Karna Gowda

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EDUCATION

Ph.D., Engineering Sciences and Applied Mathematics 2011 – 2017
Northwestern University, Evanston, IL
Dissertation: *Investigations of pattern formation in dryland vegetation*
Advisor: Mary Silber

MBL Physiology Course: Modern Cell Biology Using Microscopic, Biochemical and Computational Approaches 2016
Marine Biological Laboratory, Woods Hole, MA

B.S., Mathematics *(with distinction)* 2005 – 2008
University of Illinois at Urbana-Champaign, Urbana, IL

PROFESSIONAL EMPLOYMENT

Postdoctoral Scholar 2020 – present
Department of Ecology & Evolution and Center for Physics of Evolving Systems
University of Chicago, Chicago, IL

James S. McDonnell Foundation Postdoctoral Fellow 2017 – 2020
Department of Physics
University of Illinois at Urbana-Champaign, Urbana, IL

PUBLICATIONS

K. Gowda, D. Ping, M. Mani, and S. Kuehn. "Genomic structure predicts metabolite dynamics in microbial communities." *Cell* **185**, 530–546 (2022). doi:10.1016/j.cell.2021.12.036

↪ Highlighted by A. Flamholz and D. Newman. "The metabolic rate is the trait." *Current Biology* **32**, R215–R218 (2022). doi:10.1016/j.cub.2022.02.002

C. Gopalakrishnappa*, **K. Gowda***, K. Prabhakara*, and S. Kuehn. "An ensemble approach to the structure-function problem in microbial communities." *iScience* **25**, 103761 (2022). doi:10.1016/j.isci.2022.103761

D. T. Fraebel, **K. Gowda**, M. Mani, and S. Kuehn. "Evolution of generalists by phenotypic plasticity." *iScience* **23**, 101678 (2020). doi:10.1016/j.isci.2020.101678

P. Gandhi, L. Werner, S. Iams, **K. Gowda**, and M. Silber. "A topographic mechanism for arcing of dryland vegetation bands." *Journal of the Royal Society Interface* **15**, 20180508 (2018). doi:10.1098/rsif.2018.0508

K. Gowda, S. Iams, and M. Silber. "Signatures of human impact on self-organized vegetation in the Horn of Africa." *Scientific Reports* **8**, 3622 (2018). doi:10.1038/s41598-018-22075-5

K. Gowda, Y. Chen, S. Iams, and M. Silber. "Assessing the robustness of spatial pattern sequences in a model of dryland vegetation." *Proceedings of the Royal Society A* **472**, 20150893 (2016). doi:10.1098/rspa.2015.0893

K. Gowda and C. Kuehn. "Early-warning signs for pattern-formation in stochastic partial differential equations." *Communications in Nonlinear Science and Numerical Simulation* **22**, 55–69 (2015). doi:10.1016/j.cnsns.2014.09.019

K. Gowda, H. Riecke, and M. Silber. "Transitions between patterned states in vegetation models for semiarid ecosystems." *Physical Review E* **89**, 022701 (2014). doi:10.1103/PhysRevE.89.022701

* contributed equally.

GRANTS, HONORS & AWARDS

Postdoctoral

Funded

NSF Emerging Frontiers Grant — 2020 – 2023
"Decoding the genomic rules of denitrification in bacterial communities."
Principal Investigator: Seppe Kuehn
Role: Provided preliminary data and co-authored the proposal.
Amount: $460,060

James S. McDonnell Foundation Postdoctoral Fellowship — 2017 – 2020
"Evolving communities: how adaptation shapes microbial interactions."
Principal Investigator: Karna Gowda
Amount: $200,000

In progress

Burroughs Wellcome Fund Career Awards at the Scientific Interface (CASI) — submitted January 2022
"A statistical view of microbial community metabolism."
Principal Investigator: Karna Gowda
Amount: $500,000

NIH Research Project Grant (R01) — resubmitting March 2022
"Predicting emergent microbial community metabolism from genomic composition."
Principal Investigator: Seppe Kuehn
Role: Providing preliminary data and co-authoring the proposal.
Submitting to: NIGMS, Modeling and Analysis of Biological Systems Study Section.

