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Network analysis of cattle movements in relation to bovine tuberculosis transmission risk in Minnesota, US

Ribeiro Lima, J.¹, Thompson, B.², Craft, M.E.¹ and Wells, S.J.¹, ¹University of Minnesota, Veterinary Population Medicine, USA, ²Minnesota Board of Animal Health, USA; jlima@umn.edu

Bovine tuberculosis (BTb) was first diagnosed in cattle through slaughter surveillance in Minnesota (MN) in 2005. By the end of 2008, 12 cattle herds had found to be infected with BTb, and one of the causes for infection was determined to be the movement of infected animals between herds. USDA granted split-state status to MN in 2008, upgrading most of the state to modified-accredited advanced and only a smaller area of 6,915 km² in northwestern Minnesota as modified accredited (MA). The state has now been declared BTb free; however, since January 2008 all cattle movements within the MA were recorded. The objective of this study is to characterize cattle movements in a high risk area for BTb in MN and also identify which herds might have a higher risk to become infected and to infect other herds. The data used in this analysis includes the years 2008 through 2011. During this period, 3,762 movements were recorded with 57,460 cattle being moved, corresponding to permits issued to 682 premises, mostly representing private farms, sale yards, slaughter facilities and county fairs. Although, sale yards represented less than 2% of the nodes (premises), 60% of the movements were to or from a sale yard. Less than 2% of movements, both into and out of the MA zone involved locations outside MN (other states and Canada). Movements occurring between herds in the MA zone corresponded to 24% off the total number of movements. Preliminary network analysis was performed on 35% of the data (complete analysis will be presented at the conference). The network showed a density of 1%, a fragmentation of 88% and a clustering coefficient of 56%. The betweenness centralization index was 6.52%. The degree distribution showed that 25% of nodes performed 81% of movements. This analysis provides novel description about the contact structure of cattle movements in a high risk area for BTb, essential to support future surveillance decisions.