ZOEY WERBIN

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EDUCATION

Boston University September 2018 - August 2024
PhD in Biology, Certificate in Biogeoscience *Boston, MA*
- Advisors: Jennifer Bhatnagar and Michael Dietze
- Dissertation: Forecasting the soil microbiome

Swarthmore College September 2013 - May 2017
BA in Biology, Minor in Environmental Studies *Swarthmore, PA*

RESEARCH EXPERIENCE

Funga PBC May 2025 - Present
Ecological Data Scientist *Austin, TX (Hybrid)*
- Design and evaluate statistical analyses of field trials, carbon projects, and large-scale soil sampling campaigns
- Build machine learning models linking soil fungal communities and site conditions to pine growth and survival, used to predict fungal inoculant performance and inform treatment recommendations
- Support development of DNA amplicon sequencing pipelines (Nextflow, DADA2) for soil fungal communities
- Help design the company's data platform: a PostgreSQL ETL pipeline (Python, Windmill) that integrates field surveys, forest inventories, and DNA sequencing data with automated quality control
- Lead development of a QR-code scanning workflow for end-to-end tracking of thousands of shipped soil samples and their sequence data

Nature Tech Collective Jan 2025 - May 2025
Head of Research *Boston, MA*
- Data analysis, report writing, and proposal development on biodiversity monitoring and ecosystem services projects
- Authored research reports on startups and companies building tools for biodiversity monitoring

Boston University, Department of Biology September 2018 - August 2024
Graduate Research Fellow, PI: Jennifer Bhatnagar *Boston, MA*
- Conducted studies linking soil microbial communities to ecosystem function across spatio-temporal scales
- Developed methods for characterizing microbiome predictability and uncertainty using Bayesian hierarchical modeling and community genome-scale metabolic modeling of soil fungi, bacteria, and archaea
- Supervised undergraduate assistants in bioinformatics research

Swarthmore College, Department of Mathematics and Statistics June 2018 - August 2018
Project Scientist, PI: Steve Wang *Swarthmore, PA*
- Analyzed global biodiversity and extinction trends across geological stages using paleobiological records and modern threat levels
- Co-authored NSF-funded proposal and travel grants, leading initial data analysis and developing frameworks for contextualizing macroevolutionary patterns

Oak Ridge National Laboratory, Distributed Active Archive Center for Biogeochemical Dynamics September 2017 - May 2018
Post-Bachelor's Research Intern, Mentor: Dr. Alison Boyer. *Oak Ridge, TN*

- Conducted quality assurance for NASA atmospheric chemistry data
- Developed interactive data visualization tools for the Atmospheric Carbon and Transport - America (ACT-America) project using Shiny, a web framework for R
- Developed R package for processing ICARTT (atmospheric chemistry) data files

Florida State University, Department of Earth, Ocean, and Atmospheric Science June 2017 - August 2017
Research Assistant, PI: Olivia Mason *Tallahassee, FL*

- Implemented data processing pipelines for shotgun metagenomics and metatranscriptomics
- Created visualizations of carbon-cycling pathways in ocean microbial communities for grant proposals

Swarthmore College, Department of Biology January 2016 - August 2016
Research Assistant, PI: Elizabeth Nichols *Swarthmore, PA*

- Conducted dung beetle dissections, identified intestinal nematodes, and developed parasite identification guide at the University of Sao Paulo, Brazil
- Quantified infection intensity and conducted spatial analysis using R and QGIS

Academy of Natural Sciences of Drexel University May 2015 - August 2015
Research Assistant, PI: Jason Downs *Swarthmore, PA*

- Assisted with field material collection in fossil sites in the Catskill Formation
- Collected morphometric data on Bothriolepis (armored fish) fossils
- Characterized allometric growth patterns of adult specimens in R, and developed decision trees to diagnose the species of juvenile specimens

PUBLICATIONS

- **"Predicting biogeochemical fluxes with soil community metabolic models." Z. Werbin**, D. Segrè, M.C. Dietze, J.M. Bhatnagar. In prep (manuscript available upon request).
- **"Improved detection of fungi and uncultivated microorganisms in soil metagenomes using a comprehensive genome database" Z. Werbin**, I. Dukovski, D. Mankel, W.E. Anthony, D. Segrè, J.M. Bhatnagar, M. Felici. Submitted to ISME Communications.
- **"A direct comparison between field-measured and sensor-based estimates of soil carbon dioxide flux across six National Ecological Observatory Network sites enabled by the `neonSoilFlux` R package"** J. Zobitz, E. Ayres, **Z. Werbin**, et al., Submitted to Methods in Ecology and Evolution.
- **"Forecasting the soil microbiome at a continental scale." Z. Werbin**, C. Averill, J.M. Bhatnagar and M.C. Dietze. In review at Nature Communications Biology.
- **"Soil microbiome predictability increases with spatial and taxonomic scale."** C. Averill, **Z. Werbin**, K.F. Atherton, J.M. Bhatnagar and M.C. Dietze. Nat Ecol Evol 5, 747–756 (2021).
- **"The National Ecological Observatory Network's soil metagenomes: assembly and basic analysis" Z. Werbin**, B. Hackos, M. Dietze, J.M. Bhatnagar. F1000 Research 10:299 (2021).
- **"From DNA sequences to microbial ecology: Wrangling NEON soil microbe data with the *neonMicrobe* R package"** . C. Qin, R. Bartelme, Y. Chung, D. Fairbanks, Y. Lin, D. Liptzin, C. Muscarella, K. Naithani, K. Peay, P. Pellitier, A. St. Rose, L. Stanish, **Z. Werbin**, K. Zhu

