

Joseph Baafi

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PROFILE

Mathematical biologist specializing in mosquito ecology, infectious-disease dynamics, and climate-driven modelling. Experienced in stage-structured ODE systems, stochastic simulations, and sensitivity analysis for ecological and epidemiological processes. Proficient in R, \LaTeX , and Python, with solid experience in reproducible scientific computing and version control. Doctoral research integrates temperature, rainfall, and photoperiod effects to predict mosquito abundance, diapause, and disease transmission potential under climate variability.

EDUCATION

Ph.D. Candidate, Biology (Mathematical Biology)

Memorial University of Newfoundland, St. John's, NL

May 2020 – Present

Expected completion: January 2025

Supervisor: Dr. Amy Hurford (ahurford@mun.ca)

- Stage-structured mathematical modelling of mosquito populations incorporating temperature, rainfall, photoperiod, and diapause dynamics.
- Developed the open-source R package *climecol* for reproducible climate-data processing and visualization to support ecological and epidemiological modelling.

M.Phil. in Applied Mathematics

Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Aug 2015 – Nov 2016

- Focus on infectious-disease modelling, stability analysis, and optimal intervention strategies.
- Applied analytical and computational methods to design and evaluate control measures for Ebola transmission dynamics.

M.Sc. in Mathematical Sciences

African Institute for Mathematical Sciences (AIMS), Ghana

Aug 2014 – June 2015

- Concentration in dynamical systems and mathematical modelling of infectious and ecological systems.
- Trained in scientific computing, numerical methods, and applied problem-solving for interdisciplinary research.

B.Sc. in Mathematics

Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Aug 2009 – June 2013

RESEARCH EXPERIENCE

Doctoral Researcher

May 2020 – Present

Memorial University of Newfoundland, St. John's, NL

- Develops climate-driven, stage-structured mosquito population models using systems of differential equations and stochastic simulations.
- Investigates how temperature, rainfall, and photoperiod shape mosquito abundance, diapause, and active-season dynamics, with implications for transmission risk.
- Performs global sensitivity analyses (Latin Hypercube Sampling / Partial Rank Correlation Coefficients) and climate-scenario simulations to evaluate control thresholds.

Research Intern

Sep 2019 – Mar 2020

Mila – Quebec Artificial Intelligence Institute, Montreal, QC

- Built predictive models for public health using large-scale epidemic and opioid datasets.
- Collaborated with machine-learning researchers on interdisciplinary modelling projects, implementing reproducible computational workflows.

Master's Researcher

Jan 2015 – Nov 2016

African Institute for Mathematical Sciences (AIMS) and Kwame Nkrumah University of Science and Technology (KNUST), Ghana

- Developed compartmental models of Ebola virus transmission with optimal control interventions.
- Collaborated with researchers from Valley View University on applied mathematical-modelling projects focused on disease dynamics and control strategies.

TEACHING EXPERIENCE

Teaching Assistant

May 2020 – Present

Memorial University of Newfoundland, St. John's, NL

- Delivered tutorials in R programming, ecological data analysis, and data visualization for undergraduate biology courses.
- Mentored students in quantitative methods and scientific computing, fostering reproducible research practices.

Mathematics Lecturer

Sep 2016 – Aug 2019

Valley View University and Anglican University College of Technology, Ghana

- Taught undergraduate courses in Algebra, Statistics, Differential Equations, and Quantitative Methods.
- Supervised and evaluated 13 undergraduate research projects in applied mathematics and mathematics education.

PUBLICATIONS

1. **Baafi, J.**, & Hurford, A. (2025). Modeling the Impact of Seasonality on Mosquito Population Dynamics: Insights for Vector Control Strategies. *Bulletin of Mathematical Biology*, 87(2), 33. DOI: 10.1007/s11538-024-01409-7
2. Martignoni, M. M., Renault, J., **Baafi, J.**, & Hurford, A. (2022). Downsizing of COVID-19 contact tracing in highly immune populations. *PLOS ONE*, 17(6), e0268586. DOI: 10.1371/journal.pone.0268586
3. **Baafi, J.**, Darko, I. O., & Asenso, F. W. (2017). Vaccination as a control of infectious diseases. *J Appl Computat Math*, 6(357), 2. Available online
4. Oduro, F. T., **Baafi, J.**, & Apaaboah, G. (2016). Modelling the effect of post-mortem contact on the spread of Ebola with quarantine as an intervention. *Journal of Mathematics Research*, 8(4), 176. <https://doi.org/10.5539/jmr.v8n4p176>
5. Oduro, F. T., Apaaboah, G., & **Baafi, J.** (2016). Optimal control of Ebola transmission dynamics with interventions. *British Journal of Mathematics & Computer Science*, 19(1), 1-19. Available online

