CHRISTIAN E. GUNNING

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EXECUTIVE SUMMARY

My research explores the spatiotemporal dynamics of real-world systems that are discrete, stochastic, and non-linear. My primary focus is on population dynamics of disease systems, where I use empirical data, numerical simulations, and statistical models to elucidate ecological mechanisms. My work draws upon the theory and methodology of mathematics, statistics, and computer science, as well as chemistry, physics, and earth sciences. I am especially interested in stochastic extinction and persistence, partially observed Markov processes, and population responses to perturbation. At present, my study systems include childhood diseases in the pre-vaccine era U.S., and mosquito population dynamics in Iquitos, Peru.

I have extensive experience with linear and generalized linear modeling, bootstrap-based uncertainty quantification, frequency-domain and wavelet-based time series analysis, dynamical system simulation using both ODEs and Markov chains, and stochastic optimization. I also have a broad background in machine learning, as well as computer data structures and algorithms. I employ a range of open source computing tools in my research, including the R and C++ programming languages for data visualization, numerical simulation, and statistical modeling, and SQL for data management. I also employ reproducible research tools and best practices, including revision control.

In the classroom, I use real-world examples and student-led inquiry to teach quantitative skills to students from diverse backgrounds and experience levels. I believe that rigorous quantitative training is critical for next generation of data-driven scientists. In particular, I aim to increase student access to and personal investment in probability and statistics, scientific programming, and reproducible research methods.

EDUCATION

University of New Mexico, Albuquerque *Summer 2014*
Ph.D. with Distinction in Biology (Disease Ecology with concentration in Integrative Biology)
Committee: Drs. Helen J. Wearing (advisor), James H. Brown, Melanie Moses, and Erik Erhardt
Title: Population and metapopulation ecology of childhood diseases in the pre-vaccine era United States

University of New Mexico, Albuquerque *Fall 2009*
Masters of Water Resources (Riparian Hydroecology)
Advisors: Drs. Bruce Thomson and Roy Jemison
Title: Estimating phreatophyte evapotranspiration from diel groundwater fluctuations in the Middle Rio Grande Bosque

University of Georgia, Athens *Fall 2001*
Bachelor of Science, Biochemistry and Molecular Biology
Advisor: Dr. James Omichinski

PEER-REVIEWED PUBLICATIONS

C. Andris, D. Lee, M.J. Hamilton, M. Martino, **C.E. Gunning**, J.A. Selden (2015). The Rise of Partisanship and Super-cooperators in the US House of Representatives. PLoS ONE, 10(4), e0123507.

C.E. Gunning, E. Erhardt, H.J. Wearing (2014). Conserved patterns of incomplete reporting in pre-vaccine era childhood diseases. Proceedings of the Royal Society B 281(1794), 20140886.

C.E. Gunning & H.J. Wearing (2013). Probabilistic measures of persistence and extinction in measles (meta)populations. Ecology Letters 16(8), 985-994.

D.M. Smith, D.M. Finch, **C.E. Gunning**, R. Jemison, J.F. Kelly (2009). Post-wildfire recovery of riparian vegetation during a period of water scarcity in the Southwestern USA. Fire Ecology 5(1), 38-55.

PENDING PUBLICATIONS

Mentee co-author: †

C.E. Gunning, M.J Ferrari, E. Erhardt, H.J. Wearing. Evidence of cryptic incidence in childhood diseases. Preprint available at `http://biorxiv.org/content/early/2016/10/04/079194`. Proc. R. Soc. B (In Review).

M.R. Vella†, **C.E. Gunning**, A.L. Lloyd, F. Gould. Evaluating strategies for reversing CRISPR-Cas9 gene drives. In Prep.

G. Zilnik†, **C.E. Gunning**, F. Gould. The Evolution of Fitness Modifiers and Their Impact on Insecticide Resistance. In Prep. Draft available on request.

C.E. Gunning, K. Okamoto, H. Astete, G.M. Vasquez, E. Erhardt, C. Del Aguila, R. Pinedo, R. Cardenas, C. Pacheco, E. Chalco, H. Rodriguez-Ferruci, T.W. Scott, A.L. Lloyd, F. Gould, A.C. Morrison. Efficacy of *Aedes aegypti* control by indoor Ultra Low Volume (ULV) spraying in Iquitos, Peru. In Prep. Draft available on request.

J. Nightingale†, M. Holstad, **C.E. Gunning**. Temperature-dependence in sewer blockage frequency. In Prep. Draft available on request.

