DEER CROSSING SIGNS AND TECHNOLOGIES

One of the most widely used measures to reduce deer-vehicle crashes (DVCs) is the deer crossing warning sign (See Figure 1). The design of this sign is controlled by the *Manual on Uniform Traffic Control Devices* (MUTCD), and consists of a diamond-shaped panel with a black "Deer Crossing" legend or deer symbol and a yellow background (See Figure 1) (*1*).

It is generally acknowledged and understood by transportation professionals that roadway warning signs are most effective (i.e., they result in an alteration of speed and/or path choice) when they alert the driver to an obvious danger (e.g., a curve ahead). The use of warning signs that alert drivers to sporadic and/or warn of general possibilities, encounters, or situations (e.g., deer crossing and slow children warning signs), on the other hand, do not normally have a consistent impact on driver behavior. The overuse or misuse (i.e., installation at incorrect locations) of warning signs also reduces their overall effectiveness. Unfortunately, deer crossing signs have one or both of these characteristics.

No research literature was found that specifically considered or quantified the DVC reduction and/or vehicle speed reduction impacts of typical deer crossing signs (See Figure 1). The deer crossing sign studies that were reviewed appear to be based on the general assumption that a typical deer crossing warning sign does not generally reduce vehicle speeds (one measure of warning sign effectiveness), and that the effectiveness of these signs needs to be improved in some manner.

Documentation was found for several studies that attempted to increase the effectiveness (as measured by a reduction in vehicle speed) of typical deer crossing signs (*2*, *3*, *4*, *5*, *6*, *7*). These studies considered either permanent or temporary (i.e., only activated when deer are detected nearby) changes in the physical appearance of a typical deer crossing sign installation. In the early 1970s researchers attempted to improve the effectiveness of a deer crossing sign through permanent enhancements to its message (*2*, *3*, *4*). More recently, however, two studies investigated the effectiveness of special deer crossing

FIGURE 1 Typical deer symbol crossing warning sign (*1*).

signs with a different design that were only installed during time periods of significant animal movement (e.g., the fall months for white-tailed deer) (*5*, *6*). In addition, newer technologies have allowed a more dynamic approach to deer crossing sign improvements, and several sign systems have been designed to activate only when animals are detected near the roadway (*7*, *8*, *9*, *10*, *11*). The evaluation of one system of this type is summarized in this document (*7*). Other systems are also currently being considered, have been installed, and/or are being evaluated in several states (e.g., Indiana, Minnesota, Montana, Pennsylvania, Utah, and Washington). Detailed documentation of these installations, and their potential vehicle speed reduction and/or DVC reduction impacts, is not yet available.

Literature Summary

Deer crossing sign studies that evaluated the vehicle speed and/or DVC reduction impacts of enhanced sign designs and the application of a dynamic sign and sensor installation are described in the following paragraphs (*2*, *3*, *4*, *5*, *6*, *7*). The first two studies consider the vehicle speed reduction impacts of two technologically enhanced deer crossing sign designs (*2*, *3*, *4*). Another two studies evaluated the impacts of using special deer crossing signs along roadway segments during high DVC and/or migratory time periods (*5*, *6*). Then, brief summaries of some recently installed and documented dynamic deer crossing sign and sensor systems are provided. The effectiveness of only one of these systems, however, has been studied and documented in detail (*7*).

Sign Message Enhancement – Initial Study

Pojar, et al. have evaluated the impacts of two enhanced deer crossing sign designs (*2, 3, 4*). These designs are shown in Figures 2 and 3. The first sign evaluated was a typical diamond-shaped yellow and black warning sign with the words "DEER XING" in neon lights (See Figure 2). The other sign was also a diamond-shaped yellow and black warning sign, but included a series of deer shaped lights that activated in sequence and gave the impression of a deer jumping (See Figure 3). A small rectangular supplementary "DEER XING" sign was also added to this installation (See Figure 3). The impact of these signs was measured by comparing average operating vehicle speeds when the signs were turned toward and away from the traffic.

FIGURE 2 Lighted "DEER XING" sign (*3*).

