Samuel M. Smith

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Education

Colorado State University *Fort Collins, Colorado*

M.Sc. Ecology Aug. 2021 - December 2023

- Advisor: Colleen Webb
- Thesis: The impact of control on national-scale livestock disease outbreaks in the United States.

Lewis & Clark College *Portland, Oregon*

B.A. Biology, with Honors Aug. 2017 - May 2021

- Honors Thesis: Can seedling functional traits explain changing forest dynamics in an everwet tropical forest?

Technical Skills

Languages:	R, C++, BASH/zsh, Python, MATLAB, JAGS, Stan
Quantitative:	simulation modeling, Frequentist & Bayesian statistics, parameter estimation, sensitivity analysis, dynamical systems, hierarchical & multilevel modeling, multivariate analysis
HPC and Development:	Git, Slurm Workload Manager, VS Code, CLion, PyCharm, Valgrind, RStudio, RStudio Server

Selected Research Experience

Optimizing low-prevalence animal disease surveillance *Fort Collins, CO*

ORISE Research Fellow | *R, C++, Stan, HPC, Git* Jun. 2024 - present

- Fit power law (kernel) functions to sensitive data within a Bayesian framework using custom MCMC samplers.
- Developed an efficient simulation model in C++ for a HPC environment to predict where animals found at a slaughter originated in the U.S.
- Engineered pipelines to automate simulation setup and processing on the HPC and analyze model results.
- Maintained clear versioning with Git and regularly communicated progress via presentations and technical reports.

National scale simulation modeling of Highly Pathogenic Avian Influenza *Fort Collins, CO*

ORISE Research Fellow | *R, C++, HPC, Git* May. 2024 - present

- Developed C++ code to implement premises-level movement bans within the United States Disease Outbreak Simulation.
- Developed R code pipeline to setup model runs on HPC and process model results.

Predictive modeling of West Nile Virus transmission and evolution *Fort Collins, CO*

Research Associate II | *C++, R, Stan, HPC, Git* Feb. 2024 - present

- Developed an ordinary differential equation model that describes West Nile Virus (WNV) transmission in mosquitoes.
- Implemented a Bayesian model in Stan to estimate parameters of interest for the the WNV mechanistic model.
- Conducted sensitivity analyses on mechanistic model parameters to determine which parameters needed to be estimated versus taken from the literature.

Modeling national-scale Bovine Tuberculosis and Foot-and-Mouth Disease outbreaks *Fort Collins, CO*

Research Associate II | *C++, R, HPC, Git* Oct. 2023 - present

- Developing modular C++ code to allow for multi-species Foot-and-Mouth Disease outbreak scenarios in a pre-existing national-scale, stochastic Susceptible Infected Exposed and Recovered (SEIR) livestock disease transmission model (United States Disease Outbreak Simulation).
- Developing code to implement species-specific control policies during simulated outbreaks.
- Developed C++ code to import state-level shipment network data into the United States Disease Outbreak Simulation to dynamically replace predicted shipments between states where data were available.

Exploration of the impact of tracing cattle to and from TB-affected herds on the predicted national-scale patterns of bovine TB outbreaks *Fort Collins, CO*

Graduate Research Assistant | *C++, R, HPC, Git* Aug. 2021 - Aug. 2023

- Partnered with the United States Department of Agriculture's Center for Epidemiology & Animal Health and Animal & Plant Health Inspection Service to conceive this project, acquire funding, and develop the model.
- Developed C++ code to allow diagnostic tests to trigger shipment trace investigations from TB-affected farms.
- Used version control software to maintain development versions of the model that would later be incorporated into United States Disease Outbreak Simulation.
- Developed R code to process and analyze simulation results.

Foot-and-Mouth Disease response planning for the State of Colorado *Fort Collins, CO*

Graduate Research Assistant | *C++, R, HPC, Git* May. 2022 - Aug. 2022

- Developed C++ code to allow United States Disease Outbreak Simulation to output farm control statuses every timestep.
- Used version-control software during model development.
- Partnered with Colorado State Veterinarian's office to solicit Colorado-specific cattle movement data.
- Visualized Foot-and-Mouth Disease outbreak patterns with publicly available and custom R packages.
- Developed R code to process and analyze simulation results.

