Demographic response of mule deer to experimental reduction of coyotes and mountain lions in southeastern Idaho

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Abstract: Manipulating predator populations is often posed as a solution to depressed ungulate populations. However, predator–prey dynamics are complex and the effect on prey populations is often an interaction of predator life history, climate, prey density, and habitat quality. The effect of predator removal on ungulate and, more specifically, mule deer (*Odocoileus hemionus*) populations has not been adequately investigated at a management scale. We tested the efficacy of removing coyotes (*Canis latrans*) and mountain lions (*Puma concolor*) for increasing survival and population growth rate of mule deer in southeastern Idaho, USA, during 1997–2003. We assigned 8 game management units (GMUs) to treatments under a 2 × 2 factorial design (treatments of coyote removal and lion removal) with 2 replicates of each treatment or reference area combination. We used methods typically available to wildlife managers to achieve predator removals and a combination of extensive and intensive monitoring in these 8 GMUs to test the hypothesis that predator removal increased vital rates and population growth rate of mule deer. We determined effects of predator removal on survival and causes of mortality in 2 intensive study sites, one with coyote and mountain lion removal and one without. We also considered the effects of other variables on survival including lagomorph abundance and climatic conditions. In these 2 intensive study areas, we monitored with radiotelemetry 250 neonates, 284 6-month-old fawns, and 521 adult females. At the extensive scale, we monitored mule deer population trend and December fawn ratios with helicopter surveys. Coyote removal decreased neonate mortality only when deer were apparently needed as alternate prey, thus removal was more effective when lagomorph populations were reduced. The best mortality model of mule deer captured at 6 months of age included summer precipitation, winter precipitation, fawn mass, and mountain lion removal. Over-winter mortality of adult female mule deer decreased with removal of mountain lions. Precipitation variables were included in most competing mortality models for all age classes of mule deer. Mountain lion removal increased fawn ratios and our models predicted fawn ratios would increase 6% at average removal rates (3.53/1,000 km^2) and 27% at maximum removal rates (14.18/1,000 km^2). Across our extensive set of 8 GMUs, coyote removal had no effect on December fawn ratios. We also detected no strong effect of coyote or mountain lion removal alone on mule deer population trend; the best population-growth-rate model included previous year's mountain lion removal and winter severity, yet explained only 27% of the variance in population growth rate. Winter severity in the current and previous winter was the most important influence on mule deer population growth. The lack of response in fawn ratio or mule deer abundance to coyote reduction at this extensive (landscape) scale suggests that decreased neonate mortality due to coyote removal is partially compensatory. Annual removal of coyotes was not an effective method to increase mule deer populations in Idaho because coyote removal increased radiocollared neonate fawn survival only under particular combinations of prey densities and weather conditions, and the increase did not result in population growth. Coyote-removal programs targeted in areas where mortality of mule deer fawns is known to be additive and coyote-removal conditions are successful may influence mule deer population vital rates but likely will not change direction of population trend. Although mountain lion removal increased mule-deer survival and fawn ratios, we were unable to demonstrate significant changes in population trend with mountain lion removal. In conclusion, benefits of predator removal appear to be marginal and short term in southeastern Idaho and likely will not appreciably change long-term dynamics of mule deer populations in the intermountain west.