

# William Randolph Shoemaker, PhD

Postdoctoral Fellow

Quantitative Life Sciences — The Abdus Salam International Centre for Theoretical Physics

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## Education

### Indiana University Bloomington

2014-2020

Ph.D. Major: Biology – Evolution, Ecology, and Behavior Program

Minor: Bioinformatics

Advisor: Dr. Jay T. Lennon

### James Madison University

2010-2014

B.S. Major: Biology

Advisor: Dr. Reid N. Harris

## Professional Experience

### The Abdus Salam International Centre for Theoretical Physics (ICTP)

NSF Postdoctoral Fellow, Quantitative Life Sciences

2022 - 2023

Postdoctoral fellow, Quantitative Life Sciences

2023 - Present

Advisor: Dr. Jacopo Grilli

### University of California, Los Angeles

NSF Postdoctoral Fellow, Department of Ecology and Evolutionary Biology

2020 - 2022

Advisor: Dr. Nandita R. Garud

### Smithsonian Tropical Research Institute (STRI)

Research Assistant

2013

Advisors: Drs. Reid N. Harris and Eria A. Rebollar

## Preprints and In-Review

Karakoç, C., W.R. Shoemaker, and J.T. Lennon. Evolutionary bioenergetics of sporulation. *bioRxiv*: [2025.08.26.672491](https://doi.org/10.1101/2025.08.26.672491). 2025.

W.R. Shoemaker and J. Grilli. The macroecological dynamics of sojourn trajectories in the human gut microbiome. *bioRxiv*: [2025.06.27.661930](https://doi.org/10.1101/2025.06.27.661930). 2025.

Miklavcic, U., A. Mahnic, W.R. Shoemaker, J. Grilli, S. Janezic, and M. Rupnik. Longitudinal dynamics of ethanol-resistant microbes and sporulation in the human gut. *bioRxiv*: [2025.07.08.663423](https://doi.org/10.1101/2025.07.08.663423). 2025.

## Peer-reviewed Publications

Shoemaker, W.R., Á. Sánchez, and J. Grilli. Macroecological patterns in experimental microbial communities. *PLoS Comput. Biol.* 21 (5), e1013044. 2025.

Shoemaker, W.R. and J. Grilli. Investigating macroecological patterns in coarse-grained microbial communities using the stochastic logistic model of growth. *eLife*. 12:RP89650. 2024.

Schwartz, D.A., W.R. Shoemaker, Magalie, A., Weitz, J., and J.T. Lennon. Bacteria-phage coevolution with a seed bank. *ISME J.* 17, 1315–25. 2023.

**Shoemaker, W.R.** A macroecological perspective on genetic diversity in the human gut microbiome. *PLoS One.* 18, 7. 2023.

Wolff, R., **W.R. Shoemaker**, and N.R. Garud. Ecological Stability Emerges at the Level of Strains in the Human Gut Microbiome. *mBio.* e02502-22. 2023.

**Shoemaker, W.R.**, E. Polezhaeva, K.B. Givens, and J.T. Lennon. Seed Banks Alter the Rate and Direction of Molecular Evolution in *Bacillus subtilis*. *Genetics.* iyac071. 2022.

**Shoemaker, W.R.** and J.T. Lennon. Predicting Parallelism and Quantifying Divergence in Microbial Evolution Experiments. *mSphere.* eoo672-21. 2022.

Hughey, M.C., E.A. Rebollar, R.N. Harris, R. Ibáñez, S.C. Loftus, L.L. House, M.C. Bletz, D. Medina, M.K. Riley, **W.R. Shoemaker**, M.C. Swartwout, and L.K. Belden. An experimental test of disease resistance function in the skin-associated bacterial symbiont communities of three tropical amphibian species. *FEMS Microbiol. Ecol.* 98, fiac023. 2022.

**Shoemaker, W.R.**, D. Chen, and N.R. Garud. Comparative Population Genetics in the Human Gut Microbiome. *Genome Biol. Evol.* 14, evab116. 2022.

**Shoemaker, W.R.**, S.E. Jones, M.E. Muscarella, M.G. Behringer, B.K. Lehmkuhl, and J.T. Lennon. Microbial population dynamics and evolutionary outcomes under extreme energy-limitation. *Proc. Natl. Acad. Sci. U.S.A.* 118, 33. 2021.

**Journal Commentary:** Rillig, M.C., J. Antonovics, and I. Mansour. Microbial self-recycling and biospherics. *Proc. Natl. Acad. Sci. U.S.A.* 118, 37. 2021.

**Shoemaker, W.R.**, E. Polezhaeva, K.B. Givens, and J.T. Lennon. Molecular evolutionary dynamics of energy-limited microorganisms. *Mol. Biol. Evol.* 38, 4532-45. 2021.

