**Compensatory Mortality in a Multiple Carnivore System: Consequences for Elk Calf Survival and Elk Population Dynamics in the Southern Bitterroot Valley

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The recent expansion of large carnivores in North America may dramatically alter the population dynamics of their primary ungulate prey species. In response to declining elk (*Cervus elaphus*) calf recruitment in the southern Bitterroot Valley of Montana, we initiated a 3-yr study to determine the relative importance of top-down and bottom-up processes in explaining elk recruitment rates. We predicted that forage quality would interact with predation risk across the landscape, causing predation on elk calves to become more compensatory in areas of higher forage quality. Continuous-time survival modeling will be used to estimate the relative importance of bottom-up and top-down processes in explaining calf survival, and test the interaction of predation risk and forage quality. Overall, male elk calves have a 62.7-percent higher risk of mortality than females, and annual survival rates have significantly varied among years, with estimates of 0.27 in 2011, 0.42 in 2012, and 0.55 thus far in 2013. Mountain lions (*Puma concolor*) are the most important mortality source for elk calves, with cause-specific mortality rates of 0.17 for lions; 0.04 for black bears (*Ursus americana*); 0.03 for wolves (*Canis lupus*); 0.08 for unknown predators; 0.10 for unknown; 0.04 for natural, non-predation; and 0.008 for human-related events. Calf survival data, together with adult survival, nutrition, and carnivore population data, will be used to develop an integrated population model to forecast the effect of habitat and carnivore densities on elk population trends. This tool may help managers balance carnivore and ungulate population objectives and is applicable across all areas experiencing carnivore recovery.