

Jeremy Hemberger

USDA NIFA POSTDOCTORAL FELLOW | ENTOMOLOGIST | ECOLOGIST | SCIENCE COMMUNICATOR

University of Wisconsin-Madison | University of California Davis | University of Minnesota

☎ (608)-622-2698 | ✉ j.a.hemberger@gmail.com | 🏠 jhemberger.github.io | 📺 [jhemberger](https://www.youtube.com/jhemberger)

Professional Summary

I am an ecologist and entomologist interested in how to manage insect biodiversity in response to changes in the landscape - specifically those related to large-scale changes in agriculture and climate. I use modern ecoinformatics approaches to explore questions and patterns related to insect ecology and landscape-scale changes in agriculture and climate in concert with lab and field experimentation to test theories and develop more robust causal associations between changes in the landscape and those in insect behavior, populations, and communities. By combining these approaches, I am able to identify mechanisms to improve the resilience of biodiversity and ecological functions in agricultural landscapes, translating research findings into relevant, shovel-ready solutions that will advance the sustainability of agroecosystems forward.

Education

University of Wisconsin-Madison

PHD IN ENTOMOLOGY

Madison, WI

May 2020

University of Wisconsin-Madison

B.S. IN BIOLOGY W/EVOLUTION EMPHASIS

Madison, WI

May 2012

Publications

PUBLISHED

2024	Hemberger, J., Williams, N.M. Predicting landscape-scale native bumble bee habitat use over space, time, and forage availability	<i>in press, Ecology</i>
2024	Rosenberger, N.M., Hemberger, J., Williams, N.M. Extreme heat increases risk of pollen limitation through reductions in pollen production and pollen quality. 10.1093/aobpla/plae045	<i>AoB Plants</i>
2024	Hemberger, J., Williams, N.M. Warming summer temperatures are rapidly restructuring North American bumble bee communities. 10.1111/ele.14492	<i>Ecology Letters</i>
2023	Hemberger, J., Bernauer, O., Gaines-Day, H., Gratton, C. Landscape-scale floral resource discontinuity decreases bumble bee occurrence and alters community composition. 10.1002/eap.2907	<i>Ecological Applications</i>
2023	Hemberger, J. and Gratton C. Floral resource discontinuity contributes to spatial mismatch between pollinator supply and pollination demand in a pollinator-dependent agricultural landscapes. 10.1007/s10980-023-01707-w	<i>Landscape Ecology</i>
2023	Willians, N.M., Hemberger, J. Climate, pesticides and landcover drive current and predicted declines of the western bumble bee.	<i>PNAS</i>
2022	Hemberger, J., Rosenberger, N.M, Williams, N.M. Experimental heat waves disrupt bumble bee foraging through direct heat effects and reduced nectar production. 10.1111/1365-2435.14241	<i>Functional Ecology</i>
2022	Hemberger, J., Witynski, G., and Gratton, C. Floral resource continuity increases bumble bee reproduction relative to variable floral resources. 10.1002/EEN.13154	<i>Ecological Entomology</i>
2021	Mola, J.M., Hemberger, J., Kochanski, J., Richardson, L.L., Pearse, I. The importance of forests in bumble bee biology and conservation. 10.1093/biosci/biab121	<i>BioScience</i>
2021	Page, M.L., Nicholson, C.C., Brennan, R., Britzman, A., Hemberger, J., Greer, J., Kahl, H., Müller, U, Peng, Y., Rosenberger, N, Stuligross, C., Wang, L., Yang, L., Williams, N.M. A meta-analysis of single-visit pollinator effectiveness. 10.1002/ajb2.1764	<i>American Journal of Botany</i>
2021	Hemberger, J., Crossley, M., and Gratton, C. Historical decrease in agricultural landscape diversity is associated with shifts in bumble bee species occurrence. 10.1111/ele.13786	<i>Ecology Letters</i>
2020	Hemberger, J., Frappa, A., Witynski, G., Gratton, C. Saved by the pulse? Separating the effects of total and temporal food abundance on the performance of bumble bee microcolonies. 10.1016/j.baee.2020.04.004	<i>Basic and Applied Ecology</i>
2018	Hemberger, J., and Gratton, C. Floral resource pulse decreases bumble bee foraging trip duration in central Wisconsin agroecosystem. 10.1111/een.12516	<i>Ecological Entomology</i>

