SPEED LIMIT REDUCTION

A reduction in the operating speed of a vehicle can provide a driver with additional time and distance to react to observed conflicts. The benefits provided by additional reaction time/distance (due to vehicle speed reductions) are relatively clear for a driver approaching a stationary object in the roadway. There is more time and distance to see the object and stop or adjust the speed of the vehicle. Additional time to observe and judge the speed of a conflicting object traveling at a relatively uniform speed (e.g., other vehicles) is also beneficial. The advantages produced by a general decrease in posted speed limits on the number of deer-vehicle crashes (DVCs), and/or the ability of a driver to avoid a less predictable moving object (e.g., a deer), however, are much less clear.

A number of jurisdictions and projects have implemented, considered, and/or proposed reductions in posted speed limits as a potential DVC reduction method. The following paragraphs include a summary of the documented results from two studies that focused on the apparent relationship between lower posted speed limits and collisions between vehicles and animals.

Literature Summary

Several project and research reports have suggested a reduction of posted speed limits as a mitigation measure for animal-vehicle crashes (*1, 2, 3, 4, 5, 6*). In many cases, however, a reduction in the posted speed limit was suggested or proposed as one of several measures. Then, if a crash reduction was observed, the general conclusion was that the reduced speed limit had contributed in some manner. The implementation of multiple reduction measures, however, typically did not allow the direct impact of a speed limit reduction to be quantified.

Few research projects have specifically considered an evaluation of how much (if any) vehicle-animal crash reduction might result from a lower speed limit. Only two studies were found that attempted to investigate the direct impact of reduced posted speed limits on animal-vehicle collisions (*7, 8*). These two studies primarily focused on the correlation between posted speed limits and the collisions between vehicles and bighorn

sheep and/or elk (*7, 8*). No studies were found that focused on the impact of the reduction in posted speed limits on the number of crashes between vehicles and white-tailed deer.

Yellowstone National Park Study

In 1997, researchers in Yellowstone National Park (YNP) studied a number of factors that they believed had an impact on the number of vehicle-wildlife collisions (*7*). Two of the factors studied were posted speed limit and average operating vehicle speed (*7*). At that time, YNP had approximately 268 miles of paved roadway with six posted speed limits (*7*). The length of roadway with each posted speed limit included:

- 1.1 miles at 15 mph,
- 18.6 miles at 25 mph,
- 24.9 miles at 35 mph,
- 24.5 miles at 40 mph,
- 178.3 miles at 45 mph, and
- 20.2 miles posted at 55 mph.

From July to October 1997 the operating speeds along the 15 primary paved roadway segments in YNP were collected. These speeds were collected with a radar gun at different times of the day, and by timing vehicles over a known distance (*7*). The timing methodology for the collection of vehicle speeds was primarily used along straight segments of roadway. About 450 of the more than 1,400 vehicle speeds collected were calculated from the results of the timing method (*7*).

Each large mammal roadkill location was also collected along the roadways in YNP, and then categorized by the posted speed limit of the segment. From 1989 to 1996 there were 939 large mammal roadkill locations identified (*7*). The roadkills observed included 14 species of animals. About 40 percent of the roadkill was elk and 30 percent were mule deer (*7*). The number of bison, moose, and coyote killed on the roadway during this time period each represented about 7 to 8 percent of the total (summing to around 23 percent) for the eight years considered (*7*). The other species that were killed by vehicles all

individually represented less than 2 percent of the total killed between 1989 and 1996 (*7*). This group of animal species included white-tailed deer. About 85 percent of the vehicle-animal crashes were split about equally between the roadway segments with 45 mph and 55 mph posted speed limits (See Table 1) (*7*). The researchers also collected information about vegetation cover adjacent to the roadway and the large mammal populations within YNP.

