

CHAPTER 3 CONCLUSIONS AND RECOMMENDATIONS

A significant amount of information was reviewed and summarized for the creation of this deer-vehicle crash (DVC) countermeasure toolbox. Each of the summaries in Chapter 2 contains specific conclusions/findings (and some recommendations) about each countermeasure, and these conclusions/findings were summarized in the Executive Summary. This chapter includes more general conclusions about the current status of defining the DVC problem and evaluating the DVC reduction capabilities of existing and proposed countermeasures. The DVC countermeasures summarized in this toolbox are also grouped into five suggested categories. Recommendations are also provided as a response to each of the conclusions. Suggestions are made about how some of the gaps in the current state-of-the-knowledge for DVC countermeasure safety impacts might be addressed.

CONCLUSIONS

- DVCs are a transportation safety problem throughout most of the United States. The actual magnitude of this problem, however, can only be grossly estimated. The collection and trend analysis of the best available reported DVC (or animal-vehicle crash) data for all 50 states is needed. At a minimum, this database should also include documentation of the criteria used to define and/or differentiate a reportable DVC or animal-vehicle collision in each state. A summation and comparison of this data could then be done in a proper manner. The DVCIC has begun this task for the Upper Midwest with a goal to collect the last 10 years of DVC-related data (e.g., vehicle travel, deer populations, reported DVCs, and roadside carcass numbers). More specifically, this information should also improve the ability to identify those roadway segments with higher than expected levels of DVCs for many jurisdictions.
- It is generally recognized that reported DVC data represents only a fraction of the collisions that do occur (up to 50 percent is likely). But, deer carcass data, by location of pick-up, is not generally available. Reported DVC data are the only widespread, long-term (e.g., more than the time period of a study), easily defined, and

generally available approximation of the DVC problem along roadway segment in the United States. These are the reasons reported crashes of all types, despite the recognized weaknesses of this data, are generally used to evaluate roadway safety improvements. Some of the DVC countermeasure research reviewed for this toolbox collected roadside animal carcass data during the study time period (usually less than two years) to evaluate the safety impacts of a countermeasure. Not surprisingly, it appears that roadside carcass data for a particular roadway segment, although greater in number, has some of the same type of variability characteristics as reported DVC data. A minimum of three years of reported crash data preceding and following the implementation of a measure is generally accepted in transportation safety analysis if a simple before-and-after approach is used.

- Many factors appear to impact the number of DVCs at a particular roadway location. These factors are generally related to the characteristics of the roadway and traffic flow, the deer population, and the adjacent land use and cover. Specific examples include traffic flow volumes, deer densities or crossings, and the existence of adjacent crops or woodland. Multiple pieces of often highly variable and interrelated data usually need to be considered to properly determine why there is a DVC problem at a particular location. Several regression based DVC prediction models have been suggested with a series of input variables. However, the general applicability of a multiple regression approach to predict crashes, and/or the inclusion of factors with interrelationships in the same prediction model is typically not considered appropriate without a detailed explanation of how these may confound its results.
- The variability of the factors believed to impact the occurrence of a DVC, combined with their complex interrelationships, make it a difficult problem to evaluate, predict, and solve. The variability and generally accepted characteristics of DVC data also add to the complexity of this issue. For example, the weaknesses of simple short-term before-and-after study results, given the variability of safety data, have long been recognized. The need to specifically define and describe how control and treatment segments are comparable and independent is also important. The

complexity, interaction, and number of factors that may impact the occurrence of a DVC make this task difficult, but these characteristics of the problem also support the need to properly document the experimental design details and potential concerns about study results.

Overall, although informative, very few studies have rigorously evaluated and/or documented DVC countermeasure impacts from a safety analysis point of view. Many DVC countermeasure studies have followed the before-and-after and/or control-treatment analysis approaches mentioned above, but the impact of these experimental designs on the strength of their results or conclusions were rarely documented. These methods are the same as those used by roadway safety researchers in the past to evaluate the impacts of other improvements (e.g., addition of a left-turn lane), but the inherent statistical weaknesses (assuming a proper experimental design) of these more basic statistical analysis approaches are also now recognized.

The analysis of safety data has recently experienced a number of advancements and in the transportation profession can be considered a relatively specialized focus area. The most generally accepted and comprehensive methodology to measure the impact of safety improvements at this point in time is the Empirical Bayes approach to evaluation. It is expected that most studies in the past were limited in their evaluation due to funding levels (which impacts the possible experimental designs, project team content, and the time period of evaluation) that did not match the analysis needs for the complexity of the DVC problem.

- A number of potential DVC countermeasures are discussed in this toolbox. Many of these countermeasures have been used for decades with a limited knowledge of their DVC reduction capabilities. These limitations are described for each specific countermeasure in Chapter 2, and restrict the ability to conclusively group almost all of the countermeasures reviewed solely by their DVC reduction capabilities. For this reason, the author has grouped the countermeasures discussed in this toolbox into five

categories. These categories are defined by the apparent use of a countermeasure in the roadway environment, and the general level of research that has been completed with respect to its DVC or roadway animal mortality reduction capabilities. The five categories and their assigned countermeasures are identified below.

- Used with Conflicting Study Results:
 - Deer Whistles
 - Roadside Reflectors/Mirrors

- Used with Generally Positive Study Results:
 - Exclusionary Fencing
 - Wildlife Crossings

- Used but Rarely Studied:
 - Speed Limit Reduction
 - Deer Crossing Signs and Technologies
 - Hunting or Herd Reduction
 - Roadside Vegetation Management

- Used but Not Studied:
 - In-Vehicle Technologies (on Roadways)
 - Deicing Salt Alternatives
 - Public Information and Education
 - Roadway Maintenance, Design, and Planning Policies

- Not Generally Used but Rarely Studied:
 - Roadway Lighting
 - Deer-Flagging Models
 - Intercept Feeding
 - Repellents (on Roadways)

Recommendations for future activities related to the countermeasures in each of these categories are presented in the next section of this chapter. However, given the current state-of-the-knowledge, the DVC reduction capabilities of very few countermeasures can be stated with any confidence. The application of adequately high fences (properly installed and maintained) with properly located and designed wildlife crossings have consistently produced positive safety results while minimizing the ecological impacts of a roadway. In the case of these two countermeasures the gaps in the state-of-the-knowledge are more application oriented. The basic DVC reduction capabilities of the remainder of the countermeasures, however, must still be determined.

- At the current time, the variability and complexity of the DVC problem makes it unlikely that there is one solution that exists which could be cost effectively applied to every roadway location. Fortunately, new potential countermeasures are also always being introduced for further evaluation. More likely, and similar to other roadway safety programs, a number of measures and activities will need to be implemented to result in any significant reduction in DVCs. Some examples of these activities include the proper installation and maintenance of countermeasures and public information and education campaigns. A combined and coordinated application of engineering, education, enforcement, and ecological measures seems appropriate.

