John L. Darcy, PhD

Curriculum Vitae (March 2, 2021)

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Research Emphasis

In my research, I use mathematical models to understand how microbial communities change over time and space. My research has spanned several different study systems, including the human microbiome, mouse microbiome, native Hawaiian plants, and soil microbes living in extreme environments across the world. My most recent work at CU Anschutz uses a mathematical model I developed to ask to what extent microbes are more likely to join a microbiome if they already have a close relative living there.

Post-Doctoral Training

- US NIH NLM Computational Biology Post-Doctoral Fellowship at University of Colorado Anschutz Medical Campus, working with Catherine Lozupone. Fall 2018 - present.
- Post-doctoral researcher at University of Hawai'i at Mānoa, with Anthony Amend. Fall 2017 - 2018.

Education

- PhD in Ecology and Evolutionary Biology from University of Colorado, Boulder (2017). Partly done at Duke University. Dissertation title: Biogeographic and biogeochemical drivers of microbial community assembly. Advised by Steve Schmidt (Boulder) and Diana Nemergut (Duke).
- BA in Molecular, Cellular, and Developmental Biology (2010).

First-Author Publications *(incl. equal contribution of first two authors)*

[1] **Darcy JL**, Washburne AD, Robeson MS, Prest T, Schmidt SK, Lozupone CA. "A phylogenetic model for the arrival of species into microbial communities and application to studies of the human microbiome". *ISME J* (2020).

[2] **Darcy JL**, Cobian GM, Swift SOI, Zahn GL, Perry BA, Amend AS. "Fungal communities living within leaves of native Hawaiian dicots are structured by landscape-scale variables as well as by host plants". *Mol Ecol* (2020).

[3] **Darcy JL**, Gendron EMS, Sommers P, Porazinska DL, Schmidt SK. "Island Biogeography of Cryoconite Hole Bacteria in Antarctica's Taylor Valley and Around the World". *Front Ecol Evol* (2018).

[4] **Darcy JL**, Schmidt SK, Knelman JE, Cleveland CC, Castle SC, Nemergut DR. "Phosphorus, not nitrogen, limits plants and microbial primary producers following glacial retreat". *Sci Adv* (2018).

[5] **Darcy JL**, King AJ, Gendron EM, Schmidt SK. "Spatial autocorrelation of microbial communities atop a debris-covered glacier is evidence of a supraglacial chronosequence". *FEMS Microbiol Ecol* (2017).

[6] **Darcy JL**, Schmidt SK. "Nutrient limitation of microbial phototrophs on a debris-covered glacier". *Soil Biol Biochem* (2016).

[7] Schmidt SK, **Darcy JL**. "Phylogeny of ulotrichalean algae from extreme high-altitude and high-latitude ecosystems". *Polar Biol* (2015).

[8] **Darcy JL**, Lynch RC, King AJ, Robeson MS, Schmidt SK. "Global distribution of Polaromonas phylotypes - evidence for a highly successful dispersal capacity". *PLoS ONE* (2011).

[9] **Darcy JL**, Swift SOI, Amend AS, Lozupone C. "Generalized specificity analysis for microbial communities, with examples from Hawaiian foliar endophytic fungi, Antarctic glacier bacteria, and the human gut microbiome." *In prep* (2021).

Co-Author Publications

[10] Porazinska DL, Hu W, **Darcy JL**, Sommers P, Schmidt SK. "Primary succession of nematode communities following retreat of a high elevation glacier". 2020.

[11] Sommers P, Porazinska DL, **Darcy JL**, Vimercati L, Solon AJ, Schmidt SK. "Microbial species–area relationships in Antarctic cryoconite holes depend on productivity". 2020.

[12] Schmidt SK, Sowell P, Schubert ZR, Vimercati L, Solon AJ, Porazinska DL, Sommers P, **Darcy JL**, Gendron EMS. " Of Microbes and Mummies: Tales of Microbial Activity and Inactivity at 6000 masl". *Microbial Ecosystems in Central Andes Extreme Environments*. 2020. ISBN: 978-3-030-36192-1.

[13] Bueno de Mesquita CP, Brigham LM, Sommers P, Porazinska DL, **Darcy JL**, Suding KG, Schmidt SK. "Evidence for phosphorus limitation in high-elevation unvegetated soils, Niwot Ridge, Colorado". *Biogeochem* (2019).

