

Nathan C Layman, PhD

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Research Interests

My research uses artificial intelligence, deep learning, and machine learning models to ask ecological and evolutionary questions about outbreak dynamics, host-pathogen co-evolution, and viral transmission. Some of my recent projects include developing machine learning-based predictive models for outbreak forecasting and estimating the efficacy of wildlife disease surveillance using natural language processing-assisted data structuring. I am also passionate about public health, equitability, and open and reproducible science.

Education

04/2018 PhD Biology, Washington State University
03/2011 BS Biology, University of Washington
03/2011 BA Environmental Studies, University of Washington

Expertise

- 5 years experience developing Machine learning to address complex biological problems, including experience with Generative AI, Mask R-CNN, Semantic Segmentation, Natural Language Processing, Boosted Regression Trees, and Generalized Additive Models.
- Skilled in analyzing large, multi-modal data using R, Python, SQL, and C++.
- Experienced in developing reproducible and repeatable analysis pipelines using Amazon AWS services, git, targets, and snakemake.
- Skilled in visualizing and presenting complex biological data and developing dynamic dashboards using Shiny and Dash.
- Demonstrated ability to work collaboratively across multidisciplinary teams.
- Proficient in next-generation sequence data analysis.
- Experienced in presenting findings to stakeholders locally and internationally, as well as delivering presentations at national and international conferences.

Publications

In Prep

Layman, N.C., Cayol. C., Awada, L., Ross, N., Tizzani, P. 2024. Generative AI-assisted methods for estimating the sensitivity of disease surveillance. Target: Science of The Total Environment.

Published

Layman, N.C., Basinski, A.J., Zang, B., Eskew, E.A., Bird, B.H., Ghersi, B.M., Bangura, J., Fichet-Calvet, E., Remien, C.H., Vandi, M., Bah, M., Nuismer, S.L. 2023. *Predicting the fine-scale spatial distribution of zoonotic reservoirs using computer vision*. 2023. Ecology Letters. Ecology Letters, 00: 1-13.

doi.org/10.1111/ele.14307

Nuismer, S.L., **Layman, N.C.**, Redwood, A.J., Chan, B., Bull, J.J. 2021. *Methods for measuring the evolutionary stability of engineered genomes to improve their longevity*. Synthetic Biology, 6(1): 1-10.

doi.org/10.1093/synbio/ysab018

Basinski, A.J., Fichet-Calvet, E., Sjodin, A.R., Varrelman, T.J., Remien, C.H., **Layman, N.C.**, Bird, B.H., Wolking, D.J., Monagin, C., Ghersi, B.M., Barry, P.A., Jarvis, M.A., Gessler, P.E., Nuismer, S.L. 2021. *Bridging the gap: Using reservoir ecology and human sero-surveys to estimate Lassa incidence in West Africa*. PLOS Computational Biology, 17(3): e1008811 **doi:10.1371/journal.pcbi.1008811**

Layman, N.C., Tuschhoff, B.M., Basinski, A.J., Reimen, C.H., Bull, J., Nuismer, S.L. 2021. *Designing transmissible viral vaccines for evolutionary robustness and maximum efficiency*. Vaccine Evolution, 7(1): 1-11. **doi:10.1093/ve/veab002**

Layman, N.C., Tuschhoff, B.M., Basinski, A., Reimen, C., Bull, J., Nuismer, S. 2020. *Suppressing evolution in genetically engineered systems through repeated supplementation*. Evolutionary Applications. **doi:10.1111/eva.13119**.

Prior, C.P.*, **Layman, N.C.***, Koski, M.H., Galloway, L.F., Busch, J.W. 2020. *Westward range expansion from middle latitudes explains the Mississippi River discontinuity in a forest herb of eastern North America*. Molecular Ecology, 29: 4473-4486. **doi:10.1111/mec.15650**

Nuismer, S.L., Remien, C.H., Basinski, A.J., Varrelman, T., **Layman, N.C.**, Rosenke, K., Bird, B., Jarvis, M., Barry, P., Fichet-Calvet, E. 2020. *Bayesian estimation of Lassa virus epidemiological parameters: implications for spillover prevention using wildlife vaccination*. PLOS Neglected Tropical Diseases, 14(9): e0007920. **doi:10.1371/journal.pntd.0007920**.

