

Leah Renee Johnson

CONTACT INFORMATION

Department of Statistics
Hutcheson Hall, Virginia Tech
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Blacksburg, VA 24061

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EDUCATION

Ph.D. (Applied Mathematics and Statistics; Physics) University of California Santa Cruz	June 2006
M.S. (Physics) University of California Santa Cruz	September 2003
B.S. with Honors (Physics) The College of William and Mary, Williamsburg, VA	June 2001

ACADEMIC APPOINTMENTS

Associate Professor Statistics Virginia Tech	Aug. 2020 to Present Blacksburg, VA
Assistant Professor Statistics Virginia Tech	Aug. 2016 to July 2020 Blacksburg, VA
Assistant Professor Integrative Biology University of South Florida	Aug. 2013 to July 2016 Tampa, FL
Research Professional Ecology and Evolution University of Chicago	2012 to 2013 Chicago, IL
Temporary Lecturer Environmental Sciences Loyola University Chicago	Fall 2011 Chicago, IL
Post-Doctoral Researcher Ecology and Evolution University of Chicago	2011 to 2012 Chicago, IL
Post-Doctoral Researcher Ecology, Evolution, and Marine Biology, University of California Santa Barbara	2009 to 2011 Santa Barbara, CA
Post-Doctoral Researcher National Centre for Statistical Ecology, Statistical Lab, University of Cambridge	2006 to 2009 Cambridge, UK

ACTIVE EXTERNAL
GRANTS

As Principal Investigator:

Collaborative Research: MRA: Using NEON data to elucidate the ecological effects of global environmental change on phenology across time and space. NSF DEB#2017463. **Award Amount: \$108,968.** PI: Johnson. Project Period: 01/01/2021 - 12/31/2023 (no cost extension to 2024)

Collaborative Research: CIBR: VectorByte: A Global Informatics Platform for studying the Ecology of Vector-Borne Diseases. NSF DBI#2016264. **Award Amount: \$899,908.** PI: Johnson. Project Period: 08/01/2020 –07/31/2025

CAREER: Quantifying heterogeneity and uncertainty in the transmission of vector borne diseases with a Bayesian trait-based framework. NSF DMS/DEB #1750113 **Award Amount: \$700,000.** PI: Johnson. Project Period: 08/01/18-07/31/23 (no cost extension to 2024)

As Senior Personnel:

NEON RCN: The Ecological Forecasting Initiative RCN: Using NEON-enabled near-term forecasting to synthesize our understanding of predictability across ecological systems and scales. NSF DBI #1926388. PI: Quinn Thomas (VT) **Award Amount: \$500,000.** Project Period: 1/1/2020–12/31/2024

PREVIOUS
EXTERNAL GRANTS

As Principal Investigator:

US-UK Collab: RCN: Vector Behavior in Transmission Ecology (VectorBiTE). NIH-NSF-USDA Ecology of Infectious Diseases. Grant #1R01AI122284-01. **Award Amount: \$493,899.** PI: Johnson, L.R. Project Period: 07/2015–06/2020; No cost extension due to COVID 19 until 2022.

Quantifying how Bioenergetics and Foraging Determine Population Dynamics in Threatened Antarctic Albatrosses. NSF Division of Polar Programs, Antarctic Organisms and Ecosystems. Award #1341649, **Award Amount: \$552,327.** PI: Johnson, L.R., Co-PI: Ryan, S.J. 05/2014 – 04/2017 (no cost extension to 05/2020)

*Anthropogenic impacts on amphibian skin microbial communities and assessment of susceptibility to the fungal pathogen *Batrachochytrium dendrobatidis*.* Mianus Rover Gorge, Bedford, NY (<http://www.mianus.org/>). **Award Amount: \$15,000.** PIs: Johnson and Zachary Gajewski (graduate student advisee). Project Period: 2016–2019. (no cost extension due to COVID-19)

As Co-Principal Investigator:

Effects of temperature on vector-borne disease transmission: integrating theory with empirical data. NSF-NIH-USDA Ecology of Infectious Diseases. Award Number 1518681; PI: Mordecai, E. (Stanford). **Award Amount: \$425,343** (total award: \$1,706,292). Project Period: 07/2015–06/2020

PREVIOUS
INTERNAL GRANTS

As Principal Investigator:

Proposal Enhancement Grant for: Strategic, data-driven modeling for the design and assessment of HLB control strategies. University of South Florida internal award. **Award Amount: \$25,000.**

As Co-Principal Investigator:

The effects of temperature on bat fungal disease dynamics. Virginia Tech. Seed Grants: Advancing Transdisciplinary Communities in Infectious Disease Research. PI: Kate Langwig (Biology). CoIs- Leah Johnson (Stats), Lisa Belden (Bio), Joseph Hoyt (Bio). **Award Amount: \$10000** Project Period: 12/2018–06/2019

**REFEREED
PUBLICATIONS**

Papers are listed in reverse chronological order (by year) and alphabetical order by lead author within each year.

key: * - postdoctoral advisee; † - graduate student advisee (including committees);
^{ug} - undergraduate advisee; + - senior author

Dennington, N. L., M. K. Grossman, F. Ware-Gilmore, J. L. Teeple, **L. R. Johnson**, M. S. Shocket, E. A. McGraw, and M. B. Thomas. “Phenotypic adaptation to temperature in the mosquito vector, *Aedes aegypti*”. *Global Change Biology*, vol. 30, no. 1, 2024, e17041.

Pawar, S., P. J. Huxley*, T. R. Smallwood, M. L. Nesbit, A. H. Chan, M. S. Shocket, **L. R. Johnson**, D.-G. Kontopoulos, and L. Cator. “Variation in temperature of peak trait performance constrains adaptation of arthropod populations to climatic warming”. *Nature Ecology and Evolution*, 2024, online early. <https://doi.org/10.1038/s41559-023-02301-8>.

Brown, J. J., M. Pascual, M. C. Wimberly, **L. R. Johnson**, and C. C. Murdock. “Humidity—The overlooked variable in the thermal biology of mosquito-borne disease”. *Ecology Letters*, 2023. <https://doi.org/10.1111/ele.14228>.

Gajewski†, Z., **L. R. Johnson**, D. Medina, W. W. Crainer, C. M. Nagy, and L. K. Belden. “Skin bacterial community differences among three species of co-occurring Ranid frogs”. *PeerJ*, vol. 11, 2023, e15556.

