

Jonathan Z. Shik

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RESEARCH STATEMENT

I am an integrative evolutionary biologist exploring how physiological traits shape the fitness and co-existence of diverse species. Funded by an ERC Starting Grant, I have developed complementary approaches focusing on eco-physiology and evolutionary ecology to study how the performance of organisms in communities varies across environmental gradients in light of climate change. This interdisciplinary research combines fieldwork, lab experiments, genetic/genomic approaches and theory development. My favorite study organisms are the ants, which enable me and my collaborators to test hypotheses across levels of biological organization, from genes in genomes, to cells in multicellular bodies, to individuals in societies and symbioses. Trillions of ants inhabit diverse habitats across the planet, providing a rich canvas on which to apply integrative approaches from metabolic respirometry, to stable isotopes, DNA barcoding, to comparative genomics.

EDUCATION

PhD, University of Oklahoma (2010)
B.Sc., McGill University (2003)

APPOINTMENTS

2019-present Research Associate, Smithsonian Tropical Research Institute
2018-present Assistant Professor, Section for Ecology and Evolution, BIO, University of Copenhagen
2016-2018 Postdoctoral Researcher, Centre for Social Evolution, BIO, University of Copenhagen
2014-2016 Marie Curie Postdoctoral Fellow, Centre for Social Evolution, University of Copenhagen,
2013-2014 Postdoctoral Fellow, Smithsonian Tropical Research Institute, advisor: Bill Wcislo
2011-2013 Postdoctoral Research Associate, Department of Entomology, North Carolina State University
2010 Research Associate, University of Oklahoma, based at Smithsonian Tropical Research Institute, Panama
2009 Research Fellow: Alumni Fellowship, University of Oklahoma

EDITORIAL POSITIONS

2019-present Associate Editor, *Journal of Animal Ecology*

GRANTS AND AWARDS (TOTAL EXTERNAL FUNDING 2005 – 2018: (€ 1,849,070; \$ 2,107,875)

2019	UCPH Forward Program for Excellence in Research, €2,600 (\$2,900)
2017	European Research Council Starting Grant (ERC StG), €1.5 million (\$1,710,000) Finalist, for CNRS position at Pierre and Marie Curie University (Paris)
2014	BIO Incentive grant to support international PhD course (Faculty of Science, U.
2013	Copenhagen – together with Rachelle Adams and Koos Boomsma), €9,000 (\$10,260) EU Marie Curie International Incoming Postdoctoral Fellowship, €240,000 (\$273,600)
2012	Smithsonian Tropical Research Institute, Postdoctoral Fellowship, €55,000 (\$62,700)
2011	National Inst. for Mathematical and Biological Synthesis, short term research grant: €1700 (\$1,938)
2004-2010	Alumni Fellowship from the Graduate College at the University of Oklahoma: €22,000 (\$25,080)
Pre-2010	Competitive research grants secured during PhD: €18,600 (\$21,000)

TEACHINGGraduate-level teaching:

Invasion Biology (Head coordinator)	Spring 2019, 2020
Advanced Ecology (assistant coordinator)	Fall 2018, 2019
Evolutionary Ecology (assistant coordinator)	Fall 2018, 2019
Population Biology (lecturer)	Fall 2019
Macroecology (lecturer)	Fall 2017, 2018, 2019
Fungal Ecology (lecturer)	Fall 2018
Invasion Biology (lecturer)	Spring 2018

Graduate-level field course co-organizer:

Tropical Behavioural Ecology and Evolution, field course at the Smithsonian Tropical Research Institute	April - May 2011 April - May 2013 April - May 2015 April – May 2017
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Teaching Assistant for undergraduate courses (during PhD studies):

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

SUPERVISING*ONGOING AND NEW POSTDOCTORAL PROJECTS*

- Cairo Leal-Dutra (starts 2020): *Genomics and evolution of domesticated cultivars of leafcutter ants*
- Benjamin Conlon (starts 2020): *Physiological and molecular ecology of a complex symbiosis*

-Antonin Crumiere (September 2018 – September 2020): *Community ecology of fungus-farming ants*

