**A Risk Model for Proactive Management of Pneumonia Epizootics in Bighorn Sheep

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Pneumonia epizootics are a major challenge for management of bighorn sheep (*Ovis canadensis*). Risk factors associated with the disease are poorly understood, making pneumonia epizootics hard to predict; such epizootics are thus managed reactively rather than proactively. We developed a model that identifies risk factors and addresses biological questions about risk. Using Bayesian logistic regression with repeated measures, we found that private land, weed control using domestic sheep or goats, pneumonia history, and herd density were associated with risk of pneumonia in 43 herds in Montana that experienced 22 epizootics out of 637 herd years from 1979–2013. Within high-risk areas occupied by herds, risk increased with greater amounts of private land and use of domestic sheep or goats for weed control. Herds had >10 times greater odds of having a pneumonia epizootic if they or neighboring herds within high-risk areas had a history of pneumonia. Risk greatly increased when herds were at high density, with nearly 15 times greater odds of pneumonia compared to herds at low density. Number of federal sheep and goat allotments, proximity to nearest herds, ram:ewe ratios, normality of winter and spring precipitation, and herds with native versus mixed or reintroduced origin were not associated with increased risk. We conclude that factors associated with risk of pneumonia are complex and may not always be from the most obvious sources. The ability to identify high risk herds will help determine where to focus management efforts and what risk factors most affect each herd, facilitating more effective, proactive management.