Ryan, S. J., C. A. Lippi, O. C. Villena*, A. Singh, C. C. Murdock, and **L. R. Johnson**+. “Mapping current and future thermal limits to suitability for malaria transmission by the invasive mosquito *Anopheles stephensi*”. *Malaria Journal*, vol. 22, no. 1, 2023, p. 104.

Smith†, J. W., R. Q. Thomas, and **L. R. Johnson**+. “Parameterizing Lognormal state space models using moment matching”. *Environmental and Ecological Statistics*, vol. 30, no. 3, 2023, pp. 385–419.

Smith Jr†, J., **L. R. Johnson**, and R. Q. Thomas. “Assessing ecosystem state space models: Identifiability and estimation”. *Journal of Agricultural, Biological and Environmental Statistics*, 2023, pp. 1–24.

Thomas, R. Q., C. Boettiger, C. C. Carey, M. C. Dietze, **L. R. Johnson**, M. A. Kenney, J. S. McLachlan, J. A. Peters, E. R. Sokol, J. F. Weltzin, A. Willson, W. M. Woelmer, and C. contributors. “The NEON Ecological Forecasting Challenge”. *Frontiers in Ecology and the Environment*, vol. 21, no. 3, 2023, pp. 112–13. <https://doi.org/10.1002/fee.2616>.

Baker, E., P. Barbillon, A. Fadikar, R. B. Gramacy, R. Herbei, D. Higdon, J. Huang, **L. R. Johnson**, P. Ma, A. Mondal, A. Pires, J. Sacks, and V. Sokolov. “Analyzing Stochastic Computer Models: A Review with Opportunities”. *Statistical Science*, vol. 37, no. 1, 2022, pp. 64–89.

- Villena^{*}, O. C., S. J. Ryan, C. C. Murdock, and **L. R. Johnson**⁺. “Temperature impacts the environmental suitability for malaria transmission by *Anopheles gambiae* and *Anopheles stephensi*”. *Ecology*, vol. 103, no. 8, 2022, (Ranked within the top 10% of papers with respect to citation count among work published in an issue of *Ecology* between 1st January 2022 – 31st December 2022, through up to 12 months after publication), e3685.
- Zhang, B., R. B. Gramacy, **L. R. Johnson**, K. A. Rose, and E. Smith. “Batch-sequential design and heteroskedastic surrogate modeling for delta smelt conservation”. *The Annals of Applied Statistics*, vol. 16, no. 2, 2022, pp. 816–42.
- El Moustaid[†], F., Z. Thornton^{ug}, H. Slamani^{ug}, S. J. Ryan, and **L. R. Johnson**⁺. “Predicting temperature-dependent transmission suitability of bluetongue virus in livestock”. *Parasites & Vectors*, vol. 14, no. 1, 2021, pp. 1–14.
- Gajewski[†], Z., L. A. Stevenson, D. A. Pike, E. A. Roznik, R. A. Alford, and **L. R. Johnson**⁺. “Predicting the growth of the amphibian chytrid fungus in varying temperature environments”. *Ecology and Evolution*, vol. 11, no. 24, 2021, pp. 17920–31.
- Ryan, S. J., C. J. Carlson, B. Tesla, M. H. Bonds, C. N. Ngonghala, E. A. Mordecai, **L. R. Johnson**, and C. C. Murdock. “Warming temperatures could expose more than 1.3 billion new people to Zika virus risk by 2050”. *Global Change Biology*, vol. 27, no. 1, 2021, pp. 84–93.
- Cator, L. J., **L. R. Johnson**, E. A. Mordecai, F. El Moustaid[†], T. R. Smallwood, S. L. LaDeau, M. A. Johansson, P. J. Hudson, M. Boots, M. B. Thomas, A. Power, and S. Pawar. “The role of vector trait variation in vector-borne disease dynamics”. *Frontiers in Ecology and Evolution*, vol. 8, 2020, p. 189.
- Miazgowicz, K., M. Shocket, S. J. Ryan, O. Villena^{*}, R. Hall, J. Owen, T. Adanlawo, K. Balaji, **L. R. Johnson**, E. A. Mordecai, and C. C. Murdock. “Age influences the thermal suitability of *Plasmodium falciparum* transmission in the Asian malaria vector *Anopheles stephensi*”. *Proceedings of the Royal Society B*, vol. 287, no. 1931, 2020, p. 20201093.
- Shocket, M. S., A. B. Verwillow, M. G. Numazu, H. Slamani^{ug}, J. M. Cohen, F. El Moustaid[†], J. Rohr, **L. R. Johnson**, and E. A. Mordecai. “Transmission of West Nile and five other temperate mosquito-borne viruses peaks at temperatures between 23 C and 26 C”. *Elife*, vol. 9, 2020, e58511.
- Adapa, S. R., R. A. Taylor^{*}, C. Wang, R. Thomson-Luque, **L. R. Johnson**, and R. H. Jiang. “*Plasmodium vivax* readiness to transmit: implication for malaria eradication”. *BMC systems biology*, vol. 13, 2019, pp. 1–12.
- Boersch-Supan^{*}, P. H., and **L. R. Johnson**⁺. “Two case studies detailing Bayesian parameter inference for dynamic energy budget models”. *Journal of sea research*, vol. 143, 2019, pp. 57–69.
- Burgan[†], S. C., S. S. Gervasi, **L. R. Johnson**, and L. B. Martin. “How individual variation in host tolerance affects competence to transmit parasites”. *Physiological and Biochemical Zoology*, vol. 92, no. 1, 2019, pp. 49–57.
- Childs, L. M., F. El Moustaid[†], Z. Gajewski[†], S. Kadelka, R. Nikin-Beers, J. W. Smith Jr[†], M. Walker, and **L. R. Johnson**⁺. “Linked within-host and between-host models and data for infectious diseases: a systematic review”. *PeerJ*, vol. 7, 2019, e7057.