IN REVIEW OR IN PREPARATION:

Hemberger, J., Williams, N.M. Increase in extreme heat threatens plant-pollinator interactions across California Central Valley	<i>in preparation</i>
Hemberger, J., Rosenberger, N.M., Ogilvie, J., CaraDonna, P., Direct or indirect, that is the question: parsing the impact of climate warming on sub-alpine bumble bees and their food plants.	<i>in preparation</i>
Rosenberger, N.M., Hemberger, J., Williams, N.M., Collapse of plant reproductive success due to combined effects of experimental heat waves on plants and their insect pollinators.	<i>in preparation</i>

OTHER

2020	Hemberger, J. Where have all the flowers gone? Understanding changes in spatiotemporal floral resources and their role in driving bumble bee behavior, colony development, and populations in agroecosystems.	<i>PhD Thesis</i>
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Presentations

INVITED

2024	All the world's an oven: How rapidly warming temperatures are impacting bumble bee communities and the pollination services they provide. Annual Meetings of the Entomological Society of America. Phoenix, AZ.
2024	Untangling the knot: Wrangling big, messy data at multiple scales to understand and manage agricultural insects in a rapidly changing world? Michigan State University, East Lansing, MI.
2024	Untangling the knot: how is global change impacting bumble bees across ecological scale? Chicago Botanical Garden seminar. Chicago, IL.
2022	A messy, tangled knot: unravelling multiple global change drivers of insect behavior, occurrence, and community assembly. University of Minnesota Department of Entomology Seminar series, St. Paul, MN.
2022	Experimental heat waves disrupt bumble bee foraging through direct heat effects and reduced nectar production. Climate Science for Ecological Forecasting. London, UK.
2022	Bumble bees and agricultural landscapes of yesteryear: using museum and community science records to determine how a century of agricultural change has impacted bumble bee occurrence and community composition in the US Midwest. Entomological Society of America North Central Branch Meeting. Minneapolis, MN.
2021	Bumble bees and agricultural landscapes of yesteryear: how a century of agricultural change has impacted bumble bee occurrence and community composition in the US Midwest. Annual Meetings of the Entomological Society of America. Denver, CO.
2020	Contrasting shifts in bumble bee occurrence are associated with agricultural intensification in the North American Midwest. Annual Meetings of the Entomological Society of America. Virtual Meetings.
2019	Bumble Bees in the Landscape: State of the science, methods, and research priorities. BOMBUSS (Building our methods using sound science) 2.0. Toronto, ON. Canada.
2018	Understanding bumble bee responses to spatiotemporal resource availability using automated colony scales. Annual Meetings of the Entomological Society of America. Vancouver, BC. Canada.
2018	Thinking like a bumble bee: Understanding bumble bee resource needs in agricultural landscapes. Annual Meetings of the Entomological Society of America. Vancouver, BC. Canada.
2018	Spatiotemporal resource heterogeneity in agroecosystems: implications for bumble bees and other beneficial insects. ESA North Central Branch Meetings. Madison, WI. USA.
2018	Bumble bee responses to spatiotemporal resource abundance in WI cranberry. Entomological Society of America North Central Branch Meetings. Madison, WI. USA.
2017	Temporal resource pulse decreases bumble bee foraging duration across central Wisconsin agricultural landscapes. Annual Meetings of the Entomological Society of America. Denver, CO. USA.
2017	Using foraging behavior to determine landscape suitability for bumble bees. BOMBUSS Conference Logan, UT. USA.
2017	Spatiotemporal floral resource modeling in Wisconsin agroecosystems. BOMBUSS Conference. Logan, UT. USA.

SUBMITTED

2023	Recent climate warming has rapidly restructured North American bumble bee communities. Annual Meeting of the Ecological Society of America. Portland, OR. USA
2023	Semi-natural habitats are critical to provide season-long pollen resources for foraging bumble bees in mosaic agricultural landscapes. International Pollinator Conference. State College, PA. USA
2015	How do bees perceive the landscape? Linking bumblebee foraging to resources in Wisconsin landscapes using RFID methods. Annual Meetings of the Entomological Society of America. Minneapolis, MN. USA.
2015	What's best for bees? Determining landscape suitability of bumblebees using RFID technology. Tropentag 2015 -Management of land use systems for enhanced food security - conflicts, controversies and resolutions. Berlin, Germany.
2014	Oh, the places bees go: RFID methods connect bumblebee foraging to resources in Wisconsin landscapes. Annual Meetings of the Entomological Society of America. Portland, OR. USA.
2013	Abiotic determinants of the abundance of the West Nile virus vector, Culex pipiens, in suburban Chicago, USA. 27th National Conference for Undergraduate Research. LaCrosse, WI. USA.

