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Shotgun metagenomic sequencing for conservation genomics: rock ptarmigan as a case study

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The rock ptarmigan (*Lagopus muta*) inhabits alpine and arctic tundra throughout the northern hemisphere with its current distribution mainly determined by the last glacial maximum. In southern Europe this species is only found in fragmented populations on the main mountain ranges, where numbers are decreasing due to habitat loss, degradation and fragmentation, climate warming and human disturbance. This decline could be mitigated through conservation measures, but these require fundamental information on the evolutionary ecology, distribution and genetic diversity. Such data is difficult to collect in a species which is particularly elusive and living in extreme environments. Thanks to the technological and computational advances of recent years, understanding of species' biology has been greatly enhanced by analyzing fecal samples, collected non-invasively in the field, using shotgun metagenomics sequencing. Although this approach is still poorly tested in wild species, ongoing studies highlight its potential for conservation and biomonitoring that should be further explored. In the present study, this approach was applied to 30 rock ptarmigan from three different areas of the Paneveggio-Pale di San Martino Natural Park, characterized by contrasting rocky substrates. The shotgun metagenomic sequencing method does not require the enrichment or targeted amplification of specific molecular markers, thus allowing both qualitative and quantitative evaluation of data on different aspects related to the species. In particular, the ongoing analyses aimed to determine: i) the genomic relationships between individuals and population, ii) the fundamental resources for the species through the study of the diet, iii) the health status of individuals through the analysis of gut microbiota and parasites. First results confirmed the utility of shotgun metagenomic sequencing for conservation purposes and provides fundamental data for improving conservation strategies for this species.