KELLY ANN HEILMAN

Laboratory of Tree Ring Research
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EDUCATION

University of Notre Dame *August 2013 - 2019*
PhD
Department of Biology

Kenyon College *August 2008 - May 2012*
Bachelor of Arts, Biology and Environmental Studies. Magna cum laude

RESEARCH EXPERIENCE

Postdoctoral Research Associate – University of Arizona ***2019 - present***
To improve forecasts of forest carbon stock and fluxes, I assimilate two large datasets in a state space modelling framework: repeat censuses from the Forest Inventory and Analysis and annual tree ring growth records. We use this framework to forecast forest carbon stock and flux across the Interior West US, evaluate forecast uncertainties, and inform forest management.

PhD Graduate Research Assistant – University of Notre Dame ***2013 - 2019***
Investigated how environmental changes affect both the large-scale distribution of woody biomes, and treelevel responses to drought. Specifically, I explored how historic changes in land-use, climate, and CO2 impacted the stability and drought tolerance of the temperate savanna-forest biome boundary using historic datasets, Bayesian modelling, dendrochronology, and stable isotope geochemistry.

Aquatic Research Technician – Cleveland Metroparks ***2012 - 2013***
Performed both fish and aquatic invertebrate sampling for headwater stream restoration assessments. Led ecology field trips, and contributed to fishing expo outreach events.

Toucan Research Assistant – CATIE, Costa Rica ***2013***
Tracked the home range and seed dispersal of toucans in Turrialaba, Costa Rica. This contributed to the dissertation of Dr. Landon Jones.

Kenyon Summer Science Research Scholar – Kenyon College ***2011***
Investigated the impacts of climate change on reproduction success of a threatened minnow species.

GRANTS AND FELLOWSHIPS

National Science Foundation Doctoral Dissertation Improvement Grant DEB-1701897. *2017*

Center for Environmental Science Technology (CEST) Bayor Fellowship *2017*

UNDERC Mentoring Fellowship *2017 2018*

Arthur J. Schmitt Leadership Fellowship *2013-2019*

Leslie Douglas Frye Scholarship to Attend Kenyon College *2008-2012*

Dr. Kirby Walsh Sullivan Scholarship for Promising Students in Science *2009-2012*

PUBLICATIONS

Heilman, K.A., Dietze, M., Finley, A.O., Arizpe, A., Aragon, J., Gray, A., Shaw, J.D., Klesse, S., DeRose, R.J., Evans, M.E. Ecological forecasting of tree growth: regional fusion of tree-ring and forest inventory data to quantify drivers and characterize uncertainty. 2022 *Global Change Biology.* https://onlinelibrary.wiley.com/share/author/3PBGBXJMVPMY7C35ZPVY?target=10.1111/gcb.16038

Novick, K., Jo, I., DOrangeville, L., Benson, M. Au, T.F., Barnes, M., Denham, S., Fei, S. **Heilman, K.A.**, Hwang, T., Keyser,T., Maxwell, J., Miniat, C., McLachlan, J.S., Pederson, N., Wang, L., Wood, J. D., P. Phillips, R.P. The Drought Response of Eastern US Oaks in the Context of Their Declining Abundance. 2022 *Bioscience.*https://doi.org/10.1093/biosci/biab135.

Heilman, K.A., Trouet, V., Pederson, N., Belmecheri, S., Berke, M.A., McLachlan, J.S., Increased water use efficiency leads to decreased precipitation sensitivity of tree growth, but is offset by high temperatures. 2021. *Oecologia.* https://doi.org/10.1007/s00442-021-04892-0.

Evans, M.K.,DeRose, R. J., Klesse, S., Girardin, M. P., **Heilman, K.A.**, Alexander, M.R., Arsenault, A., Babst, F., Bouchard, M., Cahoon, S. M. P., Campbell, E., Dietze, M.C., Duchesne, L., Frank, D.C., Giebink, C.L., Gomez-Guerrero, A., Gutirrez Garca, G., Villela Gaytn, S.A., Edward H. Hogg, E.H., Metsaranta, J., Ols, C., Rayback, S. A., Reid, A., Ricker, M., Schaberg, P. G., Shaw, J. D., Sullivan, P. F. The case for adding tree rings to North Americas national forest inventories: an essential tool to guide drawdown of atmospheric CO2. 2021. *Bioscience.* https://doi.org/10.1093/biosci/biab119