Graduate

NSF-RTG Graduate Training Fellowship, Northwestern University — 2016 – 2017

NIH & Helmsley Charitable Trust Scholarship, Marine Biological Laboratory — 2016

Presidential Fellowship Finalist, Northwestern University — 2015

SAMSI Visiting Graduate Fellow, Program on Mathematical and Statistical Ecology — 2014 – 2015

Professional Development Grant, The Graduate School, Northwestern University — 2014

ComSciCon-Chicago Workshop Funding, Graduate Student Council, University of Chicago — 2014

Walter P. Murphy Fellowship, Northwestern University — 2012 – 2013

Travel grants to NSF Math & Climate Research Network meetings at SAMSI and Bowdoin College, and ComSciCon at Harvard University — 2012 – 2014

Undergraduate

National Merit Scholarship — 2005 – 2008

University of Illinois Honors Scholarship — 2005 – 2006

SELECTED PRESENTATIONS

Invited talks

Stanislas Leibler Group Meeting, Institute for Advanced Study (virtual). — March 9, 2022
"A statistical view of microbial community metabolism."

Host-microbe Center Seminar, University of Oregon (virtual). — January 31, 2022
"A statistical view of microbial community metabolism."

KITP Program on the Ecology and Evolution of Microbial Communities, Santa Barbara, CA. — July 28, 2021
"Pathway splitting in denitrifying bacterial communities."

Math, Statistics, and Computer Science Seminar, St. Olaf College, Northfield, MN. September 13, 2019
"Can we predict microbial community function from genomic structure?"

Institute for Genomic Biology Seminar, University of Illinois at Urbana-Champaign, Urbana, IL. March 29, 2019
"Mapping bacterial genomes to quantitative functional measurements."

Statistics Seminar, University of Chicago, Chicago, IL. February 3, 2017
"Measuring change and properties of banded vegetation via aerial imagery."

Physics Seminar, University of Illinois at Urbana-Champaign, Urbana, IL. April 8, 2016
"Pattern formation in dryland ecology."

GIS in the Environment & Business, Northwestern University Library, Evanston, IL. November 19, 2015
"Using GIS & remote sensing imagery to study semi-arid ecology."

Contributed talks and posters

American Physical Society March Meeting, Chicago, IL. March 16, 2022
"Genomic structure predicts metabolite dynamics in microbial communities."

American Physical Society March Meeting (virtual). March 3, 2020
"Predicting microbial community metabolic function from genomic structure."

SIAM Conference on Dynamical Systems, Snowbird, UT. May 23, 2017
"Dynamics and resilience of vegetation bands in the Horn of Africa."

SIAM Conference on Dynamical Systems, Snowbird, UT (poster). May 19, 2015
"Pattern sequences as early-warning signs of critical transition in models of dryland vegetation."

Spatio-Temporal Dynamics in Ecology, Leiden, Netherlands (poster). December 8, 2014
"Transitions between patterned states in vegetation models."

International Centre for Mathematical Sciences Tipping Points, Edinburgh, U.K. (poster). September 9, 2013
"Transitions between patterned states in vegetation models."

SACNAS National Conference, San Antonio, TX. October 5, 2013
"Regime shifts in noisy time series: injecting innovative interdisciplinary research into the classroom."

SIAM Conference on Dynamical Systems, Snowbird, UT. May 19, 2013
"A small amplitude framework for vegetation patterns in semi-arid ecosystems."

IUGG Conference on Mathematical Geophysics, Edinburgh, U.K. (poster). June 18, 2012
"Pattern formation in a spatially explicit vegetation model."

