

Jonathan Z. Shik

Postdoctoral Fellow

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EDUCATION

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| 2004-2010 | Ph. D., University of Oklahoma, Graduate Program in Ecology and Evolutionary Biology
Advisor: Dr. Michael Kaspari
Dissertation: The ecological importance of ant colony size |
| 2001-2003 | B.Sc., McGill University, Biology
Advisor: Dr. Martin Lechowicz
Thesis: The effects of human activity on the ants of a biosphere reserve |
| 1999-2001 | Cornell College (<i>transferred to McGill</i>)
Advisor: Dr. Marty Condon |

PROFESSIONAL APPOINTMENTS

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| 2016-2017 | Postdoctoral Researcher, Centre for Social Evolution, University of Copenhagen |
| 2014-2016 | Marie Curie Postdoctoral Fellow, Centre for Social Evolution, University of Copenhagen,
advisor: Jacobus Boomsma |
| 2013-2014 | Postdoctoral Fellow, Smithsonian Tropical Research Institute, advisor: Bill Wcislo |
| 2011-2013 | Postdoctoral Research Associate, Department of Entomology, North Carolina State
University, advisor: Jules Silverman |
| 2010 | Research Associate, NSF research: The stoichiometry of brown food webs, advisors: Michael
Kaspari and Adam Kay |
| 2009 | Research Fellow: Alumni Fellowship, University of Oklahoma |

PUBLICATIONS, PRESENTATIONS, AND MANUSCRIPTS

Publications Accepted to Refereed Journals:

20. Shik, J.Z., Gomez E.B., Kooij P.W., Santos, J.C., Wcislo W.T., Boomsma, J.J. (2016) Nutrition mediates the expression of cultivar-farmer conflict in a fungus-growing ant. *Proceedings of the National Academy of Sciences, USA*, 113:10121-10126.
19. Guenard, B.*, Shik, J.Z.*, Boohar, D., Lubertazzi D., Alpert G. (2016) Extreme polygyny in the previously unstudied subtropical ant *Temnothorax tuscaloosae* (Hymenoptera: Formicidae), with implications for the biogeographic study of the evolution of polygyny. *Insectes Sociaux*, doi: 10.1007/s00040-016-0498-7.
*Authors contributed equally to the study
18. Rytter, W.[^], Shik, J.Z. (2016) Liquid foraging behavior in leafcutting ants: The lunchbox hypothesis. *Animal Behaviour*, 117:179-186.
[^]Supervised masters student
17. Shik, J.Z., Schal C., Silverman, J. (2014) Diet specialization in an extreme omnivore: nutritional regulation in glucose averse cockroaches. *Journal of Evolutionary Biology*, 27:2096-2105.
16. Shik, J.Z., Kay, A., Silverman J (2014) Aphid honeydew provides a nutritionally balanced resource for incipient Argentine ant mutualists. *Animal Behaviour*, 95:33-39.
15. Shik, J.Z., Santos, J.C., Seal, J.N., Kay A., Mueller, U.G., Kaspari, M. (2014) Metabolism and the rise of fungus cultivation by ants. *American Naturalist*, 184:364-373.