ONGOING AND NEW GRADUATE & UNDERGRADUATE PROJECTS

-Sophie Mallett: Bachelors thesis: “*Nutritional plasticity in the gongylidia of Leucoagricus gongylophorus fungus*”

-David O’Tuama: Masters, “*Nutritional processing by fungal cultivars of farming ants*”

-Calum Stephenson: Masters, “*Nutritional interactions within a complex symbiosis*”

-Pol Lannes Salvado: Masters, “*The use of insect frass as fungal substrate by lower attine farmers*”

*Celia Izquierdo: Research Technician (starts June 2020)

*Julie Elmgaard Andersen & Mille Bolander: joint Masters thesis (starts September 2020)

*Emil Petersen: Masters thesis (starts September 2020)

**Jade Cefai: Bachelors student (Polytech Montpellier, France) [Postponed until 2021, COVID]

GRADUATED STUDENTS

2020

-Piet Nielsen & Enzo Buhl Langkilde: Bachelors thesis: “*Liquid media approaches to studying nutrient consumption by insect-pathogenic fungi as they invade their hosts*”

2019

-Zsuzsanna Csontos: Masters thesis, “*The nutritional basis of host specificity in insect pathogens*”

-Pol Lannes Salvado Bachelors thesis: “*The ecology of frass harvest in Panamanian attine ants*”

-Sebastian Kuford: Bachelors thesis, “*Sperm production by male attine ants*”

-Aidan James: Bachelors thesis, “*Developing nutritional media to test evolutionary hypotheses with fungus from leafcutter ant colonies*”

-Calum Stephenson: Bachelors thesis, “*Chemical communication between ants and their fungal cultivars*”

-Nathan Cyrille: Bachelors student from Université Paris-Saclay (France): “*Excretory physiology of fungus-growing ‘attine’ ants*”

2017-2018

-Maria Scotwin: Bachelors thesis, “*The nutritional ecology of crop domestication in fungus farming ants*”

-Mads Wolter Nielsen: Masters thesis, “*Nutrient flow in Acromyrmex colonies*”

-Birla Krabbe: Bachelors thesis, “*Defining an ant’s nutritional niche in three dimensions*”

-Christoffer Bergstedt: Bachelors thesis, “*The nutritional ecology of invasive Monomorium ants*”

-Winnie Rytter: Masters thesis, “*Fungus-farming ant nutritional ecology*”

-Hugo Merienne: visiting PhD student from the Research Center on Animal Cognition at the University Paul Sabatier (Toulouse, France), “*Insect metabolic physiology*”

-Cristele Sanchez Oms: visiting PhD student from the University of Tours (France), ‘*Insect metabolic physiology*’

Before 2016

-ANGELO CONCILIO: MASTERS STUDENT (UNIVERSITY OF TURINO), SMITHSONIAN TROPICAL RESEARCH INSTITUTE (2014)

-MARIANA FRANCO & ERNESTO GOMEZ: RESEARCH INTERN, SMITHSONIAN TROPICAL RESEARCH INSTITUTE (2013-2014)

-MATT GREEN & SHANNA WOOD: UNDERGRADUATE RESEARCH ASSISTANTS, NORTH CAROLINA STATE UNIVERSITY (2012-2013)

-DEANA FLATT: NSF REU UNDERGRADUATE RESEARCHER, UNIVERSITY OF OKLAHOMA (2010)

KEY INTERNATIONAL COLLABORATORS

- Audrey Dussutour (CNRS, Université Paul Sabatier, Toulouse, France)
- William Wcislo (Smithsonian Tropical Research Institute, Panama)
- Juan Santos (St. John's University, USA)
- Xavier Arnan (CREAF Centre for Ecological Research and Forestry Applications, Spain)
- Rachelle Adams (The Ohio State University, USA)
- Xim Cerda (Doñana Biological Station, Spanish National Research Council)
- David Donoso (Escuela Politecnica Nacional, Quito, Ecuador)