TEACHING

Teaching assistant

Physical Biology of the Cell Training Course, Marine Biological Laboratory 2017

Differential Equations of Mathematical Physics, Northwestern University 2016

Engineering Analysis 4 (applied differential equations, lead TA), Northwestern University 2013

Honors Calculus for Engineers (multivariable calculus), Northwestern University 2012

Linear Algebra and Differential Equations, University of Illinois at Urbana-Champaign 2007 – 2008

Pedagogical service

Guest lecturer for Partial Differential Equations course at St. Olaf College 2021

Guest lecturer for Mathematical Biology course at St. Olaf College 2020

Developed a research module for Macalester College/Harvey Mudd College REU 2016

Developed and guest lecturer for *Ecological Resilience* module in Biomathematics course at Bowdoin College 2013

Peer instructor for Calculus and Linear Algebra preliminary prep sessions 2012 – 2013

MENTORSHIP

Research projects

Kyle Crocker, currently pursuing postdoctoral studies in Ecology & Evolution, University of Chicago 2021 – present
Environmentally-imposed constraints shape division of metabolic labor in bacterial denitrification.

Chin Yi Tan, currently pursuing PhD in Physics, University of Chicago 2021
Measuring bacterial metabolism at high precision using low-cost pressure sensors.

Derek Ping, pursued BS in Physics, University of Illinois at Urbana-Champaign 2018 – 2020
Genomic structure predicts metabolite dynamics in microbial communities.
Currently pursuing PhD in Physics, Purdue University

Sungsoo Lim, pursued MS in Mathematics, University of Illinois at Urbana-Champaign 2018 – 2019
Design principles of in silico evolved oscillators.
Currently pursuing PhD in Engineering Sciences and Applied Mathematics, Northwestern University

Jingyu Li, pursued BS in Chemical and Biological Engineering, University of Illinois at Urbana-Champaign 2018
Exploration of physiological rhythms using genetic algorithms.
Currently pursuing PhD in Operations Research, Georgia Institute of Technology

Noah Gamble, pursued BS in Applied Mathematics, Northwestern University 2015 – 2017
Studying ant caste structure using phenomenological modeling and experimental colony data.
Currently pursuing PhD in Biophysical Sciences, University of Chicago

Lucien Werner, pursued MS in Applied Mathematics, Northwestern University 2015 – 2016
A topographic mechanism for arcing of dryland vegetation bands.
Currently pursuing PhD in Computing & Mathematical Sciences, California Institute of Technology

Other mentorship

Peer leader for JSMF-SFI Postdocs in Complexity Research Workshop, Santa Fe Institute 2018

Faculty research mentor for Illinois Geometry Lab, University of Illinois at Urbana-Champaign 2018

Mentored low-income first generation college students through the Chicago Scholars Foundation 2014 – 2017

Mentored a student research project through the Niles West High School STEM Mentorship Program 2013 – 2014

OUTREACH

Presented research to underserved high school students through the Schuler Scholar Program 2015 – 2016

Cofounded and led the *Communicating Science-Chicago (ComSciCon-Chicago)* workshop 2014 – 2016

Won 4th place in the Northwestern Scientific Images Contest 2016

Organized public outreach activity *American Scidol* at the MIT Museum 2014

Volunteered at the Northwestern Graduate Leadership Council's Science Pentathlon for middle schoolers 2014 – 2015

Organized the *Communicating Science National Workshop (ComSciCon)*, Cambridge, MA 2014

Attended inaugural *Communicating Science National Workshop (ComSciCon)*, Harvard University 2013

SERVICE

Professional

Organizing *Theory in Biology* virtual seminar present

Refereed manuscripts for *Science Advances*, *Current Biology*, *iScience*, 2013 – present
SIAM Journal on Applied Mathematics, *Journal of Mathematical Biology*, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, and *Communications in Nonlinear Science and Numerical Simulation*

Designed and administered the *Math and Climate Research Network* online platform 2015 – 2016

Organized the *Mathematics of Climate Tipping Points* focus group 2012 – 2015

Department

Founded and organized the *Physical Biology of the Cell* reading group	2015 – 2016
Cofounded and organized the *First-year Foundations* workshop	2012 – 2014
Founded and organized the *Dynamical Systems Student Reading Group*	2012 – 2013
Represented graduate students on departmental *Student Leadership Board*	2013 – 2015

SELECTED PRESS

- U. Chicago News, The genomic structure of microbial communities can predict metabolic activity January 26, 2022
  Also carried by Northwestern News, Phys.org, and EurekaAlert.
- SIAM News, Modeling Vegetation Patterns in Vulnerable Ecosystems March 1, 2017