In 1971 the signs in Figure 2 and 3 were installed along Colorado State Highway 82 (*3*). First, the "DEER XING" sign in Figure 2 was installed, but turned away from the traffic for 16 days (*3*). Then, the sign was turned towards traffic and activated for 28 days (*3*). After the "DEER XING" sign was removed it was replaced with the animated sign in Figure 3 for four days (*3*).

FIGURE 3 Animated deer crossing sign (*3*).

Vehicle operating speeds were collected about 800 feet downstream of the sign location from 6:00 PM to 10:00 PM each day for the time period indicated (See Table 1). This was also the only time period during the day when the enhanced signs were in operation. The speed data were collected during dry conditions with automatic recorders that used magnetic loop detectors. The number of vehicle speeds collected and/or whether any data were discarded was not documented (*3*).

TABLE 1 Average Operating Vehicle Speeds (*3*)

	Sign Turned Away from Traffic	"DEER XING" Sign Activated	Animated Deer Sign Activated
Days of Data Collection	16	28	4
Average Operating Vehicle Speed	54.5	53.0	51.6

A statistical analysis of the speed data collected show a significant difference between the average vehicle speed with the sign turned away from traffic and the average vehicle speed with either treatment sign activated (*3*). The number of data collection days for the animated sign treatment, however, was limited, and the potential for residual impacts on vehicle speed from the previous "DEER XING" sign installation should be recognized. The possible relationship between average daily vehicle speed (for the 4 hours considered) and the number of days since a treatment began was also evaluated (*3*). The objective was to investigate whether drivers habituated to the enhanced designs, and adjusted their vehicle speed. The researchers report that they found no relationship between the daily average vehicle speed and the number of days from the beginning of a treatment (*3*).

Sign Message Enhancement– Detailed Study

Pojar, et al. have also documented a more in-depth impact analysis of the animated sign design shown in Figure 3 (*4*). This study was conducted along the same highway segment as the initial study, but vehicle speed data were recorded 0.15, 0.65, and 1.5 miles downstream of the sign installation (*4*). This data was again collected with magnetic loops from 6:00 PM to 10:00 PM when the highway surface was dry (*4*). The researchers also estimated the number of nightly deer crossings in this 1.5-mile segment with spotlight surveys (one hour after sunset) within one area along its length, and recorded the number and location of deer roadkill within the study segment (*4*). The number of nightly deer crossings was estimated by simply doubling the number of deer counted by the researchers that night (*4*). In other words, it was assumed that each deer observed would cross the roadway at least twice that night. Finally, a short preliminary analysis of the vehicle speed impact of placing a deer carcass next to the sign treatment was also completed (*4*).

In 1972 and 1973, Pojar, et al. activated the animated sign in Figure 3 for two and five weeks (*4*). Those weeks when the sign was turned toward traffic (or activated) were alternated with weeks during which the sign was turned away from traffic (*4*). The number of weeks that vehicle speeds, deer crossings, and deer roadkill data were collected and/or estimated, along with the ratio of estimated deer crossings and roadkill are shown in Table 2 (*4*).

TABLE 2 Deer Crossings Per Roadkill Results (*4*)

	Data Collection Year					
	1972		1973		Total	
	Sign Turned Away	Sign Activated	Sign Turned Away	Sign Activated	Sign Turned Away	Sign Activated
Data Collection Weeks	2	2	6	5	8	7
Est. Deer Crossings	227	163	1,016	975	1,243	1,138
Total Deer Roadkill	6	3	16	17	22	20
Deer Crossings/Roadkill	37.8	54.3	63.5	57.4	56.5	56.9

The researchers from this study made several conclusions based on the data in Table 2. First, the total ratio of the estimated number of deer crossings per roadkill was not statistically different (i.e., higher) when the sign was activated (*4*). In fact, in 1972 the ratio of deer crossings per roadkill increased with the sign activated, but in 1973 it decreased. Their conclusion was that other, less readily apparent, variables were impacting this ratio (*4*).

A 0.2 to 2.9 mile per hour reduction in average vehicle speed was also calculated for the three data collection locations during the two- and five-week periods the sign were activated in 1972 and 1973, respectively (See Tables 2 and 3). All of the average vehicle speed reductions calculated (See Table 3) were also determined to be statistically significant except the 1973 observation at the 1.5-mile data collection location (*4*). The number of vehicle speeds collected to determine the average speed reductions shown in Table 3 were not documented.

