Zachary R. Miller

Postdoctoral Researcher | Yale University
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Education

University of Chicago — Chicago, IL
Ph.D. in Ecology and Evolution — 2022
NSF Graduate Research Fellow
Dissertation: *Theoretical approaches to environmental feedbacks and community coexistence*
Advisor: Stefano Allesina

Yale University — New Haven, CT
B.S. in Ecology and Evolutionary Biology & Applied Mathematics — 2017
Magna cum laude
Advisors: Oswald Schmitz and David Vasseur

Professional Appointments

Yale University, Postdoctoral Associate — New Haven, CT
Advisors: Pincelli Hull (Earth & Planetary Sciences) — 2023 – present
David Vasseur (Ecology & Evolutionary Biology)

University of Illinois, Postdoctoral Research Associate — Urbana, IL
Advisor: James O'Dwyer (Plant Biology) — 2022 – 2023

Publications

Google Scholar: scholar.google.com/citations?user=0IL4BIIAAAAJ (* equal contribution)

Refereed journal articles:

10. **Z.R. Miller** and J.P. O'Dwyer (*in press*). *Metabolic trade-offs can reverse the resource-diversity relationship*. The American Naturalist. DOI: 10.1086/732110

9. C.A. Serván, J.A. Capitán, **Z.R. Miller**, and S. Allesina (*in press*). *Effects of phylogeny on coexistence in model communities*. The American Naturalist. Pre-print: 10.48550/arXiv.2310.14392

8. P. Lemos-Costa*, **Z.R. Miller***, and S. Allesina (2024). *Phylogeny structures species' interactions in experimental ecological communities*. Ecology Letters, 27 (8). DOI: 10.1111/ele.14490

7. **Z.R. Miller***, M. Clenet*, K. Della Libera, F. Massol, and S. Allesina (2024). *Coexistence of many species under a random competition-colonization trade-off*. PNAS, 121 (5). DOI: 10.1073/pnas.2314215121
— Recommended by PCI Ecology: 10.24072/pci.ecology.100533

6. **Z.R. Miller** and S. Allesina (2023). *Habitat heterogeneity, environmental feedbacks, and species coexistence across timescales*. The American Naturalist, 202 (2). DOI: 10.1086/724821

5. A. Skwara, P. Lemos-Costa, **Z.R. Miller**, and S. Allesina (2022). *Modeling ecological communities when composition is manipulated experimentally*. Methods in Ecology & Evolution, 14 (2). DOI: 10.1111/2041-210X.14028

4. T. Gibbs, Y. Zhang, **Z.R. Miller**, and J.P. O'Dwyer (2022). *Stability criteria for the consumption and exchange of essential resources*. PLOS Computational Biology, 18 (9). DOI: 10.1371/journal.pcbi.1010521

3. **Z.R. Miller**, P. Lechón-Alonso, and S. Allesina (2022). *No robust multispecies coexistence in a canonical model of plant-soil feedbacks*. Ecology Letters, 25 (7). DOI: 10.1111/ele.14027

2. **Z.R. Miller** and S. Allesina (2021). *Metapopulations with habitat modification*. PNAS, 118 (49). DOI: 10.1073/pnas.2109896118

1. D.S. Maynard, **Z.R. Miller**, and S. Allesina (2020). *Predicting coexistence in experimental ecological communities*. Nature Ecology & Evolution, 4. DOI: 10.1038/s41559-019-1059-z

PRE-PRINTS:

Z.R. Miller, D. Vasseur, and P. Hull. *Stabilization of fluctuating population dynamics via the evolution of dormancy*. Pre-print: 10.1101/2024.09.12.612663

S. Allesina, **Z.R. Miller**, and C.A. Serván. *Intraspecific variation stabilizes classic predator-prey dynamics*. Pre-print: 10.1101/2021.09.27.461947

OTHER REFEREED WORKS:

Z.R. Miller (2019). *Digest: Does sexual conflict complicate a trade-off between fecundity and survival?*. Evolution. DOI: 10.1111/evo.13855

A.J. Mossman*, K.E. Culhane*, **Z.R. Miller***, K.M. Brock, P. Pafilis, and C.M. Donihue (2016). Natrix natrix *(LINNAEUS, 1758) found on the small islet of Tigani (Central Cyclades, Greece)*. Herpetozoa, 29.

Teaching

Guest Teaching

Community Ecology (undergraduate) — Yale University
Guest lesson on complexity-stability relationship in ecology. — Spring 2024
Developed lecture, learning activities, and assessment questions.

Teaching Assistant

Theoretical Community Ecology (graduate) — University of Chicago
Guest lesson on statistical methods and models. — Spring 2021

Computing Skills for Biologists (graduate) — University of Chicago
Worked closely with 25 students in project-based course. Guest lesson on advanced programming practices (Python-based). — Winter 2020

Principles of Population Genetics (graduate) — University of Chicago
Led quantitative review sessions and weekly paper discussions. — Winter 2019
Developed probability review materials used in future course iterations.