14. *Shik, J.Z., Donoso, D.D., Kaspari, M. (2013) The life history continuum hypothesis links traits of male ants with life outside the nest. *Entomologia Experimentalis et Applicata*, 149:99-109.
* invited review paper
13. Bednar, D., Shik, J.Z., Silverman, J. (2013) Prey handling performance facilitates behavioral dominance of an invasive over a native keystone ant. *Behavioral Ecology*, 24:1312-1319.
12. Shik, J.Z., Silverman, J. (2013) Towards a nutritional ecology of invasive establishment: aphid mutualists provide better fuel for incipient Argentine ant colonies than insect prey. *Biological Invasions*, 15:829-836.
11. Shik, J.Z., Flatt, D.^Δ, Kay, A.D., Kaspari, M. (2012) A life history continuum in the males of a Neotropical ant assemblage: refuting the sperm vessel hypothesis. *Naturwissenschaften*, 99: 191-197.
^Δ mentored undergraduate
10. Shik, J.Z., Hou, C., Kay, A., Kaspari, M., Gillooly, J.F. (2012) Toward a general life history model of the superorganism: predicting the survival, growth, and reproduction of ant societies. *Biology Letters*, 8:1059-1062.
9. Spicer Rice, E., Shik, J.Z., Silverman, J. (2012) Effect of scattered and discrete hydramethylnon bait placement on the Asian needle ant, *Pachycondyla chinensis* Emery. *Economic Entomology*, 105:1751-1757.
8. Kay, A.D., Shik, J.Z., Van Alst, A., Kaspari, M. (2012) Diet composition does not affect ant colony tempo. *Functional Ecology*, 26:317-323.
7. Shik, J.Z., Kaspari, M., Yanoviak, S. (2011) Preliminary assessment of metabolic costs of the nematode *Myrmeconema neotropicum* on its host, the tropical ant *Cephalotes atratus*. *Journal of Parasitology*, 97:958-959.
6. Shik, J.Z. (2010) The metabolic costs of building ant colonies from variably sized subunits. *Behavioral Ecology and Sociobiology*, 64: 1981-1990.
5. Kaspari, M., Stevenson, B., Shik, J.Z., Kerekes, J. (2010) Scaling biodiversity: how bacteria, fungi, and ant communities respond to the same tropical landscape. *Ecology*, 91:2221-2226.
4. Shik, J.Z., Kaspari, M. (2010) More food, less habitat: how necromass and leaf litter decomposition combine to regulate a litter ant community. *Ecological Entomology*, 35:158-165.
3. Shik, J.Z., Kaspari, M. (2009) Male lifespan in ants linked to mating systems. *Insectes Sociaux*, 52: 131-134.
2. Shik, J.Z. (2008) Ant colony size and the scaling of reproductive effort. *Functional Ecology*, 22: 674-681.
1. Shik, J.Z., Francoeur, A., Buddle, C.M. (2005) The effect of human activity on ant species (Hymenoptera: Formicidae) richness at the Mont St. Hilaire Biosphere Reserve, Quebec. *The Canadian Field Naturalist*, 118:38-42.

Manuscripts in Review:

Shik, J.Z., Consilio, A.^Δ, Kaae, T.^Δ, Adams, R.M.M. (*Ecological Entomology*) Farming ants nutritionally manage fungal mutualists and social parasites.

^ΔSupervised masters/bachelors students

Other Publications in Refereed Journals:

Shik, J.Z., Nichols, L.M., Lucky, A., Hoefnagels, M.H. (2013) Ants as model organisms to study species coexistence. Proceedings of the 34th Workshop Conference of the Association for Biology Laboratory Education, 34:233-239.

Manuscripts In Preparation:

- Shik, J.Z., Rytter, W., Michelsen, A. (*In preparation for Proceedings of the Royal Society B*) Tracing the flow of nutrients through the complex symbiotic network of the leafcutter ant *Atta colombica* using stable isotopes.
- Shik, J.Z., Gomez E.B., Kooij P.W., Santos, J.C., Wcislo W.T., Boomsma, J.J. (*In preparation for Nature Ecology & Evolution*) Nutrition and the rise of fungus farming in ants.
- Shik, J.Z., Boomsma, J.J., Baer, B. (*In preparation for Functional Ecology*) Physiological costs of sperm storage in living sperm banks, leafcutter ant queens.

GRANTS AND AWARDS

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| 2017 | European Research Council Starting Grant, €1.5 million
Finalist, for CNRS position at Pierre and Marie Curie University (Paris) |
| 2014 | BIO Incentive grant to support international PhD course (Faculty of Science, U. Copenhagen – together with Rachele Adams and Koos Boomsma), €9,000 |
| 2013 | Marie Curie International Incoming Postdoctoral Fellowship, €240,000 |
| 2012 | Smithsonian Tropical Research Institute, Postdoctoral Fellowship, €55,000 |
| 2011 | Association for Biology Lab Instructors Conference, Major Workshop, €170 honorarium
National Inst. for Mathematical and Biological Synthesis, short term research grant: €1700 |
| 2004-2010 | Alumni Fellowship from the Graduate College at the University of Oklahoma: €22,000
Graduate Research Supplemental Stipend, U. Oklahoma, Dept. Zoology: €2,200 |
| 2009 | University of Oklahoma Biostation, summer research grant: €2,200 |
| 2008 | NSF teaching grant to redesign introductory zoology: €1,400
Adams Summer Research Fellowship: €2,200
Gordon Research Conference on the Metabolic Basis of Ecology: Competitive stipend for delivering invited seminar: €1,400 |
| 2007 | Graduate Student Senate Research Stipend: €400
Adams Summer Research Fellowship: €2,200 |
| 2006 | Adams Summer Research Fellowship: €2,200 |
| 2005 | Adams Summer Research Fellowship: €2,200
Smithsonian Tropical Research Institute, Short Term Fellowship: €2,200
Honorable Mention: NSF Graduate Research Fellowship |

