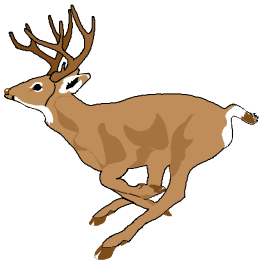
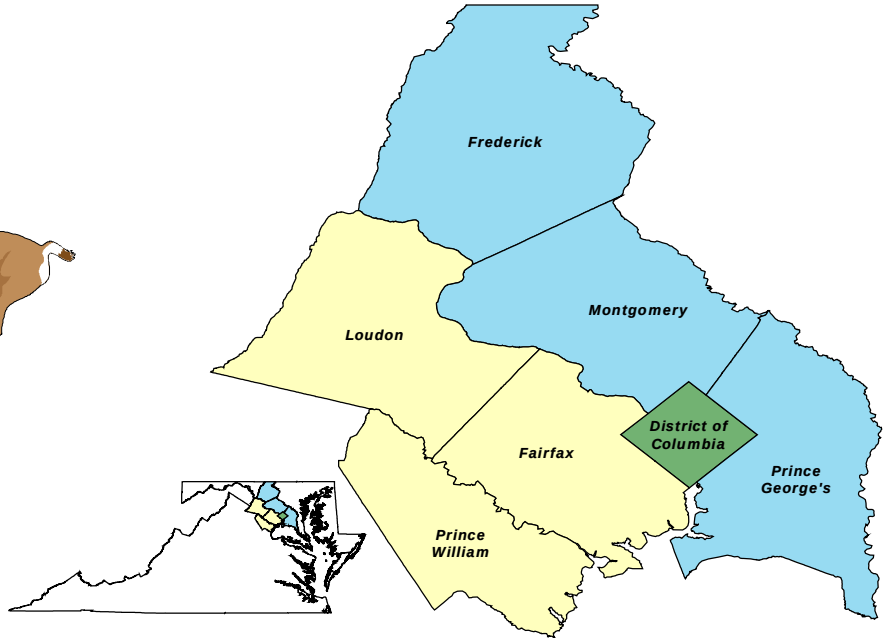
Metropolitan Washington Council of Governments
Deer Vehicle Collision Report

June 2006





EXTRA . . . EXTRA
READ ALL ABOUT IT

"The collision problem is so vexing that the Metropolitan Washington Council of Governments has convened a task force to recommend prevention measures to government officials and sponsor a driver education campaign."

D'Vera Cohn
The Washington Post
November 15, 2004

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Wildlife-Vehicle Collision Reduction Working Group

ACKNOWLEDGEMENTS

We wish to thank the following people for their time, expertise and contributions to the COG Wildlife-Vehicle Collision Reduction Working Group and the white paper that follows. For more information, please contact these Working Group members:

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EXECUTIVE SUMMARY

SECTION I

When the Metropolitan Washington Council of Governments (COG) Human Services and Public Safety Policy Committee (now known as the Public Safety Policy Committee) first approved the formation of an Animal Services Task Force (now known as the Animal Services Committee) in 2000, the elected officials that comprised the Policy Committee set one of the priorities to be wildlife issues in the Washington Metropolitan Region.

One of the first issues identified by the Animal Services Task Force was the public safety matter of wildlife and vehicle accidents. Frequently, we are informed by local traffic personalities of reports on accidents involving an animal (primarily deer) and a vehicle often causing death or injury to the animal, person or both.

Although there continue to be studies on this issue, our research indicates that most studies have been conducted in the rural United States, in Europe, and elsewhere. We felt it was time for our government and non-government partners to look at this issue in a more diverse urban/rural setting like the Washington Metropolitan Region.

On March 6, 2003 the Metropolitan Washington Council of Governments sponsored a *Deer-Vehicle Collision Reduction Regional Stakeholders' Forum* that brought together representatives from federal, state and local governments, the nonprofit animal community and other domains. These included, amongst others, federal and state wildlife management agencies, a local health department, and local police departments. The purpose of this forum was to provide an overview of this issue from a number of different perspectives and form a working group to address the problem as it now exists in the Washington Metropolitan Region.

As a working group it was not our intent to repeat the work that had already been done in other studies, but to use some of those studies as the framework for this report. The purpose of this initiative is to act as a proponent for the development of an immediate public service program to address wildlife-vehicle avoidance issues with recommendations to stakeholders that have a vested interest in the safety of both animals and the driving public throughout the Region. While the primary focus of this initiative is on deer, the overall issue of wildlife-vehicle collisions does take into account all wildlife.

According to a study by the *Center for Disease Control and Prevention (CDC)*, each year an estimated 200 human deaths result from crashes involving animals (i.e., deaths from a direct motor vehicle animal collision or from a crash in which a driver tried to avoid an animal and ran off the roadway). During 2001 and 2002, an estimated 26,647 (9.3 per 100,000 population) persons were treated annually in United States hospital emergency departments for motor vehicle–animal crash-related injuries, of which 22,498 (84.8%) were motor vehicle occupants in crashes involving larger animals.[1]

The members of the working group each asked themselves a few short questions as this report evolved. They were asked to provide perspective from the viewpoint of their organizations on the following questions:

1) What is the problem of wildlife-vehicle collisions?
2) Why is this a problem? and
3) Is this a deer population problem or a human population problem?

According to *The Washington Post*, there were nearly 6,000 dead deer picked up on Maryland and Virginia state roads near Washington in 2003. The story pointed out that some officials think the "carnage" could be double that. In the District's Rock Creek Park, officials found 39 deer killed on their roads in 2003.[2]

The peak season for deer crashes is November during mating season. Craig Watkins, who works for a contractor that removes dead animals from state roads in Fairfax and Prince William counties, comments that on some roads "it looks like a murder scene. I feel so sad sometimes that many are being hit. It's a messed-up situation. There's a lot of deer. I don't know where they come from."[3]

In the CDC study, motor vehicle animal crash data revealed that while the majority of motor vehicle (MV) occupant injuries resulted from encounters between deer and vehicles ". . . 12% of those injured resulted from MV crashes involving large domesticated animals (e.g., horses and cattle). MV occupant injuries can occur because of a direct MV collision with the large animal or from swerving or maneuvering to avoid a collision with the animal. In this study, 63.8% of younger drivers swerved to avoid the animal, resulting in an MV crash and subsequent injury."[4]

While death or injury is the most important public safety aspect of this issue, there is also a large financial facet to be considered. According to the Insurance Institute for Highway Safety, the average car insurance claim is $2,000 which adds up to $1 billion a year.[5]

Moreover, financial consideration must be given to the prevention efforts that are currently in place and for improved data collection. Mitigation efforts have included warning signs, speed restrictions, roadway fencing, and wildlife crossings (underpasses and overpasses designed for wildlife passage), but some studies to assess the cost and effectiveness of prevention measures have delivered inconsistent results. Deer whistles and other devices to reduce the likelihood of a wildlife – vehicle collision have been marketed, but have generally been found to be ineffective.

The measures likely to be the most effective, including fencing and wildlife crossings, are also among the most expensive to build and maintain.

"Local wildlife underpasses include (two at) Fort Belvoir beneath the Fairfax County Parkway, another on Route 355 at Great Seneca Park in Montgomery County and several on Route 97 in Anne Arundel County. But they are costly: The Fairfax underpass cost $1 million to build a decade ago."[6]

While the methods needed to prevent wildlife and vehicle collisions are varied, and sometimes controversial, the need to educate drivers is accepted as an ongoing priority by all. The same behaviors that are recommended to help prevent crashes in general are relevant to the education of drivers to avoid motor vehicle crashes with animals. "Driving within speed limits, staying alert and reducing distracted and drowsy driving, and eliminating alcohol-impaired driving will give drivers, particularly teenagers and younger adults, more time to react and avoid collisions."[7]

"That's what it comes down to – a willingness on the part of drivers to slow down, particularly on two-lane roads in relatively natural habitats," said Susan Hagood, a wildlife issues specialist with the Humane Society of the United States.[8]

In the Fairfax County Case Study presented in this report, the incidence of deer-vehicle collisions may have been much greater than alcohol related accidents in recent years.

This report will not provide all the answers necessary to resolve a complex public safety issue, but it is our hope that it will provide oversight and some guidance for elected officials in the COG region to actively address the steps necessary to educate their constituents and commit to working on real solutions to reduce animal-vehicle collisions.

FOOTNOTES (SECTION I)

[1] MMWR Weekly, Nonfatal Motor-Vehicle Animal Crash – Related Injuries – United States, 2001–2002, August 5, 2004.

[2] Cohn, D'Vera, The Washington Post, "A Deadly Season for Restless Deer", Page B01, November 15, 2004.

[3] Ibid.

[4] MMWR Weekly, Nonfatal Motor-Vehicle Animal Crash – Related Injuries – United States, 2001– 2002, August 5, 2004.

[5] Hedlund, J.H., Curtis, P.D., Curtis, G., Williams, A.F. *Methods To Reduce Traffic Crashes Involving Deer: What Works And What Does Not*. Insurance Institute for Highway Safety, Arlington, Virginia, 2003.

[6] Cohn, D'Vera, The Washington Post, "A Deadly Season for Restless Deer", Page B01, November 15, 2004.

[7] MMWR Weekly, Nonfatal Motor-Vehicle Animal Crash – Related Injuries – United States, 2001– 2002, August 5, 2004.

[8] Cohn, D'Vera, The Washington Post, "A Deadly Season for Restless Deer", Page B01, November 15, 2004.

WORKING GROUP RECOMMENDATIONS
SECTION II

IMMEDIATE ACTIONS:

Public Education and Awareness

- Create a seasonal awareness program centered on strong local public messages to include public service announcements on radio and local media coverage. Timing should coincide with peak deer activity that occurs during the months of May, June and October through December.

- Develop and implement a comprehensive deer collision driver education package. Driver Education should include the region's deer collision video. This information should be distributed to area driving schools, Motor Vehicle Administrations, High Schools, Community Access Television networks, and other community activity centers where public education is provided.

Data Collection Efforts

- The Working Group will create a standard for collecting and analyzing deer collision information that is to be implemented throughout the region. Protocol will address collection methods, database management, analysis, and reporting. Deer collision data is necessary to determine trends and to identify "hotspots" where mitigation may be implemented. State and local transportation agencies, law enforcement agencies, wildlife management agencies, and other agencies responsible for deer collisions need to be included in such efforts.

MITIGATION:

Existing Infrastructure

- Where deer vehicle strikes are consistent, existing infrastructure should be investigated to determine potential contributing causes. Whenever possible, the contributing factors should be mitigated. These may include, but are not limited to, fence repairs, habitat modification, installation of underpass/overpass structure, etc.

PLANNING:

Planned Infrastructure

- Agencies should consider potential wildlife/deer hazards when planning and implementing new roads and road construction projects, and involve natural resource personnel in such planning efforts. When possible, new road construction should be planned to avoid wildlife travel corridors. Consideration should be given for the impact that landscape changes will have, including on

adjacent roadways. Mitigation should be planned. These may include, but are not limited to, underpass/overpass structure, fencing, habitat modification, etc.

- Commercial and residential development should be planned to minimize disturbance to and loss of existing deer habitat and travel corridors. Wildlife should be considered during the planning and review stages of community development.

- Government agencies must consider the potential for parkland, greenways, and other refugia to facilitate deer movements and deer population growth. Deer management strategies should be considered during the planning and design of green spaces.

Deer Population Management

- Agencies should quantify deer densities on parkland and open space, with particular attention to properties adjacent to roadways with a documented/perceived high occurrence of deer vehicle collisions.

- Agencies should consider deer population management in areas with particularly high occurrences of deer-vehicle collisions.

RESEARCH:

- The Working Group should create and maintain a clearinghouse of available research and information pertaining to deer collisions and deer collision mitigation methods. This clearinghouse should be available to regional agencies seeking information pertaining to deer collisions.

- Regional agencies actively mitigating deer collisions should develop and implement measures to quantify and qualify effectiveness of methods used. This information should be made available to the taskforce for review and inclusion in the regional deer collision clearinghouse and future reports.

- Regional governments and agencies should encourage and support controlled research at the University level to quantify and qualify effectiveness of mitigation methods.

REGIONAL CASE STUDIES
SECTION III

Local, state, and federal governments represented by the Metropolitan Washington Council of Governments face many of the same challenges in assessing and addressing animal-vehicle collisions. Problems and countermeasures noted by Hedlund *et al*. (2003) and Knapp (2004) are representative of those found in the COG region. This Section describes trends in animal-vehicle collisions, data limitations, research, and methods used to address the collision problem in selected member jurisdictions.

Common themes throughout all jurisdictions include increasing trends in deer-vehicle collisions, inadequate and inconsistent data collection and reporting, and the use of a variety of abatement techniques. Research into the effectiveness of wildlife underpasses to reduce animal-vehicle collisions is ongoing in several locations within the COG region. Roadside reflectors have yielded inconclusive results across a number of sites. Deer vehicle collisions have declined significantly in several Virginia and Maryland localities following the initiation of deer population control programs. Education efforts among member jurisdictions vary considerably.

The following is a summary of six case studies prepared by government staff from Virginia, Maryland, the National Park Service National Capital Region, the District of Columbia, Montgomery County, MD and Fairfax County, VA. The complete reports are included in Appendix Section 2. For more information, please contact the Working Group members previously acknowledged (Pages 4-7).

TRENDS IN DEER VEHICLE COLLISIONS IN THE REGION

Reported deer-vehicle collisions (DVCs) have increased steadily in the past two decades throughout the Greater Washington metropolitan area. Virginia's statewide records show a 10-fold increase during the last 40 years with a 300 percent increase since 1984. Statewide in Maryland, the number increased by more than 150 percent from 1,505 in 1990 to 3,849 in 2003. In Montgomery County, MD accidents have more than doubled since 1993 from less than 900 to about 2,000 in 2004. In the city of Washington, reported DVCs in Rock Creek Park increased over 200 percent between 1994 and 2004. DVCs in several areas peaked around the year 2000. While these numbers have leveled off and even declined slightly in some jurisdictions, overall the numbers remain at or near record high levels. In all jurisdictions, the number of accidents reported is considered to be far fewer than the number that actually occur.

Increases in DVCs are attributed to growing deer and human populations. Deer populations have increased from being extremely rare in suburban areas in the 1970's to populations of over 200 deer per square mile in some suburban parks in the mid-1990s. Human population growth has resulted in fragmentation of habitat, forcing deer to cross roads more often, as well as large increases in the number of vehicles on the roads and in the miles driven annually on those roads.

DVCs result in considerable property damage to vehicles that average $2,000 to $2500 per accident, personal injuries, occasional deaths, and many dead and injured deer.

PROBLEMS IN REPORTING AND RECORDING DEER VEHICLE COLLISIONS

There is no standardized method of collecting data on DVCs in the region. Some jurisdictions depend on police reports, while others use data from the removal of road-killed animals to estimate the number of accidents that occur. Many agencies keep no records at all. Although accidents that involve personal injuries or deaths are likely to be documented, the thousands of accidents that result only in vehicle damage are unlikely to be reported. Most insurance companies do not keep detailed records on accidents that involve wildlife and do not differentiate between accidents that involve deer, other animals or objects. Without a systematic and standardized method of collecting DVC data, it is difficult to assess "hotspot areas and implement effective mitigation measures.

Varying methods of collecting DVC data leads to confusion over what these numbers actually represent and makes comparing data between regions next to impossible. For example, utilizing police reports may only capture data from accidents that result in a police response. However, if a damaged vehicle is drivable and there are no serious injuries, there is often no reason to call the police and these accidents – possibly the majority that occur – go uncounted. Some jurisdictions that use data collected on road-killed deer actually count the animals picked up by staff or contractors. Others use calls received to report dead animals on the roadside, which can result in duplicate entries when more than one motorist calls in the same animal. Combining data from police reports and road-kills would likely result in double-counts of some accidents, while others that did not result in either a police report or a deer pick-up would go uncounted. The issue is further complicated if different agencies collect data on state and county roads within the same geographic area, and each uses a different method of recording data.

A number of jurisdictions are beginning to create dialogue and seek ways to improve and standardize data collection. This will take a willingness and effort on the part of some jurisdictions to work towards new data collection protocols, but it is an important step in attempting to reduce DVCs within the region.

METHODS USED TO REDUCE DEER VEHICLE COLLISIONS

Local jurisdictions are using a variety of methods to attempt to reduce DVCs. Most fall into the categories listed below.

General Education

Many jurisdictions utilize public service announcements and press releases to increase public awareness and warn motorists about the potential for DVCs. These announcements are generally issued in the fall, just prior to the deer breeding season when the highest number of DVCs occur, and again in the spring when another spike of DVCs often occurs when yearling deer are pushed out of their mother's territories just before fawns are born. Virginia Department of Game and Inland Fisheries developed an award winning 15 second public service video in 2002 entitled "Deer Crossings" and provided it to every television market in the State via their website. Montgomery County, MD developed several PowerPoint style information slides,

which are shown periodically on the County's cable TV network during morning and evening traffic information programming.

Several jurisdictions have incorporated educational information on DVCs into other public service efforts, including programs on deer at local Nature Centers, workshops designed to help homeowners prevent deer damage to home landscapes, and a variety of websites devoted to providing education on deer and deer impacts.

Signs

Most jurisdictions use passive deer crossing signs, the familiar diamond shaped yellow sign with the running deer image. The locations for signs are often determined by local police, county and state road agencies, and generally based on deer carcass locations. It is generally accepted that the effectiveness of these signs diminishes over time. Drivers tend to become accustomed to them and they do not necessarily alter driver's behavior, especially when signs are passed regularly and no deer are seen. Some experimental passive signs have been installed that use more graphic images and wording such as, "Deer Area, Frequent Accidents Next X Miles." The effectiveness of these signs has not been rigorously tested, but preliminary review of data suggests that they are of no greater value than the regular deer crossing signs.

Some experimental work is being done to develop and test active deer crossing signs. Several designs are being investigated, most of which use infrared technology to detect deer and activate flashing warning lights for drivers.

Underpasses and Road Design

Some jurisdictions have installed underpasses designed as wildlife passages. These include large box culverts or bridges that were extended to allow adequate space for wildlife passage on either side of a stream. Site-monitoring of some of these structures has shown significant use by deer and other wildlife.

Fairfax County, Virginia and Montgomery County, Maryland are making concerted efforts to review new and retrofit road construction project designs to adjust the sizing of planned underpasses to better accommodate deer and other wildlife and to add fencing or other barriers where possible to funnel deer to underpass locations.

Reflectors

Wildlife reflectors are mounted on posts along the roadside to reflect lights of approaching vehicles to startle deer and prevent them from entering the roadway until the car has passed. These reflectors have been tested in many locations throughout the COG area (refer to Appendix Section 2 for more information on test sites in various jurisdictions). Most test results are inconclusive as to the effectiveness of the warning devices. Some locations have shown a drop in DVCs while others show an increase or no change. In some locations an initial drop was followed by a steady increase to levels above those before the installation. Determining

effectiveness is further complicated by the fact that DVCs are often spread over large areas and can fluctuate greatly from year to year depending on a wide variety of factors. One study (Cotrell, B. H., 2003, Draft Report Evaluation of Deer Warning Reflectors in Virginia), which focused on cost effectiveness, concluded that to recover costs, reflectors would have to prevent more than one DVC per mile per year.

Deer Population Reduction

Deer population management has been used in many parts of Maryland and Virginia to reduce deer numbers as a way of reducing DVCs. Efforts include changes to State game regulations to allow hunters to harvest more deer and encourage the hunting of more females. Regular hunting has been supplemented by special managed hunts in State and local park lands usually closed to hunting as well as the use of sharpshooters to remove deer at night. In the future, fertility control (i.e., immunocontraception) may be a legal option for controlling deer populations in confined or isolated settings. Fertility control in deer is currently experimental and not approved for use in free-ranging deer populations.

Deer population reductions have been correlated with dramatic reductions in DVCs on roads immediately adjacent to hunted areas (Putman, R.J. 1997. Deer and road traffic accidents: options for management. *Journal of Environmental Management* 51:43-57). At three managed hunt locations in Montgomery County, DVCs were reduced by 32%, 84% and 89% over a six year period (Montgomery County Department of Police, Whitetail Deer and Vehicle Collision Report).

* *The subject of deer population management, especially hunting, is often controversial and doesn't always allow for a full consensus recommendation to be reached. Some groups or individual citizens believe hunting is not the definitive answer to deer management. They feel this solution lacks full scientific study and/or object to hunting for ethical reasons. It is therefore important to state that full group consensus could not be reached regarding deer population management when reduction by hunting is employed as the method.*

REGIONAL PERSPECTIVES
SECTION IV

The wildlife-vehicle collision issue involves officials within local, state, and federal governments responsible for the protection and safety of people, wildlife, and property. The previous Section presented DVC trends documented by these organizations, as well as measures studied and implemented to reduce the problem. A variety of other organizations and agencies are also regularly (and often more intimately) involved with this issue. Consideration of their perspectives is therefore essential to effectively address and manage the problem of wildlife-vehicle collisions.

Statements were obtained from representatives from the American Insurance Association, Virginia Department of Transportation, Metro Traffic Network, AAA, and an independent wildlife rehabilitator. These stakeholders were asked to provide their perspectives on the causes and effects of wildlife-vehicle collisions, and potential measures to reduce the problem (Table 4.1). Most representatives agreed that in addition to an increasing deer population, *"continued development and sprawl has increased vehicular traffic into areas previously inhabited by wildlife"* (J. Russ, personal communication, *June 15, 2005*). The effects of wildlife-vehicle collisions can be devastating in terms of property damage costs, human injuries, and fatalities. While a VDOT maintenance engineer emphasized that *"the safety of the traveling public is our number one concern"* (J. Smith, personal communication, *May 3, 2005*), a wildlife rehabilitator noted, *"…we also have to look at the tremendous loss to our wildlife populations as a result of these vehicle collisions"* (P. Prouty, personal communication, *March 1, 2005*). Most agencies noted the importance of countermeasures to reduce collisions, and a AAA representative stressed that is also imperative to reduce the risk of injury and thereby *"…use common sense – wear safety belts, stay awake, alert, and sober"* (J. Townsend, personal communication, *June 6, 2005*).

Table 4.1. The causes, effects, and recommended solutions of animal- (namely deer-) vehicle collisions, compiled from written statements from representatives of state, regional, and national organizations.

Causes for Deer-Vehicle Collisions	**Source**
Increasing deer population	1b,2,3
Increasing development and sprawl (forcing wildlife to other areas)	3,4,5
Effects of Deer-vehicle Collisions	
Potential human fatalities or injury	1b,1c,2,3,4,5
Property damage costs	1c,1b,2,3
Loss to wildlife populations	2,5
Road blockages and traffic delays	3
Time and costs spent on deer carcass disposal	4
Recommended Solutions	
Countermeasures to minimize DVCs	
Install fencing with underpasses and overpasses where appropriate	1b,5
Control deer populations	1b,3
Display temporary signs during deer migration periods	1b
Animal-detection driver-warning systems[1]	1a
Clear foliage alongside roadways[1]	1a,5
Public education	3,5
Stormwater pond placement away from roadsides	5
Driver guidelines to prevent a DVC or to minimize injury	
Wear seat belts (vehicle) and helmets (motorcycle)	1c,2
Adjust driving speed to driving conditions	1c
Improve DVC data collection to develop effective countermeasures	1b
Do not exceed the posted speeds	1c,2,5
Drive defensively	2
Be attentive during pre-dawn and dusk hours, and during fall mating season	2
Use high beams, watch for silhouettes and deer's eye reflection	2
Be attentive to deer-crossing signs	2
Scan road for deer; if see one deer, watch for others	2
Do not swerve in an attempt to avoid hitting deer	2
Be attentive at all times when driving	5
Consider vehicle size; larger vehicles may have less visibility in front and therefore slower reaction times	5

[1] Report states that although this method shows promise, little research is currently available on its effectiveness.

Sources Cited

1a. Snyder, D.F. Vice President and Assistant General Council, American Insurance Association. Washington, DC, May 10, 2005.

1b. Insurance Institute for Highway Safety. Lots of approaches are under way to reduce deer collisions, but few have proven effective. Status Report. Volume 39, Number 1. Arlington, Virginia, January 3, 2004.

1c. Insurance Institute for Highway Safety. Human deaths in crashes with animals can be educed, even without reducing the collisions. *Status Report*. Volume 40, Number 1. Arlington, Virginia, January 3, 2005.

2. Townsend II, J.B. Manager/Public & Government Relations, American Automobile Association, Mid-Atlantic Chapter. Washington, DC June 6, 2005.

3. Russ, J. Director of Operations, Metro Traffic Networks. Washington, DC, June 15, 2005

4. Smith, J. District Maintenance Engineer, Virginia Department of Transportation. Richmond, Virginia, May, 2005.

5. Prouty, P.L. Wildlife Rehabilitator, Maryland Wildlife Rehabilitators Association, Rockville, Maryland, March 1, 2005.

RESEARCH SYNTHESIS
SECTION V

Deer Vehicle Collision Reduction Techniques

With the increase in DVCs across the United States, various mitigation measures have been studied and techniques continue to be developed. The complexity and variability of the DVC problem often create difficulties in designing studies that will provide conclusive results. Table 5.1 summarizes the current state-of-the knowledge of 17 potential DVC reduction techniques, as reported in Hedlund *et al*. (2003) and Knap *et al*. (2004). Moreover, a 2004 study (D'Angelo *et al*, 2004) prepared for the Georgia Department of Transportation by the University of Georgia and Berry College purports similar findings. Many measures show potential, but require additional research before deriving conclusions regarding their effectiveness. For those techniques that are found promising, studies should specify circumstances under which the measures may be applicable and are likely to be most effective.

Wildlife crossings and exclusionary fencing, particularly when used in conjunction with one another, were the only methods with sufficient scientific evidence to be regarded as effective countermeasures (Table 5.1). These techniques have consistently shown DVC reductions, and as a result, their use is increasing throughout the United States. Given the increasing attention on wildlife crossings in the U.S., research is underway on specific features that influence their use. Through a pooled-fund study by the National Cooperative Highway Research Programs, a three-year comprehensive study is underway entitled *Evaluation of the Use and Effectiveness of Wildlife Crossings* (Bissonette, J., 2004). On a more local scale, Virginia Transportation Research Council recently completed a study evaluating various underpasses to determine the size and location features of effective wildlife crossings for whitetail deer (Donaldson, 2005; see Case Studies - State of Virginia).

Technology-based deployments, such as animal-detection driver-warning systems, is one area that shows potential in reducing DVC incidents, but that requires further research before becoming applicable for general use (Table 5.1). Responding to the need for a better understanding of the impact of advanced technologies on DVC reduction, Western Transportation Institute (WTI) at Montana State University is currently conducting a pooled-fund study of *Animal-Vehicle Crash Mitigation using Advanced Technologies* (Huijser, 2000). Jointly funded by state transportation agencies in 15 states, the purpose of the study is to determine the most promising roadway and vehicle-based animal detection/driver warning systems to mitigate animal-vehicle crashes.

Only two mitigation techniques, deer whistles and deer flagging models have been studied sufficiently to confidently categorize as ineffective. Several techniques either appear to be ineffective, or may be somewhat effective in specific situations, but are impractical to implement (Hedlund *et al*., 2003; Knapp *et al*., 2004). Deer repellants and intercept feeding, for example, may be effective over a limited duration in localized areas, but would be difficult to consistently implement and ineffective as a long term strategy.

Table 5.1. Effectiveness of DVC reduction techniques, as reported in Hedlund *et al*. (2003) and Knapp *et al*. (2004)

DVC Reduction Technique	Determined Effective	Requires Additional Research	Limited Effectiveness or Appears Ineffective	Determined Ineffective	Comments
In-Vehicle Technologies (infrared vision or sensors)		✓			Potential to reduce DVCs appears to exist.
Deer Whistles				✓	
Roadway Lighting			✓		May have limited effectiveness in specialized situations.
Speed Limit Reduction			✓		Appears ineffective
Deicing Salt Alternatives			✓		May have limited effectiveness in specialized situations.
Deer-Flagging Models				✓	
Intercept Feeding (feeding stations outside roadway)			✓		May have limited effectiveness in specialized situations.
Passive Deer Crossing Signs			✓		
Temporary Passive Deer Crossing Signs and Active Signs and Technologies		✓			Appears promising in specific situations.
Roadside Reflectors or Mirrors			✓		Most studies found little long term effects.
Deer Repellants			✓		Unlikely to be useful.
Herd Reduction		✓			

DVC Reduction Technique	Determined Effective	Requires Additional Research	Limited Effectiveness or Appears Ineffective	Determined Ineffective	Comments
Public Information and Education		✓			Regular education is necessary, though its effects are difficult to assess.
Roadside Clearing		✓			
Exclusionary Fencing	✓				Effective when combined with wildlife crossings.
Wildlife Crossings	✓				Effective, particularly when combined with fencing
Roadway Maintenance, Design, and Planning Policies		✓			Appears that planning decisions may help mitigate DVC problem.

Wildlife Fertility Control

While fertility control methods were not included among the reviews summarized in the DVC reduction techniques table (Table 5.1), there are a number of ongoing projects (some in the COG region) that are testing different contraceptives for deer. Currently there are no approved, licensed contraceptives that are available for use in free-ranging white-tailed deer. There are numerous, biological, social, technical, economic and legal issues that must be addressed before wildlife contraceptives will be available for wildlife management. Although the general public may be supportive of fertility control in wildlife, the majority of state game agencies are not supportive of such tools (IAFWA, 2004).

Dolbeer (1998) used population models to compare the relative efficiency (i.e., percent decline in population size relative to number of animals sterilized or removed) of reproductive control and lethal control in managing wildlife populations. In general, it was found that reproductive control will be most effective in managing smaller wildlife species such as black rats (*Rattus rattus*) with high reproductive rates and low survival rates. Conversely, reproductive control will be much less efficient than lethal control in managing populations for larger species such as deer, coyotes (*Canis latrans*), and Canada geese (*Branta Canadensis*) that do not typically reproduce until 2 to 4 years of age and have smaller litter or clutch sizes than most rodents and small birds.

Reproductive controls may have utility to help manage deer populations in small areas that have a closed (enclosed) population. In such circumstances it will be necessary to use removal (capture-relocation, or lethal control) and contraceptives to meet population goals.

Animal-Vehicle Collision Data Collection and Application

Much of the difficulties in determining the effectiveness of mitigation techniques results from a lack of sufficient and reliable animal-vehicle collision (AVC) data. Considerable gaps exist in the consistency and accuracy of animal-vehicle collision data collection in North America. In many states, only accidents resulting in over $1,000 in damage are required to be reported by the investigating officer. This results in a significant percentage of unreported animal-vehicle accidents. Furthermore, location data for accidents is collected with varying degrees of consistency. To provide a basis for creating methods and standards that would increase AVC data quantity and quality, the Transportation Research Board's National Cooperative Highway Research Program (NCHRP) is sponsoring a 2006 research synthesis that nationally captures the state-of-the-practice for animal-vehicle collision data collection (NCHRP, 2005).

The collection of information from deer carcass pick-ups would greatly increase the DVC dataset currently available. Spatially accurate data for each deer carcass pick-up would be a drastic improvement from what is provided by the police report database alone. This dataset could assist public agencies and officials, as well as the insurance industry and auto manufacturers, in implementing methods to reduce the frequency and severity of collisions with large animals. In an effort to facilitate the collection and consistency of useful animal collision data, Western Transportation Institute (WTI) has developed an animal carcass data collection system whereby transportation maintenance crews can record carcass pick-ups with an inexpensive and user-friendly personal data assistant enabled with global positioning satellite capability. In

collaboration with Virginia Department of Game and Inland Fisheries, the Virginia Transportation Research Council plans to develop a project to test this system with select VDOT maintenance crews. If ultimately implemented by VDOT, information from this system would significantly increase Virginia's current dataset on DVCs. Spatially accurate and reliable roadkill data would allow both researchers and management to prioritize efforts on mitigation opportunities to increase safety and reduce carcass disposal costs.

