Lucas C.Wheeler, PhD

Postdoctoral Associate · Department of Ecology and Evolutionary Biology · CU Boulder

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Education

Ph.D. in Biochemistry

Eugene, OR

University of Oregon

Sep. 2012 - Dec. 2017

- Department: Chemistry and Biochemistry
- Advisor: Michael Harms
- Dissertation: Evolution of Metal and Peptide Binding in the S100 Protein Family.

B.S. in Biochemistry

Bozeman, MT

Montana State University

Sep. 2009 - June 2012

- Department: Chemistry and Biochemistry
- Advisor: Trevor Douglas

Research Experience

Postdoctoral Fellow

Apr 2022 – present

Colorado State University, Department of Soil and Crop Sciences

Fort Collins, CO

- Coordination of genomic analyses and mechanistic modeling to assist molecular breeding of climate-resilient *Sorghum* varieties.
- International collaboration with plant breeders in West Africa.

Postdoctoral Associate

Jan 2018 – present

University of Colorado

Boulder, CO

- Coordination of field trips in Brazil and Argentina to collect samples from the Petunieae clade of Solanaceae. Phylogenetics to reconstruct species relationships. Transcriptomics, biochemical analyses, and bioinformatics to study the evolution of floral traits. Handling large sequencing datasets and corresponding collection metadata.
- Development of computational approaches to 1) simulate the evolution of metabolic pathways and 2) perform segregant analyses of backcross transcriptomic data to identify genes responsible for flower color transitions.
- Acquisition of funding for the development of computational tools, management of data storage and organization for large-scale international collaborative projects.
- Volunteer efforts: Field work at Niwot Ridge Long-term Ecological Research Program collecting soil moisture and plant community composition data, and in the desert Southwest collecting samples of *Physalis* to study self-incompatibility and *Larrea* to study polyploidization.

Graduate Research Fellow

Sep 2012 – Dec 2017

University of Oregon

Eugene, OR

- Development of high-throughput binding experiments and implementation of statistical approaches to quantitatively measure the evolution of protein-peptide interaction specificity in the S100 protein family.
- Phylogenetics and biochemical analyses to characterize the evolution of metal binding affinity, specificity, and structural effects in the S100 protein family.
- Managed laboratory tasks, supply ordering, sample storage information. As first student, helped to build the lab infrastructure and foundational projects.

Undergraduate research assistant

Sep 2009 – June 2012

Montana State University

Bozeman, MT

- Engineering of virus-like particles as templates for biomedical applications, including analgesics and anti-fungal agents.
- Fluorescent labeling of biomimetic nano-materials for *in vivo* experiments in mice and fungi.

Publications

*Corresponding author †Undergraduate co-author ‡Co-first author

Wheeler LC*‡, Walker JF, Ng J, Deanna R, Dunbar-Wallis A, Backes A, Pezzi PH, Virginia Palchetti M, Roberston HM, Monaghan A, Brandão de Freitas L, Barboza GE, Moyroud E, Smith SD (2022). Transcription factors evolve faster than their structural gene targets in the flavonoid pigment pathway. Molecular Biology and Evolution

Sinnott-Armstrong M, Deanna R, Pretz C, Liu S, Harris J Dunbar-Wallis A, Smith SD, **Wheeler LC*** (2022). How to approach the study of syndromes in macroevolution and ecology. Ecology and Evolution

Huffine CA, **Wheeler LC**, Wing BA, Cameron JC (2021). Computational Modeling and Evolutionary Implications of Biochemical Reactions in Bacterial Microcompartments. Current Opinion in Microbiology

Wheeler LC, Harms MJ (2021). Were ancestral proteins less specific? Molecular Biology and Evolution

Wheeler LC*, Wing BA, Smith SD (2020). Structure and contingency determine mutational hotspots for flower color evolution. Evolution Letters

Wheeler LC‡, Perkins A, Wong CE†, Harms MJ (2020). Learning Peptide Recognition Rules for a Low-Specificity Protein. Protein Science

Wheeler LC*, Smith SD (2019). Computational modeling of anthocyanin pathway evolution: Biases, hotspots, and trade-offs. Integrative and Comparative Biology

Hiranmayi Duvvuri†, **Wheeler LC**, Harms MJ (2018). pytc: open source python software for global analyses of isothermal titration calorimetry data. Biochemistry

Wheeler LC, Anderson JA, Morrison AJ, Wong CE†, Harms MJ (2017) Conservation of specificity in two low-specificity proteins. Biochemistry

Wheeler LC, Harms MJ (2017). S100A5 binds Ca^{2+} and Cu^{2+} independently. BMC Biophysics

