

# Cole Butler

## Biomathematics Ph.D. Student

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## Personal Statement

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Driven and accomplished student who thoroughly enjoys attacking any problem with rigor and analytical clarity. Skilled in leadership and experienced working with others. Enjoys working on challenging problems in groups. Knowledgeable in using various programming languages, including but not limited to R, Python, and MATLAB. Maintains a creative way of thinking and enjoys cultivating new friendships. Passionate about studying natural systems—especially concerning disease transmission and mosquitoes—and science outreach.

## Education

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2020- **North Carolina State University**

Ph.D. in Biomathematics, minor in Statistics; Genetics and Genomics Scholar; 4.0 GPA

2016-2020 **University of Maine**

B.S. in Mathematics, summa cum laude; Honors College (highest honors); Dean's list; 3.95 GPA

## Fellowships

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- NSF Graduate Research Fellowship, 2022-present, \$138,000
- CMI Young Scholar, 2021-22, \$18,000
- NC State University Research Training Group, 2021, approx. \$5,000
- NC State University Graduate Fellowship 2020-21, \$4,000
- NC State University Provost's Doctoral Fellowship 2020-21, \$28,000
- College of Liberal Arts and Sciences Fellowship 2018, \$4,000
- Center for Undergraduate and Graduate Research Fellowship 2016 and 2019, \$1,000 each

## Honors and Awards

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- GGA Graduate Student Travel Award (2023)
- University of Maine CLAS Student Award (2020-21)
- College of Liberal Arts and Sciences Outstanding Junior Award
- Margaret Chase Smith Public Affairs Scholarship
- Ray M. Boynton Scholarship
- Theodore and Dorothy Whitehouse Scholarship
- Carl Whitcomb Meinecke Award
- James S. Stevens Award
- Edward Morrison Pacesetter Scholarship
- Michael and Jana Cote Scholarship
- Civil Engineering Department Award
- University of Maine Presidential Award
- Dominic J. Roux Scholarship

## Publications

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**Butler, C.**, and P. Stechlinski. Modeling opioid abuse: A case study of the opioid crisis in New England. (In press.)

Yadav, A., **Butler, C.**, Yamamoto, A., Patil, A., Lloyd, A., and M. Scott. CRISPR-Cas9 based split homing gene-drive targeting *doublesex* for population suppression of the global fruit pest *Drosophila suzukii*. (In press.)

**Butler, C.,** Cheng, J., Correa, L., Preciado, M., Ríos, A., Montalvo, C., and C. Kribs. Comparison of screening for methicillin-resistant *Staphylococcus aureus* (MRSA) at hospital admission and discharge. *Letters in Biomathematics*. 8 (1); 2021.

**Butler, C.,** and A. Lloyd. How the consequences of genetic load are modulated by density-dependence. (In preparation.)

## Research experience

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2020 – Present

### **Graduate student in the Lloyd/Gould lab**

- Working with Drs. Alun Lloyd and Fred Gould studying gene drives in mosquitoes
- Projects past and present include exploring how density dependence in juveniles affects drive performance, balancing drive spread and drive lethality, and the effect of resistance on drive efficiency with Dr. Sumit Dhole
- Also involved in modeling gene drive in cage trials with the fruit fly *Drosophila suzukii* with Dr. Max Scott
- Involves heavy usage of MATLAB, Python, and Mathematica for simulating and analyzing high dimensional population dynamic and genetic systems

2020

### **Dynamics and Data in the COVID-19 Pandemic**

- Workshop hosted by the American Institute of Mathematics to study COVID-19 and develop mathematical models to understand underlying disease dynamics
- Applied optimal control theory to different models to determine mathematically ideal approaches in a variety of situations

2019 – 2020

### **Modeling the opioid epidemic in Maine**

- Received funding from the Margaret Chase Smith Policy Center for a project developing an opioid epidemic model for the state of Maine
- The goal of the project was to better inform public policy decisions and serve as a template for future mathematical models of opioid use proliferation
- This work culminated in my undergraduate thesis and is in the process of turning into a publication with Dr. Peter Stechliniski (2023)