- El Moustaid[†], F., and **L. R. Johnson**⁺. “Modeling temperature effects on population density of the dengue mosquito *Aedes aegypti*”. *Insects*, vol. 10, no. 11, 2019, p. 393.
- El Moustaid[†], F., S. J. Lane, I. T. Moore, and **L. R. Johnson**⁺. “A Mathematical Modeling Approach to The Cort-Fitness Hypothesis”. *Integrative Organismal Biology*, vol. 1, no. 1, 2019, obz019.
- Johansson, M. A., ..., **L. R. Johnson**, R. B. Gramacy, J. Cohen[†], et al. “An open challenge to advance probabilistic forecasting for dengue epidemics”. *Proceedings of the National Academy of Sciences*, vol. 116, no. 48, 2019, pp. 24268–74.
- Mordecai, E. A., J. M. Caldwell, M. K. Grossman, C. A. Lippi, **L. R. Johnson**, M. Neira, J. R. Rohr, S. J. Ryan, V. Savage, M. S. Shocket, R. Sippy, A. Stewart Ibarra, M. B. Thomas, and O. Villena*. “Thermal biology of mosquito-borne disease”. *Ecology letters*, vol. 22, no. 10, 2019, pp. 1690–708.
- Ryan, S. J., C. J. Carlson, E. A. Mordecai, and **L. R. Johnson**⁺. “Global expansion and redistribution of *Aedes*-borne virus transmission risk with climate change”. *PLoS neglected tropical diseases*, vol. 13, no. 3, 2019,
NOTE: This paper was chosen as the March selection for “Best of PLOS 2019”.
<https://theplosblog.plos.org/2020/01/best-of-plos-2019/>, e0007213.
- Taylor*, R. A., S. J. Ryan, C. A. Lippi, D. G. Hall, H. A. Narouei-Khandan, J. R. Rohr, and **L. R. Johnson**⁺. “Predicting the fundamental thermal niche of crop pests and diseases in a changing world: a case study on citrus greening”. *Journal of Applied Ecology*, vol. 56, no. 8, 2019, pp. 2057–68.
- Boersch-Supan*, P. H., **L. R. Johnson**, R. A. Phillips, and S. J. Ryan. “Surface temperatures of albatross eggs and nests”. *Emu-Austral Ornithology*, vol. 118, no. 2, 2018, pp. 224–29.
- Civitello, D. J., H. Fatima, **L. R. Johnson**, R. M. Nisbet, and J. R. Rohr. “Bioenergetic theory predicts infection dynamics of human schistosomes in intermediate host snails across ecological gradients”. *Ecology letters*, vol. 21, no. 5, 2018, pp. 692–701.
- Johnson, L. R.**, R. B. Gramacy, J. Cohen, E. Mordecai, C. Murdock, J. Rohr, S. J. Ryan, A. M. Stewart-Ibarra, and D. Weikel. “Phenomenological forecasting of disease incidence using heteroskedastic Gaussian processes: A dengue case study”. *The Annals of Applied Statistics*, vol. 12, no. 1, 2018, pp. 27–66.
- Johnson, L. R.**, P. H. Boersch-Supan*, R. A. Phillips, and S. J. Ryan. “Changing measurements or changing movements? Sampling scale and movement model identifiability across multiple generations of biologging technology”. *Ecology and Evolution*, vol. 7, no. 22, 2017, pp. 9257–66.
- Mordecai[†], E. A., J. M. Cohen, M. V. Evans, P. Gudapati, **L. R. Johnson**, C. A. Lippi, K. Miazgowiec, C. C. Murdock, J. R. Rohr, S. J. Ryan, V. Savage, M. Shocket, A. Stewart Ibarra, M. B. Thomas, and D. P. Weikel. “Detecting the impact of temperature on transmission of Zika, dengue, and chikungunya using mechanistic models”. *PLoS neglected tropical diseases*, vol. 11, no. 4, 2017, e0005568.
- Voyles, J., **L. R. Johnson**, J. Rohr, R. Kelly, C. Barron, D. Miller, J. Minster, and E. B. Rosenblum. “Diversity in growth patterns among strains of the lethal fungal pathogen *Ba-*

trachochytrium dendrobatidis across extended thermal optima”. *Oecologia*, vol. 184, 2017, pp. 363–73.

Boersch-Supan*, P. H., S. J. Ryan, and **L. R. Johnson**⁺. “deBInfer: Bayesian inference for dynamical models of biological systems in R”. *Methods in Ecology and Evolution*, vol. 8, no. 4, 2016, pp. 511–18.

Taylor*, R. A., E. Mordecai, C. A. Gilligan, **J. R. Rohr**⁺, and L. R. Johnson. “Mathematical models are a powerful method to understand and control the spread of Huanglongbing”. *PeerJ*, vol. 4, 2016, e2642.

Taylor*, R. A., S. J. Ryan, J. S. Brashares, and **L. R. Johnson**⁺. “Hunting, food subsidies, and mesopredator release: the dynamics of crop-raiding baboons in a managed landscape”. *Ecology*, vol. 97, no. 4, 2016, pp. 951–60.

Johnson, L. R., T. Ben-Horin, K. D. Lafferty, A. McNally, E. Mordecai, K. P. Paaijmans, S. Pawar, and S. J. Ryan. “Understanding uncertainty in temperature effects on vector-borne disease: a Bayesian approach”. *Ecology*, vol. 96, no. 1, 2015, pp. 203–13.

Ryan, S. J., T. Ben-Horin, and **L. R. Johnson**⁺. “Malaria control and senescence: the importance of accounting for the pace and shape of aging in wild mosquitoes”. *Ecosphere*, vol. 6, no. 9, 2015, pp. 1–13.

Ryan, S., A. McNally, **L. Johnson**, E. Mordecai, T. Ben-Horin, K. Paaijmans, and K. Lafferty. “Mapping Physiological Suitability Limits for Malaria in Africa Under Climate Change”. *Vector Borne and Zoonotic Diseases*, vol. 15, no. 12, 2015, pp. 718–25.

Ryan, S. J., A. McNally, **L. Johnson**, E. Mordecai, T. Ben-Horin, K. Paaijmans, and K. Lafferty. “Changing physiological suitability limits of malaria transmission in Africa under climate change”. *Ecology Letters*, vol. 16, 2014, pp. 22–30.

Voyles, J., **L. R. Johnson**, C. J. Briggs, S. D. Cashins, R. A. Alford, L. Berger, L. F. Skerratt, R. Speare, and E. B. Rosenblum. “Experimental evolution alters the rate and temporal pattern of population growth in *Batrachochytrium dendrobatidis*, a lethal fungal pathogen of amphibians”. *Ecology and Evolution*, vol. 4, no. 18, 2014, pp. 3633–41.

Johnson, L. R., L. Pecquerie, and R. M. Nisbet. “Bayesian inference for bioenergetic models”. *Ecology*, vol. 94, no. 4, 2013, pp. 882–94.