A preliminary analysis of the change in vehicle speeds was also documented after the researchers placed three deer carcasses next to the warning signs (*4*). These carcasses were placed on the roadside each Tuesday (for an undocumented number of weeks) two

TABLE 3 Average Vehicle Speed Reductions (*Adapted from 4*)

Data Collection Distance Downstream of the Sign (Miles)	Average Vehicle Speed Reduction[1]	
	Study Year 1 1972	Study Year 2 1973
0.15	2.9	1.5
0.65	1.4	1.6
1.50	1.2	0.2

[1]Average Vehicle Speed Reduction = the average of the difference in individual vehicle speeds collected inside and outside the study area.

hours after sunset, and remained on the roadside for two hours before they were removed (*4*). The speed data collected when the carcasses were present indicate an average vehicle speed reduction of about seven miles per hour. No significant difference in average vehicle speed reductions (with the deer carcasses present) was found, however, when the animated sign was turned toward or away from the traffic (*4*).

Seasonal Use of Deer Crossing Signs

At least two studies have also been completed that investigated the seasonal use of deer crossing sign installations (*5*, *6*). In both cases the signs used had a different design than the typical deer crossing sign shown in Figure 1. The first study focused on mule deer in Utah and the animal mortality/DVC impacts of using large square yellow and black signs warning of mule deer "Migration Next X Miles" (See Figure 4) (*5*). This sign was installed at the end of roadway segments two and four miles long, and then supplemented with reminder warning signs every mile (See Figure 4). All the sign installations also included flashing amber lights and reflectorized flags (*5*). Overall, the researchers observed reductions in vehicle speed and animal mortality along the segments when the signs were installed during the mule deer migratory season (*5*). It was concluded that these reductions resulted from the installation of the signs and the fact that the drivers were mostly local commuters and understood the time and impacts of the migration (5). In other words, they knew the collision danger during particular time periods of the year, and the signs were a reminder. The addition of non-local drivers (due to a nearby park