Walker, A. P.; Kauwe, M. G. D.; Bastos, A.; Belmecheri, S.; Georgiou, K.; Keeling, R. F.; McMahon, S. M.; Medlyn, B. E.; Moore, D. J. P.; Norby, R. J.; Zaehle, S.; AndersonTeixeira, K. J.; Battipaglia, G.; Brienen, R. J. W.; Cabugao, K. G.; Cailleret, M.; Campbell, E.; Canadell, J. G.; Ciais, P.; Craig, M. E.; Ellsworth, D. S.; Farquhar, G. D.; Fatichi, S.; Fisher, J. B.; Frank, D. C.; Graven, H.; Gu, L.; Haverd, V.; **Heilman, K.A.**; Heimann, M.; Hungate, B. A.; Iversen, C. M.; Joos, F.; Jiang, M.; Keenan, T. F.; Knauer, J.; Krner, C.; Leshyk, V. O.; Leuzinger, S.; Liu, Y.; MacBean, N.; Malhi, Y.; McVicar, T. R.; Penuelas, J.; Pongratz, J.; Powell, A. S.; Riutta, T.; Sabot, M. E. B.; Schleucher, J.; Sitch, S.; Smith, W. K.; Sulman, B.; Taylor, B.; Terrer, C.; Torn, M. S.; Treseder, K. K.; Trugman, A. T.; Trumbore, S. E.; Mantgem, P. J. van; Voelker, S. L.; Whelan, M. E.; Zuidema, P. A. 2020 Integrating the Evidence for a Terrestrial Carbon Sink Caused by Increasing Atmospheric CO2. 2020. *New Phytologist.* https://doi.org/10.1111/nph.16866.

Broderick, C.M., **Heilman, K.A.**, T.A. Patterson, J.A. Peters, J.S. McLachlan. Sharp Savanna-forest Transitions in the Midwest Followed Environmental Gradients but are Absent from the Modern Landscape. 2018. *The American Midland Naturalist*, 180(1):1-17. https://doi.org/10.1674/0003-0031-180.1.1

MANUSCRIPTS IN REVIEW

Giebink, C.L., Domke, G.M., Fisher, R.A., Moore, D.J.P., **Heilman, K.A.**, DeRose, J.D., Evans, M.E.K. The policy and ecology of forest-based climate mitigation: challenges, needs, and opportunities. Accepted subject to minor revisions at Plant and Soil.

MANUSCRIPTS IN PREP

Heilman, K.A., Staver, A.C., Williams, J.W. Goring, S., Paciorek, C.J., Tipton, J.R., McLachlan, J.S. The anthropogenic collapse of savanna and forest alternative stable states in the US Midwest. In Prep.

Heilman, K.A., Burke, K.D., Dawson, A., Williams, J., McLachlan, J.S., Strong species interactions shaped past biomass, but are lost from the modern landscape. In Prep.

Dey, S.*, **Heilman, K.A.**, Schultz, E., Shaw, J.D., DeRose, R. J., C.J., Tipton, Evans, M.K., Spatio-temporal analyses of performance are needed to anticipate climate change impacts: insights from a range-wide network of tree-ring data. In Prep.

* indicates undergraduate student

PRESENTATIONS

Invited Presentations

Kelly Heilman. R. Justin DeRose, John D. Shaw, Andrew Finley, Michael Dietze, Jacob Aragon, Andrew Grey, Alex Arizpe, Stefan Klesse, Margaret E.K. Evans. Fusing tree ring and forest inventory data for ecological forecasting of tree growth responses to climate change. American Association of Geographers Annual meeting, Frontiers in Dendrochronology Session. April, 2021

Kelly Heilman. Assimilation of tree ring and forest inventory data to forecast future growth responses of *Pinus ponderosa*. August, 2020. Laboratory of Tree Ring Research Department Seminar. October 14th, 2020

Kelly Heilman, R. Justin DeRose, John D. Shaw, Andrew Finley, Michael Dietze, and Margaret Evans. Assimilation of Tree Ring and Forest Inventory Data to Constrain Uncertainty in Ecological Forecasts. SIAM Mathematics of Planet Earth, Virtual. August 14, 2020

Kelly Heilman. Forecasting long-term effects of environmental changes on vegetation: from trees to biomes. Kenyon College Biology Department Seminar. November 14, 2019

Kelly Heilman. Vegetation Responses to Long-term Environmental Changes at a Savanna Forest Boundary. Laboratory of Tree Ring Research Department Seminar. October 9, 2019

Kelly Heilman, Jason McLachlan, Neil Pederson, Valerie Trouet, Soumaya Belmecheri. Tree growth in a changing world: Factors mediating the effects of CO2 on tree ring growth and Water Use Efficiency. Ecological Society of America. August 8, 2018

Kelly Heilman. Tree growth in a changing world: Oak drought sensitivity trends at the savanna-forest boundary. Morton Arboretum, Chicago, IL. May 21, 2018

Kelly Heilman, Jason McLachlan. Quantifying vegetation structure and environmental drivers across a historic Prairie-Forest Biome Boundary. January 8, 2016. Harvard Forest Seminar Talk.

