

Defining the danger zone: Critical snow support thresholds for predator-prey interactions

Benjamin Sullender¹, Calum Cunningham¹, Jessica Lundquist¹, and Laura Prugh¹

¹University of Washington

December 8, 2022

Abstract

Snowpack dynamics have a major influence on wildlife movement ecology and predator-prey interactions. Specific snow properties such as density, hardness, and depth determine how much an animal sinks into the snowpack, which in turn drives both the energetic cost of locomotion and predation risk. Here, we quantified the relationships between 15 field-measured snow variables and snow track sink depths for widely distributed predators (bobcats [*Lynx rufus*], coyotes [*Canis latrans*], wolves [*C. lupus*]) and sympatric ungulate prey (caribou [*Rangifer tarandus*], white-tailed deer [*Odocoileus virginianus*], mule deer [*O. hemionus*], and moose [*Alces alces*]) in interior Alaska and northern Washington, USA. We first used generalized additive models to identify which snow metrics best predicted sink depths for each species and across all species. For species occurring in both sites, we then tested whether the snow metric-sink depth relationship differed across regions. Finally, we used breakpoint regression to identify thresholds for the best-performing predictor of sink depth for each species (i.e., values wherein tracks do not appreciably sink into the snow). Near-surface (0-10cm) snow density was the strongest predictor of sink depth across species. This relationship varied slightly by region for wolves and moose but did not differ for coyotes. Thresholds of support occurred at snow densities of 230 kg/m³ for coyotes, 280 kg/m³ for bobcats, 290 kg/m³ for wolves, 340 kg/m³ for deer, 440 kg/m³ for caribou, and 550 kg/m³ for moose. Together, these critical thresholds define the bounds of “danger zones,” the range of snow density in which carnivores have a comparative movement advantage over ungulates. These results can be used to link predator-prey relationships with spatially explicit snow modeling outputs and projected future changes in snow density. As climate change rapidly reshapes snowpack dynamics, these danger zones provide a useful framework to anticipate likely winners and losers of future winter conditions.

Hosted file

oik-09925-File002.docx available at <https://authorea.com/users/564507/articles/611295-defining-the-danger-zone-critical-snow-support-thresholds-for-predator-prey-interactions>

Hosted file

oik-09925-File003.docx available at <https://authorea.com/users/564507/articles/611295-defining-the-danger-zone-critical-snow-support-thresholds-for-predator-prey-interactions>