Fundamentals of Biological Data Analysis (undergraduate) — University of Chicago
Worked closely with 20 students in project-based course. Guest lessons on scientific visualization and principle component analysis. — Fall 2018

Other Teaching Experience

Software Carpentry, Workshop Instructor and Organizer — University of Chicago
Led 2-3 workshops annually on programming basics (R-based), version control, and Unix shell. Collaborated with instructor team to design and adapt lesson plans. — 2019 – 2022

Statistical Theory and Methods, Peer Tutor — University of Chicago
Hosted weekly tutorials for Biology PhD students taking statistics coursework. — 2019 – 2021

Linear Algebra Tutorial, Invited Lecturer — ICTP (virtual)
Developed linear algebra tutorial for Winter School on Quantitative Systems Biology. — Dec. 2020

Quantitative Biology Bootcamp, Course Assistant — University of Chicago / MBL
Supported week-long intensive course for incoming students across all Biology PhD programs. Led sessions on population genetics and programming in R. — Sept. 2019

Professional Development

Advancing Learning Through Evidence-Based STEM Teaching — Spring 2024
Eight-week online course offered by CIRTL (completed with distinction).

Software Carpentry Instructor Training — Spring 2020

Fellowships and Awards

Best Dissertation Award in Ecology & Evolution | **University of Chicago** — 2023

Center for Population Biology Postdoctoral Fellowship | **UC Davis** – *declined* — 2023

NSF Graduate Research Fellowship – $102,000 — 2019 – 2022

Edgar J. Boell Prize | **Yale University** — 2017
"Awarded annually to a senior for excellence in biology"

NSF Research Experiences for Undergraduates – $6,000 — 2016
Supplement to DEB-1354762 (Yale University)

NSF Research Experiences for Undergraduates – $5,500 — 2015
REU site OCE-1460963 (University of Delaware)

Summer Environmental Fellowship | **Yale University** – $1,500 — 2014

Freshman Summer Research Fellowship | **Yale University** – $3,400 — 2014

Finalist (not awarded)

Schmidt Science Fellows (1 of 6 nominees across all sciences at UChicago) — 2023

Lewis-Sigler Scholars | **Princeton University** — 2023

Environmental Fellows, High Meadows Institute | **Princeton University** — 2023

Invited Talks and Seminars

Université Gustave Eiffel | **Invited Workshop**, Champs-sur-Marne, France — Oct. 2024 (upcoming)
Evolution of dormancy in the context of complex ecological dynamics
Invited speaker for a workshop on Ecological Networks and Complex Systems

Université de Sherbrooke | **Ecology Seminar**, Sherbrooke, QC — Apr. 2024
Phylogenetic structure in species interaction networks: Inference and implications

Penn State University | **Theoretical Biology Seminar**, University Park, PA — Oct. 2023
Will a stable complex system be large?

University of California Davis | **Center for Population Biology Seminar**, Davis, CA — Jan. 2023
Theoretical approaches to environmental feedbacks and community coexistence

Princeton University | **Lewis-Sigler Scholars Day Symposium**, Princeton, NJ — Nov. 2022
Minimal models for complex plant-soil feedbacks

University of Chicago | **Sarah Cobey Lab Group Meeting**, Chicago, IL — March 2022
Host heterogeneity, immune imprinting & strain coexistence: Insights from metapopulation models

Stanford University | **Eco-Evo Lunch Seminar**, Virtual — March 2021
Coupled metapopulation dynamics with patch memory and modification

Princeton University | **Theoretical Ecology Lab Tea**, Virtual — Feb. 2021
Coupled metapopulation dynamics with patch memory and modification

Evolutionary and Ecological Systems Biology Seminar (hosted at MIT), Virtual — June 2020
Predicting coexistence in experimental ecological communities

University of Chicago | **Neuroscience Theory Group**, Chicago, IL — April 2019
Modeling complex networks as intersection graphs

Yale University | **EEB Senior Thesis Symposium**, New Haven, CT — May 2017
Elemental cycling, physiological stress, and ecosystem functioning: Confronting a stoichiometrically-explicit model with data

Conference Presentations

Ecological Society of America (ESA) Annual Meeting, Long Beach, CA — Aug. 2024
Reconciling emergent coexistence and competitive hierarchy

Ecological Society of America (ESA) Annual Meeting, Montreal, QC — Aug. 2022
Theoretical foundations of multispecies coexistence maintained by plant-soil feedbacks
Invited for organized session: "Integrating the frontiers of plant-soil feedback research"

Ecological Society of America (ESA) Annual Meeting, Virtual — Aug. 2021
Coupled metapopulation dynamics with patch memory and modification
Slides: https://zacharyrmiller.netlify.app/img/esa_2021_slides.pdf