Koski, M.H., **Layman, N.C.**, Prior, C.J., Busch, J.W., Galloway, L.F. *Selfing ability and drift load evolve with range expansion*. 2019 Evolution Letters, 3-5: 500-512. **doi:10.1002/evl3.136**

Layman, N.C., Busch, J.W. 2018. *Bottlenecks and inbreeding depression in autotetraploids*. Evolution, 72: 2025-2037. **doi:10.1111/evo.13587**

Layman, N.C., Fernando, T.R., Herlihy, C.R., Busch, J.W. 2017. *Costs of selfing prevent the spread of a self-compatibility mutation that causes reproductive assurance*. Evolution, 71: 884-897. **doi:10.1111/evo.13167**

*Shared first authorship

Press

Feb 2017 Harkness, A. *Digest: Prudent self-denial: the advantage of incompatibility in Leavenworthia alabamica*. Evolution. Reviews Layman et al 2017

Grants and selected awards

- 2017 Rexford Daubenmire Award for Graduate Education - \$30,000
- 2016 NSF Doctoral Dissertation Improvement Grant (DDIG) - \$20,000
- 2013-2017 Higinbotham Award - \$12,000
- 2012-2014 Aase Fellowship - \$4,000

Mentoring

- 2017-2020 Mentored UIIdaho and WSU graduate students in parallel computing as well as coding in R, Python and C++.
- 2018-2019 Mentored UIIdaho undergraduates in modeling, computational biology, coding, and the Gillespie algorithm.
- 2017-2016 Mentored WSU undergraduates in multiplex PCR, microsatellite analysis, RADseq and general lab work

Teaching

- 2013-2018 20-30 hours per week designing, teaching and grading lab sections for the following courses
 - Principles of Organic Evolution
 - Origins in the Natural World
 - Dynamic Systems in the Natural World
 - Introductory Biology

Presentations and invited seminars

- 2019 Spotlight session: *Swamping prevents post-release evolution in genetically modified organisms.*
Evolution 2019, Providence, RI
- 2017 Invited speaker: *The fitness effects of an initial self-compatibility mutation in Leavenworthia alabamica.*
International Botanical Congress 2017, Shenzhen, China
- 2017 Co-author, invited talk: *Population-genetic expectations for trait filtering of self-incompatibility on islands.*
International Botanical Congress 2017, Shenzhen, China
- 2017 Invited speaker: *Inbreeding depression and polyploidy as a genetic island.*
Evolution 2017, Portland, OR
- 2017 Co-author, invited talk: *Population-genetic expectations for trait filtering of self-incompatibility on islands.*
Evolution 2017, Portland, OR
- 2017 Contributed poster: *Why is self-compatibility common on islands?*
Washington State University School of Biological Sciences 2017, Pullman, WA
- 2016 Contributed talk: *Inbreeding depression and the spread of selfing in polyploids.*
EVO-WIBO 2016, Port Townsend, WA
- 2016 Contributed talk: *Inbreeding depression and the spread of selfing in polyploids.*
Washington State University School of Biological Sciences Recruitment Seminar 2016, Pullman, WA
- 2015 Contributed talk: *Inbreeding depression and the spread of selfing in polyploids.*
Botany 2015, Edmonton, AL, CA
- 2014 Contributed poster: *Challenging the Link Between Polyploidy and Self-compatibility.*
Botany 2014, Boise, ID

Other academic activities

Service

- 2017-2020 Reviewed articles for Evolution, The Journal of Evolutionary Biology, The Journal of Heredity, and PLOS
- 2017 Presented introduction to programming workshop series for Washington State University graduate students
- 2016-2017 Washington State University, School of Biological Sciences - Coordinator for the weekly seminar series, Biolunch

Employment history

- 2021–Current Research Scientist, EcoHealth Alliance. *Early disease outbreak forecasting*. New York, NY.
- 2018–2021 Postdoctoral Researcher, University of Idaho. *Modeling the stability of transmissible vaccines*. Developed mathematical models of infectious disease - Moscow ID.
- 2014–2017 Research Assistant, Washington State University. *Challenging the reproductive assurance hypothesis*. Co-designed and implemented large-scale field experiment - Moulton AL.
- 2011–2012 Fisheries Technician, Washington Department of Fish and Wildlife. *Maintained, evaluated, and transported fish stocks in central Washington*. - Chelan, WA
- 2011–2012 Botany Technician, United States Forest Service. Supervisor: Brigitte Ranne. *Plant inventory and monitoring in Washington forests*. Supervised a 4 person field crew - Entiat, WA

References

Noam Ross, Executive Director, rOpenSci

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Emma Mendelsohn, Senior Research Scientist, Computational Research Team, EcoHealth Alliance

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Scott Nuismer, Associate Professor, Department of Biological Sciences, University of Idaho

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Jeremiah Busch, Associate Professor, School of Biological Sciences, Washington State University

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