course evaluations, below).

Entom. 2010/2011 is an elective, non-majors class that is meant to introduce undergraduate students to the bizarre and fascinating world of insects. This course emphasizes insect evolution, behavior, natural history, and ecology, but also covers topics related to the interaction between humans and insects. I have worked very hard in *Alien Empire* to captivate the students with the bizarre and interesting lives of insects. I make heavy use of color

photographs to illustrate the diversity of insect form and anatomy. I use audio recordings to introduce students to the world of insect acoustic communication. I place short films (~5 mins.) throughout the lectures to show live insects in action. I also try to keep things entertaining with occasional segments from popular movies such as *A Joe's Apartment* and *A Bugs Life*. In 2004 I developed a stand alone website for the course:

<http://instruct1.cit.cornell.edu/courses/ent201/index.html>

The website provides an overview of the course as well as course materials. I use the website to post handouts (as downloadable pdf files), Powerpoint presentations (as downloadable pdf files), movie clips, reading assignments, term paper guidelines, and popular articles on insects.

Alien Empire is one of my favorite courses to teach and I think the students react well to my enthusiasm. I have been told by some students that Entom 2010/2011 is the best course they have had at Cornell. Other student comments included: AI have never had a more enthusiastic instructor since I have been at Cornell, @ ABryan is an enthusiastic teacher -- he loves the subject and transferred this excitement well, @ AI really enjoyed this class... Bugs are really neat! @, AI loved this course and would recommend it to all my friends. @

Entom 3310/3311 is a graduate/undergraduate level course in insect phylogeny and evolution. I taught this class for the first time in Spring, 2007 and am currently teaching it in Fall, 2011. This course provides students with a broad overview of insect diversity, phylogeny, evolution and fossil history. This is an important course for our undergraduate and graduate program because insects are one of the largest and most diverse groups of organisms on the planet. Phylogeny provides the comparative and evolutionary framework for investigating insect biology and this course strives to develop a solid understanding of both the methods we use to reconstruct phylogeny as well as our current estimate of insect evolutionary relationships. I emphasize that phylogenies are hypotheses that are constantly changing as new data and new methods are applied. The course also investigates how phylogenies can be used to investigate evolutionary questions, such as host-plant evolution, co-evolution of hosts and symbionts, and the evolution of eusociality. Students give presentations at the end of the semester on independent research they have done on one group of insects. The laboratory portion of the course (Entom. 3311; 1 credit) involves field collections and identification to the family level.

I have also taught other courses at Cornell. Two courses (Entom 3220, *Insect Comparative Morphology* and Entom 6350, *Insect Molecular Systematics*) are no longer offered.

c. Course descriptions:

ENTOM 2010 - Alien Empire: Bizarre Biology of Bugs
Spring. 2 credits. S-U or letter grade option. B.N. Danforth

Insects are the most abundant and diverse animals on earth. This course explores the bizarre biology of insects and their interaction with humans. It examines both the detrimental roles insects play (e.g., pests and vectors of disease) as well as their beneficial roles (e.g., pollination,

edible insects, insect products such as waxes, dyes, and silk). The course also explores the symbolic representation of insects in art, literature, and religion.

ENTOM 2011 - Alien Empire: Bizarre Biology of Bugs

Spring. 3 credits. S-U or letter grade option. B.N. Danforth

Insects are the most abundant and diverse animals on earth. This course explores the bizarre biology of insects and their interaction with humans. It examines both the detrimental roles insects play (e.g., pests and vectors of disease) as well as their beneficial roles (e.g., pollination, edible insects, insect products such as waxes, dyes, and silk). The course also explores the symbolic representation of insects in art, literature, and religion. Students taking the course for 3 credits meet once per week for small group discussions, debates, demonstrations, and documentary films on the biology of insects.

ENTOM 3220 Comparative Insect Morphology [NO LONGER OFFERED]

Spring. 4 credits. Prerequisite: ENTOM 2120 or 2410. Lec, lab. B.N. Danforth.