Table 1. Proportion of Total Roadkill and Roadway Mileage (1989-1996) (*7*)

Speed Limit (mph)	Miles of Roadway	Percent of Total Roadway Mileage	Number of Roadkills	Percent of Total Roadkills
15	1.1	0.4	3	0.3
25	18.6	7.0	42	4.5
35	24.9	9.3	59	6.3
40	24.5	9.2	35	3.7
45	178.3	66.6	418	44.5
55	20.2	7.5	382	40.7
Total	267.2	100.0	939	100.0

Overall, the YNP researchers concluded that vehicle speed was significantly related to collisions between vehicles and wildlife (*7*). This conclusion was based on a statistical comparison of the proportion of vehicle-animal collisions that occurred along roadway segments with specific posted speed limits, and the proportion of roadway mileage represented by this speed limit within YNP (See both in Table 1).

The researchers analysis of these proportions indicated that there were statistically more than the expected number of vehicle-animal collisions within the roadway segments posted with a 55 mph speed limit, and a statistically less than expected number within those segments at 45 mph or less (*7*). These conclusions were statistically significant at a 90 percent level of confidence. Overall, about 41 percent of the roadkill recorded did occur along the roadway segments with a 55 mph posted speed limit, but these segments only represented about 8 percent of the roadway miles in YNP (See Table 1) (*7*).

The average operating speed measured along the roadway segments with a 55 mph posted speed limit were about 9 to 16 mph higher than that posted (*7*). The operating speed measured along those segments with a 35 and 45 mph posted speed limit, however, were within one to three mph of that posted (*7*). The researchers concluded that the design of the roadway (versus the posted speed) had the largest impact on speed (*7*). This result is generally supported by past transportation research, and is related to driver expectations, topography, and a number of other factors. The vehicle speeds measured for this study, however, also imply a relatively large difference in the designs for the 55 mph roadway segments and those segments with lower posted speed limits within YNP. No speed results were documented for the segments with 15 or 25 mph posted speed limits.

The researchers involved with this project also concluded that pavement condition had a great impact on vehicle speed choice (*7*). They supported this and their roadway design conclusions by measuring the apparent speed impacts of one reconstruction project, and comparing the animal-vehicle crashes before and after two other reconstruction projects.

An increase in the average operating speed of about 5 mph was found when one roadway segment cross section in YNP was improved from 22 to 24 feet wide (with abrupt edges, no shoulders, and very poor pavement) to 30 feet wide with shoulders and new pavement. Assuming this type of increase would occur with all similar roadway improvements, the researchers considered the roadkill numbers along two other segments that were reconstructed. The results of this analysis produced some conflicting results. One roadway segment was repaved and there was an annual average of 7 vehicle-animal collisions in the three years before the project, but 13 collisions on average for each of the four years following (*7*). This change was found to be a statistically significant. The other repaved roadway segment, however, showed no statistically significant change in animal-vehicle crashes (*7*). There was no documentation or speculation about why these two roadways segments (and surrounding ground cover) may have produced these results.

Based on their data collection and analysis the YNP researchers recommended that roadway designs be used that encourage vehicle speeds of 45 mph or lower (e.g., narrow pavement width, tighter curves) (*7*). They believed these designs would reduce operating speeds and ultimately the number of vehicle-animal collisions. They also felt this approach was consistent with the mission and mandate within YNP. In areas where faster speeds were considered necessary the researchers suggested that fencing and underpasses might be an option.

From the other information collected as part of this study the researchers also concluded that antelope, bison, coyote, and elk were killed significantly more than expected (when comparing roadkill proportions to the proportion of adjacent forest and non-forested land) in non-forested land (*7*). Not surprisingly, this is also where the food for these animals also exists. Mule deer, on the other hand, were hit at less than expected levels in non-forested areas and more than expected in forested areas (*7*). Moose were killed along the roadways in the same proportion as the existing forested and non-forested land use (*7*). It was also found that those species with the largest populations were also involved in the most vehicle-animal collisions (*7*).