Contributed Oral Presentations

Kelly A. Heilman, Michael Dietze, Andrew O. Finley, Alexis Arizpe, Jacob Aragon, Andrew Gray, John D. Shaw, Stefan Klesse, R. Justin DeRose, Margaret E.K. Evans. Carbon accounting of ponderosa pine forests across the interior western U. S. based on tree-ring and forest inventory data: Drivers of carbon stock and flux and their uncertainties. August, 2021. Ecological Society of America

Kelly Heilman, Justin DeRose, John Shaw, Andrew Finley, Michael Dietze, and Margaret Evans. Assimilation of tree ring and forest inventory data to forecast future growth responses of *Pinus ponderosa*. August, 2020. Ecological Society of America

Kelly Heilman, Jason McLachlan, Carla Staver, Chris Paciorek, John Tipton, John W. Williams. Loss of alternative savanna and forest stable states due to historic and modern land-use. August, 2019. Ecological Society of America

Kelly Heilman, Jason McLachlan, Neil Pederson, Valerie Trouet, Soumaya Belmecheri. Anthropogenic changes impact drought sensitivity across a savanna-forest biome boundary. 10th World Dendro Conference. Thimphu, Bhutan. June 2018

Kelly Heilman, Jason McLachlan Drought sensitivity changes over the last century at the North American savanna-forest boundary. American Geophysical Union. December 11th, 2017

Kelly Heilman, Jason McLachlan, Carla Staver, Stabilization of savanna-forest alternative states to closed forests after 150 years of land use and climate changes. August, 2017 Ecological Society of America

Kelly Heilman, Jason McLachlan. What controls temperate savanna tree growth? July, 2016. North American Prairie Conference.

Kelly Heilman, Jason McLachlan Using GIS to investigate controls on vegetation at the prairie-forest boundary. November 16th, 2016. University of Notre Dame GIS day.

Kelly Heilman, Jason McLachlan, Carla Staver. Investigating controls of tree density and resilience to environmental changes at the prairie-forest boundary. November 2016. Biofrass Seminar Presentation, University of Notre Dame.

Poster Presentations

Heilman, K., DeRose, R.J., Shaw, J.D., Finely, A.O., Dietze, M.C., and Evans, M.E.K. Carbon accounting of ponderosa pine forests across the interior western US based on tree ring and forest inventory data. American Geophysical Union, December, 2021.

Heilman, K., DeRose, R.J., Shaw, J.D., Finely, A.O., Dietze, M.C., and Evans, M.E.K.. Fusion of tree-ring and forest inventory data to quantify C cycle drivers and characterize forecast uncertainty. North American Carbon Project. Virtual meeting March, 2021.

Kelly Heilman, Melissa Berke, Neil Pederson, Valerie Trouet, Soumaya Belmecheri, Jason McLachlan. Impacts of anthropogenic changes on water use efficiency and climate sensitivity: A data-model comparison. American Geophysical Union 2018.

Kelly Heilman, Jason McLachlan, A. Carla Staver, The role of disappeared disturbances in driving the North American prairie-forest boundary. American Geophysical Union, December 2016.

Heilman, K., McLachlan, J. Feng, X. Convergent Ecosystems from Divergent Environmental Drivers: revisiting drivers of the past prairie-forest ecotone across the North American Prairie Peninsula. American Geophysical Union, December, 2015.

Heilman, K., Pitcher, T.P., Heithaus, E.R. Is sperm motility correlated with red spawning coloration in Redside Dace (Clinostomus elongatus)? Kenyon College Summer Science Scholar Research Symposium 2011

TEACHING AND PROFESSIONAL EXPERIENCE

Conservation Biology 406/506 - Instructor ***Spring 2022***
University of Arizona
Instructor of record for Conservation Biology, a 400-level undergraduate course, and 500-level graduate course cross listed in Ecology and Evolutionary Biology, and School of Natural Resources and the Environment

Guest lecture in Forest Ecology Class
University of Arizona, Laboratory of Tree Ring Research – Fall 2021
Guest lectured and led discussion on the topic of forest carbon fertilization.