RECOMMENDATIONS

- The ability to define the extent and temporal/spatial trends of the DVC problem is an important element to determining its solution(s). It is recommended that a national or regional database of the best available and properly defined DVC and/or animal-vehicle collision data be created. This database should also include vehicle volume/travel estimates as a separate input variable, and potentially contain deer population estimates and roadside deer carcass data at the most detailed level available. Land use and/or land cover within a particular distance of roadway segments, and average DVC costs are also of interest. Typical DVC frequencies and

rates should be calculated from this information, and could be used to identify and possibly plot roadway locations with a higher than typical DVC safety concern (at the local and state jurisdictional levels). The ability to accomplish this task is important to the effective implementation of countermeasures. The information can also be used to assist with the development of the DVC prediction models recommended below.

- The collection of roadside deer carcasses reveals that the actual number of DVCs may be more than twice that reported. Large databases of reported crashes by location are generally available and are normally used in roadway safety evaluations, but roadside carcass frequency, by location, could be a more accurate measure of DVC problem locations. Some jurisdictions in the United States quantify the number of carcasses collected, but it is expected that few specify the roadway location where they are collected. It is recommended that a pilot study be completed that investigates the collection of roadside carcass locations and its potential value to defining the DVC problem. The ability to collect this information efficiently should be evaluated, and the carcass data compared to reported DVC frequencies and locations to determine if any patterns emerge. The collection of this data could produce a more accurate measure of the DVC problem and possibly help identify problem locations that would have been missed if only reported DVCs are used. Activities similar to those described in the recommendation above should be completed if enough roadside deer carcass data becomes available. A relationship between reported DVC frequencies and locations and those that result from the use of roadside deer carcass data could also be defined and applied as appropriate. The weaknesses and strengths of the reported DVC and roadside carcass data collected should also be investigated.
- There are many factors, some more quantifiable than others, which can lead to a DVC. There is a need to more adequately quantify the relationships between these factors, and to more properly define their individual or combined impacts on the occurrence of a DVC. The ability to proactively define roadway segment locations (and possibly roadway designs) that could result in a higher than acceptable DVC

concern requires this information. The development of a valid DVC frequency and/or rate prediction model is recommended. But, these models would need to properly take into account and recognize the inherent characteristics of DVC data, and the strength and interrelationships of the factors that may impact the occurrence of DVC. The most useable DVC prediction model would include the fewest number of easily collected or estimated independent input variables that appear to produce adequately calculated answers. It should be recalled that many factors believed to impact the occurrence of a DVC might not be independent (e.g., posted speed limit and adjacent land cover).

- The DVC problem has both ecological and transportation safety impacts. It is expected that an effective DVC countermeasure program will include a combination of engineering, education, enforcement, and ecological measures and activities. The valid installation and evaluation of DVC countermeasures requires the coordination and cooperation of transportation and natural resource professionals. An effective and acceptable DVC countermeasure should reduce vehicle-animal interactions while still allowing necessary animal behavior and movements (given an existing roadway). In many cases, the implementation of a countermeasure will require some type of tradeoff between these two simultaneous objectives.

It is recommended that the installation and evaluation of DVC countermeasures be completed with teams of transportation safety and ecology professionals. This type of active coordination, cooperation, and communication is recommended throughout the roadway development process (e.g., planning, design, and maintenance/operation) and for all types of countermeasures (from deer crossing signs to wildlife crossings). The complexity and interdisciplinary characteristics of the DVC problem, its potential solutions, and the specialized nature of analyzing their ecological and transportation safety impacts requires this type of partnership for proper countermeasure evaluations. It is expected that this approach will result in a more all-encompassing approach to DVC countermeasure research that consistently applies the most current and generally accepted ecological and safety data collection and analysis procedures.

- From a transportation safety analysis point of view, there is a general need for more well-defined and documented research related to the impacts of DVC countermeasures. The interdisciplinary team approach suggested above should address this need by involving transportation safety analysts/engineers and ecologists in the data collection, experimental design, results evaluation, and report development stages of DVC countermeasure projects. The analysis methodologies used (given the study time period and funding), and any weaknesses or confounding impacts they might produce in the project results, will also be adequately addressed by this type of research team.

- Five categories of countermeasures were identified in the Conclusions section of this chapter. The types of evaluations that need to be completed for each of the categories are somewhat different and described below.
 - Used with Conflicting Study Results: It is recommended that a properly funded, designed, and documented evaluation of these countermeasures (i.e., deer whistles and roadside reflectors/mirrors) within the roadway environment be completed to definitively determine their DVC reduction effectiveness. These measures have been implemented for decades, but the research studies that have focused on their DVC reduction effectiveness have produced conflicting results. Many of them are lacking in their approach and/or documentation.

 - Used with Generally Positive Results: It is recommended that the DVC and ecological impacts of exclusionary fencing/wildlife crossing installations continue to be evaluated, and that these studies use the most generally accepted analysis procedures. More specific safety analysis should more accurately represent the DVC reduction capabilities of these installations, and possibly reduce the variability in the DVC reductions produced by past studies.

- The DVC and ecological impacts of combining exclusionary fencing with one-way gates, earthen escape ramps, and/or wildlife crossings should also continue to be investigated. In addition, because past research into exclusionary fencing/wildlife crossing installation has consistently shown DVC reductions there are questions about the details of their application and design that need to be investigated. For example, the DVC reduction effectiveness, ecological impacts, and cost effectiveness of minimum and preferable exclusionary fencing heights and wildlife crossing designs are needed. More information about how to properly locate exclusionary fencing and wildlife crossing is also necessary, along with how to solve the problem of the required gaps in exclusionary fencing. The National Cooperative Highway Research Program recently funded a project that focuses on the use and effectiveness of wildlife crossings. Additional analysis related to the use of one-way gates, earthen escape ramps, and at-grade crossing designs may also be appropriate.

- Used but Rarely Studied: This list of countermeasures includes speed limit reductions, deer crossing signs and technologies, hunting or herd reduction, and roadside vegetation management. These measures have all been suggested as DVC countermeasures, and in some cases been used somewhat extensively. The past evaluations of the DVC reduction capabilities of these countermeasures, however, have been limited to very few studies. The DVC impact of typical deer crossing signs, for example, has not been studied, but improvements to their design have been and are also currently being considered. In other cases, the primary focus of the studies related to these countermeasures has not been DVC reduction and some of the safety analysis is lacking in rigor. Additional evaluations are recommended (using the interdisciplinary approach previously recommended) to determine the actual impact of these measures on DVCs. Replicating and improving upon the studies previously completed to refute or support their results is necessary.

