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I am fortunate to have been guided in my development as scientist by my early experiences with the rich culture and natural beauty of Glacier National Park and the surrounding Blackfeet Indian Nation of Northern Montana. Living along the jagged "backbone of the world", as the Blackfeet people named it, I was poised between timeless Native American traditions and contemporary western thinking. This juxtaposition has given me deep perspectives into the issues of competing cultural and ecological processes where elk, bighorn sheep and foraging grizzlies of Glacier flow across socio-political boundaries. These animals were demonstrating to me at an early age one of the frustrations inherent in conservation and management of wildlife: competing human interests with divergent values clashing across a patchwork landscape of disturbance and jurisdiction. This natural backdrop is also where I realized scientific investigation and education would be my contribution to guiding responsible change.

My childhood in Glacier produced a strong desire to repay this dynamic landscape that allowed me to mature as a person and a scientist. Since I'm as much indebted to the natural landscape as to the people within it, I initially began my wildlife degree to educate a broad audience through culturally and scientifically informed films. I captured wildlife, scenic landscapes and Native American culture to convey the universal value of wild places and the people who live there. I found early success winning a national film contest from Outside Magazine and filming for an award-winning documentary feature from Montana PBS. My original intent to educate people about landscape conservation has been fortified yet refined as I have been swept away by my current scientific education, which has facilitated the laboratory skills and molecular tools needed to achieve this goal through my pursuit of a PhD conducting peer-reviewed research. This is why a conservation ethic necessarily pervades my story and directs my studies; it is inseparably entwined with the scientific goals in my life. This is also why I'm driven to effectively communicate my findings now and in the future, which will ultimately dictate how I define my long-term success as a research scientist.

I am currently finishing an undergraduate degree in Honors Wildlife Biology at the University of Montana (UM). My time at UM has provided field experiences and laboratory research opportunities that have been truly vast, seemingly limited only by the personal effort I was willing to invest, which has never been in short supply.

The first of my opportunities at UM and one of the most transformational, arrived through the Science Education Alliance (SEA) Phage program offered by the Howard Hughes Medical Institute (HHMI). This program brought a group of talented students naïve to research into a collaborative learning and research environment. I was able to isolate an environmental mycobacterial phage, purify, sequence and annotate its complete genome, comparing it to the genome of its host, *Mycobacterial smegmatis*. My results suggest gene transmission events between host and virus and provide further phylogenetic support for mosaicism theory within phage throughout the range of the study (continental US). The SEA program allowed me to rapidly grow as a young researcher, interacting as a collaborator on a project with individuals of varying skills and interests as we all found our way through this advanced research topic together, augmenting each other's success. This was challenging research and I took pride in being able to support others as I quickly developed mastery of the bioinformatics and lab protocols. I was graciously chosen by my instructors and peers to represent our UM group with my research at the National Phage Symposium located at HHMI's Janelia Farm Research campus in Virginia. My results and ability to communicate them were recognized as exceptional among the 80 universities participating at the symposium by a 1st place blue ribbon award. My

success in this program acted as a springboard, increasing my momentum and excitement about entering the research profession. SEA program was also my introduction to Dr. William Holben my main research collaborator whose cavalier optimism and commitment to mentorship has carried my current successes as an undergraduate researcher and provided me an example I strive to emulate in my current and future interactions as a mentor and professional.

Montana provides unique field research opportunities to a wildlife student with my aspirations including studies of the last remaining grizzly bear populations in the lower 48 states. The summer I was recognized for my Phage research I was also able to participate as a remote biotech intern on the Grizzly Bear DNA project in the Northern Continental Divide Ecosystem (NCDE). This provided me with valuable perspectives from a multi-agency collaborative study aimed at informing management and policy decisions of this threatened species. The Population size, trends, and habitat corridors of grizzlies within the NCDE were estimated using laboriously obtained non-invasive hair-snag samples required for DNA microsatellite mark-recapture modeling. This massive study opened my eyes to the pressing needs of wildlife and the scale and effort required to examine populations even with advanced molecular techniques. I hiked study gear and collected samples over 1100 miles of NCDE trails before Spring flowed into late Fall. As I returned to academics after this extended project my now refined desire to use and improve molecular tools alongside population genetics began to drive my interests and studies at UM.

