Committee on Ecology and Transportation Newsletter

Transportation Research Board Committee ADC30 January 2014

View from the Chair

Alex Levy, Chair Ecology and Transportation Committee

Musings from the Shadowbox: Celebrating Our Legacy, Anticipating Our Future

by Alex Levy, Senior Ecologist, Arcadis US

Reflecting on the robust year that has elapsed for the TRB Committee on Ecology and Transportation, as with many who'll read this, there are always fond memories on which to muse when we're achieving science through stewardship, such as is exemplified by TRB. So, it's been a year filled with milestones for our committee; from another wildly successful annual meeting, to the International Conference on Ecology and Transportation in Scottsdale, Arizona, to a record setting infusion of technical papers, and the celebration of an icon for Landscape Ecology research and education. It's also been a year of remarkable service by members and friends of the TRB Committee on Ecology and Transportation, who voluntarily serve to make ours a better and healthier world in which to work, live, and move.

While a relative newcomer to bigger-than-project-level-thinking, it was at a TRB meeting about a decade ago that I had the privilege of breaking bread with noted landscape ecologist, Harvard Graduate School of Design's Dr. Richard T.T. Forman. There, along with a gathering of admirers and allies from the Committee on Environmental Analysis (a.k.a A1F02) and a fledgling Task Force on Ecology and Transportation (ADC30T), we were celebrating accomplishment after Dr. Forman, along with a cadre of environmental luminaries, addressed a full house, with his academic and scientific perspectives on ecology and transportation infrastructure.

Ever the advocate for research, Dr. Forman humored the banter at the table with musings on how much more research there is to be had and how zealously it must be driven: even posing the notion that, at times, research itself ought to be valued in lieu of deliberate and often regulated compensatory mitigation for transportation's impacts to natural resources. In September 2013, Dr. Forman was recognized for his contributions to science, academics, and scholastics as he transitioned to emeritus status.

As with the pilots of Transportation for Communities–Advancing Projects through Partnerships and the Integrated Ecological Framework (www.trb.org/Environment/Blurbs/168763.aspx), as well as the oft-celebrated Eco-Logical initiative (www.environment.fhwa.dot.gov/ecological/eco_index.asp), there are instances when knowledge as an outcome is more valuable than acres of in-kind habitat. Without question, the work and inquisitiveness of pioneers, like Dr. Forman will endure in successive years of TRB and in successive generations of researchers, policymakers, and practitioners.

In our own way and, very often, on our own time, each and every member and friend of the Committee on Ecology and Transportation make contributions both large and small to the advancement of research

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and practice-ready results that improve the environmental quality of surface transportation. To wit, there are a handful within the TRB Committee on Ecology and Transportation who've devoted considerable time outside their regular jobs to ensuring the success of our mission. They are Julianne Schwarzer, of the USDOT Volpe National Transportation Systems Center, who coordinated development of our program for the TRB 2014 Annual Meeting; Bridget Donaldson, of the Virginia Center for Transportation Innovation and Research, along with Bethaney Bacher-Gresock, of the FHWA Wisconsin Division, who jointly administered a committee-record of 12 peer-reviewed papers; Dr. Daniel Smith, Research Associate/Adjunct Graduate Faculty at the University of Central Florida, who revived an important tool in the poster used for our committee outreach; and Marcia Bowen, Vice President at Normandeau Associates, who tirelessly maintains the minutes for our committee's business and assembles the very periodical which you are perusing at this very moment.

Going forward, 2014 will see the end of one era, when the TRB Annual meeting convenes for the last time in its old DC home, and the beginning of a new one, as we prepare to gather in 2015 at the Washington Convention Center. This will also be the year when the TRB Committee on Ecology and Transportation engages our very first mid-year business meeting in conjunction with the regionally-focused Northeast Transportation and Wildlife Conference in Burlington, Vermont. While it's truly an enduring and perennial theme that the 2014 TRB annual meeting is embracing, *Celebrating Our Legacy, Anticipating Our Future* pays homage to the conference, as well as the steadfast work of our leaders; those who have spent years at the forge, *and especially* those who are emerging to carry us to new horizons.

To kick-off the 2014 annual meeting and our committee's tradition of service, the pages that follow contain Dr. Forman's perspectives on a recent Colloquium of the Confluence of Landscape, Road, and Urban Ecology at Harvard University's Graduate School of Design. You'll also find contributions by other committee friends and members, including international committee member Xinjun Wang's update on road ecology research from the China Academy of Transportation Sciences; Jimmy Kagan's overview of ecosystems services crediting programs for DOTs and MPOs; Bridget Donaldson's description of ongoing camera-enabled studies in Virginia for strategic animal crash mitigation; and an article by Jeff Burrell, continuing the Wildlife Conservation Society's series on pronghorn antelope conservation and connectivity in Wyoming.

Harvard Colloquium on the Confluences of Landscape, Road, and Urban Ecology: September 13-14, 2013

By Richard T. T. Forman, Graduate School of Design, Harvard University

Overview

In a bare twenty-five years, landscape ecology, road ecology, and urban ecology have sprung from synergies between ecological science and society's activities on land. Each field builds its body of theory, models, and principles. Each generates new solutions to slow, even reverse, the cascading land-and-city degradation around us. Each moves arm-in-arm with sister experts, including landscape architects, foresters, urban planners, conservationists, transportation engineers/planners, wildlife managers, hydrologists, and architects.