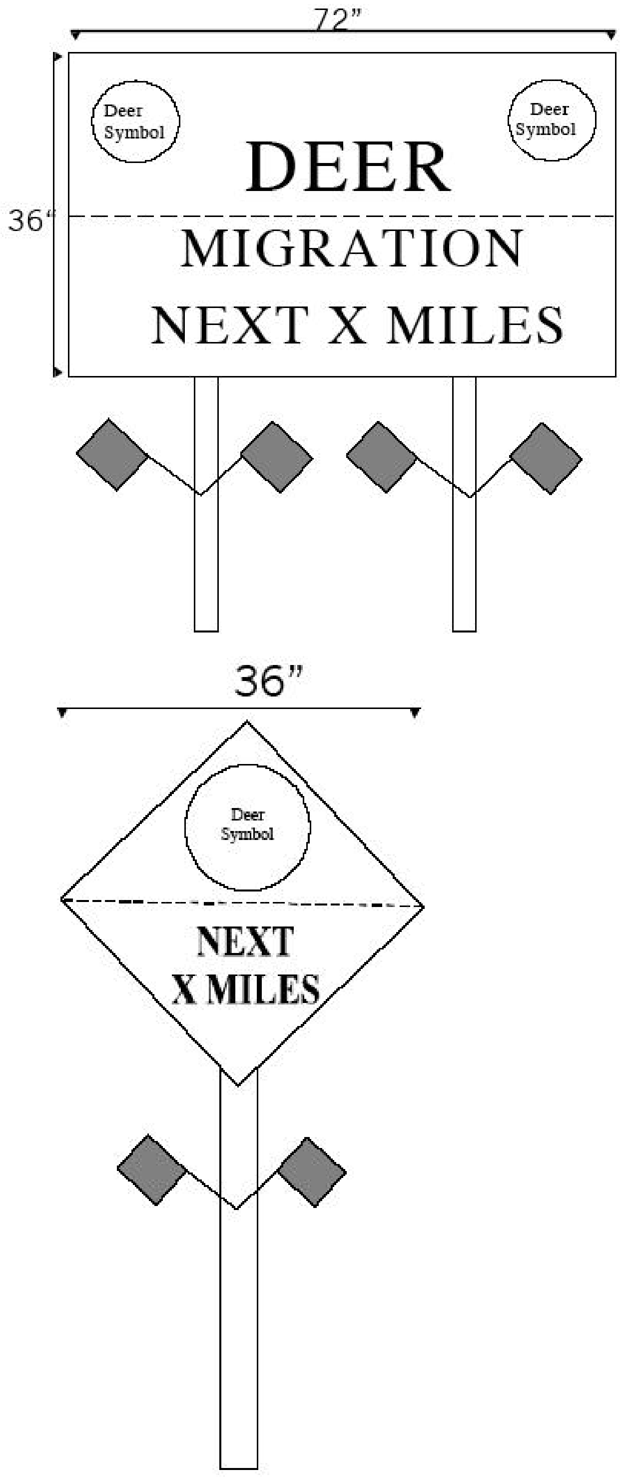

FIGURE 4 Utah primary and secondary temporary deer crossing sign designs (*5*).

opening) may reduce the impact of the signs, and this type of temporary sign use also appears to be most effective with a deer species that has a specific migratory pattern. Recently, a group tried an approach similar to that in Utah, but focused on reducing vehicle collisions with white-tailed deer in Michigan (*6*). Specially designed signs signifying a "High Crash Area" were installed along roadway segments during the fall months of 1998, 1999, and 2000 (See Figure 5) (*6*). In addition, a public education and information campaign that focused on DVCs was in operation at the same time (*6*). The signs were installed along seven roadway segments that did not previously have regular deer crossing signs.

FIGURE 5 Michigan temporary deer crossing sign design (*6*).

The researchers in Michigan collected and compared DVC and vehicle speed data to evaluate the impact of the seven specially signed roadway segments (*6*). A comparison of two years of DVC data, however, showed no reduction in this type of crash after the signs were installed within either the entire township or along the roadway segments with the new signs (*6*). Vehicle speeds before and after sign installation on two roadway segments also showed no significant difference in one case, and a statistically significant, but less than a 0.5 mile per hour reduction, along the other (*6*). The differences in the studies from Utah and Michigan include the design of the signs, species of deer, and the necessary assessment of risk (with subsequent behavioral changes) by drivers based on the predictability of the species movement.

Dynamic Deer Crossing Sign and Sensor Systems – Brief Overview

The research described previously investigated the impacts of enhanced deer crossing sign designs. If used, these enhanced signs are either constantly active or must be turned away from traffic. More recently, a number of dynamic sign and sensor systems have been proposed and/or installed. These systems typically alert the driver, through flashing lights for example, when an animal has been detected near the roadway. An example of some of the equipment used by one dynamic sign and sensor system is shown in Figures 6 and 7.

Several dynamic deer and elk crossing sign and sensor systems have been documented, and are briefly discussed below (*7*, *8*, *9*, *10*, *11*). The operation and/or effectiveness of at least some of these systems are currently being studied.

- In Minnesota, a dynamic sign and system has been installed at one location, and is planned for two other sites (*8*). The choice of locations was based on deer population and DVC data. The system uses an infrared light beam on both sides of the roadway to detect animal movement, and when these sensors are activated a battery-powered transmitter turns on amber warning lights on top of a series of traditional deer crossing signs (*8*).

- In Montana, the Western Transportation Institute has also installed and is testing a dynamic sign and sensor system that operates with radar beam sensor equipment connected to amber lights on traditional elk crossing and "When Flashing" sign installations (*9*). This is the system shown in Figures 6 and 7.

FIGURE 6 Dynamic elk sign and sensor system example (*Photo courtesy of the Western Transportation Institute*).

FIGURE 7 Solar powered animal sensors (*Photo courtesy of the Western Transportation Institute*).

- In Washington, a system has been installed along United States Highway 395 that utilizes laser beam sensors on each side of the roadway (*10*). When the laser beam is interrupted by an animal, a solar-powered red strobe light on top of a traditional deer crossing sign (with a "When Flashing" supplementary sign) is activated (*10*).

In the same state, along a segment of United States Highway 101, another approach to dynamic signing and sensing is also being studied (*11*). Radio collars have been attached to eight elk (within a herd of about 80 near the roadway). When any of the collars are within a quarter mile of the roadway a series of flashing lights are activated on elk crossing signs (*11*).

