

Behavioral Connectivity among Bighorn Sheep Suggests Potential for Disease Spread

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ABSTRACT Connectivity is important for population persistence and can reduce the potential for inbreeding depression. Connectivity between populations can also facilitate disease transmission; respiratory diseases are one of the most important factors affecting populations of bighorn sheep (*Ovis canadensis*). The mechanisms of connectivity in populations of bighorn sheep likely have implications for spread of disease, but the behaviors leading to connectivity between bighorn sheep groups are not well understood. From 2007–2012, we radio-collared and monitored 56 bighorn sheep in the Salmon River canyon in central Idaho. We used cluster analysis to define social groups of bighorn sheep and then estimated connectivity between these groups using a multi-state mark-recapture model. Social groups of bighorn sheep were spatially segregated and linearly distributed along the Salmon River canyon. Monthly probabilities of movement between adjacent male and female groups ranged from 0.08 (0.004 SE) to 0.76 (0.068) for males and 0.05 (0.132) to 0.24 (0.034) for females. Movements of males were extensive and probabilities of movement were considerably higher during the rut. Probabilities of movement for females were typically smaller than those of males and did not change seasonally. Whereas adjacent groups of bighorn sheep along the Salmon River canyon were well connected, connectivity between groups north and south of the Salmon River was limited. The novel application of a multi-state model to a population of bighorn sheep allowed us to estimate the probability of movement between adjacent social groups and approximate the level of connectivity across the population. Our results suggest high movement rates of males during the rut are the most likely to result in transmission of pathogens among both male and female groups. Potential for disease spread among female groups was smaller but non-trivial. Land managers can plan grazing of domestic sheep for spring and summer months when males are relatively inactive. Removal or quarantine of social groups may reduce probability of disease transmission in populations of bighorn sheep consisting of linearly distributed social groups.

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KEY WORDS behavioral connectivity, bighorn sheep, disease, Idaho, multi-state mark-recapture, *Ovis canadensis*, Salmon River, social groups.

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