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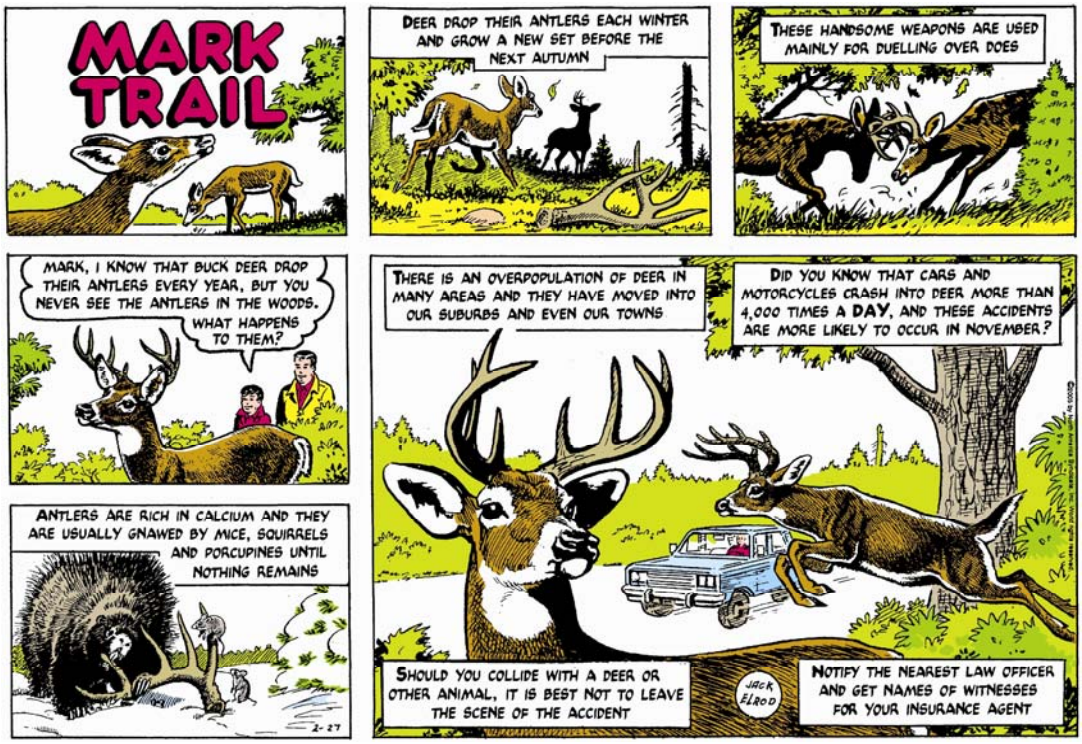
PUBLIC AWARENESS
SECTION VI

The most effective techniques for reducing deer vehicle collisions are the subject of much discourse among product vendors, government agencies, the insurance industry, non-government organizations, private citizens and others. The common theme is that our society and leadership must address this widely recognized and difficult public safety and resource management problem. Furthermore, there is clear consensus among all stakeholders in recognizing the overarching value of education and public awareness.

Different approaches will continue to be exercised in determining the most effective method to reduce interactions between wildlife and the traveling public. In the rich mosaic of development and environmental conditions that comprise the Washington, DC metropolitan area, a public education campaign would be a highly valuable and executable strategy. This strategy should be continuously developed and delivered through outreach efforts that include press releases, public service announcements, school programs, and the creative use of marketing and other media tools.

The following are examples of recent public awareness efforts aimed at curbing the growing conflict between wildlife and highways at both national and regional levels.

MARK TRAIL BY DODD & ELROD



NEWS RELEASE

FOR IMMEDIATE RELEASE
November 3, 2004

CONTACT:
Rick Busch
Telephone: 804-367-6872

DRIVERS, USE CAUTION TO AVOID HITTING DEER

Richmond, VA -- The Virginia Department of Game and Inland Fisheries (VDGIF) is encouraging Virginia's drivers to be more cautious as they travel the Commonwealth's highways this season. Fall is the breeding season for deer. Consequently, deer are more active now as they search for mates. One-half to two-thirds of all deer/vehicle collisions occur in the months of October, November and December. While less than 1 percent of vehicle fatalities involve deer collisions in Virginia, hitting a deer can cause considerable damage to both people and property.

VDGIF estimates the population of white-tailed deer in the Commonwealth at this time of year to be approximately 900,000. The number has been stabilized at between 900,000 and one million for almost 10 years. Each year hunters in Virginia harvest almost 200,000 deer. Without hunting, white-tailed deer, due to their reproduction rate, could double their population within five years.

The Virginia Department of Game and Inland Fisheries recommends the following tips to drivers to avoid hitting a deer.

1. When driving, particularly at dusk and dawn, slow down and be attentive. If you see one deer, likely there will be others. If one deer crosses the road as you approach, others may follow.
2. Deer habitually travel the same areas; therefore deer crossing signs have been installed by the Virginia Department of Transportation. Use caution when you see these signs.
3. Drivers should apply brakes, even stop if necessary, to avoid hitting a deer, but should never swerve out of the lane to miss a deer. A collision with another vehicle, tree or other object is more likely to be serious than hitting a deer.
4. Any person who is involved in a collision with a deer or bear while driving a motor vehicle, thereby killing the animal, should immediately report the accident to the game warden or other law enforcement officer in the county or city where the accident occurred.
5. Drivers who collide with a deer or bear, thereby killing the animal, may keep it for their own use provided that they report the accident to a law enforcement officer where the accident occurred and the officer views the animal and gives the person a possession certificate.

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Robert L. Ehrlich, Jr., *Governor*
Michael S. Steele, *Lt. Governor*
C. Ronald Franks, *Secretary*

NEWS RELEASE

Seasonal Deer Movement Raises Risk Of Vehicle Collisions

ANNAPOLIS — Maryland Department of Natural Resources (DNR) Wildlife & Heritage Service advises motorists to be especially alert for deer moving across roads and highways during October and November. In 2003, the reported deer-vehicle mortality in Maryland was 3,849.

Many animals have seasonal time periods when their movements increase in order to migrate, reproduce or find food. White-tailed deer movements increase within their home ranges and young bucks establish new home ranges. Adult bucks driven by surging hormones begin to move about in search of receptive females. Does are also more active, looking for a mature buck. Young male fawns, born the previous Spring may become separated from their mother as a result of this breeding behavior.

Yearling bucks (about l.5 years old), participating in their first breeding season, typically relocate many miles from their natal home ranges. Research conducted in Kent County, Maryland found that most yearling males disperse during October for an average distance of 4 miles.

This reproductive induced deer movement means that more deer will be crossing highways during October and November. Motorists need to heighten their awareness for the potential of deer crossing the road in front of them. DNR offers the Maryland motorists the following tips to improve the odds of avoiding a deer and vehicle collision:

- A deer standing near the road may suddenly leap onto the road. Slow down and sound your horn to scare the deer away from the road.
- If you see a deer crossing the road ahead, slow down and scan for more deer. Deer travel in groups; others may be nearby, but out of view.
- Slow down and brake to avoid hitting a deer, but do not swerve. Swerving can cause a driver to lose control and strike another vehicle. The vehicle also may leave the roadway and strike a tree or roll over.
- All during the year, increase your awareness for deer in the early morning hours and late afternoon hours. Deer commonly move between daytime resting areas to evening feeding locations.
- Be more alert in areas of deer-crossing highway signs throughout the year. These warning signs indicate locations of frequent deer crossings.

Maryland's colorful fall is an excellent time for wildlife recreational pursuits. Wildlife behavior in the fall enhances bird watching, wildlife photography, wildlife observation and hunting. Enjoy traveling to your favorite outdoor recreational areas with your family and friends, but be extra wary of deer along Maryland's roads and highways. For more information, go to http://www.dnr.state.md.us/wildlife/deerhunting.asp

U.S. Department of Transportation
Office of Public Affairs
Washington, D.C.
www.dot.gov/briefing.htm

News

FOR IMMEDIATE RELEASE

Thursday, May 15, 2003
Contact: Bill Outlaw
Telephone: 202-366-0660
FHWA 16-03

Federal Highway Promotes Simpler and Smarter Ways to Protect Wildlife

The U.S. Department of Transportation's Federal Highway Administration (FHWA) today announced the start of a first-of-its-kind website that highlights examples of simple and low cost methods and techniques being used to protect wildlife and fish on transportation projects.

"Secretary Mineta has asked us to create a safer, simpler and smarter national transportation system for all Americans," FHWA Administrator Mary E. Peters said. "This new website provides countless examples of how states are practicing sound stewardship by finding simple ways to reduce the effects of highways on wildlife."

The website is called KEEPING IT SIMPLE: Easy Ways to Help Wildlife Along Roads. It includes more than 100 "success stories" from all 50 states. The exemplary activities and processes featured range from installing nesting boxes to modifying maintenance schedules to placing wood-top rails on deer fences. Users can search the site by state and by one of four categories: "Along Roads," "On or Near Bridges," "On or Along Waterways," and "On Wetlands and Uplands."

One example is Arizona's "Watch out for Elk" signs used to get motorists to slow down. If you drive along the heavily forested mountain segments of State Route 260 between Payson and Show Low, AZ, you'll notice this four-part warning sign: "Keep your eyes open and your speed slow. Watch out for elk as you go." To increase motorist awareness about a high elk population along this stretch of SR 260 and to decrease the spiraling number of vehicle-wildlife accidents, the Arizona Department of Transportation placed Burma Shave-style signs on both sides of the highway, each message 500 feet from the next. The slogans, created by the department and local school children, have reduced driving speeds on this mountain road and have helped decrease the number of vehicle accidents involving elk and other large game animals.

Not only do these methods protect wildlife, they also improve highway safety for motorists nationwide. Crashes between motor vehicles and animals account for a large percentage of the total crashes in many areas, and the number has been increasing over the years. An estimated 200 people die each year from crashes involving wildlife.

Find the KEEPING IT SIMPLE website at
http://www.fhwa.dot.gov/environment/wildlifeprotection/index.cfm

APPENDIX SECTION 1

The Montgomery County Deer Management Work Group
2000 Shorefield Road, Wheaton, MD 20902
M-NCPPC, Montgomery County Department of Park and Planning
Maryland Department of Natural Resources Wildlife Division
Montgomery County Cooperative Extension Service
Montgomery County Police Department
USGS, Biological Services Division

Summary of ad hoc committee on management options to reduce deer-vehicle collisions (DVCs) on County roadways

June 1998

In 1996, an ad hoc committee was formed by the Montgomery County Deer Management Work Group (DMWG) to discuss management options available to reduce DVCs on roads in Montgomery County, Maryland. The committee had representation from Montgomery County Department of Public Works and Transportation (MC-DPWT), Maryland State Highway Administration (MD-SHA), Montgomery County Police Department (MCPD), The Maryland National Capital Park and Planning Commission (M-NCPPC), The Fund for Animals, and The Humane Society of the United States (HSUS). The committee met for a period of about one year. During this time members reviewed a large volume of literature on this topic, visited various sites where management options were being utilized and tested, interviewed product manufacturers and people responsible for installing and testing various methods, met with road designers and reviewed and made recommendations on current building projects to improve design for wildlife. Below is a summary of the committee's findings.

Signs

- In general, not effective, typical deer crossing signs are mostly ignored
- Need to add distances (i.e. next 2 miles, etc) to all existing deer crossing signs
- Need to review locations so they are placed where needed; too many reduce effectiveness
- Need to review mechanism for reviewing where signs should be installed. DPWT used to work with DNR, this has changed due to limited DNR staff. DMWG will now provide DVC data to DPWT and they will make decisions based on history of accidents at site.
- While some studies have found lighted signs ineffective, intuitively it seems we could experiment with innovative signage, i.e. lighted with flashing lights; new design with more dramatic picture; show number of accidents, use seasonally.

Wildlife Reflectors (Streiter-lite)

- Conclusions on effectiveness mixed
- Most studies done on highways, few on rural or urban roads
- Only effective after dark
- Funding in most test sites provided by sportsmen groups
- Most accidents in the county do not happen in high concentration areas but are widely spread around the county. This limits the effectiveness of this system to reduce DVCs on a broad scale

Speed Reduction

- There is good evidence to support that higher speed results in more Deer Vehicle Collisions (DVCs)
- There is little support from road agencies to reduce posted speed limits; it is believed it will have little effect because drivers will ignore the slower limits. Road agencies believe it could have negative effect on general safety by having a few drivers obeying the lower speeds and most not. A high variability of speeds is a major cause of accidents
- There was more support for reduced limits from animal activist groups
- Speed traps suggested as a way of reducing speed in high risk areas; Question regarding if county police set up speed traps after dark?

Driver Education, Public Service Announcements

- All agreed this is most important step
- Need to get information on high risk times of year, and driving tips to wider audience
- Suggestion for a required training film for high school and other driver education schools

Fencing

- Few areas where fencing can be applied, can't use where cross roads, driveways etc. require break in fence
- Areas with fencing need to be inspected regularly and repaired immediately. A fence with a hole is worse than no fence at all
- Need to look at one-way gates and other options to allow deer trapped on fenced roads to escape
- Need to stress the use of fencing in future construction of limited access roads such as the inter-county connector (ICC)

Design/ Habitat Alteration

- A body of literature on road design to reduce wildlife impacts has been collected and shared between participating agencies
- Where roads cross streams, especially in parkland, bridges should be used to span the widest area possible to allow for and encourage safe wildlife passage under the road
- Where box-culverts must be used the largest opening possible should be used that is at least eight feet in height and has an openness ratio of at least 1 when the following formula is applied – width of opening × height of opening/length of culvert

- A report was written and presented to the ICC committee in 1997 on concerns about the routing of this road and design features that should be incorporated to reduce DVCs
- Landscaping of roadways and mowing regimes should not encourage deer to enter right-of- way for food or shelter

APPENDIX SECTION 2

CASE STUDIES REPORTS

The six case studies that follow represent the diversity of problems and efforts being used to address animal-vehicle collisions in the COG region. Statewide reports for Maryland and Virginia are complemented by more focused analyses from Montgomery County, Maryland, and Fairfax County, Virginia. The National Park Service, National Capital Region, report features Rock Creek Park in Washington, DC. Taken together, these case studies begin to paint the picture of the social, economic, and ecological aspects of the animal-vehicle collision issue in the Metropolitan Washington area.

STATE OF VIRGINIA

TRENDS IN DEER-VEHICLE COLLISIONS IN VIRGINIA

Reported deer-vehicle collisions in Virginia have increased at least 10-fold during the last 40 years. (Table A2.2) Due to underreporting, accurate estimates of total vehicle collisions involving deer are not available. Assuming the ratio of reported deer-vehicle accidents to deer carcass retrievals observed in Fairfax County (approximately 1:6, Table A2.1) could apply to the rest of the state, the 5,513 total accidents reported during 2004 translate to more than 33,000 carcasses retrieved statewide annually. The number of deer that are struck by vehicles but not retrieved is unknown. Based on their known market share in Virginia, State Farm Insurance (State Farm Insurance, January, 2006) projected 37,707 deer-vehicle claims for all insurance companies in the state during July 1, 2004 - June 30, 2005. For 2002-03 and 2003-04, the projections were 41,072 and 39,182 claims, respectively.

Although deer are a serious concern to motorists and public agencies, deer-vehicle collisions are responsible for less than 1% of all motor vehicle casualties in Virginia. During each year between 1999 and 2003, an average of 2.2 of 839 (0.26%) total fatal accidents and an average of 384 of 54,831 (0.70%) total injury accidents involved deer. However, these data do not include all casualties that resulted from accidents in which drivers did not actually collide with deer (e.g., swerving to miss deer).

Increases in deer-vehicle collisions in Virginia are attributed to growing deer and human populations (Fig. A2.1, Table A2.2). Since 1968, the statewide deer population has increased from approximately 200,000 to 1,000,000 (400%) and the statewide human population has increased from approximately 4.6 to 7.4 million (61%). Human population growth has resulted in increased traffic and increased fragmentation of habitat, the latter forcing deer to cross highways more often. Vehicle traffic in Virginia has increased over 200% since 1968, from less than 26 to more than 80 billion miles driven annually. During 1966 to 2003, deer-vehicle accidents resulting in human injury correlate more closely with miles driven ($\rho = 0.98$) than with the deer population index ($\rho = 0.93$), while accidents causing property damage correlate closely with both ($\rho = 0.97$, Fig. A2.1).

The number of accidents for which property damage was reported increased from 496 in 1966 to 5,105 in 2004 (929%, Fig. A2.1). In 2003, the total property damage reported from deer-vehicle collisions was $13,443,412, or $2,530 per accident. Reported accidents with injuries but no fatalities increased from 19 to 407 (2,042%) during 1966 to 2004 (Figure A2.1).

Fatal vehicle accidents involving deer in Virginia averaged less than one per year through the late 1980s, 1 to 1.5 during the early 1990s, and over two per year during the late 1990s (Figure A2.2). 2003 was the only year since 1988 when no fatal vehicle accidents involving deer were reported. Except during 1989, each fatal accident involving deer resulted in the death of only one person.

Since 1966, an average of 1.19 persons has been injured per accident involving injuries. The number of persons injured per accident was lower in the 1980s (1.18) and 1990s (1.17) than in the 1970s (1.30; $F = 12.15$; $P < 0.001$), perhaps owing to increased availability and use of seat belts, child safety seats, and other modern safety equipment.

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS REGION (MWCOG)

Deer-vehicle collision data is limited for Virginia jurisdictions in the MWCOG region (Table A2.1). Each jurisdiction was contacted but only Fairfax County provided data (obtained from VDOT and filtered for duplicates, David Lawlor, Fairfax County Police Department, personal communication). VDOT initiated a database of deer carcass retrievals from roadways in the VA-MWCOG area during fiscal year 2004 (July 1, 2003 to June 30, 2004). Prior to FY2004, VDOT pooled carcass retrieval data for all types of animals. Incorporated cities retain responsibility for picking up animal carcasses within their jurisdictions (Wayne Pigg, VDOT, personal communication).

VDOT data indicates that 3 of the 11 fatal accidents in Virginia during 1999-2003 occurred in the MWCOG region (1999 – Fairfax County, 2001 – Loudoun and Prince William Counties). The MWCOG region accounts for only 2% of the land area in Virginia, but accounts for 13% of the injury accidents (258 of 1,920 during 1999 to 2003; Fairfax – 123, Loudoun – 75, Prince William – 60).

BEAR AND ELK CRASHES IN VIRGINIA

Besides white-tailed deer, black bear and elk are the only other wildlife species likely to present safety risks to Virginia drivers. Virginia's black bear population is growing and expanding beyond historically limited ranges in the western mountains and the Great Dismal Swamp in southeastern Virginia. Between 1994 and 2001, Virginia Department of Game and Inland Fisheries (VDGIF) obtained reports of 15 to 42 bears killed annually by vehicles in Virginia, though no trend is discernible using this incomplete dataset. VDOT began keeping data on reported bear crashes in 2001. During the years 2001 to 2003, 44 reported accidents involving bears resulted in property damage totaling $118,700 and 3 accidents resulted in 3 persons injured. At least 2 human fatalities have resulted from vehicle collisions with bears (Dennis Martin, VDGIF, personal communication).

Elk have dispersed into southwestern Virginia from Kentucky where some 1,550 elk were released as part of an ambitious restoration program during 1998 to 2001. Two elk-vehicle collisions were reported in Virginia in 2002 and 2003, neither of which caused injury (Allen Boynton, VDGIF, personal communication). The collision in 2002 resulted in an estimated $5,000 in damage.

PROBLEMS IN REPORTING AND RECORDING DEER-VEHICLE COLLISIONS

Deer-vehicle collisions involving human fatalities or injuries in Virginia presumably are reported completely, although casualties resulting from a near miss with a deer are not necessarily categorized as deer-related. Accidents only causing damage to vehicles or other property are less likely to be reported to authorities. Investigating officers in Virginia are not required by law to report accidents where damages are less than $1,000.

VDOT retrieves, and/or contracts retrieval of, carcasses from most primary, secondary, and interstate highways in Virginia. Deer carcasses needing retrieval are reported by drivers or law enforcement officers and entered into the Smart Traffic or Virginia Operations Information System (VOIS) (Earl Sharp, VDOT, personal communication). This system will allow for an accurate means of accounting for deer-vehicle collisions with increasingly consistent use of the system among VDOT districts and avoidance of duplicate entries (i.e., one deer carcass can be reported numerous times by several passing motorists). Although the system does not categorize deer differently than other animals retrieved, VOIS can be queried for deer if data entered included the word "deer." Emergency service requests (e.g., carcasses presenting a hazard in the roadway) are often recorded in non-searchable journals, whereas routine service requests (e.g., carcasses are on side of road) are entered in the system (Earl Sharp, VDOT). VDGIF and VDOF personnel have begun a dialogue to improve the gathering of deer carcass data.

METHODS USED TO REDUCE DEER-VEHICLE COLLISIONS IN VIRGINIA

General Education

A 15 second public service announcement entitled "Caution: Deer Crossings" was produced by VDGIF video production staff in 2002 and was provided to every television market in Virginia and via the VDGIF website. The video received a second place award for "Television Public Service Announcements" from the Association for Conservation Information in 2002.

Signs

Passive deer crossing signs have been placed by VDOT personnel throughout the state in areas considered likely for deer to cross roadways.

Underpasses

Wildlife crossings are typically underpasses, such as culverts or bridges, designed to facilitate safe wildlife movement beneath a transportation corridor (Photo A2.1). Virginia Transportation Research Council (a partnership between VDOT and University of Virginia) recently completed a study that evaluated the design and location features that influence the use of underpasses by deer and other wildlife in Virginia (Donaldson, 2005).

Photo A2.1. Wildlife Crossing in Fairfax County, Virginia.

Remote cameras installed at seven underpasses, most of which were not specifically designed as wildlife crossings, recorded over 2,700 wildlife photographs, and documented 1,040 white-tailed deer crossings in the most heavily used structures (Photo A2.2). Underpasses with a minimum height of 12 ft received heavy use by deer, thereby reducing DVCs . Structures that were suitable for deer passage were also heavily used by a variety of wildlife species, including coyote, red fox, raccoon, groundhog, and opossum. The report demonstrated that if only a minimal number of DVCs is prevented by an effective underpass, the savings in property damage alone can outweigh the construction costs of the structure. The report provides guidance in cost effective underpass design and location features that are necessary to consider for increasing motorist safety and habitat connectivity.

Photo A2.2. Photographs of a deer using underpass sites monitored by Virginia Transportation Research Council, 2004-2005.

Reflectors

A study conducted during 2000 to 2002 by VRTC provided no evidence that deer warning reflectors placed at 10 sites in Virginia were effective in reducing deer-vehicle collisions (Cotrell, B. H., 2003, Draft Report Evaluation of Deer Warning Reflectors in Virginia). The red, double-sided reflectors, mounted on posts along the roadside, reflect lights of approaching vehicles and create moving, low-intensity red light beams intended to deter deer. The study concluded that, to recover costs, reflectors would have to prevent more than 1.14 deer-vehicle collisions per mile per year.

Deer Population Reduction

Regulated hunting is the primary means to control deer populations across Virginia. However, site-specific programs are often needed where traditional hunting methods may not be appropriate. A growing number of urban areas in Virginia employ archery- or shotgun-only hunting, managed hunts, out-of-season kill permits, and sharpshooting by specialists to reduce deer populations and/or deer damage to gardens, ornamental plants, and vehicles.

Active programs in Fairfax County (cf. Fairfax County report), the City of Lynchburg, and the Town of Blacksburg provide evidence that deer population reduction can reduce deer-vehicle collisions. From 1993 to 2003, Lynchburg hunters and wildlife specialists removed over 2,600 deer from within the city. Deer-vehicle collisions have decreased some 50% since initiation of the deer reduction program in 1992 (Figure A2.3, Lynchburg Police Department, unpublished data). In Blacksburg, the portion of vehicle collisions involving deer increased from 4% in 1990 to 8% in 1998, prompting city officials to initiate a deer control program in 2000. Deer-vehicle collisions in Blacksburg have decreased from 58 in 2001, to 44 in 2002, to 39 in 2003, to 28 in 2004, to 18 in 2005 (Blacksburg Police Department, unpublished data).

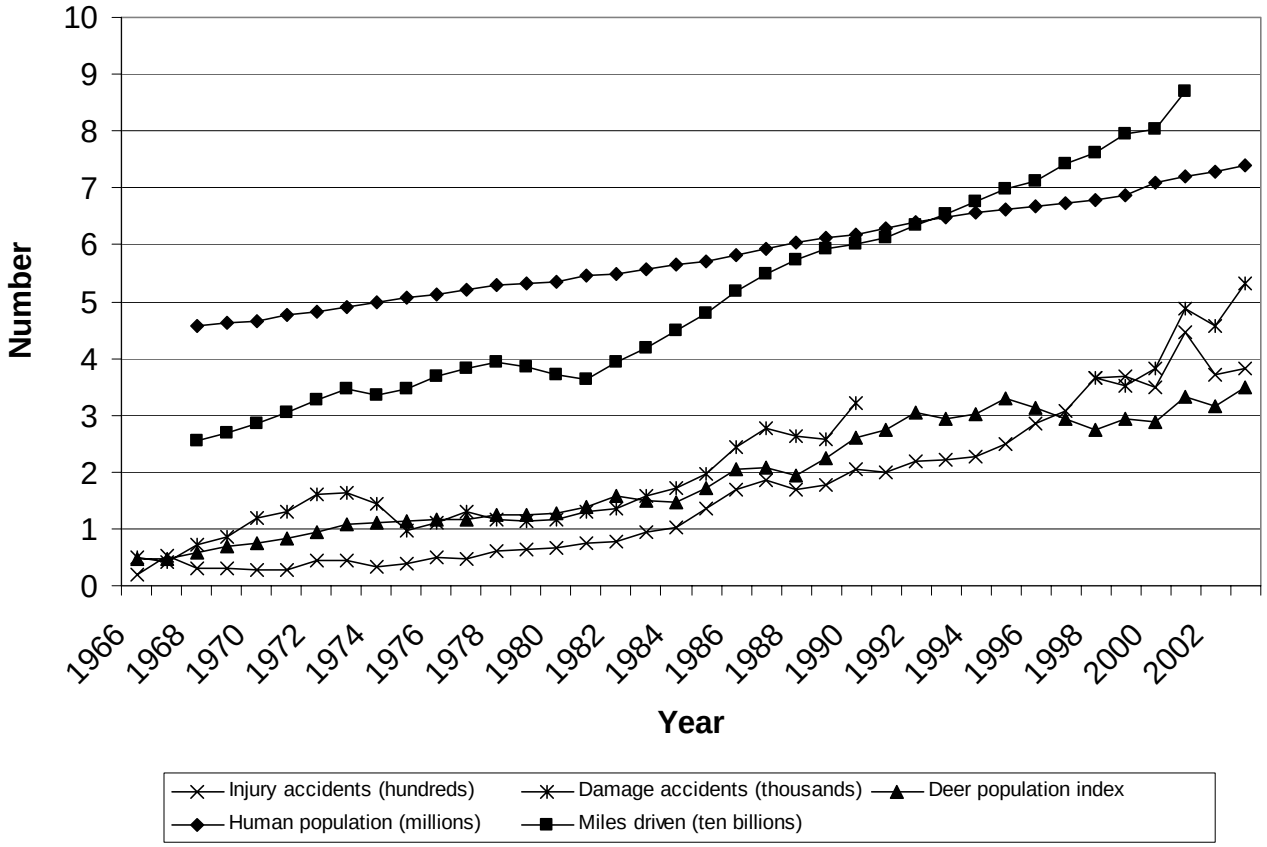


Figure A2.1. Trends in reported deer-vehicle accidents, deer population, human population, and vehicle miles driven in Virginia from 1966 to 2003. Due to changes in methodologies, data for damage accidents during 1991 to 1997 and miles driven during 2002 to 2003 were not used.

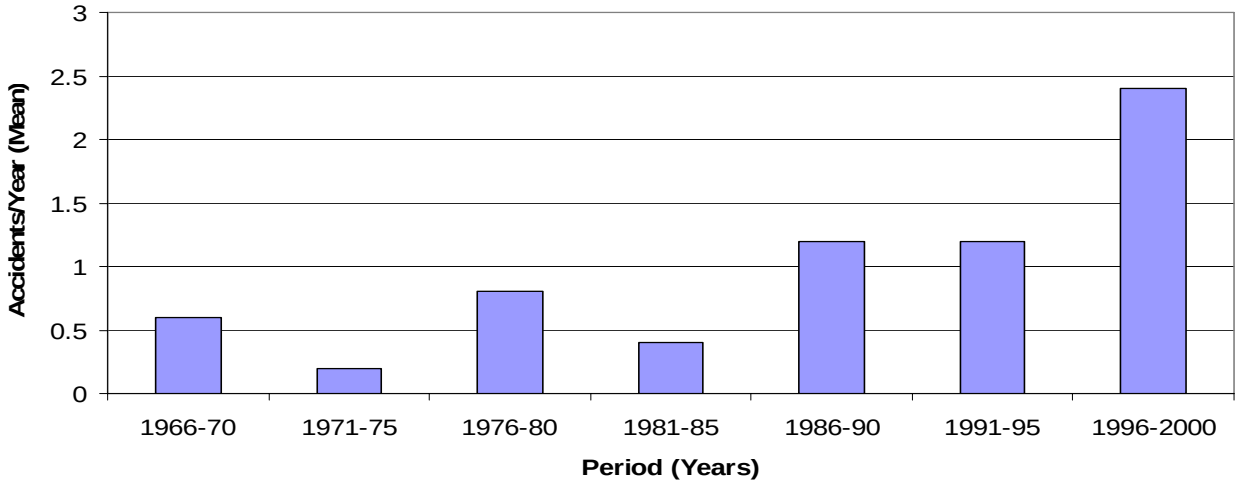


Figure A2.2. Mean number of fatal deer-vehicle accidents per year during 5-year periods from 1966-2000 in Virginia.

Table A2.1. Recorded deer-vehicle collisions for Virginia jurisdictions within the Metropolitan Washington Council of Governments region.

Jurisdiction	Reported/ Pickups?[1]	1996	1997	1998	1999	2000	2001	2002	2003[2]
Alexandria	NA	-	-	-	-	-	-	-	-
Fairfax Co.	Pickups	1438	1324	1131	1060	930	870	1057	1371 (2321)[3]
	Reported[4]			167	196	161	165	132	179
	Reported[5]				249	203	209	191	243
Loudoun Co.	Pickups	-	-	-	-	-	-	-	(672)
	Reported[5]				221	229	252	273	255
Arlington Co.	NA	-	-	-	-	-	-	-	-
Falls Church	NA	-	-	-	-	-	-	-	-
Prince William Co.	Pickups	-	-	-	-	-	-	-	(380)
	Reported[5]				122	130	157	168	161
City of Fairfax	NA	-	-	-	-	-	-	-	-
Manassas	NA	-	-	-	-	-	-	-	-
Manassas Park	NA	-	-	-	-	-	-	-	-

[1] Collisions only reported by investigating law enforcement officers versus collisions where carcasses were picked up from highway.

[2] Parenthetical data () represents carcasses reported by motorists or officers to be picked up by VDOT during July 1, 2003 – June 30, 2004; this data likely includes duplicates.