Mordecai, E. A., K. P. Paaijmans, **L. R. Johnson**, C. Balzer, T. Ben-Horin, E. de Moor, A. McNally, S. Pawar, S. J. Ryan, T. C. Smith, and K. Lafferty. “Optimal temperature for malaria transmission is dramatically lower than previously predicted”. *Ecology Letters*, vol. 16, no. 1, 2013, pp. 22–30.

Voyles, J., **L. R. Johnson**, C. J. Briggs, S. D. Cashins, R. A. Alford, L. Berger, L. F. Skerratt, R. Speare, and E. B. Rosenblum. “Temperature alters reproductive life history patterns in *Batrachochytrium dendrobatidis*, a lethal pathogen associated with the global loss of amphibians”. *Ecology and Evolution*, vol. 2, no. 9, 2012, pp. 2241–49.

Johnson, L. R., and C. J. Briggs. “Parameter inference for an individual based model of chytridiomycosis in frogs”. *Journal of Theoretical Biology*, vol. 277, no. 1, 2011, pp. 90–98.

Pecquerie, L., **L. R. Johnson**, S. A. Kooijman, and R. M. Nisbet. “Analyzing variations in life-history traits of Pacific salmon in the context of Dynamic Energy Budget (DEB) theory”. *Journal of Sea Research*, 2011.

Johnson, L. R. “Implications of dispersal and life history strategies for the persistence of Linyphiid spider populations”. *Ecological Modelling*, vol. 221, no. 8, 2010, pp. 1138–47.

Merl, D., **L. R. Johnson**, R. B. Gramacy, and M. Mangel. “amei: an R package for the Adaptive Management of Epidemiological Interventions”. *Journal of Statistical Software*, vol. 36, 2010, pp. 1–32.

Nisbet, R. M., E. McCauley, and **L. R. Johnson**. “Dynamic energy budget theory and population ecology: lessons from *Daphnia*”. *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 365, no. 1557, 2010, pp. 3541–52.

Merl, D., **L. R. Johnson**, R. B. Gramacy, and M. Mangel. “A statistical framework for the adaptive management of epidemiological interventions”. *PloS One*, vol. 4, no. 6, 2009, e5807.

Johnson, L. R. “Microcolony and biofilm formation as a survival strategy for bacteria”. *Journal of theoretical biology*, vol. 251, no. 1, 2008, pp. 24–34.

Johnson, L. R., and M. Mangel. “Life histories and the evolution of aging in bacteria and other single-celled organisms”. *Mechanisms of ageing and development*, vol. 127, no. 10, 2006, pp. 786–93.

Sadrozinski, H.-W., V. Bashkirov, B. Keeney, **L. R. Johnson**, S. G. Peggs, G. Ross, T. Satogata, R. W. Schulte, A. Seiden, K. Shanazi, et al. “Toward proton computed tomography”. *IEEE Transactions on Nuclear Science*, vol. 51, no. 1, 2004, pp. 3–9.

Schulte, R., V. Bashkirov, T. Li, Z. Liang, K. Mueller, J. Heimann, **L. R. Johnson**, B. Keeney, H.-W. Sadrozinski, A. Seiden, et al. “Conceptual design of a proton computed tomography system for applications in proton radiation therapy”. *IEEE Transactions on Nuclear Science*, vol. 51, no. 3, 2004, pp. 866–72.

Johnson, L., B. Keeney, G. Ross, H.-W. Sadrozinski, A. Seiden, D. Williams, L. Zhang, V. Bashkirov, R. Schulte, and K. Shahnazi. “Initial studies on proton computed tomography using a silicon strip detector telescope”. *Nuclear Instruments and Methods in Physics Research Section A*, vol. 514, nos. 1–3, 2003, pp. 215–23.

Sadrozinski, H.-W., V. Bashkirov, M. Bruzzi, **L. Johnson**, B. Keeney, G. Ross, R. Schulte, A. Seiden, K. Shahnazi, D. Williams, et al. “Issues in proton computed tomography”. *Nuclear Instruments and Methods in Physics Research Section A*, vol. 511, nos. 1–2, 2003, pp. 275–81.

IN REVIEW/
SUBMITTED

key: * - postdoctoral advisee; † - graduate student advisee (including committees);
ug - undergraduate advisee; + - senior author

Dietze, M., E. P. White, A. Abeyta, C. Boettiger, N. Bueno Watts, C. C. Carey, R. Chaplin-Kramer, R. E. Emanuel, S. M. Ernest, R. Figueiredo, M. D. Gerst, **L. R. Johnson**, M. A. Kenney, J. S. McLachlan, I. C. Paschalidis, J. A. Peters, C. R. Rollinson, J. Simonis, K. Sullivan-Wiley, R. Q. Thomas, G. M. Wardle, A. Willson, and J. Zwart. “Forecasting the Field of Ecological Forecasting”. *In Review*, 2023.

Villena^{*}, O. C., A. Arab, C. A. Lippi, S. J. Ryan, and **L. R. Johnson[†]**. “How environmental, geographic, socio-demographic, and epidemiological indicators influence malaria prevalence”. *In Review*, Preprint: <https://www.researchsquare.com/article/rs-3382942/v1> 2023.

OTHER PAPERS

key: ^{*} - postdoctoral advisee; [†] - graduate student advisee (including committees);
 ^{ug} - undergraduate advisee; ⁺ - senior author

Boersch-Supan^{*}, P. H., and **L. R. Johnson[†]**. “A tutorial on Bayesian parameter inference for dynamic energy budget models”. *bioRxiv preprint*, 2018, p. 259705.

Johnson, L. R. “Correction to: Aerial activity of Linyphiid spiders: modeling dispersal distances from meteorology and behavior”. *Journal of Applied Ecology*, 2007.

Heimann, J., **L. Johnson**, T. Satogata, and D. Williams. “The requirements and limitations of computer simulations applied to proton computed tomography”. *2003 IEEE Nuclear Science Symposium. Conference Record (IEEE Cat. No. 03CH37515)*. IEEE, 2003, pp. 3663–66.

Li, T., Z. Liang, K. Mueller, J. Heimann, **L. Johnson**, H. Sadrozinski, A. Seiden, D. Williams, L. Zhang, S. Peggs, et al. “Reconstruction for proton computed tomography: a Monte Carlo study”. *2003 IEEE Nuclear Science Symposium. Conference Record (IEEE Cat. No. 03CH37515)*. IEEE, 2003, pp. 2767–70.