- Used but Not Studied: A number of the countermeasures discussed in this toolbox are being used (sometimes sporadically), but their DVC impacts have never actually been studied. It is recommended that the efficient and effective application of these potential countermeasures (i.e., in-vehicle technologies; public information/education campaigns; and roadway maintenance, design, and planning policies) be investigated, and their DVC impacts properly quantified.
- Not Generally Used, but Rarely Studied: Four countermeasures (e.g., roadway lighting, deer-flagging models, intercept feeding, and repellents (along roadways)) summarized in this toolbox have rarely been studied for application in the roadway environment. It is recommended that it may be appropriate to further evaluate these measures and support or refute the results of the studies that have been completed. It is rare that non-definitive and unreplicated studies are used to determine the overall usefulness of a roadway safety improvement. New studies that follow currently accepted ecological and safety data analysis approaches are recommended along with an evaluation of the advantages and disadvantages of applying these measures.
- In addition to interdisciplinary teams, the complexity and variability of the DVC problem, the factors that impact it, and its potential solutions require long-term (i.e., multi-year) and large-scale (i.e., multi-jurisdictional) evaluation projects. Two organizational activities are recommended to address this issue.

First, it is recommended that a properly funded regional or national roadway deer-vehicle (or large ungulate-vehicle) crash reduction research center be created. It is believed that the initiation and operation of this type of center would begin to address the more consistent and long-term approach needed to properly evaluate the effectiveness of existing and proposed DVC countermeasures. In addition, the center can serve as a focal point for those interested in the reduction of large ungulate-

vehicle crashes, promote standardized and generally accepted research in the area, and encourage interdisciplinary DVC evaluation teams through the request for proposal process. It should also lead to an increase in the current state-of-the-knowledge, more appropriate countermeasure installations, and a reduction in the costly DVC safety problem.

Second, it is also recommended that an annual DVC or large ungulate-vehicle crash symposia be established for those interested in the area of study. It is suggested that these meetings should also include interdisciplinary workshops about the most current and generally accepted procedures for ecological and transportation safety data collection and analysis procedures. Information sharing sessions would focus on gaps in the current state-of-the-knowledge, current DVC countermeasure research, and application issues. The organization of this meeting could be one of the first activities for the research center previously suggested.

BIBLIOGRAPHY

- Adler, Jr., B. *Outwitting Deer*. Lyons Press, New York, NY, 1999, pp. 177.
- Allen, R.E. and D.R. McCullough. Deer-Car Accidents in Southern Michigan. *Journal of Wildlife Management*, Volume 40, 1976, pp. 317 to 325.
- AMBS Consulting. *Fauna Usage of Three Underpasses Beneath the F3 Freeway Between Sydney and Newcastle*. Final Report to the New South Wales Roads and Traffic Authority. Sydney, Australia, 1997.
- Andelt, W.F., K.P. Burnham, and J.A. Manning. Relative Effectiveness of Repellents for Reducing Mule Deer Damage. *Journal of Wildlife Management*, Volume 55, Number 2, 1991, pp. 341 to 347.
- Andelt, W.F., D.L. Baker, and K.P. Burnham. Relative Preference of Captive Cow Elk for Repellent-Treated Diets. *Journal of Wildlife Management*, Volume 56, Number 1, 1992, pp. 164 to 173.
- Andrle, S.J., K.K. Knapp, T. McDonald, and D.E. Smith. *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties*. Iowa Highway Research Board Project TR-441. Iowa State University, Center for Transportation Research and Education, Ames, IA, April 2001.
- Armstrong, J.J. *An Evaluation of the Effectiveness of Swareflex Deer Reflectors*. Research and Development Branch, Ministry of Transportation. Ontario, Canada, 1992.
- Ballon, P. Premieres Observations sur L'Efficacite des Passages à Gibier sur L'Autoroute A36 (In French). In the *Highway and Wildlife Relationships Conference Proceedings*. Held in Strasbourg, France, June 5 to 7, 1985. Service d'Etudes Techniques de Routes et Autoroutes, Bagneaux, France, 1987, pp. 311 to 316.
- Bank, F.G., C.L. Irwin, G.L. Evink, M.E. Gray, S. Hagood, J.R. Kinar, A. Levy, D. Paulson, B. Ruediger, and R.M. Sauvajot. *Wildlife Habitat Connectivity Across European Highways*. Report No. FHWA-PL-02-011. United States Department of Transportation Federal Highway Administration, Washington, D.C., August 1992.
- Barnum, S.A. *Identifying the Best Locations along Highways to Provide Safe Crossing Opportunities for Wildlife*. Report No. CDOT-DTD-UCD-2003-9. Colorado Department of Transportation, Research Branch, Denver, CO, August 2003.
- Bashore, T.L. *Redirecting Deer Movements By the Use of Flagging Behavior Models*. M.A. Thesis, Millersville State College, Millersville, Pennsylvania, 1975.

Bashore, T. L., W.M. Tzilkowski, and E.D. Bellis. Analysis of Deer-Vehicle Collision Sites in Pennsylvania. *Journal of Wildlife Management*, Volume 49, Number 3, 1985, pp. 769 to 774.

Beier, P. and S. Loe. A Checklist for Evaluating Impacts to Wildlife Movement Corridors. *Wildlife Society Bulletin*, Volume 20, 1992, pp. 434 to 440.

Bekker, H., B. Van Den Hengel, H. Van Bohemen, and H. Van Der Sluijs. *Natuur Over Wegen (Nature Across Motorways)*. Ministry of Transport, Public Works, and Water Management, Delft, The Netherlands, 1995.

Bellis, E.D., H.B. Graves, B.T. Carbaugh, and J.P. Vaughn. *Behavior, Ecology, and Mortality of White-Tailed Deer Along a Pennsylvania Interstate Highway*. The Pennsylvania State University Institute for Research on Land and Water Resources. Research Publication Number 71, Pennsylvania State University, State College, PA, October 1971.

Bellis, E.D., and H.B. Graves. Highway Fences as Deterrents to Vehicle-Deer Collisions. In the *Transportation Research Record 674*, Transportation Research Board, National Research Council, Washington, D.C., 1978, pp. 53 to 58.

Bertwistle, J. The Effects of Reduced Speed Zones on Reducing Bighorn Sheep and Elk Collisions with Vehicles on the Yellowhead Highway in Jasper National Park. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*, Missoula, MT, September 13 to 16, 1999, pp. 727 to 735.

Bissonette, J.A. and M. Hammer. *Effectiveness of Earthen Return Ramps in Reducing Big Game Highway Mortality in Utah*. Utah Cooperative Fish and Wildlife Research Unit Series 2000, Utah State University, Logan, UT, November 2000.

Bonds, W. Yellowstone to Cody Reconstruction Project. In the *Proceedings for the Transportation Related Wildlife Mortality Seminar*, Orlando, FL, April 30 to May 2, 1996, pp. 122 to 129.

Brown, M. Deer Alerts May Reduce Accidents, Save Money. February 24, 1998. http://www.ameslab.gov/esha/Lessons_Learned/Green_Alerts/980224a.htm. Accessed August 24, 2002.

Brown, W.K., W.K. Hall, L.R. Linton, R.E. Huenefeld, and L.A. Shipley. Repellency of Three Compounds to Caribou. *Wildlife Society Bulletin*, Volume 28, Number 2, 2000, pp. 365 to 371.