Wheeler LC, Donor MT, Prell JS, Harms MJ (2016). Multiple Evolutionary Origins of Ubiquitous Cu^{2+} and Zn^{2+} Binding in the S100 protein Family. PLoS ONE

Wheeler LC‡, An-Lim S, Marqusee S, Harms MJ (2016). The thermostability and specificity of ancient proteins. Current Opinions in Structural Biology

Strengths & Skills

Data management	Organization of large datasets and collection metadata, automated data backup, Git/Github
Project coordination	Management of collaborative projects, organization of symposia and seminars
Interpersonal skills	Collaboration on large projects, working in teams, mentoring students, serving on committees, teaching
Communication & Scholarship	Writing research publications and detailed literature reviews, public and academic presentations
Botanical Field Work	Plant ID & collection, tissue preservation, reflectance spectroscopy, photography, microscopy, cytogenetics
General Field Skills	Navigation (maps, GPS), manual vehicle operation, hiking/backpacking, trip planning, sample transport
Computational specialties	Molecular phylogenetics & evolution, biostatistics, transcriptome assembly, gene expression, simulations
Molecular Biology	PCR, cloning, RNA & DNA extraction, gel electrophoresis, NGS library prep, bacterial culture, phage display
Biochemical techniques	Protein expression & purification, isothermal titration calorimetry, CD spectroscopy, HPLC, ultracentrifugation
Programming languages	Python (> 5 yrs), R (> 5 yrs), Bash (> 5 yrs), Julia (2 yrs), Snakemake (2 yrs), C++ (< 1 yr), SQL (< 1 yr)
Spoken Languages	English (native speaker), Spanish (conversational, proficient in reading and writing)), French (intermediate)

Funding

2019	**Research Innovation Office Seed Grant**, $50,000	*CU Boulder*
2015	**Mechanisms of Protein Evolution III: Student Travel Award**, $600	*SMBE*
2013-2016	**Molecular Biology and Biophysics Training Grant (UO-IMB)**, $75,000	*NIH*
2011-2012	**Montana INBRE Research Award**, $1500	*MT INBRE*
2011	**Swager Summer Research Award**, $600	*MSU*
2011	**Geer-Howald-Callis Summer Research Award**, $1200	*MSU*

Workshops, trainings, & courses

2021	**Learn C++ course**, Codeacademy	*Online*
2021	**Learn SQL course**, Codeacademy	*Online*
2021	**Diversity, Equity, and Inclusion Workshop**, CU	*Boulder, CO*
2020	**ALTEC Spanish Advanced Conversation**, CU	*Boulder, CO*
2018	**Navigating the NSF Review Process as a Beginning PI**, CU	*Boulder, CO*
2017	**Individual Development Plan (IDP) workshop**, UO	*Eugene, OR*
2016	**Illumina Metagenomics Workshop**, UO	*Eugene, OR*

Teaching Experience

Guest lecturer — *University of Colorado (Boulder)*
Herpetology — *2022*
Invited to give lecture and lead discussion on rattlesnake venom evolution

Guest lecturer — *University of Colorado (Boulder)*
Comparative Genomics — *2021*
Invited to give lecture and lead discussion of the role of structural variants in adaptation and speciation

Guest lecturer — *University of Colorado (Boulder)*
Phylogenetics and Comparative Biology — *2021*
Invited to give lecture and lead discussion of forensic phylogenetics for tracing the origin of viral infections

Co-instructor — *University of Colorado (Boulder)*
Plants and Society — *2020*
Assembled remote lectures and assignments on topics ranging from genetic engineering to ethnobotany

Guest lecturer — *University of Hawai'i at Mānoa*
Convergence and constraint: Lessons from the evolution of flower color — *2020*
Invited to give a remote guest lecture on pleiotropy and genetic constraints for upper level evolution class

Guest Instructor — *University of Colorado (Boulder)*
Biochemistry of Flower Color — *2018*
Developed and taught a lecture and lab exercise for visiting high-school students with CU Upward Bound

Instructor — *University of Oregon (Eugene)*
Biochemistry Recitation: Metabolism — *2013*
Led article discussions and group activities for this course to supplement the primary lecture course

Teaching assistant — *University of Oregon (Eugene)*
Biochemistry Laboratory — *2013*
Helped to plan, organize, and lead the laboratory that accompanied the upper-level biochemistry course

Teaching assistant — *University of Oregon (Eugene)*
General Chemistry Laboratory — *2012*
Helped to test activities and lead the laboratory that accompanied the introductory chemistry course

Volunteer Instructor — *Juniper Elementary (Bend, OR)*
Advanced 5th grade math — *2007*
Designed and taught a pre-algebra course for a group of advanced 5th grade students

