The importance of inverse density dependence in population viability analysis: implications for the recovery of mountain caribou in British Columbia

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The distribution of forest-dwelling woodland caribou (Rangifer tarandus caribou) has contracted across North America following human settlement. Predation, however, is generally considered the proximate limiting factor over most of their distribution. Increased predation may be facilitated by logging and other changes to caribou habitat that favour early seral stage forest and lead to increased densities of alternate prey species. Because of declining population trends and increasing population fragmentation woodland caribou within the Southern Mountain National Ecological Area of Canada have been listed as 'threatened' by the Committee on the Status of Endangered Wildlife in Canada necessitating the implementation of recovery schemes to conserve and stabilise remaining populations. Population viability analysis (PVA) is a commonly used tool to project population trends under current and novel conditions and to develop recovery strategies for endangered species. Reliable estimates of future population projections are dependent on an understanding of the relationship between population density and population growth rate. For example, in the absence of density dependence in either the functional or numerical response of predators, the proportional effect of the total response will be uniformly inversely density dependent. Thus at high predation levels, predators can cause extinction below a threshold density where prey are secondary and predators depend on some other primary prey. Despite the important consequences of inverse density dependence in predictive population models, most viability analyses continue considering only density dependence. I used long-term census data and radiotelemetry locations of >350 collared individuals sampled over the entire distribution of the mountain ecotype of woodland caribou in British Columbia to delineate population structure and document size and trend of these populations. My results indicate that smaller caribou populations decline at the fastest rate. Using information on population density and cause of mortality, I show that the decline of mountain caribou populations is consistent with predictions of inverse density dependent predation where caribou are secondary prey and the numerical response of predators is dependent on alternate prey species. Finally, I demonstrate the effects of this inverse density dependence on population persistence and the recovery of mountain caribou in British Columbia.