METE K. YUKSEL

last updated: August 2024
email: mete.yuksel@mail.utoronto.ca • website: metekaanyuksel.github.io

EDUCATION

Ph.D. in Ecology and Evolutionary Biology (EEB)
September 2022 - present | University of Toronto (UofT), Toronto, Ontario
Supervisors: Drs. Matt Osmond and Nicole Mideo

B.S. in Mathematics *General and Applied Quantitative Modeling Options*
B.S. in Statistical Science *General Option*
August 2018 - May 2022 | University of Idaho (UofI), Moscow, ID

Relevant Coursework:

- Proof via number theory
- Linear algebra
- **Ordinary* & partial* differential equations**
- **Mathematical biology**
- Microbiology
- Cell & molecular biology
- Systems biology
- **Genomics**
- **Mathematical genetics***
- Evolutionary biology*
- **Molecular evolution***
- Bias in STEM*
- **R programming**
- Modern physics
- Probability theory*
- Mathematical statistics
- Stochastic processes
- **Theory of linear models***
- **Bayesian statistics***
- **Computational statistics***
- Sample survey methods
- Likelihood inference*
- Point-set topology*
- Advanced calculus
- Measure & integration theory*
- Complex analysis*
- Fourier analysis*
- Functional analysis*
- **Numerical methods**
- Groups & fields*
- Commutative algebra

* indicates graduate-level coursework. **Bolded** courses are of particular relevance. Blue text indicates course was taken at the University of Toronto; otherwise, courses were taken at the University of Idaho.

RESEARCH INTERESTS & EXPERIENCE

Interests: viral evolution; zoonotic emergence; recombination; modifier theory; coalescent theory

A NULL MODEL FOR THE EVOLUTION OF THE RECOMBINATION LANDSCAPE

Department of Ecology & Evolutionary Biology, University of Toronto | March 2024 --- present

- Developed a mechanistic mathematical framework to understand how the distribution (i.e., *landscape*) of recombination along a chromosome evolves, holding recombination rate constant. The model predicts how the mean, variance, and higher pointwise moments of the recombination landscape under neutrality. We are applying this theory to flowering plant landscape that have been estimated using population and/or laboratory crosses to estimate parameters such as the distribution of locations where modifiers arise.

BAYESIAN HIERARCHICAL MODELING OF UNGULATE ERADICATION EFFORTS
Contract with Parks Canada, Government of Canada | November 2024 --- present

- Developed Bayesian statistical model to determine how to best to conduct eradication of an invasive deer species on a remote island in British Columbia, Canada. From occurrence-nonoccurence data in enclosed regions on this island, the model predicts the probability of a false negative (i.e., > 0 deer) in a region.
- Eradication effort was canceled, so model was only applied to simulated data.

SPILLCOMBINAVOIR: RECOMBINATION AND VIRAL EMERGENCE
Department of Ecology & Evolutionary Biology, University of Toronto | September 2023 --- present

- Developed theory to understand how recombination shapes pathogen evolution in wildlife and domestic animal reservoirs, and the spillover and sustained transmission of such pathogens in human hosts.
- Modeling shows that the extent of recombination between loci underlying emergence is greatest in short-lived, acutely infected hosts and the extent of linkage disequilibrium (i.e., statistical associations between such mutations) greatest at the other end of the life history axis.
- We test predictions of the theory using all avian H5Nx sequences from 2022-present. We do this in two ways. First, we calculate linkage disequilibrium between mutations found on different segments of the flu genome and regress mean LD on body size, a proxy for mean lifetime. The results are consistent with predictions of the theory. Second, we infer reassortment networks and rates for all segment pairs (e.g., the HA and NA, PB1 and MP) associated to a host (e.g., mallards) and flyway (e.g., East of the Rockies).
- Publication in prep.

MODELING TO INFORM MANAGEMENT OF CHINOOK SALMON IN THE WILLAMETTE
Department of Fish and Wildlife Sciences, University of Idaho | May 2022 --- August 2022

- With Matt Keefer and Dr. Chris Caudill, analyzed a statistical model of Chinook Salmon abundance (with life history-specific mortality, environmental stochasticity, etc.) in the Willamette River system.
- Built a Shiny app to inform management decisions made by the U.S. Army Corps of Engineers.
- Technical report written and shared with US Army Corps. Publication in prep.

STATISTICAL (EPI)GENETICS OF BREAST CANCER

- Inspired by a previous study using gene expression data from various breast and blood cancer sub-types, a collaborator and I compiled, cleaned, and used Illumina 450K methylation array data to

    1. identify differentially methylated genes between healthy, stem cell, and breast cancer tissues
    2. reconstruct the phylogenetic relationships between the tissue types.
    3. estimate the effect of differentially methylated genes on cancer severity.