Mentorship & Service

Research Mentorship

Clair Huffine — *Boulder, CO*
PhD student — *2021-2022*
Co-mentored a project to model the cyanobacterial carboxysome

Mikayah Oxendine — *Remote*
Undergraduate (Summer student) — *2020*
Oversaw mentorship (by graduate student Sukuan Liu) of project on carnivorous plants in Southeastern North America

Chandra Jacobs — *Remote*
Undergraduate (Summer student) — *2020*
Oversaw mentorship (by graduate student Jesse Harris) of project on phylogenetc relationships between medicinal plants

Chantelle Yazzi — *Remote*
Undergraduate (Summer student) — *2020*
Oversaw mentorship (by graduate student Chelsea Pretz) of project on analysis of flavonols in Navajo Tea (*Thelesperma*)

Ashley Hamilton — *Boulder, CO*
Undergraduate (Summer REU student) — *2019*
Guided a project in the bioinformatic analysis of transcriptomic data from the genus *Iochroma*

Alice Backes — *Boulder, CO*
Visiting masters student — *2018*
Guided a project in the bioinformatic analysis of transcriptomic and genomic data in online databases

Jocelyn Hernandez — *Eugene, OR*
Undergraduate (Summer Program for Undergraduate Research) — *2017*
Helped student to develop tools to study epistasis in protein evolution

Amber Rolland — *Eugene, OR*
PhD rotation student — *2016*
Helped to guide a project studying metal binding in the S100A8/A9 heterodimer complex

Erik Burlingame — *Eugene, OR*
Masters student — *2016*
Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Samantha Sivagnanam — *Eugene, OR*
Masters student — *2016*
Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Wendy Su — *Eugene, OR*
Masters student — *2016*
Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Caitlyn Wong — *Eugene, OR*
Undergraduate (honors thesis) — *2015 - 2017*
Guided a project characterizing the structural response of S100 proteins to binding of metals and peptides

Hiranmayi Duvvuri — *Eugene, OR*
Undergraduate student — *2015-2016*
Helped student to learn techniques and carry out isothermal titration calorimetry experiments

Sarina Pollat — *Eugene, OR*
Undergraduate (Summer Program for Undergraduate Research) — *2015*
Guided a project measuring the thermodynamics of metal and peptide binding in S100 proteins

Abigail Tami — *Eugene, OR*
Undergraduate (Summer Program for Undergraduate Research) — *2014*
Guided a project measuring the thermodynamics of metal and peptide binding in S100 proteins

Sunny Ketchum — *Eugene, OR*
Graduate rotation student — *2014*
Guided a project developing the molecular tools to study the S100A8/A9 protein complex

Kevin McKnaught — *Eugene, OR*
Graduate rotation student — *2014*
Helped student to develop a method for expression and purification of certain S100 proteins

Kendall Saboda — *Bozeman, MT*
Undergraduate student — *2012*
Helped student with the engineering and molecular cloning of custom virus-like particles

Kristen Hyberg — *Bozeman, MT*
Undergraduate student — *2011-2012*
Helped student with the molecular cloning, expression, and purification of custom virus-like particles

Service activities

Solanaceae seminars — *Colorado*
Co-organizer — *2021-present*
Helping to organize the SOL Seminar Online international seminar series

CDA Noxious Weed Advisory Committee — *Colorado*
Committee member — *2021-present*
At-large member, helping to advise CO department of agriculture on strategies for noxious weed management

CCL Colorado Virtual Seminars — *Colorado*
Co-organizer — *2020-2022*
Helped to organize interdisciplinary seminar and discussion group on climate policy

Smith lab Summer internship for Native American undergraduates — *Remote/in-person*
Volunteer — *2020-2021*
Helped to coordinate a Summer research experience for former students from the CU Upward Bound program

Bridge Program Choose Research Panel — *Remote*
Volunteer — *2020*
Sat on a panel discussion for community college transfer students interested in undergraduate research

McKenzie school district outreach — *Remote*
Volunteer — *2019-present*
Science discussions for 2nd grade classroom in the McKenzie school district in Oregon

CU Upward Bound — *Colorado*
Instructor — *2018-present*
Leading virtual and in-person outreach activities for high school students

Pinhead Institute — *Telluride, CO*
Instructor — *2019*
Leading "Punk Science" outreach activities for K-12 students

2019 Mayors' Climate Panel — *Denver, CO*
Co-organizer — *2019*
Helped to organize the 2019 Mayors' Climate Panel. Managed online registration and speaker invitations

Citizens' Climate Lobby — *Golden, CO*
Volunteer — *2018 - present*
Helped to organize tabling events, educational presentations, and lobby meetings with US representatives