PREPRINTS AND SUBMITTED MANUSCRIPTS

6. **Baafi, J.**, & Hurford, A. (2025). Effect of Climate Warming on Mosquito Population Dynamics in Newfoundland. *bioRxiv*. <https://doi.org/10.1101/2025.09.07.674692>

RESEARCH DISSEMINATION

Conference Presentations

1. **Baafi, J.** (2025, July). Effect of climate warming on mosquito population dynamics in Newfoundland. *Society for Mathematical Biology (SMB) Annual Meeting*, Edmonton, Canada.
2. **Baafi, J.** (2024, June). Modeling the impact of seasonality on mosquito population dynamics: Insights for vector control strategies. *Canadian Applied and Industrial Mathematics Society (CAIMS) Annual Meeting*, Kingston Ontario, Canada.
3. **Baafi, J.** (2024, April). Modeling the impact of seasonality on mosquito population dynamics (Poster). *Biology Graduate Student Symposium (BGSS)*, Memorial University, St. John's, Canada.

4. **Baafi, J.** (2024, April). Modeling the impact of seasonality on mosquito population dynamics: Insights for vector control strategies. *Scientific Endeavours in Academia (SEA) Conference*, Memorial University, St. John's, Canada.
5. **Baafi, J.** (2023, May). Modeling the impact of seasonality on mosquito population dynamics: Insights for vector control strategies. *6th Conference on Computational and Mathematical Population Dynamics (CMPD6)*, Winnipeg, Canada.
6. **Baafi, J.** (2023, April). Modeling the impact of seasonality on mosquito population dynamics. *Biology Graduate Student Symposium (BGSS)*, Memorial University, St. John's, Canada.

Invited Talks

7. **Baafi, J.** (2024, June). *Seminar: OMNI-RÉUNIS Super Spreader Seminar Series (SSSS)*, York University, Toronto, Canada.

FUNDING AND AWARDS

- **Graduate Research Assistantship** – Funded through Memorial University School of Graduate Studies and NSERC-supported research grant (2020–Present).
- **AIMS Master's Scholarship** – Fully funded program covering tuition, accommodation, and stipend (African Institute for Mathematical Sciences, Ghana, 2014–2015).
- **Participant, Clinic on Meaningful Modeling of Epidemiological Data (MMED)** – Fully funded training workshop on data-driven approaches to infectious-disease modelling, Cape Town, South Africa (2016).
- **Participant, Simons Computational Neuroscience Imbizo** – Fully funded international training program on advanced research methods in computational neuroscience, Cape Town, South Africa (2019).

PROFESSIONAL ACTIVITIES & SERVICE

- **Peer Reviewer**, *Bulletin of Mathematical Biology* (2023) – Reviewed one manuscript on mathematical modelling in population biology.
- **Committee Member**, Scientific Endeavours in Academia (SEA) Conference, Memorial University of Newfoundland (2024) – Assisted in organizing and coordinating sessions on infectious disease and ecology.
- **Committee Lead**, OMNI-RÉUNIS Super Spreader Seminar Series (2023–2024) – Organized hybrid seminars and facilitated interdisciplinary discussions on infectious disease modelling.

LEADERSHIP & TRAINING

- **AARMS-EIDM Summer School Participant** – Trained in mathematical epidemiology, model calibration, and data-informed decision-making (2023).
- **Epidemiological Modelling Clinic**, African Institute for Mathematical Sciences (AIMS-Ghana) — Hands-on experience in infectious-disease modelling and analysis (2016).
- **CareerTech Data Analytics Workshop** – Strengthened R-based data handling and visualization for scientific communication (2022).

SKILLS

Modeling & Analysis

- Deterministic and stochastic ODE modeling
- Global sensitivity and uncertainty analysis (LHS/PRCC)
- Climate data processing and time-series modeling

Computational Tools

- R, Python, and \LaTeX
- Git, GitHub, and Linux environments
- Reproducible workflows, version control, and data visualization