Abstract:

Populations of large terrestrial carnivores are in various stages of recovery worldwide and the question of whether there is compensation in mortality sources is relevant to conservation. Here, we show variation in Wisconsin wolf survival from 1979 to 2013 by jointly estimating the hazard of wolves' radio-telemetry ending (endpoint) and endpoint cause. In previous analyses, wolves lost to radio-telemetry follow-up (collar loss) were censored from analysis, thereby assuming collar loss was unconfounded with mortality. Our approach allowed us to explicitly estimate hazard due to collar loss and did not require censoring these records from analysis. We found mean annual survival was 76% and mean annual causes of mortality were illegal killing (9.4%), natural and unknown causes (9.5%), and other human-caused mortality such as hunting, vehicle collisions and lethal control (5.1%). Illegal killing and natural mortality were highest during winter, causing wolf survival to decrease relative to summer. Mortality was highest during early recovery and lowest during a period of sustained population growth. Wolves again experienced higher risk of human-caused mortality relative to natural mortality as wolves expanded into areas with more human activity. We detected partial compensation in human- and natural-caused mortality since 2004 as the population saturated more available habitat. Prior to 2004, we detected additivity in mortality sources. Assessments of wolf survival and cause of mortality rates and the finding of partial compensation in mortality sources will inform wolf conservation and management efforts by identifying sources and sinks, finding areas of conservation need, and assessing management zone delineation.

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