

## SEAN MCKENZIE, PHD

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### PROFILE

I am a biologist conducting research at the interface of social evolution, molecular biology, neuroscience, and behavior. I am currently a Marie Skłodowska-Curie post-doctoral fellow at The University of Lausanne, where I study the genomics, neurodevelopment, and evolution of the insect olfactory system. I am also engaged in teaching and science education, and do a considerable amount of programming and bioinformatics. My career goal is to teach, primarily at the undergraduate level, and continue neuroscience, genetics and evolution research.

### CAREER

The University of Lausanne; Lausanne, Switzerland

**Marie Skłodowska-Curie post-doctoral fellow**

**2018 - present**

Department of ecology and evolution

Keller research group

### EDUCATION

The Rockefeller University; New York, NY

**Ph.D. Biological sciences: Social evolution and behavior**

**2018**

Lab: Laboratory of Social Evolution and Behavior

PI: Dr. Daniel Kronauer

Sewanee: The University of the South; Sewanee, TN

**B.S. Environmental Studies: Ecology and Biodiversity**

**2011**

Minor: International and Global Studies

### PUBLICATIONS

Chandra V, Fetter-Pruneda I, Oxley PR, Ritger AL, McKenzie SK, Libbrecht R, Kronauer DJC. 2018. Social regulation of insulin signaling and the evolution of eusociality in ants. *Science* 361: 398-402

Marizzi C, Florio A, Lee M, Khalfan M, Ghiban C, Nash B, Dorey J, McKenzie SK, Mazza C, Cellini F, *et al.* 2018. DNA barcoding Brooklyn (New York): A first assessment of biodiversity in Marine Park by citizen scientists. *PLoS One* 13: e0199015

Allen JL, McKenzie SK, Sleith R, Alter SE. 2018 (pre-print). First genome-wide analysis of an endangered lichen reveals isolation by distance and strong population structure. *BioRxiv* doi: 10.1101/237164

Trible W, Olivos-Cisneros L, McKenzie SK, Saragosti J, Chang N-C, Matthews BJ, Oxley PR, Kronauer DJC. 2017. *orco* Mutagenesis Causes Loss of Antennal Lobe Glomeruli and Impaired Social Behavior in Ants. *Cell* 170: 727-735

McKenzie SK, Fetter-Pruneda I, Ruta V, Kronauer DJC. 2016. Transcriptomics and neuroanatomy of the clonal raider ant implicate an expanded clade of odorant receptors in chemical communication. *Proc Natl Acad Sci USA* 113: 14091-14096.

McKenzie SK, Oxley PR, Kronauer DJC. 2014. Comparative genomics and transcriptomics in ants provide new insights into the evolution and function of odorant binding and chemosensory proteins. *BMC Genomics* 15: 718.

Oxley PR, Ji L, Fetter-Pruneda I, McKenzie SK, Li C, Hu H, Zhang G, Kronauer DJC. 2014. The genome of the clonal raider ant *Cerapachys biroi*. *Curr Biol* 24: 451-458.

CONFERENCE TALKS AND PRESENTATIONS

McKenzie, SK and Kronauer, DJC. 2017. Comparative genomics of ant communication. Global Biodiversity Genomics Conference, Washington DC

McKenzie, SK and Tribble, W. 2015. Finding the source of invasive populations of clonal raider ant. 6<sup>th</sup> biannual SINNERS Meeting, Scranton PA.

McKenzie, SK, *et al.* 2014. Molecular and neural basis of chemosensation in the ant *Cerapachys biroi*. 17<sup>th</sup> Int Congr IUSSI, Cairns QLD, Australia

McKenzie, SK. 2013. Chemical Communication in *Cerapachys biroi*. 2<sup>nd</sup> biannual SINNERS Meeting, Millbrook NY

McKenzie, SK. 2012. Antennal transcriptomics in the ant *Cerapachys biroi* provide insights into the evolution and function of odorant binding and chemosensory proteins. 2012 IUSSI-NAS Meeting, Greensboro NC

INVITED TALKS AND GUEST LECTURES

Invited speaker, Winter 2016, Special Seminars, Facultad de Microbiologia, Universidad de Costa Rica.