Provides a detailed introduction to the external and internal anatomy of insects. Lectures introduce basic concepts in insect morphology, such as the organization of the insect body plan and organ systems, functional morphology, homology, phylogeny, modularity, and development. The lab introduces students to the basic methods of insect microdissection, specimen preparation, and scientific illustration. High-quality, publishable illustrations are produced based on student artwork.

ENTOM 3310 - Insect Diversity and Evolution

Fall. 3 credits. Prerequisite: ENTOM 2120. Co-requisite: ENTOM 3311. Offered alternate years. B. N. Danforth.

Insects are the dominant terrestrial organisms on planet earth both in terms of the number of species as well as in biomass. This course will provide a detailed look at insect diversity, phylogeny, natural history, and the insect fossil record. We will examine what is known about insect higher level relationships based on morphology and DNA sequence data and explore how phylogenies can be used to examine the evolution of behavior, life history, ecology, and natural history. Students will come away from the class with a deeper understanding of insect biodiversity, evolution, natural history, and phylogeny.

ENTOM 3311 - Insect Diversity and Evolution Laboratory

Fall. (Offered alternate years) 1 credit. Prerequisite: ENTOM 2120. Co-requisite: ENTOM 3310. Course fee: Lab fee \$40. B.N. Danforth.

This laboratory will introduce students to the diversity of insects and their identification. Collections will be made in the early part of the semester. Labs will introduce students to insect collecting techniques and insect identification to the family level. Optional weekend field trips to natural areas will take place early in the semester. Entomology undergraduates wishing to count Insect Phylogeny and Evolution toward their Group A requirement should take the laboratory as well as the lecture for a total of 4 credits.

ENTOM 3340 - Tropical Field Entomology

Winter. 4 credits. Prerequisite: ENTOM 2120 or BIOEE 1610.

This course will give students hands-on exposure to insect biodiversity, ecology, and behavior in a neotropical rainforest environment. Students will gain experience in insect sampling and survey methods, insect identification to the family level, insect natural history, experimental design and data collection in a field setting, basic statistics, interpretation and evaluation of scientific literature, and scientific writing. Course takes place over a two-week period for approximately 12 hr/day. The course takes place at the La Selva Field Station in Costa Rica from January 4-18, 2015. Applications are due to Professor Danforth by October 1, 2014.

ENTOM 4610 - Model-Based Phylogenetics and Hypothesis Testing

Spring. 3 credits. Prerequisite: BIOEE 1780 or BIOMG 2800 or equivalent, or permission of instructor.

E. Murray, B. Danforth

A variety of disciplines in biological research address questions that rely on a phylogenetic framework for hypothesis-testing, including the fields of ecology, epidemiology, behavior, physiology, evolution, and genomics. This course will provide an advanced undergraduate/graduate level introduction to model-based methods of phylogenetic analysis including maximum likelihood and Bayesian methods. The emphasis will be on DNA sequence data and issues associated with reconstructing phylogenetic trees from multiple gene loci. In addition, the course will cover how phylogenies can be used in the context of evolutionary hypothesis testing (including fossil-calibrated phylogenies, character mapping, ancestral state reconstruction, community ecology, and historical biogeography) using rigorous statistical methods. The course will include a computer laboratory for performing analyses using real data sets. Beginning skills in R programming will be introduced, and students will build an independent dataset to analyze using the techniques introduced in class.

ENTOM 6350 - Insect Molecular Systematics [NO LONGER OFFERED]

Spring. 2 credits. Prerequisite: permission of instructor. B.N. Danforth

Analysis of DNA sequence variation can provide a powerful tool for resolving problems in insect systematics, from species-level taxonomic decisions to higher-level (ordinal) relationships. This course introduces students, through readings of the primary literature, to the basic methods of insect molecular systematics, including DNA extraction, gel electrophoresis, PCR, DNA purification, and DNA sequencing (manual and automated). Results are analyzed using available computer programs. Students are encouraged to collect preliminary data for thesis or post-doctoral research.

