# A quantitative comparison of the reliability of animal detection systems and recommended requirements for system reliability

Marcel P. Huijser*, e-mail: mhuijser@coe.montana.edu
Tiffany D.H. Allen, e-mail: tiffany.holland@coe.montana.edu
Matt Blank, e-mail: mblank@coe.montana.edu
Mark C. Greenwood, e-mail: greenwood@math.montana.edu
Shaowei Wang, e-mail: swang@coe.montana.edu

* Corresponding author: Western Transportation Institute at Montana State University (WTI-MSU), PO Box 174250, Bozeman MT 59717-4250, USA. Phone: 406-543-2377.

Animal detection systems have the potential to reduce collisions with large mammals and improve human safety while not blocking or confining animal movements across the road. However, reliable warning signs are essential as the effectiveness of these systems depends on driver response. To investigate the reliability of the systems we constructed a controlled access test facility near Lewistown, Montana, USA. Nine systems were installed to detect horses and llamas that roamed in an enclosure. The llamas and horses served as a model for wild ungulates. Data loggers recorded the date and time of each detection for each system. Animal movements were also recorded by six infrared cameras with a date and time stamp. By analyzing the images and the detection data, we were able to investigate the reliability for each system. The percentage of false positives (i.e., a detection is reported by a system but there is no large animal present in the detection zone) was relatively low for all systems (≤1%). The percentage of false negatives (i.e., an animal is present in the detection zone but a system failed to detect it) was highly variable (0–31%). The percentage of intrusions (i.e., animal intrusions in the detection area) that were detected varied between 73 and 100 percent. The results suggest that some animal detection systems are quite reliable in detecting large mammals with few false positives and false negatives, whereas other systems have relatively many false negatives. In addition we investigated how the reliability of individual systems was influenced by environmental conditions. Finally we surveyed three stakeholder groups—employees of transportation agencies, employees of natural resource management agencies, and the traveling public—with regard to their expectations on the reliability of animal detection systems and compared the reliability of the nine systems to these expectations.