# Survival and Recruitment of Gray Wolf Pups Before and after Harvest

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Knowledge about recruitment in a population can be critical when making conservation decisions, particularly for harvested species. Harvest can affect population demography in complex ways and this may be particularly true for species whose successful reproduction is linked with complex social dynamics. We used noninvasive genetic sampling and a natural experiment to estimate recruitment in gray wolves (Canis lupus) before and after harvest in the northern Rocky Mountains, Idaho USA (2008-2013). We hypothesized that recruitment would decline after hunting and trapping began and that the decline in recruitment would be attributable to the harvest of pups and not subtler mechanisms associated with group dynamics and reduced reproductive success. We collected fecal samples from wolves in 10 packs for 6 consecutive years, extracted DNA, and genotyped 154 individual pups across 18 microsatellite loci. Population harvest rates averaged 23.8% (SD = 9.2). Our hypothesis that recruitment would decline was supported; survival from 3 – 15 months of age decreased from 0.60 (95% CI: 0.48-0.72) without harvest to 0.38 (95% CI: 0.28-0.48) with harvest and recruitment declined from 3.2 (95% CI: 2.1-4.3) to 1.6 (95% CI: 1.1-2.1) pups per pack after harvest was initiated. We attributed just 18-38% of pup mortality directly to harvest and suggest that there are indirect effects of harvest on recruitment that may be associated with changes in group size and structure. Models that do not include both direct and indirect effects of harvest on recruitment may underestimate the potential impact of harvest on population growth in social species.