COMPETITIVE EXCLUSION BY CURVATURE
NSF-Simons Center for Quantitative Biology, Northwestern University | June 2021 --- August 2021

- Worked with Drs. Alvin Bayliss and Vladimir Volpert as part of the Quantitative Biology Undergraduate Summer Research Program at Northwestern University.
- Investigated a spatially-explicit (PDE) formulation of the Lotka-Volterra model with two species. Using methods from asymptotic analysis, we showed that curvature at the interface of regions in which species reside facilitates competitive exclusion and defines the nature, e.g., asymptotic speed, of invasion!

ECOLOGY OF GENETIC INTERVENTIONS AGAINST DISEASE
Departments of Mathematics & Biological Sciences, UofI | November 2019 --- May 2022

- With Drs. Chris Remien, Steve Krone, and Jim Bull, investigated the eco-evo-epidemiological consequences of gene drive releases (and other genetic interventions) to suppress vector-borne diseases.
- In work now published in *Evolution, Medicine, and Public Health*, we analyzed mathematical models of human/vector infection dynamics in discrete "patches," distinguished only by the mode of mosquito biting (i.e., frequency- versus density-dependent mosquito-to-human transmission).

PUBLICATIONS

Yuksel, M. K., Osmond, M., Mideo, N. Host constraints on viral recombination and evolutionary emergence. In preparation for *Evolution Letters.*

Keefer, M., **Yuksel, M. K.**, & Caudill, C. Assessing the role of juvenile life history diversity and adult translocation on cohort productivity in a Chinook Salmon population. Submitted to *Fisheries*.

Keefer, M., **Yuksel, M. K.**, & Caudill, C. Decision Support Modeling for Outplanting Adult Chinook Salmon in the Santiam River Basin (Technical Report 2022-1 for US Army Corps of Engineers).

Yuksel, M. K., Remien, C. H., Karki, B., Bull, J. J., & Krone, S. M. (2021). Vector dynamics influence spatially imperfect genetic interventions against disease. *Evolution, Medicine, and Public Health, 9*(1), 1-10.

TEACHING EXPERIENCE

- **(Co-)instructor** at University of Toronto for the following courses:

Fall 2024	EEB313: Quantitative Methods in R for Biology
Fall 2023	EEB313: Quantitative Methods in R for Biology

- **Teaching assistant** at University of Toronto for the following courses:

Winter 2025	EEB325: Evolutionary Medicine
Winter 2024	EEB313-CD: Quantitative Methods in R for Biology
Fall 2023	EEB319: Population Ecology
Fall 2022	EEB458: Evolutionary Quantitative Genetics
Fall 2022	BIO120: Adaptation & Biodiversity

- **Teaching assistant** for Dr. Jennifer Johnson-Leung, of the UofI Department of Mathematics:

Fall 2021	MATH 461: Abstract Algebra I
Spring 2021	MATH 215: Proof via Number Theory
Fall 2020	MATH 215: Proof via Number Theory
Fall 2019	MATH 330: Linear Algebra

- Summer 2019, Fall 2021, Spring 2022: **algebra & calculus tutor** at UofI Polya Center.

CD = course development.
The most recent version of the course website for EEB313 can be found here.

MENTORSHIP

Summer 2023	Litong Zheng, MSc work-study student Developed interactive web application of models of viral evolution, spillover, and emergence.

TECHNICAL SKILLS

Advanced:	R • bash • LaTeX
Intermediate:	FORTRAN '95 • Python • Julia
Familiar:	Mathematica • C

I have particular experience with the following:

- Numerical methods to solve differential equations, e.g., finite-difference and spectral methods.
- Stochastic simulation and computer-intensive statistical methods, including Markov Chain Monte Carlo, expectation-maximization, the Gillespie algorithm, and particle filtering.
- Fitting Bayesian statistical models using Stan and JAGS.
- Analyzing full-genome sequence, methylation, and gene expression data.
- Parallel (mutli-core and cluster) computing.
- Tidying, statistical analysis, and visualization of scientific data.
- Shiny app development, including dynamic UI design and reactive programming.

SCHOLARSHIPS, GRANTS, & OTHER AWARDS

John B. George Award (presented to the top graduating senior in the UofI College of Science), Spring 2022
College of Science Dean's Award in Mathematics & Statistics, Spring 2022
Outstanding Senior in Department of Mathematics & Statistical Science, Spring 2022
NSF Graduate Research Fellowship Honorable Mention, 2022
College of Science Dean's List, Fall 2018 - Spring 2022

