# ANIMAL-VEHICLE CRASH MITIGATION USING ADVANCED TECHNOLOGY PHASE II: SYSTEM EFFECTIVENESS AND SYSTEM ACCEPTANCE

**Final Report**

**SPR 3(076)**

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## PHASE II: SYSTEM EFFECTIVENESS AND SYSTEM ACCEPTANCE

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by

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Representatives of the DOTs that funded the project, the system vendor, and WTI-MSU personnel during a field visit at the MT site on 15 July 2008 (Photo: Marcel Huijser, WTI-MSU).

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## DISCLAIMER

# EXECUTIVE SUMMARY

The Animal-Vehicle Crash Mitigation Using Advanced Technology Study was initiated in the fall of 1999. The results through the fall of 2005 (Phase I) have been documented in detail in an earlier report; the accomplishments of Phase I included the following:

- Identification of existing animal detection system technologies and their vendors;
- Selection of two of these systems for field tests;
- Deployment of the two selected systems (one in Montana, and one in Pennsylvania);
- Documentation of the experiences with system installation;
- Testing of the reliability of the systems; and
- Formulating advice for future development and application, including cost-benefit analyses.

One of the two experimental animal detection systems – the one that was installed along US Highway 191 in Yellowstone National Park, Montana – proved to be able to detect elk (*Cervus elaphus*) reliably. However, as a result of steep slopes and curves, the system had blind spots where large animals were able to approach the road undetected. Therefore the warning signs could not be attached, and the effectiveness of the system in reducing vehicle speed and in reducing the number of collisions with large wild animals could not be evaluated.

Phase II of the project, the subject of the current report, was aimed at making the system modifications required to be able to attach the warning signs and investigate the effectiveness of the system in reducing vehicle speed and in reducing the number of collisions with large wild animals. This summary is structured according to the objectives for Phase II:

*Objective 1: Modify the system so that the blind spots cover 2-5% of the total length of the system at the most, install remote access to the system through a satellite connection, and make other repairs and modifications as necessary.*

The system was modified and repaired (see Chapter 2). After system modifications, blind spots covered 1.09% of the total length of the system, which meant that better coverage was achieved than the stated objective. Remote access through a satellite connection was achieved, not only allowing for a higher intensity of system monitoring, but also allowing for the warning signs to be manually turned on or off, either for research or management purposes.

System monitoring revealed that various parts of the system showed ongoing wear and tear and that replacement parts were sparse or not available. This led to repairs rather than replacements and relatively intensive monitoring of the system for potential new problems. Mainly because of the experiences at the study site, the vendor (STS, now ICx Radar Systems) has developed a more integrated, more compact, and more robust animal detection system. This should result in a smaller footprint and a reduced impact on landscape aesthetics, more reliable operation (fewer

false positives and false negatives), longer life span, and greater distance between the sensors and associated equipment.

*Objective 2: Investigate the effectiveness of the system with regard to reduction of vehicle speed in response to activated warning signs.*

Southbound traffic reduced speed when traveling through the road section with the animal detection system, both with warning lights off and on. Northbound traffic increased speed when traveling through the road section with the animal detection system, both with warning lights off and on. It is uncertain why northbound traffic increased speed. Perhaps this increase in speed related to the geometry of the road, sight distance, or the proximity of the boundary of Yellowstone National Park two miles farther north.

Nonetheless, passenger cars, pick-ups, vans, and trucks with two units or more all had lower vehicle speed with the warning signs activated compared to warning signs off. For both travel directions combined, the speed of passenger cars, pick-ups, and vans was 1.52 mi/h (2.45 km/h) lower with warning signs activated. For trucks with two units or more vehicle speed was 0.91 mi/h (1.46 km/h) lower with warning signs activated.

While vehicles only reduced their speed by a small degree, reductions in vehicle speed are associated with a disproportionate decrease in the probability of severe accidents when traveling at high speed (*Kloeden, et al. 1997*). In addition, fewer or less severe wildlife-vehicle collisions may not only be obtained through lower vehicle speed, but can also be obtained through increased driver alertness (see Chapter 1, Introduction). Activated warning signs are likely to make drivers more alert. Driver reaction time to an unusual and unexpected event can be reduced from 1.5 sec to 0.7 sec if drivers are warned (*Green 2000*). With a constant passenger vehicle speed of 57.45 mi/h (92.44 km/h) with lights on, this leads to a potential reduction in stopping distance of 67.3 ft (20.5 m).