Bruinderink, G, and E. Hazebroek. Ungulate Traffic Collisions in Europe. *Conservation Biology*, Volume 10, Number 4, August 1996, pp. 1059 to 1067.

Cadillac.com - Models - DeVille - Safety & Security.
<http://www.cadillac.com/cadillacjsp/models/featureDynamic.jsp?model=deville&feature=nightvision>. Accessed March 2002.

Calvo, R. N., and N, J. Silvy. Key Deer Mortality, U.S. 1 in the Florida Keys. In the *Proceedings for the Transportation Related Wildlife Mortality Seminar*, Orlando, FL, April 30 to May 2, 1996, pp. 312 to 322.

Carbaugh, B.T. *Activity and Behavior of White-Tailed Deer (Odocoileus Virginianus) Along an Interstate Highway in a Forest Region of Pennsylvania*. Dissertation. The Pennsylvania State University, State College, PA, 1970.

Chorba, J. *Deer Resistant Plants*. <http://home.ptd.net/~jchorba/deerlist.htm>. Accessed January 27, 2003.

Clevenger, A.P. Permeability of the Trans-Canada highway to Wildlife in Banff National Park: Importance of Crossing Structures and Factors Influencing their Effectiveness. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Edited by G.L. Evink, P. Garrett, D. Ziegler, and J. Berry. Report FL-ER-69-98. Florida Department of Transportation, Tallahassee, FL, 1998, pp 109 to 119.

Clevenger, A.P. and N. Waltho. Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. *Conservation Biology*, Volume 14, Number 1, February 2000, pp. 47 to 56.

Clevenger, A.P. *Highway Effects of Wildlife*. Progress Report 6 prepared for Parks Canada, Banff, Alberta, Canada, 2001.

Clevenger, A.P., B. Chruszcz, and K.E. Gunson. Highway Mitigation Fencing Reduces Wildlife-Vehicle Collisions. *Wildlife Society Bulletin*, Volume 29, Number 2, 2001, pp. 646 to 653.

Clevenger, A.P., J. Wierzchowski, B. Chruszcz, and K. Gunson. GIS-Generated Expert Based Models for Identifying Wildlife Habitat Linkages and Mitigation Passage Planning. *Conservation Biology*, Volume 16, Number 2, 2002, pp. 503 to 514.

Conover, M.R. Effectiveness of Repellents in Reducing Deer Damage in Nurseries. *Wildlife Society Bulletin*, Volume 12, 1984, pp. 399 to 404.

Conover, M.R. Comparison of Two Repellents for Reducing Deer Damage to Japanese Yews During Winter. *Wildlife Society Bulletin*, Volume 15, 1987, pp. 265 to 268.

Conover, M.R. and G.S. Kania. Effectiveness of Human Hair, BGR, and a Mixture of Blood Meal and Peppercorns in Reducing Deer Damage to Young Apple Trees. In the *Eastern Wildlife Damage Control Conference Proceedings*. Held in Gulf Shores, AL in 1987, pp. 97 to 101.

Conover, M.R., W.C. Pitt, K.K. Kessler, T. J. DuBow, and W.A. Sanborn. Review of Human Injuries, Illnesses, and Economic Losses Caused by Wildlife in the United States. *Wildlife Society Bulletin*, Volume 23, 1995, pp. 407 to 414.

Doerr, M.L., J.B. McAninch, and E.P. Wiggers. Comparison of 4 Methods to Reduce White-Tailed Deer Abundance in an Urban Community. *Wildlife Society Bulletin*, Volume 29, Number 4, 2001, pp. 1105 to 1113.

DePerno, C.S., J.A. Jenks, S.L. Griffin, L.A. Rice. Female Survival Rates in a Declining White-Tailed Deer Population. *Wildlife Society Bulletin*, Volume 28, Number 4, Winter 2000, pp. 1030 to 1037.

Drzewucki, Jr., V. *Gardening in Deer Country*. Brick Tower Press, New York, NY, 1998, pp. 108.

Eckler, J. *Irondequoit Live Deer Spotlight Survey, Fall 2000*. New York State Department of Environmental Conservation, Albany, NY, January 2001.

Endries, M., T. Gilbert, and R. Kautz. Environmental Planning in Florida: Mapping Wildlife Needs in Florida: The Integrated Wildlife Habitat Ranking System. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC, 2003, pp. 525 to 534.

Evink, G.L. Florida Department of Transportation Initiatives Related to Wildlife Mortality. In the *Proceedings for the Transportation Related Wildlife Mortality Seminar*, Orlando, FL, April 30 to May 2, 1996, pp. 302 to 311.

Evink, G., T.A. Messmer, and B. Ruediger. Working Towards Creating Ecological Highways: Challenges and Opportunities. In the *Wildlife and Highways: Seeking Solutions to an Ecological and Socio-Economic Dilemma*, The Wildlife Society Annual Meeting Held in Nashville, TN, 2000, pp 168 to 177.

Evink, G.L. *NCHRP Synthesis 305 – Interaction Between Roadways and Wildlife Ecology*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, D.C., 2002.

Falk, N.W. *Fencing as a Deterrent to Deer Movement along Highways*. Dissertation. The Pennsylvania State University, State College, PA, November 1975.

Feldhamer, G. A., J.E. Gates, D.M. Harman, A.J. Loranger, and K.R. Dison. Effects of Interstate Highway Fencing on White-Tailed Deer Activity. *Journal of Wildlife Management*, Volume 50, Number 3, 1986, pp. 497 to 503.

Finder, R. A. *Relationships between Landscape Patterns and White-tailed Deer/Vehicle Accidents*. Master Thesis. Southern Illinois University-Carbondale, Carbondale, IL, 1997.

Ford S.G. *Evaluation of Highway Deer Kill Mitigation on SIE/LAS-395*. Report No. FHWA-CA-TP-80-01. California Department of Transportation, Sacramento, CA, 1980.

Ford, S.G. and S.L. Villa. *Reflector Use and the Effect They Have on the Number of Mule Deer Killed on California Highways*. California Department of Transportation, Sacramento, CA and United States Department of Transportation, Washington, D.C., August 1993, pp.17.

Forman, R.T.T. and R. D. Deblinger. The Ecological Road-effect Zone for Transportation Planning and Massachusetts Highway Example. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Report No. FL-ER-69-98. Florida Department of Transportation, Tallahassee, FL, 1998, pp. 78 to 96.

Forman, R.R.T. Spatial Models as an Emerging Foundation of Road System Ecology and a Handle for Transportation Planning and Policy. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Report No. FL-ER-73-99. Florida Department of Transportation, Tallahassee, FL, 1999, pp. 119 to 124.

Forman, R.T.T., D. Sperling, J.A. Bissonette, A.P. Clevenger, C.D. Cutshall, V.H. Dale, L. Fahrig, R. France, C.R. Goldman, K. Heanue, J.A. Jones, F. J. Swanson, T. Turrentine, and T.C. Winter. *Road Ecology Science and Solutions*. Island Press, Washington, D.C., 2003.

