Demographic Uncertainty and Disease Risk Drive Climate-Informed Mountain Goat Management

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ABSTRACT: Scientists and managers have raised concerns about mountain goat populations in many areas in recent years. Both climate change and respiratory pathogens associated with widespread pneumonia epidemics in bighorn sheep may negatively affect mountain goat populations. Mountain goat demographic and population data are difficult to collect and sparsely available, making population management decisions difficult. We developed predictive models incorporating these uncertainties and analyzed results within a structured decision making framework to make management recommendations and identify priority information needs in Montana, USA. We built a resource selection model to forecast occupied mountain goat habitat and account for uncertainty in effects of climate change, and a Leslie matrix projection model to predict population trends while accounting for uncertainty in population demographics and dynamics. Additionally, we predicted disease risks while accounting for uncertainty about presence of pneumonia pathogens and risk tolerance for mixing populations during translocations.

Our analysis predicted that new introductions would produce more area occupied by mountain goats at mid-century, regardless of the effects of climate change. Population augmentations, carnivore management, and harvest management may improve population trends, although this was associated with considerable uncertainty. Tolerance for risk of disease transmission affected optimal management choices because translocations are expected to increase disease risks for mountain goats and sympatric bighorn sheep. Expected value of information analyses revealed that reducing uncertainty related to population dynamics would affect the optimal choice among management strategies to improve mountain goat trends. Reducing uncertainty related to the presence of pneumonia-associated pathogens and consequences of mixing microbial communities should reduce disease risks if translocations are included in future management strategies. We recommend managers determine tolerance for disease risks associated with translocations that they and constituents are willing to accept. From this, an adaptive management program can be constructed wherein a portfolio of management actions are chosen based on risk tolerance in each population range combined with the amount that uncertainty is reduced when paired with monitoring, to ultimately improve achievement of fundamental objectives.

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