Using Machine Learning and Remotely Sensed Data ToImprove Models of Elk and Mule Deer Nutritional Landscapes in Western Montana

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The availability of nutritional resources for elk and mule deer is one of the defining characteristics of their habitat in Montana, representing a key bottom-up factor that drives individual- and population-level responses. Elk and mule deer conservation and management decision-making is therefore improved by quantifying the environmental characteristics that drive spatial and temporal heterogeneity in nutritional abundance and quality at landscape scales. Much of the existing work modeling nutritional landscapes has relied on intensive field surveys. While those efforts have yielded useful insight, it is not clear how well they can be used to generalize over larger scales and across time. Further, while many studies have incorporated remotely sensed data products to improve predictions of forage quality, direct vegetation indices (e.g., NDVI) may not accurately reflect biologically relevant changes, especially where dense forest cover occludes accessible forage. Instead, it is likely that the best nutritional landscape models will couple directly observable phenomena with ancillary environmental characteristics. In this study, we modeled elk and mule deer forage quality usingon-the-ground measurements of forage quality from multiple studies across western Montana as training data predicted by a combination of metrics of land cover, topography, weather, soil chemistry and texture, climatic water balance, and disturbance by fire and timber harvest. We report on the data acquisition and spatial modeling techniques that have contributed to model accuracy across the region, including maps of interannual variability that may improve our understanding of dynamic nutritional landscapes and inform further efforts in elk and mule deer management.