Foster, M.L. and S.R. Humphrey. Use of Highway Underpasses by Florida Panthers and Other Wildlife. *Wildlife Society Bulletin*, Volume 23, Number 1, 1995, pp. 95 to 100.

Fraser, D. and E.R. Thomas. Moose-Vehicle Accidents in Ontario: Relation to Highway Salt. *Wildlife Society Bulletin*, Volume 10, Number 3, 1982, pp. 261 to 265.

Gibeau, M.L., and K. Heuer. Effects of Transportation Corridors on Large Carnivores in the Bow River Valley, Alberta. In the *Proceedings for the Transportation Related Wildlife Mortality Seminar*, Orlando, FL, April 30 to May 2, 1996, pp. 77 to 90.

Gibeau, M.L. and S. Herrero. Roads, Rails, and Grizzly Bears in the Bow River Valley, Alberta. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Edited by G.L. Evink, P. Garrett, D. Ziegler, and J. Berry. Report FL-ER-69-98. Florida Department of Transportation, Tallahassee, FL, 1998, pp 104 to 108.

Gladfelter, L. *Effect of Wildlife Highway Reflectors on Deer-Vehicle Accidents*. Iowa Highway Research Board Project HR-210. Iowa Department of Transportation, Ames, Iowa, 1984.

Gloyne, C.C. and A.P. Clevenger. Cougar Use of Wildlife Crossing Structures on the Trans-Canada Highway in Banff National Park, Alberta. *Wildlife Biology*, Volume 7, 2001, pp. 117 to 124.

Gordon, D.F., M.C. Coghill, and F.W. Dunham. *Evaluation of Deer Highway Crossing Safety Measures*. Colorado Department of Transportation. Project Number W-38-R-23, Final Report-9206020. Denver, CO, 1969.

Gordon, K.M, S.H. Anderson, B. Gribble, M. and Johnson. *Evaluation of the FLASH (Flashing Light Animal Sensing Host) System in Nugget Canyon, Wyoming*. Report No. FHWA-WY-01/03F. University of Wyoming, Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, WY, July 2001.

Gosson, J.T. Deer Whistles Prevent Costly Accidents. *The National Sheriff*. Volume 40, Number 5, October/November 1988.

Graves III, H.B., and E.D. Bellis. *The Effectiveness of Deer Flagging Models as Deterrents to Deer Entering Highway Rights-of-Way*. Institute for Research on Land and Water Resources, The Pennsylvania State University, University Park, Pennsylvania, 1978.

Gunther, K.A., M. J. Biel, and H. L. Robison. Factors Influencing the Frequency of Road-killed Wildlife in Yellowstone National Park. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*, Fort Myers, FL, February 9 to 12, 1998, pp. 395 to 405.

Hani, E.H., and M.R. Conover. Comparative Analysis of Deer Repellents. In the *Repellents in Wildlife Management Symposium Proceedings*. National Wildlife Research Center, United States Department of Agriculture Animal and Plant Health Inspection Service, Fort, Collins, CO. Held in Denver, CO, August 8 to 10, 1995, pp. 147 to 155.

Harris, M.T., W.L. Palmer, and J.L. George. Preliminary Screening of White-Tailed Deer Repellents. *Journal of Wildlife Management*, Volume 47, 1983, pp. 516 to 519.

Hart, R.M. *Deer Proofing Your Yard and Garden*. Story Communications, North Adams, MA, 1997, pp. 155.

Harwood, D.W., F.M. Council, E. Hauer, W.E. Hughes, and A. Vogt. *Prediction of the Expected Safety Performance*. Federal Report FHWA-RD-99-207. United States Department of Transportation Federal Highway Administration, Washington, D.C., December 2000.

Heinrich, H. and S. Predl. Can We Landscape to Accommodate Deer? The Tracy Estate Research Garden. In the *Proceedings of the Sixth Eastern Wildlife Damage Control Conference (1993)*, Held in Asheville, NC. University of Nebraska Lincoln, School of Natural Resource Science, <http://wildlifedamage.unl.edu/>, 1995, pp. 102 to 112.

Hubbard, M. W., B. J. Danielson, and R. A. Schmitz. Factors Influencing the Location of Deer-Vehicle Accidents in Iowa. *Journal of Wildlife Management*, Volume 64, Number 3, July 2000, pp. 707 to 713.

Hunt, A., H.J. Dickens, and R.J. Whelan. Movement of Mammals Through Tunnels Under Railway Lines. In the *Australian Zoologist*, Volume 24, 1987, pp. 89 to 93.

Hygnstrom, S.E. and S.C. Craven. Electric Fences and Commercial Repellents for Reducing Deer Damage in Cornfields. *Wildlife Society Bulletin*, Volume 16, Number 3, 1988, pp. 291 to 296.

Ishmael, W.E., D.E. Katsma, T.A. Isaac, and B.K. Bryant. Live Capture and Translocation of Suburban White-Tailed Deer in River Hills, Wisconsin. In the *Proceedings of the 55th Midwest Fish and Wildlife Conference – Urban Deer: A Manageable Resource*, St. Louis, MO, December 1993, pp. 87 to 96.

Ingebrigtsen, D.K. and J.R. Ludwig. Effectiveness of Swareflex Wildlife Warning Reflectors in Reducing Deer-Vehicle Collisions in Minnesota. *Minnesota Wildlife Report*, Number 3, 1986.

Insurance Institute for Highway Safety. Deer, Moose Collisions with Motor Vehicles Peak in Spring and Fall. *Status Report*. Volume 28, Number 4, April 3, 1993.

Iverson A. L., and L. R. Iverson. Spatial and Temporal Trends of Deer Harvest and Deer-Vehicle Accidents in Ohio. *The Ohio Journal of Science*, Volume 99, Number 4, September 1999, pp. 84 to 94.

Jackson, S.D. and T. Tynning. Effectiveness of Drift Fences and Tunnels for Moving Spotted Salamanders *Ambystoma Maculatum* Under roads. In *Amphibians and Roads*. Edited by T.E.S. Langton. ACO Polymer Products, Shefford, Bedfordshire, England, 1989, pp. 93 to 100.

Jared, D. *Evaluation of Wild Animal Highway Warning Reflectors*. Office of Materials and Research, Georgia Department of Transportation. Special Assignment 98003, Atlanta, GA, November 1999.

Jaren, V., R. Andersen, M. Ulleberg, P.H. Pedersen, and B. Wiseth. Moose-Train Collisions: The Effects of Vegetation Removal with a Cost-Benefit Analysis. *Alces*, Volume 27, 1991, pp. 93 to 99.

Jenks, J.A., W.P. Smith, and C.S. DePerno. Maximum Sustained Yield Harvest Versus Trophy Management. *Journal of Wildlife Management*, Volume 66, Number 2, 2002, pp. 528 to 535.

Jescavage-Bernard, K. *Gardening in Deer Country: Ornamental Plants for Eastern Gardens*, <http://doityourself.com/pest/gardeningindeercountry.htm>. Accessed November 22, 2003.

