Chris Talbot – Personal Statement, UMinnesota Plant & Microbial Biology PhD

Research Interests: Understanding the genomic mechanisms underlying adaptation is crucial for predicting how plants and other species might respond to future change. Such predictions enable conservationists to allocate resources more 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 of plants (including agriculturally significant and invasive species). 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 Minnesota centered around these questions:

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 ecological and evolutionary processes from complex genomic data?
3. How can insights into the 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 Minnesota, with whom I would be excited to work. Dr. Yaniv Brandvain's experience working with the evolutionary mechanisms of plant adaptation aligns closely with my skills and interests. For example, we have discussed a potential project investigating the evolutionary and ecological basis of traits that facilitate stress tolerance in *Leptosiphon parviflorus*. This project would benefit from my research experience in floral community ecology and population genetics and align closely with my interests in global change biology. My conversations with Dr. Brandvain helped refine and solidify my research plans.

Dr. Dave Moeller is another faculty member at the University of Minnesota with whom I have discussed potential collaboration. We have discussed using machine learning and other computational methods to evaluate the evolutionary and ecological basis of the expansion of invasive species. This research would enhance predictions of invasive species trajectories and inform the management of invasive populations. This work aligns closely with my skills in computation, population genetics, and ecology and my interest in global change biology.

I will also continue my commitment to outreach, as demonstrated through previous efforts as a volunteer educator at the local botanic gardens and other local organizations. At the University of Minnesota, I will collaborate with local museums and gardens, proposing interactive exhibits to engage the community with science. I will also work with the local Indigenous communities, through collaboration with Minnesota's strong Department of American Indian Studies, to incorporate Indigenous ways of knowing into outreach programs where appropriate.

Background and Trajectory Leading 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, soon after my younger sibling was born. 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 Minnesota.

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 – I got my GED and enrolled. 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 Minnesota, 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 these experiences. I look forward to continuing this work through graduate teaching assistantships and mentoring undergraduate researchers at Minnesota, 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.

Previous Research Experience: I began pursuing scientific research through 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 investigate the genomic and evolutionary mechanisms underlying aposematism. I also assisted in caring for, breeding, and rearing 100+ amphibians in the lab. My work with Dr. Márquez provided hands-on experience with lab work in genetics, an invaluable skill for my proposed research program. 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, as well as a SACNAS 2022 travel grant, both of which cemented my research interest.

With Dr. Marjorie Weber, I conducted independent research on spatiotemporal floral color community dynamics, asking whether flowers of a color bloom together and what ecological and evolutionary mechanisms might drive such patterns. I developed a Python program with a Graphical User Interface to extract floral color from thousands of iNaturalist images. I then used generalized linear mixed models to analyze relationships among floral color, phylogeny, and distribution across 1,000+ species. I identified a correlation between phylogenetic and floral color dispersion in co-flowering assemblages, indicating that communities with closer relatives display more disparate floral colors. 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. Additionally, with Dr. Weber, I gained experience with lab techniques and multiple months of fieldwork experience, preparing me for a wide range of experiments and projects at Minnesota.

Now, as a computational technician in Dr. Gideon Bradburd's lab at Michigan, I directly engage with population genetics by testing and documenting *gaia*, which 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 evolutionary biology and provided expertise in modern techniques, setting me up for success in studying evolutionary genetics and ecology at the University of Minnesota. 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 the University of Minnesota 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 the University of Minnesota's dedication to innovative global change research, as exemplified by the Interdisciplinary Center for the Study of Global Change. I would be excited to engage in community engagement activities at Minnesota's Conservatory and Arboretum. My proposed advisors at Minnesota provide the optimal network to advance my research program. Through collaboration with other faculty, departments, and organizations, I can gain a well-rounded perspective on approaching complex problems in evolutionary biology while producing meaningful and applicable research. Attending the University of Minnesota would be an invaluable foundation for my research program after graduation, and I would be excited to engage with local communities in the Twin Cities. I hope to soon begin contributing to Minnesota's diverse, rigorous, and forward-thinking academic environment.