Funding

GRANTS

Pending	Assessing the impact of heat waves on sunflower pollination to promote climate-resilient summer seed crops. California Department of Food and Agriculture Specialty Crop Block Grant	\$344,015
Pending	Collaborative research: Assessing Wild Bees’ Resilience to Heat Waves across Scales of Biological Organization. NSF Division of Environmental Biology	\$849,000
2024-2026	Using bumble bee morphometric differences to explore drivers of rusty patched population declines. USFWS Great Lakes Resoration Initiative	\$93,000
2024-2026	Developing a scaleable bumble bee monitoring program for the North Central US. USGS Cooperative Ecosystem Studies Unit	\$260,000
2020-2022	USDA NIFA Post-doctoral Fellowship: Can bees take the heat? Measuring and modeling bumble bee foraging, colony dynamics and crop visitation in response to increasing heat waves	\$164,000
2018-2020	Baldwin Ideas Grant (co-written with Claudio Gratton and Hannah Gaines-Day). Show me the bees! Engaging growers with citizen science to improve management of crop pollinators	\$88,080
2017-2021	UW CALS WAES Hatch Grant (co-written with Claudio Gratton) - Modeling wild bee occurrence in Wisconsin agriculture	\$127,000
2016	Center for Integrated Agricultural Systems Mini-Grant, Spatiotemporal floral resources and bumble bee abundance in WI cranberry agroecosystems	\$1000
2015-2019	NSF Graduate Research Fellowship, Honorable mention	Not funded
2014	Center for Integrated Agricultural Systems Mini-Grant, Effect of Planting additional, non-crop floral resources on pollinator dependent crop production	\$1500

AWARDS

2024	Entomological Society of America - Travel Award	\$750
2023	Great Lakes Chapter of the Ecological Society of America - Travel Award	\$500
2019	International Pollinator Conference - Travel Award	\$500
2017	Albert J. & Adelaide E. Riker Scholarship	\$1500
2017	Kinney Merrit Travel Award	\$1000
2017	BOMBUSS Student Travel Award	\$1000
2016	Best Presentation Award – Wisconsin Ecology Spring Symposium	\$400
2015	President’s Prize (Best presentation) - Runner up, Entomological Society Meetings, Minneapolis, MN	\$50

Research

Research Scientist

AGROECOSYSTEMS RESEARCH GROUP - UW MADISON

Madison, WI

October 2024 - present

- Model development and support of decision support tools for natural pest management/natural enemy populations in Wisconsin agriculture

Postdoctoral Scholar

ADVISED BY DRS. JAMES CRALL AND CLAUDIO GRATTON (UW-MADISON)

Madison, WI

September 2022 - September 2024

- Labortory and field research on insect climate/landscape ecology, manuscript preparation, data science and modeling

USDA NIFA Postdoctoral Fellow

Davis, CA

ADVISED BY DR. NEAL WILLIAMS (UC DAVIS)

April 2020 - September 2022

- Laboratory and field research on bumble bee climate and thermal ecology (i.e., heatwave response), manuscript preparation, data science and modeling

Graduate Research Assistant

Madison, WI

ADVISED BY DR. CLAUDIO GRATTON (UW-MADISON)

August 2013 - May 2020

- Bumble bee rearing and care, field and laboratory experiments, statistical analyses, upkeep of lab website, maintenance of data and facilities.

Research Technician

Madison, WI

CO-ADVISED BY DR. ANINDO CHOUDHARY (ST. NORBERT COLLEGE) AND DR. REBECCA COLE (USGS NATIONAL WILDLIFE

HEALTH CENTER)

May 2012 - January 2013

- Parasitology diagnostics, necropsy, specimen curation, assistance in ongoing research projects

Undergraduate Independent Research

Madison, WI

CO-ADVISED BY DR. TAVIS ANDERSON AND DR. TONY GOLDBERG (UW-MADISON)

December 2010 - December 2012

- Mosquito rearing, data entry and analysis, completion of senior thesis: Biotic and abiotic determinants of West Nile Virus vector *Culex pipiens* larval success in suburban Chicago, USA.