Mueller, K., Z. Liang, T. Li, F. Xu, J. Heimann, **L. Johnson**, H. Sadrozinski, A. Seiden, D. Williams, L. Zhang, et al. “Reconstruction for proton computed tomography: A practical approach”. *2003 IEEE Nuclear Science Symposium. Conference Record (IEEE Cat. No. 03CH37515)*. IEEE, 2003, pp. 3223–25.

Schulte, R., V. Bashkirov, T. Li, J. Z. Liang, K. Mueller, J. Heimann, **L. R. Johnson**, B. Keeney, H.-W. Sadrozinski, A. Seiden, et al. “Design of a proton computed tomography system for applications in proton radiation therapy”. *2003 IEEE Nuclear Science Symposium. Conference Record (IEEE Cat. No. 03CH37515)*. IEEE, 2003, pp. 1579–83.

Johnson, L., B. Keeney, G. Ross, H.-W. Sadrozinski, A. Seiden, D. Williams, L. Zhang, V. Bashkirov, R. Schulte, and K. Shahnazi. “Monte Carlo studies on proton computed tomography using a silicon strip detector telescope”. *2002 IEEE Nuclear Science Symposium Conference Record*. IEEE, 2002, pp. 916–20.

THESES

Dissertation, Department of Physics, University of California Santa Cruz. *Mathematical Modeling of Cholera: from Bacterial Life Histories to Human Epidemics*. (2006)
 UCSC Science Library call number: 978-0-542-70547-2

Senior Honors Thesis, Department of Physics, College of William and Mary. *How Parallel are Parallel Universes?:* William and Mary Library. LD6051.W5m Physics, 2001, J63.

AWARDS, AND
FELLOWSHIPS

- Early Career Fellow, Mathematical Biosciences Institute, Ohio State University (2013)
- Finalist, Kings College Junior Research Fellowship, University of Cambridge (2008)
- College Research Associate, Jesus College, University of Cambridge (2006-09)
- President’s Dissertation Year Fellow, UCSC (2005-06)
- GAANN Fellow (Graduate Assistance in Areas of National Need), UCSC (2002-05)

- ISBA Travel Grant (2004) from NSF for World Meeting in Viña del Mar, Chile
- Institute of Electrical and Electronics Engineers (IEEE) Travel Grant (2002), for outstanding student researcher/presenter for the NSS/MIC Conference in Norfolk, VA
- Regents Fellowship, UCSC (2001)

SOFTWARE, CODE,
AND DATA

Data for: Phenotypic adaptation to temperature in the mosquito vector, *Aedes aegypti* [Data set]. Dennington, N., Thomas, M., McGraw, E., Grossman, M., **Johnson, L.R.**, Ware-Gilmore, F., Teeple, J., & Shocket, M. (2023). Zenodo. DOI: 10.5061/dryad.z8w9ghxgc

bayesTPC: Bayesian fitting for Thermal Performance Curves. S. Sorek, L.R. Johnson, and J.W. Smith Jr. GitHub Repo: <https://github.com/johnwilliamsmithjr/bayesTPC>

Predicting the fundamental thermal niche of crop pests and diseases in a changing world: a case study on citrus greening: R code. R.A. Taylor*, S.J. Ryan, C.A. Lippi, D.G. Hall, H.A. Narouei-Khandan, J.R. Rohr, **L.R. Johnson**⁺. May 2019. DOI: 10.5281/zenodo.3235271.

vbdcast: Vector-borne disease forecasting. L.R. Johnson and R.B. Gramacy (2017). GitHub Repository. <https://github.com/lrjohnson0/vbdcast>

Data from: Changing measurements or changing movements? Sampling scale and movement model identifiability across generations of biologging technology. **L.R. Johnson**, P.H. Boersch-Supan, R.A. Phillips, S.J. Ryan (2017). Dryad Digital Repository. <https://DOI.org/10.5061/dryad.t1r3v>

deBInfer: Bayesian inference for dynamical models of biological systems in R. P.H. Boersch-Supan, **L.R. Johnson**, and S.J. Ryan. <https://cran.r-project.org/web/packages/deBInfer/index.html>

amei: An R package for the Adaptive Management of Epidemiological Interventions: D. Merl, **L. R. Johnson**, R. B. Gramacy, M. S. Mangel. <http://www.cran.r-project.org/web/packages/amei/index.html>

PRESENTATIONS

Trait-based Approaches to Bridge the Gaps Between Mechanistic and Phenomenological Modeling for Ecological Applications.

- Invited Seminar (Online), Center for Climate Physics, Institute for Basic Science (IBS), Pusan National University, Busan, Republic of Korea. Jan. 2024
- Colloquium, Department of Statistics, Texas A&M. Dec. 2023
- Invited Seminar, Imperial College, Silwood Park, Ascot, UK. March 2023
- Invited Seminar, CREEM (Centre for Research into Ecological and Environmental Modelling) University of St. Andrews, Scotland, UK. Sept 2022

Invited panelist in the *Ifakara Master Classes in public health and medical entomology*. 14 December 2023. This was a 3 hr long facilitated discussion held via Zoom. >500 attendees participated over the course of the masterclass.

YouTube recording: <https://www.youtube.com/watch?v=hSm8qb8Bz3Q>.

How can we use statistics to understand ABMs? Examples from frogs and fish, Invited Talk in Symposium “Agent-based modeling for wildlife management” at The Wildlife Society Annual Meeting, Louisville KY, Nov 2023.

Strategic vs. Tactical Modeling Approaches to Predicting Vector-borne Diseases, Invited Talk at Epidemiological forecasting of infectious disease for public health, Organized by the Royal

Society. Maidenhead, UK. 15 - 16 March 2023

Strategic vs. Tactical Modeling Approaches to Predicting Mosquito-borne Disease in the Americas:

- Invited (Virtual) Colloquium, Department of Statistics, Iowa State, April 2022
- Invited (Virtual) Seminar, Department of Biostatistics and Epidemiology, University of Massachusetts Amherst, March 2022
- Invited (Virtual) Colloquium, Department of Mathematics, Virginia State University, Nov. 2021
- Invited (Virtual) Colloquium, Department of Statistics, University of Florida, Oct. 2020
- Invited Colloquium, Department of Statistics, The Ohio State University. Jan. 2020
- Invited Colloquium, Department of Statistics, Simon Fraser University, BC, Canada. Oct. 2019
- Invited Colloquium, Department of Statistics, Colorado State University. Nov. 2017.
- Invited Seminar, Public Health Grand Rounds seminar series, Virginia Tech, April 2017

A trait-based framework for understanding and predicting the transmission of vector-borne infections.