Presentations for Professional Meetings:

- Kooij, P.W., Gaya, E., Shik, J.Z., Dentinger, B.T.M. (2016) On the origin of mutualisms: where did fungus farming in ants begin? European Society of Evolutionary Biology, Groningen, The Netherlands, 2017.
- Kooij, P.W., Gaya, E., Shik, J.Z., Dentinger, B.T.M. (2016) On the origin of mutualisms. 8th Brazilian Congress for Mycology, Florianopolis, Brazil, 2016.
- Shik, J.Z., Wcislo, W. T., Boomsma, J.J. Nutrition mediates the expression of cultivar-farmer conflict in a fungus-growing ant. IUSSE Europe, Helsinki, Finland, 2016.
- Rytter, W., Michelsen, A., Shik, J.Z. Tracing the flow of nutrients through the complex symbiotic network of the leafcutter ant *Atta colombica* using stable isotopes. IUSSE Europe, Helsinki, Finland, 2016.
- Rytter, W., Shik, J.Z. The leafcutter lunchbox: linking digestive physiology and foraging behavior of four Panamanian leafcutter ant species. Oikos, Turku, Finland, 2016
- Shik, J.Z., Wcislo, W. T., Boomsma, J.J. Transitions in farming performance across the attine phylogeny. Oikos, Turku, Finland, 2016.
- Shik, J.Z., Wcislo, W. T., Boomsma, J.J. Physiological consequences of social transitions in ants. International Congress of Entomology, Orlando, Florida, 2016.

- Shik, J.Z., Gomez, E., Wcislo, W.T., Boomsma, J.J. Nutrition mediates cultivar-farmer conflict in a primitive fungus-growing ant. European Society for Evolutionary Biology, Lausanne, 2015.
- Wall, B.M., Jones, T.H., Shik, J.Z., Adams, R.M.M. Evolution of alarm signals: a comparative study of exocrine gland chemistry in attine ants with a special focus on alarm pheromones. International Society of Chemical Ecology, Stockholm, 2015.
- Shik, J.Z. Nutritional adaptations in the cultivars grown by fungus-growing ants. Plant-Insect-Microbe Interactions Symposium. University of Copenhagen, Denmark, 2015.
- Kooij, P.W., Shik, J.Z., Gomez, E., Wcislo, W., Boomsma, J.J. Fast-growing fungal crops grown by the ant *Trachymyrmex cornetzi* appear more resistant to the fungal pathogen *Escovopsis*. Northwest European Society for the Study of Social Insects, London, 2014.
- Shik, J.Z. Physiological transitions in farming ants. In the symposium: Nutrition: Behavior and Life History, International Society for Behavioral Ecology, New York, 2014.
- Shik, J.Z., Gomez, E., Santos, J.C., Kaspari, M., Boomsma, J.J., Wcislo, W.T. Physiology and the transition from hunting to farming in ants. International Union for the Study of Social Insects, Cairnes, Australia, 2014.
- Shik, J.Z. The evolutionary ecology of fungus growing ants. Smithsonian Fellows Symposium, Panama City, Panama, 2014.
- Shik, J.Z. Linking the traits of male ants with the ecological demands of diverse mating systems. Association of Tropical Biology and Conservation, San Jose, Costa Rica, 2013.
- Silverman, J., Shik, J.Z., Schal, C. Nutrient regulation and post-ingestive utilization in glucose averse German cockroaches. Entomological Society of America, Knoxville, TN, 2012.
- Shik, J.Z. Toward a general life history model of the superorganism. In the symposium: Social Insects and the emergence of novelty: from local rules to global behaviour. Entomological Society of America, Knoxville, TN, 2012.
- Shik, J.Z., Kay, A.D., Silverman, J. Energy subsidies from aphid mutualists fuel invasive establishment by Argentine ants. Ecological Society of America, Portland, OR. 2012.
- Shik, J.Z. Towards a comparative physiology of insect societies. The Gordon Research Conference: Metabolic Basis of Ecology, Biddeford, ME, 2012.
- Kay, A.D., Shik, J.Z., Van Alst, A., Miller, K.A., Kaspari, M. Diet composition does not affect ant colony tempo. Entomological Society of America, Reno, NV. 2011.
- Shik, J.Z. Using metabolic scaling to examine how ant colonies work: the case of *Pheidole* majors. IUSSI Congress: The International Union for the Study of Social Insects, Copenhagen, Denmark 2010.
- Shik, J.Z. Metabolic scaling links the traits of individual ants to their colonies. Ecological Society of America, Albuquerque, NM. 2009.
- Shik, J.Z. Ant colony size and the scaling of reproductive effort. Ecological Society of America, Milwaukee, WI. 2008.
- Shik, J.Z. The metabolic implications of ant colony size. Gordon Research Seminar: Metabolic Basis of Ecology, Biddeford, ME. 2008.