Jones, J.M., and J.H. Witham. Urban Deer “Problem-Solving” in Northeast Illinois: An Overview. In the *Proceedings of the 55th Midwest Fish and Wildlife Conference – Urban Deer: A Manageable Resource*, St. Louis, MO, December 1993, pp. 58 to 65.

Jull, L.G. Plants not Favored by Deer. *UW Extension Bulletin A3727*. Available at <http://www1.uwex.edu/ces/pubs/>. University of Wisconsin-Extension, Madison, WI, 2001.

Kinley, T.A., N.J. Newhouse, and H. N. Page. *Problem Statement: Potential to Develop an Area Repellent System to Deter Ungulates from Using Highways*. Prepared for the Insurance Cooperation of British Columbia, Kamloops, British Columbia. November 2003.

Kuser, J.E., and L.J. Wolgast. Deer Roadkill Increases with No-Firearms-Discharge Law. In *The Bulletin*. New Jersey Academy of Science, Piscataway, NJ, Volume 28, 1983, pp. 71 to 72.

Lamoureux, J., M. Crete, and M. Belanger. Effects of Reopening Hunting on Survival of White-Tailed Deer (*Odocoileus Virginianus*) in the Bas-Saint-Laurent Region, Quebec. *Canadian Field-Naturalist*, Volume 115, Number 1, 2001, pp. 99 to 105.

Land D., and M. Lotz. Wildlife Crossing Designs and Use by Florida Panthers and Other Wildlife in Southwest Florida. In *Trends in Addressing Transportation Related Wildlife Mortality*. Edited by G.L. Evink, D. Ziegler, P. Garrett, and J. Berry. Report FL-ER-58-96. Florida Department of Transportation, Tallahassee, FL, 1996, pp 323 to 328.

Lavsund, S. and F. Sandegren. Moose-Vehicle Relations in Sweden: A Review. *Alces*, Volume 27, 1991, pp. 118 to 126.

Lehnert, M. E. and J.A. Bissonette. Effectiveness of Highway Crosswalk Structures at Reducing Deer-Vehicle Collisions. *Wildlife Society Bulletin*, Volume 25, Number 4, 1997, pp. 809 to 818.

Little, S.J., R.G. Harcourt, and A.P. Clevenger. Do Wildlife Passages Act as Prey-Traps? *Biological Conservation*, Volume 107, pp. 135 to 145.

Loewer, P. *Solving Deer Problems – How to Keep them out of the Garden, Avoid them on the Road, and Deal with them Everywhere!* The Lyons Press, Guilford, CT, 2003, pp. 247.

Ludwig, J., and T. Bremicker. Evaluation of 2.4-Meter Fences and One-Way Gates for Reducing Deer-Vehicle Collisions in Minnesota. In the *Transportation Research Record*

- 913, Transportation Research Board, National Research Council, Washington, D.C., 1983, pp. 19 to 22.
- Mcaffery, K.R. Road-Kills Show Trends in Wisconsin Deer Populations. *Journal of Wildlife Management*, Volume 37, Number 2, 1973, pp. 212 to 216.
- McClain, T., and D. Lonsdorf. 2003 Motor-Vehicle Deer Crash Facts. <http://www.dot.wisconsin.gov/safety/motorist/crashfacts/docs/deerfacts.pdf>. Accessed May 13, 2004.
- McGowen, P. Brochure: *Announcing the U.S. Highway 191 Animal Detection, Driver Warning System*. Western Transportation Institute, Montana State University. Bozeman, MT, 2001.
- McGowen, P. Draft *Topic Scanning Paper for Proposed Advanced Rural Transportation Systems Committee Research Agenda, Topic Area: Animal Vehicle Collisions*. Intelligent Transportation Society of America, Washington, D.C., Accessed at www.itsa.org/committee.nsf in March 2002.
- McGuire, T.M. and J.F. Morrall. Strategic Highway Improvements to Minimize Environmental Impacts within the Canadian Rocky Mountain National Parks. *Canadian Journal Civil Engineering*, Volume 27, 2000, pp. 523 to 532.
- Melchior, M.A., and C.A. Leslie. Effectiveness of Predator Fecal Odors as Black-Tailed Deer Repellents. *Journal of Wildlife Management*, Volume 49, Number 2, 1985, pp. 358 to 362.
- Messmer, T. A., C.W. Hedricks, and P.W. Klimack. Modifying Human Behavior to Reduce Wildlife-Vehicle Collisions Using Temporary Signing. In the *Wildlife and Highways: Seeking Solutions to an Ecological and Socio-Economic Dilemma*. Held in Nashville, Tennessee, September 12 to 16, 2000, pp. 134 to 147.
- Meyer, E. and I. Ahmed. Modeling of Deer-Vehicle Crash Likelihood Using Roadway and Roadside Characteristics. In the *Proceedings of the Transportation Research Board Annual Meeting*. Transportation Research Board, National Research Council, Washington, D.C., 2004.
- Michael, E.D. *Wildlife Use of Different Roadside Cover Plantings*. West Virginia Department of Highways. WVU Report No. 77-247, Charleston, WV, 1980.
- Minnesota Department of Transportation. News Release: *New Deer Alert System May Lessen Motorist-Deer Collisions in Minnesota*. St. Paul, MN, June 12, 2001. Accessed at www.dot.state.mn.us in March 2002.
- Minnesota Department of Transportation. *Plant Selector Program*. <http://plantselector.mn.dot.state.us>. Access November 22, 2003.

Müller-Schwarze, D. Responses of Young Black-Tailed Deer to Predator Odors. *Journal of Mammalogy*, Volume 53, Number 2, 1972, pp. 393 to 394.

Nielsen, C.K., R.G. Anderson, and M.D. Grund. Landscape Influences on Deer-Vehicle Accidents in an Urban Environment. *Journal of Wildlife Management*, Volume 67, 2003, pp. 46 to 51.

Oakasa, T. *Deer-Vehicle Crash Models for Wisconsin Counties*. Masters Thesis. University of Wisconsin-Madison, 2003.

Olbrich, P. Untersuchung der Wirksamkeit von Wildwarnreflektoren und der Eignung von Wilddurchlässen (In German). In *Zeitschrift für Jagdwissenschaft*, Volume 30, 1984, pp. 87 to 91.

Pafko, F. and B. Kovach. Minnesota Experience with Deer Reflectors. In compendium for *Transportation and Wildlife: Reducing Wildlife Mortality and Improving Wildlife Passageways Across Transportation Corridors*. Conference held in Orlando, FL from April 30 to May 2, 1996. Florida Department of Transportation, Tallahassee, FL and United States Department of Transportation Federal Highway Administration, Washington, D.C., August 1996, pp. 116 to 124.

Palmer, W.L., J.M. Payne, R.G. Wingard, and J.L. George. A Practical Fence To Reduce Deer Damage. *Wildlife Society Bulletin*, Volume 13, Number 3, 1985, pp. 240 to 245.