- Invited Seminar, part of the Virtual Global Climate Change Seminar Series at Weill Cornell Medicine. Dec. 2020.
- Invited Talk, in the session “Climatic and environmental drivers of infectious disease transmission” at the International Environmetrics Society conference (TIES). Scheduled. 14-16 September 2020. Postponed due to COVID-19 pandemic
- Invited Colloquium, Department of Environmental Sciences, University of Virginia, Sept. 2019
- Invited Colloquium, Ecology, Evolution, and Conservation Program, University of Nevada at Reno, Reno, NV. 14 March 2019
- Invited Talk, DIMACS MPE 2013+ Workshop on Global Change and Vector-borne Diseases: Mapping Emerging Infectious Diseases; Fairfax, VA; 13-15 August 2018

Bridging the gaps between mechanistic and phenomenological modeling for ecological applications, Invited Session Talk “The New Era of Ecological Statistics”, Joint Statistical Meeting, 2020 (virtual).

Killer Mosquitoes: predicting vector borne disease risks now and in the future Invited Speaker in the Daniel B. Suter Science Seminar series at Eastern Mennonite University, Harrisonburg, VA. December 4, 2019.

Phenomenological forecasting of infectious diseases: Dengue as a case study. Invited Talk, Organized Oral Session “Advancing the Ecological Forecasting Initiative: Novel Applications, Discoveries, and Opportunities”, Ecological Society of America Annual meeting, Louisville, KY, Aug 2019

Agent-Based Models in Ecology, Invited Talk at workshop on “Agent-Based Models for Exploring Public Policy Planning”, Lorentz Center, Leiden, the Netherlands, July 2019.

Introduction to Methods and Tools, Ecological Forecasting Initiative (EFI) Conference, June 2019, AAAS, Washington DC. Session introduction and panel moderation.

Mathematical models and the fundamental thermal niche of huanglongbing, a vector-borne pathogen of citrus trees. Invited Colloquium, Department of Geography, Old Dominion University, Richmond, VA. 29 March 2019.

Introduction to the Vector Behavior in Transmission Ecology RCN. Invited talk, Workshop on “Ecology and Evolution of Infectious Diseases International Partnership: Lessons Learned and Forward Look”, hosted by the BBSRC. London, UK. 18-19 March 2019.

Connecting individual traits and behavior to population level patterns using mechanistic models. Invited Talk, Organized Oral Session “Novel Modeling Approaches in Disease Ecology”, Ecological Society of America Annual meeting, New Orleans, LA, Aug 2018

Mathematical models and the fundamental thermal niche of huanglongbing, a vector-borne pathogen of citrus trees. Invited Colloquium, Department of Geography, University of Florida, Gainesville, FL; 15 February 2018.

A trait-based framework for understanding and predicting the transmission of vector-borne infections: Perspectives from the VectorBiTE RCN. Invited Talk, MUVE Section Symposium: Innovations in Disease Management: Integrating Entomology and Community Engagement, Meeting of the Entomological Society of America, Denver, CO, Nov. 2017

Merging Data and Mechanistic Models with Sathya Gopalakrishnan, Invited Talk, SESYNC Workshop on Cross-Disciplinary Socio-Environmental Statistics in the Anthropocene, Annapolis, MD, Sept. 2017

Combining tactical and strategic approaches to predict vector-borne disease, Invited talk in the mini symposium “Confronting Biological Models with Data: Dealing with Complexity and Sparsity” at the Society of Mathematical Biology Annual Meeting, Salt Lake City, UT, July 2017.

deBInfer: Bayesian inference for dynamical models of biological systems in R:

- Contributed Talk. International Statistical Ecology Conference (ISEC), Seattle, WA. June 2016
- Contributed Talk. DEB Symposium, Tromsø, Norway, May 2017

Data needs for middle-term epidemic predictions: splitting the difference between tactical and strategic models. Invited talk, DIMACS (Center for Discrete Mathematics and Theoretical Computer Science) Workshop on Zika, University of Berkeley. December 5, 2016.

Mechanistic Models for Vector-Borne Disease: What are they good for? Invited talk, Vector-BiTE 2016, March 23-25, 2016.

Statistical Inference for Mechanistic Models: Case Studies in Ecology:

- Invited Seminar, Department of Computational Mathematics, Science and Engineering, Michigan State, January 12, 2015
- Invited Seminar, Department of Statistics, Virginia Tech, December 7, 2015
- Invited Seminar, Department of Integrated Mathematical Oncology, Moffitt Cancer Center, December 17, 2015

How hot is malaria? - open challenges in evaluating the impact of climate on the transmission of vector-borne disease.

- Mathematical Biology Seminar, Virginia Tech, Blacksburg, VA. September 2016

- Contributed Talk, Epidemics 5 - Fifth International Conference on Infectious Disease Dynamics, St. Petersburg, FL. December 2015.
- Invited seminar, SAMSI Ecology Transition workshop, May 2015

A Pragmatic Approach to Forecasting Dengue Incidence: Invited Presentation, Pandemic Prediction and Forecasting Science and Technology (PPFST) Working Group and The White House Office of Science and Technology Policy (OSTP). Washington D.C. September 21, 2015.