[3] Includes 208 carcasses on interstates within VDOT district, 95% of which presumably were in Fairfax County (Wayne Pigg, VDOT, personal communication).

[4] From Fairfax County Police Department records.

[5] From Virginia Department of Transportation records; may include accidents from independent cities contained within county boundaries.

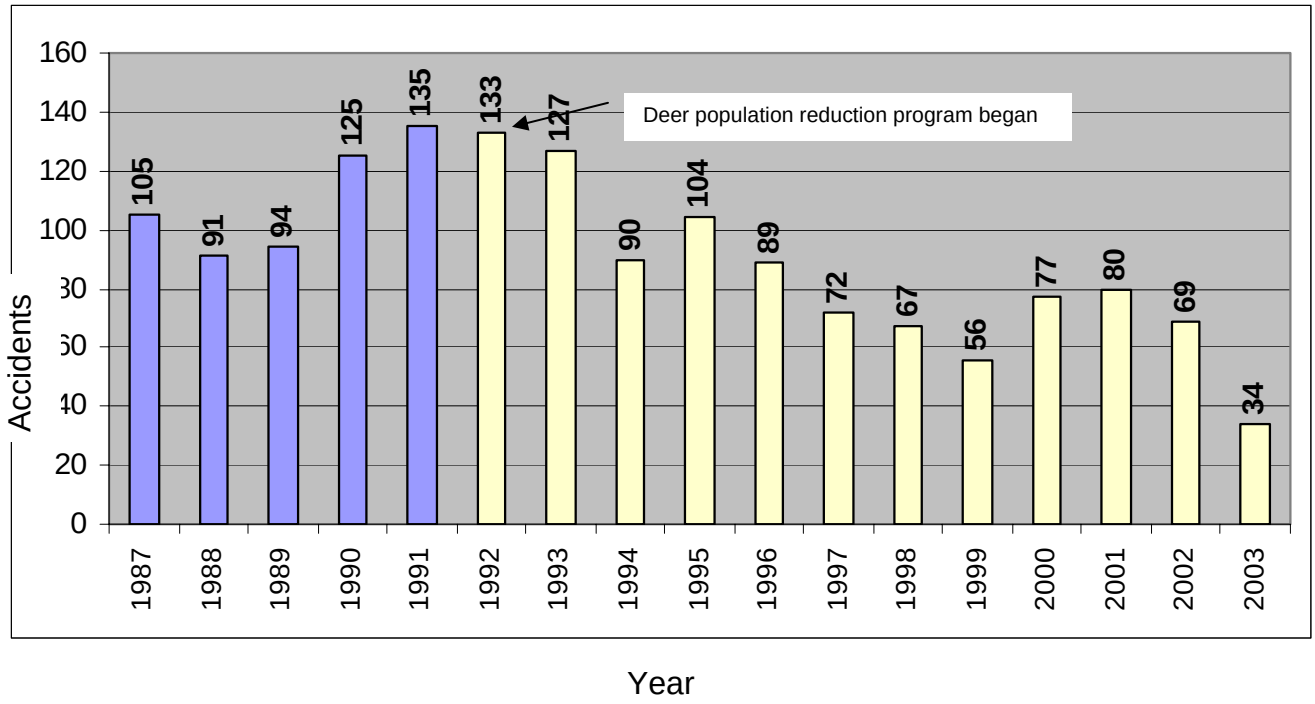


Figure A2.3. Vehicle accidents involving deer in the City of Lynchburg, Virginia (1987 to 2003). A deer population reduction program was initiated in 1992.

Table A2.2. Human and deer data associated with deer-vehicle collisions in Virginia. Data obtained from Virginia Departments of Transportation, Motor Vehicles, and Game and Inland Fisheries.

Year	Fatal Accidents[1]	Persons Killed[1]	Injury Accidents[1,2]	Persons Injured[1,3]	Property Damage Accidents[1,4]	Deer Population Index[5]	Human Population[6]	Miles Driven[7]
1966	0	0	19	24	496	0.48		
1967	2	2	53	67	429	0.47		
1968	0	0	31	43	712	0.58	4,558,000	25,614
1969	1	1	30	39	858	0.69	4,614,000	26,951
1970	0	0	29	40	1181	0.74	4,651,487	28,419
1971	0	0	28	34	1310	0.82	4,753,000	30,504
1972	1	1	44	61	1607	0.93	4,828,000	32,717
1973	0	0	44	55	1635	1.07	4,907,000	34,664
1974	0	0	32	38	1434	1.11	4,978,000	33,634
1975	0	0	38	45	963	1.15	5,056,000	34,641
1976	1	1	49	71	1110	1.17	5,133,000	36,710
1977	2	2	48	62	1304	1.17	5,206,000	38,105
1978	0	0	61	87	1156	1.25	5,284,000	39,250
1979	0	0	64	86	1129	1.24	5,325,000	38,478
1980	1	1	67	78	1165	1.29	5,346,818	37,163
1981	1	1	76	89	1305	1.39	5,444,100	36,348
1982	0	0	77	96	1369	1.58	5,492,800	39,396
1983	0	0	93	103	1569	1.49	5,564,700	41,920
1984	1	1	103	127	1717	1.48	5,643,900	44,904
1985	0	0	136	167	1972	1.73	5,715,100	47,928
1986	2	2	169	206	2430	2.04	5,811,700	51,725
1987	0	0	186	214	2767	2.06	5,932,300	54,834
1988	0	0	170	206	2637	1.94	6,036,900	57,453
1989	1	2	177	205	2563	2.24	6,120,200	59,337
1990	3	3	204	242	3220	2.61	6,187,358	60,178
1991	2	2	199	231	[1741]	2.73	6,288,000	61,099
1992	1	1	220	272	[268]	3.04	6,394,000	63,447
1993	1	1	221	264	[239]	2.94	6,490,600	65,419
1994	1	2	227	264	[196]	3.03	6,551,500	67,609
1995	1	1	249	308	[204]	3.31	6,618,358	69,811
1996	3	3	285	332	[239]	3.14	6,666,200	71,309
1997	2	2	282	319	[258]	2.92	6,737,500	74,142
1998	1	1	341	392	3163	2.73	6,789,200	76,262
1999	4	4	369	439	3518	2.94	6,872,900	79,463
2000	2	2	350	410	3825	2.87	7,078,499	80,452
2001	4	4	447	521	4887	3.33	7,196,800	86,969
2002	1	1	372	424	4566	3.16	7,287,800	[75,263]
2003	0	0	382	450	5314	3.50	7,364,600	[76,830]
2004	1	1	407	456	5105	3.18	7,458,900	

[1] Data reported by investigating law enforcement officers. Data cannot be used in discovery or as evidence in a Federal or State court proceeding or considered for other purposes in any action for damages against VDOT or the State of Virginia.

[2] Accidents involving deer with no persons killed but at least one person injured.

[3] Persons injured in fatal and injury crashes.

[4] Accidents involving deer with no persons killed or injured but with damage to vehicles or other property (report not required for property damage crashes less than $1000). Data for 1991-1997 were not used in this report due to a change in methodology.

[5] Male deer harvested during all hunting seasons in Virginia/total land area of Virginia; male deer harvest relates to overall deer population.

[6] From Weldon Cooper Center for Public Service at University of Virginia.

[7] In millions; based on gasoline consumption during 1968-2001; data for 2002-2003 not used in this report due to change in methodology.

STATE OF MARYLAND

TRENDS IN DEER-VEHICLE COLLISIONS IN MARYLAND

The Maryland Department of Natural Resources (MDNR) Deer Project is responsible for the oversight of deer management across the state. Current population estimates (from 2004 data) place the statewide deer population at approximately 242,000 animals. The Deer Project has a population management objective to reduce the statewide deer herd to approximately 215,000 animals by the year 2007, to achieve a better balance of the deer population with the needs of Maryland's citizens.

Data concerning deer vehicle collisions (DVC) are reported to MDNR by a broad spectrum of agencies, including state, county, and local law enforcement agencies, animal control officers, park rangers, and roadway maintenance crews. MDNR annually tabulates data on deer vehicle collisions from each county jurisdiction, via the collection of Maryland Non-Hunting Deer Tags. These tags are submitted by various agencies that recover deer carcasses or report deer-vehicle collisions (DVC) on Maryland roadways.

As white-tailed deer numbers have increased across many areas of the state, so have the number of reported deer-vehicle collisions (DVC). Maryland Reported DVC increased by more than 200 percent between 1990 and 2004. (Table A2.3.) A 1996 MDNR public survey on deer found that 12 percent of residents surveyed in Central Maryland reported striking a deer with a vehicle during the previous year. Eight percent of those reporting an accident involving deer, also reported a personal injury. Information from Maryland insurance agencies indicates that the vehicle repair cost for a collision with a deer in Maryland averages about $2,000 per incident. Fatalities caused by DVC are not reported to MDNR, thus have not been tabulated here, but appear to be uncommon, resulting in fewer than one fatality annually.

Trend data of reported DVC shows an overall upward trend, statewide, but a recent decline in DVC has occurred since totals peaked in the year 2000, with 4,364 DVC reported. (Table A2.3) The most recent (2004) data indicates that 4,297 DVC were reported to MDNR in that year. (Table A2.3.) Based on their known market share in Maryland, State Farm Insurance (State Farm Insurance, January, 2006) projected 22,820 deer-vehicle claims for all insurance companies in the state during July 1, 2004 - June 30, 2005. For 2002-03 and 2003-04, the projections were 26,169 and 21,968 claims, respectively.

DVC DATA FROM THE MARYLAND METRO-WASHINGTON COG REGION

The Maryland jurisdictions in the MWCOG (MDMWCOG) region consist of Montgomery, Prince George's, and Frederick counties. Information on DVC for the region are obtained from similar sources as the statewide data (Table A2.3). Reported DVC for the MDMWCOG region indicate a marked increase from 1990 to 2004 (Figure A2.5). 2,091 DVC were reported in the year 2004. DVC's peaked in the year 2000 when 2,598 were reported. The data trend for the MDMWCOG region mirrors the statewide data, which suggests that MDNR's efforts to reduce the deer population may be working.

PROBLEMS WITH DEER-VEHICLE COLLISION REPORTING

DVC are reported by motorists to a variety of sources, including state and county law enforcement officers, park rangers, Natural Resources Police, and directly to the Maryland DNR, Wildlife & Heritage Service staff.

Various state and county agencies retrieve deer and other animal carcasses from Maryland's roadways. Roadway maintenance crews for state and county maintained roadways recover and dispose of animal carcasses from their respective jurisdictions. Maryland Department of Transportation – State Highway Administration (MDOT-SHA) staff recover carcasses primarily from state-maintained (primary) roadways, while county and local agencies recover carcasses primarily from county-maintained (secondary) roads. In certain locales, local Animal Control officers or contractors also retrieve animal carcasses from roadways. Not all of these crews tabulate the number and species of carcasses they recover -- some do not differentiate between domestic animals, deer, and other wildlife.

MDNR regulations require that each deer killed by motor vehicles be tagged and reported to DNR via a department issued "non-hunting" tag, available from MDNR. MDNR supplies these tags to agencies that handle deer carcasses, or those that respond to vehicle collisions that involve deer. This reporting system is the primary method used to tabulate DVC in Maryland. Each agency that handles deer carcasses is required by MDNR regulation to report DVC killed deer using this reporting system. Many deer are not reported using this system, therefore, accurate totals of deer-vehicle collisions (DVC) are often not available. For this reason, the actual number of DVC could potentially be much greater than the reported number.

Some problems with this reporting system are evidenced by varying reporting rates across similar jurisdictions. A survey done by MDNR reported that many agencies involved in deer carcass removal do not keep accurate records of the numbers of deer picked up. Some agencies only estimate the number of deer carcasses retrieved, while some keep no records at all. Every agency that responded to the survey reported that they believed DVC have increased within their jurisdiction over the past five years. Documentation of reported DVC shows an overall increasing trend in DVC statewide.

In 2000, MDOT-SHA began a project that maps the location of DVC on all roadways within the state to determine the locations of deer crossing "hotspots." The information learned from this project could help improve the collection of DVC data statewide, and could help MDNR and local government agencies with their efforts to target certain locations for potential DVC avoidance measures, which could help reduce DVC in Maryland.

METHODS USED TO REDUCE DEER-VEHICLE COLLISIONS IN MARYLAND

General Education

MDNR informs the public about DVC and the methods that can be used to avoid DVC through the media, via news releases, and information distributed through the internet via the department's webpage.

Signs

Passive deer crossing signs have been placed by MDOT-SHA personnel throughout the state in areas considered likely for deer to cross roadways. MDOT-SHA has previously used the abundance of deer carcass locations along roadways as criteria to determine where to place passive signs. They are currently using GPS mapping along with mile marker numbers to identify "hotspot" locations or locations where deer strikes are most frequent, to determine deer crossing locations.

Underpasses

Wildlife underpasses, located on the Great Seneca Highway, were installed specifically to facilitate travel of wildlife and to reduce wildlife-vehicle collisions. These underpasses are being monitored by the Humane Society of the United States (HSUS) for wildlife usage and to examine the effects of passages on vehicle collisions with deer and other wildlife. Although most of the underpasses are showing use by deer, the lack of sufficient location data for deer-vehicle collisions may hinder evaluation of these wildlife underpasses in reducing collisions (Bridget Donaldson, VTRC, personal communication).

Roadside Reflectors

The red, double-sided reflectors, mounted on posts along the roadside, reflect the lights of approaching vehicles and create moving, low-intensity red light beams intended to deter deer. Studies on the effectiveness of reflectors proved inconclusive and were strongly debated. A report by Cotrell concluded that to recover costs, reflectors would have to prevent more than 1.14 deer-vehicle collisions per mile per year. (Cotrell, B. H., 2003, Draft Report Evaluation of Deer Warning Reflectors in Virginia). A recent study done by the University of Georgia (D'Angelo, et. al, 2006), on deer behavior in response to roadside reflectors, found reflectors ineffective in altering deer behavior to reduce deer vehicle collisons. Anecdotal evidence provided by Howard, Montgomery, and Harford counties, show inconclusive evidence of the effectiveness of deer warning reflectors in reducing deer-vehicle collisions. More stringent testing of reflectors may be needed before a determination can be made on their effectiveness.

Deer Population Reduction

Regulated hunting is the primary means used to manage deer populations in Maryland. However, site-specific programs (unlimited antlerless deer bag limits for archery hunters, managed hunts, and sharpshooting) are used in developed areas where traditional hunting methods may not be appropriate. An increasing number of urban and suburban communities are requesting information on nontraditional methods, such as sharpshooting and managed hunting to reduce local deer populations.

Maryland Deer Cooperators are licensed to use sharpshooting, and "catch and kill" methods to reduce deer populations in suburban areas where traditional population management methods have not been effective, or are prohibited due to social or legal constraints. Since 2001, Maryland Deer Cooperators have taken over 2,000 deer using sharpshooting. Montgomery and Howard

county wildlife management authorities have used sharpshooting to reduce locally abundant deer numbers, and have reported a marked reduction in DVC.

Managed deer hunts have been used by state, county, and private land managers, to reduce deer numbers and to mitigate deer-human conflicts. The respective authorities for Montgomery and Howard county parks and recreation have used managed hunts to deer numbers and DVC in their respective jurisdictions. The incidence of DVC decreased by 73% after managed deer hunts at Seneca Creek State Park reduced the local deer density there. (Figure A2.7).

Maryland DVC Data

Table A2.3 Reported Maryland DVC's from 1990 – 2004, documented by MD-DNR, Wildlife & Heritage Service.

County	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Allegany	96	106	56	113	145	145	122	115	108	113	124	121	103	70	73
Anne Arundel	51	61	88	33	125	69	122	96	53	42	287	283	1	7	9
Baltimore	81	96	113	109	158	73	73	67	28	37	39	49	36	34	40
Calvert	50	88	98	7	19	29	121	64	37	26	138	158	1	7	4
Caroline	23	24	35	35	40	48	38	61	26	32	5	1	5	2	7
Carroll	100	122	109	169	177	90	121	92	21	124	110	78	51	46	38
Cecil	42	28	49	50	56	43	24	40	22	9	17	15	15	9	8
Charles	86	103	153	16	107	48	201	116	64	11	368	413	1	8	8
Dorchester	17	23	26	19	10	19	24	21	27	10	3	8	2	10	5
Frederick	182	112	136	177	197	130	185	177	188	118	138	144	74	39	53
Garrett	103	86	23	71	139	44	39	44	90	42	32	68	66	46	290
Harford	51	62	55	86	92	75	79	62	61	35	43	17	12	30	8
Howard	88	127	149	213	233	225	258	124	46	34	37	25	923	1296	1546
Kent	44	51	50	38	39	29	24	25	40	22	39	2	13	17	9
Montgomery	58	73	110	1074	1334	1423	986	1902	1897	1981	2094	2045	2162	2083	2024
Prince George's	45	70	76	34	54	48	82	23	42	24	366	235	3	2	14
Queen Anne's	64	79	98	57	87	55	75	80	54	35	41	16	34	22	26
St. Mary's	18	60	129	55	55	47	87	97	46	25	165	181	10	13	7
Somerset	6	8	16	12	2	19	15	13	19	6	8	6	3	4	2
Talbot	46	33	75	43	42	50	48	61	65	19	14	9	10	12	6
Washington	205	165	179	196	279	188	315	233	200	209	257	320	135	66	100
Wicomico	24	40	34	47	21	51	42	41	38	12	20	17	13	12	15
Worcester	25	21	33	33	13	38	22	38	28	4	13	13	18	13	5
Totals	**1505**	**1638**	**1917**	**2687**	**3425**	**2986**	**3103**	**3593**	**3200**	**2971**	**4364**	**4229**	**3691**	**3849**	**4297**

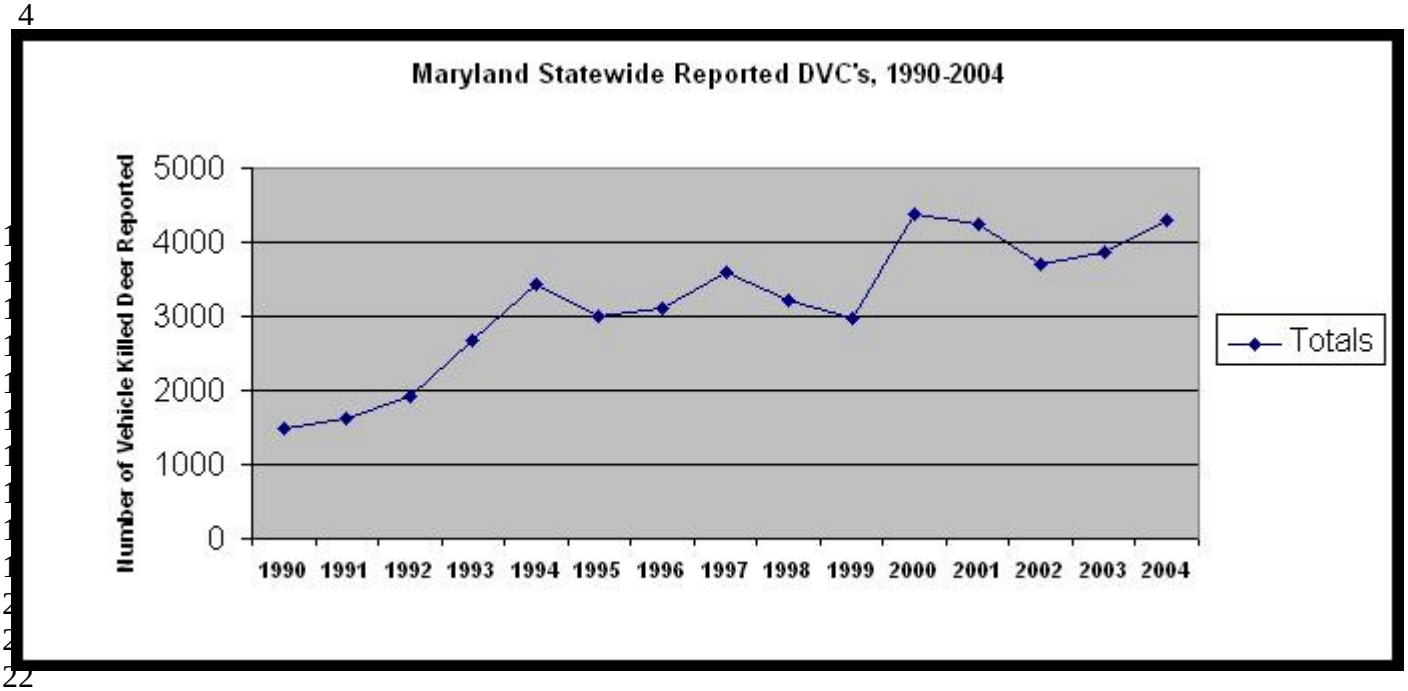


Figure A2.4. Reported DVC for Maryland, 1990 to 2004

MW COG Jurisdiction	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Montgomery	58	73	110	1074	1334	1423	986	1902	1897	1981	2094	2045	2162	2083	2024
Prince George's	45	70	76	34	54	48	82	23	42	24	366	235	3	2	14
Frederick	182	112	136	177	197	130	185	177	188	118	138	144	74	39	53
Totals	285	255	322	1285	1585	1601	1253	2102	2127	2123	2598	2424	2239	2124	2091

Figure A2.5 Reported DVC for MWCOG Jurisdictions, 1990 through 2004.

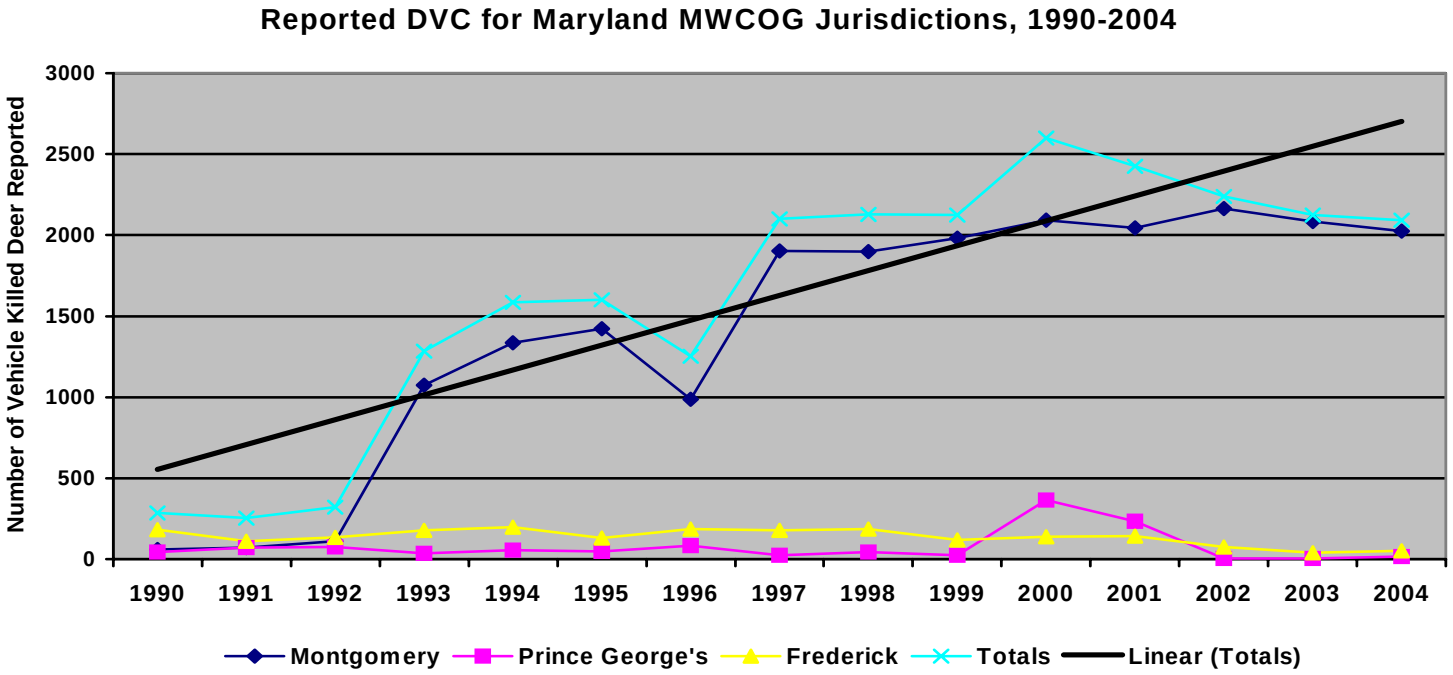


Figure A2.6. Reported DVC data for Metropolitan Washington Council of Governments (MWCOG) jurisdictions showing trend line.

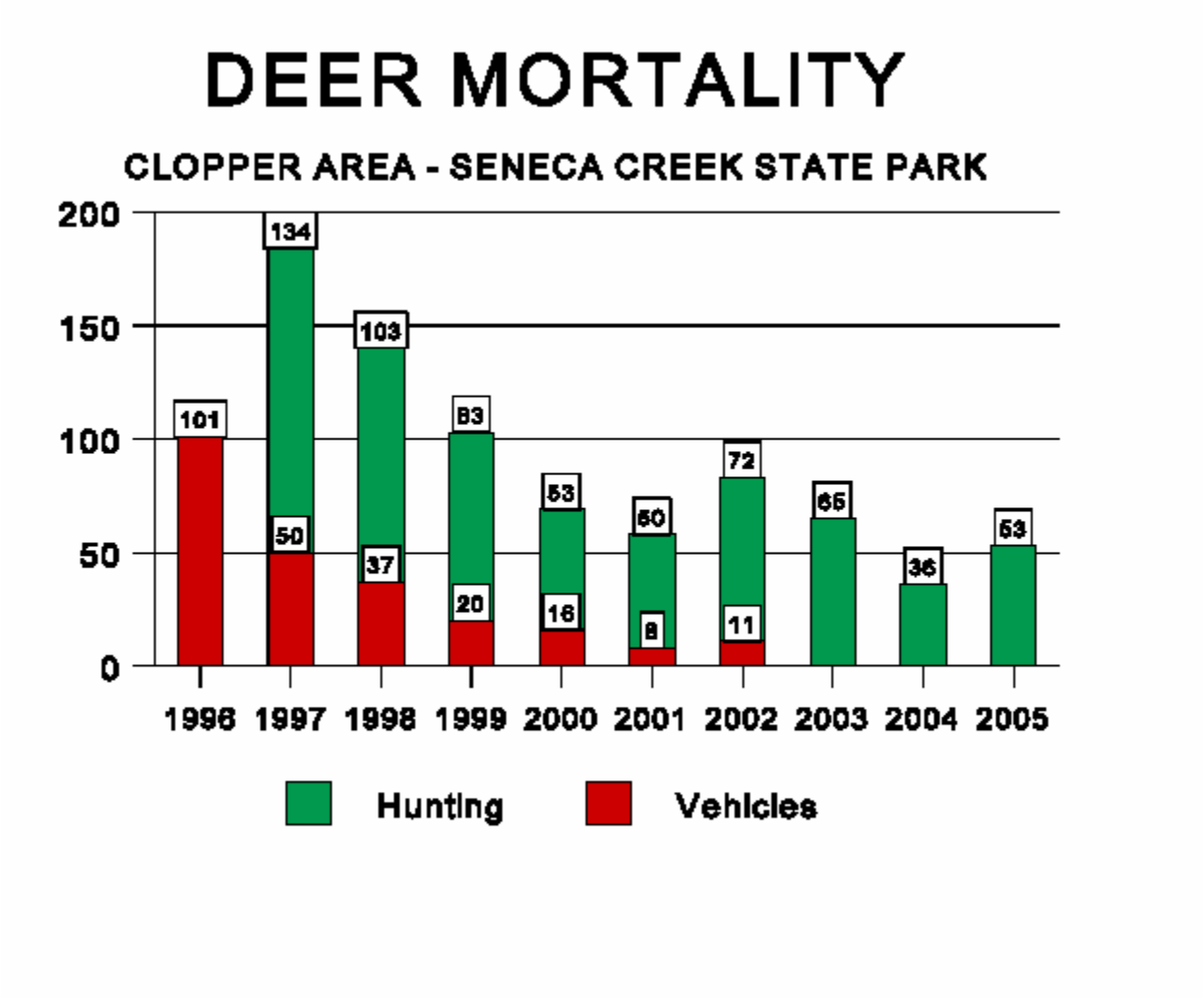


Figure A2.7 Deer mortality from DVC and managed hunt – Seneca Creek State Park

DISTRICT OF COLUMBIA

The District of Columbia is approximately ten square miles of a mostly urban landscape with a human population of 572,059 (per the 2000 census). The deer population is unknown.

Land uses consist of a mixture of residential (including row houses and mid- to high-rise apartment buildings), federal facilities, commercial, District and Federal-run parkland, and vacant land.

Significant acreage of the District remains as park land. Landholders are both the Federal government including National Park Service (NPS), U.S. Department of Agriculture (USDA), and the District government, DC Department of Parks and Recreation (DC-DPR). NPS maintains several thousand acres in DC with the majority of acreage in Rock Creek Park (1,755 acres), Ft. DuPont Park (376 acres), Anacostia Park (over 1,200 acres) and National Parks-Central with a cumulative 6,600 square acres. The U.S. Department of Agriculture maintains the U.S. Arboretum which is a 440 acre park. DC-DPR maintains a total of 800 acres; mostly shared among 4 large parks though there are multiple community parks throughout the District. This abundant parkland provides habitat for various wildlife species.

There are many corridors throughout the District that are known to be used by deer and other wildlife. The D.C. Metro system is comprised of 43 miles of above-ground track with 904 rail cars. Train tracks are lined with vegetation and have become major pathways for movement of wildlife throughout the District. These corridors allow access to internal portions of the District without alternate routes for escape. This often results in deer or other wildlife in main intersections or jumping into building windows.

There are several entities that address wildlife issues within the District. The DC Department of Health Animal Control responds to citizen calls regarding sick and injured wildlife. Annually, Animal Control Officers are dispatched to approximately 50 calls regarding injured deer. The following chart lists mortality incidence of deer brought to the DC Animal Shelter from June 2004 to April 2005.

Number	Disposition
30	Deer that could not be saved and were euthanized
1	Deer escaped
3	Died while in custody at Animal Shelter
4	Died when Animal Control Officer arrived on scene
3	Deer was released to the wild unharmed

Among these deer, 20 were female, 18 were male, and 3 were recorded as unknown. Only four were returned to the wild.

Oftentimes, deer-vehicle collisions result in immobilization of the animal and ultimate euthanasia. There are seldom cases where rehabilitation and/or relocation is possible.

The Department of Sanitation responds to calls regarding dead animals on roadways. Deer and other wildlife are collected and disposed of. Unfortunately, there is little to no data collected regarding the frequency, location or any other information of such occurrences. This information would provide a useful database for the future collection of the frequency of collisions that are fatal for wildlife. When combined with the data of non-lethal collisions that are reported to Animal Control, yearly trends can be analyzed.

The need for standardized data collection among jurisdictions is pertinent in making comparisons, determining trends and, ultimately, in producing a plan for minimizing wildlife vehicle collisions.

Many entities respond to and collect data of wildlife vehicle collisions. These agencies span police, fire, insurance, animal control, local and state park services, state and federal wildlife and natural resource management. As a result, it is necessary to determine a central location for data collection with the goal of collecting information on a representative sample of collisions without overlap. Based on their known market share in Washington, D.C., State Farm Insurance (State Farm Insurance, January, 2006) projected 222 deer-vehicle claims for all insurance companies in the District during July 1, 2004 - June 30, 2005. For 2002-03 and 2003-04, the projections were 333 and 154 claims, respectively.