INVITED SEMINARS

- 2020 Liverpool University (*cancelled, COVID*)
Symposium: Communal Nutrition, International Union for the Study of Social Insects, Toulouse, France (*postponed 2021, COVID*)
- 2019 Danish Oikos Society, Aarhus, Denmark
- 2018 Lund University, Departmental Seminar, Lund, Sweden
Smithsonian Tropical Research Institute, Tupper Seminar, Panama
Centre for Macroecology, Evolution and Climate, University of Copenhagen, Denmark
Symposium: Latest frontiers in the nutritional ecology of social insects, Entomological Society of America, Vancouver, Canada
- 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, Panama
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 WORKSHOPS

- 2020 (planned) Teaching and Learning in Higher Education (*Adjunktpædagogikum*) at the Department of Science Education, University of Copenhagen
- 2019 Ant Biodiversity Data Synthesis Meeting, Okinawa Institute of Technology, Japan
 Pedagogy Course, University of Copenhagen
- 2017 DNA barcoding summit, diversity in a Panamanian fungus growing ant community, University of Copenhagen
- 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

ACADEMIC SERVICE

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

Acta Ethologica, Agricultural and Forest Entomology, Animal Behaviour, Arthropod-Plant Interactions, Behavioral Ecology and Sociobiology, Biological Invasions, Biological Journal of the Linnean Society, Biology Letters, Current Zoology, Ecography, Ecological Entomology, Ecology, Ecology and Evolution, Ecology Letters, Ecosystems, Entomologia Experimentalis et Applicata, Environmental Entomology, European Journal of Entomology, Evolution, Evolutionary Biology, Functional Ecology, Global Change Biology, 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, Journal of Thermal Biology, Myrmecological News, Naturwissenschaften, Oecologia, Oikos, PeerJ, PLoS One, Proceedings of the Royal Society B, Rangeland Ecology and Management, Revista Brasileira de Entomologia, Scientific Reports

Reviewer: Grant Agencies

European Research Council (ERC, Advanced Grants), National Science Foundation (USA), Sapere Aude (Denmark), US-Israel Binational Agricultural Research and Development Fund (BARD: US-Israel), Binational Science Foundation (BSF: US-Israel), Austrian Science Fund

Grant Review Panels

Fundação para a Ciência e a Tecnologia, I. P. (FCT) (Reviewed 25 proposals (15 as lead reviewer) for the Central Portuguese Funding Agency, April 2018)

Current Professional Affiliations

International Union for the Study of Social Insects, British Ecological Society, Danish Oikos Society

Symposium Organizer

- 2020 Insect eco-physiology, International Congress for Entomology (every 4th year), planned Helsinki, Finland, (Co-organized)
- 2018 Social insect eco-physiology across scales, International Union for the Study of Social Insects (every 4th year), Guarujá, Brazil (co-organized)
- 2016 Physiological responses to environmental change, International Congress for Entomology (every 4th year), Orlando, Florida, USA (Co-organized)

UNIVERSITY SERVICE

Academic committees & service

- 2018 Panelist and speaker in ERC Starting Grant Information Meeting at KU
- 2017-2018 Section of Ecology and Evolution weekly seminar organizer
BIO-Conference organizing committee
- 2009 Zoology representative in the graduate student senate
- 2008 Graduate student Zoology Department faculty representative
- 2007 Graduate student representative on Zoology Department admissions committee

Public outreach

- 2014-2017 Culture Night, organized the social insect booth, Copenhagen, Denmark
- 2016 Consulted with the Copenhagen Zoo on a new exhibit on ecology and evolutionary biology and a new leafcutter ant husbandry project
- 2015 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

- Substantial coverage in September 2017 for my ERC Starting Grant by the Danish press (<http://magisterbladet.dk/news/2017/september/myrererdygtigelandmaend>)
- 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://riaus.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>)

PUBLICATIONS, PRESENTATIONS, AND MANUSCRIPTS [IMPACT FACTOR]

H-INDEX = 13, I10-INDEX = 17; TOTAL CITATIONS = 356 (GOOGLE SCHOLAR)

