

## Effects of Birth Date, Sex, Maternal Characteristics, and Environmental Conditions on Mass and Survival of Bighorn Lambs

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**Abstract:** For ungulates living in strongly seasonal environments, variation in parturition date should have strong fitness consequences. We investigated birth date interactions with sex, maternal characteristics, and environmental variables to affect the growth and survival of bighorn sheep (*Ovis canadensis*) lambs and yearlings. Over 13 yr, the estimated birth date of 206 lambs ranged from May 21 to July 18. Late-born lambs of both sexes were lighter at weaning than early-born lambs. Weaning success of the mother the previous year and November to December precipitation affected the date of birth. Birth date had no effect on lamb summer growth rate. To assess the parameters affecting lamb mass at weaning, we tested a model including lamb characteristics, maternal previous reproductive status, maternal mass and age, and environmental conditions. Fecal crude protein values during summer correlated positively with lamb mass in September. Birth date affected lamb survival if considered alone, but not when weaning mass was included in the model. Birth date had a negative effect on yearling mass in early June. However, when accounting for the mass of lambs in September, birth date was not significant on mass of yearlings and 2-yr-olds in June and September for either sex. Lamb mass in September correlated with June and September mass as yearlings, but had no correlation with mass at 2 yr. Our results suggest that birth date affects several traits of individuals, such as mass in June and September. This, in turn, affects survival and ultimately may affect individual fitness. During the short growing season, bighorn lambs must accumulate sufficient body resources to survive winter, and females may be selected to synchronize birth with forage productivity. Our data also suggest complex relationships among different factors, and maternal quality plays an important role in affecting lamb life history.

*BIENN. SYMP. NORTH. WILD SHEEP AND GOAT COUNC. 15: 2006*

**Key words:** bighorn sheep, birth date, forage productivity, *Ovis canadensis*, survival, synchronize births.

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