Range-Wide Genetic Analyses to Guide the Future Management of California Bighorn Sheep

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ABSTRACT: Over the past century, bighorn sheep managers have conducted hundreds of translocations across western North America to augment existing populations and to reintroduce individuals to previously occupied habitats. While these translocations have been broadly successful in restoring populations, most were undertaken without baseline genetic information. For example, the taxonomic basis of the putative California bighorn sheep lineage has been historically contentious, resulting in jurisdictions differing in whether they manage California and Rocky Mountain bighorn sheep as the same entity or separate evolutionarily significant units. This distinction is important for future management because all California bighorn herds in the United States descend from repeated translocations of individuals sourced from a few herds in British Columbia, potentially resulting in low levels of genetic diversity and limited evolutionary potential. In fact, some jurisdictions have already mixed California and Rocky Mountain individuals to mitigate the potential negative consequences of low diversity in California bighorn herds. To guide future management, we genotyped >2,000 bighorn sheep individuals from across western North America using DNA sequence data. Based on genomewide variation at several thousand single nucleotide polymorphisms (SNPs), we uncovered strong genetic differentiation between California, Desert, and Rocky Mountain bighorn sheep, suggesting they indeed represent independent evolutionary lineages. Further, we identified several herds with mixed ancestry, resulting from past translocations and occasionally subsequent dispersal. Finally, while California bighorn sheep generally have low levels of genetic diversity, there was ample variation, so those California herds with higher diversity could be prioritized as sources for future translocations. Based on patterns of differentiation, hybridization, and levels of genetic diversity, we conclude by proposing several suggestions for the future management of California bighorn sheep.

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