RESEARCH EXPERIENCE

Post-doctoral Researcher Oct 2014 - Present
Departments of Entomology and Mathematics, NCSU Raleigh, NC

· Statistical analysis of *Aedes aegypti* field spraying trials in Iquitos, Peru
· Continue development of Skeeter Buster of *Aedes aegypti* population dynamics simulation model
· Mentor graduate students in Mathematics and Entomology

Research Assistant Jan 2010 - Oct 2014
Wearing Lab, UNM Biology Albuquerque, NM

· Conduct original research for publication and assist with grant writing
· Systems administrator and data manager
· Undergraduate training and mentorship

Hydrology Research Technician Jan 2006 - Jan 2009
Rocky Mountain Research Station, U.S. Forest Service Albuquerque, NM

· Conduct original research and prepare technical reports for U.S. Forest Service
· Collect and managed environmental monitoring data

Plant Genetics Lab Technician Jun 2003 - Jun 2004
Malmberg Lab, UGA Plant Biology Athens, GA

· Isolated DNA, Conducted PCR
· Design data entry and management system

NMR Lab Technician Jan 2001 - Jun 2002
Omichinski Lab, UGA Biochemistry and Molecular Biology Athens, GA

· Administer mixed Unix workstation cluster
· Evaluate linux hardware/software for high-performance NMR data visualization

GRANTS

Jun 2011 ($2,000). UNM PiBBS Student Enrichment Grant to attend SFI Complex Systems Summer School.

May 2010 ($500). EEID Conference Workshop travel grant.

Mar 2010 ($80,000). Center for Evolutionary & Theoretical Immunology (CETI) Seed Grant, Waning Immunity in Influenza and Whooping Cough, Contributing author.

Aug 2009 (≈$50,000). Program in Interdisciplinary Biological and Biomedical Sciences (PIBBS), 2 year fellowship.

May 2007 ($4,400). UNM Graduate Research and Development grant, Hydrological research in the Middle Rio Grande Bosque.

AWARDS

Apr 2013 ($500). UNM Biology Department Scholarship.

Apr 2013 Graduate oral presentation, 2^{nd} place. UNM Biology Research Day.

Apr 2010 ($500). UNM SRAC travel grant to attend useR 2010.

Apr 2010 Graduate poster presentation, 1^{st} place. UNM Biology Research Day.

CONTRIBUTED TALKS

C.E. Gunning, A.L. Lloyd. Skeeter Buster Past, Present, and Future: Challenges and Issues in Modeling Mosquito Populations. Society of Vector Ecology. Albuquerque, NM. Sep 2015. SAMSI Program on Mathematical and Statistical Ecology Transition Workshop. Durham, NC. May 2015.

C.E. Gunning, H.J. Wearing. Appropriate Measures of Persistence in Childhood Diseases. SAMSI Program on Mathematical and Statistical Ecology Transition Workshop. Durham, NC. May 2015.

C.E. Gunning, H.J. Wearing. Reporting rate variation in U.S. cities. UNM Biology Research Day. Albuquerque, NM. Apr 2013.

C.E. Gunning. Measles dynamics in the pre-vaccine era United States: Linking models and data. UNM Biology Brownbag seminar series. Albuquerque, NM. Oct 2011.

C.E. Gunning, H.J. Wearing. Measles epidemics in pre-vaccine era United States cities: Linking models and data. Ecological Society of America conference. Austin, TX. Aug 2011.

C.E. Gunning. Spatio-temporal ecology of measles. UNM Biology Research Day. Albuquerque, NM. Apr 2011.

C.E. Gunning. Rwave - Detecting synchrony of influenza between U.S. states. useR 2010 Conference. Gaithersburg, MD. Jul 2010.

CONTRIBUTED POSTERS

C.E. Gunning, E. Erhard, H.J. Wearing. Pre-vaccine era reporting rates of measles and whooping cough. Ecology and Evolution of Infectious Disease (EEID) Conference. Fort Collins, CO. Jun 2014.

C.E. Gunning. Reporting rate variation of acute, immunizing diseases in pre-vaccine U.S. cities. Ecology and Evolution of Infectious Disease (EEID) Conference. State College, PA. May 2013.

C.E. Gunning. Stochasticity, persistence, and extinction in measles (meta)populations. Models of Infectious Disease Agent Study (MIDAS) meeting. Atlanta, GA. Jun 2012.

C.E. Gunning, H.J Wearing. Stochasticity, persistence, and extinction in measles (meta)populations: Are we measuring what we think we're measuring? Ecology & Evolution of Infectious Disease (EEID) Conference. Ann Arbor, MI. May 2012.

C.E. Gunning. Using wavelets to detect synchrony of influenza between U.S. states. UNM Biology Research Day. Albuquerque, NM. Apr 2010.

C.E. Gunning. Linear Modeling of the Response of Groundwater Level to River Flow in the Middle Rio Grande Bosque, Water Year 2006. National Groundwater Association (NGWA) Conference. Albuquerque, NM. May 2007.