2024-27	CAD$79,500	University of Toronto Data Sciences Institute Doctoral Fellowship
2023-24	CAD$10,000	University of Toronto Institute for Pandemics Graduate Studentship
2022-24	CAD$10,000	University of Toronto Doctoral Recruitment Award
2022-27	CAD$50,000	University of Toronto Connaught International Doctoral Scholarship
2021-22	USD$7,594	UofI Department of Mathematics Pyrah, Karen & Family Scholarship
2021	USD$4000	Northwestern Quantitative Biology Undergraduate Summer Research Program
2020-22	USD$3000	UofI College of Science Hill Undergraduate Research Fellowship
2020-21	USD$3000	UofI Department of Mathematics Eugene and Osa Taylor Scholarship
2020	USD$4161	UofI Office of Undergraduate Research Summer Undergraduate Research Fellowship
2019-20	USD$2222	UofI Mathematics Department Scholarship
2019	USD$1500	UofI Department of Biological Sciences Undergraduate Research Grant

PRESENTATIONS

2024 Patterns, causes, and consequences of recombination rate variation***

"A null model for the evolution of the recombination map"

2025 UofT EEB Undergraduate Union Graduate Student Series*** (upcoming)
2024 UofT Data Science Institute Research Symposium
2024 Mathematical Models in Ecology and Evolutionary Biology

"Host constraints on viral recombination and emergence"

2024 Evolution, the joint annual conference of the ASN, SSB, and SSE***
Talk part of Recombination Rate Variation Symposium organized by K. Samuk & S. Johnston
2024 UofT Annual Microbiology and Infectious Diseases Research Day
2024 UofT Institute for Pandemics Annual Symposium
2023 UofT EEB Undergraduate Union Graduate Student Series***
2023 Ecology and Evolution of Infectious Diseases (EEID) Conference
2023 UofT Atwood Colloquium in Ecology & Evolution***

"Using patterns of differential methylation to infer relationships between cancer sub-types"

2022 Workshop in Mathematical and Computational Biology*

"Competitive exclusion by curvature"

2023 UofT EEB Undergraduate Union Graduate Student Series***
2022 UofI Office of Undergraduate Research Symposium
2022 2022 Pacific Inland Mathematics Undergraduate Conference***
2021 UofI College of Science Student Research Exposition
2021 Northwestern Quantitative Biology SURP Symposium***

"Vector dynamics influence spatially imperfect of genetic interventions against disease"

2021 UofI Office of Undergraduate Research Symposium
2020 UofI College of Science Student Research Exposition***
2020 Idaho Undergraduate Research Conference

*** indicates talk, poster otherwise.

LEADERSHIP & SERVICE

Ongoing	**Ad-hoc reviewer** for *Journal of Evolutionary Biology* (x1), *G3* (x2)
2024-present	**Infectious investigation: EEB outreach in Toronto public high schools**
2024	**EPIC x USRA Graduate Student Mentor** Mentored two summer undergraduate research students through program organized by the Emerging & Pandemic Infections Consortium at the University of Toronto.
2024	**University of Toronto Atwood Colloquium in Ecology & Evolution Chair** Organized annual Colloquium of students, postdoctoral fellows, and faculty in the Dept. of Ecology & Evolutionary Biology at UofT. Coordinated selection and visits of invited speakers, scheduling of talks and coffee breaks, and a reception which usually concludes the event.
Fall 2023-	**Organizer of University of Toronto EEB Scientific Racism Reading Group** Developed and co-lead a reading/discussion group on how research in ecology and evolutionary biology intersects with society (e.g., race and IQ testing, plastic pollution).

2023-24	**University of Toronto EEB Student Journal Club and Seminar Co-Chair**
2023-24	**CUPE 3902 Unit 1 Depy. Ecology & Evolutionary Biology Steward** Surveyed and fostered support for Union activities in the Department. Developed a handbook for students in my department, with the goal of clarifying how Union processes (e.g., filing a hiring grievance, filing health insurance claims, etc.) work.
Winter 2023-	**Writer and Associate Editor for The University of Toronto *EEB Quarterly***
2022-23	**Member of University of Toronto EEB Wellness Committee and EDI Subcommittee** Co-led the development of a $8K undergraduate summer research award for students who self-identify as Black, Indigenous, or People of Colour (BIPOC), and which was not based on GPA. Criteria such as enthusiasm for research and lived experiences used in evaluating applications. In 2023, three students were awarded funds to conduct research in EEB.
July 2022-Sept 2024	**Volunteer at Toronto Fort York Food Bank**
2020-21	**Undergraduate member of University of Idaho Coronavirus Committee** Identified inconsistencies/gaps in University of Idaho masking, testing, and ventilation policies, and provided COVID policy recommendations to administrators. The work of the committee concluded with the development of a publicly-accessible dashboard with current case counts, hospitalization data, etc. for the University of Idaho and City of Moscow, ID.
2017-19	**Member of the City of Moscow, Idaho Sustainable Environment Commission** Communicated with the City Council and Mayor about sustainability matters at the University of Idaho, local businesses, etc. The Commission also worked to stop the use of neonicotinoids, a class of pesticides with chemical structure similar to nicotine, in City parks.