

Montana Elk Winter Habitat Distribution as a Function of Winter Severity

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Understanding the quality and distribution of winter habitat is an essential component of delineating the most important wildlife habitat requirements throughout the year for large ungulates. Severe winters can be an important cause of winter mortality in elk (*Cervus canadensis*), especially in populations that are less able to access seasonal resources without large migrations. Therefore, it is critical to study how elk respond to severe winter weather and how that response impacts the distribution of suitable habitat. In order to derive a more mechanistic understanding of elk winter habitat in Montana, we used more than 36,000 elk location points from winter aerial surveys from 2010-2022 to build regional random forest models optimized for studying wildlife-habitat relationships and explicitly evaluated the effects of minimum temperatures and snow cover on elk distributions and how those elements of weather influenced their selection for land cover and terrain features. These models performed very well in predicting out-of-sample data and we used them to create new maps of elk winter habitat in Montana. We found that minimum temperature was among the most important variables driving elk distribution in each region and that both minimum temperature and snow water equivalent interacted with shrub cover density, tree cover density, and topographic heterogeneity to determine where elk were most likely to be found. We also found that in each region, the distribution of predicted habitat varied depending on the severity of recent winter weather. In combination with explicitly mapped model prediction uncertainty, the maps our models produced provide actionable information for biologists and habitat managers across the state, and could inform future habitat management actions at landscape scales. Further, our methods may be a template for researchers and managers in other states interested in developing models of ungulate winter habitat that explicitly vary with recent weather severity.