Long, H., W. Sung, S. Kucukyildirim, E. Williams, S. Miller, W. Guo, C. Patterson, C. Gregory, C. Strauss, C. Stone, C. Berne, D. Kysela, **W.R. Shoemaker**, M. Muscarella, H. Luo, J.T. Lennon, Y.V. Brun, and M. Lynch. Evolutionary determinants of genome-wide nucleotide composition. *Nat. Ecol. Evol.* 2, 237-240. 2018.

**Shoemaker, W.R.**, and J.T. Lennon. Evolution with a seed bank: the population genetic consequences of microbial dormancy. *Evol. Appl.* 11, 60-75. 2018.

Kuo, V., **W.R. Shoemaker**, M.E. Muscarella, and J.T. Lennon. Whole genome sequence of the soil bacterium *Micrococcus* sp. KBS0714. *Genome. Announc.* 5, eoo697-17. 2017.

**Shoemaker, W.R.**, K.J. Locey, and J.T. Lennon. A macroecological theory of microbial biodiversity. *Nat. Ecol. Evol.* 1, 0107. 2017.

Rebollar, E.A., S.J. Simonetti, **W.R. Shoemaker**, and R.N Harris. Horizontal and Pseudo-environmental Transmission of the Antifungal Probiotic Bacterium *Janthinobacterium lividum* on Green Frog (*Lithobates clamitans*) Tadpoles. *Appl. Environ. Microbiol.* 82, 2457-2466. 2016.

**Shoemaker, W.R.**, M.E. Muscarella, and J.T. Lennon. Genome Sequence of the Soil Bacterium *Janthinobacterium* sp. KBS0711. *Genome. Announc.* 3, eoo689-15. 2015.

## Commentaries

**Shoemaker, W.R.** Eco-evolutionary dynamics: The repeatability of ecological diversification in an evolving minimal microbial community. *Curr. Biol.* 34:R140-R143. 2024.

## Grants

Graduate Research Excellent Grant (GREG). Society for the Study of Evolution - Rosemary Grant Advanced Award. PI: W.R. Shoemaker, co-PI: J.T. Lennon. \$3,472. 2018.

NASA Astrobiology Early Career Collaboration Award. *Microbial dormancy and adaptation to energy-limitation.* PI: W.R. Shoemaker, co-PIs: J.T. Lennon, V. Orphan. \$5,000. 2017.

SSE Education and Outreach Committee Grant. *Generating a novel summer course in evolutionary biology for Indiana high school students.* PI: L. Cole, co-PIs: W.R. Shoemaker, D. Schwab. \$1,000. 2017.

## Fellowships, Honors, and Awards

Seal of Excellence, MSCA Postdoctoral Fellowships, European Research Area.	2022
Postdoctoral Research Fellowship in Biology, National Science Foundation.	2020 - 2023
Floyd Microbiology Fellowship, Indiana University, Bloomington, IN, USA.	2016, 2017, 2019
Louise Constable Hoover Fellowship, Indiana University, Bloomington, IN, USA.	2017
The Women's Welsh Clubs of America Scholarship, Rocky River, OH, USA.	2014-2020
Hoffman Science & Mathematics Scholarship. James Madison University, Harrisonburg, VA, USA.	2010-2014

## Talks

- Macroecological Insight into Microbial Communities via Coarse-graining. ECO<sup>2</sup>STAT. Cagliari, Italy. 2025.
- Macroecological Insights into Microbial Communities via Coarse-graining. [Young Biophysicist Meeting](#). Online. 2025.
- RNA-DNA oscillatory dynamics reflect the physiological state of microbial communities. APS Global Physics Summit. Anaheim, CA, USA. 2025.
- Macroecological laws in natural and experimental microbial systems. Humanitas Research Hospital. Pieve Emanuele, Italy. 2024.
- Macroecological laws in coarse-grained microbial systems. Physics of Living Systems Student Research Network. The Abdus Salam International Centre for Theoretical Physics. Trieste, Italy. 2024.
- Macroecological laws in coarse-grained microbial systems. Stochastic Models and Experiments in Ecology and Biology. L'Aquila, Italy. 2024
- Macroecological patterns in coarse-grained microbial systems. APS March Meeting. Minneapolis, MN, USA. 2024.
- Disentangling ecological processes in natural and experimental microbial community assembly. Division of Microbial Ecology, University of Vienna, Vienna, Austria. 2024.
- Modeling the physiological and demographic consequences of recycling in closed microbial systems. Advanced School on Quantitative Principles in Microbial Physiology. The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy. 2023.
- Predicting Macroecological Patterns in Microbial Communities across Taxonomic and Phylogenetic Scales. ASM Microbe. Houston, TX, USA. 2023.
- Coarse-graining communities in a consumer-resource setting. FIRC Institute of Molecular Oncology Physics Retreat. Torrazzetta, Italy. 2023.
- Experimental macroecology in microbial systems. APS March Meeting. Las Vegas, NV, USA. 2023.
- Experimental Macroecology. [Eco-evolutionary Dynamics of Microbial Communities Across Scales](#). The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy. 2022.
- The population dynamics and evolutionary outcomes of energy-limited microorganisms. [MicroSeminar](#). Online. 2020.
- The impact of seed banks on the molecular evolutionary dynamics of rapidly adapting populations. UCLA, Los Angeles, CA, USA. 2020.