[14] Sommers P, Fontenele RS, Kringen T, Kraberger S, Porazinska DL, **Darcy JL**, Schmidt SK, Varsani A. "Single-stranded DNA viruses in Antarctic cryoconite holes". *Viruses* (2019).

[15] Sommers P, Porazinska DL, **Darcy JL**, Zamora F, Fountain AG, Schmidt SK. "Experimental cryoconite holes as mesocosms for studying community ecology". *Polar Biol* (2019).

[16] Bowen T, **Darcy J**, Schmidt S. "RE: Pika's cold adaptation a liability with climate change". *Science* (2019).

[17] Gendron EMS, **Darcy JL**, Hell K, Schmidt SK. "Structure of bacterial and eukaryote communities reflect in situ controls on community assembly in a high-alpine lake". *J Microbiol* (2019).

[18] Vimercati L, **Darcy JL**, Schmidt SK. "The disappearing periglacial ecosystem atop Mt. Kilimanjaro supports both cosmopolitan and endemic microbial communities". *Sci Rep* (2019).
[19] Vargas-Gastélum L, Chong-Robles J, Lago-Lestón A, **Darcy JL**, Amend AS, Riquelme M. "Targeted ITS1 sequencing unravels the mycodiversity of deep-sea sediments from the Gulf of Mexico". *Environ Microbiol* (2019).
[20] Vimercati L, Solon AJ, Krinsky A, Arán P, Porazinska DL, **Darcy JL**, Dorador C, Schmidt SK. "Nieves penitentes are a new habitat for snow algae in one of the most extreme high-elevation environments on Earth". *AAAR* (2019).
[21] Tipton L, **Darcy JL**, Hynson NA. "A Developing Symbiosis: Enabling Cross-Talk Between Ecologists and Microbiome Scientists". *Front Microbiol* (2019).
[22] Sommers P, **Darcy JL**, Porazinska DL, Gendron EM, Fountain AG, Zamora F, Vincent K, Cawley KM, Solon AJ, Vimercati L, Ryder J, Schmidt SK. "Comparison of microbial communities in the sediments and water columns of frozen cryoconite holes in the McMurdo Dry Valleys, Antarctica". *Front Microbiol* (2019).
[23] Schmidt SK, Gendron EM, Vincent K, Solon AJ, Sommers P, Schubert ZR, Vimercati L, Porazinska DL, **Darcy JL**, Sowell P. *Life at extreme elevations on Atacama volcanoes: the closest thing to Mars on Earth?* 2018.
[24] Solon AJ, Vimercati L, **Darcy JL**, Arán P, Porazinska D, Dorador C, Farías ME, Schmidt SK. "Microbial Communities of High-Elevation Fumaroles, Penitentes, and Dry Tephra "Soils" of the Puna de Atacama Volcanic Zone". *Microb Ecol* (2018).
[25] Kennedy RC, Fling RR, Robeson MS, Saxton AM, Schneider LG, **Darcy JL**, Bemis DA, Zhao L, Chen J. "Temporal dynamics of gut microbiota in triclocarban-exposed weaned rats". *Environ Sci Pollut R* (2018).
[26] Sommers P, **Darcy JL**, Gendron EM, Stanish LF, Bagshaw EA, Porazinska DL, Schmidt SK. "Diversity patterns of microbial eukaryotes mirror those of bacteria in Antarctic cryoconite holes". *FEMS Microbiol Ecol* (2018).
[27] Knelman JE, Graham EB, Ferrenberg S, Lecoeuvre A, Labrado A, **Darcy JL**, Nemergut DR, Schmidt SK. "Rapid shifts in soil nutrients and decomposition enzyme activity in early succession following forest fire". *Forests* (2017).
[28] Schmidt SK, Vimercati L, **Darcy JL**, Arán P, Gendron EM, Solon AJ, Porazinska D, Dorador C. *A Naganishia in high places: functioning populations or dormant cells from the atmosphere?* 2017.