* = graduate student; ** = undergraduate student

30. Shik JZ, Dussutour A. (*In Press*) Nutritional dimensions of invasive success. ***Trends in Ecology & Evolution***, X:X-X. [15.24]
29. Crumiere AJJ, Stephenson CJ, Nagel M, Shik JZ (*In Press*) Using nutritional geometry to explore how social insects navigate nutritional landscapes. ***Insects***, 11(1) doi: 10.3390/insects11010053. [2.139; *invited review*]
28. Krabbe, B.A.**, Arnan, X., Lannes, P.**, Echtvad Bergstedt, C.**, Stenbak Larsen, R., Pedersen, J.S., Shik, J.Z. (2019) Using nutritional geometry to define the fundamental macronutrient niche of the widespread invasive ant *Monomorium pharaonis*. ***PLoS One***, 14: e0218764.
27. Shik JZ, Arnan X, Oms CS*, Cerda X, Boulay R (2019) Evidence for locally adaptive metabolic rates among ant populations along an elevation gradient. ***Journal of Animal Ecology***, 88:1240-1249.
26. Rodrigues da Costa R*, Vreeburg SME*, Shik JZ, Aanen DK, Poulsen M (2019) Can interaction specificity in the fungus-farming termite symbiosis be explained by nutritional requirements of the crop fungi? ***Fungal Ecology***, 38:54-61 [3.10]
25. Kooij PW, Dentiger BM, Donoso D, Shik JZ, Gaya, E. (2018) Cryptic diversity in Colombian edible ants, *Atta* spp. Fabricius, 1804 [Hymenoptera: Formicidae: Attini]. ***Insects***, X:X-X. [1.848]
24. Sapountzis P, Zhukova M, Shik JZ, Schiøtt M, Boomsma JJ (2018) Reconstructing the symbiotic functions of intestinal Mollicutes in fungus-growing ants. ***eLife***, 7:e39209. [7.725]
23. Hamilton N*, Jones, TH, Shik JZ, Wall B*, Schultz TR, Blair HA**, Adams RMM (2018) Context is everything: Mapping Cyphomyrmex-derived compounds to the fungus-growing ant phylogeny. ***Chemoecology***, 28:137-144. [1.642]
22. Shik JZ, Rytter W*, Arnan X, Michelsen A (2018) Disentangling nutritional pathways linking leafcutter ants and their co-evolved fungal symbionts using stable isotopes. ***Ecology***, 99:1999-2009. [5.175]
21. Shik JZ, Consilio A*, Kaae T*, Adams RMM (2018), Farming ants nutritionally manage fungal mutualists and social parasites. ***Ecological Entomology***, 43:440-446. [1.687]
20. Shik JZ, Gomez EB**, Kooij PW*, Santos JC, Wcislo WT, Boomsma JJ (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. [9.423]
19. Guenard B, Shik JZ, Booher 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. [1.267]
18. Rytter W*, Shik JZ (2016) Liquid foraging behavior in leafcutting ants: The lunchbox hypothesis. ***Animal Behaviour***, 117:179-186. [3.068]
17. Shik JZ, Schal C, Silverman J (2014) Diet specialization in an extreme omnivore: nutritional regulation in glucose averse cockroaches. ***Journal of Evolutionary Biology***, 27:2096-2105. [3.483]