Jasper National Park Study (Alberta, Canada)

The animal collision reduction impact of reduced speed limits was also studied along the Yellowhead Highway in Jasper National Park – Alberta, Canada (*8*). The highway consists of two 13.3-foot (3.7 meter) lanes and 10.8-foot (3 meter) paved shoulders. In 1991 the posted speed limits were reduced along three sections of this highway from 55 mph (90 kilometers per hour (kph)) to about 42 mph (70 kph). The number of vehicle collisions with bighorn sheep and/or elk was then compared for specific time periods before and after the posted speed limit change (*8*). The three segments selected for this study were chosen because of the number of bighorn sheep, elk, and/or mule deer collisions that had occurred along them, and their traffic and/or pedestrian flow. Overall, however, it was found that the traffic flow along each of the segments was similar, and that the design of the roadway provided good driver visibility (i.e., most of the roadway has passing sight distance available). The three sections of roadway selected

(approximate length of 2.5 miles (4 km), 1.5 miles (2.5 km), and 5.6 miles (9 km)) were posted as "Slow Down for Wildlife" speed zones with wildlife crossing warning signs and a lower posted speed limit (*8*). There are similar signs along the Yellowhead Highway, but the posted speed limit is not normally reduced. The vehicle operating speeds measured along two of these selected speed reduction roadway segments indicated that between 73 percent and 89 percent of the vehicles traveled at 55 mph (90 kph) or less in the posted 42 mph (70 kph) speed limit segment (*8*).

The number of bighorn sheep-vehicle and elk-vehicle collisions that occurred along the three speed reduction roadway segments was collected for 8 years before and after (1983 to 1998) the posted speed limit reduction. In addition, the elk population adjacent to the Yellowhead Highway was estimated from aerial and roadside counts. From 1983 to 1998 the population of the elk increased by approximately 132 percent (*8*). The greatest increase (about 178 percent) appeared to occur adjacent to the 5.6 mile (9 km) "Slow Down for Wildlife" speed zone considered in this study (*8*). This zone experienced an elk presence on a seasonal basis, and was adjacent to an area where a permanent elk herd presence existed. The bighorn sheep population in the park area was believed to be relatively stable or experiencing a small increase (*8*). In general, the researchers indicated that these bighorn sheep were randomly distributed on five rock outcroppings adjacent to the park roadways throughout the day. Three of these rock outcropping were within the two of the roadway segments selected for study.

The Jasper National Park researchers found that the number of bighorn sheep-vehicle collisions increased only slightly (82 before the change and 83 after) in the two speed reduced (42 mph (70 kph)) segments considered for this type of collision (*8*). This small increase occurred despite the fact that vehicular flow increased by 50 percent during the study time period, and the number of bighorn sheep-vehicle collisions decreased by 33 percent (30 before the change to 20 after) along the 55 mph (90 kph) posted speed limit segments adjacent to the "Slow Down for Wildlife" zones (*8*). The study documentation, however, did not indicate the length of the 55 mph (90 kph) roadway segments considered. An analysis of variance calculation by the researchers caused them to

conclude that there appeared to be a relationship between *increases* in bighorn sheep-vehicle collisions and the reduction in posted speed limit (*8*). A more general and non-statistical evaluation of the overall study time period bighorn sheep-vehicle crash data trends, however, indicated (according to the researchers) that the number of bighorn sheep-vehicle collisions in the 42 mph (70 kph) zones appeared to be increasing before the posted speed limit reduction, but generally decreased after the change (*8*). The collision trends in the 55 mph (90 kph) zones appeared to be relatively stable throughout the study time period (*8*).

The Jasper National Park researchers believed that the behavior of the bighorn sheep may have negated the impact of the slower speed limits (*8*). They found that most of the bighorn sheep-vehicle crashes recorded in the area occurred during the day, that the sheep became habituated to the traffic, and that they would remain in the roadway as a small herd even as vehicles tried to move along the roadway. It was speculated that bighorn sheep could be easily seen and avoided in the day, and that the reduction in vehicle speed (and increased congestion) which occurred because of the herds in and adjacent to the roadway, may have resulted in the observed patterns of the bighorn sheep-vehicle collisions in the time period considered.