In the absence of data it is difficult to determine how effective any tools are in reducing wildlife vehicle collisions. However, there is no question that a need exists to focus on reducing such collisions. This challenge outlines the need for both a human behavior modification and an animal modification (potentially both behavioral and population density). For the purpose of proposing long-term approaches it is necessary for standardized data to be collected.

MONTGOMERY COUNTY, MARYLAND

In 1993, Montgomery County established a Citizen Task Force to study the problems associated with a growing population of white-tailed deer. In 1995 the County, following recommendations from the Task Force, established the Deer Management Work Group (DMWG). This interagency work group wrote the Comprehensive Management Plan for White-tailed Deer in Montgomery County, MD and provides recommendations on an annual basis to guide the Plan's implementation. The DMWG recommendations include measures to help address deer-vehicle collisions (DVCs).

In 1996, an ad hoc committee was formed by the DMWG to discuss management options available to reduce DVCs on roads in Montgomery County, Maryland. The findings of this group are attached as Appendix 1.

TRENDS IN DEER-VEHICLE COLLISIONS IN MONTGOMERY COUNTY

Table A2.4 is a summary of DVCs reported by the Montgomery County Police Dept. (MCPD), Animal Control and MD-SHA for the years 1994 to 2004. After rising steadily through the mid 1990s, DVCs have leveled off since 2000 with a very slight downward trend over the past two years (see Table A2.4). Last year's count of 1997 DVC's is the lowest since 2000. This is despite a steady increase in county residents, automobiles, miles of roads, and width of many roads. DVCs around parkland where deer population management has been implemented have declined as deer populations have been reduced (see deer population reduction below).

Numbers of DVCs reported from specific roads can vary widely from year to year. For example a 1.5-mile stretch of Brink Road in 1996 and 1997 had one of the highest concentrations of DVCs in the county (18 and 21 respectively). In 1998 the same stretch of road had only 7. In 1999 the number increased to 11, in 2000 it was 9 and in 2001 it was 13. It is likely that deer are responding to a number of natural and man-made conditions including crop rotation, acorn production, development or other pressures that can change drastically from year to year. This makes it difficult to establish patterns and to justify expensive long-term remedies for what may be temporary conditions.

Table A2.4. Deer-vehicle Collision Data 1994 to 2004

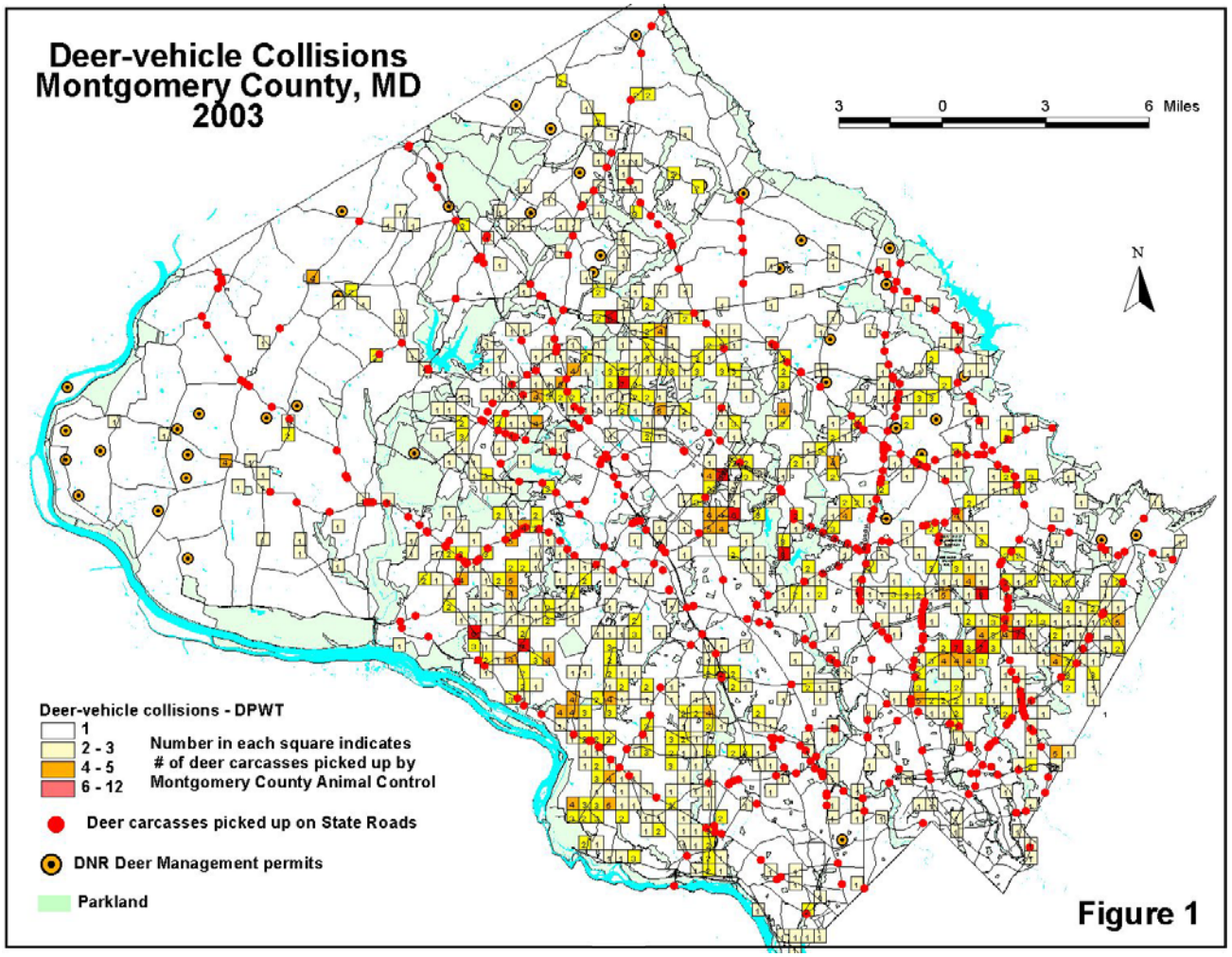
Source	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
MCPD[1]	1,343	1,244	1,776	1,705	1,774	1,891	2,033	2,003	2,127	2,047	1,997
Animal Control	447	509*	521*	547*	631*	1,059*	1,112*	1,123*	1,194*	1,180*	1,749*,[2]
SHA	211	192*	200*	390*	608*	572*	675*	713*	n avail	341*	n avail.

1 - number includes incidents where deer were struck but deer were not recovered.
2 - Number increase is due to new method of reporting data
* - -Mapped locations
Various sources as noted

Deer-vehicle collisions are widespread throughout the county (Figure A2.8). While DVC concentrations are identified and analyzed for remedial actions, these concentration points make up only a fraction of the total. DVCs are mapped using grids approximately 1,000 feet square. In 2002 Animal Control recorded road-killed deer picked up in 754 grid blocks. Of the 754 blocks 86% (651 blocks) had only 1 or 2 DVCs. Ninety-five percent (95%) had three or fewer collisions. Most DVCs countywide don't occur in concentrated areas but are spread broadly over the county. Therefore, countywide efforts in education, improved driving habits, improved signage, road design and deer population management are important to long-term, general reductions of DVCs.

DVCs continue to be high at several cloverleaf interchanges of Interstate 270 (I-270). Due to high traffic volumes and high speeds it is likely that DVCs are especially dangerous at these locations. Most of I-270 is fenced but the fences must have breaks at exit ramps and vegetation growing within cloverleaves may attract deer. Methods to address these localized DVCs require further investigation.

Figure A2.8. Deer Vehicle Collisions, Montgomery County, MD 2003



Source: M.C. Deer Management Work Group

METHODS OF RECORDING DEER-VEHICLE COLLISIONS

Data on DVCs in the county are collected from the following sources.

1. The Montgomery County Police Department (MCPD) keeps records on deer collisions on county roads that require police response as well as dead deer seen on roads by police officers and reported to the Division of Animal Control (Animal Control) for pick-up. The MCPD data, because it includes data on collisions in which the deer are not necessarily recovered, includes the most complete numbers for county roads but does not include all deer collisions on state roads or the many DVCs that go unreported. The data is analyzed by the MCPD and an annual report is issued. A copy of this report is sent to the DMWG and included in the appendix of their annual report.
2. Animal Control is responsible for picking up dead deer on county roads. Detailed location information is collected when citizens or the police call in to report dead deer for pickup. This data is sent to the DMWG in an annual summary report and mapped in our GIS system. Beginning in 2005, GPS will be used to locate deer picked up on county roads in order to better capture this data including locations of the many deer that are not reported but are picked up incidentally on route to other pickups.
3. Road-killed deer on state roads within the county are picked up by the State Highway Administration (SHA). GIS location data is sent to the DMWG and mapped along with County data.

The data provided by the above agencies in some cases is complementary and in other cases overlaps considerably. Due to the detailed location information provided, the flexibility of the database, and in order to eliminate overlap, only Animal Control and SHA data are used for mapping (Figure A2.8). The distribution of deer-vehicle collision locations is used to help delineate hotspots for DVCs in the county.

METHODS USED TO REDUCE DEER-VEHICLE COLLISIONS IN MONTGOMERY COUNTY

General Education

M-NCPPC delivers public service announcements each year during October/November to warn citizens about DVCs. Beginning in 2005, this information will also be broadcast on the County's cable TV network during morning and evening traffic information programming. The M-NCPPC also includes information about avoiding DVCs on its website, "Living with Deer in Montgomery County" and in our Homeowner Workshop program that provides education for homeowners on dealing with deer problems.

Signs

Passive deer crossing signs have been placed by MDOT and Montgomery County Dept. of Public Works (DPWT). These signs are being upgraded as time and funding allows to indicate the length of roadway that has high deer accident numbers (*e.g.* next 3 miles). Some experimental passive signs have been installed that picture a dead deer and a damaged car with

the wording, “Deer Area, Frequent accidents next X miles”. The effectiveness of these signs has not been rigorously tested but review of DVC data suggests that they are of no greater value than the regular deer crossing signs. Efforts have been made to use the DVC data collected by Animal Control and SHA to better locate deer crossing signs.

Underpasses and Road design

As the County’s planning agency, M-NCPPC has the opportunity to review all road projects. Several years ago arrangements were made to have all new bridge construction reviewed by the Chair of the County’s deer management program. Since that time several bridge designs on county and state roads have been changed in order to better accommodate deer crossing. The DMWG has provided recommendations on several major road projects in recent years including the Inter-County Connecter and the extension of Mid-county highway (M-83). In most cases efforts have been made to incorporate suggested designs into bridges, fencing and roads in an attempt to reduce DVCs.

Reflectors

Streiter-lite Wildlife reflectors have been installed in several locations in the county. From 1997 to 2000 two sites were studied using general DVC data as described above to try to determine their effectiveness. After an initial reduction in DVCs at the test sites, the numbers increased to higher than they had been before the reflectors were installed. During the same period at several control sites DVCs remained about the same or decreased. Statistically, the results were inconclusive due to the small sample size, the small number of accidents at most sites and the large variation of accidents from year to year.

It is worth noting that the County’s contractor, who picks up nearly 2,000 deer a year on county roads, feels strongly that the reflectors do reduce DVCs.

Deer Population Reduction

Managed deer hunts were initiated at three park locations in Montgomery County in 1996 including two county parks, Little Bennett Regional Park and the Agricultural History Farm Park, and Seneca Creek State Park. Since that time the County Park program has expanded greatly. In 2004-2005 it included managed hunting as well as sharpshooting programs (deer are removed at night by specially trained park police officers using special equipment) at 14 parks. All hunts achieved their harvest goals and were completed safely.

MCPD has monitored DVCs on roads adjacent to these parks since the managed hunts were initiated. Data shows that there has been a significant reduction in DVCs in the areas surrounding the parks (see Table A2.5).

Table A2.5. Annual DVCs recorded by MCPD on roads within ½ mile of managed hunt sites 1996 – 2002

Location	1996	1997	1998	1999	2000	2001	2002	Change '96 – '02
Seneca Creek State Park	101	50	37	20	16	8	11	-90
Little Bennett Reg. Park	43	29	9	11	10	10	7	-36
Ag/History Farm Park	40	29	42	38	31	39	27	-13

Source MCPD

FAIRFAX COUNTY, VIRGINIA

HOW DEER CAME TO THE PUBLIC AGENDA

Something happened in Fairfax County about twenty years ago which set the stage for a situation which would polarize its citizens. This was not the typical issue of a new road bisecting a neighborhood nor was it the "not in my backyard" rally against some proposed building. This was something new, something that would not be resolved quickly. This would be a protracted debate.

Simultaneously, the same issue was erupting across the eastern United States. Each township, county, city and hamlet was faced by the same agonizing problem. White-tailed deer had invaded suburbia. They had tasted the azaleas, day lilies, hostas and fertilized lawns and liked what they had found. They were, in fact, the proverbial guest who came to dinner and never left. Deer had adapted to urbanization.

This adaptation coincided with a wave of construction which provided more and more landscaped yards. Much of the construction simultaneously destroyed sections of forest which had always been the home of the deer. The forest had always been good habitat for deer. Deer actually prefer what is commonly referred to as *edge habitat*. This is the interface zone of two different habitats such as where a forest meets a field. That is exactly what is produced when a house is built in a forest. Unintentionally, good deer habitat had been transformed, on a massive scale, into ideal deer habitat. This new superior habitat came with a bonus. Hunting would be restricted due to the density of this urbanization. Now the deer population was free to expand practically unchecked.

In response to a human fatality caused by a deer-vehicle collision, the Fairfax County Board of Supervisors adopted a proposal on December 8, 1997, to pilot managed deer hunts as part of an effort to address problems associated with the overabundance of deer. In accordance with this plan, County staff conducted a series of pilot programs during 1998 in order to test and improve methods for reducing deer populations on public lands. In 1999, former County Executive Robert O'Neill, Jr. appointed a committee made up of County citizens and local experts in deer management techniques to evaluate the County's plan for deer management and to make additional recommendations to the Board of Supervisors and staff. This Committee endorsed the County's *Integrated Deer Management Plan*, the continued use of deer reduction techniques, as well as community education activities to help residents better understand the safety and environmental issues associated with deer overabundance. This Committee also supported the recommendations of the Environmental Quality Advisory Council (EQAC). The EQAC has long supported the *Integrated Deer Management Plan.* EQAC further supports "a sound ecological approach that emphasizes biodiversity without preferential treatment of particular species." (Fairfax County, Virginia 2002)

THE PROBLEMS

What problems can result from an expanding urban deer herd? To some degree, this can depend upon one's perspective. If you are a gardener, a birder, a hiker or have children who play outside, you may have some first-hand experience with problems evolving from an overabundance of deer. By the same token, if you drive a car through deer habitat in this region, you have either had the misfortune of striking a deer, had close encounters, or have witnessed the evidence of deer-vehicle collisions (DVCs) by other motorists.

One result of deer overabundance that receives less attention than DVCs or tick-borne diseases is the damage inflicted upon natural habitats. Overbrousing of native plants by deer eventually leads to a visible brouseline in the understory of forests. A brouseline is a distinct horizontal line below which little vegetation remains. This is the result of deer eating nearly everything within their reach. Once this line becomes visible, deer have little difficulty in maintaining it. As new growth attempts to sprout, it is quickly consumed. The result is the local loss of certain plant species, the loss of food and cover for other wildlife and an inability for the forest to produce future generations of trees.

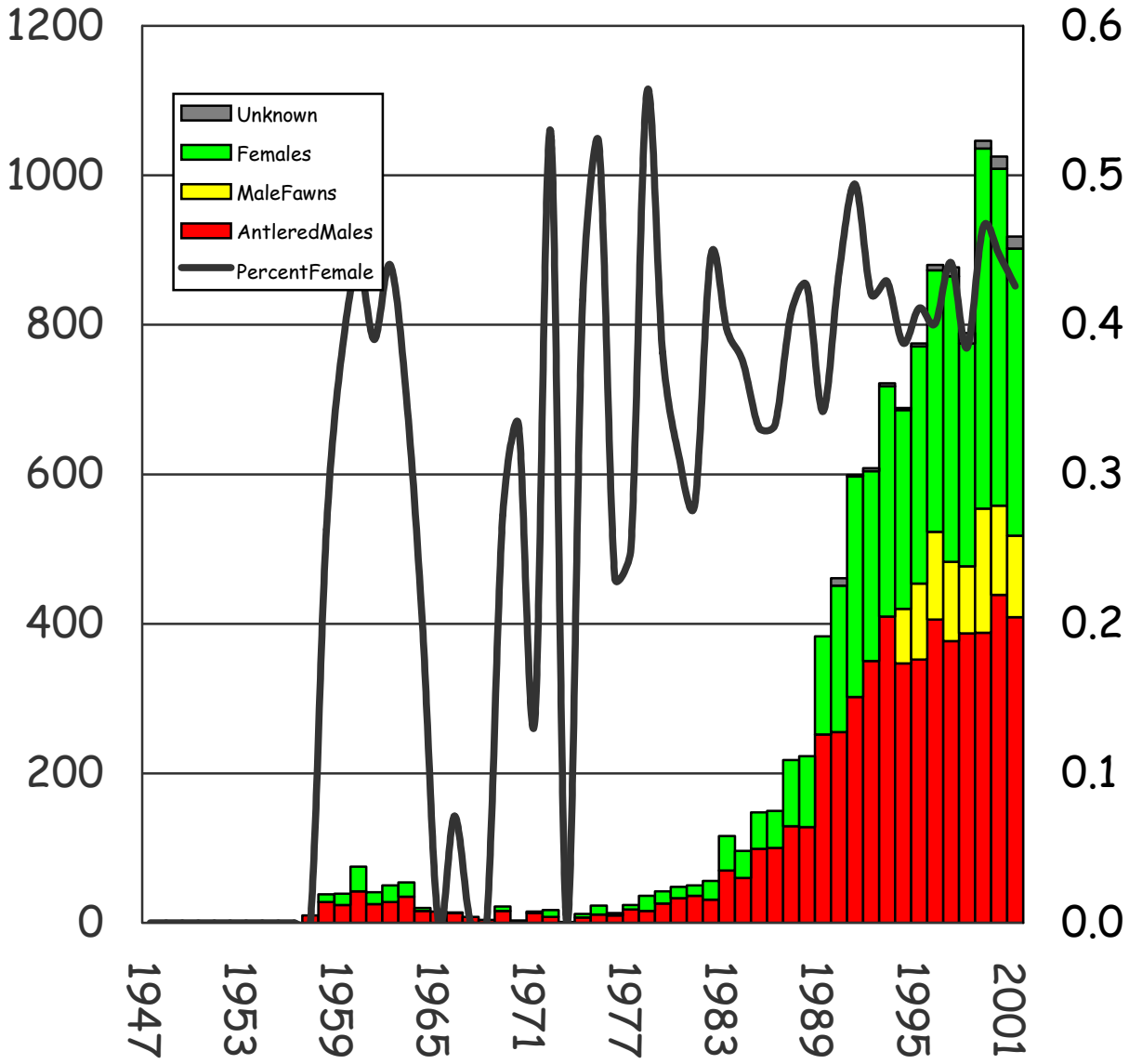
One method of measuring the result is to consider the vegetation deer would consume. A deer eats 4-6 pounds of food per 100 pounds of body weight each day. As an example, by the spring of 2005, the Fairfax County Deer Management Program had removed 594 deer from Bull Run Regional Park. Assuming an average consumption of 5 pounds of food per day these deer would have eaten approximately 2,970 pounds of vegetation each day. In a year, this would amount to about 1,084,050 pounds (542 tons) of vegetation removed from this park and the surrounding neighborhoods. This estimate would assume that the number of deer stayed constant with no mortality and no deer born into the herd.

As deer herds increase, more problems result and more property owners seek relief through various available options. Commercial deer repellants can work in certain applications. Fencing to exclude deer from defined areas can be more successful but may not be a viable option due to community restrictions, zoning limitations or general esthetics. Effectiveness will be associated with the technique selected, deer densities, alternative food resources, and weather (DeNicola, *et al.*, 2000).

Some property owners utilize hunting as a means of reducing the number of deer as well as a means of altering deer behavior. Deer are more likely to avoid properties which they consider to be hazardous. The number of deer harvested can be one means of tracking trends in deer herd growth. As the number of deer increase, so do the opportunities for deer to be taken by hunters. The following graph, Figure A2.9, illustrates how deer abundance began to change in the mid 1980s.

Figure A2.9. Fairfax County Deer Harvest from 1947-2001

Produced by Matt Knox and provided Courtesy of the Virginia Department of Game and Inland Fisheries



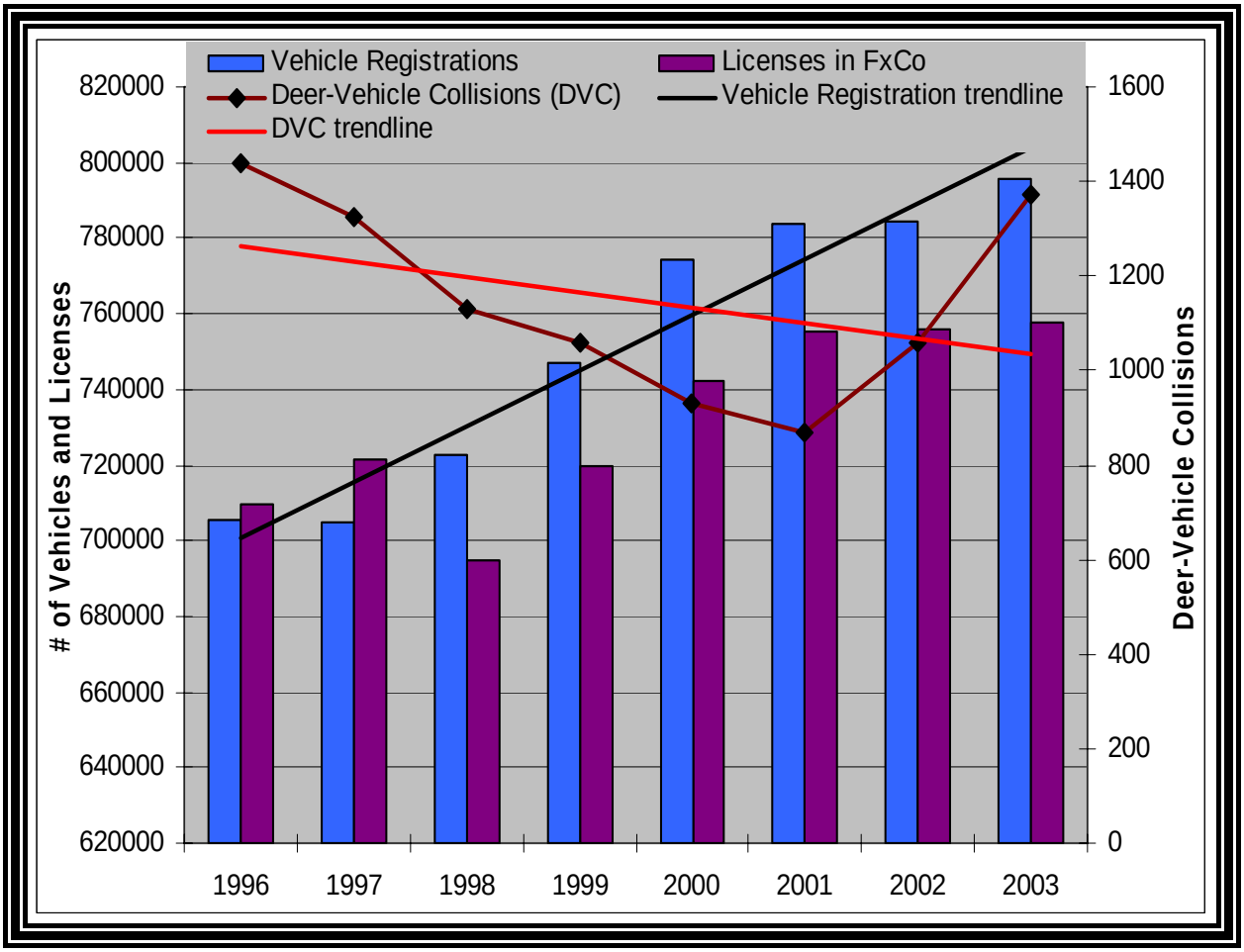
TRENDS IN DEER-VEHICLE COLISIONS IN FAIRFAX COUNTY

Mr. Michael A. Uram, Crime Analyst (retired) for the Fairfax County Police Department collected and documented data on deer-automobile collisions (DVCs) from 1998 through most of 2003. This data set included 900 DVCs which occurred between January 1998 and September 11, 2003. Deer-vehicle collision data was collected on many variables. These included the location of the accident, date of accident, day of the week, hour of the day, point of impact, habitat description, make of vehicle, age of driver, driver's years of experience, speed of vehicle, etc.

From this data, some interesting points surfaced. The most common day for a DVC was Friday. The most common time was between 7:00 p.m. and 8:00 p.m. It might be expected that inexperienced drivers would be more likely to be involved in a DVC. The Fairfax County data shows, however, that drivers between the ages of 36 and 40 with an average of 20 years driving experience comprised the most common demographic. Male drivers were involved in 64.7% of the DVCs studied.

The most common location for DVCs was not rural areas but was actually residential areas (52.1%) followed by business areas (22.3%). Most vehicles (61.3%) involved in DVCs were traveling between 35 mph and 45 mph at the time of impact. Average vehicle damage for this period was $2,142.33 with a total estimated property damage of $1,928,095.00.

There were 1,371 deer picked up on Fairfax County roadways in 2003, up from 1,057 in 2002. This represents only the second increase since the initiation of the Deer Management Program. The increase is a result of many combined factors including an increase in traffic volume, registered cars, human population, urban development, and loss of habitat. Figure A2.10 reveals the trends and correlation in the number of licensed drivers registered in Fairfax County, the number of vehicles licensed in Fairfax County and the number of deer-vehicle collisions in the County since 1996. Since 1996 there has been a ten percent increase in registered vehicles and a seven percent increase in licensed drivers within Fairfax County. In contrast the number of deer vehicle collisions has decreased five percent. The actual increase in traffic would be much greater. These numbers do not include the increased traffic associated with population growth in neighboring counties and their use of Fairfax County roadways. As an example, Fairfax County's population has increased 11 percent since 1996; however, Prince William County and Loudon County populations have increased 23% and 73%, respectively. The Virginia Department of Transportation (VDOT) predicts a five percent increase in traffic volume each year due to population growth in and around Fairfax County. If deer collisions had risen at this same rate (five percent), there would have been 2,023 deer picked up by VDOT during 2003 in Fairfax County.



- 2003 data represents the 2003-2004 Fiscal Year

Figure A2.10 reveals the relationship between; the number of licensed drivers in Fairfax County, the number of vehicles registered in Fairfax County and the number of deer carcasses reported to VDOT on Fairfax County roadways from 1996 to 2003.

Alcohol Related Accidents

For quite some time, citizens have benefited from substantial public education campaigns on the dangers of drinking and driving. As a result, most people realize the threat that this deadly combination can pose to everyone using our highways. How does this threat compare with DVCs? If we compare a conservative estimate of the number of DVCs with the known number of alcohol related accidents for Fairfax County, the scale of the problem becomes more apparent. One study (Decker *et al*., 1990) determined that actual DVCs are six times higher than the number reported as recovered carcasses. However, this figure would be greatly influenced by average vehicular speed as well as a number of other factors. In Fairfax County, a conservative estimate of deer killed by vehicles is calculated by multiplying the number of dead deer picked up by a factor of two. The following graph, Figure A2.11 compares this data over recent years. The actual number of DVCs will likely remain unknown. If the actual number is closer to 6 times the number of recovered carcasses, then its magnitude is substantially greater than that depicted in the following graph. By this standard, the year 1997, which had the highest recorded

number of dead deer pick-ups (1,887), would have had an estimated 11,322 DVCs compared to 849 alcohol related accidents. In that year, the number of DVCs would have been 13.33 times greater than the recorded alcohol related accidents.

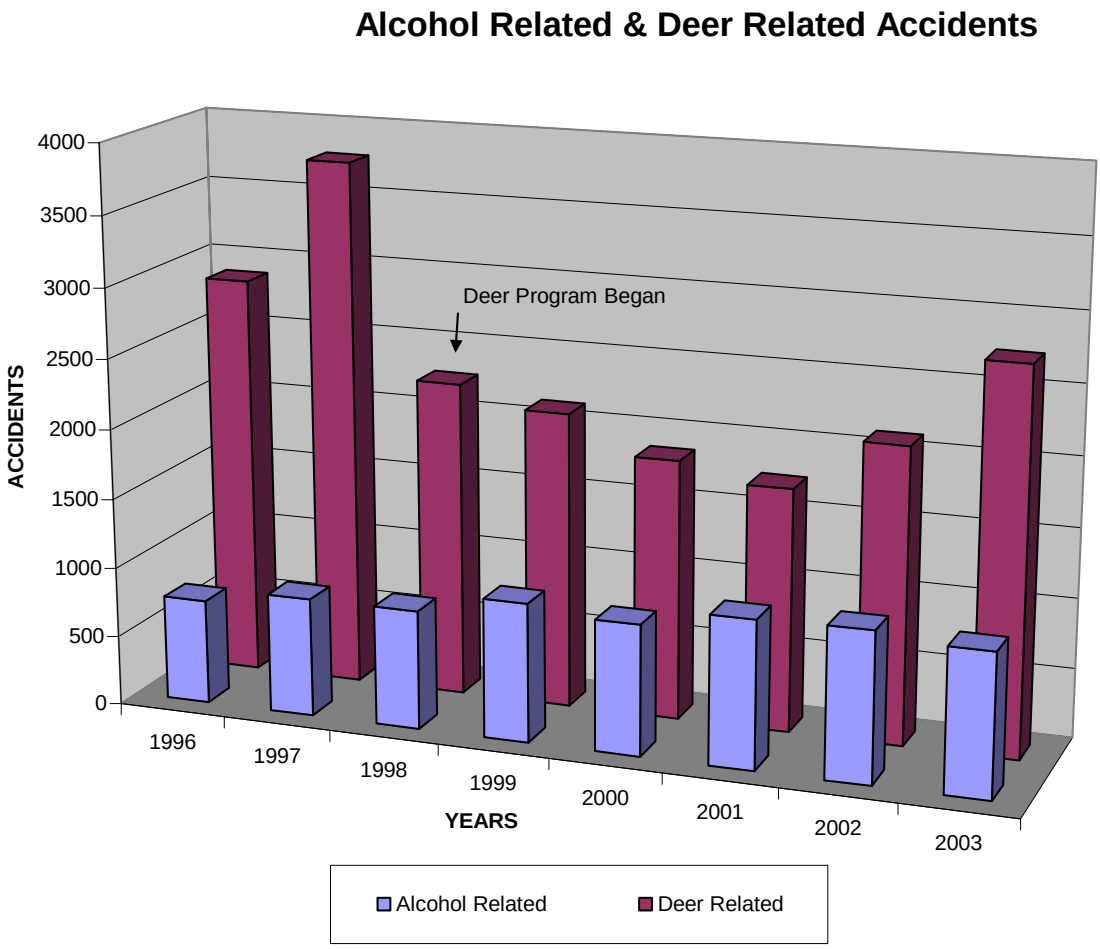


Figure A2.11 Alcohol Related and Deer Related Accidents 1996 to 2003.