TEACHING

INSTRUCTOR

Probability for Scientists Fall 2013, UNM Biology and Statistics

· Course designer, lead instructor
· Mixed undergraduate/graduate course (primarily undergraduate)
· Hands-on course covering introductory probability, statistics, and data analysis

TEACHING ASSISTANT

Biology for Non-majors Spring 2014, UNM Biology

Statistical Programming Spring 2013, UNM Statistics

· Mixed undergraduate/graduate course (primarily graduate)
· Also guest lectured

Mathematical Biology Fall 2012, UNM Biology

· Mixed undergraduate/graduate course (primarily undergraduate)
· Also guest lectured

Genetics Spring 2009, UNM Biology

Ecology & Evolution Fall 2008, UNM Biology

· Assisted in writing course material

GUEST LECTURER

Theoretical Ecology Spring 2015, Univ. of Montana

· Also assisted students with R

WORKSHOPS AND TRAINING

Computational Skills for Scientists Training Workshop Aug 2016, Univ. of Montana

· Guest lecturer

Industrial Math/Stat Modeling Workshop for Graduate Students July 2015, NCSU

· Guest instructor, student mentor

Software Carpentry Workshop Jan 2015, NCSU

· Teaching assistant, guest lecturer

UNM R Programming Group Fall 2010 - Spring 2013, UNM

· Organized and led weekly R programming group
· Participants included undergraduate and graduate students and professors

Ecology Workshop May 2010, Univ. of Michigan

· Teaching assistant

· NSF-funded graduate training program, part of Ecology and Evolution of Infectious Disease conference

MENTORING

Spring 2015 - present. Robert Liberatore, Math Education Software Developer

Fall 2015 - present. Michael Vella, NCSU Mathematics Ph.D. Student

Fall 2015 - Fall 2016. Gabriel Zilnik, NCSU Entomology Masters Student

Fall 2012 - Fall 2015. Joshua Nightingale, UNM Biology Undergraduate Student

Spring 2011 - Spring 2012. Nathan Cournoyer, UNM Biology Undergraduate Student

CONFERENCES AND PROFESSIONAL EVENTS

Sep 2015. Society of Vector Ecology Conference. Albuquerque, NM.

Nov 2014. American Society of Tropical Medicine and Hygiene Annual Conference. New Orleans, LA.

Jun 2014. Ecology and Evolution of Infectious Disease Conference. Colorado State University. Fort Collins, CO.

May 2013. Ecology and Evolution of Infectious Disease Conference. Pennsylvania State University. State College, PA.

May 2012. Ecology and Evolution of Infectious Disease Conference and Workshop. University of Michigan. Ann Arbor, MI.

Oct 2011. Rcpp R Programming Master Class. San Francisco, CA.

Aug 2011. Ecological Society of America Conference. Austin, TX.

Jun 2011. Santa Fe Institute Complex Systems Summer School. Santa Fe Institute. Santa Fe, NM.

Jul 2010. useR 2010 Conference. Gaithersburg, MD.

May 2010. Ecology and Evolution of Infectious Disease Conference and Workshop. Cornell University. Ithica, NY.

Aug 2009. Ecological Society of America Conference. Albuquerque, NM.

May 2007. National Groundwater Association Conference. Albuquerque, NM.

PROFESSIONAL SERVICE

Reviewer, Ecology Letters.

Reviewer, Theoretical Ecology.

Grant reader, Graduate Research Allocations Committee (GRAC). UNM Biology.

SOFTWARE DEVELOPMENT

Fall 2014 - Present. Develop and maintain Skeeter Buster: a stochastic, spatially-explicit, agent-based C++ simulation model of *Aedes aegypti* population dynamics.

Spring 2013. Wrote code, documentation, and tests according to specifications of Drs. J. M. Rowland and C. Qualls for `discrimArts`: R package for probability distribution estimation.

2010 - 2012, ongoing. Contributor to `Rcpp`: R package for C++ development.

2009 - 2012. Maintainer of `Rwave`: R package for continuous wavelet transforms.

2010 - 2011. Contributor to `xts` and `zoo`: R packages for time series handling and analysis.

REFERENCES

Alun Lloyd
Department of Mathematics — North Carolina State University
· Post-doctoral co-advisor (in collaboration with Fred Gould)
· email: alun_lloyd@ncsu.edu
· phone: 919.515.1910

Fred Gould
Department of Entomology & Plant Pathology — North Carolina State University
· Post-doctoral co-advisor (in collaboration with Alun Lloyd)
· email: fred_gould@ncsu.edu
· phone: 919.515.1647

Helen Wearing
Department of Biology, Department of Mathematics and Statistics — University of New Mexico
· Co-author, Ph.D. Advisor
· email: hwearing@math.unm.edu
· phone: 505.277.0357

Erik Erhardt
Department of Mathematics and Statistics — University of New Mexico
· Co-author, teaching collaborator
· email: erike@stat.unm.edu
· phone: 505.750.4424