*Objective 3: Investigate the effectiveness of the system with regard to the number of collisions with large animals.*

The number of reported collisions with large mammals or the number of large mammal road mortalities from the treatment section after the system became operational was 66.7% lower than before the system became operational. The number of reported collisions with large mammals or the number of large mammal road mortalities from the treatment section after the system became operational was 57.6% lower than in comparable control sections. While both the comparison in time and space suggest that the animal detection system resulted in fewer collisions with large mammals, the relatively short road length of the treatment section combined with one year of data collection after the system became operational do not allow for a statistical test and a firm conclusion. Nonetheless, the available data on the effectiveness of animal detection systems in reducing collisions with large mammals is consistent and suggests that animal detection systems indeed result in fewer collisions with large mammals (see review in Chapter 4). It is important to note though that an animal detection system must be detecting large animals reliably before one investigates the effectiveness of a system in reducing collisions with large mammals.

*Objective 4: Investigate the acceptance of the system by drivers, the Montana Department of Transportation, and Yellowstone National Park.*

A majority of drivers who responded to the survey and who drove the road section with the animal detection system had the following responses to the survey:

- Often or always worried about hitting large ungulates on the road (81%);
- Noticed the animal detection system (96%);
- Were aware that large animals may be on or near the road in this area when the warning signs were activated (91%);
- Reduced their speed (40%) or became more alert (45%) as a result of the activated warning signs;
- Thought the system was helpful when it was activated (52%);
- Would like to see the US Highway 191 system stay in place (59%);
- Thought animal detection systems were a good idea, in general (71%);
- Expected animal detection systems to detect all (32%) or nearly all (19%) large animals that approach the road;
- Would allow for no more than 20% of all detections to be false (i.e., not related to large animals) (52%);
- Expected animal detection systems to reduce collisions with large animals by over 70% (60%);
- Found it very important to make potential improvements on the reliability of animal detection systems (63%); and
- Found it very important to have clear and easy to understand warning signals (64%).

However, 17% of the respondents thought there were no animals on or close to the road, or did not understand the meaning of the signs when the warning signs were not activated, perhaps leading to an absent or wrong driver response (less alert, faster vehicle speed). The respondents who were critical of the animal detection system along US Highway 191 in Yellowstone National park expressed concerns about the reliability of the system, the costs of this type of mitigation measure, and the effect of the system on landscape aesthetics.

The Montana Department of Transportation (MDT) was concerned about the reliability and robustness of the animal detection system and maintenance effort (see also ***Huijser, et al. 2006***). Although the system had proven to detect elk reliably (see also ***Huijser, et al. 2006***), the requirements for system coverage were met (see Chapter 2), and remote access through satellite was established to facilitate system monitoring and system management, nevertheless substantial concerns remained with regard to the wear and tear of the system, the associated level of system monitoring, and lack of spare parts. These concerns caused MDT to support system removal after completion of the research project. Yellowstone National Park was mostly concerned about landscape aesthetics (see also ***Huijser, et al. 2006***). For Yellowstone National Park, system removal was a condition for Phase II of the project.

*Objective 5: Remove the system by 31 August 2008, as a condition set by Yellowstone National Park.*

On 18 August 2008 the first sensors were removed. System removal was completed on 12 September 2008.

In addition to addressing the objectives discussed above, the researchers formulated a step plan for agencies considering the installation of an animal detection system alongside a road and recommendations for the research and monitoring of the reliability and effectiveness of animal detection systems.

If a transportation agency is interested in deploying an animal detection system, the following steps are recommended:

- Define the problem;
- Obtain an overview of all effective mitigation measures;
- Obtain an overview of all animal detection systems;
- Select a system;
- Take lessons from other projects into account;
- Prepare for technical difficulties, delays, and maintenance;
- Make a realistic risk assessment;
- Conduct system acceptance tests;
- Document and publish experiences; and
- Document and publish data on system reliability and system effectiveness.

The researchers formulated the following recommendations for the research and monitoring of the reliability and effectiveness of animal detection systems:

- Measure system reliability;
- Standardize how system reliability is measured;
- Investigate the influence of environmental conditions;
- Suggest and adopt minimum norms for system reliability;
- Conduct meta-analyses;
- Consider a BACI analysis;
- Keep the search and reporting effort for crashes and carcasses constant;
- Investigate the mechanism behind system effectiveness;
- Investigate system reliability along the roadside;
- Investigate the effect of the system and activated signs on speed on-site; and
- Investigate the effect of the system and activated signs on driver response on-site.

While animal detection systems should still be characterized as experimental, the results of Phase II of this project are encouraging and suggest that animal detection systems can be effective in reducing collisions with large mammals. Nonetheless, additional research is needed, especially with regard to the effectiveness of animal detection systems in reducing collisions with large mammals, as the current data are not robust.