Dynamics of Herd Growth

Deer population estimates were conducted by the Wildlife Biologist in four County parks in 2002 using infrared-triggered cameras and a ratio driven model as designed by Harry A. Jacobsen *et al.* (1997) at Mississippi State University. The survey can only be conducted when male deer have their antlers so there is limited time to accomplish this laborious task. The model computed deer densities between 37deer/mi^2 and 185deer/mi^2 in the park censuses. The model only estimates deer populations and many factors can influence deer behavior and thus the model. These factors include food availability, mating behavior, local hunting pressure, social hierarchy, adjacent land uses, and human activity. Deer do not recognize park boundaries and thus are in constant flux in and out of the parks.

Aside from estimating deer densities, the camera surveys produce a fawn to doe ratio which sheds light on herd reproduction and herd growth. The ratio of fawns to does in 2003 was 0.57

fawns per doe up from 0.43 in 2002 indicating an upward trend. These numbers not only show greater reproduction but also increased fawn survival and are considerably higher than the average VDGIF data for the Northern Piedmont region provided by archers at 0.38 for 2002 and 0.38 for 2003 (Matt Knox, VDGIF, Personal Communication). Fetal production rates for 2003 were calculated using 2003-2004 culling data. The fetal production rate for 2003 was 1.35 fetuses per adult doe, down from 1.42 in 2002.

Reproductive rates are only one part of the population picture. In developing suburban and urban areas, the loss of habitat pushes wildlife into ever decreasing spaces. This factor alone will tend to drive DVC rates up. Remaining deer habitat becomes fragmented requiring deer to cross highways in order to access traditional feeding or bedding areas.

Mortality represents the other side of the balance beam. Mortality can come from many sources but in urban areas, the automobile is usually the top predator. It is important to record and track other causes of deer mortality in order to develop an accurate understanding of the deer population within the County. Mortality sources include the following:

Road-killed Deer

A study by Allen and McCullough in 1976 indicated that deer-vehicle collisions are fatal to deer 92 percent of the time. Many deer struck by automobiles will never be included in deer carcass reports. These would include those which died off the right-of-way and those deer picked up by others. In Fairfax County, there were 1,371 deer carcasses reported to the Virginia Department of Transportation (VDOT) during 2003. A conservative estimate of deer killed by vehicles in Fairfax County during 2003 would be 2 × 1,371 and this number will be used to account for deer which died off the right-of-way and those deer picked up by others. As mentioned earlier Decker *et al*., 1990 had determined that actual deer-vehicle collisions are six times higher than the number reported as recovered carcasses. However, this figure would be greatly influenced by average vehicular speed and other variables.
Total…….……..….2,742

Destroyed As a Result of Injury

Fairfax County Animal Control Officers and Police Officers are routinely dispatched to answer calls regarding injured deer. Most of these deer were injured as the result of an automobile accident. The other most common cause of the injury is due to a collision with a stationary object (fence, plate glass window, etc.). The following data is for the 2003 calendar year.
NOTE: These deer should be considered as a portion of the VDOT number given above and NOT as additional deer. After an officer dispatches a deer, VDOT is notified of the location to expedite its pickup.
Total……....195

Epizootic Hemorrhagic Disease (EHD)

EHD was first diagnosed in Fairfax County during the fall of 1999. Fifty-three dead deer were found in the southeastern portion of the County. This disease is of no threat to humans. Weather plays an important role in this disease. If the late summer weather is conducive to the production of the insects which transmit the disease, another episode could follow. There were no known outbreaks of EHD in Fairfax County since 1999.

Kill Permits

The Virginia Department of Game and Inland Fisheries (VDGIF) issues kill permits to property owners who can show evidence of deer damage. These permits allow the property owner or those designated by the owner to kill deer on the property outside of the normal deer hunting season. The importance of this program cannot be overstated. The deer taken under this method and those taken during the regular deer hunting season are currently the only means available to provide relief to private communities. Although some larger properties utilize firearms, most of the deer are taken with archery equipment. The number of permits issued each year should not be used as a measure of deer damage. The method of issuing such permits has changed, as has public awareness of this option. The VDGIF issued Fairfax County residents 187 kill permits in 2002 (a 26 percent increase from 2001), and these resulted in 249 deer being harvested. Of these 249 deer, an impressive 208 were does.
Total……..……..249

Hunting on Private Property

In the 2003-2004 deer hunting season, there were 915 deer taken by hunters on private properties within Fairfax County. Most of these deer were taken by bowhunters.
Total…….915

METHODS USED TO REDUCE DEER-VEHICLE COLLISONS IN FAIRFAX COUNTY

General Education

Education efforts included a wide variety of outreach programs. Television, radio, web pages, brochures, newspapers, magazines, and public presentations have all been used to inform the public about the Deer Management Plan and the actions being taken. The Environmental Quality Advisory Council's *Annual Report on the Environment* has a section devoted to environmental impacts of deer. A brochure on Fairfax County Deer Management has been printed. There is a Fairfax County Deer Management web page, as well as the Fairfax County Police Department's Deer Crashes web page. Cards have been printed with the URL of the Deer Management web page for distribution at major events and other public functions. The acquisition of additional reference books on deer related topics is an ongoing contribution by public libraries.

An interactive display on living with urban wildlife is presented each year at the Celebrate Fairfax Festival as well as other large events. Celebrate Fairfax provides an opportunity to reach a large number of County citizens. These large events are perfect venues for wildlife displays.

The County's cable television channel runs an updated segment about deer and the County's Deer Management Program seasonally. A special program was produced about the overabundance of deer and the associated problems. This program is also repeated seasonally. The Police Department Public Information Office produces a news release on safe driving tips to heighten public awareness of the increased hazard that deer pose during the fall rut.

Fairfax County Park Authority (FCPA) has developed displays about deer at their nature centers. FCPA has also established demonstration deer exclosures in various parks to educate visitors on the effects of deer overbrowsing on park habitats.

The Wildlife Biologist, in partnership with the Police Department's Crime Prevention officers, uses this well-established program as a means of meeting with local communities to answer citizen wildlife concerns and to disseminate information about the County's wildlife programs.

Staff education is also an important facet of the program. Various meetings have been held to ensure that staff is aware of the details of the Deer Management Program and are better able to respond to citizen inquiries. Staff briefings have been presented to Board of Supervisors staffs, the Police Department Public Information Office, Police Department station roll call meetings, the Office of Public Affairs, and the Fairfax County Park Authority park managers.

Signs

The Fairfax County Police Department, the Fairfax County Wildlife Biologist and the Virginia Department of Transportation (VDOT) work cooperatively to identify areas of high DVCs. Passive deer crossing signs are placed by VDOT at many of these locations. It is generally accepted that the effectiveness of these signs diminishes with time. Drivers tend to become accustomed to seeing such signs and do not necessarily alter their driving behavior. Even if drivers do adjust their speed in response to the signs, if they do not see deer near the signs, they tend to ignore future warnings (Putman, 1997)

Underpasses and Road Design

Two underpasses designed as wildlife crossings were constructed beneath the Fairfax County Parkway in the mid 1990's. These structures were recently monitored by the Virginia Transportation Research Council as part of a study to determine the effectiveness of underpasses in terms of use by wildlife and the associated reduction in DVCs (Donaldson, 2005). Other road construction projects throughout the County have employed sound abatement walls and fencing to minimize DVCs.

Reflectors

The Fairfax County Police Department has completed a three year Deer Crash Abatement Program. The program was primarily funded through Virginia Department of Motor Vehicle grants totaling more than $81,000. Roadside reflectors were installed along seven sections of highway within the County. The first three of the locations were completed by November of 2000. Deer Related Crash data was collected and compiled for these sites. The remaining sites have not been completed long enough to make significant data analysis practical.

For clarification, it is important to differentiate between the terms “deer related crashes” and “dead deer pick-ups.” Deer related crashes is a term used by the Police Department to designate accidents in which a collision with a deer results in personal injury or property damage of $1,000 or more. Dead deer pick-ups are the number of dead deer removed from highway rights-of-way by the Virginia Department of Transportation (VDOT). Mike Uram, Fairfax County Police Department Crime Analyst (retired), compiled the number of deer related crashes and the dead deer pick-ups from 1998 to the installation date and from the installation date to February 2002. This was done for each of the first three sites.

The first site is the section of Telegraph Road between South Kings Highway and Old Telegraph Road. This site showed an increase of 8.6 percent in deer related crashes and a decrease of 70 percent in dead deer pick-ups. The second site is the Fairfax County Parkway between Braddock Road and Popes Head Road. This section showed a decrease in both categories. Deer related crashes decreased 61 percent and dead deer pick-ups decreased by 42 percent. The third site is the Fairfax County Parkway between Franklin Farm Road and Sunrise Valley Drive. Here deer related crashes decreased 42 percent while dead deer pick-ups increased 75 percent. As these figures indicate, no conclusions can be correlated with the use of these reflectors. During the period of study, two of the sites were significantly altered by the construction of high sound abatement walls making the sites virtually impassible to deer.

Deer Population Reduction

Fairfax County has utilized both managed hunts and sharpshooting to locally reduce deer herds. Managed hunts are currently being used in Fairfax County by the Northern Virginia Regional Park Authority, Fairfax County Park Authority, Mason Neck National Wildlife Refuge, and Mason Neck State Park. Managed hunts have proven to be a practical, effective and economical technique to reduce deer herds on tracts of public lands within Fairfax County.

The Fairfax County sharp-shooting program has proven to be safe, effective, and economical as well. Other communities from across the country look to this program as a model of success. Local jurisdictions from both Virginia and Maryland have worked with our staff in the past or are currently doing so to design and implement similar programs.

FEDERAL: NATIONAL PARK SERVICE
NATIONAL CAPITAL REGION

WHAT IS THE PROBLEM WITH WILDLIFE-VEHICLE COLLISION?

Reported deer-vehicle collisions in Rock Creek Park have increased over 200 percent between 1994 and 2004. Since many of the collisions that take place in the park go unreported, these numbers are probably far below the actual numbers of deer that are struck in the park.

Many of the National Park Service (NPS) lands in the National Capital Region (NCR) are within the jurisdiction of the MWCOG region. These include Prince William Forest Park, Manassas National Battlefield, Wolf Trap Farm Park, George Washington Memorial Parkway (Clara Barton Parkway), Chesapeake and Ohio Canal National Historical Park, Rock Creek Park, National Capital Parks-Central, and National Capital Parks-East (Baltimore Washington Parkway and Suitland Parkway). Parks that are in the NCR but outside the jurisdiction of MWCOG are Harpers Ferry National Historical Park, Antietam National Battlefield, Monocacy National Battlefield, and Catoctin Mountain Park.

With the exception of Rock Creek Park (Figure A2.12), most of the parks within the MWCOG's area do not have accurate data on deer-vehicle collisions. Anecdotal information obtained from park maintenance staff who are responsible for removing deer carcasses from park roads report that on the George Washington Parkway a total of 25 to 50 deer are struck per year; 10 to 20 per year are struck on the Clara Barton Parkway; and 25 to 30 deer per year are struck on the Baltimore Washington Parkway. Numbers of collisions at Prince William Forest Park and Manassas are unknown. Two parks outside the MWCOG area do have more accurate deer-vehicle collision numbers. These are Antietam and Catoctin.

WHY IS THIS A PROBLEM?

The National Park Service is mandated to protect and preserve wildlife populations on park land to allow for the enjoyment by future generations. Wildlife-vehicle collisions are significantly reducing some populations in the park and are making it more and more difficult to sustain these populations. Small, isolated populations of reptiles and amphibians are especially vulnerable to even a few losses caused by traffic. Populations of opossum and gray fox may have been reduced by vehicle collisions as well.

Although serious injuries to motorists have not been reported from wildlife-vehicle collisions on park roads, significant property damage is occurring which may lead to increases in insurance costs and possibly medical costs. The NPS is also concerned that a deer-vehicle collision may lead to a human fatality.

In addition, to the above concerns, wildlife-vehicle collisions on park roads cause traffic back-ups and cost time when employees respond to remove carcasses from roads.

IS THIS A DEER POPULATION PROBLEM OR A HUMAN POPULATION PROBLEM?

The NPS thinks it is both a deer population problem as well as a human population problem. The expansion of the Washington Metro area outward in all directions has created ideal habitat for deer. Where there were once unbroken tracts of woods and agricultural areas, now there is a mosaic of woodlots and housing developments that create edge habitats that deer favor. These isolated, islands of forest habitat are often connected by stream valleys, trails, parkways, and greenways that allow deer to move from area to area.

Deer densities in the NCR parks indicate that all of the parks are now over 40 deer per square mile. Several parks (Catoctin, Monocacy, and Manassas) are close to 200 deer square mile. All parks, except Prince William, show evidence of deer overpopulation. Browse lines are evident, vegetation has been altered, and little or no tree regeneration is present.

FIGURE A2.12. Deer-Vehicle Collisions, Rock Creek Park, 1989-2004

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1989	1	1	0	0	0	0	0	0	0	0	0	0	1
1990	0	0	0	0	2	0	0	0	0	0	1	0	3
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	1	2	4	2	9
1993	0	0	0	0	2	0	1	0	0	1	2	0	6
1994	0	0	0	0	0	4	0	0	0	2	8	2	16
1995	2	5	0	0	1	0	0	2	1	5	2	1	19
1996	0	1	2	0	1	0	2	0	2	1	2	1	12
1997	2	0	1	2	0	4	1	1	3	6	8	2	30
1998	1	0	2	2	0	1	0	0	2	4	5	3	20
1999	3	0	4	1	2	1	1	3	2	4	1	0	22
2000	1	1	1	0	0	0	4	0	3	7	5	2	24
2001	1	4	0	2	0	2	4	1	2	6	6	4	32
2002	3	0	1	1	4	0	3	4	3	4	1	1	25
2003	1	1	2	3	4	2	1	4	1	7	8	5	39
2004	1	1	3	0	3	2	6	1	4	3	5	7	36

National Parks With Yellow-Diamond Deer Warning Traffic Signs

Great Falls, Virginia
C&O Canal, Great Falls, Maryland
National Capital Parks East
Rock Creek Park

Catoctin Mountain Park also has a road that was designed with curves and turns to reduce speeds.

National Parks With No Deer Warning Signs

Manassas Battlefield
Antietam Battlefield
Harper's Ferry
Catoctin Mountain Park

FOCUS ON ROCK CREEK PARK, WASHINGTON, D.C.

Wildlife/Vehicle Collisions 1995-2003

Since 1995, wildlife vehicle collisions involving white-tailed deer have been increasing on the roads in and around Rock Creek Park. A total of 223 deer carcasses have been reported in the period of 1995 through 2003. Increasing deer populations coupled with a high volume of vehicular traffic on park roads has led to more deer vehicle conflicts.

Rock Creek Park, a unit of the National Park Service, was created by an act of Congress in 1890 to preserve the natural features of the lower Rock Creek valley and at the same time create a public park and pleasuring ground for the people of Washington, D.C. Located entirely within the District of Columbia the park comprises nearly 3,000 acres. Numerous entry routes are used to access Rock Creek Park. The access point most heavily used by visitors is the Rock Creek and Potomac Parkway. From north to south, other major points of entry include Beach Drive at the Maryland State Line along with several other roads.

The following case study will highlight the traffic volume on two park roads, Beach Drive and the Rock Creek and Potomac Parkway between 1995 and 2003. Wildlife vehicle collisions will also be described for this time period and data will be presented showing the increase of reported deer collisions on these two roads between 1995 and 2003. Although several species of wildlife are impacted by traffic volume in the park, white-tailed deer will be highlighted because of their large size and the potential for serious property damage caused by collisions with the same.

Collisions with vehicles kill or injure terrestrial and semi-aquatic animals on roads in Rock Creek Park, along the Rock Creek and Potomac Parkway, and on adjoining city streets. Since 1980, the park staff has kept informal counts of carcasses along roads and streets within and adjacent to the park and parkway. The data include species, date, and location where each carcass was found. The counts are non-systematic and were collected incidental to other

activities. Because of the informal nature of the data collection and the frequent removal of roadkill carcasses by scavengers such as crows and raccoons, the park roadkill counts probably are lower than actual animal deaths. Larger, more conspicuous animals, particularly mammals, tend to be more represented in the count, as opposed to smaller animals such as songbirds, amphibians, and reptiles that are more easily overlooked or scavenged.

For the nine years between 1995 and 2003, park staff recorded 1,165 roadkilled carcasses. Table A2.6 summarizes these data by class and by selected species.

Table A2.6. Recorded roadkills in and adjacent to Rock Creek Park and the Rock Creek and Potomac Parkway, 1995 to 2003

Type	Number	Percent of Total Roadkills Recorded
Total Recorded Roadkills, 1995 to 2003	1,165	100
Mammals	1,018	88
Squirrel	412	35
Raccoon	278	24
Opossum	55	5
Deer	223	19
Fox	19	2
Other	32	3
Birds	75	6
Reptiles	50	4
Others	22	2

Between a quarter and a third of the annual recorded roadkill in the park and vicinity occurs on Beach Drive. Beach Drive, which runs generally north and south, is the main route through the northern portion of the Park. Beach Drive extends approximately 6.6 miles from the Maryland State Line at the Park's northwestern boundary to its intersection with the Rock Creek and Potomac Parkway south of the National Zoo. For example, in the year 2003, 130 carcasses were recorded, including 35 on Beach Drive. Of these 35 recorded roadkills in 2003, 11 were deer.

The Rock Creek and Potomac Parkway is a four lane parkway that extends approximately 2.6 miles south from its intersection with Calvert Street to its intersection with Ohio Drive and Parkway Drive just south of the Theodore Roosevelt Bridge. The Parkway is a limited-access facility which currently serves as a primary urban commuter route within the District of Columbia. In the year 2003, 9 carcasses were recorded on the parkway. Recorded deer kills represent about 55% of the total number of roadkills on the parkway in 2003 (5 of 9).

For the purposes of this case study, reported deer carcasses were separated out of the total number of reported roadkilled animals on Beach Drive and the Rock Creek and Potomac Parkway. Table A2.7 summarizes the roadkilled deer carcasses that were recorded on Beach Drive and the Rock Creek and Potomac Parkway from 1995 to 2003. The Table also shows the percentage of the annual total of deer roadkills recorded on each road for each year.

Table A2.7. Recorded roadkilled deer on Beach Drive and Rock Creek and Potomac Parkway, 1995 through 2003. Number in parenthesis indicates the percentage of annual total of roadkilled deer

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
Beach Drive	4(21)	3(25)	7(23)	7(35)	5(23)	4(17)	8(25)	7(28)	11(28)	56(25)
Rock Creek Parkway	3(16)	4(33)	5(17)	2(10)	5(23)	1(4)	4(13)	5(20)	5(13)	34(15)
Annual Total	19	12	30	20	22	24	32	25	39	223

The above data show that recorded deer carcasses have increased over time on both Beach Drive and the Parkway. This is also consistent with the population estimates of the park's deer density. National Park Service staff began conducting trend counts of the park deer population in September, 1996. These counts have been repeated each year since then and have shown a four fold increase in deer numbers. Beginning in 2000, park staff began estimating fall deer density using the Distance method. Population estimates have climbed from approximately 59 deer per square mile to 99 deer per square mile in the four years that the estimate was conducted. These numbers are consistent with the region-wide increase in deer numbers and the subsequent increase in deer vehicle collisions.

Traffic volumes are the best indicator of the use of a highway system. This data is also the primary indicator of vehicle utilization of the Park roads. Daily traffic volumes are obtained at two permanent National Park Service traffic counters: one at the intersection of Beach Drive and Joyce Road, the second on the Rock Creek and Potomac Parkway north of Waterside Drive. Seasonal variations in traffic volumes at Rock Creek Park are not as extreme as those that might be seen at a traditional rural park. This consistency in traffic volumes is due to the high number of commuters using Park roads, and the Park's location within a large metropolitan community. The Parkway data shows even more consistent use throughout the year than does the Beach Drive data. Table A2.8 shows the daily traffic volumes on Beach Drive and the Rock Creek and Potomac Parkway in October. The table also shows data for October of 1995 and October of 2003.

Table A2.8. Traffic volumes on Beach Drive at Joyce Road and the Rock Creek and Potomac Parkway at Waterside Drive, October 1995 and 2003.

	Beach Drive Southbound at Joyce Road 1995	Beach Drive Southbound at Joyce Road 2003	Rock Creek Parkway at Waterside Dr. North 1995	Rock Creek Parkway at Waterside Dr. North 2003	Rock Creek Parkway at Waterside Dr. South 1995	Rock Creek Parkway at Waterside Dr. South 2003
Total Vehicles for Month	86,707	75,925	303,672	288,014	331,540	319,851
Average for 31 Days in Month	2,797	2,449	9,796	9,292	10,695	10,318
Total Weekday Volume	81,460	73,354	220,343	217,419	255,352	253,523
Weekday Average	10,016	9,453	10,016	9,453	11,607	11,023

The data above show that traffic volumes during the month of October have remained basically the same or decreased somewhat on park roads during the period from 1995 to 2003. As part of the development of a General Management Plan (GMP) for Rock Creek Park, a transportation study was conducted on park roads to aid in the planning process for the GMP. As part of the transportation study vehicle speeds were analyzed on park roads. The study found that most visitors drive at or above the posted speed limits on Park roads. The speed data indicated that the average 85th percentile speed (the speed at or below 85 percent of the traffic is moving) on Beach Drive is 39 to 40 mph, which is 15 mph over the posted speed limit of 25 mph. The average 85th percentile speed on the Rock Creek Parkway was 42 to 43 mph, which is eight mph over the posted speed limit of 35 mph.

All of the above data indicate that several factors could be contributing to the increase in the number of vehicle collisions involving deer. Increasing deer populations can certainly be the major cause of the increase in deer collisions. Traffic volume numbers from the month of October presented do not seem to indicate that traffic can be the sole reason for higher numbers of roadkills. High speed and driver inattentiveness could be reasons for increased numbers of carcasses. To accurately portray the cause of these higher numbers, a more detailed study would need to be conducted that could examine factors contributing to each deer vehicle collision. This type of analysis would allow trends or similarities between incidents to be identified.

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APPENDIX SECTION 3

PERSPECTIVES ADDENDUM

Beyond official government, however, there are other perspectives to be considered by those who also have a stake in this issue. Some of those stakeholders provide their unique perspective in the views that follow:

AMERICAN INSURANCE ASSOCIATION
David F. Snyder, Vice President and Assistant General Counsel

According to Mr. Snyder, "Collisions with wildlife are a serious, although not the most serious, highway safety issue. Eliminating totally such collisions is challenging and may require long term strategies. But there are some things that every driver can do to reduce the risk of collisions and injuries after one occurs. The first is to wear seatbelts at all times. So, if the unexpected occurs, vehicle occupants have as much protection as possible. The second is to constantly focus on driving when driving, whether in urban, suburban or rural areas, during night or day and in good or bad weather. This will give the earliest warning and the greatest ability to respond. The third is to adjust driving speed to driving conditions, such as low visibility, and abide by posted speeds and warnings."

In its research the COG Wildlife-Vehicle Avoidance Working Group reviewed reports from the Insurance Institute for Highway Safety (IIHS) that forms a background for this issue. IIHS is an independent, nonprofit, scientific and educational organization dedicated to reducing the losses -- deaths, injuries, and property damage -- from crashes on the nation's highways. The Institute is wholly supported by auto insurers.

The following two excerpts from the IIHS publication STATUS REPORT lay out the issue from the auto insurers' perspective.

STATUS REPORT
Volume 40, Number 1, January 3, 2005
"Human deaths in crashes with animals can be reduced, even without reducing the collisions"

Most deaths in collisions with deer and other animals occur in subsequent events when a vehicle runs off the road or a motorcyclist falls off the bike. Many of these deaths wouldn't occur with appropriate protection. In a new study of the characteristics of fatal vehicle-animal crashes, the Institute found that 60 percent of people killed riding in vehicles weren't using safety belts, and 65 percent of motorcyclists killed weren't wearing helmets.

"A majority weren't killed by contact with the animal," says Allan Williams, the Institute's chief scientist. "As in other kinds of crashes, safety belts and motorcycle helmets could have prevented many of the deaths."

Fatal crashes involving animals have increased, federal government data show. During 1998 to 2002, the annual average was 155 crashes in which vehicle occupants died. This compares with an average of 119 during 1993 to 1997. In 2003 there were 201 fatal crashes, a 27 percent increase compared with 2002.

The Institute examined 147 police reports on vehicle-animal collisions in which there were human fatalities. The deaths occurred in nine states in different regions of the country, Colorado, Georgia, Minnesota, Missouri, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin. The reports account for 32 percent of fatal vehicle-animal crashes in the United States during 2000 to 2002.

Passenger vehicles were involved in more than half of the crashes. Motorcycles were the striking vehicles in more than one-third even though registered cars, SUVs, and pickups outnumber motorcycles by about 40 to 1.

Usually a single vehicle: Eighty percent of the collisions with animals involved one passenger vehicle, motorcycle, truck, all-terrain vehicle, or moped. In 38 percent of the crashes a motorcycle struck an animal, and the rider fell off. Thirty-six percent of the crashes involved a passenger vehicle or truck striking an animal and then running off the road and hitting an object or overturning. In five percent of the crashes, the animal went through the striking vehicle's windshield.

Twenty percent of the crashes involved multiple vehicles. In half of these, the struck animal became airborne and went through the windshield of an oncoming vehicle. The other crashes resulted in deaths when the vehicles that struck animals then hit other vehicles or a second vehicle struck the animal and then ran off the road.

"Belts and helmets could have made a difference," Williams says. "The absence in most states of helmet laws covering all riders is a factor. In states with universal helmet laws, 80 percent of cyclists were helmeted, compared with 14 percent in states without such laws."

Deer are biggest problems. Deer were struck in three out of four of the crashes. These crashes were most likely to occur in late fall, coinciding with deer breeding and migration. The impacts occurred most often in rural areas, on roads with 55 mph or higher speed limits, and in darkness or at dusk or dawn.

An estimated 1.5 million deer-vehicle crashes occur each year on U.S. roads, resulting in at least $1.1 billion in vehicle damage. A recent Institute report identified countermeasures that could reduce collisions (see *Status Report*, Jan. 3, 2004; on the web at iihs.org). One method that's proven not to work is the use of whistles mounted on vehicles.

"The best defense to avoid injury is for the people in vehicles to use their safety belts and for motorcyclists to wear helmets," Williams says.

Types of vehicles that struck animals, killing vehicle occupants		
	Number	**Percent**
Passenger vehicles	**80**	**54**
Motorcycles	**55**	**37**
Medium or heavy trucks	**9**	**6**
All-terrain vehicles, mopeds	**3**	**2**

Note: If more than 1 vehicle struck an animal, the first striking vehicle is indicated.

Animals in the collisions in which vehicle occupants were killed		
	Number	**Percent**
Deer	**113**	**77**
Cattle	**13**	**9**
Horses	**9**	**6**
Dogs	**9**	**6**
Bear	**1**	**1**
Cat	**1**	**1**
Opossum	**1**	**1**

Types of vehicle-animal crashes in which vehicle occupants were killed		
	Number	**Percent**
Single-vehicle crashes		
Motorcyclist or operator of all-terrain		
vehicle or moped struck animal, fell off vehicle	**56**	**38**
Passenger vehicle or truck struck animal,		
went off road, struck fixed object and/or overturned	**53**	**36**
Animal went through window of passenger vehicle	**8**	**5**
Multiple-vehicle crashes		
Vehicle struck animal, which then went through windshield		
of oncoming vehicle	**14**	**10**
Vehicle struck animal and then collided with another vehicle	**12**	**8**
Vehicle struck animal; then another vehicle struck same		
animal, went off road, struck fixed object and/or overturned	**3**	**2**
Other crash types	**1**	**1**

For a copy of "Characteristics of vehicle-animal crashes in which vehicle occupants are killed" by A. Williams and J.K. Wells, write: Publications, Insurance Institute for Highway Safety, 1005 North Glebe Road, Arlington, VA 22201, or email publications@iihs.org.

STATUS REPORT
Volume 39, Number 1, January 3, 2004
"Lots of approaches are under way to reduce deer collisions, but few have proven effective"

Deer-vehicle collisions pose a sizable hazard in the United States. Numerous methods have been tried to reduce such crashes, often without scientific foundation or evaluation. A new Institute-sponsored review summarizes the various approaches, finding that some are effective at least in some situations. Some methods show promise, but more research is needed. And some methods simply do not work.

Big problem is getting bigger: "The problem is definitely growing," says the study's lead author, James H. Hedlund of Highway Safety North. "Populations of deer are increasing. It's not a problem that's going to go away." The best estimate is that more than 1.5 million deer-motor vehicle crashes occur each year on U.S. roads. These collisions result in about 150 occupant deaths and more than $1 billion in vehicle damage. More precise data are hard to come by because collisions with deer often aren't reported to police. When they are, they're usually categorized along with collisions with horses, cattle, moose, elk, and other animals.

Insurers pay the costs of many deer collisions, but most companies don't code deer strikes separately under comprehensive losses. Erie Insurance Group is one company that does track deer claims separately and publishes results. The data, which come primarily from eastern states with large deer populations, estimate an average of 12 deer claims per 1,000 insured vehicles in 2002. This represents a 12 percent increase since 1998. Claims vary widely from state to state, but overall the rate of claims has increased every year except for a small decrease from 2001 to 2002.

The average cost of a deer claim in 2002 was $1,960. Such costs represented 38 percent of all comprehensive losses.

There are three general strategies to reduce deer-vehicle collisions. These include modifying driver behavior, modifying deer behavior, and reducing the number of deer. Each method reviewed in the study falls into one of these general strategies.

Fencing is effective: The only broadly accepted method of reducing deer collisions that's theoretically sound and proven effective is to install fencing, combined with underpasses and overpasses where appropriate. Fencing that's sufficiently high, long, strong, and anchored with no gaps or tunnels will prevent deer from crossing roads.

"This approach certainly works," Hedlund says. But he adds that "it's expensive and can be intrusive."

Other measures show promise: Reducing the size of deer herds also will reduce collisions with vehicles. But this approach is controversial. There's public resistance to deer kills. There also are technical questions including how much herd reduction is necessary and over how wide an area a reduction must occur to reduce collisions with motor vehicles.

Establishing broad areas of cleared ground alongside roadways reduces the foliage that might attract deer toward the road. This approach also increases the likelihood that drivers will see deer approaching the road. More studies are needed to confirm these effects.

Displaying temporary signs during deer migration periods has been shown to reduce collisions by about half (see this page).

Another potentially promising approach involves signs that activate when deer are detected near a road. Detection methods include infrared light, radar, laser, radio frequency beams parallel to roads, and heat detection cameras. Little research is available on effectiveness.

Approaches with limited effects: For more than 30 years reflectors and mirrors have been used along roads in Europe and some U.S. states. The most common system, made by Swareflex, involves reflectors on posts installed at regular intervals along the roadside. Reflected light from vehicle headlights is thought to form a visual "fence" that deer aren't expected to cross.

More than 10 studies of this and similar systems yield conflicting results. The basic behavioral questions about reflectors are whether deer can see light in the wavelengths, whether deer are reluctant to cross such light beams, and whether deer become habituated to the light beams over time. The balance of research evidence indicates little in the way of long-term effects for this approach.

Research indicates that feeding deer at stations removed from roadways can be somewhat effective in keeping deer from crossing the roads (see *Status Report*, April 3, 1993). But there are downsides including the continuing costs of this approach, the possibility of attracting more deer to the roadsides, and the likelihood that deer will become dependent on the food offered at the stations.

Limited studies have been conducted of the effects of repellents with unpleasant tastes applied to food and/or area repellents that smell unpleasant to deer. The research findings are mixed. Repellents can be effective in changing the patterns of deer feeding and movement, but they aren't likely to keep deer away from roads.

Methods that don't work: The most common approach to deer-vehicle collisions is to post permanent signs at fixed locations warning drivers of deer crossings. The locations of the signs don't vary throughout the year, regardless of whether collisions with deer are likely or not. The effects haven't been evaluated, but these passive signs are thought to be widely ignored.