Ecological Society of America (ESA) Annual Meeting, Virtual — Aug. 2020
Testing the predictive value of phylogeny for community productivity
Video: https://zacharyrmiller.netlify.app/talk/esa_2020/video

Ecological Society of America (ESA) Annual Meeting, Louisville, KY — Aug. 2019
Predicting coexistence in experimental ecological communities
Slides: https://doi.org/10.7490/f1000research.1117379.1

REU Research Symposium | **University of Delaware**, Lewes, DE — Aug. 2015
Characterizing the sources and structure of genetic diversity in a model of mutualism exploitation

Professional Service

Editorial Service
PNAS (guest editor, 2023)

Journal Peer Reviewer
The American Naturalist, Biology Letters, Ecography, Ecology, Ecology Letters, Journal of Mathematical Biology, Oikos, Methods in Ecology and Evolution, Nature Computational Science, Nature Ecology & Evolution, New Phytologist, PLOS Computational Biology, PNAS

Grant Peer Reviewer
NSF DEB - Population & Community Ecology (ad hoc reviewer, 2023 and 2024)

Session Organizer, Ecological Society of America (ESA) Annual Meeting — Aug. 2024
Organized symposium titled *Emergent coexistence in microbial communities and beyond*

Student Seminar Chair, Department of Ecology and Evolution — University of Chicago, 2020 – 2021
Organized and hosted weekly student research seminars. Organized selection and hosting of student-invited speakers for departmental seminars.

Panelist on Peer Review, Department of Ecology and Evolution — University of Chicago
Discussed peer-reviewing process, best practices, and strategies with graduate students and postdocs. — Sep. 2021

PhD Admissions Committee Member, Department of Ecology and Evolution — University of Chicago
Evaluated and interviewed PhD applicants as a student representative on departmental admissions committee. Solicited, summarized, and presented student input to faculty. — 2018 – 2019

Co-President, Yale Ecology and Evolutionary Biology Undergraduates Society — Yale University
Organized department outreach events, field trips, and social activities. — 2016 – 2017

Mentorship

Kai Padilla-Smith | Yale University, undergraduate research — 2024 - present
Dillon Max | University of Illinois, undergraduate research — 2023 – present
Sylvia Gimbel | University of Illinois, undergraduate research — 2022 – 2023
Ricardo Muñiz Trejo | University of Chicago, graduate community mentor — 2020 – 2021

Outreach

Young Scholars Program, University of Illinois Chicago — Chicago, IL
Guest speaker on "Randomness and rainforests" for summer mathematics program. — July 2021

Volunteer Tutor, Strive Tutoring (2018-2019) and Tutoring Chicago (2020-2021) — Chicago, IL
Provided one-on-one instruction and support for local K-12 students (weekly). — 2018 – 2021

Panelist, Women in STEM Symposium — Chicago, IL
Panelist on research careers and opportunities for Chicago-area women in STEM. — March 2019

Exam Writer and Grader, UChicago Science Olympiad — Chicago, IL
Mentored undergraduate Science Olympiad chapter through writing and grading ecology and herpetology exams for high school invitational. — 2018 – 2019

Staff Writer, Yale Scientific Magazine — New Haven, CT
Authored articles on scientific research for a general audience. — 2013 – 2016
Select articles available at http://www.yalescientific.org/author/zacharymiller/.

Event Volunteer, Resonance — New Haven, CT
Guided high school students through events, tours, and group discussions on Yale campus. — 2014 – 2016

Event Volunteer, Science on Saturdays — New Haven, CT
Led science demonstrations and hands-on activities for local K-8 students. — 2013 – 2015

Workshops and Working Groups

Function of Evolving Systems — New York, NY
Invited workshop hosted by the Simons Foundation — Dec. 2024 (upcoming)

Understanding and Predicting Pathogen Communities (PATHOCOM) Annual Meeting — New York, NY
Attended as external collaborator (PI: Detlef Weigel; ERC Synergy Grant 9514444) — Sep. 2023 & June 2024

sTime: The dynamics of community turnover across space and time — Leipzig, Germany
Working group hosted at iDiv — Apr. 2024

Merging Statistical Theory and Analyses at the Interface of Microbial and 'Macrobial' Ecology — Montreal, QC
Invited working group (PI: Mathew Leibold; NSF Award number: 2224331) — Aug. 2022

Data and Models in Ecology & Evolution — Orsay, France
Funded summer school at Institut Pascal, Université Paris-Saclay — July 2019

Skills and Memberships

Natural languages: English (native), Spanish (limited)

Programming languages: R (expert); Python, Java, MATLAB (proficient); C (limited)

Other computing: LaTeX, Git, Mathematica

Professional Memberships: Ecological Society of America