CHAPTER 1 – INTRODUCTION

BACKGROUND

The linear nature of surface transportation systems creates a suite of concerns for transportation and natural resource management agencies as they seek to ameliorate the impacts of their projects on environmental resources, as roads divide habitats and hydrological features. To help better understand the interactions between roads and environment the discipline of road ecology has emerged in the last 10 years. Road ecology strives to understand surface transportation infrastructure and its impacts on wildlife and motorist safety, aquatic resources, habitat connectivity, and many other environmental values.

The effects of roads on wildlife populations have been the focus of many studies in the last decade and increasing concern for transportation and natural resource management agencies. Roads affect populations in numerous ways, from habitat loss and fragmentation, to barriers to animal movement, and wildlife mortality. The impact of roads on wildlife populations is a significant and growing problem worldwide. In rural and suburban areas of North America, accidents with wildlife are quickly becoming a major safety concern for motorists as shown in Figure 1.

In parts of North America today, roads are a serious obstacle to maintaining population connectivity and a threat to the long-term survival of some regionally important wildlife populations. Wildlife crossing structures are intended to increase permeability and habitat connectivity across roads and reduce wildlife–vehicle collisions. These are above-grade (wildlife overpasses) or below-grade (wildlife underpasses) structures designed to facilitate movement of animals and connections among populations. Like landscape corridors, the conservation value of wildlife crossing structures are gaining attention as applied measures to help adapt changes in species ranges and animal distributions to climate change. The effect of roads on wildlife and biodiversity in general are a primary reason why the public raises questions about the environmental impacts of roads and vehicles. Calls for implementation of solutions are increasingly heard from environmental scientists, the transportation community, and decision makers.

Over the last decade, federal, state and provincial land management and transportation agencies have become increasingly aware of the effects that roads have on wildlife. Significant advances in our understanding of these impacts have been made; however, the means to adequately mitigate these impacts have been slower in coming. There are examples where wildlife crossing structures and fencing significantly reduce the impacts of roads on wildlife populations and have increased motorist safety. Anticipated population growth and ongoing highway investments in many regions as shown in Figure 2, coupled with the resounding concern for maintaining large-scale landscape connectivity for wildlife populations has generated increasing interest in crossing structures as management tools. Yet currently there is limited knowledge and technical guidance on how best design wildlife crossing systems for the range of wildlife found throughout North America.

Figure 1. Photo. Accidents with wildlife in rural and suburban areas are becoming a major safety concern for motorist and transportation agencies (credit: John Nordgren).

JUSTIFICATION

There is currently an urgent need to provide transportation and other stakeholder agencies with technical guidance and best management practices on the planning and design of wildlife crossing mitigation measures. Research in this area has increased over the years but has not resulted in sufficient rigorously tested practices useful to transportation agencies. As a result, many transportation agencies continue to build costly structures for wildlife connectivity with little evidence-based guidance. Technical guidelines and best management practices have not been articulated and are still much in need for many North American wildlife species and their habitats.

The siting of wildlife crossing structures is equally as important as their design. Identifying the proper location of crossing structures is critical for designing effective mitigation of the barrier effect caused by roads. The number of methods used to determine these key locations on roads has increased in recent years. However, few attempts have been made to critically review the techniques that are currently available to transportation agencies.