- In Finland, a dynamic elk warning sign and sensor system has also been installed (*10*). This approximately 800-foot project uses microwave radar sensor equipment, 16 passive infrared detectors, and a rain detector to reduce the number of false detections. Animal detections activate lighted fiber optic signs (*10*). The speed of the vehicles in the study area is also being measured.

- In Wyoming, the Flashing Light Animal Sensing Host (FLASH) system was installed along United States (U.S.) Highway 30 between Kemmerer and Cokeville (*7*). The reliability and the effectiveness of this system has been studied and documented. The details of this system, along with the results of this study, are described in the following section.

The Nugget Canyon, Wyoming Dynamic Sign and Sensor Study

The Flashing Light Animal Sensing Host (FLASH) system was installed in Nugget Canyon, Wyoming along U.S. Highway 30 (*7*). This segment of roadway crosses a mule deer migration route, and in 1989 a seven-mile eight-foot fence was erected along both sides of the roadway. A 300-foot gap, however, was left in the fence for the mule deer migration (*7*). The FLASH system was installed and tested within this 300-foot gap from December 2000 to May 2001 (*7*).

The Nugget Canyon dynamic sign and sensor system consists of a group of roadside detector sensors connected to amber flashing lights mounted on deer crossing signs (*7*). These signs are located approximately 985 feet from each end of the study area (i.e., the fence gap), and have the legend "Deer on Road when Lights are Flashing" (*7*). A total of three sensor systems have been installed to detect deer activity within the study area (*7*). These systems include a series of active (i.e., break-the-beam) infrared sensors on both sides of the roadway that, when combined with the roadside signs and flashing lights described above, represent the FLASH system (*7*). The other two deer activity sensing systems in the study area include a combination of the infrared scopes on both sides of the roadway and in-ground geophone installed on one side of the roadway (these sensors detect ground vibrations from nearby deer), and a set of microwave sensors (*7*). Infrared and low-light video cameras were also installed in December 2000, and could be used to observe almost the entire study area (*7*).

The evaluation of the FLASH system in Nugget Canyon consisted of three parts. First, the activation reliability and/or accuracy of the active infrared and the infrared scope/Geophone sensor designs were compared to the results of a video camera. Then, vehicle speeds and classifications were collected both inside and outside the study area (with loop detectors) during normal FLASH system operations (*7*). Speed measurement devices were located outside the study area (i.e., before drivers could observe the new warning sign configuration), and between the signs. Finally, the vehicle speed impacts of five different sign, flashing light, and/or deer presence situations were tested during the study time period (December 2000 to May 2001) (*7*).

The sensor accuracy test revealed a number of complications with the application of these types of systems. For example, in 30 hours of observation the FLASH infrared sensors operated correctly, but by the second month of testing the system was beginning to experience a large number of false activations. Overall, during the study time period, more than 50 percent of activations were determined to be false (*7*). These false activations, among other things, appeared to be caused by birds and snow from snowplows breaking the infrared sensor beams (*7*).

The combination of the geophone and infrared scopes appeared to be very reliable (*7*). During 30 hours of observation this system always registered an activation when a deer was present, and never registered an activation when there was no deer present (*7*). A comparison to the video camera results indicates that this level of reliability continued throughout the study time period (*7*). The system tended to overestimate the number of actual deer crossings (because it registered deer as they moved back and forth across the sensors), but it did so in a reliable and somewhat predictable manner (*7*). The researchers concluded that some form of the geophone/infrared scope sensing system had the most potential for future installations (*7*).

The second and third parts of the Nugget Canyon study evaluated the vehicle speed reduction impacts of eight different situations. The first five situations described in the following list were observed during four different two-hour time periods to evaluate the impacts of different sign, flashing light, and deer presence configurations (*7*). The final three situations represent the three combinations found to occur during the normal operation of the FLASH system (*7*). Speed data from two days that were randomly chosen from each month of the study time period were used in this analysis. All eight situations are briefly described in the following list:

1. A baseline or "expected" average vehicle speed reduction was calculated from data collected when the flashing lights on "Attention: Migratory Deer Crossing" signs were continually active.