Evaluating costs and benefits of state-dependent control policies *Fort Collins, CO*

Master's Thesis Research | *C++, R, HPC, Git* Aug 2021 - present

- Developed C++ code to implement new epidemiological intervention strategies into the United States Disease Outbreak Simulation.
- Conducted sensitivity analysis on USDOS control parameters.
- Developed bash scripts to manage the submission of jobs and movement of output files on a high performance computing cluster.
- Used version control software to maintain up-to-date model code where it was being actively developed by myself and colleagues.
- Developed self-contained R code to process and analyze simulation results, including generate cost estimates for individual outbreaks.

Can seedling functional traits explain liana and tree seedling dynamics in an everwet tropical forest? *Portland, OR*

Lewis & Clark College's Department of Biology Honors Thesis | *R, HPC* Aug. 2020 - May 2021

- Conceived a research question, conducted 6 months of analyses in R on a large, complex dataset from eastern Ecuador, and produced an undergraduate honors thesis.
- Interpreted and communicated the results from complex models to supervisor weekly, both orally and as a written manuscript at the end of the semester.
- Fit multilevel statistical models (generalized linear mixed effects models) to survival and abundance data while using information criteria to determine model fit.
- Conducted a full suite of comparative phylogenetic analyses to understand whether of evolutionary history drives trait distributions in eastern Ecuador.

Understanding the role of precipitation regimes on plant diversity and above ground biomass in the Chihuahuan Desert *Las Cruces, NM*

National Science Foundation Research Experience for Undergraduates (REU) Jun. 2020 - Aug. 2020

- Responsible for the implementation and maintenance of Automatic Rainfall Manipulation Shelters for 3 ongoing experiments. Routinely repaired plumbing and electrical systems to ensure the shelters remained operational throughout the summer.
- Developed and conducted an independent project examining the effects of long-term drought stress on Honey mesquite (*Prosopis glandulosa*) stem and leaf traits.

Dynamical interactions between plant and oomycete biodiversity in a temperate forest *Wind River, WA*

Lewis & Clark College Roger's Summer Science Intern May 2019 - Aug. 2019

- Conducted plant community composition and structure surveys in a mixed conifer forest.
- Collected duff and sorted out conifer seeds by species and viability. Routinely identified various species of conifer seedlings, shrubs, and forbs.
- Conducting statistical analyses in R to understand the effects of soil moisture on coniferous seedling growth and survival rates.

Publications

[1] Brandon J. Simony, Ryan S. Miller, Lindsay M. Beck-Johnson, **Samuel M. Smith**, Colleen T. Webb. "Stochastic modeling of bovine tuberculosis dynamics in white-tailed deer." Research in Veterinary Science. November 2025.

[2] **Samuel M. Smith**, Colleen T. Webb, Stefan Sellman, Tom Lindström, Lindsay M. Beck-Johnson. "Potential benefits of state-dependent control policies are outweighed by costs of infrequent, but dramatically larger disease outbreaks." Proceedings of the Royal Society Open Science. July 2025.

[3] **Samuel M. Smith**, Colleen T. Webb, Lindsay M. Beck-Johnson, *et al.* "United States annual cattle market sales estimate data," Data in Brief. Aug. 2025.

[4] Metz, M.R., Wright, S.J., Zimmerman, J.K., Hernandéz, A., **Smith, S.M.**, Swenson, N.G., Umaña, M.N., Valencia, L.R., Waring-Enriquez, I., Wordell, M., Zambrano, M., Garwood, N.C.. "Functional traits of young seedlings predict trade-offs in seedling performance in three neotropical forests." Journal of Ecology, Oct. 2023.

[5] **Samuel M. Smith**, Colleen T. Webb, Lindsay M. Beck-Johnson, *et al.* "Modeling national-scale bovine tuberculosis outbreak dynamics in the U.S. cattle population" Journal of Preventative Veterinary Medicine. *in prep*, 2025.

[6] Brandon S. Simony, Ryan S. Miller, **Samuel M. Smith**, Lindsay M. Beck-Johnson, Colleen T. Webb, "Wildlife's role in driving the persistence of bovine Tuberculosis in United States' cattle herds. Research in Veterinary Sciences. *In prep*, 2025.

[7] **Samuel M. Smith**, Brandon S. Simony, Clayton Hallman, Katie Portacci, Ryan S. Miller, Lindsay M. Beck-Johnson, Colleen T. Webb, "Within-herd modeling of bovine tuberculosis dynamics" Preventative Veterinary Medicine. *In prep*, 2025.