Modelling the bioenergetics and foraging behaviours of albatrosses: Ecosystems Seminar, British Antarctic Survey. June 2015

From Individuals to Populations: Inference for Individual Based Models in Ecology: Invited Talk, Southern Regional Conference on Statistics, Carolina Beach, NC. June 2015

Inference for Mechanistic Models: Case Studies in Ecology:

- Seminar, Integrative Biology, University of South Florida, February 2013
- Seminar, Mathematics and Statistics, University of North Carolina Greensboro, March 2013.
- Mathematical Biosciences Institute, Visitor Seminar Series, Ohio State, October 2013.
- Seminar, School of Life Sciences, Arizona State University, October 2014

Bayesian Inference for Dynamic Energy Budget Models: Contributed talk, INTECOL 2013, London, UK, August 2013

Inference for Mechanistic Models in Ecology: From Individuals to Populations: Mathematical Biology Seminar Series, Duke University, April 2012

Parameter Inference for an Individual Based Model of Chytridiomycosis in Frogs:

- Contributed Talk, Amphibian Pathogens Annual Meeting, Tempe, Arizona, Nov 2010
- Contributed Talk, International Statistical Ecology Conference, Canterbury, July 2010
- Statistics Seminar Series, UCSB, May 2010 (jointly with Cherie Briggs)

Optimal Foraging Strategies in Albatrosses: Contributed talk, Annual Meeting of the Society for Mathematical Biology, July 2009

A statistical framework for the adaptive management of epidemiological interventions: Worms and Bugs Seminar Series, DAMTP, University of Cambridge, January 2009

Dispersal Strategies and Population Persistence of Linyphiid spiders: Contributed Talk, International Statistical Ecology Conference (ISEC), St. Andrews, July 2008

*Modeling Microcolony Formation in **Vibrio Cholerae***:

- Ecology Seminar, Zoology Dept, University of Cambridge, December 2007
- Mechanics and Mathematical Biology Seminar, DAMTP, University of Cambridge, February 2008

Implications of Aging in Bacteria:

- Worms and Bugs Seminar Series, DAMTP, University of Cambridge, January 2008
- Invited talk at the 2005 UVA Meeting on Evolutionary Demography, University of Virginia, Charlottesville, VA. Oct. 28-30 2005

POSTERS

deBInfer: *Bayesian inference for dynamical models of biological systems* in R. International Society for Bayesian Analysis World Meeting, Sardinia, Italy. June 2016

Effects of uncertainty in temperature dependencies of physiological responses on predictions of R_0 for malaria: a Bayesian approach. Workshop on Uncertainty, Sensitivity and Predictability in Ecology: Mathematical Challenges and Ecological Applications, Mathematical Biosciences Institute. October 26-30, 2015

Data-Driven Mathematical Models for HLB: Testing Interventions in a Virtual World. International Research Conference on Huonglongbing (IRCHLB). Orlando, FL. 9-13 February 2015

Effects of uncertainty in temperature dependencies of physiological responses on predictions of R_0 for malaria: a Bayesian approach. 2014 Opening workshop for the SAMSI Program on Mathematical and Statistical Ecology. August 18-22, 2014

Effects of uncertainty in temperature dependencies of physiological responses on predictions of R_0 for malaria: a Bayesian approach. 2013 EEID Conference, The Pennsylvania State University, State College, Pennsylvania, 20-23 May, 2013

Parameter Inference for an Individual Based Model of Chytridiomycosis in Frogs. 2011 EEID Conference in Santa Barbara, CA. 19-20 June 2011

Life Histories and Aging in Bacteria and other Single-celled organisms: Evolution 2007 conference in Christchurch, New Zealand. 16-19 June 2007.

Monte Carlo Studies on Proton Computed Tomography using a Silicon Strip Detector Telescope: Poster Talk at the 2002 IEEE Nuclear Science Symposium and Medical Imaging Conference, Norfolk, VA.

TEACHING

Courses at Virginia Tech:

Graduate:

- *STAT 5984: SS: Teaching Statistics* - Fall 2019

Dual Undergraduate/Graduate:

- *STAT 4214/5214: Methods of Regression/Advanced Methods of Regression* - Fall terms 2017- 2021 (two sections Fall 2021); Spring 2022.

Undergraduate:

- *STAT 36165 Biological Statistics 1* - Spring 2020, Fall 2023
- *STAT 3616: Biological Statistics 2* - Fall 2016; Spring 2018
- *CMDA/STAT 4664: Comp Stochastic Modeling* - Spring terms 2017, 2019, 2021, 2023

Courses at USF:

Graduate:

- *Data Analysis for Scientists* - Fall 2015
- *Organic Evolution* - Fall 2015
- *Mathematical Biology* - Spring 2015
- *Applied Regression for Scientists* - Fall 2014

Undergraduate:

- *Organic Evolution* - Fall 2015

Courses Elsewhere:

Temporary Lecturer (Loyola University Chicago)

Evolution and Genetics, Fall 2011 (undergraduate)

Workshop Instructor

- 2023 VectorByte workshop on Mathematical and Statistical Methods for Vector-borne disease applications (co-organized and taught). Held in Blacksburg, VA. Materials are available here:

<https://www.vectorbyte.org/training>

- 2021 VectorBiTE RCN workshop on Mathematical and Statistical Methods for Vector-borne disease applications (co-organized and taught). This training session was entirely online. Materials are available here:

<https://vectorbite.github.io/VBTraining3/>

- 2019 Ecological Forecasting Summer Short Course (July 28-Aug 2, 2019). I will be one of the instructors for this, focusing on Bayesian Methods.

<https://ecoforecast.wordpress.com/summer-course/>

- 2019 VectorBiTE RCN workshop on Mathematical and Statistical Methods for Vector-borne disease applications (co-organized and taught). This was a training workshop that was held as part of the VectorBiTE RCN annual meeting. Materials are available here:

<https://github.com/vectorbite/VBiTraining2>

- 2018 VectorBiTE RCN workshop on Mathematical and Statistical Methods for Vector-borne disease applications (co-organized and taught). This was a training workshop that was held as part of the VectorBiTE RCN annual meeting. Materials are available here:

github.com/vectorbite/VBiTraining#the-vectorbite-training-workshop-materials

- 2011 Ecology and Evolution of Infectious Diseases (EEID) Ecology workshop. (22-25 June 2011)

Guest Lecturer (UCSB)

Theoretical Population Ecology, Spring 2010 (undergraduate)

I designed and taught a 2 week (5 lecture) module on stochastic modelling.

Supervisor (University of Cambridge)

This consisted of small group teaching (1-3 students) to cover coursework in depth.