2019 – 2020

### **Mosquito species distributions and network models**

- Studied how metapopulation network characteristics and mosquito species abundance affect disease transmission with a focus on Zika and Chikungunya
- Among other things, I developed a species distribution model of the *Ae. aegypti* mosquito in R

2018

### **MRSA research at the Mathematical and Theoretical Biology Institute**

- Research Experience for Undergraduates (REU) program
- I led a team of international students with the help of Dr. Christopher Kribs
- We studied how hospital screening strategies control within-hospital spread of MRSA
- Our work has been presented at various conferences and resulted in a publication

2017 – 2018

### **Modeling organisms on artificial landscapes**

- Proposed and received funding through a university grant with Dr. David Hiebeler
- Developed a computational model in R simulating artificial ecological systems on a discrete-state lattice
- Presented our findings at a local conference

2017 – 2020

### **Topological analysis of breast cancer simulations and wavelet processed mammograms**

- Was a member of the Computational Modeling, Analysis of Imagery and Numerical Experiments (CompuMAINE) lab
- I wrote an algorithm to scan mammograms using a topological technique attempting to distinguish between benign and malignant cancerous growths
- My work involved extensive use of the ImageJ and R programming languages
- Also spent some time modeling the growth of cancer microcalcifications in artificial environments

### **Invited talks**

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**Butler, C. “The Importance of Dispersal in Gene Drive Control,”** presented at the following venues:

- 2023 Joint Mathematics Meeting, oral presentation in-person
- 2023 Texas Tech University biomathematics seminar, oral presentation virtually

### **Presentations**

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**Butler, C. “Sexy Peacocks: The Mathematics of Sexual Selection in Birds,”** 2023 Triangle Area Graduate Mathematics Conference (TAGMaC), Duke, oral presentation in-person

**Butler, C. “Gene drives and over-suppression,”** presented at the following venues:

- 2022 TAGMaC, NC State oral presentation in-person
- 2022 NC State Graduate Symposium, NC State, poster presentation in-person
- 2022 Biology and Medicine Through Mathematics (BAMM) Conference, VCU, oral presentation in-person
  - Received \$350 travel award
- 2022 Gordon Research Conference on Genetic Biocontrol, Ventura, CA, poster presentation in-person
- 2022 Society for Industrial and Applied Mathematics LS22/AN22, Pittsburgh, PA, oral presentation in-person
  - Received \$650 travel award
  - Session leader
- 2022 Genetics and Genomics Academy 5<sup>th</sup> Annual Retreat, NC State, poster presentation in-person
- 2022 European Society for Mathematical and Theoretical Biology Conference, poster presentation virtually
  - Received Landahl-Busenbergl Award (\$750)
- 2022 International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems, Lafayette, LA, oral presentation in-person
  - Received \$650 travel award

**Butler, C. “Using differential equations to model individual behaviors that limit disease spread,”** contributed paper and oral presentation at 2021 MathFest.

**Butler, C. “Mathematically modeling gene drive control of mosquito-borne diseases,”** presented at the following venues:

- 2021 Genetics and Genomics Initiative 4<sup>th</sup> Annual Retreat, NC State, poster presentation virtually
- 2021 Society for Mathematical Biology Annual Meeting, oral presentation held virtually
- 2021 Society for Industrial and Applied Mathematics Annual Meeting, oral presentation held virtually

**Butler, C.** “[A mathematical model of the opioid epidemic in Maine](#),” 2020 TAGMaC, held virtually.

**Butler, C.** “[A predator-prey model with parasitic infection of the predator](#),” 2020 Virtual Symposium on Biomathematics and Ecology Education and Research (BEER), held virtually.

**Butler, C** and M. Preciado. “[Comparison of screening for methicillin-resistant \*Staphylococcus aureus\* \(MRSA\) at hospital admission and discharge](#),” presented at the following venues:

- 2018 Mathematical and Theoretical Biology (MTBI) Conference, Arizona State University, Tempe, AZ
- 2018 Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) Conference, San Antonio, TX
- 2018 National Institute for Mathematical and Biological Synthesis (NIMBioS) Conference, Knoxville, TN

**Butler, C.** “[Population models on continuous-valued heterogeneous landscapes](#),” 2018 University of Maine Student Symposium, University of Maine, Orono, ME.