Invited Presentations:

- 2017 North Carolina State, Raleigh, USA
 University of Illinois at Urbana-Champaign, USA
 California State University, Fresno, USA
 Hebrew University of Jerusalem, Israel
- 2016 University of Pierre and Marie Curie, Paris, France
 University of Regensburg, Regensburg, Germany
 Symposium: Physiological responses to environmental change, International Congress for Entomology, Orlando, Florida, USA
 Michigan State University, USA
 University of Scranton, Pennsylvania, USA
 Jodrell Laboratory, Royal Botanic Gardens, Kew, London
- 2015 Smithsonian Tropical Research Institute, Panama City, Panama
 Institute of Science and Technology, Vienna, Austria

- Centre for Social Evolution, University of Copenhagen, Denmark
 Centre for Macroecology, Evolution and Climate, University of Copenhagen, Denmark
 University of Oklahoma, Norman, USA
 Universite Paul Sabatier, Toulouse, France
 University of Pierre and Marie Curie, Paris, France
- 2014 Symposium: Nutrition: Behavior and Life History, International Society for Behavioral Ecology, New York
- 2013 Smithsonian Tropical Research Institute: Tupper Talk
 University of Oklahoma, Norman, Oklahoma
 University of Costa Rica, San Jose: Departmental Seminar
- 2012 Symposium: Social Insects and the emergence of novelty: from local rules to global behaviour. Entomological Society of America, Knoxville, Tennessee
 Gordon Conference Metabolic Ecology, Biddeford, Maine
- 2011 National Evolutionary Synthesis Center, Durham, North Carolina
 North Carolina State University, Department of Entomology
 Eastern Tennessee State University, Department of Biology
 University of Tennessee, Department of Ecology and Evolutionary Biology
- 2010 Smithsonian Tropical Research Institute: Behavior Discussion Group
 Smithsonian Tropical Research Institute: Bambi Seminar on BCI
 University of Oklahoma, Zoology Department Seminar
- 2009 Kansas State University, Seminars in Ecology and Evolutionary Biology
 Departmental retreat of Zoology, Lake Texoma, The University of Oklahoma
- 2008 Gordon Research Seminar: Metabolic Basis of Ecology, Biddeford, Maine. 2008.
 Ecomunch Seminar, Graduate Program in Ecology and Evolutionary Biology, University of Oklahoma
- 2007 Smithsonian Tropical Research Institute: Bambi Seminar on BCI

Specialized Training:

- 2008, 2013 Respirometry Course, Sable Systems International, Las Vegas, NV
- 2006 Soil Acarology Course, The Ohio State University Acarology Laboratory, Columbus, OH
- 2005 The Ant Course, California Academy of Sciences & Harvard University Museum of Comparative Zoology, Portal, AZ

TEACHINGGraduate-level course organizer:

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| Tropical Behavioural Ecology and Evolution, field course at the Smithsonian Tropical Research Institute (Co-organizer with Rachelle Adams, instructor) - University of Copenhagen and Ohio State University since 2017 | April - May 2011
April - May 2013
April - May 2015
April - May 2017 |
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Undergraduate courses:

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| Concepts in Biology (non-majors) | Spring 2010
Fall 2008
Spring 2007 |
| Introductory Zoology | Fall 2007
Spring 2006 |

Principles in Ecology

Fall 2006

Spring 2005

Fall 2005

ACADEMIC SERVICE

Professional Service:

Reviewer: Peer-Reviewed Journals (average 14 reviews per year)

Acta Ethologica, Agricultural and Forest Entomology, Animal Behaviour, Arthropod-Plant Interactions, Biological Invasions, Biological Journal of the Linnean Society, Biology Letters, Current Zoology, Ecography, Ecological Entomology, Ecology, Ecology and Evolution, Ecosystems, Entomologia Experimentalis et Applicata, Environmental Entomology, European Journal of Entomology, Evolution, Evolutionary Biology, Functional Ecology, Insect Conservation and Diversity, Insects, Insectes Sociaux, Journal of Animal Ecology, Journal of Applied Entomology, Journal of Asia-Pacific Entomology, Journal of Insect Behavior, Journal of Insect Physiology, Journal of Insect Science, Myrmecological News, Naturwissenschaften, Oecologia, Oikos, PLoS One, Proceedings of the Royal Society B, Rangeland Ecology and Management, Revista Brasileira de Entomologia, Scientific Reports