Guest lecture in Graduate Seminar on Ecological Forecasting
University of Arizona, Laboratory of Tree Ring Research – Fall 2019
Guest lectured and led discussion on a Bayesian State-Space model, Intro to Bayesian Statistics, and led discussion on the role of Ecological Forecasting in our own research.

Workshop on Introduction to Bayesian Statistics in R
University of Arizona Research Bazaar – May 2020 and May 2021
Developed and taught a workshop on an introduction to Bayesian Statistics and how to implement simple Bayesian models in R. All course materials are available on github.

General Ecology Lab Lead Teaching Assistant ***2018***
University of Notre Dame
Contributed to ongoing course development by creating new lesson plans and leading writing workshops for students. I also assisted the Teaching Assistants with lessons, leading field trips, and developing student writing skills.

General Ecology Lab Teaching Assistant ***2014, 2016, 2017***
University of Notre Dame
Prepared fieldwork experiments and discussions, lead field trips, advised students on data analysis, developed student scientific writing and intellectual virtues, and graded all material.

UNDERC Summer Course Research Mentor ***2017-2018***
Notre Dame Environmental Research Center
Mentored five undergraduate students on independent summer research projects. This included teaching the students dendrochronology methods, forestry field data collection, implementing statistics using

R, and the scientific writing process.

General Biology Lab - Teaching Assistant ***2013***
University of Notre Dame
Prepared introductory lectures, set up lab equipment, advised students on independent research projects, and graded all assignments.

Aquatic Systems Biology - Laboratory Teaching Assistant ***2011***
Kenyon College
Teaching duties included organizing lab materials, bringing students on field expeditions, and teaching students aquatic ecology methods.

Introductory Biology Lab - Teaching Assistant ***2010-2012***
Kenyon College
Assisted instructor in preparing lecture and experimental design, and led students through experimental protocols.

Introductory Biology Lab and Microscopy Lab Preparation Assistant ***2010-2011***
Kenyon College
Prepared lab materials for each lab meeting, and helped to develop lesson plans each week.

VOLUNTEER AND SERVICE

Organzational

Tucson-based taskforce of Arizona Science Policy Network ***2021-present***
co-organizer member
Starting up a Tucson-based taskforce of the Arizona Science Policy Network, focused on advocating for science-based solutions to issues facing our communities.

Jogging Organization for Graduate Students (JOGs) ***2018-2019***
President
Co-founded a social running club for graduate students to network with fellow runners.

University of Notre Dame Graduate Student Union ***2017-2018***
Social chair and community engagement chair
Coordinated campus-wide social and community engagement events for graduate students and families, including a Charity Gala. Served as a voting member of Notre Dame Graduate Student Union.

Society of Schmitt Fellows University of Notre Dame ***2015-2017***
Treasurer
Handled Society of Schmitt Fellows annual budget and co-organised a fund for conference presentation travel grants.

Social Chair
Co-organised monthly social activities for STEM graduate students.

Outreach Committee
Planned outreach events to local animal shelters and communicated local outreach opportunities.

Reviewer

Journals
Science, Ecosphere, Scientific Reports, Forest Ecology and Management, Michigan Academician.
Proposals
National Science Foundation Biology Program

COMMUNITY OUTREACH AND ENGAGEMENT

Science Policy

Memo on the Filibuster on behalf of Union of Concerned Scientists ***July 2021***
Co-wrote a memo on the historical use of the filibuster, its misuses, and details potential outcomes of filibuster reform, as it relates to Senator Mark Kelly's policy objectives. This was a joint effort between members of the Arizona Science policy network, and was sent on behalf of the Union of Concerned Scientists.

AGU Broadening participation in STEM advocacy day ***June 2021***
Met with staffers from Raul Grijavla, Kirsten Sinema, and Senator Mark Kelly's office to ask for them to support several bills that would help broaden and diversify participation in STEM, including the RESTART STEM Act (S. 1297), the STEM Opportunities Act, and the Reconciliation in Place Names Act. This meeting was on behalf of American Geophysical Union.