d. Student Evaluations

I have summarized the student evaluations over the past 11 semesters in the spreadsheet on the following page and have provided the most recent course evaluations for two classes: Entom 2010/2011, *Alien Empire, Spring 2011* and Entom 3310/3311, *Insect Phylogeny and Evolution, Fall 2009*. Overall, my teaching evaluations are good. Out of a total of 5 points, the students evaluated my overall teaching between 4.06 and 4.86. Similarly, the courses I have taught are ranked between 3.96 and 4.86. Entom 2010/2011 (*Alien Empire: Bizarre Biology of Bugs*) has the largest enrollment of undergraduate students (between 60 and 140 students since inception) and the students ranked this class between 4.1 and 4.48 over the past four offerings. The graduate-level courses (Entom 3220, 3310/3311, and 6350) have similarly high ratings. My teaching skills receive some of the highest scores: between 4.31 and 4.75. There do not appear to be obvious changes in the ratings my classes receive over time.

Recent student evaluations of Entom 2010/2011, *Alien Empire, Spring 2011* were overall extremely positive. Students gave the course an overall rating of 4.34 and scored my teaching skills as 4.69. One student commented: A Danforth was AWESOME! Unbelievably caring, nice, and a great teacher. By far one of the best professors I've had at Cornell. The class was incredibly enjoyable, and I'd recommend it to anyone. His organization (i.e. the website) was great, and truly wanted us to learn. A+ Another student commented: AI really loved this class. I wish I had time to take more entomology courses because they are so interesting, but it will probably be a while before I can if I ever can. This is a good course for anyone, no matter their interest. Professor Danforth is also a really effective lecturer and I never had trouble paying attention, which has been the case in some of my other classes. @

Recent student evaluations of Entom 3310/3311, *Insect Phylogeny and Evolution, Fall 2011* were very high. The course was given an overall rating of 4.75 and my teaching skills were rated 4.75. Recent student comments included: A Professor Danforth was particularly good at explaining methodology, and treating it as a variable tool which must be considered along with results. His explanation of molecular phylogenetic modeling and analysis was the most clear and easiest to grasp of many that I have been exposed to. @ and AI loved the lecture course!

Extension

I do not have a formal extension appointment at Cornell, but I am a strong believer that scientific results, including studies of biodiversity, phylogeny, and pollination ecology, be made readily accessible to the general public. As part of our USDA-funded apple pollination project (see Research section), we are making a serious effort to disseminate our findings to the apple

growers, orchard managers and anyone who can make effective use of our findings. We do this in a number of ways. First, a number of people in my lab (Mia Park, EJ Blitzer, Laura Russo myself) have given extension talks at regional meetings of New York apple growers. We have developed recommendations for managing and maintaining native bee diversity in and around apple orchards in central NY. We have also recently published one extension publication (Park, M.G., et al. 2010) and one extension booklet based on funding from the Northeast IPM program (Park, M.G., et al. 2012)

My lab is also heavily involved in the annual open house sponsored by the Department of Entomology at Cornell. This one-day event (Insectapalooza!) attracts over 3000 visitors to our department every fall semester. My lab presents displays and posters about bee biodiversity, bee biology and ecology, and the importance of conserving native pollinators. We have developed a powerpoint template that allows anyone in my lab to develop a high-quality, professional-style display on any topic. Our displays include photos, text, pinned insects, and other biological specimens relevant to the topic (see figure at right). We have prepared over 12 such displays over the past three years.

Finally, I have been involved with a local elementary school (Cayuga Heights Elementary) in developing a 5th grade project on the biology of mason bees. This project was initially developed in 2010 with the help of a fifth grade teacher, Connie Patterson. The program is now run every year by Cayuga Heights instructors.

Park, M.G., M.C. Orr, & **B.N. Danforth** (2010). The role of native bees in apple pollination. *New York State Fruit Quarterly* 18(1): 21-25.

Park, M.G., **B.N. Danforth**, J. Losey, D. Biddinger, Mace Vaughan, J. Dollar, E. Rajotte, & A. Agnello (2012). *Wild Pollinators of Eastern Apple Orchards and How to Conserve Them*. Cornell University, Penn State University, and The Xerces Society. URL: <http://www.northeastipm.org/park2012>