Cost Distance Models to Predict Contact Between Bighorn Sheep and Domestic Sheep

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ABSTRACT: Infectious disease transmission from domestic sheep threatens the persistence of bighorn sheep (*Ovis canadensis)* populations throughout western North America. Quantifying spatial separation between the two species is an essential component in assessing the risk of disease transmission. We present a spatial analysis to evaluate infectious disease risks for endangered Sierra Nevada bighorn sheep (*O. c. sierrae)*. We combined a resource selection probability function with a cost distance analysis to quantify the risk of grazing domestic sheep in proximity to Sierra bighorn sheep core home range from a habitat perspective. Our approach accounted for the spatial separation between the species as well as the configuration of resources that influenced Sierra bighorn sheep movement. We assessed the potential for contact by predicting where Sierra bighorn sheep were likely to travel. Our method established a risk threshold which could be used to optimize grazing regimes of public land allotments, private leases and hobby farms. We compared our approach to a standard buffer approach and determined that our cost distance model better quantified how risk varied among parcels that are located equidistant from Sierra bighorn sheep core home range. Sierra bighorn sheep clearly selected and traveled within habitat that provides escape terrain. Our model, which included a log normal transformation, characterized the high relative cost (i.e., reduced likelihood) to traveling beyond selected habitat and predicted that such movement is less likely. As a result, our habitat-based risk threshold was 48% smaller in area than the standard buffer area that included landscape which bighorn did not use. Our framework offers a quantitative method for land managers to evaluate domestic sheep grazing and the potential for co-habitation to minimize the risk of disease transmission.

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