[29] Schmidt SK, **Darcy JL**, Sommers P, Gunawan E, Knelman JE, Yager K. "Freeze–thaw revival of rotifers and algae in a desiccated, high-elevation (5500 meters) microbial mat, high Andes, Perú". *Extremophiles* (2017).
[30] Washburne AD, Silverman JD, Leff JW, Bennett DJ, **Darcy JL**, Mukherjee S, Fierer N, David LA. "Phylogenetic factorization of compositional data yields lineage-level associations in microbiome datasets". *PeerJ* (2017).
[31] Schmidt SK, Porazinska D, Concienne BL, **Darcy JL**, King AJ, Nemergut DR. "Biogeochemical Stoichiometry Reveals P and N Limitation Across the Post-glacial Landscape of Denali National Park, Alaska". *Ecosystems* (2016).
[32] Kennedy RC, Fling RR, Robeson MS, Saxton AM, Donnell RL, **Darcy JL**, Bemis DA, Liu J, Zhao L, Chen J. "Temporal Development of Gut Microbiota in Triclocarban Exposed Pregnant and Neonatal Rats". *Sci Rep* (2016).
[33] Nemergut DR, Knelman JE, Ferrenberg S, Bilinski T, Melbourne B, Jiang L, Violle C, **Darcy JL**, Prest T, Schmidt SK, Townsend AR. "Decreases in average bacterial community rRNA operon copy number during succession". *ISME J* (2016).
[34] Schmidt SK, **Darcy JL**. "Phylogeny of ulotrichalean algae from extreme high-altitude and high-latitude ecosystems". *Polar Biol* (2015).
[35] Knelman JE, Schmidt SK, Lynch RC, **Darcy JL**, Castle SC, Cleveland CC, Nemergut DR. "Nutrient addition dramatically accelerates microbial community succession." *PloS one* (2014).
[36] Lynch RC, **Darcy JL**, Kane NC, Nemergut DR, Schmidt SK. "Metagenomic evidence for metabolism of trace atmospheric gases by high-elevation desert Actinobacteria." *Front Microbiol* (2014).
[37] Schmidt SK, Nemergut DR, **Darcy JL**, Lynch R. "Do bacterial and fungal communities assemble differently during primary succession?" *Mol Ecol* (2014).
[38] Lynch RC, **Darcy JL**, Kane NC, Nemergut DR, Schmidt SK. "Metagenomic evidence for metabolism of trace atmospheric gases by high-elevation desert actinobacteria". *Front Microbiol* (2014).
[39] Knelman JE, Schmidt SK, Lynch RC, **Darcy JL**, Castle SC, Cleveland CC, Nemergut DR. "Nutrient addition dramatically accelerates microbial community succession". *PLoS ONE* (2014).
[40] Naff CS, **Darcy JL**, Schmidt SK. "Phylogeny and biogeography of an uncultured clade of snow chytrids." *Environ Microbiol* (2013).
[41] Nemergut DR, Schmidt SK, Fukami T, O'Neill SP, Bilinski TM, Stanish LF, Knelman JE, **Darcy JL**, Lynch RC, Wickey P, Ferrenberg S. "Patterns and processes of microbial community assembly." *MMBR* (2013).
[42] Naff CS, **Darcy JL**, Schmidt SK. "Phylogeny and biogeography of an uncultured clade of snow chytrids". *Environ Microbiol* (2013).
[43] Schmidt SK, Nemergut DR, Todd BT, Lynch RC, **Darcy JL**, Cleveland CC, King AJ. "A simple method for determining limiting nutrients for photosynthetic crusts". *Plant Ecol Div* (2012).
[44] Rhodes M, Knelman J, Lynch RC, **Darcy JL**, Nemergut DR, Schmidt SK. "Alpine and arctic soil microbial communities". *The Prokaryotes*. 2012. ISBN: 9783642301230.

