

THE POTENTIAL EFFECT OF ENERGY DEVELOPMENT ON UNGULATES IN EASTERN MONTANA: A LITERATURE REVIEW

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Energy development is arguably one of the biggest threats to wildlife conservation in eastern Montana. Drawing on the published and gray literature, we review the effects of energy development throughout similar habitats present in eastern Montana throughout Alberta, Montana, Idaho, Wyoming, Colorado, and elsewhere in the Rocky Mountain west on ungulates including mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), bighorn sheep (*Ovis canadensis canadensis*), and pronghorn antelope (*Antilocapra americana*). We summarized effects of different kinds of energy development (treatments), different study designs (from weaker to stronger inference; observational, comparative, experimental, before-after-control-impact), response variables (vigilance, group size, resource selection, survival, etc), and general conclusions of each study. In general, we found that most studies focused on short-term effects of energy development on individual ungulate species during initial development phases. Despite the short-term perspective, most studies showed negative effects on some response variable during energy development. However, we argue that short-term, individual species-focused studies are unlikely to demonstrate the cumulative, community-level impacts of broad-scale landscape conversion associated with extensive energy development on wildlife. We illustrate this point with two case studies; cumulative impacts on woodland caribou in Alberta's boreal forest, and mule deer in Wyoming. We conclude by reviewing principles of adaptive management as applied to landscape scale energy development and provide a template for future studies of the effects of energy development on the ecological communities of eastern Montana.