2. The sign legend was changed to "Deer on Road When Lights are Flashing", but the flashing lights remained continually active. This allowed the quantification of the average vehicle speed reduction that might be due to the sign message change and continually flashing lights without a deer present.

3. A realistic taxidermist deer mount was added to the roadway environment. Everything stayed the same as the second situation, but a deer mount was added about 10 feet from the traveled way. This setup allowed an approximation of the average

vehicle speed reduction impacts of the system with continually flashing lights and a "deer" in the right-of-way.

4. The third situation was repeated, but the flashing lights were deactivated. The speed reduction data collected during this situation could be used to evaluate the impact of the flashing lights.

5. The second situation was repeated, but the flashing lights were remotely activated when the driver could observe that the system was active. This situation was evaluated to measure the vehicle speed impacts if the drivers knew the system was active.

6. The FLASH system was fully operational, and vehicle speeds were summarized and compared for those situations when the flashing lights were activated and an actual deer was present.

7. The FLASH system was fully operational, and vehicle speeds were summarized and compared for those situations when the flashing lights were not active and no actual deer was present.

8. The FLASH system was fully operational, and vehicle speeds were summarized and compared for those situations when the flashing lights were activated, but no actual deer was present (this situation represents a false activation).

The average vehicle speed reductions calculated for the eight situations described are shown in Table 4 (*7*). These results show that when the system worked as it was designed, and the lights were activated with actual deer present (Situation 6 in Table 4), drivers slowed their vehicles by a statistically significant average of 3.6 miles per hour (*7*). The data also show that the average speed reduction calculated for the situation when the lights were not flashing and no deer were present (Situation 7 in Table 4) was less then one mile per hour, but this reduction was also determined to be significant by

TABLE 4 Nugget Canyon Average Vehicle Speed Reductions (*7*)

Situation	Flashing Light Operation	Sign Legend	Actual or Decoy Deer Present?	Average Speed Reduction (miles per hour)[1]	Sample Size[2]
1	Continuous	"Attention: Migratory Deer Crossing"	No	1.2	NA
2	Continuous	"Deer on Road When Lights are Flashing"	No	2.3	NA
3	Continuous	"Deer on Road When Lights are Flashing"	Decoy Deer Present	12.3	NA
4	Deactivated	"Deer on Road When Lights are Flashing"	Decoy Deer Present	8.0	NA
5	Remotely Activated	"Deer on Road When Lights are Flashing"	No	4.7	NA
6	FLASH Sensor Activated	"Deer on Road When Lights are Flashing"	Actual Deer Present	3.6	655
7	Not Activated	"Deer on Road When Lights are Flashing"	No	0.7	8,153
8	FLASH Sensor Activated	"Deer on Road When Lights are Flashing"	No	1.4	1,965

[1]Average speed reduction is the average of the differences in measured vehicle speeds inside and outside of the study area. Average speed reduction for Situations 1 to 5 is for passenger cars only. The average speed reduction for Situations 6 to 8 is for all vehicles.
[2]NA = not available or documented.

the researchers (*7*). Finally, the average vehicle speed reduction produced by the activation of the lights when no deer were present (i.e., a false activation or Situation 8 in Table 4) was only 1.4 miles per hour (*7*). This reduction was also determined to be significantly different than zero, and was 2.2 miles per hour less than when the lights were activated with a deer present (*7*). This 2.2 mile per hour difference could be an approximate measure of the average speed reduction due to the presence of a deer. It is much smaller, however, than the 8.0 miles per hour speed reduction data shown in Table 4 for a deactivated sign and sensor system with a deer decoy (Situation 4 in Table 4) (*7*). A comparison of the speed reduction results for the remote-control activation of the flashing lights (Situation 5 in Table 4) to those for the fully operational system (Situation 6 in Table 4) also show that the remotely activated system might be used quickly to approximate the impact of one that is fully installed and operating. The FLASH system researchers considered it unlikely that the largest vehicle speed reduction observed during the normal operation of the FLASH system (i.e., 3.6 miles per hour) would produce a reduction in DVCs.

