Estimating the Fission-Fusion Dynamics in Social Behavior of Bighorn Sheep

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ABSTRACT: Understanding and predicting movement of bighorn sheep is critical for conservation planning and disease risk mitigation, and important environmental drivers of bighorn movement have received extensive attention. However, social factors surrounding group fission and fusion events also directly affect movement, but they are infrequently measured in the wild and rarely linked to underlying factors such as relatedness or shared life stage. Here, we explore three dimensions of bighorn fission-fusion dynamics: group size, composition, and spatial cohesion. Identifying the critical processes that shape female social structure and fission-fusion dynamics is an important step toward accurately forecasting how animals interact with ramifications on connectivity, gene flow, and pathogen transmission. We estimate these fission-fusion dimensions and link fission-fusion events to social processes and fitness outcomes using a long-term, individual-level dataset on bighorn sheep from the Bison Range in Montana. We examine the variance in group composition, group size, and group spatial cohesion and assess what part of those variances can be systematically explained by population size, age, or sex structure. We model group switching choices as a function of social covariates through a discrete choice model contrasting conditions such as relatedness, cohort representation, agreement in reproductive status, and group size in an animal's current group to parallel conditions in all other groups detected that day. This preliminary investigation of core fission-fusion attributes, along with their motivating biological processes, is a first step toward quantifying the role of social forces in shaping bighorn movements. Integrating these factors with environmental information may improve our ability to forecast movements and predict the consequences of connectivity on system dynamics.

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