Interviewee, CUNY Science Forward Video Series (*Animal Communication* and *Tools of Seeing*). [macaulay.cuny.edu/eportfolios/scienceforward/videos/](http://macaulay.cuny.edu/eportfolios/scienceforward/videos/)

Guest lecturer, Fall 2014 & Fall 2015, CUNY IDC3002H Science & Technology in NYC, Professor Jessica Allen

Invited speaker, Fall 2014, Biology Department Seminar Series, Sewanee: The University of the South

RESEARCH

*Department of Ecology and Evolution, University of Lausanne, Lausanne Switzerland | [unil.ch/dee](http://unil.ch/dee)*

**Evolutionary development of the insect olfactory system 2018 – present**

Neural circuit evolution is a vital process in behavioral adaptation. In the insect olfactory system, the evolution of novel olfactory circuits permits organisms to respond to or discriminate between additional stimuli. However, the evolution of a novel olfactory circuit is an extremely complex process, requiring coincidental changes in receptor gene repertoire, cell type repertoire, receptor gene expression, and neuronal targeting. I plan to investigate this process using two approaches. First, I will use comparative genomics and neuroanatomical development in the ants to find genetic differences leading to the extremely divergent olfactory systems observed in this group. Second, I will attempt to conduct single-cell sequencing on developing neurons in the silk-moth to chart the course of cell-type differentiation, receptor gene choice, and neuronal targeting and identify coordinating factors which may be hotspots for circuit evolution.

*Laboratory of Social Evolution and Behavior, Rockefeller University, NYC | [lab.rockefeller.edu/kronauer](http://lab.rockefeller.edu/kronauer)*

**Olfactory neurogenomics and chemical communication in *Ooceraea biroi* 2012 - 2017**

The eusocial insects are excellent models to understand the neurobiological and genetic basis of communication, and understanding their communication systems may shed light on the very foundations of social behavior. My PhD research focused on the genetics and neurobiology of chemical communication in the model eusocial insect *Ooceraea biroi*. I used transcriptomics and phylogenetics to characterize the contributions of two protein families (OBPs and CSPs) towards chemical communication in ants. I also used comparative genomics, transcriptomics, and neuroanatomy to uncover genetic and neurobiological specializations for social communication in ants, especially in the odorant receptor (OR) gene family and the antennal lobe of the ant brain.

*Laboratory of Neurogenetics and Behavior, Rockefeller University, NYC | vosshall.rockefeller.edu*

**Localization of chemosensory gene expression in *Aedes aegypti* 2011**

I participated in an ongoing project to characterize the chemosensation of oviposition sites in the mosquito *Aedes aegypti* by working to develop a procedure to visualize chemosensory receptor protein expressions in external sensory tissues. I primarily worked to clone receptor genes from leg mRNA, discovering a novel ionotropic receptor in the process, and develop an *in-situ* hybridization protocol.

*Landscape Analysis Lab, Sewanee, TN | lal.sewanee.edu*

**Sewanee Forest History Project 2008-2011**

Sewanee has seen intense and heterogeneous forest management for the last 80 years. This project reconstructed land use history using forestry records and examined current forest ecology as a function of past land use. Using Geospatial Information Systems (GIS) and multidimensional scaling I was able to show strong relationships between a given forest patch's timbering history and the successional trajectory of canopy tree species.

AWARDS AND FELLOWSHIPS

*Post-doctoral Fellowships*

Marie Skłodowska-Curie individual post-doctoral fellowship	2018 – present
Smithsonian Institute post-doctoral fellowship	2017 (declined)

*The Rockefeller University*

NIH NRSA Trainee: Genetics and Cell Biology	2013-2016
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*Sewanee: The University of the South*

Summa cum Laude with full honors	2011
Phi Beta Kappa	2011
Yeatman Award in Biology	2010
Order of Gownsmen (academic honor society)	2008

PEER REVIEW

I have conducted peer review for:

- *Evolution*
- *Molecular Ecology*
- *PLoS One*
- *BMC Genomics*
- *Frontiers in Zoology*
- *Insect Molecular Biology*

TEACHING AND MENTORSHIP

*Laboratory of Social Evolution and Behavior*

**Mentor- rotation students and undergraduate student 2017**

In January through April I mentored a rotation student, Peter Mussel Pires, helping him design and carry out an independent research project to examine brain development in the clonal raider ant. I also co-mentored an undergraduate student over the summer as part of the Summer Undergraduate Research Fellowship program, and in the fall I co-mentored an additional rotation student studying the genomic structure of the clonal raider ant.

*Centro de Investigación en Estructuras Microscópicas, Universidad de Costa Rica, San Jose, CR*

**Instructor- Genome assembly and annotation workshop 2016**

Along with Max Winston (PhD candidate, U Chicago), I planned, helped organize, and taught a 5 day, 40 hour intensive workshop on the bioinformatics of genome annotation and assembly. I developed the entire

annotation portion of the workshop, designing lectures and practical laboratory exercises to give students the capacity to use state of the art bioinformatics to annotate genomes.

