Elk Behavioral Responses to Re-establishment of Wolves: the Indirect Consequences of Living in a Risky Environment

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It is well-documented that predators limit prey populations in many systems through the direct killing and consumption of prey. What is less well studied and understood are the indirect consequences of predators on the behavior of prey that are attempting to minimize predation risk. We conducted an intensive telemetry-based study of the Madison-Firehole elk (*Cervus elaphus*) herd and colonizing wolves (*Canis lupus*) in the central portion of Yellowstone National Park from 1991-2006 to test the prediction that wolves have altered various

elk behavioral responses including group size, winter home range size, activity patterns, and habitat selection. Prior to significant wolf reestablishment of the study area (1991-1997), we randomly collected approximately 6000 elk locations, representing 5000 elk group with associated group size, activity budgets, and habitat selection attributes. These data are complimented by more than 5000 elk locations, representing 3500 elk groups and associated data when wolves had an established presence in the study system from 1998 through 2006. After wolf re-introduction elk that formally lived in a predator-free environment for many decades were subjected to varying levels of predation risk thus allowing us to investigate how these behaviors change at different temporal and spatial scales. Comparison of pre-wolf and post-wolf data demonstrates changes in elk behavior at a variety of spatial and temporal scales; presumably due to elk responses to predation risk. It is unclear whether these behavioral changes resulted in decreased individual fitness or reductions in population vital rates; how-ever, we hope that continued monitoring will provide additional insights as this predator-prey system develops.