The ineffectiveness of another approach has been proven. Deer whistles that attach to vehicles have been available for more than 20 years. The whistles produce ultrasonic noise (16 to 20 kHz) when a vehicle exceeds about 30 mph. The presumption is that deer will hear the noise and be

warned away. It's unclear whether deer do hear the noise, but in any event studies show the whistles have no effect on deer behavior.

"People approach this hoping to find quick and easy solutions, but there aren't any. Whistles don't work," Hedlund says.

What would help: Better reporting of motor vehicle collisions with deer would help. It also would be useful to record the precise locations of the deer collisions to identify the problem areas.

"Now that we know some measures are effective and other measures show promise, we need better data to help decide where and how to apply these measures," Hedlund concludes.

For a copy of "Methods to reduce traffic crashes involving deer: what works and what does not" by J.H. Hedlund *et al*., write to: Publications, Insurance Institute for Highway Safety, 1005 N. Glebe Rd., Arlington, VA 22201, or email publications@iihs.org.

Something that works: signs reduce deer hits

Temporary warning signs, posted in spring and fall when mule deer migrate, reduce the number of deer killed in collisions with vehicles. The signs, evaluated in an Institute-sponsored study, represent a simple and cost-effective approach to the problem.

Working with officials in Idaho, Nevada and Utah, researchers at Utah State University developed signs to warn drivers they were entering areas of increased deer activity. Unlike traditional crossing signs that remain in place all year, the signs designed for the study were displayed only during migration and featured attention-getting reflective flags and flashing lights.

Besides the warning signs posted as drivers entered migration zones, there were smaller signs posted at one-mile intervals to remind motorists of the deer migration and indicate the number of miles left in the zone.

Researchers recorded numbers of deer killed in zones where signs were posted versus similar stretches of highway without signs. Records were compiled before and after the signs were posted. Researchers also measured vehicle speeds to see if motorists were exercising caution.

The number of deer killed in signed zones was reduced by half. Vehicle speeds went down.

Temporary signs are simple to erect and maintain. The average cost of treating four miles of road was $1,740. This technique does require coordination between local wildlife biologists and highway officials to track migration seasons. The most applicable areas are western states, where mule deer follow predictable migration patterns. The movements of white-tail deer in eastern states aren't as predictable.

For a copy of “Effectiveness of temporary signs in reducing deer-vehicle collisions during mule deer migrations” by T.L. Sullivan *et al*., write to: Publications, Insurance Institute for Highway Safety, 1005 N. Glebe Rd., Arlington, VA 22201, or email publications@iihs.org.

To reiterate, the American Insurance Association believes that to prevent collisions and/or to reduce the risk of serious injury drivers need to heed the following driving recommendations:

- Focus on driving when driving
- Wear seat belts
- Do not exceed the posted speeds

The American Insurance Association believes that wildlife-vehicle collisions pose a serious, although not the most serious, highway safety issue in the United States.

AMERICAN AUTOMOBILE ASSOCIATION
AAA MID-ATLANTIC CHAPTER
John B. Townsend II

REDUCING WILDLIFE-VEHICLE COLLISIONS

"Crossing the highway late last night,
He shoulda looked left and he shoulda looked right.
He didn't see the station wagon car.
And skunk got squashed and there you are.
You got your dead skunk in the middle of the road…
(And it's) stinking to high heaven."

That catchy lyric made songwriter/folk singer Loudon Wainwright III famous after his song "Dead Skunk" became a hit in 1972. Although Wainwright has a sense of humor that is both "whimsical and earthy," as one critic puts, today the deer is likely to be the dead animal in the middle of the road. It is no laughing matter.

Now numbering in the hundreds of thousands, collisions with deer are the most common type of collision with wildlife. It is estimated 350,000 deer are killed each year in these collisions.

Such collisions are also taking a toll on human beings too. It is estimated 13,000 motorists are injured each year in these crashes, with fatalities in the hundreds.

The Virginia deer, better known as the white-tailed deer, is found in most parts of the United Sates. He can be found from "Alaska to Bolivia" and in your backyard and the busy highway you use to commute. The collision between a 3,000-5,000 pound vehicle and a white-tailed deer - with an adult weight averaging from about 100 to 350 pounds -- is not a pretty picture. It's instant carnage.

Hunted to the brink of the vanishing point in the 1800's, the white-tailed deer population has made a Lazarus-like comeback in the United States. Environmentalists cite changing land use laws, strict game laws, and a lack of natural large predators as the primary reasons for the reversal of fortunes.

Sadly, the story does not have a fabled ending like Walt Disney's immortal 1942 animated classic *Bambi*. The film about the deer born "the prince of the forest," it is said, "altered people's view of deer and their relationship to man."

Of necessity, generations of motorists who came of age with the animated classic are learning how to drive safely when the deer population is out and about. In addition to learning to live in harmony with nature, we must also learn how to cope with wildlife seeking out food and romance in the urban sprawl.

It happens each year without fail. When the rutting season and the hunting season converge, moonstruck deer and unsuspecting motorists prove that opposites crash and collide.

Each year AAA Mid-Atlantic warns motorists that more than 60 percent of these crashes in the Washington area occur from October through January. That's when the lovesick white-tailed deer population is on the move across busy roads -first during their mating season, and then foraging for food and shelter.

Nationwide, 200 people die each year in some 725,000 collisions with the deer population. More than 29,000 people are injured as a result, and hundreds of thousands of deer die on the road or of their injuries. The total cost in car repairs tops $1 billion.

Last year the average damage to cars was more than $2,200. The average number of deer/vehicles collisions in Maryland is 4,220. Reported deer/vehicle strikes across Maryland have risen by 62 percent over the past five years.

The number of yearly deer collisions in Montgomery County, Maryland increased by 105% in the six year period between 1996-2001. In just one year the number of deer-vehicle collisions dramatically increased by 28 percent in Virginia. The number soared from 4,727 in 2000 to 6,030 in 2001.

Deer-vehicles collision rates are skyrocketing in the area as the deer population continues to escalate. Compounding matters, the autumnal rise in deer-vehicle collisions occur during rush hours.

During the rutting season, deer and motorists are on the move during the same hours, at dawn and at dusk. The old cliché of the deer stuck in the headlights is true. Like moths, they are attracted to lights. It's deadly.

To avoid becoming a statistic, use common sense -- wear safety belts, stay awake, alert and sober. To avoid deer, AAA Mid-Atlantic offers the following tips:

- Deer make driving dangerous even on residential and city streets. To protect them, your passengers, and yourself, drive defensively.

- Buckle up. Your odds of walking away from a collision with a deer improve dramatically if you and all your passengers are wearing seat belts.

- Slow down! Driving at or below the speed limit improves your chances at stopping safely if a deer runs in front of you.

- If you do hit a deer, the slower speed will reduce the likelihood of seriously injuring yourself and your passengers.

- Don't rely on deer whistles, deer fences, or other gadgets – it is arguable whether they can help. But they won't prevent all deer from crossing your path.

- Instead: Pay extra attention during the pre-dawn and dusk hours, especially during the fall mating season.

- Use your high beams, and watch for the reflection of deer's eyes and their silhouettes on the shoulders of roads.

- Take note of deer-crossing signs, which indicate areas of frequent deer movement. They're not placed arbitrarily. And stay alert for deer near forested areas and farmland, especially when farmers are harvesting.

- Scan the road for deer. If you spot deer near the edge of the road, slow down to prepare for their unpredictable movements.

- If you see one deer, slow down and keep your eyes focused for more as they tend to travel single file in small herds. And remember the exact spot where you saw a deer cross the road. They are creatures of habit and often use the same paths again.

When highways become lovers' lanes for deer, it takes a human toll. According to federal officials, "In half of the animal-related accidents surveyed in 2001-02, motorists were injured by hitting the animals while the other half was hurt by swerving to avoid hitting animals."

For this reason, AAA advises motorists to abide by the maxim "Don't veer for deer!" This year, drive defensively and stay on look-out for deer. Motorists swerving to avoid deer sometimes hit another vehicle or a fixed object.

Another common result of swerving to avoid a deer is entering the median or a roadside ditch after losing control and ultimately rolling over. Interestingly, 84 percent of collisions with deer occurred at speeds of 35 miles per hour or more. If it becomes clear that you won't be able to avoid colliding with a deer, drive to survive:

- ✓ Don't swerve. Few drivers die or are seriously injured in a collision with a deer – except when they try to dodge it, and veer into oncoming traffic, a tree, or off the road.

- ✓ It is generally safer to hit the deer than run off the road or risk injuring another motorist.

- ✓ Brake until the last fraction of a second before impact, then let off your brakes. This will cause the front end of your car to rise, increasing the odds that the struck deer will pass underneath your car, instead of being launched into your windshield and seriously injuring you or your passengers.

- ✓ If you do strike a deer, do not touch it or try to move it yourself.

- ✓ Always remember, report the crash to local law enforcement.

AAA Mid-Atlantic reminds motorists that deer crashes are life-threatening and costly. For the safety of motorist and animal, exercising caution is key.

METRO TRAFFIC NETWORKS
Jim Russ, Director of Operations

WHAT IS THE PROBLEM WITH WILDLIFE-VEHICLE COLLISIONS?

The problem is multi-faceted. First of all, there is a public safety aspect. Many wildlife-vehicle collisions result in personal injury and, in some cases, death to the occupant of the vehicle involved. Secondly, there is a time-lost quotient to a portion of the motoring public. A number of these collisions result in lane blockages and thus delays to those using the roadway where the incident occurred. Thirdly, these accidents cause property damage and therefore an actual dollar cost.

WHY IS THIS A PROBLEM?

It's obvious why this is a problem. These collisions cause injuries, deaths, property damage, dollar and time loss. I think the better question is *why does this problem exist?* Continued development and sprawl has injected increased vehicular traffic into areas previously inhabited by wildlife. There have been a couple of results. Because of the increased development, wildlife now find themselves co-existing with vehicular traffic. Squeezing wildlife out of their familiar habitats has forced a migration to other areas, some even more densely populated and saturated with traffic than the area they left behind. The increased interaction between wildlife and vehicles obviously has led to an increased level of collisions between the two.

IS THIS A WILDLIFE POPULATION PROBLEM OR A HUMAN POPULATION PROBLEM?

Both. Continued development by humans has had a number of results from the disruption of existing wildlife habitats to the forced migration of wildlife to other areas. It's also clear that there is a burgeoning population of wildlife in this area; deer in particular. With the increasing number of roads, vehicles and wildlife in this area, there can be only one result; an increased number of collisions.

Other than a public safety education campaign, I feel that there needs to be a renewed effort to control the size of the wildlife population in this area.

VIRGINIA DEPARTMENT OF TRANSPORTATION
Jim Smith {Individual Perspective}

What the DVC problem means to VDOT as an agency. First and foremost, VDOT is about public safety. The safety of the traveling public is our number one concern. Deer-vehicle collisions obviously can and do cause fatalities and considerable property damage. Needless to say, such accidents have an adverse affect on public safety.

There are two other concerns, obviously much less in importance that the safety issue. First of all, it takes manpower and equipment to respond to DVC's and to remove the dead deer. This has some affect on what other work can be accomplished with those same resources. Secondly, proper disposal of the dead deer is a problem, particularly in more urbanized areas.

Is it a deer problem, or a human problem? From my perspective, it's difficult to separate the two. It's a problem of the deer and the vehicle (human) being in the same place at the same time. And, in areas of greater traffic, those conflicts may be more frequent and possibly more involved.
In some of our fast growing counties, and as subdivisions are pushing out further into what used to be rural areas, the conflicts seem to be growing.

So, this is a deer problem in terms of losing habitat, and it's a human problem in terms of safety, resources, and proper disposal of the remains."

MARYLAND LICENSED WILDLIFE REHABILITATOR
Perrie'Lee Prouty

WHAT IS THE PROBLEM WITH WILDLIFE-VEHICLE COLLISION?

It is the property damage and possible personal injury or death to owners of vehicles that hit wildlife. But, we also have to look at the tremendous loss to our wildlife populations as a result of these vehicles collisions. Wildlife collisions are increasing across not only the metropolitan area, but across the country.

WHY IS THIS A PROBLEM?

Since most of what I do is animal rescue and transport, I find myself trying to get animals off or away from roads. I am going to comment on my observations from that point of view. Rehabilitators frequently receive calls from citizens in need of assistance with either injured or dead deer as well as other wildlife in or along roadway. Some wildlife populations can be severely affected by car hits, i.e. turtles.

Since I am on the roadway frequently especially during much of the spring and summer months, I will list the reasons that I think are causes of more animal related accidents:

1. Driving too fast for the posted speed.
Statistics on speeding will speak for itself. I am seeing drivers driving at high rates of speeds on small residential and rural roads. A local radio station hosted a program one morning during which several people bragged about how they not only speeded but avoided receiving tickets. A greater number than expected were women.

2. Inattentive drivers who may be multi-tasking as they drive.
When I am doing rescues anywhere near a road, I try to get eye contact with the driver. I have been passed by drivers who I know never saw me let alone the animal(s) in need. I will not attempt rescues on roads such as I-270 or the #495 (Beltway). I have seen an increase in drivers speeding past school buses discharging children as well as not yielding for emergency vehicles of any kind.

3. Vehicle Size (coupe v/s SUV which is more like a truck).
I am seeing more small people driving very large cars such as SUV's. After seeing a petite woman run down 3 shopping carts in parking lot, I do not believe the drivers are able to see what is directly in front of them. As a result of larger cars, I think reaction times may be slower than those in smaller cars with more visibility directly in front of the vehicle.

4. Lack of experience in crisis – need for more education.
Stopping to assist a woman who had hit a fawn on an exit ramp of I-270, I asked her if she had seen the 3 adult deer preceding the fawn. Her response to me was, "I just didn't know what to do." "I just froze." After asking several of my female friends what they would have done, I got similar responses including not even using their brakes. I think all of us need some education in defensive driving.

5. Development that is encroaching into wildlife habitats.
Rehabilitators are receiving more wildlife calls now than say eight years ago. The wildlife community is keenly aware of the effect that development is having on wildlife. If it is not from seeing animals in their yard, it is seeing them and thinking they all need to be rescued. People are seeing more of them injured along the roads. More people are calling us about nuisance animals at their residences or places of business. These are all a result of the animals trying to find food, water and shelter in and around the development. The animals are being squeezed into smaller and smaller areas with no way to move about without crossing a road.

6. Vegetation or lack of it along the roads. Stormwater ponds next to highways/roads.
Most of the rescue calls I receive are for waterfowl. Ducks and Canada Geese trying to get from nesting areas to stormwater ponds located along the sides of roads or in clover-leafs of the interstates. On several occasions I have seen deer at these ponds in broad daylight. Areas where the woods are close to the roads are areas I frequently see deer crossing in groups. I have also observed deer grazing along the sides of roads, or birds feeding on shrubs along the roads. The shrubs usually contain berries. Birds of prey (i.e. hawks) are frequently hit by cars as they forage for rodents eating discarded food along the sides of the roads.

7. Lack of fencing or barriers to stop animals from crossing roads.
My observations, like others on the working group, are that most of the dead deer are located in areas of no fencing or barrier. Examples: exit ramps on MD I-270, I-370. Dead deer as well as other wildlife have been seen at the exit areas of #495 (Beltway). Many of the animals have made it to the jersey walls where they are hit. I have on two occasions, seen 2-3 dead deer, together, at the same location of jersey wall – River Road/Burning Tree Golf Course area of #495. Other roads where I see frequent roadkill are MD #32 and #100. Both roads are without fencing. I would like to mention that there is an annual and bi-annual movement of wildlife during which times you will see more animals dead or injured along the roads. Depending on the species, these are movements for mating, foraging, post-weaning (when there is a reshuffling of territory) as well as times around nesting and birthing. Knowing the cycles of the species alerts you to the animals seen along the roads. It is during these times of movement that animals come into harms way.

IS THIS A DEER POPULATION PROBLEM OR A HUMAN POPULATION PROBLEM?

I believe it is both a deer population as well as human population problem. With the destruction of forests, the creation of farmland, the increase in housing development as well as increase in the number of people, we are creating edge habitats that are just what the deer like. Many of the plantings used are attractive to the deer. The wooded islands that might exist are not connected, in most cases, by greenway corridors which would be used by the wildlife. These isolated islands are surrounded by roads on which more and more people are traveling all times of the day and night.

CONCLUSIONS AND COMMENTS.

Humans are encroaching more and more into wildlife habitats. As a result, we are encountering them more frequently than we were 20 years ago. I think driver education should include animal

avoidance. People responsible for building roads must be more mindful of fencing, barriers and placement of stormwater ponds as well as vegetation they plant along the roads. I believe more underpasses or even overpasses for wildlife need to be part of the design for our highway/road infrastructure. I also think that our radio/television stations can assist us by including more seasonal PSA's.

Lastly, I would like to mention that as rehabilitators, we receive many calls from citizens desperately in need of assistance for large injured wildlife especially deer hit by cars but not killed. We have a difficult time getting responses from either the police departments or the Department of Natural Resources personnel. We are told to have the citizen call numbers given us by both agencies. Feedback, in the case of desperate calls tells us otherwise. If the deer is hit Monday to Friday before 4:00 PM, there is a chance someone will answer the call. Hopefully someone will respond, but that has not always been the case. After 4:00 PM. Forget it. Fact: deer are most active at dawn and dusk. Dusk is usually after 4:00 PM. 24 hour telephone number messages dealing with injured deer usually go unanswered. I think the public deserves better and more; especially the injured animal. If anything, the animal needs to be humanely euthanized. I do not know the answer to the problem; however, maybe this comment will start a dialogue to address the issue.

APPENDIX SECTION 4

EVALUATION OF STRATEGIES DESIGNED TO REDUCE DEER-VEHICLE COLLISIONS:

AN ANNOTATED BIBLIOGRAPHY

{Only the Conclusions and Recommendations Section of this Report is Presented Here}

June 30, 2004

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CONCLUSION AND RECOMMENDATIONS

Although many aspects of deer biology have been well studied, we lack a basic understanding of the anatomy and physiology related to the hearing and visual capabilities of deer, information which may prove integral to the invention of economically effective strategies to minimize deer-vehicle collisions. Further, our knowledge of deer behavior relative to roads is inadequate. Limiting our evaluations of deer-vehicle collision mitigation devices to comparisons of deer road-kill statistics, for example, tells little about the complex interaction of deer and motorist behavioral traits that leads to collisions. When conducting future tests, we should make detailed observations of deer behavior relative to the implementation of mitigation techniques and, when possible, also document motorist awareness and response to the strategies. Such data may be used to improve strategies during the design and planning stages rather than as a basis for critique after mitigation strategies are widely instituted or enter the manufacturing process.

At present, fences of the appropriate height may be the most effective method to exclude deer from roads. However, transportation and wildlife managers have an ethical responsibility to consider the potential ecological impacts of fencing on animal populations. Traditional fence designs may severely limit gene flow among populations separated by fenced roads. Fencing also may restrict wildlife access to resources critical to their survival. Crossing structures within fenced roadway corridors may provide partial habitat connectivity for some wildlife species, and have proven most successful when used where traditional migratory routes of mule deer, elk, and other migratory species intersect highways. However, white-tailed deer generally do not make mass seasonal migrations, and are more likely to cross roads within their home ranges on a daily basis. Over a single kilometer, a roadway may be intersected many times by the home ranges of different white-tailed deer in an area. A stark example of the crossing rate of white-tailed deer was reported in a study of deer mortality on a new Pennsylvania highway where Bellis and Graves (1971) documented an average of more than 22 road-killed deer/km over a 14-month period. Previous reports rated wildlife crossing structures as cost prohibitive for most applications. Considering the road-crossing behavior of white-tailed deer and the cost of wildlife crossing structure installation, reliance on fencing to prevent deer-vehicle accidents likely is not a feasible option.

Currently there is no simple, low-cost solution for reducing the incidence of deer-vehicle collisions. Like fencing, other devices, including wildlife warning reflectors and motorist warning systems, are used where deer regularly cross roads. Only instituting collision reduction techniques at select areas or “hotspots” will not guard against non-habitual deer road crossings, which typically occur during the peak seasons for deer-vehicle collisions (breeding and fawning). To guard against these collisions and to provide the most effective system for minimizing deer-vehicle collisions, we have three general conclusions and recommendations:

1) Vehicle-mounted deer warning systems may have the best potential for minimizing deer-vehicle collisions; however, to date none of these systems has been designed in accordance with the senses of deer. Therefore, future research and development of vehicle-mounted deer warning systems must be based on detailed knowledge of deer vision, hearing, and behavior.

2) Every year, motorist awareness of the danger of deer-vehicle collisions can decline over time. Therefore, agencies should develop and routinely implement education programs and/or highway warnings to enhance motorist awareness prior to and during the seasons of greatest danger for deer-vehicle collisions (breeding and fawning).

3) Deer overabundance can increase the potential for deer-vehicle collisions. Therefore, agencies and municipalities should implement proper deer herd management programs designed to control deer abundance.

APPENDIX SECTION 5

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Methods to Reduce Traffic Crashes Involving Deer: What Works and What Does Not

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ABSTRACT

More than 1.5 million traffic crashes involving deer are estimated to occur each year in the United States. These crashes produce at least $1.1 billion in vehicle damage and about 150 fatalities annually. Deer-related crashes are increasing as both deer populations and vehicular travel increase.

Many methods have been used in attempts to reduce deer crashes, often with little scientific foundation and limited evaluation. This paper summarizes the methods and reviews the evidence of their effectiveness and the situations in which each may be useful. The only widely accepted method with solid evidence of effectiveness is well-designed and maintained fencing, combined with underpasses or overpasses as appropriate. Herd reduction is controversial but can be effective. Deer whistles appear useless. Roadside reflectors appear to have little long-term effect, although additional well-designed evaluations are needed before firm conclusions can be drawn. Both temporary passive signs and active signs appear promising in specific situations, but considerable research is required to evaluate long-term driver response and to improve and test deer detection technology for active signs. Other methods using advanced technology require substantial additional research and evaluation.

INTRODUCTION

Deer and motor vehicles do not share the nation's highways gracefully or safely. Although precise data are not available, the best estimates suggest that more than 1.5 million deer-vehicle crashes (DVCs) in the United States in 2002 produced at least $1.1 billion in vehicle damage, about 150 human fatalities, and at least 1.5 million dead deer (Conover *et al*., 1995; DeerCrash, 2003; Williams, 2003a). These numbers are rising every year as both the number of deer and the amount of motor vehicle travel continue to increase.

Many methods have been proposed and implemented in attempts to reduce DVCs. Few have been documented or evaluated well. This summary reviews the methods and evidence of their effectiveness. For the methods with solid evidence we discuss conditions most appropriate for their use. For promising methods we suggest additional research. Finally, we provide data collection and reporting recommendations that, if implemented, will help to understand the DVC problem more clearly and evaluate DVC control methods more accurately.

Deer Population and Crash Trends

Deer inhabit all of the United States, including Hawaii, where they have escaped from captivity. White-tailed deer are common east of the Rocky Mountains, especially in northeastern, southeastern, and midwestern states; mule deer are found from the Rocky Mountains west, with smaller populations of black-tailed deer in some locations. In southern areas, white-tailed deer usually occupy fixed range areas year-round. In northern areas with deep snow, white-tailed deer may travel many miles between summer ranges and winter deer yards. These movements depend somewhat on winter severity and spring greenup. Mule deer have regular migratory routes between summer and winter ranges.

Deer population totals are difficult to estimate, but there is abundant evidence that deer populations have increased over the past century. McCabe and McCabe (1997) estimated a North American white-tailed population of 24-33 million in 1500, before European settlement began, which dropped below 2 million by 1900 and then rose to 16-17 million by 1997. Other estimates placed the total U.S. deer population at 25-30 million by the end of the twentieth century; for example, Knapp (2001) estimated more than 27 million deer. Knox (1997) estimated that Virginia's deer population increased from about 25,000 in 1923 to about 900,000 in 1994.

Nationwide DVC counts also are difficult to estimate, but there is strong evidence that they are increasing. Most state crash data files record crashes with animals but do not distinguish deer from other animals such as moose, elk, horses, and cattle. The National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System, a census of all fatal traffic crashes, shows an average of 154 fatal crashes involving animals in the four years 1998-2001, compared with an average of 111 in the four years 1992-95, an increase of 39 percent. NHTSA's General Estimates System estimates about 274,000 total police-reported crashes with animals annually in 2000-01 compared with 222,000 in 1992-93, an increase of 24 percent (Williams, 2003a). Data from states that distinguish deer from other animals suggest that most animal crashes involve deer: 99.7 percent in Michigan (Highway Safety Information System (HSIS), 1995), more than 90 percent in Minnesota (HSIS, 1995), and 93 percent in Pennsylvania (Williams, 2003a).

DVCs increased by 54 percent in Pennsylvania from 1994 to 2000 (Williams, 2003a), by 51 percent in Iowa from 1990 to 1997 (Hubbard *et al*., 2000), and by 69 percent in five states combined (Illinois, Maine, Michigan, Minnesota, and Utah) from 1985 to 1991 (HSIS, 1995). In 1999, 16 percent of all reported traffic crashes in Wisconsin were DVCs, up from 5 percent in 1978 (DVCR Working Group, 2000). The number of DVC claims at a major automobile insurance company rose 21 percent from 1998 to 2001 (Williams, 2003b).

Many DVCs are not reported to police. In a small telephone survey in New York, Decker *et al*. (1990) found that police were notified of about half, and insurance companies of less than half, of the DVCs. Taking the police underreporting into account, Conover *et al*. (1995) estimated that about 1.5 million DVCs occurred annually in the mid-1990s. The reported crashes alone produced more than $1.1 billion in vehicle damage (in 1993 dollars); the unreported crashes added additional vehicle damage costs. More recently, an estimated 131,500 DVCs occurred in 2000 in the five upper midwest states of Illinois, Iowa, Michigan, Minnesota, and Wisconsin, producing 23 deaths, 4,650 injuries, and $222 million in vehicle damage (DeerCrash, 2003).

DVCs are seasonal. White-tailed deer DVCs peak in October and November during the breeding season, with a secondary peak in May and June as yearling deer disperse from their birth ranges (Allen and McCullough, 1976 (Michigan data); Decker *et al*., 1990 (New York data); Puglisi *et al*., 1974 (Pennsylvania data); HSIS, 1995 (data for five states combined)). Mule deer DVCs are most frequent during the spring and fall migrations (Messmer *et al*., 2000). DVCs occur predominantly in darkness, on high-speed, two-lane, rural roads (HSIS, 1995; Williams, 2003a), especially when forest cover is close to the roadway (Finder *et al*., 1999).

Study Approach

We reviewed both published studies and other information obtained from highway safety, motor vehicle insurance, and natural resources sources. Three review studies were especially useful: Danielson and Hubbard (1998), DeerCrash (2003), and Putman (1997). The DeerCrash website (deercrash.com) contains an extensive bibliography and periodically updates summaries of information on specific methods. Studies involving animals other than deer were not reviewed systematically but were included when appropriate.

Three general strategies to reduce DVCs are to modify driver behavior, modify deer behavior, or reduce the number of deer. Each can be attempted in several ways. We summarize the theoretical basis and supporting evidence for each method and assess the available evaluation studies. We did not conduct a formal meta-analysis with specific criteria to define high-quality studies. Rather, we give more weight to methods with evidence from studies with sound designs, controls for potentially confounding influences, adequate sample sizes, and consideration of how the method's effectiveness may change over time.

METHODS TO AFFECT DRIVER BEHAVIOR

Three methods to affect driver behavior are to increase driver awareness of deer and the possibility of DVCs, improve the visibility of deer on or approaching roadways, and reduce driving speeds so drivers have more time to avoid crashes.

General Education

General education consists of efforts to provide information about DVC dangers so drivers will watch more carefully for deer and drive more slowly. Typical methods include news stories and public awareness campaigns in peak DVC seasons. About half the states use some form of general education (Romin and Bissonette, 1993; Sullivan and Messmer, 2003).

None of the general education campaigns has been evaluated. In other traffic safety areas such as impaired driving and occupant protection, stand-alone general education campaigns have not been effective in modifying driver behavior (O'Neill, 2001; Williams, 1994). Campaigns can be effective when they present new information that directly affects drivers and that is reinforced by something drivers can observe. For example, publicity announcing increased enforcement of a safety belt use law can be effective when the publicity is followed with extensive law enforcement presence. It is unlikely that DVC general education is useful unless it provides information on very specific and time-sensitive situations, such as the beginning of mule deer migration across a short road segment. In these situations, either temporary passive or active signs may be more effective than general campaigns.

Signs

Roadside signs attempt to warn drivers of specific locations and even times when deer may be present. Passive signs have a fixed message at all times, though they may use lights or animation to attract attention. Active signs are lighted when deer are detected on or near the roadway.

Passive signs: Roadway signs warning drivers of deer-crossing locations are used in almost all states (Romin and Bissonette, 1993; Sullivan and Messmer, 2003). Most are passive: fixed signs in fixed locations, with the same message in words or pictures at all times and in all seasons, usually a standard yellow diamond sign with the figure of a deer, as specified in the *Manual of Uniform Traffic Control Devices*.

No studies have evaluated the effectiveness of standard deer warning signs in increasing driver awareness of deer, in reducing driving speeds, or in reducing DVCs. Because passive signs are used so frequently at locations where deer are present only occasionally, drivers probably ignore them (Putman 1997, Sullivan and Messmer, 2003).

Lighted and animated signs: Three methods have been used to attempt to increase the effect of deer warning signs. The first is to make the signs more visible with lights, flags, or even a lighted and animated figure of a deer. In a small study of lighted and animated signs, Pojar *et al*. (1975) found a slight effect on vehicle speeds but no effect on DVCs.

Temporary passive signs: The second method, used on roads crossed by mule deer migration corridors, installs or uncovers passive signs only during migration periods. Messmer *et al*. (2000) used large warning signs with battery-powered flashing amber lights at the ends of a two-mile and a four-mile roadway section, together with smaller flashing signs at each milepost within the two sections. Travel speeds during three migration periods when the signs were displayed and activated dropped about 8 mph from pre-migration levels, and DVCs dropped by 50 percent in the spring and 70 percent in the fall migration compared with three previous years. In a more extensive study of the same technique, using a more powerful research design, Sullivan *et al*. (preprint) placed similar temporary lighted signs on five roadway sections in three states with an adjacent section, separated by a buffer section, as a control. DVCs were about 50 percent lower in signed than in control sections across all sites. Vehicle speeds also were lower in signed sections.

Active signs: The final method uses signs that are activated only when deer are detected near the roadway. Detection methods include infrared light (in Minnesota), radar (Wyoming), laser (Washington), radio frequency beams parallel to the roadway (Indiana), and heat detection cameras (British Columbia). In Washington, radio collars have been attached to 8 elk in a herd of 80 near a segment of Highway 101. Flashing "elk warning" signs are activated when any of the collared elk come within one-quarter mile of the roadway (DeerCrash, 2003).

The only evaluation of these methods to date is a small study of a segment of U.S. 30 in Nugget Canyon, Wyoming (Gordon *et al*., 2001). An eight-foot fence was erected along both sides of the roadway, with a 300-foot gap through which migrating deer could cross. Two deer detection systems were used: infrared heat sensors, and geophones that detect ground vibrations combined with infrared light beams that detect motion across the beam. Both systems detected almost all deer (very few false negatives). The heat sensor system also was activated by birds and snow (more than 50 percent false positives), while the combined geophone and infrared system had no false positives. Vehicle speeds dropped by about 4 mph when the "deer on road when lights are flashing" sign was lighted, regardless of whether the sign was triggered by a deer, a false positive, or remotely by a researcher. DVC data were not collected, and it is unclear whether the observed speed reduction would be large enough to affect DVCs.