Publication Metrics

- 43 published papers
- 1693 citations (as of 03/2020)
- h-index = 19
- i10-index = 23

Mentorship and Team Leadership

- Mentored Matthew Marshall, an undergraduate student as part of CU Anschutz Summer Bioinformatics Fellowship. I mentored Matt in developing a computer program that analyzes microbial communities in a competitive-lottery framework. We met twice weekly, and I created a production schedule and advised Matt on both programming and writing. Matt is preparing software for pulic release, and has written a release note for publication.
- Lead a team at UH to develop and test a 3D-printed air sampler, to be used in large-scale sampling of air microbiota on the Hawaiian Islands. Team included 2 PhD students and 3 undergraduate students. Samplers were succesfully deployed in-situ and operated without supervision in the rainforest for multiple days until collected.
- Advised Adam Solon's honors thesis project in 2016. Adam used Illumina sequencing to compare microbial communities from multiple sites in the Chilean Atacama Desert, and this work is now published in Microbial Ecology [24]. He was awarded summa cum laude.
- Advised Cerrise Weibern honors thesis project in 2015. She sequenced genomes of 8 Janthinobacterium strains and constructed a robust phylogeny of the species. She was awarded magna cum laude.
- Advised Zack Schubert's honors thesis project in 2014. I taught him how to implement complex simulation models in R, and together we made and compared mathematical models of water availability in soil undergoing freeze-thaw cycling. He was awarded summa cum laude.
- Mentored three undergraduate students from 2012 to 2014: Todd BT, Schrepel WA, and Choi RB. All three performed and helped design experiments. Todd BT is a co-author on several publications.
- Mentored two local middle school students, who completed a science fair project on E. coli transgenics. They won first prize in their school science fair competition, and went on to compete at state level.

Teaching

- Started "Aloha R", a computational biology workshop for graduate students at UH (Spring 2018). Weekly meetings focused on core programming skills, since many students view R as a "copy and paste" analytical platform rather than a robust programming environment. I also emphasized code documentation and repeatability.
- Guest lecturer for Ecology of Microbial Symbiosis (Spring 2018). Taught 2 lecture classes reviewing bioinformatics approaches used by microbial symbiosis researchers.
- Guest lecturer for Microbial Ecology (Fall 2016) Taught 3 lecture classes introducing students to modern molecular and bioinformatic approaches to microbial ecology.
- Ecology Lab TA (Fall 2013) Taught ecological theory and field methods, as well as basic statistics and computer programming in R. Three-hour periods with 20 students, 2x/week.
- Microbiology lab TA (Spring 2012) Taught basic microbiological technique, and modern molecular methods. Also wrote weekly quizzes and gave recitation. Two-hour periods with 18 students, 4x/week.

Funding and Awards

- NIH NLM Computational Biology Postdoctoral Fellowship (present position).
- 2019 Front Range Microbiome Symposium award for best presentation. $100.
- International Geological Society travel grant. Kyoto, Japan, December 2017. ¥100,000.
- Mycological Society of America travel award. San Juan, Puerto Rico, December 2017. $2,500.
- SCAR XIIth International Biology Symposium Travel Grant. KU Leuven, December 2016. $2,500.
- Remote (control) sensing: using a drone for environmental science. CU EBIO grant, April 2014. $992.
- High-throughput climate change modeling from the gene's perspective. Dean's Graduate Student Research Grant Award, CU Boulder, October 2014. $5,000.

Selected Presentations and Posters

- Nepotism and Specificity In the human microbiome (Invited talk, 2020). CU Anschutz Computational Biology seminar series. Aurora, Colorado.
- What are compositional data and why do I care? (Invited talk, 2020). CU Anschutz Computational Biology seminar series. Aurora, Colorado.
- A phylogenetic model for the arrival of species into microbial communities (Invited talk, 2019). NIH NLM Computational Biology Training Conference. Indianapolis, Indiana.
- Specificity analysis of microbiome data: All the math (Chalk talk, 2019). CU Anschutz Microbiome group chalk talk.
- Monte Carlo analysis of Foliar Fungal Endophytes reveals habitat specificity to elevation, precipitation, and host plants (Seminar, 2019). Hawaii Ecosystems Conferencein Hilo, Hawaii.
- A phylogenetic model for the arrival of species into microbial communities (Poster, 2019). Front Range Microbiome Symposium in Fort Collins, Colorado.

- Cryoconite holes are microbial islands (Seminar, 2018). International Glaciological Society meeting in Kyoto, Japan.
- Island biogeography of glacial microbiota in Antarctica's Taylor Valley and around the world (Seminar, 2017). Scientific Committee on Antarctic Research Biology meeting in Leuven, Belgium.
- Using Adobe Illustrator to make scienetific figures (Seminar, 2016). CU Boulder EBIO dept. Brown-bag talk.
- Phylogenetic and biogeochemical characterization of a debris-covered glacier (Poster, 2013). ASM General Meeting 2013 in Denver CO.
- Identification and characterization of microbial communities in high-elevation snowpacks (Poster, 2013). LTER meeting 2013 in Estes Park, CO.
- Comparing spatial distributions of microorganisms using minimal genetic distance. ASM General Meeting 2012 in San Francisco, CA.