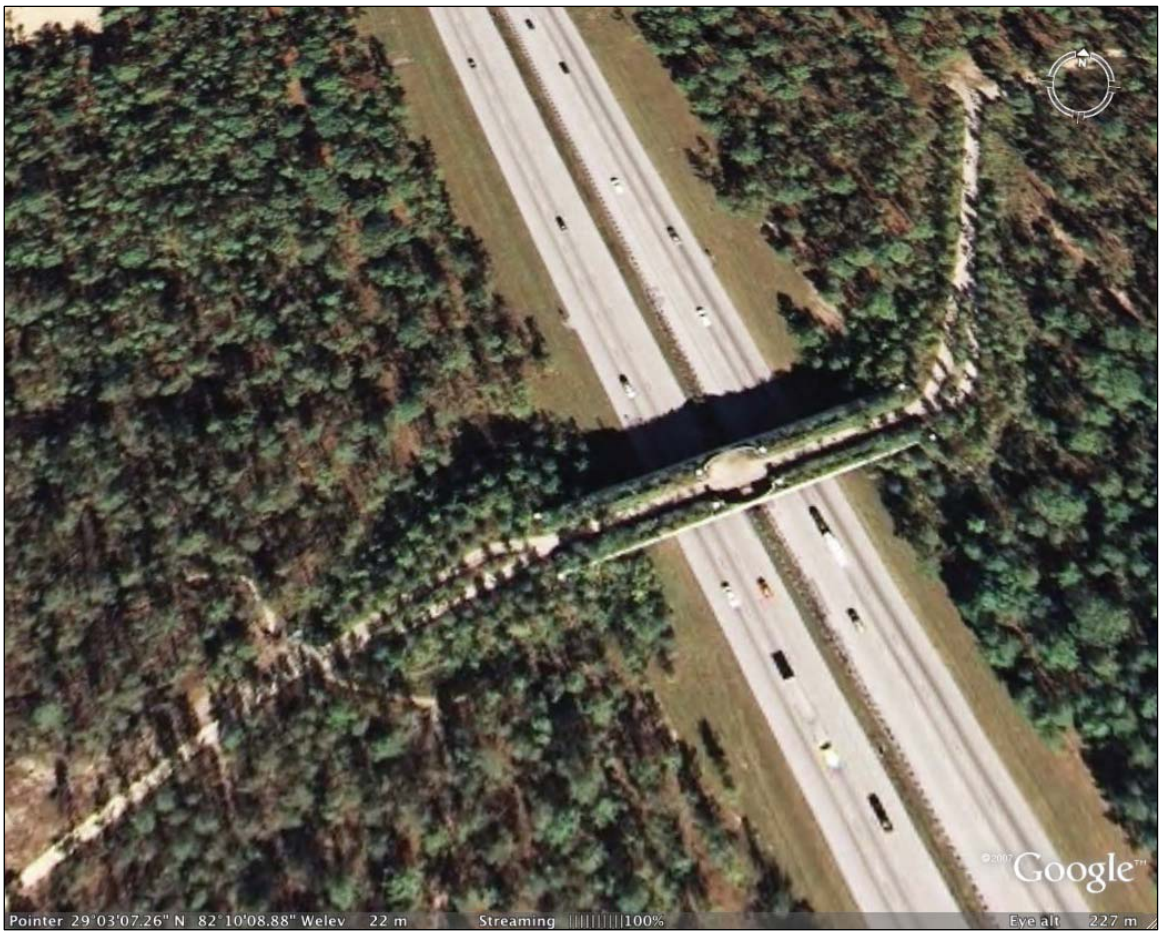

Figure 2. Photo. Wildlife crossings are becoming more common in highway expansion projects in North America. An example is the Greenway Landbridge on Interstate 75 in Marion County, Florida (Credit: Google Earth).

Two recent publications help guide transportation agencies in the development of effective wildlife crossing structures. "Safe Passage" (Southern Rockies Ecosystem Project 2007) provides a simplified approach to planning the location and design of wildlife crossings. A comprehensive National Cooperative Highway Research Project 25-27 report provides decision support for issues related to the planning and general design of wildlife crossings. Both reports, however, lack technical guidelines for the design of wildlife crossings and fencing for species and species groups in North America.

Performance evaluations are not a regular part of transportation projects with wildlife crossing structures. Most monitoring efforts have been largely short-term or sporadic. Monitoring typically is aimed at single species; consequently, such programs may not recognize the requirements of other non-target species and populations in the area. Further, monitoring is rarely conducted long enough to meet the adaptation periods (or learning curves) wildlife need to begin using crossings on a regular basis. Guidance is still needed on the increasing number of techniques available for monitoring wildlife crossings, designing sound monitoring programs, and evaluating performance for adaptively managing future transportation projects.

IMPORTANT DATES IN ROAD ECOLOGY HISTORY

1955—First wildlife crossing built in United States: Black bear underpass, Florida
1974—First wildlife crossing built in Europe: Badger tunnel, The Netherlands
1975—First wildlife overpass built in United States: Interstate 15, Utah
1982—First wildlife crossing built in Canada: Trans-Canada Highway wildlife underpass, Banff National Park
1982—First wildlife overpass built in Europe: Le Hardt, France
1990—First wildlife overpass built in Canada: Coquihalla Highway, British Columbia
1991—ISTEA: Intermodal Surface Transportation Efficiency Act of 1991
1996—"Transportation and Wildlife: Reducing Wildlife Mortality and Improving Wildlife Passageways Across Transportation Corridors." First international meeting on wildlife and transportation in Orlando, Florida (30 April to 2 May 1996)
1997—National Academies publication "Toward a sustainable future: addressing the long-term effects of motor vehicle transportation on climate and ecology," National Academy Press, Washington, D.C.
1998—TEA-21: Transportation Efficiency Act of the 21st Century
1998—First International Conference on Wildlife Ecology and Transportation (ICOWET) at Fort Meyers, Florida (10–12 February 1998)
2001—ICOWET becomes ICOET (International Conference on Ecology and Transportation), Keystone, Colorado
2001—Federal Highway Administration (FHWA) European Scan Tour, "Wildlife habitat connectivity across European highways"
2002—National Cooperative Highway Research Program (NCHRP) Synthesis paper published, "Interaction between roadways and wildlife ecology: a synthesis of highway practice"
2003—"Road Ecology: Science and solutions" published by Island Press. First major publication that outlines, describes and synthesizes available knowledge of the ecological effects of roads and emerging field of road ecology
2005—SAFETEA-LU passed (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
2005—National Academies publication "Assessing and Managing the Ecological Impacts of Paved Roads," National Academy Press, Washington, D.C.
2005 – First Transportation Research Board Task Force on Animal–Vehicle Collisions (ANB20(2))
2006—First Transportation Research Board (TRB) Standing Committee (ADC30) on Ecology and Transportation
2007—Society for Conservation Biology (SCB) has session at the ICOET meeting in Little Rock, Arkansas
2008—Western Governors' Association policy resolution to protect wildlife migration corridors and crucial wildlife habitat in the West
2008—FHWA report to U.S. Congress on mitigation measures aimed at reducing wildlife–vehicle collisions
2008—FHWA manual provides technical guidance on the design and implementation of mitigation measures that are considered best practice to reduce wildlife-vehicle collisions
2010—ARC International Wildlife Crossing Infrastructure Design Competition. First design crossing competition. Launched in 2010, and winners announced at the 2011 Transportation Research Board meeting, Washington, DC.

