Understanding the functional components of predator-prey response to habitat restoration: A Bayesian approach

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Abstract: Effective action planning for recovering endangered populations of boreal caribou (*Rangifer tarandus caribou*) requires an understanding of the functional interactions between: (1) responses by predators to current and prospective future habitat conditions, (2) responses of prey to population and habitat conditions influencing apparent competition, and (3) residual effects of past population bottlenecks. Monitoring recovery trajectories when human-altered habitats are restored requires consideration of many cause-effect linkages operating among multiple species and across multiple ecological scales. We developed a Bayesian Belief Network (BBN) to help frame potential functional responses of 2 predators (wolves, bears) and 2 prey (moose, caribou) to a large-scaled, silviculturally-based, habitat restoration experiment conducted within the Cold Lake caribou herd area in the Alberta oil sands. The full BBN consists of three general components: (1) those related to predator and prey movements, including use of non-restored and restored habitat features as those opposed conditions affect travel speed and search rates of predators; (2) those related to daily and seasonal use of habitat and how that may affect encounter probabilities between predators and prey; and (3) those related to the probability of kill given an encounter between predator and prey. These components structured in a BBN architecture support the application of the basic parameters in Holling's disc equation, particularly: seasonal predator search rates and probability of a kill given an encounter (i.e., the area of effective search). We used the BBN to map the functional response spatially and to assess the dynamics of the predators and prey (demographics and response to restoration treatments). Our understanding of these hypothetical responses will, in the future, help shape management actions designed to reduce predator density and prey risk. To demonstrate the management utility of this approach, we plan to set BBN prior probabilities for each model component using 4 types of data: (1) habitat conditions measured semi-annually; (2) GPS relocation data from 128 individual predators (77 wolves; 51 bears) and 34 prey (25 moose and 9 caribou); (3) kill site investigations; and (4) DNA analyses of prey species density.

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