Reviewer: Grant Agencies

National Science Foundation (USA), Sapere Aude (Denmark)

Professional Affiliations

Ecological Society of America

American Society of Naturalists

International Union for the Study of Social Insects

Institutional Service:

Student Advising

- 2017 Hosted an international DNA barcoding summit in Copenhagen to discuss cryptic diversity in a Panamanian fungus growing ant community
Hosted PhD student Cristele Sanchez Oms from the University of Tours (France) to study adaptive metabolic physiology of ants from an elevational gradient (collaboration with Dr. Xim Cerda and Dr. Raphael Boulay)
Supervised undergraduate thesis of Christoffer Bergstedt on nutritional ecology of invasive *Monomorium* ants
- 2015-2017 Hosted and supervised ERASMUS student Pol Lannes Salvado from the University of Barcelona, Spain.
Masters student at the University of Copenhagen, on attine nutritional ecology, Winnie Rytter
- 2013-2014 Masters student Angelo Concilio, University of Turino, Smithsonian Tropical Inst.
Research Intern at the Smithsonian Tropical Research Institute, Mariana Franco
Research Intern at the Smithsonian Tropical Research Institute, Ernesto Gomez
- 2011-2013 Supervised two undergraduate field assistants, Matt Green and Shanna Wood, during postdoctoral research at North Carolina State University.
- 2010 Supervised an NSF REU undergraduate, Deana Flatt, during her first trip to a tropical forest. Guided her as she assisted with my research and helped her develop her own project, which was published in *Naturwissenschaften*
- 2004-2009 Undergraduate Research Assistants in the Kaspari lab at the University of Oklahoma: Shelly Sudberry, Matt Dowling, Julie Miller, Risa Walters, Deanna Flatt

Guest Lectures

- 2013 Field Research Course for Latin American Researchers, Smithsonian Tropical Research Institute, Panama

- 2012 Organized workshop on ant ecology lab at the National Conference: Association for Biology Lab Instructors Conference, Chapel Hill, North Carolina
- 2011 Graduate Student Seminar in Insect Ecology, '*Energy Flow, Nutrients, Ecosystem Function*', North Carolina State University
- 2010 Undergraduate Zoology Society, '*How to study ants*', The University of Oklahoma
Concepts in Biology, '*Community ecology*', The University of Oklahoma
- 2009 General Introductory Biology Lecture, '*Community ecology and ants*', U. Oklahoma
- 2005-2007 Entomology Course, '*Hymenoptera*', The University of Oklahoma

Academic committees

- 2009 Zoology representative in the graduate student senate
- 2008 Graduate student Zoology Department faculty representative
- 2007 Graduate student representative on Zoology Department admissions committee

Community Service:

Public outreach

- 2016 Consulted with the Copenhagen Zoo on a new exhibit on ecology and evolutionary biology and a new leafcutter ant husbandry project
- 2014, 2015 Culture Night, organized the social insect booth, Copenhagen, Denmark
Collaborated with Dr. Jacobus Boomsma, Dr. Christian Peeters, and artist Naret Phansua on educational cartoon titled 'The fungus growing ants: from simple gardening to industrial farming'. This movie is being shown in natural history museums in France and is planned to be used in Denmark as well.
- 2012 Talk at high school: The North Carolina School of Science and Mathematics, '*The Social Insects*'
- 2010 Panel on '*Careers in the Biological Sciences*', Graduate student representative, The University of Oklahoma
Darwin Day lecture for the lay public, '*The evolution of eusociality*', The University of Oklahoma

In the Media

- My 2016 PNAS paper had an Almetric score of 98, ranked in the 97th percentile of tracked articles of similar age in all journals, having been covered by several major news outlets
(<http://www.pnas.org/content/113/36/10121.full?tab=metrics>)
- <http://riais.tv/blogs/do-ant-farmers-forage-their-%E2%80%98lunchbox%E2%80%99>
(Australia's Science Channel)
- Smithsonian Institution Newsletter: 'How much energy is needed to farm fungus?'
(http://www.jonathanshik.com/uploads/2/6/2/9/26297749/strinews_aug_22_2014.pdf)
- ScienceDaily.com: 'Research predicts growth, survival of 'superorganism' ant colonies'
(<http://www.sciencedaily.com/releases/2012/12/121219092819.htm>)
- Association for Biology Laboratory Education
(<http://www.ableweb.org/conf/able2012/photopub/index2.html>)