## Posters

**Shoemaker, W.R.** and Grilli, J. The stochastic logistic model predicts coarse-grained patterns of diversity across disparate environments. Mathematical modelling of microbiomes. Max Planck Institute for Evolutionary Biology. Plön, Germany. 2022.

**Shoemaker, W.R.** A macroecological perspective on genetic diversity in the human gut microbiome. International Symposium on Microbial Ecology, Lausanne, Switzerland. 2022.

**Shoemaker, W.R.**, Polezhaeva, E., Givens, K.B., and Lennon, J.T. Seed banks alter the molecular evolutionary dynamics of *Bacillus subtilis*. APS March Meeting, Chicago, IL, USA. 2022.

**Shoemaker, W.R.**, Polezhaeva, E., Givens, K.B., and Lennon, J.T. Microbial evolution under energy-limitation. Gordon Research Conference: The Structure, Ecology and Evolution of Interactions Within Microbial Populations, Andover, NH, USA. 2019.

**Shoemaker, W.R.** and Lennon, J.T. How parallel are evolution experiments? Gordon Research Seminar: Microbial Population Biology, Andover, NH, USA. 2019.

**Shoemaker, W.R.**, Locey, K.J., and Lennon, J.T. Connecting global biodiversity predictions to molecular thermodynamics. Boston University Theory in Biology, Boston, MA, USA. 2018.

**Shoemaker, W.R.** and Lennon, J.T. Dormancy constrains the rate and direction of adaptive evolution. Population, Evolutionary and Quantitative Genetics Conference, Madison, WI, USA. 2018.

**Shoemaker, W.R.** and Lennon, J.T. The contribution of dormancy to microbial evolution. Society for Molecular Biology and Evolution, Austin, TX, USA. 2017.

**Shoemaker, W.R.** and Lennon, J.T. The genetic structure of energy limited populations. International Symposium on Microbial Ecology, Montreal, Quebec, Canada. 2016.

**Shoemaker, W.R.**, Locey, K.J., and Lennon, J.T. Constraint-based predictions for the distribution of abundances of microorganisms. Midwest Ecology and Evolution Conference, Bloomington, IN, USA. 2015.

## Organizer/Instructor/Chair: Symposia, Workshops, Conferences, Reading groups

Co-instructor. Exploring Metabolic Cross-Feeding in a Synthetic *Pseudomonas* Consortium. Hands-on School in Quantitative Biology. ICTP, Trieste, Italy. 2025.

Co-organizer and co-instructor. [Microbial coexistence in a chemostat setting](#). Hands-on Quantitative Biology School. University of Havana, Havana, Cuba. 2024.

Co-instructor. [Evolution in an ecological context](#). IICII (ICTP-ICGEB, Curie Institute, and IFOM) Summer School in Quantitative Biology. Milan, Italy. 2024.

Session Chair. Eco-evolutionary Dynamics. Physics of Living Systems Physics of Living Systems Student Research Network. The Abdus Salam International Centre for Theoretical Physics. Trieste, Italy. 2024.

Co-organizer. Evolutionary Dynamics. APS March Meeting 2024. Minneapolis, MN, USA. 2024.

Co-instructor. [Tutorial on ecological dynamics](#) Advanced School on Quantitative Principles in Microbial Physiology: from Single Cells to Cell Communities. The Abdus Salam International Centre for Theoretical Physics. Trieste, Italy. 2023.

Co-organizer. Evolutionary Genetics in Natural Microbial Populations. Society for Molecular Biology and Evolution. 2021.

Organizer. Quantitative Experimental Approaches in Microbial Evolution and Ecology. World Microbe Forum. 2021.

Organizer. Microbial Evolutionary Dynamics Reading Group. Indiana University, Bloomington, IN, USA. 2018.

Organizer. Quantitative Evolutionary Dynamics Reading Group. UCLA, Los Angeles, CA, USA. 2020-2021.

Organizer. Environmental Genomics Group. Indiana University, Bloomington, IN, USA. 2015-2017.

