

Estimating Bighorn Sheep Abundance Using Noninvasive Sampling at a Mineral Lick within a National Park Wilderness Area

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ABSTRACT Conservation of species requires accurate population estimates. We used genetic markers from feces to determine bighorn sheep (*Ovis canadensis*) abundance for a herd that was hypothesized to be declining and in need of population status monitoring. We sampled from a small but accessible portion of the population's range where animals naturally congregate at a natural mineral lick to test whether we could accurately estimate population size by sampling from an area where animals concentrate. We used mark-recapture analysis to derive population estimates, and compared estimates from this smaller spatial sampling to sampling of the entire bighorn sheep range. We found that estimates were somewhat comparable; in 2009, the mineral lick sample and entire range sample differed by 20 individuals, and in 2010 they differed by only 1 individual. However, we captured 13 individuals in the entire range sample that were not captured at the mineral lick, and thus broke a model assumption that all individuals had an equal opportunity of being captured. This eliminated the possibility of inferring a total population estimate from just animals visiting the mineral lick, but because estimates were relatively similar, monitoring at the mineral lick can provide a useful index for management and conservation. We compared our results to a radio collar study conducted in 2003-2004 and confirmed that the population remained stable since 2004. Our population estimates were 78 (CI= 62–114) in 2009 and 95 (CI= 77–131) in 2010. Between 7 and 11 sampling dates were needed to achieve a CV of 20% for population estimates, assuming a capture probability of between 0.09 and 0.13. We relied on citizen science volunteers to maximize data collection and reduce costs; 71% of all fecal samples were collected by volunteers, compared to 29% collected by paid staff. We conclude our technique provides a useful tool to managers for monitoring, and could be tested and applied in similar populations where animals congregate with high fidelity at a mineral lick or other area.

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KEY WORDS bighorn sheep, citizen science, feces, genetic tagging, mark-recapture, microsatellites, mineral lick, noninvasive population estimate, *Ovis canadensis*.

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