*Division of Natural Sciences, College of Mount Saint Vincent, Riverdale, NY*

**Adjunct Professor- Animal Behavior Lab**

**2015**

Co-organized upper level Animal Behavior course and taught the laboratory section. Developed novel inquiry-based laboratory activities and oversaw independent research projects. Wrote lab portions of syllabus and tests and graded all lab projects and lab sections of tests.

*Rockefeller University Social Evolution Field Course*

**Teaching Assistant (whole course) and Student Instructor (Social Insect Identification and Natural History)**

**2014, 2016**

Assisted in planning, coordination, and execution of week-long field course on social evolution. Co-taught session on social insect collection, identification and natural history.

*Social Insects in the North East RegionS (SINNERS)*

**Workshop Instructor (Local Ant Identification) and IT coordinator**

**2013**

Planned, coordinated, and co-taught an ant identification workshop. Also coordinated technology logistics during conference and helped in overall conference planning and execution.

*Rockefeller University Summer Undergraduate Research Fellowship (SURF) Program*

**SURF Journal Club Advisor**

**2013, 2015, 2016**

Helped plan and execute journal club, including supervising a small group of undergraduates and helping them prepare and present a discussion of recent research.

*Sewanee Landscape Analysis Lab, Sewanee, TN | [lal.sewanee.edu](http://lal.sewanee.edu)*

**Acting Lab Manager**

**2010**

Provided interim support including geospatial analysis and mapping for Sewanee Environmental Institute and Sewanee Department of Biology. Provided guidance for student projects and coordinated ongoing LAL research including land-use history research, floral inventory compilation, and ecological mapping of the Sewanee domain.

*Sewanee Biology Department, Sewanee, TN | [biology.sewanee.edu](http://biology.sewanee.edu)*

**Teaching Assistant – to Professor Zigler in “Field Investigations in Biology”**

**2010**

Aided in logistics and instruction of the introductory field biology course.

SPECIALIZED COURSEWORK

**Scientists teaching science**

**2014**

9-week online course in science education through the New York Academy of Sciences.

**The Ant Course**

**2012**

Ten-day field course on the identification, systematics, and natural history of ants in the Kibale Forest of Uganda.

ADDITIONAL INTERNATIONAL WORK AND STUDY EXPERIENCE

**Ant collecting field work: Bangladesh**

**2014**

Three weeks of myrmecology field work in Dhaka, Jessore, Khulna, and Sreemangal, collecting clonal raider ants and other subterranean ants for population genetic and biodiversity studies, respectively.

**Geospatial Information Systems Consultant: Haiti** 2011

Four week consulting trip working with Zanmi Agrikol and Zanmi Lasante (Cange) and Technoserve Haiti (Port-au-prince) to build local GIS resources, train local personnel in informatics and mapping, and conduct mapping field work

**Sewanee: Summer in China and Cambodia** 2010

Four week program investigating development in transitional and developing economies with fieldwork in Beijing, Shanghai, and Phnom Penh

**Organization for Tropical Studies: Tropical Biology Semester in Costa Rica** 2009

Semester long program studying tropical biology, environmental policy, and Spanish in various field stations around Costa Rica

LANGUAGES**Human**

English – native language

Spanish – able to converse, read, and write with basic competence

Haitian Creole – basic written and verbal communication abilities

French – basic written and verbal communication abilities

**Computer**

Python Programming Language – advanced programming and data management/analysis abilities

R Statistical Programming Language – basic scripting and data analysis abilities

Javascript – basic scripting abilities

HTML and CSS – moderate proficiency

SKILLS

Computer Informatics – Proficient in genomic and transcriptomic analysis tools. Training and work experience with Geographical Information Systems, especially Manifold and ARC GIS, as well as computer database systems such as Microsoft Access and bioinformatics programming in python and R.

First Aid – Wilderness Advanced First Aid certification and 40 hours of first responder training

OUTREACH ACTIVITIES*CUNY Science Forward Bio Blitz*

Annual event organized by CUNY Science Forward to engage undergraduates at CUNY's Macaulay Honors College in surveying biodiversity, both to help catalogue biodiversity in the New York area as well as teach scientific data collection and field work to undergraduate students. I served as “taxon leader” in 2015 and 2016, leading small groups in collecting and identifying ants at Freshkills Park, Staten Island, NY and Brooklyn Bridge Park, Brooklyn, NY.

*Metropolitan Society for Natural Historians | [metropolitannaturalhistory.wordpress.com](http://metropolitannaturalhistory.wordpress.com)*

Organization seeking to promote outdoor education and enjoyment by residents of the New York City area. Co-founder and Patrician Emeritus.

*Friends of Big Canoe Creek | [bigcanoecreek.org](http://bigcanoecreek.org)*

Local watershed advocacy organization, Springville, AL. Founding member and treasurer from 2009-2011.