

CHAPTER 1 INTRODUCTION

Collisions between white-tailed deer and vehicles are a significant safety and increasingly costly concern for Wisconsin, the Upper Midwest region, and throughout most of the United States. The range (i.e., habitat area) of the white-tailed deer includes almost the entire United States (excluding only Alaska, Hawaii, and portions of three other states). Nationally, it has been estimated that more than a million deer-vehicle crashes (DVCs) may occur each year, and that the cost of these DVCs is more than a billion dollars (*I*).

REGIONAL AND STATE PROBLEM

Total Crashes

Table 1 shows the total number and an estimated cost of the DVCs reported in five states within the Upper Midwest. Data from Wisconsin, Minnesota, Michigan, Illinois, and Iowa are shown. These five states are members of the Deer-Vehicle Crash Information Clearinghouse (DVCIC) based at the University of Wisconsin – Madison.

DVCs in the Upper Midwest can represent a significant percentage of the total number of reported crashes. For example, more than 21,500 DVCs were reported in Wisconsin in 2003 (See Table 1) and this represents about 16.5 percent of all the crashes reported in the state. In fact, DVCs were more than 50 percent of all reported crashes in two Wisconsin counties during 2003. The total number of reported DVCs in the Upper Midwest (See Table 1) is believed to represent more than 15 percent of those estimated to occur DVCs nationally (*I*).

In addition, it is also generally accepted that the number of *reported* DVCs under represents the *actual* number of DVCs that occur. Nationally, it has been estimated that only about 50 percent of all DVCs are reported (*I*). In Wisconsin, for example, the number of deer carcasses normally removed from the roadways by contractors of the Department of Natural Resources is typically more than twice the number of DVCs reported to the Department of Transportation each year. This under-reporting can occur for a number of reasons (e.g., minimum reporting criteria, motorists leaving the scene,

TABLE 1 Recent Upper Midwest Deer-Vehicle Crashes

State	Pre-Hunt Numbers in Deer Herd	Deer-Vehicle Crashes*	Deaths	Injuries	Vehicle Damage**
Michigan (Year: 2003)	1,800,000 (Year: 2002)	67,760	11	1,913	\$115.2 mil
Wisconsin (Year: 2003)	1,663,000	21,666	13	792	\$36.8 mil
Minnesota (Year: 2002)	1,140,000 (Year: 2003)	5,550	5	520	\$9.4 mil
Illinois (Year: 2002)	750,000 (Year: 2002)	23,645	2	976	\$40.2 mil
Iowa (Year: 2002)	210,000 (Year: 2000)	6,987	2	523	\$11.9 mil
Total	5,563,000	125,608	33	4,724	\$213.5 mil

*It has been estimated that the total number actual deer-vehicle crashes may be at least twice as large as those reported. In Minnesota it is believed to be three to four times as large as those reported. As expected, the number of unreported deer-vehicle crashes probably varies from state to state due to different reporting procedures, etc., and few states track the number of carcass collections. Minimum property damage crash reporting thresholds can also be different: \$1,000 in IA, MN, and WI; \$500 in IL, and \$400 in MI. The number of reported crashes in Iowa is for animal collisions.

**Vehicle damage cost estimate based on just \$1,700 per reported crash.

and enforcement priorities). Of course, there are also DVCs in which a deer leaves the roadway right-of-way, dies, and the carcass is never found.

Injuries, Fatalities, and Property Damage

DVCs do result in some injuries and rarely have a fatality as an outcome (although in 2003 Wisconsin experienced a double fatality DVC), but almost always produce vehicle damage. In 2003, 13 fatalities and 792 occupant injuries resulted from the 21,666 DVCs reported in Wisconsin. Eight of the 13 fatalities were motorcyclists. The number of fatalities and injuries related to DVCs in Wisconsin during the last 20 years is shown in Figure 1. Total vehicle property damage costs (ignoring medical treatment costs, lost work time, police officer time, environmental and hunting impacts, and several other intangibles) of the DVCs reported in Upper Midwest was roughly estimated at 213.5 million dollars. A value of \$1,700 was used to calculate this estimate, and this is considered relatively conservative. Property damage costs for individual DVCs are often