Quantitative Problem Solving & Research Communication Consortium — *Eugene, OR*
Co-chair & co-founder — *2016 - 2017*
Helped to organize presentations & brainstorming sessions for graduate students and postdocs

UO SafeRide Program — *Eugene, OR*
Volunteer — *2016 - 2017*
Helped to provide free, safe rides at night for members of the university community

Mad Duck Science Fridays — *Eugene, OR*
Volunteer — *2013 - 2017*
Helped to organize and run engaging science learning activities for middle school students

Associated Students of MSU — *Bozeman, MT*
Student Senator — *2010 - 2011*
Served on several committees and acted as liaison to several student groups

Undergraduate Chemistry Society — *Bozeman, MT*
Secretary & Vice-president — *2009 - 2012*
Helped to organize fundraisers and to provide educational activities for local and rural Montana schools

Sacajawea Middle School — *Bozeman, MT*
Volunteer Mentor — *2009-2010*
Mentored a gifted student in advanced math; oversaw development of a project on fractals

Juniper Elementary School — *Bend, OR*
Volunteer Mentor — *2005 - 2008*
Provided tailored educational activities to students with special needs

Presentations and Seminars

Sol International Conference — *Online*
"Phylotranscriptomic analysis of flower color evolution in Petunieae" — *November 2020*
- Submitted poster

Solanaceae Seminar Series — *Online*
"An integrative approach to studying the evolution of floral pigmentation" — *September 2020*
- Invited talk

Botany virtual meeting — *Online*
"Phylotranscriptomics of the Petunieae clade of Solanaceae" — *July 2020*
- Submitted talk

Evolution meeting — *Providence, RI*
"Preferential fixation of structural or regulatory mutations depends on pathway position" — *June 2019*
- Submitted talk

Society for Integrative and Comparative Biology — *Tampa, FL*
"Computational modeling of anthocyanin pathway evolution" — *Jan. 2019*
- Submitted talk

Geobiology Supergroup Seminar — *Boulder, CO*
"Computational modeling of flower color evolution" — *Nov. 2018*
- Invited talk

Quantitative Think Tank — *Boulder, CO*
"Developing a computational model of the anthocyanin pathway" — *Oct. 2018*
- Submitted talk

Society for Molecular Biology and Evolution — *Austin, TX*
"Phage display and deep sequencing to study the evolution of binding specificity" — *July 2017*
- Submitted poster

Institute of Molecular Biology Seminar Series — *Eugene, OR*
"Evolution of metal and peptide binding in the S100 protein family" — *May. 2017*
- Annual seminar

Third International Symposium on Protein Folding and Dynamics — *Bangalore, India*
"Tracing the evolution of peptide binding specificity in the S100 protein family using phage display and deep sequencing" — *Nov. 2016*
- Submitted talk

Gibbs Conference on Biological Thermodynamics — *Carbondale, IL*
"Preferential fixation of structural or regulatory mutations depends on pathway position" — *Sep. 2016*
- Submitted talk

Life at the Nanoscale mini-symposium — *Eugene, OR*
"Tracing the evolution of peptide binding specificity in the S100 protein family using phage display and deep sequencing" — *Jun. 2016*
- Submitted poster

Institute of Molecular Biology Seminar Series — *Eugene, OR*
"Tracing the evolutionary history of transition-metal binding and peptide binding specificity in the S100 protein family" — *Apr. 2016*
- Annual seminar

Mechanisms of Protein Evolution III: Origins — *Denver, CO*
"Tracing the evolutionary fluctuations of peptide binding specificity in the S100 protein family" — *Nov. 2015*
- Submitted talk

Gibbs Conference on Biological Thermodynamics — *Carbondale, IL*
"Tracing the evolutionary fluctuations of peptide binding specificity in the S100 protein family" — *Sep. 2015*
- Submitted poster

Protein Folding Consortium Workshop — *Berkeley, CA*
"Probing the evolutionary history of peptide binding specificity in the S100 protein family" — *May. 2015*
- Submitted talk

Institute of Molecular Biology Seminar Series — *Eugene, OR*
"Probing the evolution of peptide-binding specificity in the S100 protein family" — *May. 2015*
- Annual seminar

Gibbs Conference on Biological Thermodynamics — *Carbondale, IL*
"Evolutionary biophysical studies of peptide specificity in the S100s" — *Sep. 2014*
- Submitted poster

Grad Talk Series — *Eugene, OR*
"Evolution as a molecular match maker: how do biological molecules evolve to recognize each other?" — *Nov. 2014*
- Invited talk

Protein Folding Consortium Workshop — *Ann Arbor, MI*
"Evolutionary biophysical studies of protein function in the S100 family" — *May. 2014*
- Submitted poster