

Correspondence Between Birth Weight and Causes of Death in Neonatal Lambs

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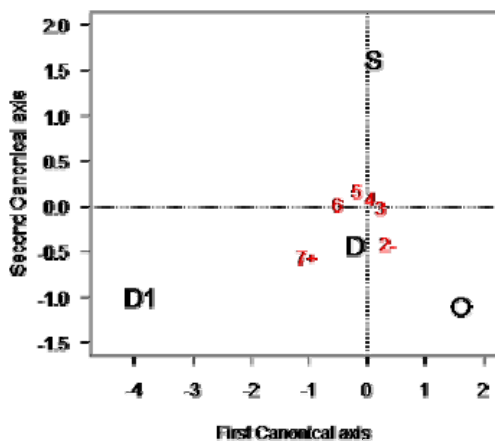
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Autopsy procedures (Holst 2004) permit categorical diagnosis of the likely causes of death and may provide direction to improve lamb survival. Given the relationship between birth weight (bwt) and mortality, this paper reports on relationships between bwt and causes of death.

Data were analysed from 1800 lambs born in 2003 and 2004 (Hopkins *et al.* 2007). Lambs dying within 5 days of birth were autopsied (Holst 2004). Cause of death was pooled into discrete mutually exclusive categories, namely dystocia (D1), birth injury (D), starvation (S) and other causes (O). D1 lambs were stillborn with oedema and without cranial or spinal cord injury. D lambs had significant cranial and spinal cord injury. S lambs are without evidence for D and not fed. Predation, cold exposure, premature, dead in utero, infection, misadventure and undiagnosed causes were included in O. The binary responses for inclusion in each death category (Yes or No) were analysed separately using logistic regression in ASReml (Gilmour *et al.* 2006). Fixed effects included year, sex, sire and dam breed, litter size and bwt. Random terms included dam, sire group and an interaction between dam and year. In addition, bwt was rounded to the nearest integer (2 to 7+ kg) and the 4 x 6 table (cause of death x bwt) was subjected to correspondence analysis (ter Braak 1995). On the first canonical axis each death category is assigned a score (weighted average equal zero) and from these the scores for the birth weight categories can be determined using a weighted average. The weights are related to the values in the table being analysed. The scores assigned to each death category are chosen so as to maximally spread out the scores for the birth weight categories. Subsequent axes are restrained to be orthogonal to earlier canonical axes

Of the 397 dead lambs, 348 were included in the statistical analyses, 56%, 4%, 26% and 14% were categorised as D, D1, S and O respectively. The only significant fixed effects in the separate logistic regressions were bwt ($P = 0.001$) for the categories D1 and O and dam breed ($P = 0.01$) and litter size ($P = 0.03$) for category S. The first two axes for the correspondence analysis are plotted in Figure 1.



This plot suggests categories D1 and O are more prevalent with heavier and lighter lambs respectively, which is in agreement with the bwt trends associated with the logistic regressions. The correspondence analysis suggests that as bwt increases, cause of death is likely to change from O toward D1. Category S appears to be more associated with animals of average bwt whilst category D appears to be unrelated to bwt. The results also suggest that lambs dying from D are associated with the whole range of bwt. Since D accounted for 56% of deaths, large improvements in lamb survival may not occur by targeting bwt.

Figure 1. Ordination plot for death category and birth weight deviations

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