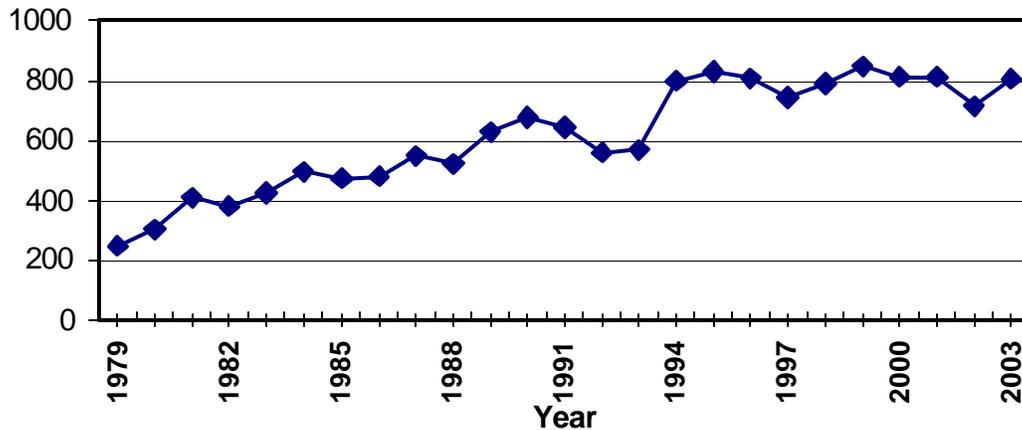


FIGURE 1 Wisconsin deer-vehicle crash fatalities and injuries (2).

much higher. The human, environmental, and economic impacts of DVCs are significant, and they are not expected to decrease as both vehicle-travel and the white-tailed deer population continue to increase.

TOOLBOX PURPOSE AND CONTENT

A number of DVC countermeasures or reduction methods have been proposed or implemented throughout the world. A primary objective of these countermeasures is to reduce the probability or likelihood of a DVC occurring along a roadway by influencing either the behavior of the driver or the animal. A significant amount of money is spent on the implementation of these countermeasures each year.

The purpose of this toolbox is to describe and discuss the current state-of-the knowledge related to 16 potential DVC countermeasures. Its content has several unique characteristics, and unlike previous summaries it is written from the point-of-view of a traffic operations and transportation safety researcher and analyst. It is also the opinion of the author that the level of detail provided is unlike any other general DVC countermeasure review document currently available. In addition, if a more detailed

summary does exist for a specific countermeasure (e.g., repellents and wildlife crossings) their key findings are discussed and the document is appropriately referenced for the reader.

This toolbox provides the detail needed by the reader to clearly understand what level of knowledge exists with respect to the DVC reduction effectiveness of each countermeasure discussed. In possible, some of the key choices and concerns related to the implementation or application of particular countermeasures are also identified. This information should be useful to professionals that must currently make and defend decisions (given the current state-of-the-knowledge) about whether or not to implement one or more DVC countermeasures. The toolbox can also be used to identify the characteristics that should be the focus if and when a countermeasure is applied, and to better understand the complexities of the proper monitoring and evaluation plans needed for those that do implement DVC countermeasures. Finally, researchers can use this toolbox (and other DVCIC documents) to identify the gaps in the current state-of-the-knowledge that need to be addressed in order to effectively implement a countermeasure and properly understand its expected DVC reduction impacts.

This toolbox contains three levels of discussion. The executive summary contains a general description of what was found in the literature for a particular countermeasure. Chapter 2, on the other hand, includes a detailed description and review of the research that has focused on the countermeasures. Each of the countermeasure summaries in the chapter is written as a self-contained document with its own conclusions and references. Some of the countermeasures have been studied much more extensively than others. Chapter 3 contains conclusions about the status and value of existing and generally available research documentation about DVC countermeasure effectiveness.

Recommendations are also provided about how and what might be done to extend and expand the current state-of-the-knowledge in this area. The content of all three discussions should be used in combination by the reader to understand the current state-of-the-knowledge for a particular countermeasure, and to determine the transferability,

validity, and general applicability of that knowledge to their particular situation. This toolbox should also be considered a living document, and if possible will be updated as appropriate (See www.deercrash.com).