Data restrictions allowed the evaluation of elk-vehicle collisions within only one of the speed reduction segments selected. Based on the documentation reviewed, it appears that the effectiveness of the speed reduction was measured by a statistical comparison of the number of elk-vehicle collisions that did occur to the number of expected collisions (*8*). The number of expected elk-vehicle collisions was calculated from crash data collected within a 13-mile (21 km) 55-mph (90 kph) segment of roadway surrounding the reduced speed study segment. This 13-mile (21 km) roadway segment, along with the 5.6-mile (9 km) speed reduction segment of interest, experienced about 79 percent (315 of 398) of the vehicle-elk collisions observed between 1983 and 1998. Elk-vehicle collisions per mile (km) increased by 84 percent within the 13-mile (21 km) roadway segment posted at 55 mph (90 kph), but by only 24 percent along the 5.6-mile speed reduction segment posted at 42 mph (70 kph) (*8*). The authors observed that the general trend in elk-vehicle

collisions also appeared to show an increase in the number of crashes along the entire segment before the posted speed limit reduction, but a general decrease in 42 mph (70 kph) segment after the change (*8*). The authors concluded that a statistical association existed between the 42 mph (70 kph) speed reduction zone and a reduction in elk-vehicle crashes along the segment considered (*8*). In other words, decreasing the posted speed limit had a significantly negative effect on the number of elk-vehicle collisions that occurred (*8*).

Conclusions

It has been suggested by the researchers of the two studies summarized in this document that there is a relationship between animal-vehicle collisions and posted speed limits. In some cases, but not all, their research appears to show a less then expected number of animal-vehicle collisions along roadway segments with lower posted speed limits. One study statistically compared the proportion of roadway mileage with a particular posted speed limit to the proportion of animals killed along those segments. The other study compared the frequency of animal-vehicle collisions and animal-vehicle crashes per roadway length before and after a posted speed limit change. No studies were found that focused on the number of white-tailed deer-vehicle crashes and posted speed limit. However, the results of the two studies summarized indicate that the potential impact of speed reductions on animal-vehicle crashes could depend on the species considered. Several other limitations to the results presented in this summary are discussed below.

Overall, like the analysis of many other animal-vehicle crash countermeasures, the two studies summarized in this document don't address a number of factors that could impact the validity and usefulness of their conclusions. For example, neither study quantitatively considered the differences in traffic volume or adjacent animal population along the segments considered. In other words, crash numbers normalized by actual exposure were not compared. The comparison of the proportion of animal-vehicle collisions to the proportion of roadway mileage also assumes a uniform distribution of animal population throughout the segments considered, and ignores any relationships that might exist between roadway design, topography, posted speed limit, operating speed, and animal

habitat. For example, it is possible that more animals exist near straight roadway segments with high posted speed limits because these roadways are built within wide river valleys. Alternatively, roadways with higher speed limits (typically in rural areas with larger animal populations) may also have better design features (wider clear zones, lanes, etc.) that provide the driver better visibility of the roadside and the increase or assist with the possibility of avoiding a crossing animal. Consideration of these types of interrelationships are essential to repeatable and verifiable evaluations of the specific impact of speed limit reductions on the number of animal-vehicle crashes. Effectively determining and defining a relationship (if any) between reduced posted speed limits (or operating speeds) and the number of animal-vehicle collisions along a roadway segment will require additional research studies that attempt to address, control for, and/or quantify the impact and potential interaction of these and other factors.

Finally, there are also some less theoretical issues that must be addressed for the effective application of this type of countermeasure (if it was found to be effective). One of the studies summarized did conclude that the choice of operating speed appeared to be primarily impacted by the roadway and roadside design features. This conclusion is also generally accepted in the transportation profession. In other words, a reduction in posted speed limit that is not considered reasonable by the driving public will generally be ignored. This type of situation has been shown to increase the possibility of a crash between two vehicles along roadways (some drivers will slow and many others will not). Therefore, any consideration or study of the impacts of a speed reduction in posted speed limit must first determine whether the posted speed limit is or will be followed. In addition, it must also be acknowledged that roadway designs which require slower speeds will also have operational, cost, and some other safety impacts that need to be considered before the roadway design is implemented.

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