# INFECTION AND IMMUNITY IN A BIGHORN SHEEP METAPOPULATION

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***Abstract:*** We hypothesized that the temporal dynamics of pneumonia in bighorn sheep (*Ovis canadensis*) can be explained by the development of herd immunity within populations. To account for the pneumonia dynamics observed in Hells Canyon bighorn sheep, we examined the probability of surviving a bighorn sheep pneumonia epidemic given past exposure(s) to pneumonia, for 512 radio-collared bighorn sheep in 14 demographically independent populations in Hells Canyon where 36 pneumonia epidemics had been recorded over the 14 year study period. To understand the role of maternal immunity in lamb epidemics, we examined lamb survival, given dam exposure history, for 370 ewe-lamb pairs. In ewes, exposure to pneumonia induced short-lived protective immunity to pneumonia that lasted 1 to 2 years. An individual ewe's probability of surviving an epidemic improved with cumulative exposure events experienced over its lifetime. Translocation was a significant predictor of survival, with translocated ewes having 3.4 to 4.5 times the hazard of dying of pneumonia than resident sheep. Translocation was the only significant predictor of ram survival through pneumonia epidemics, with translocated rams being 5 times more likely to die of pneumonia than resident sheep. Lambs' hazard of dying increased, paradoxically, with the number of times their dam had been exposed to pneumonia. Our results suggest an interaction between resistance to infection and resistance to disease in this bighorn sheep metapopulation, where resistant individuals interact with carriers to produce the pneumonia dynamics observed in Hells Canyon. Some simple mathematical models of the patterns observed in our data confirm that a small proportion of carriers must be responsible for long-term persistence of pneumonia.

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***Key words:*** *Ovis canadensis*, bighorn sheep, pneumonia, Hells Canyon, Montana, translocation.

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