My first lesson in rapid environmental change was on my 4th birthday. Despite my parents' best efforts, we couldn't make rent. Migrating from shelter to shelter, we slept on family members' couches for months. Amidst the chaos, I discovered a stable microhabitat that nurtured my growth. My first refuge was John Ball Zoo. A sanctuary for my curiosity, the zoo ignited my fascination with the living world. After zoo visits, my mother says, I begged for wildlife encyclopedias as bedtime stories.

My second lesson in rapid environmental change was at age 7 when our new TV disappeared overnight. Such disturbances became a long-term constant in our domestic ecosystem, my father pawning off everything for his next high. There was only one thing he never touched – the old hand-me-down computer I got from my grandparents. My second refuge was that computer. Offering a digital ecosystem of endless possibilities, my creativity thrived as I played games, met people, and learned to code.

My third lesson in rapid environmental change was when I transferred schools three times in 7th grade. My divorced mother translocated my sibling and me from one apartment to the next to keep us safe from our estranged father. Thankfully, a new interest made school transitions easier: My third refuge was the band room. Band offered a stable, predictable environment and community. For the first time, I began learning to properly socialize, work in a team, and wholeheartedly pursue a goal.

In high school, after my father took his life, I struggled to stay afloat. Not even those refuges that once provided comfort and safety could keep me going. Faced with a 1.7 GPA, I dropped out and resigned to grueling 12-hour warehouse shifts. But that… sucked. I was tired and bored. Something had to change. GED? *Check*. Community college enrollment? *Check*. Three part-time jobs to make ends meet? *Check*.

While my childhood was marred by repeated disturbances, I adapted by seeking safe refuge in stable environments. Uncertainty at home drove me to grow diverse interests, providing broad knowledge and curiosity. I developed the resilience and adaptability that now comprise my greatest strengths. My childhood experiences were, unbeknownst to me, evolving me into a specialist in change, of adaptation. It's almost poetic, then, that I would find my calling in studying *biological adaptation to rapid change*.

Intellectual Merit:

Returning to school, my choice of major felt obvious: computer science. As a kid, I was obsessed with *Minecraft*. The game's customizability remains unrivaled, featuring infinite world generation and a diverse ecosystem of plugins and modifications. Building a house in-game was cool, but adding custom assets and gameplay sounded way cooler. Using Codecademy and YouTube, I went from creating simple JavaScript programs to complex Minecraft mods, phone games, and a personal website.

Becoming a great programmer remained my goal when I enrolled at Grand Rapids Community College (GRCC). Google or Microsoft, *here I come*. Challenging, exciting computer science and math courses provided unrivaled motivation: I achieved a 3.86 GPA at GRCC with multiple semesters on the Dean's and President's Lists. A Bachelor's degree, a goal I had abandoned years ago, felt back in reach.

When my acceptance letter to the University of Michigan (UMich hereafter) came, I felt like I had made it – the first in my family to go to college, I had a good, well-paying career in the bag. My Fall of 2020 was spent enthusiastically learning about data structures, math, and statistics. But then reality set in: I was committing to a life behind the screen, taking orders from massive tech corporations. What about my love for nature? Losing motivation, my grades were suffering. I loved programming, but I wanted to program something *meaningful*. I started enrolling in courses in ecology and evolution. I also joined UMich's Undergraduate Research Opportunity Program (UROP) through Changing Gears, a division aimed at transfer students interested in academia. After receiving offers from four labs in Ecology & Evolutionary Biology, I joined Roberto Márquez's lab as an assistant in Fall 2021.

Dr. Márquez offered many projects, but CRISPR piqued my interest most. The results were stunning. By knocking out the gene *MC1R* in *Phyllobates auratus*, the frogs developed translucent body parts, helping study the development of their bright warning coloration. Eager to help refine the technique, I used glass needles so thin that the tip was nearly invisible to inject dozens of freshly fertilized eggs with various concoctions of Cas9 enzyme and guide RNA. I received the 2022 UROP Biomedical &

Life Sciences Summer Fellowship, which funded an additional three months of full-time work. Beyond scientific exposure, Dr. Márquez filled crucial gaps in my knowledge of academia. A PhD could be fully funded? I could pursue research without six-figure loans? My interest in an academic career was solidified after winning a travel grant to attend SACNAS in 2022, where I saw hundreds of individuals from a diverse range of backgrounds applying their unique skills to solve important scientific problems. Though graduation was years away, I started looking for potential PhD advisors.

Dr. Marjorie Weber, then at Michigan State, stood out. On top of intriguing science, her leadership in *Project Biodiversify* reflected her dedication to inclusivity and outreach. When she took a job at UMich that Fall, I made my move, transferring to her lab for my independent UROP project. After chatting, she planted a seed of an idea – "Do flowers that bloom together tend to be similar colors?" – and she encouraged me to get creative, applying my coding skills to explore an exciting biological question.

I dove into the literature. I learned that when blooming together, wildflowers compete for pollinators that could make or break species' survival. Floral colors' role in attracting pollinators is highly influential on interspecific competition. Flowers that bloom together may tend to have disparate colors to attract specialist pollinators and avoid competition, but this pattern had not been tested at large spatial scales. Given the independence to creatively investigate how ecological processes translate into large-scale floral community composition, I started collecting data: a list of over 1,000 species with color data from a field guide and range and blooming period data from public databases. Throughout data collection and analysis, I experienced the twists and turns, roadblocks, and victories of an independent research project for the first time. I found that co-flowering species tend to show more disparate floral colors than expected by chance. I won a UMich Biological Station Student Fellowship for fieldwork comparing broad-scale to observed local patterns. By the end of my undergrad, my UROP project blossomed into an honors thesis for which I received Highest Honors in Ecology & Evolutionary Biology.