Peer-Review

Journals I've peer-reviewed for are listed on my Publons profile (slow to update).

Journal	Number of Reviews	Recency
NPJ Biofilms and Microbiomes	2	2020
Nature Communications	3	2019
Ecology and Evolution	1	2020
Data in Brief	1	2020
PeerJ	1	2019
Plant and Soil	1	2019
Molecular Ecology	4	2018
Environmental Microbiology	1	2018
Frontiers in Microbiology	1	2017
The ISME Journal	1	2018
Journal of Biogeography	1	2018

Data and Analytical Skillset

Spatial analyisis [2, 3, 8]
Spatiotemporal analysis [2, 5, 33]
Comparative genomics [4, 36]
Mathematical modeling and simulation modeling [1, 2, 6]
Geographic information systems (GIS) [2, 3, 5]
Meta-analysis [1, 3, 8]
Project-level version control [4, specificity R package]
High-throughput sequencing analysis [1–3]
Temporal analysis [1, 32, 35]
Landscape ecology [2, 4, 5]
Phylogenetics [7, 8, 40]
Multivariate satistical analysis [2, 5, 17]
Spatial experimental design [3–5]
Machine learning (current project)
Genome assembly and metagenome assembly [4, 36]
High-throughput sequencing pipelining [1–3]

Programming Languages

Language	Proficiency	Example
R	(expert)	github.com/darcyj/specificity
C#	(advanced)	github.com/darcyj/XtendR_Csharp
Shell/Bash	(advanced)	github.com/darcyj/fasta-scripts
C++	(intermediate)	github.com/darcyj/specificity
Python	(intermediate)	github.com/darcyj/cardpricer
LaTeX	(beginner)	github.com/darcyj/cv
HTML+CSS	(beginner)	jldarcy.tk

General Software Knowledge

Linux system admininstration
Slurm
qGIS
Rstudio
Mendeley
Microsoft Office (Word, Excel, Ppt)
Libre Office (Writer, Calc)
Sublime Text
MonoDevelop
High performance computing (HPC)
Adobe Illustrator
Adobe Photoshop
Zoom
Unix command line tools

Molecular Biology and Bioinformatics Software Knlowledge

Qiime/Qiime2
Phyloseq
Usearch/Vsearch
DADA2
BLAST
SRA Toolkit
SOAPdenovo
MetaVelvet
MaxBin
metaSPAdes
Samtools
BWA
MrBayes
FastTree
MUSCLE
SEPP
ITSxpress
Fastx Toolkit

Laboratory Skillset

Bacterial culture	Illumina sequencing prep	Fluorescence microscopy
Microcosm experiments	Sanger sequencing prep	Phase-contrast microscopy
Media prep/creation	DNA/RNA purification	Staining/fixing
Culture preservation	Qubit/Nanodrop	Computational microscopy
Cloning	Gel electrophoresis	Primer development
PCR/qPCR/Colony PCR	Plate reader analyses	Various soil analyses

Fieldwork Expertise

- Sample collection in extreme conditions at high altitude (>6000 masl).
- Drone flight and data capture at high altitude (>5000 masl).
- Sampling based off of remote sensing data and planned spatial experimental designs.
- Wilderness survival after a grizzly bear destroyed my tent+bag+pad followed by 12 hours of rain.
- Extemporaneous experimental design under hypoxic conditions.
- Logistic coordination with indigenous peoples in the Peruvian Andes.
- Extended backpacking campaigns above 5000 masl.
- Experience in Antarctica's McMurdo Dry Valleys, including helicopter travel, ice climbing, and glacier traverse.
- Rainforest backpacking and sample collection in Hawaii.

Photos

Standing at the terminus of the Canada Glacier in the McMurdo Dry Valleys, Antarctica.

With my labmate Lara amongst penitentes on the stratovolcano Llullaillaco in the Chilean Andes.