In summary, standard passive signs, although low-cost and low-maintenance, are unlikely to have any effect, though no evaluations substantiate this conclusion. The one study of lighted signs showed no effect on DVCs. Initial results are encouraging for temporary passive signs used in defined mule deer migratory corridors during migratory periods, which can vary from year to year. More testing is needed before the potential of active signs can be evaluated accurately. The two main issues are to refine detection technology to minimize false positives and false negatives and to determine the effects of these signs on driver behavior and DVCs.

Deer Visibility

The sooner a driver sees a deer on or approaching a roadway, the better the chance of avoiding a crash. Deer visibility can be improved through roadway lighting, roadside clearing, or methods to enhance drivers' nighttime vision.

Roadway lighting: Roadway lighting is commonly used to improve driver vision in urban areas, freeway interchanges, and other potentially dangerous locations. Because most DVCs occur at night, roadway lighting is an obvious potential countermeasure. In the only study of the effect of roadway lighting on DVCs, Reed and Woodard (1981) studied a single three-quarter-mile section in Colorado using a one week on/one week off design. The lighting did not affect overall deer crossings or driving speeds, and the study was too small to detect an effect on DVCs.

Roadway lighting is expensive. Only two states reported using lighting to control DVCs (Romin and Bissonette, 1996). It is unlikely to be useful except in very specialized situations.

Roadside clearing: A broad clear roadside area allows drivers to see deer that may enter the road and reduces forage that may attract deer close to the roadway. Finder *et al*. (1999) found that the most important landscape or topographical feature predicting high DVC sites in Illinois was the distance between the roadway and forest cover. In a study in Norway, Jaren *et al*. (1991)

found that a clear 20-30 meter strip reduced crashes between railway trains and moose by more than 50 percent. Putman (1997) and Bruinderink and Hazebroek (1996) recommend reducing forage near the roadside. Roadside clearing raises many issues beyond DVC control, such as the costs of acquiring roadside right-of-way and of maintaining a clear area, the potential safety benefits if trees adjacent to the roadway are removed, and the aesthetics of cleared areas along secondary roads.

Infrared detection from vehicles: A potential long-term strategy to improve drivers' night vision is to equip vehicles with infrared technology that can detect deer and other heat-emitting objects and transmit information to drivers on heads-up displays. These systems have been introduced recently in Cadillacs (General Motors, 2000) and as aftermarket equipment for heavy trucks (Bendix, 2002), but their effects on DVCs have not been evaluated. Any strategy involving vehicle modifications requires many years to implement in the majority of the vehicle fleet.

Speed Limits

An approach often suggested to reduce traffic crashes in many situations is to attempt to reduce travel speeds through lower speed limits. Unfortunately, lower speed limits do not necessarily produce lower travel speeds (Transportation Research Board, 1998). The only study to evaluate the effects of speed limit changes on wildlife crashes involved short road segments in the highly regulated environment of Jasper National Park. Bertwistle (1999) compared sheep and elk crashes for eight years before and eight years after the speed limit was reduced from 90 to 70 km/h on three highway segments of 2.5 km, 4 km, and 9 km. He found that sheep crashes *increased* on these segments and decreased on adjoining segments where the speed limit remained at 90 km/h. Elk crashes increased on the speed-limit-reduction segments and increased more on the unchanged segments. No travel speed data were collected to measure the direct effect of the speed limit change. Bertwistle notes that differences in sheep and elk behavior likely explain the crash result differences.

Speed limit reductions together with deer warning signs may be useful in very specific locations with high deer populations or migration routes. However, unless speed limits are actively enforced, they are unlikely to affect travel speeds significantly, and perhaps not even then. Although seven states reported reducing speed limits in an attempt to control DVCs (Romin and Bissonette, 1996), the effects of these speed limit reductions have not been evaluated.

METHODS TO AFFECT DEER BEHAVIOR

Deer behavior management strategies attempt to either physically block deer from the roadway or make the roadway less attractive to deer by appealing to their senses of sight, sound, or smell.

Physical Control

Fencing: Fencing provides a physical barrier that attempts to prevent deer from entering the roadway. Every review of DVC control methods during the past 20 years has concluded that properly designed and maintained fencing, used together with appropriate underpasses, overpasses, and one-way deer gates, is the most effective method for reducing DVCs both in the United States (Danielson and Hubbard, 1998; Reed *et al*., 1979) and in Europe (Bruinderink and Hazebroek, 1996; Putman, 1997; Staines *et al*., 2001). State wildlife administrators agree, while

state highway administrators rank fencing second to reducing deer herd size (Sullivan and Messmer, 2003). In 1992, 11 states had erected fencing to reduce DVCs (Romin and Bissonette, 1996). Crashes with moose were reduced by 80 percent after about 1,300 km of main roads in Sweden were fenced (Lavsund and Sandegren, 1991).

Aside from herd reduction, fencing is the only DVC method that unquestionably is effective if applied properly. Fencing that is sufficiently high, strong, long, and well-anchored with no gaps or tunnels will prevent deer from crossing a fenced road section. The issues with fencing involve the details and side effects.

• *Physical characteristics:* Fencing must be sufficiently high and long. Several studies have found 2.4 m (7.8 ft) fencing effective (Ward, 1982 (in Wyoming); Reed *et al*., 1982 (in Colorado); Ludwig and Bremicker, 1983 (in Minnesota)). White-tailed deer will jump a 2.2 m (7.4 ft) fence in search of food (Bellis and Graves, 1978). Fencing must extend far enough along a roadway to discourage deer from detouring around the ends of the fenced section. The necessary length depends on deer movement patterns. After one year's experience, Ward (1982) extended a fenced section from 6.7 to 7.8 miles and reduced end runs substantially. Electric fencing, currently being studied in Michigan, may provide an effective alternative to chain-link fencing (DVCR Working Group, 2000). Curtis *et al*. (1994) summarized the characteristics and effectiveness of various fencing types used to prevent deer from damaging crops.

• *Maintenance:* Regular checks are required to repair tunnels and breaks caused by erosion, animals, falling trees, and people. Deer regularly test a fence and are quick to pass through any breaks or gaps (Ward, 1982). Deer can crawl though openings less than 10 inches high under a fence (Bellis and Graves, 1978; Falk *et al*., 1978).

• *Effect on deer movements:* Fencing design should consider deer movement patterns and provide safe passage routes, as appropriate, through underpasses or other methods.

• *Escape routes:* Deer that manage to enter a fenced roadway need some way to escape. One-way gates have been found generally successful (Reed *et al*., 1974; Ward, 1982; Ludwig and Bremicker, 1983).

• *Costs:* Effective fencing is costly to construct and maintain. Iowa recently estimated construction costs for 8 ft chain-link fence on one side of a roadway at $42,000 per mile (Danielson and Hubbard, 1998).

• *Other effects:* Roadway fencing or more substantial physical barriers may have other benefits such as reducing noise in adjacent properties or preventing pedestrian access to high-speed roads. Fencing and barriers may have positive or negative aesthetic implications.

Underpasses and overpasses: Deer underpasses, and more rarely used overpasses, allow deer to cross a roadway without encountering vehicles. Deer sometimes use underpasses or overpasses created when highways cross rivers or tunnel through ridges. Seven states report using underpasses specifically to allow deer crossings (Romin and Bissonette, 1996). Olbrich (1984) noted 824 under- and overpasses for animals on 823 km of federal highway in West Germany.

To be effective, fencing or other barriers are required to channel deer to underpasses and overpasses.

Ward (1982) describes how a system of fencing and six underpasses was used along 7.8 miles of interstate highway crossing a mule deer migration route. The system did not disrupt deer movement and virtually eliminated DVCs. Other studies consider whether and how underpasses and overpasses are used rather than how they affect DVCs. Deer can be reluctant to use them, even when highly motivated to move along a migration route or to forage (Reed *et al*., 1975). Deer can remain wary or frightened even after several years of experience with the same underpass (Reed, 1981). Ward (1982) placed forage in underpasses to attract deer.

Factors affecting the use of underpasses and overpasses include their locations in relation to natural deer paths, size (wide openings and short lengths), design (earth floors), visual appearance (exit clearly visible from entrance, light walls and ceiling), and woody cover at the entrances (Danielson and Hubbard, 1998; Hartmann, 2003; Putman, 1997). In particular, some studies propose a minimum acceptable underpass "openness factor" of entrance area divided by underpass length (Putman, 1997).

Fencing and underpasses have been used to assist various species. Hartmann (2003) summarizes several case studies of underpass and overpass use by elk, bear, panther, mountain goats, and even salamanders. Singer and Doherty (1985) describe an underpass construction for mountain goats that directed almost all goats under rather than across the highway. Foster and Humphrey (1995) review other useful studies.

Underpasses and overpasses are expensive when included in original highway construction. Adding them to an existing highway is even more expensive.

At-grade crosswalks: Crosswalks may provide a middle ground between a fully separated underpass or overpass and uncontrolled crossings marked only with signs. In the only study to date, Lehnert and Bissonette (1997) installed nine crosswalks on about 13 miles of two-lane and 4 miles of divided four-lane highways in Utah, with similar adjacent roads used as controls. At each crosswalk, fencing and landscaping directed deer to the crosswalk area. Because fencing was not permitted on the highway shoulder, the deer were channeled to the highway on a dirt path bordered by cobblestones. A similar path bordered by cobblestones crossed the divided highway's median strip. White painted cattleguard lines bounded the path across the highway surface. One-way gates in the fencing near the crosswalks allowed deer that moved beyond the crosswalk area to leave the roadway. Passive signs warned drivers to expect deer in the crosswalk areas.

The crosswalks appeared to decrease DVCs by about 40 percent, although the small sample size precluded any definitive conclusions. The crosswalk design of cobblestones and cattleguard stripes directed many, but not all, deer across the road as intended. Although drivers may have been more alert for deer at crosswalk areas, fewer than 5 percent responded to crosswalk signs by slowing down or turning on their high-beam headlights.

Crosswalks may be worth additional study to determine if design improvements can contain deer more effectively and if active signs that detect deer in the crosswalk area can improve driver awareness and actions.

Crosswalks, underpasses, and overpasses are more likely to be effective for western mule deer than eastern white-tails. Mule deer have defined migratory routes across highways, so DVCs are confined to relatively few locations where these expensive control methods can be justified. In contrast, white-tailed deer crashes occur throughout substantial lengths of two-lane, rural roads (Maine Department of Transportation, 2002). Further, DVCs occur most frequently in the fall breeding season, when antlered males are chasing females. At these times, crosswalks or other methods short of the complete physical control provided by substantial fences are unlikely to keep deer off the highway.

Sensory Control

Reflectors: Reflectors, used in Europe and some areas of the United States for more than 30 years, are the most contentious DVC control method. They have strong advocates, strong opponents, and conflicting results from more than 10 studies. The most commonly used and most frequently evaluated system, manufactured by Swareflex, consists of reflectors installed on posts at regular intervals along the roadway. Light from vehicle headlights is reflected to form a continuous "visual fence" of red, bluegreen, or white light that deer are expected not to cross. Red reflectors form a visual barrier that humans cannot detect, so that it does not distract drivers. In 1992, 22 states reported using reflectors (Romin and Bissonette, 1997).

The basic behavioral questions about reflectors are whether deer can see light in the wavelengths used, whether deer are reluctant to cross such light beams, and whether deer become habituated to light beams over time. Zacks (1986) studied the effect of red and white light from Swareflex reflectors on penned white-tailed deer. He found no evidence that a beam of red or white light produced by reflectors from a static source, as opposed to a moving vehicle, affected deer behavior. Ujvari *et al*. (1998) exposed fallow deer in a large forested area to light from WEGU reflectors (a design similar to Swareflex) during a period of 15 nights. They found the proportion of deer that did not react to the reflected light increased over time: on the first night, 99 percent of the deer fled from low-intensity reflected light, while on the final three nights about 40 percent were completely indifferent to higher intensity light.

DeerCrash (2003) describes and summarizes 10 studies that attempt to evaluate the effect of roadside reflectors on DVCs using different study designs. The overall results are at best ambiguous.

• Four studies used designs that alternately cover and uncover the reflectors along a roadway segment. One found reflectors effective and three did not.

• Four studies used before/after designs. One found reflectors effective, one did not, and two had inconclusive results.

• Two studies used treatment/control designs. One found that reflectors were effective at some sites but not at others and the other study found no effect.

The best study in terms of its design, size, and power is Reeve and Anderson (1993), who used a cover/uncover design with control segments for three years on a 24.1 km segment of U.S. 30 in Wyoming that crosses a major mule deer migration route. They recorded 126 DVCs when the reflectors were uncovered, 64 when covered, and 147 on control segments. They concluded that the reflectors had no effect on DVCs.

Schafer and Penland (1985) provide the most positive site-specific evidence of effectiveness. They studied four roadway sections totaling 3.68 km in Washington during three years, in an area populated largely by white-tailed deer. They also used a cover/uncover design but with no control segments. They recorded 52 DVCs when reflectors were covered and only 6 when uncovered, concluding that the reflectors were highly effective.

Pafko and Kovach (1996) summarize results from a larger but less controlled application in Minnesota. Reflectors were installed at 16 road segments totaling 16.35 miles, four segments each in coniferous forest, prairie farmland, central hardwood, and metropolitan hardwood habitats. Average annual DVC counts on these segments for several years before and seven years after installation show 79 to 90 percent reductions in DVCs in the three rural habitats from pre-installation DVC averages of 98 to 214. In the metropolitan habitat, DVCs increased by 87 percent from a pre-installation average of 11.8.

These three examples illustrate the difficulties of drawing definitive conclusions from even the best studies. The very substantial reductions from high DVC totals found by Pafko and Kovach (1996) suggest significant effects even though their simple before/after design does not control for other factors that may influence DVCs and their DVC counts may not be completely accurate. However, the authors note that estimated statewide deer populations were increasing during the study, DVCs did not decrease substantially on other roads, and the reductions appeared stable for several years. The increase in metropolitan areas may be due to small sample sizes, traffic volume increases, or reflector ineffectiveness on heavily traveled roads. Reeve and Anderson (1993) and Schafer and Penland (1985) reach very different conclusions from similar studies. Schafer and Penland had a considerably smaller study, with no control area, in an area populated largely by whitetails, while Reeve and Penland's study was on a mule deer migratory route.

If reflectors are effective, they offer obvious advantages. They are cheaper to install and maintain than physical barriers created with fencing and underpasses, though their cost is not insignificant — an estimated $8,000 to $10,000 per mile for installation (Danielson and Hubbard, 1998) plus annual maintenance to repair or replace damaged reflectors. Reflectors form a barrier only when vehicle headlights are present, so they allow deer to cross roads freely during daylight hours. However, the evaluations to date leave many questions unanswered. There appears to be no solid behavioral evidence that deer are reluctant to cross a light beam produced by reflectors. Do deer cross a beam at will, as suggested by Zacks (1986)? Do deer become habituated to such a beam, as found by Ujvari *et al*. (1998)? Are reflectors effective on high-volume roadways where there are few breaks in traffic to permit deer to cross? Are they effective on migratory routes or low-volume roads through established range areas where deer move freely?

Simple metal mirrors to reflect vehicle headlights as white light flashes also have been installed in a manner similar to reflectors. It appears that deer rapidly become accustomed to them, and they corrode quickly (Gilbert, 1982; Putman, 1997). Lavsund and Sandegren (1991) concluded from a large experiment that mirrors had no effect whatsoever on moose crashes in Sweden.

Flagging: An early attempt to influence deer behavior through sight was based on the observation that white-tailed deer raise their tails as a warning sign to other deer. Graves and Bellis (1978) placed rear-view silhouette models of deer with raised tails along a highway. These deer flag models did not affect deer movements (see also DeerCrash, 2003).

Whistles: Deer warning whistles have been available to the public for more than 20 years. A typical whistle is attached to a vehicle and produces ultrasonic noise in the range of 16-20 kHz when vehicle speed exceeds about 30 mph (DeerCrash, 2003). Whistles are based on the presumption that deer can hear and will be warned away from noise in this range. Twenty states reported using whistles in 1992 (Romin and Bissonette, 1997), although state wildlife agency and transportation department administrators ranked whistle effectiveness lowest of all common methods (Sullivan and Messmer, 2003).

Romin and Dalton (1992) conducted the only high-quality study of whistle effects. They drove past 150 groups of deer at distances up to 100 meters and a speed of 65 km/h, observing deer behavioral responses. Two common brands of whistles had no effect on deer behavior, even when deer were within 10 meters of the road. Romin and Dalton were unaware of any research demonstrating that deer are frightened by sound in the range produced by whistles. In a review of the effects of sound on animals and birds of many species, Bomford and O'Brien (1990) concluded that sounds of the type produced by whistles (steady noise rather than specific alarm or distress signals) may influence movements in the short term but that mammals and birds become accustomed to these sounds after long or frequent exposure.

Several less scientific reports and considerable anecdotal evidence either support or deny the effectiveness of whistles. For example, Cline (1989) reported on a one-year test of whistles attached to 42 Michigan State Police vehicles in five locations; 43 vehicles in five other locations served as controls. There were 14 DVCs involving police vehicles in the test locations and 5 in the control locations during the prior year; during the experimental year, there were 5 DVCs in each location. Based on these results, Cline concluded that the whistles were effective.

Roadside whistles, as opposed to vehicle-mounted whistles, are being tested in Saskatchewan (Beaupré, 2002). A series of noisemaking devices together with vehicle detection sensors was mounted along a 5 km section of highway. When the sensors detect a vehicle, the device warns deer with either sound or light signals.

In summary, there is no firm evidence that whistles are effective and considerable evidence that they are not. In the only high-quality study (Romin and Dalton, 1992), deer were not affected by whistles. It is unclear whether deer can hear whistles, whether whistle noise is covered by traffic noise, or whether deer become accustomed to whistle noise over time. In the absence of any solid studies that whistles are effective, they cannot be recommended.

Repellents: Chemical and biological substances attempt to repel deer in two ways. Contact repellents with unpleasant tastes applied to a food source seek to reduce or eliminate feeding. Area repellants with unpleasant smells, such as predator urine, seek to prevent deer from entering or crossing an area.

Several studies, summarized in El Hani and Conover (1995) and DeerCrash (2003), evaluated the effectiveness of various repellents on the feeding patterns of white-tailed and mule deer. Some repellents reduced feeding, but none completely stopped deer from feeding or entering an area. The studies also showed that deer habituate to repellents and will not be deterred by them if sufficiently hungry. No study in the United States has evaluated the effects of repellents in reducing DVCs, and repellents are not used systematically in any state to control DVCs (Romin and Bissonette, 1996). Putman (1997) reported that repellent "scent fences" have been studied in Germany, with mixed results. Early results from a repellent "odor fence" installed along 53 km of roadway in British Columbia, using posts and boxes every 0.25 km, reportedly showed a 36 percent DVC reduction from the prior 10 years, and a test of four different repellents along 16 km of roadway on Vancouver Island began in 1999 (DVCR Working Group, 2000).

Repellents are most likely to hinder deer movements when applied in conjunction with fences or other physical barriers (Curtis *et al*., 1994). Jordan and Richmond (1992) demonstrated that an electric fence treated with repellents was more effective in deterring deer from feeding on apples than an electric fence alone, although repellent effectiveness decreased significantly after several weeks. The combination of repellents and fences has proved useful for home gardens and agricultural fields (Curtis *et al*., 1994) but would be expensive to install and maintain along highways.

Intercept feeding: In certain locations, deer regularly cross roadways to feed. Wood and Wolfe (1988) studied three such road sections in Utah for two years. On the treatment portion of each section, they established and maintained feeding stations more than 1,200 feet away from the roadway. They found lower DVCs in some, but not all, treatment areas. They noted that a feeding program has continuing costs, may make deer dependent on the food provided, and may attract more deer to the roadside. They concluded that intercept feeding may be useful only temporarily in specific situations.

Salt alternatives: Some authors suggest that deer may be attracted to roadways by salt applied to melt ice in the winter and that other deicing substances should be used instead (Feldhamer *et al*., 1986; DeerCrash, 2003). However, no studies have investigated the issue.

METHODS TO AFFECT DEER POPULATIONS

If there were no deer, or no deer near highways, there would be no DVCs. Deer herd reduction has long been considered an appropriate strategy for reducing DVCs as well as crop and garden losses caused by deer (DeNicola *et al*., 2000). State transportation department administrators rated herd management as potentially the most effective DVC control strategy, while state wildlife administrators rated it second only to fencing (Sullivan and Messmer, 2003).

The only herd reduction strategy that would completely eliminate DVCs would be to eliminate all deer, which the general public would not accept. Indeed, even in a high DVC area, only a minority of the public wished to reduce the deer population (Stout *et al*., 1993). In a survey of 10 randomly selected large metropolitan areas, 63 percent of respondents wanted no change in the number of deer in their neighborhoods, 27 percent wanted more deer, and only 10 percent wanted fewer deer (Conover, 1997).

Two reports document how local deer herd management policies can affect DVCs. In 1972, Princeton, New Jersey, passed a no-firearms-discharge ordinance. DVCs then increased by 436 percent in 10 years, from 33 in 1972 to 144 in 1982, compared with no statistically significant change in two adjoining townships where firearms hunting continued to be allowed (Kuser, 1995). Princeton then tried to reduce DVCs and other deer-related problems with deer whistles, reflectors, and increased bowhunting, but DVCs continued to rise, to 167 in 1991 and 227 in 1992.

Irondequoit, New York, began a selective deer culling and bowhunting program in 1993. About 125 deer were removed in each of the next eight years. DVCs dropped from 227 in 1992 to about 100 annually in the late 1990s (Eckler, 2001).

Although herd reduction can be controversial, common sense and expert opinion agree that substantial and continued herd reductions will reduce DVCs (Danielson and Hubbard 1998; DVCR Working Group, 2000). But many questions remain, including the effectiveness of herd reductions over a large area on DVCs, the amount of herd reduction necessary to reduce DVCs substantially, how deer range and migration patterns influence the effect of herd reductions on DVCs, and how to design cost-effective herd reduction programs (Brown *et al*., 2000). Wisconsin and other states are pursuing aggressive deer herd reduction programs (DVCR Working Group, 2000). Data from these programs may help address these questions.

SUMMARY AND CONCLUSIONS

Effective Methods with Solid Scientific Evidence

Fencing, combined with underpasses and overpasses as appropriate, is the only broadly accepted method that is theoretically sound and proven to be effective. Fencing is expensive to construct and maintain, and even the best fencing will not prevent all deer from entering a roadway.

Promising Methods Where More Information Is Needed

Herd reduction is unquestionably effective in reducing DVCs if the deer population in a specific area is reduced by a substantial amount. More research is needed on the minimum area needed for herd reduction to have a substantial effect and on the expected impact of a given amount of herd reduction on DVCs. A herd reduction strategy should be part of an overall wildlife management program that balances the costs and benefits of maintaining wildlife populations.

Roadside clearing may be effective, although there is very limited information supporting it. Roadside clearing must be part of a broader strategy of roadway design and maintenance. Both temporary passive signs and active signs appear promising in specific situations, but considerable research is required to evaluate long-term driver response and to improve and test deer detection technology for active signs.

At-grade crossings for deer, perhaps combined with active signs, offer a long-shot chance at providing greater safety than uncontrolled crossings marked only with passive signs. At-grade crossings are most promising for highways crossing mule deer migration routes in western states.

Infrared driver vision technology in vehicles may be effective in the future. Its development and implementation will depend on its usefulness in improving driver night vision overall, not on its effect on DVCs.

Methods With Limited Demonstrated Effectiveness

Although reflectors have been studied fairly often, most studies were not designed or conducted well. The balance of the available evidence is that reflectors have little long-term effect, especially for white-tailed deer in suburban areas. Additional high-quality studies would be useful to investigate deer response and habituation to light beams and the effectiveness of reflectors when implemented.

Roadside lighting and intercept feeding may have limited effectiveness in specialized situations. Both methods are costly and have side effects that must be considered carefully.

Deer repellents can have limited effectiveness in modifying deer feeding and movement patterns. It is unlikely that repellents will be useful in roadway applications.

Methods that Appear Ineffective Based on Available Evidence

General education, passive signs, and lower speed limits appear ineffective in influencing driver behavior and reducing DVCs. The lack of good studies proving their ineffectiveness probably results from the unwillingness of funding organizations to allocate resources to study methods that are so unpromising.

Ineffective Methods with Evidence from Controlled or Experimental Situations

Deer whistles and deer flagging signs are not effective.

DISCUSSION AND RECOMMENDATIONS

Previous reviews of DVC control methods (Reed *et al*., 1979; Bruinderink and Hazebroek, 1996; Putman, 1997; Danielson and Hubbard, 1998; Staines *et al*., 2001) reached conclusions similar to ours, as did a review of moose-vehicle crashes in Sweden (Lavsund and Sandegren, 1991). There is no quick, cheap method to reduce DVCs. Fencing and herd reduction programs can be effective if they are designed and maintained well, but they are neither cheap nor quick.

DVC control must be part of an overall environmental strategy that balances the competing needs of humans and wildlife. For example, there is a trend in suburban areas to preserve or create green space and wildlife corridors (Houck, 1990). These areas must be carefully planned and coordinated by transportation, natural resource, and urban planning agencies to avoid attracting more deer and increasing DVCs.

Data Collection and Reporting

States should identify crashes involving deer on their state crash report forms and crash data files rather than aggregating crashes involving all animals. Without this, it is difficult to track DVC totals, trends, and patterns. States also should record precise DVC locations, as Maine does (Maine Department of Transportation, 2002), using GIS or other methods, to identify areas with high DVC frequencies. This information is critical in deciding where fencing, herd reduction, active signs, or other DVC control methods are needed.

Research

Research is needed in the following areas.

• *Herd reduction:* minimum geographic area needed to be effective, effect of different amounts of herd reduction on DVCs in various settings

• *Active signs:* improved deer detection technology, long-term driver response

• *Temporary passive signs and at-grade crossings:* additional field trials under varying circumstances

• *Reflectors:* deer response and habituation, effect of reflector systems as implemented

• *Intensive general education:* effects of intensive driver awareness programs for DVCs in targeted communities

• *Integrated DVC program:* effects of coordinated program including signs, roadside clearing, and general education in specific high DVC locations

• *Data:* multi-state survey of DVC reporting to police, insurance companies, and wildlife agencies

ACKNOWLEDGMENTS

This study was supported by the Insurance Institute for Highway Safety. The opinions, findings, and conclusions are those of the authors and do not necessarily reflect the views of the Insurance Institute for Highway Safety.

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APPENDIX SECTION 6

Deer Vehicle Collision Reduction Working Group Conference

FINAL REPORT

Milwaukee, WI • April 17-18 2000

WISCONSIN DEPARTMENT OF TRANSPORTATION

WISCONSIN DEPT. OF NATURAL RESOURCES

SAND COUNTY FOUNDATION

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JOINING FORCES FOR SAFER ROADS

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Reducing Deer-Vehicle Collisions

EXECUTIVE SUMMARY

Deer-vehicle collisions are a growing cause for alarm. The reported number has tripled in 20 years to one of six reported Wisconsin crashes. Many more go unreported, making the total more than an estimated 60,000 each year. With direct costs estimated at $93-$184 million and untold personal and indirect costs, this clearly is a serious economic and safety concern.

To address the issue, the Wisconsin Departments of Transportation and Natural Resources and their private partner, Sand County Foundation, contacted leaders in insurance, highway safety, highway management and engineering, landscape ecology, local government, law enforcement, and related fields, from the region and Canada. Representatives joined in a working session on April 17-18, 2000, to map a regional strategy for cutting the number and severity of deer-vehicle crashes (DVCs). This report highlights the strategies and commitments to lowering DVCs in the next several years that were identified at the conference.

Background:

Existing DVC data is incomplete and much of the research on collision counter-measures is unreliable. Rigorous studies in Iowa and Michigan are testing conventional and electric fence, signs, reflectors, and other devices. Canada reports success with one- and two-sided fences, overpasses, reflectors, and odor repellents. A Michigan DVC coalition does public and driver education.

Recommendations:

The conference objectives sought immediate action, necessary research and information clearinghouse plans, and personal and institutional commitments. The recommendations are:

Immediate Action: Develop a comprehensive public education program. Support state wildlife agencies' statewide deer herd reduction programs. Create a "tool box" of possible actions that could be tailored and implemented at specific sites.

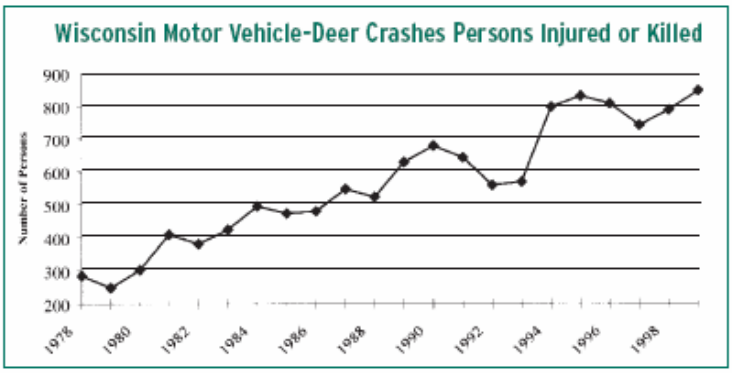
Necessary Research: Conduct research to determine: if local deer herd reduction can lower DVCs; if fencing and other barriers help prevent DVCs; and if modifying road corridor habitat can reduce DVCs. Create a "Center for Research Excellence" to address scientific standards, research quality, and funding.

Information Clearinghouse: The Clearinghouse should be regional with public-private funding. It should gather and disseminate: reliable DVC data, information, possible solutions, wildlife management alternatives, roadway management successes, relevant scientific research, and education materials. It should be housed at a University of Wisconsin system campus or comparable institution, and collaborate with Great Lakes and Mississippi Valley regional organizations.

Commitments:

Every conference recommendation received written support. Individual and institutional commitments provided representation from insurance companies, resource agencies, transportation agencies, centers of research, and private conservation organizations. In addition: Sand County Foundation committed to participate in the Clearinghouse; to design, initiate and recruit for the proposed Center for Research Excellence; and to secure financial contributions. WisDOT endorsed the Clearinghouse and offered to lead the effort initially, promoted integrated multidisciplinary "deershed" management and highway safety efforts, and urged continued individual effort. WisDOT's potential roles include: direction, support, and funding for a Clearinghouse; collaboration on its housing and operation; and creating a common, verified database.

These commitments, along with our future as working partners, should make it possible to significantly reduce deer-vehicle crashes in Wisconsin and across the region.



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A report of the Deer Vehicle Collision Reduction Working Group Conference, April 17-18, 2000

Deer and vehicles collide on Wisconsin's roads alarmingly often, with high seasonal peaks in fall and late spring and daily peaks at dawn and dusk. The result is compromised safety and significant costs, and the problem is growing. Since 1980 the number of deer-vehicle crashes has leaped from one in 20 to one in six of all reported crashes. Furthermore, the actual number is probably more than twice what is officially reported.

Economic and personal losses are also significant. Vehicle repair and related direct costs in Wisconsin were $93-$184 million in 1998, according to recent estimates in the paper *Monetizing the Cost of Auto-Deer Collisions,* by Gregory Krohm. Indirect and non-economic consequences raise the reckoning by millions more.