AGU Voices for Science Advocacy Day ***May 2021***
Met with staffers from Raul Grijavla, and Senator Mark Kelly's office to ask for them to support increases in science funding for NSF and USGS in the FY 22 budget request. This meeting was on behalf of American Geophysical Union and the Voices for Science Program.

Meeting with policymakers to strengthen the role of science in democracy ***April 2021***
Met with Coral Evans (former Mayor of Flagstaff, and current staffer for Senator Mark Kelly) to discuss science policy, voting rights, and democracy. We thanked Sen. Kelly for his support of the For the People act, and spoke in support of the John Lewis VRA and the Environmental Justice for All Act. This meeting was on behalf of Union of Concerned Scientists.

Arizona Science Policy Day ***March 2021***
Led and organized a discussion of nature-based climate solutions to address the climate crisis, developed a one-pager to disseminate to Arizona Legislators, and engage with students interested in climate-related policies. This event was a part of Arizona Science Policy Networks Science Day

Organized meetings with policymakers for Climate Advocacy Week ***October 2020***
Led and organized a meeting with our Arizona Senators' offices (Kirsten Sinema[D], Martha McSally[R]) and our local House representative (Ann Kirkpatrick[D]) to discuss policy to address the climate crisis and offer our expertise as climate and planetary scientists. This event was a part of AGU's Climate Advocacy Week

Community Engagement

Macrosystems exhibit for Laboratory of Tree Ring Research lobby ***2020***
Helped to develop and create a series of outreach videos about our research forecasting forest responses to climate change for the Laboratory of Tree Ring Research lobby.

Southern Arizona Foresters ***2019***
Gave a research talk and led a discussion during the Southern Arizona Foresters Luncheon.

STEM Programming at the Boys and Girls Club of South Bend ***2016-2017***
Organized weekly science activities for elementary school students in the Boys and Girls Club after school program.

Planting Science Mentor ***2017-2018***
Mentored High School Science classes during independent research projects online.

Volleyball Head Coach ***2017***
Coached 6th grade girls volleyball team at St. Pius X School in Granger, IN.

TEACHING AND COURSE DEVELOPMENT TRAINING

Center for Integration of Teaching and Research Learning
University of Arizona – Fall 2021
Participating in the CIRTL postdoc practitioner certificate, which involves an online teaching course, biweekly faculty learning community discussion, co-teaching and observations, and development of an teaching e-portfolio

Teaching Where the Magic Happens: Field Course Design Workshop
Ecological Society of America – August 2017
Attended a workshop to develope short field courses, discussed risk management, best teaching practices, and dealing with logistics while developing remote field-based learning experiences.

A Practical Guide to Teaching and Learning in STEM
University of Notre Dame Kaneb Center — January 2018
Participated in a workshop lead by Rebecca Brent and Richard Felder, focused on designing successful sciences courses with measurable learning objectives, active learning, and appropriate assessment.

Striving for Excellence in Teaching Certificate
University of Notre Dame Kaneb Center — March 2018
Participated in 5+ workshops on teaching and course design at University of Notre Dame, and provided reflections on how the workshops provided skills to improve my own teaching.

Wakonse Conference on College Teaching
May 24-29th 2018
Participated in the 2018 Wakonse Teaching Fellowship Conference in Michigan, where college educators share teaching methods, reflect on personal strengths and weaknesses as college teachers, and craft short- and long-term professional goals.

Introduction to Course Design University of Notre Dame Kaneb Center — Spring 2017
Participated in a 5-week workshop series to improve my course design and help develop teaching phi-

losophy.

GET-STEM Program
University of Notre Dame Kaneb Center — Fall 2016
Volunteered in the Graduate Educators Teaching Science Technology Engineering and Math program.

HONORS, AWARDS, AND CERTIFICATES

American Geophysical Union Voices for Science *2021-2022*

Postdoctoral Professional Development Certificate *2020*

University of Arizona Postdoc Speed Talk Finalist *2020*

Saint Joseph Academy Alumni 25 under 35 Award *2016*

Distinction Award Biology Senior Exercise *2012*

OPPORTUNITIES CANCELED DUE TO ONGOING COVID-19 PANDEMIC

In addition to most of the conferences, seminars, and research collaborations moved online or delayed during my post-doctoral research, several engagement opportunities were cancelled, or otherwise impeded by the ongoing COVID-19 pandemic.

Co-Instructor of Using Bayesian statistics in Dendroecology at Northe American Dendro-Ecological Fieldweek (NADEF), July 2020

Science Cafe Speaker at Tucson Festival of Books, March 2020