Palmer, W.L., R.G. Wingard, and J.L. George. Evaluation of White-Tailed Deer Repellents. *Wildlife Society Bulletin*, Volume 11, 1987, pp. 164 to 166.

Peek, F.W., and E.D. Bellis. Deer Movements and Behavior Along an Interstate Highway. In the *Highway Research News*. Number 36, Highway Research Board, Washington, D.C., 1969, pp. 36 to 42, 1969.

Pfister, H.P., V. Keller, H. Reck, and B. Georgii. *Bio-Ecological Effectiveness of Wildlife Overpasses or "Green Bridges" Over Roads and Railway Lines* (In German). Herausgegeben vom Bundesministerium für Verkehr Abteilung Strassenbau, Bonn-Bad Godesberg, Germany, 1997.

Pojar, T.M., D. F. Reed, and T.C. Reseigh. *Lighted Deer Crossing Signs and Vehicular Speed*. Report No. HS-011935. Colorado Department of Natural Resources, Division of Game, Fish, and Parks. Denver, CO, 1971.

Pojar, T.M., D. F. Reed, and T.C. Reseigh. Deer Crossing Signs May Prove Valuable in Reducing Accidents and Animal Deaths. In the *Highway Research News*, Volume 46, 1972, pp. 20 to 23.

Pojar, T.M., D. F. Reed, and T.C. Reseigh. Effectiveness of A Lighted, Animated Deer Crossing Sign. *Journal of Wildlife Management*, Volume 39, Number 1, 1975, pp. 87 to 91.

Porter, W.F. A Baited Electric Fence for Controlling Deer Damage to Orchard Seedling. *Wildlife Society Bulletin*, Volume 11, Number 4, 1983, pp. 325 to 327.

Predl, S. Efforts to Manage the White-Tailed Deer of Princeton Township, New Jersey. *Northeast Wildlife*, Volume 50, 1993, pp. 49 to 55.

Puglisi, M.J., J.S. Lindzey, and E.D. Bellis. Factors Associated With Highway Mortality of White-Tailed Deer. *Journal of Wildlife Management*, Volume 38, Number 4, 1974, pp. 799 to 807.

Putnam, R.J. Deer and Road Traffic Accidents: Options for Management. *Journal of Environmental Management*, Volume 51, 1997, pp. 43 to 57.

Reed, D.F., T.M. Pojar, and T.N. Woodard. Use of One-Way Gates by Mule Deer. *Journal of Wildlife Management*, Volume 38, Number 1, 1974, pp. 9 to 15.

Reed, D.F., Woodard, T.N., and Pojar, T.M. Behavioral Response of Mule Deer to a Highway Underpass. *Journal of Wildlife Management*, Volume 39, Number 2, 1975, pp. 361 to 367.

Reed, D. F., T. N. Woodard, and T. D. I. Beck. *Highway Lighting to Prevent Deer-Auto Accidents. Final Report.* Report CDOH-P&R-R-77-5. Colorado Division of Highways, Denver, Colorado, 1977.

Reed, D.F., T.N. Woodard, and T.D.I. Beck. *Regional Deer- Vehicle Accident Research.* Report Number FHWA-CO-RD-79-11. Colorado Division of Wildlife, Denver, Colorado, November 1979.

Reed, D. F. and T. N. Woodard. Effectiveness of Highway Lighting in Reducing Deer-Vehicle Accidents. *Journal of Wildlife Management*, Volume 45, Number 3, 1981, pp.721 to 726.

Reed, D.F., T.D. Beck, and T.N. Woodard. Methods of Reducing Deer-Vehicle Accidents: Benefit-Cost Analysis. *Wildlife Society Bulletin*, Volume 10, 1982, pp. 349 to 354.

Reed, D.F. and A.L. Ward. Efficacy of Methods Advocated to Reduce Deer-Vehicle Accidents: Research and Rationale in the USA. In the *Highway and Wildlife Relationships* Conference Proceedings. Held in Strasbourg, France, June 5 to 7, 1985. Service d'Etudes Techniques de Routes et Autoroutes, Bagneaux, France, 1987, pp. 285 to 293.

- Reeve, A.F. and S.H. Anderson. Ineffectiveness of Swareflex reflectors at reducing deer-vehicle collisions. *Wildlife Society Bulletin*, Volume 21, 1993, pp. 127 to 132.
- Reilley, R.E. and H.E. Green. Deer Mortality on a Michigan Interstate Highway. *Journal of Wildlife Management*, Volume 38, 1974, pp. 16 to 19.
- Risenhoover, K. J. Hunter, R. Jacobson, and G. Stout. *Hearing Sensitivity in White Tailed Deer*. Department of Wildlife and Fisheries Sciences, Texas A & M University, College Station, TX, 1997.
- Roach, G. and R. Kirkpatrick. Wildlife Use of Roadside Woody Plantings in Indiana. In the *Transportation Research Record 1016*. Transportation Research Board, National Research Council, Washington, D.C., 1985, pp. 11 to 15.
- Rogers, E. *An Ecological Landscape Study of Deer-Vehicle Collisions in Kent County, Michigan*. Prepared for Kent County Road Commission, Grand Rapids, MI. White Water Associates, Incorporated, January 2004.
- Rodríguez, A., G. Crema, and M. Delibes. Factors Affecting Crossing of Red Foxes and Wildcats Through Non-Wildlife Passages Across A High Speed Railway. *Ecography*, Volume 20, 1996, pp. 287 to 294.
- Rodríguez, A., G. Crema, and M. Delibes. Use of Non-Wildlife Passages Across a High Speed Railway by Terrestrial Vertebrates. *Journal of Applied Ecology*, Volume 33, 1997, pp. 1527 to 1540.
- Romin, L.A., and L.B. Dalton. Lack of Response by Mule Deer to Wildlife Warning Whistles. *Wildlife Society Bulletin*, Volume 20, Number 4, 1992, pp. 382 to 384.
- Romin, L.A., and J.A. Bissonette. Deer-Vehicle Collisions: Status of State Monitoring Activities and Mitigation Efforts. *Wildlife Society Bulletin*, Volume 24, Number 2, 1996, pp. 276 to 283.
- Roof, J. and J. Wooding. Evaluation of the SR 46 Wildlife Crossing in Lake County, Florida. In *Trends in Addressing Transportation Related Wildlife Mortality*. Edited by G.L. Evink, D. Ziegler, P. Garrett, and J. Berry. Report FL-ER-58-96. Florida Department of Transportation, Tallahassee, FL, 1996, pp 329 to 336.
- Rosell, C., J. Parpal, R. Campeny, S. Jove, A. Pasquina, and J.M. Velasco. In *Habitat Fragmentation & Infrastructure*. Edited by k. Canters. Ministry of Transport, Public Works, and Water Management, Delft, The Netherlands, 1997, pp. 367 to 372.
- Schafer, J.A. and S.T. Penland. Effectiveness of Swareflex Reflectors in Reducing Deer-Vehicle Accidents. *Journal of Wildlife Management*, Volume 49 Number 3, 1985, pp. 774 to 776.

