Avian conservation research is becoming increasingly more important as our environment continues to change due to anthropogenic impacts. In fact, 29% of avian biomass has been lost in North America since the 1970s [1]. As environmental changes accumulate, quantifying the extent that human-caused climate stressors are affecting bird populations remains a priority, so that populations found to be most vulnerable to these stressors can be given conservation priority. One tool that has become increasingly important in the measurement of life stress in wild avian populations is telomere length. Telomeres [Figure 1] are non-coding regions of DNA that cap the end of chromosomes and protect genomes. Telomeres shorten with cell division, and this rate is accelerated by environmental stressors [2]. Telomere length has been found to be highly correlated to lifespan [3], making telomere length an ideal proxy for fitness. Several studies use telomeres as a biomarker for understanding avian life history events, including environmental stress responses, due to the link between telomere length and survival [3]. In avian genetic and genomic research, blood has been hailed as the gold standard for measuring telomere length because it offers the most up-to-date snapshot of an individual's DNA. Recent research suggests that telomere length and rate of shortening in blood is correlated to that found in feathers [4]. The goal of my research initiative is to compare the rate of telomere shortening in blood versus body and tail feathers [Figure 1]. I will do this by asking the following two questions. Figure 1 - blood, flight, and body feathers will be collected from recaptured individuals of a variety of species. DNA will be extracted from each cell type and the telomeres will be measured to investigate rate of telomere shortening. Mason, Noelle 2 Question 1 - "Do the telomeres found in blood cells shorten at the same rate as those found in feathers?" I hypothesize that telomeres found in blood cells will be shorter when collected at the same time as feathers, as the telomeres found in feathers are likely found in tissues cells trapped in the shaft of the feather at the time of molting. This is significant in that scientists would be able to connect telomere length to time of molting, as molts are cyclical and predictable. However, if telomeres found in feathers shorten at a rate comparable to that of blood, it would allow researchers to use telomere lengths found in feathers as a proxy for measuring environmental stress, eliminating the need for blood collection in the field. This would reduce the cost of time, effort, and money in the field and allow for increased use of telomere measurements in avian studies. Question 2 - "Do telomeres shorten at the same rate in flight versus body feathers?" It is thought that tissue trapped in the shafts of feathers would provide a glimpse of telomere length at the time the feather was molted, thus the telomere length found in tissue would be longer than that found in blood samples. I hypothesize that they will shorten at comparable rates, as both types of feathers would be molted at the same time, thus trapping tissue from the same time frame. If this is the case, it would allow scientists in the field to collect body feathers instead of flight feathers upon recapture of an individual. A recaptured bird may not have enough flight feathers to collect for analysis, as some should be left for flight. Body feathers are the easiest to collect in the field and can be collected upon recapture with minimal impact on the bird's flight capabilities. Any results from this study would be significant in informing the methods of researchers using telomeres as a measure of stress in avian life history. This research initiative closely aligns with the DFO's mission in furthering the study of birds and their Colorado habitats. My work in quantifying the correlation between telomere length in blood vs. feathers will add to a body of work helping other avian researchers to understand the impact of human-caused environmental stress on avian health and lifespan. This body of work allows scientists and conservation policymakers to assess the human impact on bird populations, especially in the state of Colorado and associated with Colorado State University. Mason, Noelle 3 This project also involves the creation of the Fort Collins Feederwatch program at the Colorado State University Environmental Learning Center [Figure 2], aligning with the DFO mission to enhance educational initiatives and preservation regarding local birds. While the feeder complex will offer me a place to sample the same individuals across the study period, it will remain in place after the completion of my study. In addition to being a reliable sampling station in Fort Collins, it will be used as a place of education and citizen science in numerous aspects. The complex will host numerous counts and surveys April through November in association with the

Cornell Lab of Ornithology's North American Feederwatch program to monitor changing range and abundance of North American bird species over time. Dr. Kristen Ruegg plans to use the feeder complex as a part of her ornithology curriculum starting in Spring 2022, as well as teach undergraduate and graduate students the basics of bird handling and sampling. Additionally, it will be integrated into Dr. Ruegg's summer Bird Camp, a multi-day educational experience for middle schoolers focusing on the science of migration. Other educational outreach programs will be conducted at this location, including but not limited to educational experiences for Girl Scouts and other elementary schoolers. Through interaction with the bird feeder complex and the Environmental Learning Center at CSU, it is my hope that an appreciation for birds and their subsequent conservation will be sparked in the Fort Collins area. Locations: The majority of my research will be conducted at the bird feeder complex at the Environmental Learning Center associated with Colorado State University in Fort Collins, Colorado. This is a 212 acre riparian area located near the Cache la Poudre river, offering habitat to resident and migrating populations of a variety of bird species. Some samples may also be conducted at the bird feeder Figure 2 - A red-breasted nuthatch feeds at a tube feeder on the CSU campus. Similar feeders will be used for the Fort Collins Feederwatch program. Mason, Noelle 4 complex situated at the Fort Collins Museum of Discovery, located in a similar riparian habitat about three miles northwest of the Environmental Learning Center. The focus on gathering samples at the bird feeder complexes comes from the necessity of recapturing individuals over the course of the study. All lab work will be conducted in the laboratory of my advisor, Dr. Kristen Ruegg, at Colorado State University. Timetable: This project is to projected to begin at the end of May 2021 and continue through the end of the academic year ending in May 2022. I will sample once a month throughout the summer and early fall months. DNA extraction from samples will occur within the weeks following each sample's collection, and be stored for later laboratory analysis using quantitative polymerase chain reaction(qPCR). This analysis, which will measure the telomere length in each sample, will be carried out during the fall semester of the 2021-2022 school year from September to December. Data analysis and writing of associated publications and presentations will happen in the spring of 2022, with the end goal being to submit a paper for publication by the end of May 2022. Methods: The Fort Collins Feederwatch program, which is currently in construction, involves three squirrel-proof tube feeders, set up in a triangular formation at least 100 meters apart. The feeders will be maintained by Environmental Learning Center staff and filled with a seed blend in order to attract a variety of local species. Beginning in the summer of 2021, I will begin mist netting for resident individuals of a variety of species, including Black-capped chickadees, Red-breasted Nuthatches, House Finches, House sparrows and other common Fort Collins birds. Birds will then be banded with a USGS bird band and routine measurements will be taken. A blood sample of at least 10 µl will be collected via brachial venipuncture in addition to one tail feather and five body feathers from each individual. Blood will be stored in a collection tube with lysis buffer, and feathers will be stored in BGP coin envelopes until extraction. I will continue target mist netting throughout the breeding season, aiming to recapture individuals at least once, so I am able to observe changes in telomere length over time in blood and feathers. DNA will be then be extracted from both blood and feather samples. I will measure telomere length of recaptured individuals using qPCR. With this data, I Mason, Noelle 5 hope to find if there is a difference in the rate of telomere shortening between blood, body and flight feathers.