Teaching

LEAD OR CO-INSTRUCTOR

University of Wisconsin-Madison

Fall 2017

INSECT ECOLOGY LABORATORY - ENTOMOLOGY 451

- Curriculum development, lab preparation, instruction, field research trips, statistical instruction, writing mentor. Co-instructor with Dr. Matthew McCary

University of Wisconsin-Madison

Fall 2013

GENERAL ZOOLOGY - ZOOLOGY 152

- Laboratory instructor for ecology and evolution-themed labs. Facilitate laboratories and group-based discussion/work, mentor students on semester-long independent research project.

University of Wisconsin-Madison

Summer 2015

UW-MADISON COLLEGE FOR KIDS

- Preparing a curriculum and teaching a 4 day short course on insects for middle school students, including lab and field components

GUEST LECTURES

Global Change and Biodiversity

UNIVERSITY OF WISCONSIN-MADISON

Fall 2024

- Lecture on impact of extreme weather on biodiversity and ecosystem function

Plant-Insect Interactions

UNIVERSITY OF WISCONSIN-MADISON

Spring 2024

- Lecture on global change and plant-insect interactions

Plant-Insect Interactions

UNIVERSITY OF WISCONSIN-MADISON

Spring 2022

- Lecture on global change and plant-insect interactions

Insect Ecology

UNIVERSITY OF WISCONSIN-MADISON

Fall 2021

- Lectures on insect mutualisms and plant-pollinator interactions

Insect Ecology

UNIVERSITY OF WISCONSIN-MADISON

Fall 2019

- Lecture on pollination ecology and pollinators in agriculture

Plant-Insect Interactions

UNIVERSITY OF WISCONSIN-MADISON

Spring 2018

- Lecture on pollination, pollinator ecology, and bumble bees

Insect Ecology

UNIVERSITY OF WISCONSIN-MADISON

Fall 2017

- Lecture on pollination ecology and pollinators in agriculture

General Zoology (Case-based)

UNIVERSITY OF WISCONSIN-MADISON

Spring 2017

- Developed a inquiry-based, cooperative learning module to address core ecological concepts including pollination ecology, interspecific competition, resource ecology, agroecology, and basic statistics

Mentoring

Nick Rosenberger

PHD STUDENT

University of California Davis

January 2021 - present

- Collaborator on PhD experiment investigating heat wave impacts on pollination of *Brassica napus*

Grant Witynski

UNDERGRADUATE RESEARCH ASSISTANT

University of Wisconsin-Madison

June 2018 - December 2019

- Worked on bumble bee rearing, experiment upkeep, field work, bee identification, and independent research

Agathe Frappa

RESEARCH TECHNICIAN

University of Wisconsin-Madison

June 2018 - August 2018

- Visiting graduate student from Universite Montpellier; bumble bee rearing, experiment upkeep, field work, bumble bee identification, and statistical analysis

Brad Harrison

NSF RESEARCH EXPERIENCE FOR TEACHERS FELLOW

University of Wisconsin-Madison

June 2017 - August 2017

- Worked with field-based bumble bee and wildflower surveys, specimen curation and identification, developed teaching unit in coordination with research experience

Gabriel Foote

UNDERGRADUATE RESEARCH ASSISTANT

University of Wisconsin-Madison

Spring 2014 - Spring 2015

- Field and laboratory experimental assistance, independent research investigating effects of RFID tag size on bumble bee behavior

Ian Shi

MIDDLE SCHOOL SCHOLAR

University of Wisconsin-Madison

Fall 2014-Spring 2015

- I mentored Ian for the Wisconsin Science Olympiad. He went on to win the state competition and qualify for nationals, in which he competed in May of 2015

Professional and Academic Service

Wisconsin Ecology

GRADUATE STUDENT REPRESENTATIVE - EXECUTIVE COMMITTEE

Madison, WI

2017 - 2019

- One of four graduate students responsible for providing direction to Wisconsin Ecology, as well as organizing Wisconsin Ecology events including spring symposium, undergraduate job fair, and graduate student socials.