Scheifele, M. P., D. G. Browning, and L. M. Collins-Scheifele. Analysis and Effectiveness of “Deer Whistles” for Motor Vehicles: Frequencies, Levels, and Animal Threshold Responses. *Acoustics Research Letters Online*, Volume 4, Number 3, July 2003, pp. 71 to 76.

Scott, J.D. and T.W. Townsend. Characteristics of Deer Damage to Commercial Tree Industries of Ohio. *Wildlife Society Bulletin*, Volume 13, 1985, pp. 135 to 143.

Simons, P. *Camouflage Gardening: Deer Resistant Plants*.
<http://lonestar.texas.net/~jleblanc/deerplants.html>. Accessed January 27, 2003.

Singleton, P.H. and J.F. Lehmkuhl. *I-90 Snoqualmie Pass Wildlife Habitat Linkage Assessment*. United States Department of Agriculture, Forest Service, Wenatchee, WA, March 2000.

Smith, D.J., L.D. Harris and F.J. Mazzotti. A Landscape Approach to Examining the Impacts of Roads on the Ecological Function Associated with Wildlife Movement and Movement Corridors: Problems and Solutions. In the *Proceedings of the International Conference on Wildlife Ecology and Transportation*. Report No. FL-ER-58-96. Florida Department of Transportation, Tallahassee, FL. 1996, pp. 301 to 315.

Stephens, P.G. *Deer Resistant Ornamental Plants for the Northern United States*. Nichols Garden Nursery, Englishtown, NJ, 1994, pp. 69.

Sullivan, T.P., L.O. Nordstrom, and D.S. Sullivan. Use of Predator Odors as Repellents to Reduce Feeding damage to Herbivores II. Black-tailed Deer (*Odocoileus Hemionus Columbianus*). *Journal of Chemical Ecology*, Volume 11, Number 7, 1985, pp. 921 to 935.

Swihart, R.K. and M.R. Conover. Reducing Deer Damage to Yews and Apple Trees: Testing Big Game Repellent™, Ro-Pel™, and Soap as Repellents. *Wildlife Society Bulletin*, Volume 18, 1990, pp. 156 to 162.

Swihart, R. K., J. J. Pignatello, and M. J. Mattina. Adverse Responses of White-Tailed Deer, *Odocoileus Virginianus*, to Predator Urines. *Journal of Chemical Ecology*, Volume 17, Number 4, 1991, pp. 767 to 777.

Task Force for Roadside Safety. *Roadside Design Guide*, 3rd Edition. American Association of State Highway and Transportation Officials, Washington, D.C., 2002.

Tierson, W.C. Controlling Deer Use of Forest Vegetation with Electric Fences. *Journal of Wildlife Management*, Volume 33, Number 4, October 1969, pp. 922 to 926.

Transportation News: Infrared Night Vision System Lets Drivers See and Avoid Danger. http://www.honeywell.com/en/trans/announcement_details.jsp?rowID=2&docID=31&catID=10. Accessed March 2002.

Treweek, J. and N. Veitch. The Potential Application of GIS and Remotely Sensed Data to the Ecological Assessment of Proposed New Road Schemes. *Global Ecology and Biogeography Letters*, Volume 5, 1996, pp. 249 to 257.

Tubbs D.M. *Ecology and Behavior of White-Tailed Deer (Odocoileus Virginianus) Along A Fenced Section of a Pennsylvania Interstate Highway*. Dissertation. Pennsylvania State University, State College, PA, December 1972.

Ujvari, M., H.J. Baagoe, and A.B. Madsen. Effectiveness of Wildlife Warning Reflectors in Reducing Deer-Vehicle Collisions: A Behavioral Study. *Journal of Wildlife Management*, Volume 62, Number 3, 1998, pp. 1094 to 1099.

United States Department of Transportation. *Manual on Uniform Traffic Control Devices*, Millennium Edition. United States Department of Transportation, Federal Highway Administration. Washington, D.C., 2000.

University of California Cooperative Extension Placer and Nevada Counties. *Deer Resistant Plants for the Sierra Foothills (Zone7)*. Publication Number 31-113, University of California, October 2001, pp. 9.

Veenbaas, G. and G.J. Brandjes. The Use of Fauna Passages along Waterways Under Motorways. In *Key Concepts in Landscape Ecology*. Edited by J. W. Dover, and R.G.H. Bunce. International Association of Landscape Ecology, Preston England, 1999, pp. 315 to 320.

Ward, A.L. Mule Deer Behavior in Relation to Fencing and Underpasses on Interstate 80 in Wyoming. In the *Transportation Research Record 859*, Transportation Research Board, National Research Council, Washington, D.C., 1982, pp. 8 to 13.

Ward, J.S. Limiting Deer Browse Damage to Landscape Plants. *Bulletin 968*. The Connecticut Agricultural Experiment Station, New Haven, CT, November 2000.

Waring, G.H, J.L. Griffis, and M.E. Vaughn. White-Tailed Deer Roadside Behavior, Wildlife Warning Reflectors, and Highway Morality. *Applied Animal Behavior Science*, Volume 29, 1991, pp. 215 to 223.

Washington Department of Fish and Wildlife. News Release: *New Signs Flash Elk Warning to Motorists*. Olympia, WA, May 25, 2000. Accessed at www.wsdot.wa.gov in March 2002.

Wisconsin Department of Natural Resources. *Deer Population Goals and Harvest Management Environmental Assessment*. Editors William J. Vander Zouwen and D. Keith Warnke. Wisconsin Department of Natural Resources, Madison, WI, 1995.

Wood, P., and M.L. Wolfe. *Intercept Feeding as a Means of Reducing Deer-Vehicle Collisions*. Department of Fisheries and Wildlife, Utah State University, Logan, UT, 1988.

Woods, J.G. *Effectiveness of Fences and Underpasses on the Trans-Canada Highway and Their Impact on Ungulate Populations Project*. Canadian Parks Service, Natural History Division, Calgary, Alberta, Canada, March 1990.

Woods J.G, and R. H. Munro. Roads, Rails and the Environment: Wildlife at the Intersection in Canada's Western Mountains. *Proceedings for the Transportation Related Wildlife Mortality Seminar*, Orlando, FL, April 30 to May 2, 1996, pp. 47 to 54

Yanes, M., J.M. Velasco, F. Suárez. Permeability of Roads and Railways to Vertebrates: The Importance of Culverts. *Biological Conservation*, Volume 71, 1995, pp. 217 to 222.

Zacks, J. L. *An Investigation of Swareflex Wildlife Warning Reflectors*. Report No. HRP 0010 (7). United States Department of Transportation Federal Highway Administration. Washington, D.C., July 1985.

Zacks, J.L. Do White Tailed Deer Avoid Red? An Evaluation of the Premise Underlying the Design of Swareflex Wildlife Reflectors. *Transportation research Record 1075*, Transportation Research Board, National Research Council, Washington, D.C., 1986, pp. 35 to 43.