After graduation, Dr. Weber hired me as a research tech. From chemically processing grape leaves to observe the sharp crystals within, to months in the field studying domatia-like mite-housing structures on ferns, there were many exciting projects to help with. My lab and fieldwork skills grew exponentially while I honed in on what types of work I found most exciting. During this time I also worked towards publishing my honors thesis work. Leveraging my tech skills, I built a GUI (available on GitHub) for a repurposed computer vision method. With help from undergrads, we used the GUI to collect continuous floral color data from thousands of iNaturalist images. To better use these data, I learned the ins and outs of statistical mixed models, giving my study more statistical rigor. Our results confirmed my earlier findings – co-flowering groups of flowers display more disparate floral colors than expected by chance. This result suggests floral color may facilitate the coexistence of close relatives, or even generate speciation between overlapping populations. I've been fortunate to present these methods and results multiple times, including a poster *and* talk at both the Botany *and* Evolution conferences in 2024. The manuscript is in preparation for submission to *Ecology* as my first first-author publication.

Growing as an academic, I'm exploring ways to play to my strengths while developing new skills and sticking to what inspires me. Combining my interest in global change, my strong background in computation, and my budding skills in genetics, I've become interested in population genetics and local adaptation. This summer, I joined Dr. Gideon Bradburd's lab as a computational tech, where I'm honing my skills in evolutionary biology. In particular, I'm exploring spatial population genetics, leveraging statistical and computational methods to understand the spatial distribution of past and present genetic diversity. I'm learning to simulate natural selection in space using *SLiM* and infer the locations of ancestors of contemporary genomic samples using a new in-house method, *gaia*, for which I'm developing documentation, tutorials, and an interactive interface to visualize output. Our goal is to facilitate easy access to the method for scientists and curious community members.

As a tech with Dr. Bradburd at UMich, I'll continue developing skills to jump-start my PhD program at Cornell with Drs. Therkildsen and Messer. With them, I'll research the genomic consequences of rapid environmental change through time and space. Understanding species responses to change is my

greatest motivation for studying ecology and evolution, as I aim to contribute to the prevention of further biodiversity loss. I've found a path that integrates real-world problems I care about with activities that bring intrinsic motivation, like learning, programming, and teaching. The interdisciplinary skills and interests I've developed will allow me to dig deeper and publish sooner during my dissertation.

Broader Impacts:

Giving back has always been important to me. At 17, I got my first teaching gigs, working with local high school drumlines. Teaching was the most fulfilling thing I had ever done. My dedication to teaching well landed me jobs as the Director of Percussion at Spring Lake Public Schools and Lake Orion Community Schools. As Director, I designed safe environments that fostered the learning and growth of over three hundred high schoolers. Many band students come from unsafe homes as I did, and I enjoyed encouraging communication, self-expression, and hard, fulfilling work to facilitate their growth.

I've also sought other places to foster safe havens for students. Whether it be as a professional tutor in Math or English Tutorial Labs, a transfer student peer mentor at UMich, or a volunteer field trip guide at Matthaei Botanical Gardens, I've found numerous opportunities to use my personal experiences to help others. The best part? Seeing people go from intimidated to confident in unfamiliar environments. What do adult learners at a community college, inner-city students on hiking trails, and transfer students at UMich often all have in common? Senses of uncertainty and isolation. Being able to relate, comfort, and guide others reveals hidden value in my adverse experiences and provides great fulfillment.

Volunteering has become an integral part of my routine. As a test writer and supervisor for the UMich Science Olympiad, I write fast-paced exams on forestry and ecology for middle and high schoolers and facilitate the exams on event days. Science Olympiad is an integral resource for introducing students to STEM. Outside my pursuits in youth education, I've found purpose in community engagement as the founder and president of Students for Public Power @UMich. Together with Ann Arbor for Public Power (*A2P2*), we advocate for public management of power utilities to facilitate equitable distribution and increased renewables. We've gotten results, having crossed multiple major political barriers so far.

Moving forward as a graduate student at Cornell, I'll participate in the Graduate Student School Outreach Program (*GRASSHOPR*), where I'll design 3- to 5-session mini-courses aimed at high school freshmen. I will communicate my research in an accessible way, discussing the impacts of human activity on the environment from a basic computational and genomic perspective. I'll emphasize the diversity of ways to make an impact, whether it be lifestyle changes, volunteering, or careers. Outside of the K-12 environment, I'll work with Dr. Daniel Anstett, a plant and computational biologist at Cornell, to modernize Cornell's museum collections websites to engage broader audiences with science. We will turn Cornell's research museums into epicenters for community engagement with biology. Throughout my PhD program, I will mentor undergraduate students interested in research, aiming to pay forward the wealth of support my mentors offered me. I'm confident that engaging with and supporting diverse communities throughout the scientific process will foster greater trust in scientists and accumulate much-needed support in our fight against the biodiversity crisis.

Future Goals:

I want to foster sustainable environments for living things, whether it's a population of fish or a classroom of students. Academia allows me to do both while stimulating my intellectual curiosity. As a PhD student, I'll build my computational, statistical, writing, and genetics toolkits. My thesis will culminate in the contribution of a large, open-access dataset for further analyses, and robust methods for examining evolutionary responses to rapid environmental change, from overexploitation to sudden climate shifts. As a professor, I'll continue synthesizing interdisciplinary approaches to solve challenging and important ecological and evolutionary problems. Through science communication and outreach in the classroom and out, I'll make my findings accessible, seeking to aid the fight against biodiversity loss. As the pace of climate change continues to exceed expectations, we are forced to recognize that rapid environmental change is the new norm. Academic life is the best place to use my interests, skills, and experiences with rapid environmental change to care for other beings in our uncertain future.