Wisconsin is not alone. Deer-vehicle crashes (DVCs) are common and increasing from Iowa to Maine – a direct result of exploding white-tailed deer populations and growing vehicle travel miles. The upper Midwest, Great Lakes region and New England regions have the worst DVC problem.
To address this phenomenon, the State of Wisconsin Departments of Transportation and Natural Resources contacted leaders in insurance, highway safety, highway management and engineering, landscape ecology, local government, law enforcement, and related fields, from the region and Canada, to address DVC costs and injuries.

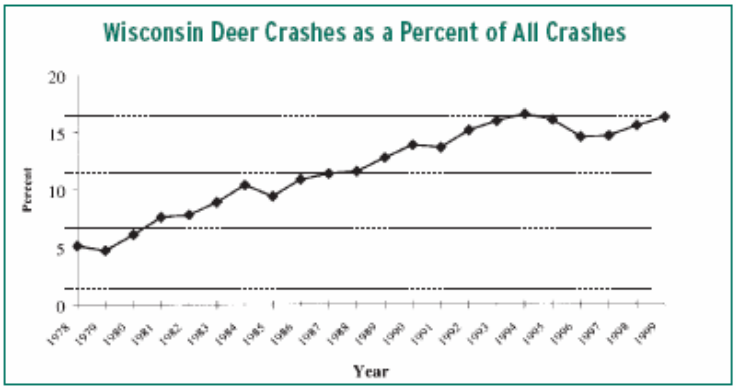
By collaborating in a working conference and on subsequent actions the organizers and participants hope to help prevent needless human injuries and deaths from deer-vehicle crashes. The Deer Vehicle Collision Reduction Working Group Conference, held April 17-18, 2000, had three objectives:

- Identify three actions, determined at the conference, to help reduce DVCs.
- Commit to three sound research projects that hold promise for future risk reduction.
- Define the scope and mandate of a clearinghouse of information related to DVCs.

To prepare for their conference deliberations, Working Group participants received background statistics reports and related research reports on what is currently known about DVCs. At the start of the conference Lt. Governor Scott McCallum, WisDOT Secretary Terry Mulcahy, and Sand County Foundation Chairman Reed Coleman, offered vision, encouragement and inspiration.

Ernie Stetenfeld, AAA Wisconsin, and Dennis Hughes, a WisDOT safety analyst, summarized DVC data. They also supplied a decision matrix procedure to help participants organize and rank 28 possible actions and research topics. Further presentations described current DVC research and successful coalition efforts. In addition, participants were advised of useful Web site resources such as the new Federal Highway Administration Web site which addresses transportation and wildlife safety matters generally. [www.fhwa.dot.gov/environment]

Following are brief summaries of the Working Group Conference case study presentations, coalition examples, and subgroup conclusions.



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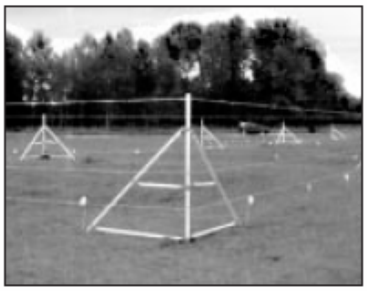
RESEARCH CASE STUDIES

Local-scale research Two Michigan studies

Dean Premo, President, White Water Associates (WWA)

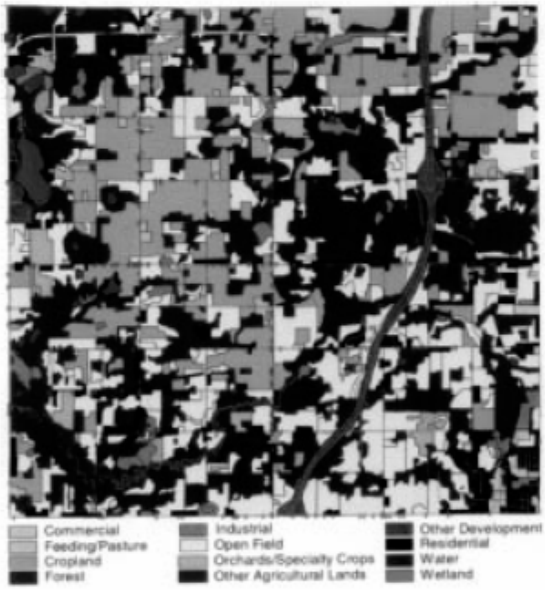
Most deer-vehicle crash research studies are short-term and lack appropriate research questions, rigorous experimental design, and adequate statistical analysis. In contrast, WWA is using a more rigorous approach to study new-generation electric fence to separate deer from cattle feeding and use areas to prevent the spread of bovine tuberculosis. Wildlife research studies have shown that most deer prefer not to leap high fences, though they can. Minimal electric fencing appears to deter the majority of deer. A six-foot electric fence may be highly effective.



"A new generation of electric fencing is being tested in Michigan for its effectiveness in preventing the spread of disease between deer and livestock."

A second study is now underway near Grand Rapids, in Kent County Michigan. The county has the highest number of DVCs in Michigan and some areas have the highest known DVC numbers of anywhere on earth. Good research at the township and county level is possible because the Michigan State Police data bank has extensive DVC data and there is a flexible, interactive geographic information system database of the county developed by Grand Valley State University. The research is funded by the Michigan State Police, which is committed to improving safety for highway users against this and other major threats.

The study of four townships is evaluating two countermeasures: seasonal posting with 71 deer crossing signs to modify human behavior, and Streiter Lite reflectors on six miles of road to modify deer behavior. Data from the first test year showed no statistically significant differences for either measure. This is not surprising since data from a limited experiment on small stretches of road is nearly guaranteed not to produce statistically reliable results. A second, equally important, component of the study is to evaluate the processes and approaches, i.e., how to effectively conduct this kind of research.



"Computer mapping of deer-vehicle crashes can show associations between high incident zones and certain landscape features."

Statewide-scale research Deer Vehicle Accidents in Iowa

Brent Danielson, Associate Professor, Animal Ecology, Iowa State University

Iowa has seen an exponential increase in DVCs between 1970 and 1998. This suggests that DVC rates have become much worse and that the deer population has exceeded the capacity of predators to control it. In addition, 25% of all DVCs occur at 3% of Iowa mileposts. A review of existing technology found that fences, overpasses and underpasses are proven effective; whistles, highway lighting, and mirrors are proven ineffective. Deer herd management for lowered density is also effective. Items with undetermined effectiveness were reflectors, habitat modification, crosswalks, chemical repellents, and lower speed limits. Untested were active warning signals, motion detectors, and vehicle modifications. Typical DVC studies lack controls and replications and thus cannot provide reliable results.

Danielson's (with co-author Michael Hubbard) analysis related DVCs to landscape features and land uses using data in the Iowa GAP database nearing completion by Iowa State University. The research also included multiple

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variables like traffic flows, distance to the nearest town, and local deer harvest. They found that distance to the nearest highway bridge was the most important landscape variable relating to high numbers of DVCs (14 or more per milepost). They suggest a combined approach of low-cost fencing to guide deer crossings and infrared detectors that activate driver-warning signs to reduce DVCs.

Region-wide management Wildlife-Vehicle Collisions in Canadian National Parks

Terry McGuire, Director, Highway Services Center, Parks Canada

Major highways and railroad tracks cross through Banff National Park in Alberta. Wildlife vehicle crashes (WVC) are having a major impact on species viability. Having tried signage (alone and with flags), reflectors, and chemicals in the road salt, they took the drastic measure of installing 2.5 meter game fence along the Trans Canada Highway (TCH) – 45 kilometers in Banff National Park. This produced a 97% reduction in WVCs with ungulates (mostly elk) and 75% reduction for smaller animals. (The average daily traffic count on the TCH is about 22,000 vehicles in summer and 12,000 in winter.)

Wildlife underpasses were built during widening of the TCH. Both 3-meter culverts and 2x4x3 meter box culverts were employed. These are readily used by ungulates, but carnivores are more reluctant. Gates in the fences were developed to allow human entry and exit. Parks Canada staff also tried a wildlife overpass. The overpass is 50 meters wide, covered with soil, and landscaped. It cost $1.8 million (Canadian) to construct. All types of wildlife readily use it. Research is continuing. With a total of 180 kilometers of TCH in the park, managers of wildlife and highways are considering whether the overpass method may prove to be uneconomical relative to underpasses or other devices.

"Experience on the Trans Canada Highway shows that comprehensive fencing of the ROW, in combination with wildlife underpasses, can be effective, but would prove cost prohibitive due to the scale of the problem."

Statewide information considerations Current Wisconsin Data

Dennis Hughes, Chief, Safety Policy Analysis Section, Wisconsin Department of Transportation

In 1999 there were 21,289 police-reported DVCs among 120,000-130,000 total collisions. Six people were killed and 841 highway users were injured in DVCs. In Wisconsin the peak of DVCs is in October-December with another significant rise in May and June. Motorcyclists are at particular risk. They suffer 40% of the deaths and 60% of the injuries.

The DVC trend is up: In 1978 only 5% of all reported crashes were DVCs, in 1999 it was 16%. In nine counties 45% of all crashes are deer hits. In five counties they are over 50%, making DVCs the number one traffic safety issue.

These data probably represent only 30%-40% of all DVCs in the state. In 1999 44,897 deer carcasses were removed from roads under contract with the state DNR, compared to 21,289 reported DVCs. There are a number of reasons for under-reporting. Self-reports are not included. Collisions are reportable only if there is personal injury or the property damage is over $1,000. Some county sheriffs have stopped reporting DVCs because law enforcement staff resources may be overwhelmed. Most DVCs on the Interstate system are not reported. Individuals may be reluctant to report them due to fear of insurance rate increases, lack of insurance, low value of vehicle, speeding at the time of the crash, etc.

SUCCESSFUL COALITIONS AND CLEARING HOUSE PARTNERSHIPS

Florida Fire Safety Partnership and Colorado Flood Safety Collaboration

Brent Haglund, President, Sand County Foundation

In north Florida, where naturally occurring fires have been suppressed for a long time, the risk of uncontrolled fires is high. Costs to human property and lives could

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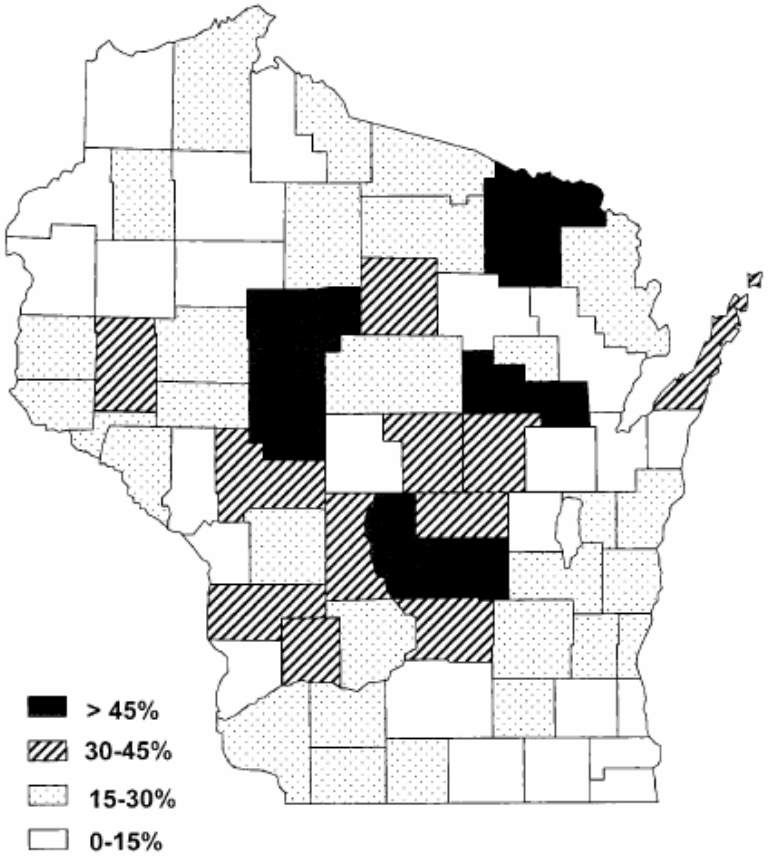
Wisconsin Deer Crashes as a Percentage of All Crashes by County (1999)



be severe. Prescribed fire is an alternative that people can be educated to understand and accept. A coalition of Florida's Department of Forestry, The Nature Conservancy, and timberland owners developed a database and presented education on the need for prescribed fires. The program was successful at saving property during severe fire outbreaks in recent summers.

In Ft. Collins, Colorado, a flood management coalition defined the risk and cost, established a sound database, shared action options, and implemented the actions by moving buildings out of the flood plain. The result was improved safety for most city residents in low-lying areas.

Michigan Coalition to Reduce Deer-Vehicle Collisions

Jerry Basch, Manager, Community Safety Services, AAA Michigan

Michigan has the nation's highest number of reported DVCs. In 1998 alone there were about 65,000 incidents, half of them in October, November and December. This number is probably 30% to 50% of the total actual DVCs. The average cost for insurance payment per vehicle (not including the owner-paid deductible portion) was $1,784 in 1998. The estimated direct cost in Michigan of the known DVCs is $100 million per year. AAA of Michigan organized a Deer Crash Coalition that includes law enforcement and conservation groups, state agencies, and insurance companies.

The Coalition's initial goal was education and awareness regarding DVCs. A literature review identified seven potential methods for reducing DVCs:

1) deer population management
2) right-of-way vegetation and width
3) right-of-way clearing
4) warning signs
5) driver speed reduction
6) driver education
7) public awareness

The Coalition prepares posters for sites that sell deer hunting licenses, billboards, and brochures, and holds an annual press conference each fall. The Coalition meets several times per year and participants contribute in-kind support. There is no budget because in this active partnership responsibility, funding, talent, and services are shared.

Management Improvements on British Columbia Highways

Graham Gilfillan, Project Manager, Insurance Corporation British Columbia, Winter Road Research and Development

The Insurance Corporation of British Columbia (ICBC) is the province's only third-party

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automobile insurance company. Its annual revenue is approximately $2.7 billion (Canadian). ICBC processes about 6,600 animal-related claims a year costing on average about $2,300 each. Wildlife-vehicle collisions (WVC) have been on a steady incline since 1993. ICBC has installed and is testing reflectors, fencing, predator scents, and "deer whistles."

Reflectors - 350 wildlife reflectors were installed on a 3.5 kilometer section of highway in May 1999. They are bagged and unbagged bi-weekly and monitored. The BC Ministry of Transportation and Highways has installed another 152 kilometers of reflectors. The two successful installations have reduced WVC 23% and 40%, respectively.

Fencing - ICBC installed 15 kilometers of one-sided wildlife fence in the interior of BC. It cost $128,000 ($8,540/kilometer) and has reduced wildlife collisions by 96%. 320 kilometers of two-sided fencing on the Coquihalla Highway cost $40,000-$80,000 per kilometer and reduced wildlife collisions 100%.

Predator scents - An "odor fence" along 53 kilometers of highway, using posts and boxes every 0.25 kilometer showed a 36% reduction from the 10-year history. A test of four different animal repellants used simultaneously on 16 kilometers of highway on Vancouver Island began in 1999. Early results show a 50%-100% reduction, and highway maintenance staff noted an immediate response with wildlife vacating the treated areas.

Wildlife whistles - In the 100 Mile House region "deer whistles" were distributed to resident volunteers. The two-year study will be monitored and measured by the ICBC claim center in 100 Mile House.

Future technology - ICBC is reviewing technology that detects animals for up to two miles ahead on roadways and would initiate a sign message to lower the speed limit.

WORKING GROUP RECOMMENDATIONS

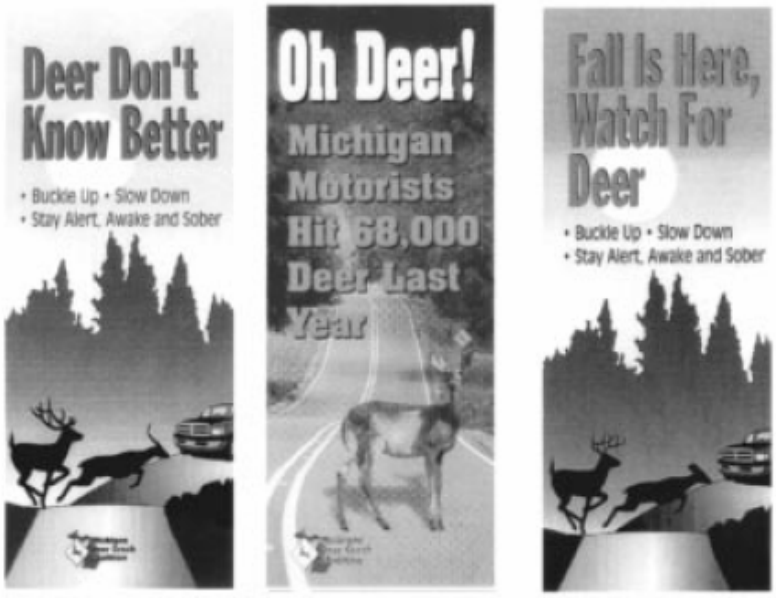
On Tuesday, April 18, the Working Group split into three subgroups. Each group was charged with addressing one of the conference objectives and expected to produce three specific recommendations to further that objective. Participants represented the relevant interest groups and agencies including: wildlife research and management; local, state and federal roadway management; insurance industry; automobile and motorcycle drivers; safety analysts; and safety coalitions.

To facilitate their efforts, the subgroups were provided background information prior to the conference which was sound and relevant. Brief case studies, safety data, and a decision matrix presented during the conference also helped bring participants to a common understanding of the issues and options. Skilled practitioners facilitated the subgroup discussions and reported each group's recommendations to the full Working Group. Following is a summary of each subgroup's recommendations.

Promising Pathways: Implementing Immediate Actions

Neil Palmer,
Palmer & Associates, Facilitator

The Promising Pathways subgroup proposed a goal of reducing (not eliminating) DVCs: specifically a 20% reduction in 3 years. They believe this measurable goal is critical to gaining and retaining public support and participation. To achieve the goal they proposed four actions:



"The Working Group recommended collaboration with existing organizations such as the Michigan Deer Crash Coalition, and to target educational materials to 'high impact' groups."

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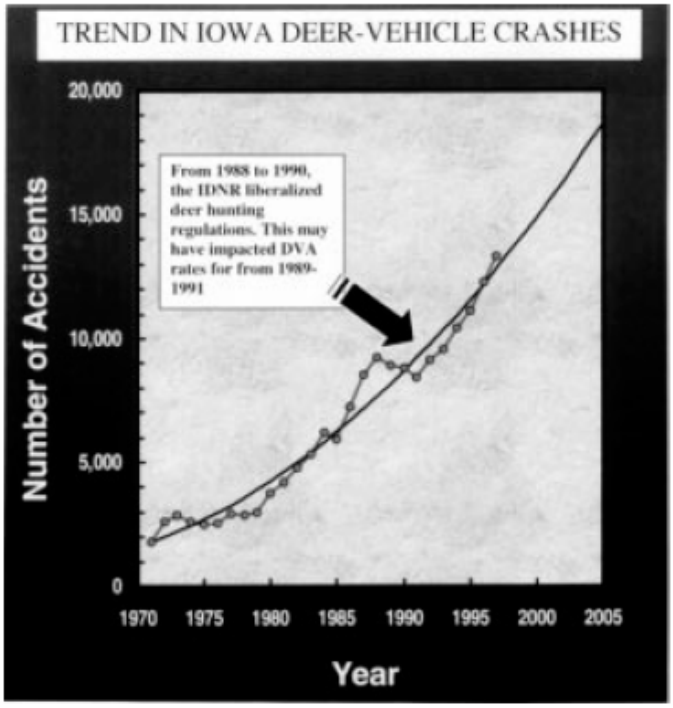
Comprehensive public education program - The group recommended developing educational tools for targeting specific high impact groups. These include the grades K-5 age group because there are short & long term benefits associated with youth education, and older drivers, since both drivers and passengers are at risk. This program will require cooperation between agencies, highway safety groups and experts in educational programming. Initially, these should be implemented as a statewide strategy. Other public educational initiatives should include a seasonal awareness program during the deer breeding season, for example, with strong local public messages. Details of design, timing, etc. need to be worked out.

Deer herd reduction - Wisconsin DNR and wildlife agencies in other states are pursuing aggressive deer herd reduction programs. The group strongly supported these efforts. They also recommended selectively implementing mitigation actions identified in the decision matrix as highly relevant with a high probability of success.

Collaborate with existing organizations - The group agreed that a successful program must bring together information, funds and other resources to manage the public education program, seek new opportunities and provide incentives for local projects, and selectively apply "tools" from a "tool box" of mitigation actions.

Tool box for use in targeted "hotspot" areas - Assuming there are identifiable "hot spot" areas, the Promising Pathways group called for a five-step active process: 1) Evaluate the site based on existing information and data. 2) Determine the best tool to use there. 3) Tailor the chosen tool specifically to fit the site. 4) Implement the tool. 5) Evaluate the tool's usefulness in reducing DVCs.

Tools to include in the box are: herd reduction, selective use of physical barriers (fencing, culverts, underpasses), roadside management, local education, road signs and speed limits, and other items on the decision matrix that have medium to high effectiveness. Tools to exclude from the box (pen further, conclusive research) include whistles and reflecto



"The Working Group called for actively supporting State wildlife agencies' deer herd reduction programs, and wishes to test the effectiveness of local area herd management in reducing DVCs."

Necessary Research

Brent Danielson, Iowa State University, Facilitator

The Research group identifie critical research questions th attention and proposed a Cer Research Excellence.

Can we reduce DVCs by lo area deer herd reduction? It is well established that stat deer herd reduction leads to reduction in DVC rates. Will work at smaller scales? Sub- include: 1) How does the spa scale of management limit th effectiveness and enforceabi hunting regulations? 2) How initial deer density effect the of local reduction Will hunters be m accepting of local reductions in herd density if improv quality accompan them? 4) What incentives and regulations will ir landowners and h to cooperate in lo herd reductions?

Can fencing and associated techn be used as a cost effective method reducing DVCs? As with deer herd reduction, it is we established that continuous deer-p fencing along rigl ways can signific reduce DVC rates there less expensi barriers that can eliminate a portio

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deer crossings or route them to predictable locations? Sub-issues include: 1) A cost/benefit analysis is needed on fencing to determine what minimum height and weight fence will keep most deer from crossing the road? 2) Are there chemical scent fences effective for keeping deer off roadways? 3) Are there driver alert/deer detection devices that could work in concert with fencing to known deer crossings? 4) What benefits can be gained with electrification of fences?

Can we reduce DVCs through modification of road corridor habitat?

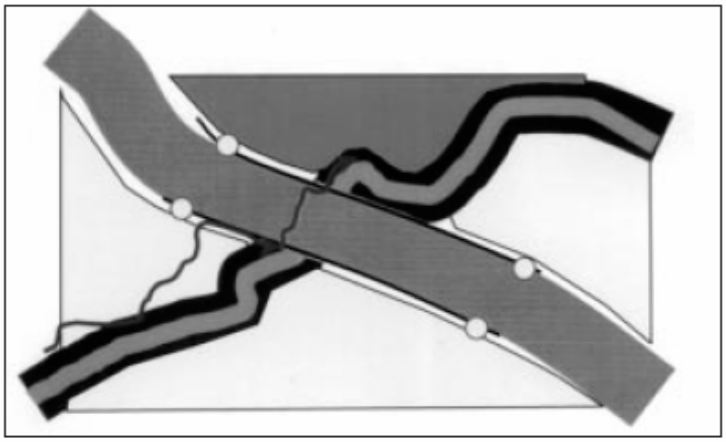
The land through which roads pass can provide both food and cover to deer, and it can also obscure or improve visibility for motorists. Sub-issues include: 1) How do the variety of vegetation and methods of vegetation management at roadsides in the right-of-way (ROW) affect the ways deer use the areas for food and cover? 2) How does vegetation management affect drivers' ability to detect and react to deer in ROWs, if at all? 3) How do land-use patterns outside the ROW affect the spatial distribution of deer and their movement patterns across roadways?

Center for Research Excellence - Past research on DVCs has suffered from poor experimental design and in some cases under-funding. In order to provide transportation officials and the public with sound conclusions about DVCs, the Research group recommended a Center for Research Excellence to set and maintain standards, call for proposals, manage peer review of proposals for quality experimental research, and distribute funds through a competitive grant process. The advisory board would establish the research goals and approve all funding of research proposals. Board members would include representatives of potential funding sources and federal highway groups, biologists, landowners, and experts in transportation safety and traffic engineering.

Interactive Information Clearinghouse: Scope and Mandate

Scott Klug,
CEO, Trails Media Group,
Facilitator

The Clearinghouse subgroup identified four descriptors of an effective Information Clearinghouse.



"The Working Group would like research to determine if there are cost effective barriers that can reduce deer crossings or route them to predictable locations."

Potential users - Potential users include members of safety coalitions, researchers, government agencies, national and state parks managers, private landowners, conservation groups, schools, product manufacturers, and news media.

Scope of relevant information - The Clearinghouse should be a resource for: DVC statistics; possible mitigation actions; availability of wildlife management programs; implications of different roadway management strategies; educational materials and effective public information approaches; and validated research outcomes.

Level of operation - The Information Clearinghouse would operate most effectively at a regional level. Two regional associations, the Great Lakes Governor's Conference and the Mississippi Valley Conference, may provide the Clearinghouse with an improved presence at that level.

Clearinghouse funding - The Clearinghouse should be funded through a public-private partnership, including federal agency, state agency, insurance company sources, etc. Participants including funders (WisDOT, researchers, insurance industry, etc.) will define Clearinghouse policies. WisDOT, Wisconsin DNR and Sand County Foundation should take the lead in developing possible suitable arrangements such as locating the Center at a University of Wisconsin system campus or comparable institution. The Clearinghouse should emphasize collaboration with Great Lakes and Midwest universities and build political support for Federal seed funds using Midwest governors and state DOTs (similar to the Midwest Rail Association.)

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CONCLUSION AND COMMITMENTS

At the conference conclusion each participant was asked to make a commitment to work on one or more of the recommendations.

Brent Haglund, President of Sand County Foundation (SCF), called for improved highway safety in the face of sharply rising deer-vehicle crashes. He noted that SCF is founded on Aldo Leopold's land ethic, which encompasses human well being. SCF committed to participate in and assist in starting the Clearinghouse; to initiate the Center of Research Excellence and investigate funding opportunities as proposed by the Research group; and to recruit individuals to serve on the board of advisors or as proposal reviewers.

Terry Mulcahy, Secretary, WisDOT, said that those attending the conference have the skills and knowledge to effectively address the serious safety concern of deer-vehicle crashes. The proposed Clearinghouse is a strong first step. Another will be developing an agenda that integrates "deershed" management and highway safety. He urged each participant to stay involved and commit to specific tasks. These efforts will help realize the goals of the conference and substantially improve highway safety, saving lives and money.

While WisDOT needs further discussions with prospective partners before making specific commitments, its potential roles include: direction, support, and funding for a Clearinghouse; creation of a common, verified database; and commitment of WisDOT personnel to collaborate with a University of Wisconsin campus or a comparable institution to house and operate the Clearinghouse.

Every conference recommendation received overwhelming support from the Working Group. In addition, individuals and institutions in attendance committed to be a part of at least one action item. Insurance companies, resource agencies, transportation agencies, research institutions, and private conservation organizations were represented, as the following list shows. With these commitments as the next step and a future of working as partners it should be possible to significantly reduce deer-vehicle crashes in Wisconsin and across the region.

COMMITMENTS

The table on the next page lists Working Group participants, their affiliations, and their commitments to the conference recommendations:

Promising Pathways (Action):

- Education: Develop a comprehensive public education program.
- Statewide Herd Reduction: Support state wildlife agencies' statewide deer herd reduction programs.
- Tool Box: Create a "tool box" of possible actions that could be tailored and implemented at specific sites.

Research:

- Herd Management (local) Conduct research to determine if local deer herd reduction can lower DVCs.
- Barriers: Conduct research to determine if fencing and other barriers help prevent DVCs
- Corridor Habitat: Conduct research to determine if modifying road corridor habitat can reduce DVCs.
- Center: Create a "Center for Research Excellence" to address scientific standards, research quality, and funding.

Clearinghouse:

Create a regional Clearinghouse, with public-private funding, to disseminate validated information on DVCs.

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Working Group Commitments List

Commitment		Promising Pathways (Action)			Research Programs			Clearinghouse	Center	Board of Directors
Person	Institution	Education	Herd Reduction (statewide)	Tool Box	Herd Management (local)	Barriers	Corridor habitat			
Andrle, Steve	Iowa State Univ.								Yes	
Basch, Jerry	AAA Michigan							Yes		
Brandemuehl, Dave	Rep. Wis Assembly									
Bremer, Bill	FHWA			Yes		Yes				
Coleman, Reed	Sand County Foundation							Yes	Yes	
Craven, Scott	UW Wildlife Ecology	Yes	Yes							
Daniel, John	Wisconsin DNR							Yes		
Danielson, Brent	Iowa State Univ.				Yes	Yes	Yes	Yes	Yes	
Deacon, Brad	Michigan Dept. of Ag.	Yes								
Evans, John	WisDOT							Yes		
Fox, Patrick	Waushara Co. Sheriff	Yes				Yes				
Frassetto, Frank	Staff US Rep Tom Petri									
Gent, Steve	Iowa DOT				Yes					
Gilfillan, Graham	ICBC Canada					Yes				
Haglund, Brent	Sand County Foundation								Yes	Yes
Haldeman, Don	Rural Mutual Ins. Co.				Yes					
Hauge, Tom	Wisconsin DNR		Yes							
Howells, Tom	WI Motor Carriers	Yes								
Hughes, Dennis	WisDOT							Yes		
Jansen, Jim	Iowa DNR		Yes							
Jessen, Brenda	Sand County Foundation							Yes	Yes	
Kittredge, Buck	ABATE	Yes								
Klug, Scott	Trails Media Group							Yes		
Kuemmel, Dave	Marquette Univ.					Yes				
Kujawa, Allison	Wis Counties Assoc.						Yes			
Ladd, Dave	WI Conservation Congress		Yes							
Manning, Tom	State Farm Ins. Co.									
McAleese, Kevin	Sand County Foundation				Yes			Yes	Yes	
McCallum, Scott	Lt. Govenor, WI									
McGowen, Pat	Montana State Univ.							Yes		
McGuire, Terry	Parks Canada									
Mulcahy, Terry	WisDOT							Yes		
Palmer, Neil	Neil Palmer & Assoc.	Yes		Yes						
Poulson, Dan	Wis Farm Bureau		Yes						Yes	
Powers, Christi	WisDOT							Yes		
Premo, Dean	White Water Assoc.				Yes	Yes	Yes			
Schneider, Steve	Kempers Ins.							Yes		
Schumacher, Dave	Wis State Patrol	Yes								
Shields, Emmer	Ashland County Highways	Yes		Yes			Yes			
Stadelman, Rick	Wis Towns Assoc.	Yes		Yes						
Stark, Richard	WisDOT						Yes			
Stetenfeld, Ernie	AAA Wisconsin	Yes		Yes						
Stone, Jeff	Rep. Wis Assembly									Yes
Thompson, Charles	WisDOT									
Weinholzer, Robert	Minnesota DOT					Yes				Yes
Whitcomb, Scott	Michigan DNR		Yes		Yes					
Wood, Jim	Wood Communication Grp.							Yes		
Zurawik, Chet	Milwaukee County			Yes			Yes			

Participants in the Working Group Conference committed themselves to future involvement in the above categories.

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The Sand County Foundation and its partners express their thanks and appreciation to the Wisconsin Department of Transportation and the Bradley Fund for the Environment for their generous funding and overall guidance in support of the Working Group Conference.

Additional printed copies may be obtained by contacting Sand County Foundation

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