· "**A tree-planting decision support tool for urban heat island mitigation.**" **Z. Werbin**, L. Heidari, P. Brochu, S. Buckley, L. Butler, C. Connolly, L. Houttuijn Bloemendaal, T. McCabe, T. Miller, L. Hutyra. PloS one, 15(10), e0224959.

PRESENTATIONS

FRP First Trip to Mars: How to pack light Space Travel With Earth Wisdom 2024 Symposium
Presenting author *Boston, MA, USA*

· "Predicting soil composition and activity using microbial community metabolic models." Zoey Werbin, M.C. Dietze, & J.M. Bhatnagar.

Ecological Society of America 2023 Annual Meeting
Contributed talk - presenting author *Portland, Oregon, USA*

· "Forecasting the soil microbiome across the United States." Zoey Werbin, C. Averill, M.C. Dietze, & J.M. Bhatnagar.

Ecological Society of America 2022 Annual Meeting
Invited talk - presenting author *Montreal, Quebec, CA*

· "Predicting soil microbiome structure and function using genome-scale metabolic modeling." Zoey Werbin, M.C. Dietze, & J.M. Bhatnagar.

American Geophysical Union 2021 Fall Meeting
Contributed talk - presenting author *Virtual*

· "From Bacterial Genomes to Biogeochemical Fluxes: Metabolic Modeling of the Soil Nitrogen Cycle." Zoey Werbin, J. Lopez-Nava, M.C. Dietze, & J.M. Bhatnagar.

Ecological Society of America 2021 Annual Meeting
Contributed talk - presenting author *Virtual*

· "Drivers of seasonal and interannual change in the soil microbiome." Zoey Werbin, M.C. Dietze, & J.M. Bhatnagar.

British Ecological Society 2020 Annual Meeting
Invited talk - presenting author *Virtual*

· "Forecasting the soil microbiome using microbial networks." Zoey Werbin, M.C. Dietze, & J.M. Bhatnagar.

Ecological Society of America 2020 Annual Meeting
Contributed talk - presenting author *Virtual*

· "Partitioning spatio-temporal variability in the soil microbiome." Zoey Werbin, C. Averill, M.C. Dietze, & J.M. Bhatnagar.

American Geophysical Union 2019 Fall Meeting
Contributed talk - presenting author *San Francisco, CA*

· "Forecasting the Soil Microbiome." Zoey Werbin, C. Averill, M.C. Dietze, & J.M. Bhatnagar.

American Geophysical Union 2019 Fall Meeting
Contributed poster *San Francisco, CA*

· "Airborne Data Visualizer: A Generalizable Web Application for Visual Exploration Of Greenhouse And Trace Gas Concentrations Observed From Aircraft" J.J. McNelis, A. Boyer, B.E. Wilson, Zoey Werbin, D. Wright, Y. Wei, & R. Shrestha

Ecological Society of America 2019 Fall Meeting
Contributed talk - presenting author *Louisville, KY*

· "Ecological forecasting of soil bacteria: predicting taxonomic and functional groups across the United States." Zoey Werbin, C. Averill, M.C. Dietze, & J.M. Bhatnagar.

Ecological Society of America 2019 Fall Meeting
Contributed talk *Louisville, KY*

· "Prediction and scale of the temperate forest mycobiome." C. Averill, J.M. Bhatnagar, M.C. Dietze, & Zoey Werbin.

Ecological Society of America 2019 Fall Meeting
Contributed talk *Louisville, KY*

· "Forecasting the forest mycobiome." C. Averill, J.M. Bhatnagar, M.C. Dietze, A. Raiho, & Zoey Werbin.

Ecological Society of America 2019 Fall Meeting
Contributed talk *Louisville, KY*

· "Linking iterative forecasting to hypothesis testing: a case study for how to do this in practice." M.C. Dietze, K.I. Wheeler, C. Averill, J.M. Bhatnagar, J.R. Foster, S.L. LaDeau, K. Weathers, Zoey Werbin, & K.A. Zarada.