### **Participant: Symposia, Workshops, Roundtables, Synthesis Groups**

Mobile Elements in Microbial Evolution - QBio Summer Research Course. Kavli Institute for Theoretical Physics. University of California, Santa Barbara, CA, USA. 2024.

*Naturam totam complectari animo:* Towards a relational ecology. Pontifical University of the Holy Cross. Rome, Italy. 2024.

Italian Foundation for Cancer Research (FIRC) Institute of Molecular Oncology Physics Retreat. Torrazzetta, Italy. 2023.

Eco-evolutionary Dynamics of Microbial Communities Across Scales. The Abdus Salam International Centre for Theoretical Physics. Trieste, Italy. 2022.

Microbial Interactions at Multiple Scales. Santa Barbara Advanced School Of Quantitative Biology. Kavli Institute for Theoretical Physics. University of California, Santa Barbara, CA, USA. 2021.

Quantitative Approaches in Ecosystem Ecology. The Abdus Salam International Centre for Theoretical Physics. Trieste, Italy. 2020.

Evolutionary Quantitative Genetics 2016. National Institute for Mathematical and Biological Synthesis (NIMBioS). University of Tennessee, Knoxville, TN, USA. 2016.

Anvi'o workshop. University of Montreal, Montreal, Quebec, Canada. 2016.

### **Teaching**

**Developer, Co-Instructor.** Numerical Methods in Python. Quantitative Life Sciences Diploma Program. ICTP. Fall 2022, 2023, 2024, 2025.

**Associate Instructor.** BIOL-L 111 Foundations of Biology: Diversity, evolution, and ecology. *Indiana University*. Fall 2014, fall 2019, spring 2019, spring 2020.

**Associate Instructor.** BIOL-L 113 Biological Laboratory. *Indiana University*. Fall 2018.

**Associate Instructor.** BIOL-L 318 Evolution. *Indiana University*. Spring 2018.

**Co-Instructor.** BIOL-Z 620 [Quantitative Biodiversity](#). *Indiana University*. Spring 2017.

### **Mentorship**

**Mentor.** PhD students: José Camacho-Mateu (Charles III University of Madrid), Richmond Crisostomo (University of Montpellier), Roaa Mohammed Yagb Omer (SISSA), Matteo Sireci (University of Granada). ICTP. 2022 - Present.

**Mentor.** Master's/PhD student. Richard Wolff. *UCLA*. 2021-2022.

**Mentor.** Undergraduate honors thesis. Sarah Bald (now PhD student at Boston University). *UCLA*. 2021-2022.

**Mentor.** Bruins-In-Genomics (B.I.G.) Summer Undergraduate Research Program. *UCLA*. 2021.

**Mentor.** Undergraduate students: Peyton Thomas and Jessica Zellinger. *Indiana University*. 2015 – 2018.

**NSF REU Mentor.** Mentee: Jared Brewer (Transylvania University). *Indiana University*. 2016.

**Mentor.** Undergraduate Stephen J. Simonetti. *James Madison University*. 2013 – 2014.

## **Public Outreach**

**Interviewee.** "The Ecosystem Dynamics That Can Make or Break an Invasion". Gabriel Popkin. Quanta Magazine. 2025.

**Volunteer.** Maker Faire Trieste. 2024.

**Volunteer.** Letters to a Pre-Scientist. 2018 - 2022.

**Volunteer.** Skype a Scientist. 2019 - 2022.

**Organizer and co-Instructor.** [Foundations in Science and Mathematics..](#) 2016 – 2018.

**High School STEM Mentor** Jim Holland Summer Science Research Program. Mentee: Dakayla Calhoun. 2015.

**Science Radio Hour & Journal Club Host** Disentangling the Bank. WXJM. Harrisonburg, VA, USA. 88.7 FM. 2012-2014

## **Professional Service**

**Quantitative Life Sciences Postdoc Representative,** ICTP. 2023 - 2025.

**UAW 5810 Postdoc Union Leadership Committee,** UCLA. 2020 - 2022.

**EEB Program Representative,** Indiana Graduate Workers Coalition. 2018-2020.

**Reviewer: Scientific journals.** Applied and Environmental Microbiology, BMC Biology, Cell Reports Sustainability, Cell Systems, Communications Biology, Current Biology, eLife, mBio, Nature Communications, Nature Ecology and Evolution, PCI Evolutionary Biology, PLOS Computational Biology, PLOS One, Royal Society Open Science, Scientific Reports, Trends in Genetics.

**Reviewer: Funding bodies.** Deutsche Forschungsgemeinschaft (German Research Foundation).

## **Professional Society Membership**

American Physical Society (APS)

American Society of Microbiology (ASM)

Genetics Society of America (GSA)

Society for Molecular Biology and Evolution (SMBE)

Society for the Study of Evolution (SSE)