16. Shik JZ, Kay A, Silverman J (2014) Aphid honeydew provides a nutritionally balanced resource for incipient Argentine ant mutualists. *Animal Behaviour*, 95:33-39. [3.068]
15. Shik JZ, Santos JC, Seal JN, Kay A, Mueller UG, Kaspari M (2014) Metabolism and the rise of fungus cultivation by ants. *American Naturalist*, 184:364-373. [4.725]
14. Shik J.Z., Donoso DD, 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. [1.442; *invited review*]
13. Bednar D*, Shik JZ, Silverman J (2013) Prey handling performance facilitates behavioral dominance of an invasive over a native keystone ant. *Behavioral Ecology*, 24:1312-1319. [3.083]
12. Shik JZ, 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. [2.855]
11. Shik JZ, Flatt, D**, Kay AD, Kaspari M (2012) A life history continuum in the males of a Neotropical ant assemblage: refuting the sperm vessel hypothesis. *Naturwissenschaften*, 99: 191-197. [2.098]
10. Shik JZ, Hou C, Kay A, Kaspari M, Gillooly JF (2012) Toward a general life history model of the superorganism: predicting the survival, growth, and reproduction of ant societies. *Biology Letters*, 8:1059-1062. [2.823]
9. Spicer Rice E*, Shik JZ, Silverman J (2012) Effect of scattered and discrete hydramethylnon bait placement on the Asian needle ant, *Pachycondyla chinensis* Emery. *Economic Entomology*, 105:1751-1757. [1.609]
8. Kay AD, Shik JZ, Van Alst A**, Kaspari M (2012) Diet composition does not affect ant colony tempo. *Functional Ecology*, 26:317-323. [5.21]
7. Shik JZ, 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. [1.394]
6. Shik JZ (2010) The metabolic costs of building ant colonies from variably sized subunits. *Behavioral Ecology and Sociobiology*, 64:1981-1990. [2.565]
5. Kaspari M, Stevenson B, Shik JZ, Kerekes J* (2010) Scaling biodiversity: how bacteria, fungi, and ant communities respond to the same tropical landscape. *Ecology*, 91:2221-2226. [5.175]
4. Shik JZ, 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. [1.687]
3. Shik JZ, Kaspari, M. (2009) Male lifespan in ants linked to mating systems. *Insectes Sociaux*, 52:131-134. [1.267]
2. Shik JZ (2008) Ant colony size and the scaling of reproductive effort. *Functional Ecology*, 22:674-681. [5.21]
1. Shik JZ, Francoeur A, Buddle CM (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.

Other Publications in Refereed Journals:

Shik JZ, Nichols LM, Lucky A, Hoefnagels MH (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.

In Review/Revision

Fisher RM, Shik JZ, Boomsma JJ The evolution of multicellular complexity: the role of relatedness and environmental constraints.

Shik JZ, Kooij PW, Donoso D, Santos JC, Gomez EB, Franco M, Crumière AJJ, Arnan X, Howe J, Wcislo WT, Boomsma JJ Nutritional niches reveal fundamental domestication tradeoffs in fungus-farming ants.

In Preparation

Crumière AJJ, Shik JZ *The N-dimensional nutritional niche of leafcutter ants*

Howe J, Boomsma JJ, Shik JZ *Resolving the fungicultural food web of lower-attine ant farmers in a Panamanian rainforest using eDNA*

Csontos Z, Shik JZ, de Fine Licht HH Nutritional ecology and host specificity of entomopathogenic *Metarhizium* fungi

PRESENTATIONS FOR PROFESSIONAL MEETINGS

Crumiere A, Shik JZ (2019) Nutritional provisioning of fungal cultivars by leafcutter ants. ESEB.

Shik, J.Z. (2018) Nutritional dimensions in insect-fungus co-evolution. Mini Symposium: Fungal ecology and evolution. Section for Ecology and Evolution, University of Copenhagen.

Pedersen J.S., Krabbe, B.A., Shik, J.Z. (2018) Pharaoh ant workers regulate nutrition to prioritize colony growth over individual survival. International Union for the Study of Social Insects. Brazil.

Shik, J.Z., Oms, C.S., Arnan, X., Cerda, X., Boulay, R. (2018) Metabolic temperature sensitivity in ants. International Union for the Study of Social Insects. Brazil.

Oberweiser M, Beres Z, Shik J.Z., Adams, R.M.M. (2017) Unraveling a Panamanian caterpillar/ant mutualism. Ohio State University Student Research Symposium, 2017.

Mularo, A.J., Shik, J.Z., Adams, R.M.M. (2017) Dynamics of pseudoscorpions in a neotropical rainforest. Ohio State University Student Research Symposium.

Kooij, P.W., Gaya, E., Shik, J.Z., Dentinger, B.T.M. 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. 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. IUSI 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.