OBJECTIVES

This handbook provides technical guidelines for the planning, design and evaluation of wildlife crossing structures and their associated measures (fencing, gates) that facilitate the safe movement of wildlife across roads and increase motorist safety. It has been prepared for transportation, natural resource and land management agencies responsible for planning, designing and implementing measures for mitigating the impacts of roads on wildlife populations. Stakeholder and other groups involved in mitigation planning will also find this handbook useful in their discussions with agencies.

This handbook describes how to increase the effectiveness of established designs and recommends ways to design for particular species and species groups in different landscapes. The guidelines can be used for wildlife crossings on new or existing highways, highway expansions (e.g., two-lane to four-lane) and bridge reconstruction projects. The response of particular wildlife species to these measures may vary across North America. Therefore, the design guidelines are intended to be generalized and a starting point for the future development of more regionalized, landscape-specific guidelines based on an adaptive management process.

This handbook is the product of an extensive collection and synthesis of current literature, knowledge, and science-based data with regard to the current practices in wildlife crossing mitigation. This handbook provides a sound scientific basis for effective planning, policy and implementation of mitigation aimed at reducing habitat fragmentation and mortality effects of roads on wildlife populations. Recommended designs once implemented and their performance evaluated through monitoring will serve to advance our understanding of the utility of different wildlife crossing designs across North America.

ORGANIZATION

This handbook is organized to provide assistance to transportation and natural resource management practitioners charged with the planning, design and performance evaluations wildlife crossing mitigation. This handbook was designed so that chapters could be consulted independently, depending on the information or technical guidance needs, or all chapters in a practical sequence of project development.

Chapter 2 – Intersections provides background information on the ecological function of roads and examines the main impacts roads have on wildlife populations. These primary functions are important for understanding the landscape and biological context of mitigating road effects on wildlife.

Chapter 3 - Planning and Placement describes in a stepwise approach the different methods to plan the location of highway mitigation for wildlife movement with wildlife crossings at different spatial scales (project-level or systems/landscape-level) of resolution. Planning resources used to help identify appropriate locations for wildlife crossings are listed and describe how they can be used at the two different scales of application.

Chapter 4 - Design is the core of this handbook material. This chapter addresses the question of how to space wildlife crossings followed by context-sensitive and species-specific considerations

in selecting 11 types of wildlife crossing design, based on habitat quality and topography. The 11 wildlife crossing types consist of over-grade and below-grade crossing structures ranging from landscape bridges to amphibian-reptile tunnels. The specific details of each wildlife crossing type are compiled in "Hot Sheets" at the back of this handbook shown in Appendix C. The latter part of the chapter provides guidelines for planning the dimensions of the 11 types of wildlife crossings, in addition to the suitability of each wildlife crossing type for six species groups and 20 species of North American wildlife.

Chapter 5 - Monitoring outlines the basics of monitoring wildlife crossing structures, including a stepwise approach to testing whether management objectives have been met, how to determine performance targets, what monitoring methods are available, and how to design rigorous studies evaluating performance of built mitigation. The chapter concludes discussing the benefits of monitoring for adaptive management and their direct application to future transportation planning.

Suggested Reading—Rather than provide footnotes or literature citations throughout the document, key literature is cited at the end of each chapter for further reading.

Appendix A consists of a glossary of commonly used terms throughout this handbook.

Appendix B lists all the common and scientific names of wildlife covered in this handbook.

Appendix C lists Hot Sheets 1 -14 for the different wildlife crossings showing their fencing and gate details.

Appendix D provides a framework for designing monitoring studies.

Appendix E lists the current monitoring techniques available.

Appendix F and G list relevant handbooks and professional journals with information on wildlife crossing design, planning and performance.

SUGGESTED READING

Davenport, J., Davenport, J.L. (eds). 2006. *The ecology of transportation: managing mobility for the environment.* Springer, London, UK.

Evink, G., 2002. *Interaction between roadways and wildlife ecology: a synthesis of highway practice*. National Cooperative Highway Research Program Synthesis 305. Transportation Research Board, Washington, D.C.

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