(Part IA/B = first and second year undergraduate; Part II = advanced undergraduate)

- *Part II Mathematical Biology*
- *Part IB Statistics*
- *Part IA Differential Equations*
- *Part IA Newtonian Dynamics*

Teaching Assistant, Tutor/Grader (UCSC)

- *Introductory Physics I (Lab)*
- *Introductory Physics II (Lab)*

- *Calculus*
- *Managerial Statistics*
- *Intro to Probability Theory*
- *Design and Analysis of Computer Simulation Experiments*

MENTORING EXPERIENCE

Current

Postdoctoral Researchers

- Paul Huxley (2021 – present)

PhD Students (Primary advisor or committee chair)

- Alecia Arneson (Bio; 2022 –)
- Parul Patil (Stats; 2022 –)
- Piper Zimmerman (Stats; 2023 –)

Graduate Committees (non-primary advisor)

- Sara Teemer (Bio; PhD, 2020 –)
- Jeremy Jenrette (F&W; PhD, 2022 –)

Masters Students (non-thesis: [†] - primary advisor/committee chair)

- Alecia Arneson (DAAS; expected Spring 2024)

Undergraduate researchers

- Sean Sorek (Stats/Math; F2022 –)
- Joe Harrison (CMDA; F2023 –)

Previous

Postdoctoral Researchers

- Oswaldo Villena-Carpio (2018 – 2021)
- Philipp Boersch-Supan (2014 – 2018)
- Rachel Taylor (2014 – 2016)

PhD Students (Primary advisor or committee chair)

- Zachary Gajewski (Bio; 2015 – 2021)
- Fadoua El Moustaid (Bio; 2015 – 2019)
- John Smith Jr. (Stats; 2018 – 2022)

Graduate Committees (non-primary advisor)

- Ryan Nikin-Beers (VT, Math; PhD, 2018)
- Sarah Burgen (USF, Bio; MS, 2016)
- Jeremy Cohen (USF, Bio; PhD, 2016)

Masters Students (non-thesis: [†] - primary advisor/committee chair)

- Zachary Gajewski [†] (DAAS; 2018 – 2019)
- Yuxin Zhao [†] (DAAS; 2018 – 2019)
- Samantha Sunshine (Stats MS; Fall 2018)
- John W. Smith Jr. (Stats, MS; Fall 2018)
- Tessa Anwell-Prince [†] (Stats, MS; Fall 2020)

- Shibaji Chakraborty (DAAS; Fall 2020)
- Jo Pinko [†] (Bio; 2020 – 2022)

Undergraduate Researchers

At VT:

- Lauren Chapman (Stats; 2021)
- Connor Lachance (Stats; 2021)
- Iulia Voina (Stats; 2019 – 2020)
- Cordell Harris (Stats; Fall 2020)
- Laelaf Abebe (Stats; Fall 2020)
- Zorian Thornton (Stats/CMDA; 2017 – 2019)
- Hani Slamani (CMDA/Stats; 2017 – 2018)
- Andrew Ahnn (CS; summer 2018)
- Sarah Hebert (CMDA; summer 2018)

At USF:

Matthew Cuffaro (math), Abigail Dobson (biology), James Martin (public health), Luc Olivier (math)

High School Students

- Robert Lee (BHS; Summer 2018)

Mentor (University of Cambridge)

I set and supervised a project for students taking Part III (master's level) mathematics, and co-supervised a summer undergraduate researcher with scientists from the British Antarctic Survey.

PROFESSIONAL ACTIVITIES

Editorial Positions:

- **Subject Matter Editor** for *Ecosphere* (Sept. 2017 to present)
- **Subject Matter Editor** for *Epidemics* (July 2020 to present)
- **Associate Editor** for *Annals of Applied Statistics* (July 2020 to present)

Reviewer for: Science; American Statistician; EcoHealth; Journal of the Royal Society Interface; American Naturalist; Journal of Theoretical Biology; Theoretical Population Biology; Oikos; Theory in Biosciences; Aging Cell; PLoS One; Journal of Sea Research; Population Ecology; Stochastic Environmental Research and Risk Assessment (SERR); Trends in Parasitology; Animal Conservation; Journal of Applied Ecology; Proceedings of the Royal Society B; Tropical Medicine & International Health

Grant Reviews:

Ad Hoc: year (number of proposals)

NSF Office of Polar Programs - 2014 (2)

NSF Biological Sciences Division - 2018 (1)

Medical Research Foundation (independent charity of the UK Medical Research Council) - 2023 (1)

Panels: year (number of proposals)

NSF Biological Sciences Division - 2016 (10), 2017 (13), 2020 (8), 2021 (8)

NSF Cross Cutting (multiple directorates) - 2022 (3)

Workshop/Working group participation

Organized the Invited Session "Agent-Based Models for informing public policy: applications and statistical challenges" for the JSM 2020 Annual Meeting.

Co-organizer for the Organized Oral Session "Ecological Forecasting: Applications, Discoveries, and Opportunities" at the 2020 ESA Annual Meeting (held virtually)

Invited Session Co-Organizer for Society of Mathematical Biology Annual Meeting, Montreal, Ontario, Canada.

Organized the VectorBiTE RCN 2018 Meeting and Workshop, held in Asilomar, CA

Organized the VectorBiTE RCN 2016 Meeting, held in Clearwater, FL

VectorBiTE working group on Environmental influences across stages. From March 2016 to 2022.

SAMSI Working group on Multivariate Models, Climate, and Biodiversity. from August 2014-2015.

NCEAS/Luce Fellow working group on Malaria and Climate Change (2011-2013)

Department/University Committees

VT:

Stats Dept Personnel Committee (Fall 2023 – present)

Stats Dept Ad Hoc committee, Biostats expectations (Fall 2023)

Stats Dept Teaching Evaluation Committee (Fall 2022 – present)

Stats Dept Seminar Committee (Fall 2018 – Fall 2022)

Statistics Service Course Pedagogy Committee (Fall 2018 – 2022)

Stats Dept Policy Committee (2016 – 2019)

CMDA Scholarship/Awards committee (2017 – present)

Statistics Hiring Committee (Spring 2022)

Mathematics/CMDA hiring committee (Fall 2016, Fall 2021)

Infectious Diseases IGEP Steering Committee Member (Fall 2022 to present)

Group Leader for Computational Biology and Disease Modeling in the Center for Emerging, Zoonotic, and Arthropod-borne Pathogens (CeZAP) (Fall 2021 to present)

Interfaces of Global Change Advisory Board (Summer 2020 to Summer 2022)

Interfaces of Global Change Admissions Committee (Spring 2018 – Spring 2019)

USF Integrative Biology: Graduate Admissions and Policy Committee; Seminar Committee.

Miscellaneous other service

Outreach through Skype a Scientist (Spring 2023 – present)

FSLI Faculty Mentoring Program (as a mentor) (2022-2023)

Moderator for Women in Data Science at VT workshop, Feb 12, 2019

Advisory Board for Ecological Forecasting Research Coordination Network