I worked as a bio-technician and volunteered on several more field projects in the following years that strengthened my understanding of how fish and wildlife genetic conservation research was being conducted on the landscape and how I could innovate it. In January of 2013 I volunteered as a tech for the Glacier National Park Fisher DNA Project. I assisted in remote sample acquisition to establish the possible distribution of fisher, a close relative of the wolverine, in Glacier traveling on skis to maintain and sample remote cameras and non-invasive hair collection sites. In summer of that year I broadened my experience by assisting a master's student in his investigation of the effects of cattle grazing on salmonid diversity in headwater streams along the Rocky Mountain Front. My steady performance and ability to conduct strenuous research with a smile led to a volunteer opportunity with the Fish and Wildlife Service where I assisted in the ongoing pit-tag survey of Bull Trout, a federally listed species under the Endangered Species Act, in the Boulder River of Glacier. I value fieldwork highly as a means of continually grounding my research purpose to real world issues and maintaining the perspectives necessary to ask the right questions concerning the dynamics of wildlife across a complex landscape. These types of projects easily translate into outreach opportunities as techs interact directly with the public and volunteers over the course of the research. They have hands on appeal and a powerful wildlife context that can be infectious for young volunteers. As an NSF Fellow I would be able to provide these opportunities throughout my research career.

During this time my curiosity and passion for quantitative genetic methods and success in these advanced topics caused me to effortlessly range far beyond the assigned wildlife curriculum at UM, producing my current awareness of molecular biology. I balanced my field excursions and academics with relevant laboratory research to augment the skills I would need as a researcher. I was accepted into the Holben Lab and I assisted Ellen Lark, a PhD candidate in daily with her study assessing the effects of anti-biotic treatments, pro-biotics and the invasion of the pathogen *C. difficile* on the composition of the mouse gut microbiome. This was an excellent opportunity to build collaborative and organizational skills on a complex project. I progressed through basic and advanced animal use protocols and learned about ethical study design and challenges when using the mouse model for microbial ecology. This study was crucial in my

awareness of how microbiomes can predict general host condition, which became a foundation for my current research. I will use the lab techniques and bioinformatics approaches learned during this experience broadly in my future research concerning biomarkers for wildlife health and disease monitoring.

Through these past experiences it is clear I was building the confidence to begin standing on my own as a successful research scientist. One of the experiences I recall that cemented this change in perspective was a problematic 454 data set that had produced anomalous patterns when analyzed. I was asked by Dr. Holben to diagnose the issue. I was able to recognize a pattern in the data that led me to find that human error at the sequencing lab had produced grossly mislabeled sequence files. This saved thousands of dollars and I was able to breath new life into the project. I hope to co-author a "metagenomic best practices" publication in the near future based on the results. This small problem gave me exposure to writing in the Perl language and its solution produced confidence in my abilities to think both critically and scientifically. After this experience using the tools and knowledge at my disposal to independently investigate complex systems ceased to be an abstract goal; it is now an exhilarating reality.

After my successes working with mouse and rat models and large microbiome data sets, I began preparing a proposal to apply these techniques to wildlife populations and was able to orchestrate an exciting research project as an undergraduate. I approached the state wildlife agency, Montana Fish Wildlife and Parks and with Dr. Holben began a collaboration with the lead biologist Dr. Kelly Proffit who agreed to collect health metrics and scat samples of 110 individuals from 4 populations of wild elk while also GIS collaring each individual to assist us in an investigation of the elk microbiomes ability to function as a microbial biomarker for health. I believe that microbial biomarkers and whole genome sequencing will become affordable and practical for use in large scale population contexts in the near future and I hope from my experiences to be a leader in this exciting new field as I grow closer to attaining my goals of facilitating landscape level wildlife conservation. I received research and scholarship support through grants from NSF-EPSCoR's Montana Institute on Ecosystems Fellowship, various UM research scholarships, and generous support from the Holben Lab, all of which are allowing me to pursue this research as an undergraduate. This early success at procuring funding has given me momentum and confidence at navigating the grant process as I enter graduate school and beyond where research success can hinge on appropriating funding.

As I finish my last semesters at UM as an undergraduate I look forward to broadening my skills as a scientists in graduate school. I will continue to build upon my knowledge of constantly advancing topics like bioinformatics and genomics to master and innovate the field. I will also improve personal attributes that support my ability to have impact as a professional in both conducting and conveying my science.

An NSF GRF would support me during my investigations and allow me to explore my larger role in supporting young scientists through continued mentorship and research collaboration within the Holben Lab as I progress towards a career in science. I will share my passion for research as it was passed to me, by complete inclusion in the scientific process and through infectious enthusiasm. Applying the newest techniques in molecular genetics to explore the interconnected systems of biology is a rewarding path that I think has a gravitational quality, making it an exhilarating opportunity to create and foster passion in young scientists by bringing them into this environment. With a fellowship I believe my research can produce direct positive impacts on the natural world and with my mentorships I can support young scientists as they walk their unique paths toward scientific research as I have done.