Boston University Bioinformatics Student-Organized Symposium Jun 5 2019
Lightning talk *Boston, MA*

· "Spatial forecasting of the soil microbiome."

NSF Macrosystems PI Meeting May 15 2019
Contributed poster - presenting author *Boulder, CO*

· "The Near Term Ecological Forecasting Initiative: Microbial Diversity and Function." J.M. Bhatnagar, C. Averill, Zoey Werbin, M. Dietze, K.I. Wheeler, K.A. Zarada, S.L. Ladeau, J.R. Foster, K. Weathers, J. Brentrup.

Royal Society - The past is a foreign country: how much can the fossil record actually inform conservation? 2019 Discussion Meeting
Contributed poster - presenting author *London, UK*

· "Comparing the age selectivity of modern extinctions with Phanerozoic background and mass extinctions." Zoey Werbin, J.D. Wojciehowski, H. Wang, C.E. Habermeier, N.A. Heim, S. Finnegan, J.L.Payne., E. Nichols, & S.C. Wang.

American Geophysical Union 2018 Fall Meeting
Contributed poster *Washington, DC*

· "Predictability and scale of the Earth microbiome" C. Averill, Zoey Werbin, M. Dietze, & J. Bhatnagar.

American Geophysical Union 2018 Fall Meeting
Contributed poster *Washington, DC*

· "The persistence of root carbon in soil: data and modeling gaps." A. Malhotra, R.Z. Abramoff, P.J. Hanson, J.W. Harden, C. Hicks Pries, R.B. Jackson, M.L. McCormack, R.J. Norby, D. Sihi, B.N. Sulman, P.E. Thornton, S.J. Tumber-Davila, A. Walker, Zoey Werbin & C.M. Iversen.

Geological Society of America 2018 Annual Meeting
Contributed poster *Indianapolis, IN*

· "Are we entering a sixth mass extinction? Age selectivity of modern extinctions." H. Wang, C.E. Habermeier, Zoey Werbin, J.D. Wojciehowski, N.A. Heim, S. Finnegan, J.L. Payne, & S.C. Wang. DOI: 10.1130/abs/2018AM-323991

Geological Society of America 2018 Annual Meeting
Contributed talk *Indianapolis, IN*

· "Comparing the age selectivity of modern extinctions with Phanerozoic background and mass extinctions." S.C. Wang, Zoey Werbin, J.D. Wojciehowski, H. Wang, C.E. Habermeier, N.A. Heim, S. Finnegan & J.L. Payne. DOI: 10.1130/abs/2018AM-324110

Climate Change Science Institute (CCSI) Lunch and Learn Seminar Apr 10 2018
Seminar talk *Oak Ridge, TN*

· "Interactive Data Exploration Using R Shiny."

Geological Society of America 2016 Annual Meeting
Contributed poster - presenting author *Denver, CO*

· "Taxon age selectivity in modern extinctions." Zoey Werbin, S.C. Wang, S. Finnegan, J.L. Payne. DOI: 10.1130/abs/2016AM-286536

AWARDS AND FELLOWSHIPS

Graduate Research Fellowship Fall 2021-Spring 2024
National Science Foundation

· Five-year research fellowship, including three years of stipend funding and cost-of-education allowance (approx. $138,000 total)

Travel Award Summer 2023
Research Experience in Microbiomes Network

· Funding for attendance at ESA Annual Meeting, Aug 2023 ($1800)

Dr. Marion R. Kramer Scholarship Summer 2021
Boston University Department of Biology

· 4-month research stipend for outstanding achievement by female and women PhD students in Biology.

Travel Award Summer 2020
Boston University Graduate Student Organization

· Funding for attendance at ESA Annual Meeting, Aug 3-8 2020 ($500)

Graduate Student Travel Awards Fall 2019, Spring 2020, Spring 2022, Spring 2023
Boston University Department of Biology *$200-$1000*

· Funding for conference attendance

Biogeoscience Student Awards Spring 2019, Spring 2020, Fall 2021
Boston University Biogeoscience Program *$290-$500*

· Funding for conference attendance

Microbiome Fellowship Spring and Fall 2020
Boston University Microbiome Initiative

· One-year stipend to fund microbiome research that transcends the disciplinary boundaries of biology, physics, and mathematics. Founded biweekly Microbiome Initiative journal club. (approx. $34,000)

Graduate Student Travel Award Fall 2019
Boston University Department of Biology

· Funding for attendance at AGU Fall Meeting in San Francisco, CA, Dec 9-13 2019 ($200)

Biogeoscience Student Award Spring 2019
Boston University Biogeoscience Program

· Funding for attendance at ESA Fall Meeting in Louisville, KY, Aug 11-16 2019 ($480)

ESA+USSEE Annual Meeting Travel Award Spring 2019
Ecological Society of America (ESA)

· Funding for attendance at ESA Fall Meeting in Louisville, KY, Aug 11-16 2019 ($500)

Graduate Student Travel Award Spring 2019
Boston University Department of Biology

· Funding for attendance at ESA Fall Meeting in Louisville, KY, Aug 11-16 2019 ($200)

Dean's Fellowship Fall 2018
Boston University Graduate School of Arts & Sciences

· Fall and Spring semester stipend ($28,325)

NSF Sedimentary Geology and Paleobiology Award #1760634 2018-2019
"RUI: Comparing age selectivity in modern extinctions and the fossil record."