Entomology Graduate Student Association

STUDENT CHAIR FOR INSECT AMBASSADORS, WEB COMMITTEE

Madison, WI

2014 - 2019

- Responsible for graduate student input to department policy and on goings, including outreach web presence. Coordinator and leader of UW Entomology Insect Ambassadors outreach organization

Wisconsin Society for Conservation Biology

POLLINATOR COMMITTEE CHAIR AND CITIZEN SCIENCE PROGRAM LEADER

Madison, WI

2015 - 2016

- Responsible for helping guide a citizen science based pollinator monitoring project at the UW Lakeshore preserve, including workshops and field days

Outreach and Education

Bumble Bees of Wisconsin

WEB DEVELOPMENT, GRAPHIC DESIGN

- Online and graphical guide to the bumble bees found throughout Wisconsin. Includes information on identification, species biology and ecology, as well as conservation tips. www.wisconsinbumblebees.com

Agricultural intensification and Midwest bumble bees

WEB DEVELOPMENT, GRAPHIC DESIGN

- Online companion to the paper Contrasting shifts in bumble bee species occurrence are associated with agricultural intensification in the North American Midwest. Includes species-by-species interactive data exploration and ability to explore model explanatory variables in detail. https://wi-bumblebees.shinyapps.io/histbumble_shiny_2020/

COMMUNITY OUTREACH

- 2019 Science on Tap - Bumble Bees of Wisconsin. Madison, WI. 30 in attendance
- 2019 Bumble Bee ID Workshop. Olbrich Gardens, Madison, WI. 15 in attendance
- 2019 National Pollinator Week Talk. Olbrich Gardens, Madison, WI. 11 in attendance
- 2018 Madison Optimists Society, Madison, WI. 25 in attendance
- 2018 Science on Tap - The Buzz about Bees. Madison, WI. 60 in attendance
- 2017 Organic Valley GRASSUP, Madison, WI. 100+ in attendance
- 2017 Gateway Technical College - Wild Bees of Wisconsin, Racine, WI. 110+ in attendance
- 2016 Nerd Nite Madison - Tagging bees - for science! Madison, WI. 200+ in attendance
- 2016 LIFE Seminar, UW Stevens Point, Stevens Point, WI. 50 in attendance
- 2016 Nature Walk - Pope Farm Conservancy. Middleton, WI. 40 in attendance
- 2016 UW Arboretum - Pollinator Awareness Talk. Madison, WI. 100 in attendance
- 2015 Science on Tap - The Secret Lives of Bumble Bees. Minocqua, WI. 160+ in attendance
- 2015 UW Arboretum BeeFest. Madison, WI. 45 in attendance
- 2015 Dane County Beekeepers Association. Madison, WI. 40 in attendance
- 2015 Ridges Sanctuary, Bumble Bee Workshop and Talk. Bailey's Harbor, WI. 30 in attendance
- 2015 Seeds of Service - Pollinators in Urban Agriculture. Chicago, IL. 125 in attendance
- 2015 Sauk Prairie Optimist Club. Sauk Prairie, WI. 40 in attendance
- 2015 Master Gardeners of Door County. Egg Harbor, WI. 75 in attendance

K-12 EDUCATION

- 2013- Insect Ambassadors classroom presentations. Topics vary by request. Over 75 presentations led at locations present around central and southern Wisconsin.

Technical skills

SPATIAL DATA SCIENCE

- Software QGIS, ArcGIS, GRASS, R, RStudio (e.g., sf, terra, raster, landscapemetrics, climate packages)
- Capacities Land-use change analysis, climate data wrangling and analysis, analyzing remotely sensed data, spatial data manipulation and visualization

STATISTICS

- Software R, RStudio, Markdown, R Markdown (e.g., glmmTMB, mgcv, gam, lme4, nlme, ranger, randomforest, spatialReg packages)
- Capacities Hierarchical modeling, spatial regression models, time series analysis, spatiotemporal generalized additive models, machine-learning (random forest, boosted regression trees), advanced frequentist statistics, basic Bayesian statistics, model validation, model visualization, analysis reporting (e.g., R Markdown)

DATA VISUALIZATION

- Software R, RStudio, Adobe Illustrator/Photoshop, QGIS, R Shiny, R Markdown
- Capacities Graphic design, infographic design, figure and map creation, R Shiny application development