Presentations

Supporting Emergency Disease Management with State-Dependent Control — *Penn. State Univ., State College, PA*
Samuel M. Smith, Lindsay M. Beck-Johnson, Colleen T. Webb — May 22 - 25, 2023
Ecology and Evolution of Infectious Diseases Annual Meeting

Supporting emergency disease management with structured decision-making — *Fort Collins CO*
Samuel M. Smith, Lindsay M. Beck-Johnson, Colleen T. Webb — Feb. 24, 2023
2023 Front Range Student Ecology Symposium

Do flexible, state-dependent control strategies improve Foot-and-Mouth Disease outbreak outcomes? — *Emory University, Atlanta, GA*
Samuel M. Smith, Lindsay M. Beck-Johnson, Colleen T. Webb — Jun. 4 - 10, 2022
Ecology and Evolution of Infectious Diseases Annual Meeting

Can seedling functional traits help explain liana and tree seedling dynamics in an everwet tropical forest? — *Montreal, Quebec ,Canada*
Samuel M. Smith, Nancy C. Garwood, Margaret R. Metz — Aug. 14 - 19, 2022
Ecological Society of America Annual Meeting

Seedling functional traits help explain liana and tree seedling dynamics in an everwet tropical forest. — *Fort Collins CO*
Samuel M. Smith, Nancy C. Garwood, Margaret R. Metz — Feb. 24, 2022
2022 Front Range Student Ecology Symposium

Seedling functional traits may help explain changing liana and tree seedling dynamics in an everwet tropical forest. — *Fort Collins, CO*
Samuel M. Smith, Nancy C. Garwood, Margaret R. Metz — Nov. 9, 2021
2021 Graduate Student Showcase

Awards and Honors

Feb. 2023	**Best Presentation (3rd), Front Range Student Ecology Symposium:** Supporting emergency disease management with structured decision-making.	*Fort Collins, CO*
Sep. 2022	**Co-PI, USDA Cooperative Agreement:** Exploration of the impact of tracing cattle to and from (Bovine Tuberculosis) TB-affected herds on the predicted national-scale patterns of bovine TB outbreaks (**$80,000**)	*Fort Collins, CO*
Oct. 2021	**Office of International Programs Global Impact Award** for a poster presentation at the Graduate Student Showcase	*Fort Collins, CO*
Aug. 2021	**Colorado State Graduate Fellowship**	*Fort Collins, CO*
May 2021	**Departmental Honors**: Lewis & Clark Biology Department Thesis	*Portland, OR*
Nov. 2019	**Dinah Dodds Endowment for International Education** awarded funding to conduct an informal study the impacts of small women's groups on Tanzania's natural resources (**$1,830**)	*Arusha, Tanzania*
Dec. 2016	**Eagle Scout Award**	*Sewanee, TN*

Teaching

Basic Concepts of Plant Life Laboratory (BZ105) — *Fort Collins, CO*
Graduate Teaching Assistant — Aug. 2021 - Dec. 2021

Principles of Plant Biology (BZ120) — *Fort Collins, CO*
Graduate Teaching Assistant — Jan. 2022 - May 2022

Plant Biology (BIO323), Ecology and Environmental Science (BIO141), Biological investigations into the formation and function of cilia (BIO110) — *Portland, OR*
Undergraduate Teaching Assistant — August 2019 - May 2022

Training

Pandemic Scenario Modeling and Science Communication — *Emory University, Atlanta, GA*
Ecology and Evolution of Infectious Diseases — Jun. 2022

Inclusive Pedagogy — *Fort Collins, CO*
The Institute for Learning and Teaching — Jan. 2022 - Feb. 2022

Transforming graduate education to meet challenges of the Anthropocene — *Fort Collins, CO*
Graduate Degree Program in Ecology, Front Range Student Ecology Symposium — Feb. 24, 2022

Wildland Firefighting Certification — *Sewanee, TN*
The University of the South, Department of Earth and Environmental Systems — Jan. 2022

Wilderness First Responder Training — *Portland, OR*
NOLS Wilderness Medicine — Nov. 2020

Service

Front Range Student Ecology Symposium — *Colorado State University*
Graduate Degree Program in Ecology steering committee member — Aug. 2022 - Present

Graduate Degree Program in Ecology Peer Mentor — *Colorado State University*
Peer mentor for incoming graduate students — Aug. 2022 - Present

Library Education and Technology Committee — *Lewis & Clark College*
Student representative — Aug. 2020 - May 2022

57th Annual International Affairs Symposium *Lewis & Clark College*
Steering committee member Aug. 2018 - April 2019