DVC COUNTERMEASURE LITERATURE CATEGORIES

A significant amount of literature about DVC countermeasures and other DVC-related subjects was reviewed to create this toolbox. However, only a small amount of this documentation would be considered valid and repeatable research that might produce transferable countermeasure effectiveness results. This type of information was summarized in this toolbox if it was generally available for a particular countermeasure. In some cases, however, the level of knowledge, documentation, and literature for a particular countermeasure is much less valid (but may seem to be the current state-of-the-knowledge because it has been repeated numerous times during the last two to three decades).

In general, three types of literature on DVC countermeasures were identified as part of the activities related to the creation of this document. First, a large number of the documents and webpages related to DVC countermeasures are primarily anecdotal in nature when DVC reduction effectiveness is addressed (e.g., multiple oral testimonials). These sources of information typically did not include any formal scientific studies or surveys, experimental design, or data to support their conclusions. Another type of DVC countermeasure report or document that exists includes those that describe an organized study of one or more DVC countermeasures. For these types of studies, the characteristics of the experimental design (e.g., length of study period, statistical approach, and definition of the control and treatment study areas) are key to determining whether the approach has the appropriate rigor for the results to have widespread applicability. For this toolbox, it was found that many DVC countermeasure studies of this type had limitations on their usefulness and/or transferability, and their results needed to be understood in their defined context. It also requires the detailed documentation of the countermeasure study, and this may or may not exist. The study approach may also explain why studies of similar countermeasures produce contradictory

results. As previously mentioned, this toolbox provides enough detail and discussion that the context of the results from many studies can be understood and used properly. The third type of report reviewed for this toolbox consisted of those well-documented (and sometimes peer-reviewed) studies of DVC countermeasure effectiveness. This countermeasure toolbox, to the greatest extent possible, focuses on the content of original documentation that is non-anecdotally based reports.

Many of the published studies of DVC countermeasure effectiveness were either completed several decades ago or relatively recently (in North America in any case). In fact, there are also several major ongoing and planned projects that won't be completed before this toolbox is completed. Interest in the proper investigation of DVC countermeasure effectiveness also appears to be gaining momentum. The results presented in this report also support the significant need for a more scientifically valid and quantitative evaluation of this type. Updates to the toolbox will be done as appropriate.

DVCIC BACKGROUND

In April 2000 a Deer Vehicle Collision Reduction Working Group Conference was held in Milwaukee, Wisconsin. The objective of this meeting was to develop a strategy for the reduction of DVCs and their severity within the Upper Midwest. The creation of a DVCIC was one of the recommendations proposed by the Working Group Conference attendees.

The DVCIC was initiated in July 2001 and is currently funded by the Wisconsin Department of Transportation. This countermeasure toolbox is one of the primary products of the DVCIC. The general focus of the DVCIC is the exchange, evaluation, and/or summary of the current state-of-the-information in the area of white-tailed deer and vehicle crashes (i.e., DVCs) in the Upper Midwest (i.e., Wisconsin, Illinois, Minnesota, Iowa, and Michigan). The stated objectives of the DVCIC include:

- The compilation of current DVC-related knowledge (e.g., a countermeasure toolbox);
- The development and promotion of standard DVC-related research, and DVC data collection and information management approaches;
- The collection, evaluation, and analysis of regional DVC-related data;
- The creation and/or update of a DVC-related data information system (e.g., the DVCIC webpage – <http://www.deercrash.com>);
- The distribution of useful DVC-related information/findings (e.g., a countermeasure toolbox; research reviews, conclusions, and recommendations; DVC-related data collection and estimation procedures, presentations, workshops, seminars, and a regional data summary); and
- A long-term contribution to the decrease in the frequency/severity of DVCs by providing useful information and monitoring.

Each of the five states included in the DVCIC has representation on its Technical Advisory Committee and Board of Directors. In addition, because the DVC issue has both transportation and ecology components, the technical committee includes representatives from the Department of Natural Resources and the Department of Transportation from each state. The webpage for the project is located at www.deercrash.com, and it includes this and other reports, links, and any updates that might be completed for the documents after they are printed.

REFERENCES

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