When the sign legend and/or the flashing light characteristics were changed manually, or a roadside deer decoy was added to the study area, the data indicated that average vehicle speeds decreased much more dramatically when deer decoys were present on the roadside (*7*). In fact, the data show that the combination of the continually flashing lights and the deer decoy (Situation 3 in Table 4) produced a speed reduction of about 12 miles per hour (*7*). In addition, when the deer decoy was presented without the flashing lights (Situation 4 in Table 4), an average speed reduction of 8.0 miles per hour was calculated (*7*). These results would appear to indicate that the presence of the flashing lights may produce about a four mile per hour passenger car speed reduction impact (*7*). Finally, the change in the sign legend also appeared to approximately double (i.e., 1.2 to 2.3 miles per hour) the average vehicle speed reduction calculated, and the possible reasons for the difference in the data for the flashing lights being continuously operated (Situation 2 in Table 4) and when they were remotely activated (Situation 5 in Table 4) were not explained. All five average speed reductions are significantly different than zero, but the researchers concluded that these reductions in vehicle speed would most likely not reduce the probability of a DVC (*7*).

Conclusions

In the first two studies summarized in this document Pojar, et al. concluded that the lighted sign design improvements they proposed (See Figures 2 and 3) and evaluated did significantly reduce average vehicle speeds. However, the outcome of a more in-depth study of the animated design (See Figure 3) did not appear to indicate that its resultant vehicle speed reduction had actually resulted in a reduction of the number of deer roadkill (i.e., DVCs) in the study area (See Table 2). However, the variability in DVCs and the factors that impact their occurrence limits the validity and transferability of the study results presented here because they are based only on 15 weeks of data.

The seasonal use of specially designed deer crossing signs was also considered in two states (See Figures 4 and 5). Researchers in Utah installed signs during the mule deer migratory season, and observed reductions in vehicle speed and DVCs. However, researchers in Michigan investigated the impact of a different deer crossing sign design that was installed during the fall months (a "high" DVC and white-tailed deer movement time period), and generally found no significant reduction in DVCs or vehicle speed. The differences in these two studies include sign design, animal species, and apparently the general ability of drivers to appropriately assess the risk of a collision at a particular time and location. In Utah the familiarity of the drivers with the distinct migratory seasons and locations of the mule deer were believed to have had an impact on the sign effectiveness. It is proposed that more consistent and incremental studies may be needed to support or refute the speed- and DVC-reduction impacts of properly installed (i.e., at "high" DVC locations) deer crossing signs for both the existing and any proposed designs. An incremental approach (e.g., first add an additional text message, then reflectorized flags, and then amber flashing lights) may be necessary to determine what changes to deer crossing signs are the most effective. The appropriate use of temporary signs is clearly less expensive then some of other potential DVC countermeasures discussed in this toolbox.

A number of dynamic sign and sensor systems are being considered or have been installed throughout the world. Several of these systems were briefly described in this summary. The recent development of these systems requires an initial evaluation and improvement of their activation reliability. One key to the successful analysis and application of these systems is the minimization of false activations. The number of false activations should be noted in the analysis of these systems and not included in the data used to calculated average speed reductions. The presence of false activations could also cause drivers to lose confidence in the validity of the system and its intended purpose (eventually resulting in no speed reduction even when deer are actually present). The operation and effectiveness of some of the systems described in this summary are currently being studied, but only one analysis appears to have been documented at this time (*7*).

The Nugget Canyon FLASH system in Wyoming has been studied and documented (*7*). In this case, the effectiveness of the system was evaluated by comparing the average vehicle speed reduction calculated for eight different situations (See Table 4) (*7*). The researchers doing the evaluation concluded that when the system worked properly it produced a small, but statistically significant, reduction in average vehicle speeds. However, they did not believe the average speed reduction found would reduce DVCs (*7*). Reductions in average vehicle speeds were also found when the lights were continuously flashed and/or a deer decoy was introduced on the roadside. In fact, the largest average vehicle speed reduction calculated (See Table 4) was when the lights were flashing and the deer decoy was present (*7*).

A complete analysis of the benefits and costs of these systems should be considered before installation. Overall, additional evidence is also needed to evaluate whether the costs (e.g., time and money) for an improved sign design or dynamic sign and sensor system is worth the reduction in average vehicle speed that may occur. Additional research and the results from ongoing studies should help in this evaluation. The DVC reduction potential of posted speed limit reductions (which can be related to operating speed) are discussed in another section of this document.

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