Chris Talbot – Candidate Statement, University of Chicago Ecology & Evolution PhD

Research Interests: 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 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. 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 Chicago investigating:

1. How do spatial and temporal patterns of genetic variation inform our understanding of population demography and local adaptation?
2. How 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?

I have already had extensive conversations with two faculty members at the University of Chicago with whom I would be excited to work. Dr. John Novembre's experience working with method development for spatial population genetic inference aligns closely with my skills and interests. Our conversations regarding potential projects in his lab, including developing novel methods to infer population migration history, have helped me refine and solidify my research plans.

Dr. Julia Kreiner is another faculty member at the University of Chicago with whom I have discussed potential collaboration. We have discussed the development and application of novel methods for assessing the impact of global change, particularly land use change, on species adaptation. This work would align closely with my skills in computational biology and my interest in global change.

Background and Trajectory Leading to Graduate School: Resilience and determination mark my journey to graduate school. Long before my first biology course, I had already begun learning about the impact of rapid environmental change and the importance of resilience. My first lesson in rapid environmental change came at age four when we were evicted from our apartment and began migrating from couch to couch. Throughout childhood, I adapted to housing and food insecurity, persistent home invasions, and transfers from one school district to another as we evaded my estranged father. During high school, my father took his life. Faced with a 1.7 GPA, overwhelmed and hopeless, I dropped out.

Today, I am a computational lab tech at the University of Michigan. The first in my family with a college degree, I graduated with highest honors. The key to this successful transition was three critical refuges that nurtured my growth and offered stability while defining my career trajectory and leading to my interest in a PhD at the University of Chicago.

My first refuge was an old hand-me-down laptop. From age 11, I taught myself to program using Codecademy and YouTube, finding comfort in the logic and predictability of coding. Stuck in an unfulfilling retail job after dropping out of high school, I wanted to turn my programming hobby into a career. My family had no academic experience and no financial support to offer, but I decided to attend community college. There, I developed skills and interests and shared those interests with other non-traditional students as a tutor in the mathematics and language arts drop-in tutoring labs.

Transferring to the University of Michigan to study computer science, I took an intense quantitative course load, including work in data structures, algorithms, discrete math, and the rigorous *Honors Mathematics I*, a proof-based course covering fundamental real analysis, linear algebra, and topology. Though the coursework was fun, I changed majors to pursue environmental careers. My quantitative perspective contributed to research in my new field, where I emphasized clean, efficient code, problem-solving through abstract thought, and thorough statistical analysis. At the University of Chicago, my quantitative foundations will enable me to contribute to complex research immediately.

My second refuge was the band room. Music classes offered an accessible community of like-minded peers as my family transitioned from one school district to the next. Through various band classes and extracurriculars, I learned to socialize and pursue a common goal with a team. I gained leadership experience and learned the importance of inclusivity and strong communication. After high school, I began teaching, committed to fostering inclusive environments where students from all backgrounds could thrive. This goal culminated in Director of Percussion roles at two state-medalist competitive band programs. As Director, I emphasized the importance of self-care, self-confidence, and community. I honed my project management, supervision, and time management skills by leading teams of educators, volunteers, and students while taking full-time classes. My passion for mentoring and teaching deepened through my experiences. I look forward to continuing this work through graduate teaching assistantships and mentoring undergraduate researchers at Chicago, preparing me for an academic career where I can combine research excellence with effective mentorship.

My third refuge was my local zoo, where I developed a fascination with the natural world and a sense of environmental responsibility. Since those early childhood trips to the zoo, I have witnessed the persistent degradation of our natural world. While studying computer science, I found myself craving a way to use my skills to protect the environment. Switching majors to ecology & evolutionary biology at Michigan allowed me to pursue courses in evolution, genetics, and botany, emphasizing global change.

Having found refuges of stability throughout my life, I've also sought to give back, engaging in outreach and education to provide others with similar opportunities. For example, I've written forestry and botany exams for the Science Olympiad, volunteered to lead field trips at Matthaei Botanic Gardens, and founded and led Students for Public Power @UM. I aim to continue this commitment to community engagement in Chicago through collaborations with local museums, gardens, and schools.

Previous Research Experience: My journey into scientific research began with Michigan's *Changing Gears* program, which focuses on providing transfer students with research opportunities. My first research experience was with Dr. Roberto Márquez, with whom I helped develop CRISPR-Cas9 techniques in poison-dart frogs to evaluate aposematism's genetic and evolutionary basis. Dr. Márquez's love for science sparked my own interest in academia. Furthermore, he mentored me through applying for (and receiving!) Michigan's Biomedical & Life Sciences Summer Fellowship and a SACNAS 2022 travel grant, helping to shape my academic trajectory and underscoring the importance of hands-on research.

With Dr. Marjorie Weber, I conducted independent research on spatiotemporal floral color community dynamics, asking if flowers of a color bloom together. I developed a Python user interface to extract floral color from thousands of iNaturalist images. I used mixed models to analyze relationships among floral color, phylogeny, and distribution across 1,000+ species. This work culminated in an honors thesis for which I received Highest Honors, presentations at multiple international conferences (Botany and Evolution), and a first-author manuscript in preparation for publication.

As a computational technician in Dr. Gideon Bradburd's lab, I now engage with evolutionary biology, spatial population genetics, and method development. I am assisting with developing and testing *gaia*, a method that leverages Ancestral Recombination Graphs to infer the spatial locations of ancestors given georeferenced genomic samples. I am using *SLiM* simulations and *tskit* API to test the impact of various temporal sampling schemes on *gaia's* inference accuracy. I am also developing an interactive map dashboard to visualize the geography of human ancestry. This experience solidified my passion for evolutionary inference and prepared me to successfully design robust models and create new inference methods with Drs. Novembre and Kreiner.

Looking Forward: Ultimately, I aim to leverage my computational skills to further our understanding of how biodiversity will respond to global change. The University of Chicago's Ecology & Evolution department offers an ideal environment for this work, combining my proposed advisors' expertise, cutting-edge global change ecologists like Dr. Trevor Price, and institutional commitment to climate action through the new Institute for Climate and Sustainable Growth. I look forward to contributing to Chicago's diverse, rigorous, and forward-thinking academic environment, where evolutionary and ecological perspectives intersect to address pressing environmental challenges.