Wolf-Livestock Conflict in Montana: Spatial and Temporal Factors Influencing Livestock Loss

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Successful wolf (*Canis lupus*) recovery in Montana has brought with it some negative impacts on livestock producers in certain areas and time periods. We assessed the spatial and temporal patterns of wolf depredations on livestock in Montana at a broad, statewide scale during the past decade (2005–2014). These analyses highlighted areas of concentrated and consistent wolf-livestock conflicts, such that, for example, 50% of the statewide conflicts occur in 5% of the state. We then used generalized linear mixed-models to test covariates potentially predictive of both conflict presence (zero vs. non-zero depredation events) and conflict severity (number of events given at least 1), including the assessment of lethal controls and hunter harvest as tools to reduce conflicts. Using administrative hunting districts (HDs) as the unit of analysis, we found that conflict presence increased for HD-years with wolves present ($P<0.001$), higher wolf pack densities ($P=0.006$), higher livestock densities ($P<0.001$), and intermediate proportionate areas of agricultural land ($P<0.001$). HDs with depredations the previous year were more likely to continue having them ($P<0.001$), though lethal removal of wolves significantly reduced this effect ($P=0.038$). Direct effects of wolf hunter harvest were shown to marginally ($P=0.152$) reduce year-to-year conflicts, but indirect effects of harvest would also be expected given its role in determining wolf numbers, a primary driver of conflicts. Minimizing livestock losses is a top priority for successful wolf management, and these results shed light on the broad-scale patterns behind chronic problems and the tools used to address them.