Chris Talbot – Academic Statement of Purpose, University of Michigan
Ecology & Evolutionary Biology PhD

Research Interests

Driven by my experience and long-standing interests in environmentalism and programming, my research interests now focus on developing computational and statistical methods to study evolutionary adaptation. Understanding the mechanisms underlying adaptation is crucial for predicting how species can respond to future change, enabling conservationists to allocate resources effectively by targeting populations at greater risk of extinction or with higher chances of long-term survival. To this end, using spatiotemporal population genomic data, I aim to infer the relative strength, importance, and timing of evolutionary processes such as selection, drift, and gene flow in natural populations. These data encode information about evolutionary patterns and processes over contemporary timescales and across landscapes. Inferring evolutionary processes using these data will provide unique insights into the tempo and mode of evolution and the potential of species to adapt to future climate and other human-induced changes.

I would be excited to develop a research program at the University of Michigan that centers around the following questions:

1. How do spatial and temporal patterns of genetic variation inform our understanding of population demography and local adaptation?
2. In what ways can computational and statistical methods be enhanced to better infer evolutionary processes from complex genomic data?
3. How can insights into the evolutionary mechanisms of adaptation help predict species resilience under future global change?

Having completed my undergraduate degree in Michigan's Ecology & Evolutionary Biology department, I have established relationships with many faculty. In particular, I am currently working with Dr. Gideon Bradburd, who has helped me develop my research interests. We've discussed many potential projects, including novel evolutionary inference methods for inferring populations' demographic and geographic history. I'd be excited to continue working with Dr. Bradburd as my PhD advisor.

I want to use coalescent theory and ancestral recombination graphs to bridge gaps between population genetics, macroevolution, and ecology. Doing so may open up new approaches to addressing global change and conservation issues. To this end, I'm interested in co-advising with several faculty, including Dr. Dan Rabosky and Dr. Luis Zaman, whose interest in rigorous and unique approaches to evolutionary problems aligns closely with my goals.

Background and Trajectory Leading to Graduate School

At age 11, I programmed my first Minecraft mod, setting forth my interests in programming and problem-solving and defining my career trajectory. The first in my family to

attend college, I studied computer science during my Associate's degree before transferring to the University of Michigan. Seeking ways to align my skills and environmental interests, I declared a major in Ecology & Evolution, seeking to use my quantitative skills to solve environmental crises. I built computational skills in discrete mathematics, algorithms, proof-based real analysis, and linear algebra while engaging in rigorous biological coursework, including macroevolution and genetics.

In Dr. Roberto Márquez's lab at Michigan, I gained hands-on experience developing CRISPR techniques in poison-dart frogs to study the evolutionary and genetic mechanisms generating aposematism. A Biomedical & Life Sciences Fellowship allowed me to research full-time for a summer. After completing that project, I began independent research on spatiotemporal floral community dynamics, asking whether flowers of a color bloom together with Dr. Marjorie Weber. I developed a Python program to extract floral color from thousands of iNaturalist images and used mixed models to analyze relationships among floral color, distributions, and phylogeny across 1,000+ species. I discovered that close relatives that overlap in time and space tend to display more disparate floral colors than expected by chance, receiving Highest Honors for this work. I have an associated first-author manuscript in preparation.

Now, as a computational technician in Dr. Gideon Bradburd's lab at Michigan, I directly engage with population genetics by testing and documenting *gaia*, a statistical method implemented as an *R* package that leverages Ancestral Recombination Graphs to infer the spatial locations of a population's ancestors. Using *SLiM* simulations, I am examining the impact of temporal sampling schemes on inference accuracy. I am also developing an interactive map dashboard to visualize *gaia* inference. This experience has solidified my passion for population biology and provided expertise in modern techniques, setting me up for success in designing new, robust models of evolutionary processes as a graduate student at the University of Michigan. Additionally, I've honed my programming skills in the context of large projects, preparing me to develop complex new programs and software to contribute to the computational biology ecosystem at Michigan and at large.

Looking Forward

Ultimately, I aim to leverage my computational skills to further our understanding of how biodiversity will respond to global change. I admire Michigan's dedication to biodiversity research, and I believe the Ecology & Evolutionary Biology PhD program is the best place to leverage my strengths to contribute to biodiversity research. My proposed advisors at Michigan provide the optimal network to advance my research program. Through collaboration or co-advising arrangements with these and other theoretical and empirical-focused faculty at Michigan, I can gain a well-rounded perspective on approaching complex problems in evolutionary biology. I hope to continue contributing to Michigan's diverse, rigorous, and forward-thinking academic environment as a PhD student.