· Co-authored proposal, carried out analyses, mentored two undergraduate students, and created outreach activities (total budget: $54,059). PI: Steve Wang (Swarthmore).

Professional Opportunities Fund Travel Grant Fall 2016
Swarthmore College, Provost's Office

· Funding for attendance at Geological Society of America Fall Meeting 2016 ($807)

Peter and Aleck Karis Fellowship in Environmental Studies Summer 2016

· Research stipend to explore host-parasite response to landscape scale forest cover ($4350). PI: Elizabeth Nichols (Swarthmore).

SERVICE, TEACHING AND OUTREACH

Peer Review

· Referee for publications including Biogeochemistry, Global Change Biology, Fungal Ecology, Science Advances, Scientific Reports, Journal of Ecology, Soil Biology and Biochemistry, mBio, mSystems, Journal of Applied Ecology, Functional Ecology.

Prospective Scholars Mentor Apr 2021 - Aug 2024
Boston University

· Mentoring prospective students in the Masters/PhD application and interview process.

Graduate Women in Science and Engineering (GWISE) Mentor Sept 2018 - Aug 2024
Boston University

· Mentoring undergraduate BU students in STEM fields.

Teaching Fellow Jan 2020 - May 2020
Boston University

· Delivered instruction for lab sections of undergraduate introductory ecology course
· Developed remote lab protocols during COVID-19, including new "Introduction to Data Analysis in R" lab

Ecological Forecasting Summer Course July 2019 - July 2020
Boston University *Boston, MA*

· Teaching assistant for annual workshop on forecasting natural phenomena (additional description below).

Peripeteia Planning Committee Member (STEM Liaison) September 2015 - May 2017
Swarthmore College, Provost's Office

· Planned interdisciplinary panel discussions and organized annual weekend of informal classes taught by community members.

Science Associate January 2015 - May 2016
Swarthmore College, Department of Biology

· Led discussion groups for undergraduate Organismal and Population Biology courses
· Attended weekly seminars on pedagogical research and teaching philosophies

Intern June 2014 - August 2014
Florida Department of Environmental Protection

· Assisted in regulatory visits to businesses and factories in the FL DEP Southeast District.

WORKSHOPS AND TRAININGS

Microbiomes for All! Short Course August 2023

· Training in developing beginner-friendly instructional materials for microbial data analysis. Funded by REMnet (Research Experiences for Microbiologists).

Explore NEON Graduate Student Workshop November 2018
National Ecological Observatory Network (NEON) Headquarters *Boulder, CO*

· Workshop on NEON data collection and quality assurance, API usage, R packages, and biorepository. Met with NEON researchers to discuss microbial data availability and research plans. One of ten students selected for attendance and funding.

Ecological Forecasting Summer Course July 2018
Boston University *Boston, MA*

· Workshop on forecasting natural phenomena. Topics included Bayesian statistics, partitioning forecast uncertainty, data assimilation, machine learning, and decision science. One of fifteen early-career scientists, agency scientists, and graduate students selected for attendance and funding.

Introduction to Deep Learning Workshop February 2018
Oak Ridge National Laboratory *Oak Ridge, TN*

· Workshop on deep learning and neural networks, led by the NVIDIA Deep Learning Institute (DLI).

Institute for Emerging Sustainability Leaders July 2015
Amazon Center for Environmental Education and Research *Lima, Peru*

· Participated in workshops throughout Peru to address success and shortcomings of climate change policies. Learned strategies for communication between researchers, cultural groups, policy-makers, and stakeholders.

SKILLS

Programming	Python/TensorFlow, R, MATLAB, Bash scripting, PostgreSQL
Data Science	Machine learning, predictive modeling, Bayesian statistics, network analysis, data curation and wrangling, measurement error propagation
Visualization	Matplotlib, HTML5/CSS, Circos, ggplot2, R Shiny
Bioinformatics	Genome-scale metabolic modeling (COMETS, MICOM, GECKO), dynamic FBA, metagenomics, transcriptomics, genome assembly, functional gene analysis
Other tools	ArcGIS/QGIS, Nextflow, Snakemake, AWS, Docker, Git/GitHub (CI/CD pipelines)