## **Teaching**

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### **Teaching**

- Teaching assistant and recitation leader for MA 241 Calculus II, fall semester, 2021
- Teaching assistant and recitation leader for MA 241 Calculus II, spring semester, 2022

### **Tutoring**

- Math Multimedia Center tutor for NC State students, spring semester, 2022
- Freelance tutor for subjects including calculus, differential equations, linear algebra, basic math, programming, and writing (2020-present)
- Volunteer algebra tutor for local high schools (2020-21)

## **Outreach**

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### **Community**

- BugFest at the North Carolina Museum of Natural Sciences (2022)
  - Volunteered at a mosquito exhibit as part of BugFest
  - Oversaw interactive activities that educated children and parents on mosquitoes
- North Edgecombe Teamship program
  - Through my tutoring connections, I recruited and led a team of four graduate students to oversee a project involving a class of local high school students
  - The goal of the project was to present students with a real-world problem for them to solve; our topic was how to improve recruitment and retention of students from underrepresented groups at NC State
- Science communication
  - I have given talks on my research and experiences in graduate school to students at Cardinal Gibbons and Edward Little High Schools
  - In 2022 I was a participant in ComSciCon-Triangle, a workshop for broadening a student’s ability to communicate their research effectively

### **NC State and beyond**

- Info session panelist for new Genetics and Genomics scholars (2022)
- Info session panelist for undergraduates in research at NC State (2022)
- Co-organizer of the Triangle Contest in Mathematical Modeling (TriCoMM) (2021-present)
- Organizer of the Math Club at the University of Maine (2018-19)
- Member of Pi Mu Epsilon (2019-20)
- Sophomore Owl tradition society (2017)

## Service

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### Service to professional organizations, societies, and other entities

- Journal reviewer for *Letters in Biomathematics* (3), *PLoS Genetics* (1), *Cell Reports* (1), *Journal of Mathematical Biology* (1), *Ecology Letters* (1), *Physical Review E* (1), and *Journal of Theoretical Biology* (1)
- Treasurer of SIAM NC State chapter (2022-present)
- Member of the SMB Website Publication Board (2022-present)

### Service to NC State

- President of the Biomathematics Graduate Student Association (2022-present)
  - Fundraised hundreds of dollars for department t-shirts, events, and office amenities
  - Organized weekly seminars featuring presentations from students, post docs, and faculty (both internal and external)
  - Active member of the Legislative Affairs and Student Advocacy Committee
  - Assisted with recruitment, including giving talks on my work 2022-23
  - Served as vice president from 2021-22
  - Organized a weekly journal club from 2020-21
- Participant and contributor to Gene Drives in Agriculture: Workshop on Risk Assessment and Research Prioritization (2022)
- Assisted in recruitment for both GGA and BMA

## Mentorship

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### Community

- Assisted in mentoring a high school student interested in learning more about the mathematical modeling of COVID-19
- Mentor and tutor for correctional education program through a program offered at UNC Chapel Hill (2020-21)

### NC State

- Undergraduate research mentor with the Comparative Medicine Institute (CMI) (2021-22)
  - Drafted and submitted two interdisciplinary grant proposals to CMI at NC State to fund a semester and a summer of research with interested undergraduate students; both projects were funded
  - Mentored three undergraduate students in topics ranging from statistics to agent-based modeling
  - Research projects culminated in the students presenting their work at the CMI Annual Research & Innovation Summit
- Mentor for the Genetics and Genomics Scholars program (2021-present)
- Volunteer for Undergraduates Union Graduates (UUG), helping math undergraduates at NC State plan for their future (2020-22)

## Programming Languages

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- Very knowledgeable in MATLAB, R, Mathematica, Python, and NetLogo
- Knowledgeable in HTML, C++, Git, Bash, and ImageJ

## Professional Memberships

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Society of Mathematical Biology (2019-)

Society of Industrial and Applied Mathematics (2020-)

Society for Advancement of Chicanos/Hispanics and Native Americans in Science (2018-)