The time has arrived to explore and highlight linkages among the three dynamic fields, both to discover new important patterns and principles, and to catalyze useful applications for a vibrant future. That is the colloquium challenge. Imagine, for instance: viable ecological designs for outer-suburb/sprawl area; improving or replacing the patch-corridor-matrix model; an optimal arrangement of urban greenspaces for flooding/heat/wildlife/recreation; an ecologically

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and socioeconomically designed regional transportation system; useful equations for flows/movements across land mosaics; spatially optimal flows benefiting both city and ring-around-the-city; an ecologically robust mesh of geomorphic and built patterns; sustainable adaptation for combined urbanization and climate change; and big-picture solutions concurrently addressing many of society's core goals. Giant needs, many confluences, ripe opportunities.

Landscape, road, and urban ecology synergies promise new visions, as well as novel applications for land and city. This colloquium should open up a cornucopia of ideas, patterns, principles, and projected solutions that energize everyone.

The Colloquium

Speakers in the program featured several leaders in the area of surface transportation and road ecology:

Paul Wagner (Washington State Department of Transportation and member of ADC30), "Road Ecology: The Nature of Transportation and the Road Ahead" (Figure 1)

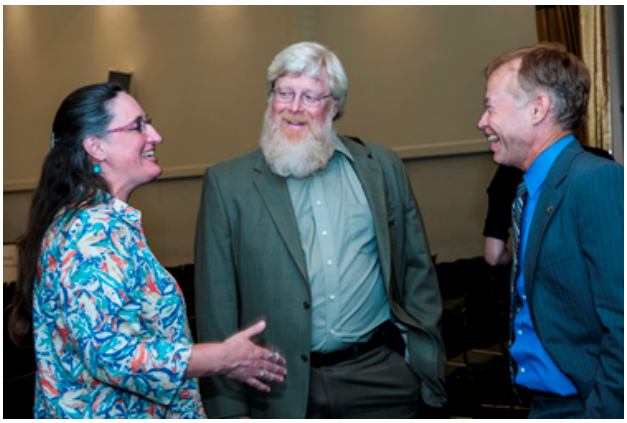

Figure 1. Committee members Paul Wagner (center) and Joe Burns (right) with Carolyn Wagner (left).

Daniel Sperling (University of California-Davis), "Innovative Transport Technologies and Vehicles to Improve Air Quality, Climate Change and Livability"

Lenore Fahrig (Carleton University-Ottawa), "How Can We Maximize Biodiversity in Urbanized Regions?"

Tony Clevenger (Banff National Park & Montana State University), "Taming the Sleeping Giant: How Small-Scale Mitigation Has Continental-Scale Impacts"

Richard Forman (Harvard University), "Ecology for Land and City: Tying Landscape, Road, and Urban Ecology Together for Society" (Figure 2) In addition, a celebratory dinner was held in the dinosaur room of Harvard's venerable Museum of Comparative Zoology. The speakers included:

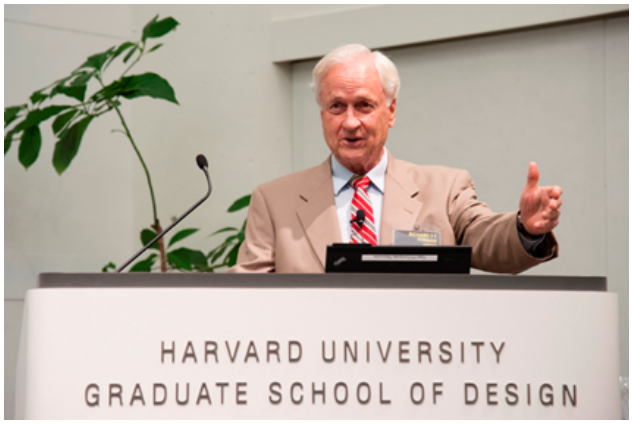

Figure 2. Author and Committee Friend and former member, Dr. Richard T.T. Forman

Jerry Franklin (University of Washington)

Patricia (Trisha) White (National Wildlife Federation, and formerly Defenders of Wildlife and former member of ADC30).

Several key researchers, professionals and others who have contributed to road/transportation ecology attended the colloquium and actively participated: **Joe Burns** (USDA Forest Service-Washington, DC and member of ADC30); **Lauren A. Augustine** (The National Academies, Earth & Life Sciences); **Scott Jackson** (University of Massachusetts); **Mark McDonnell** (Australian Research Centre for Urban Ecology, University of Melbourne); **Douglas Olson** (O2 Planning & Design-Calgary); **Alison Bowden** (The Nature Conservancy-MA Chapter); **Anna Hersperger** (Swiss Federal Research Institute WSL-Zurich); **Xavier Mayor** (XMF Environmental Consulting, Spain); **Michael Van Valkenburgh** (MVVA Associates-Brooklyn).

The Colloquium and Celebratory Dinner were held in recognition of Richard T. T. Forman's transition from Professor to Research Professor at Harvard University. He now teaches one graduate course per year and focuses more on research and writing. His next book, ***Urban Ecology: Science of Cities*** (100 line drawings, 50 photos, 1700 references, etc.), is due approx. February 2014 from Cambridge University Press (New York).

Helping DOTs and MPOs Create Ecosystem Services Crediting Programs

By Jimmy Kagan, Director of the Oregon Biodiversity Information Center, Oregon State University.

The ability to measure and value the services that nature provides creates the potential to effectively preserve these services and to assign units and costs for both mitigation and restoration. However, while the need for functional methods of assessment have been discussed for years, practical methods of implementing measures and values concepts across resources are just beginning to be tested across the country, especially in the transportation arena.

Transportation agencies and their partners who are interested in implementing a crediting system are challenged by a lack of specific guidance on where to begin implementing ecosystem crediting, the variety of ecosystem crediting approaches that is relevant to transportation, and a wide range of local factors. Some of the local factors that need to be considered include the availability of data and expertise, the type of credit unit most acceptable to agencies or most available in existing crediting systems, differing regulatory drivers, agency relationships and interest in innovative approaches, and the unique mix of biodiversity and infrastructure challenges.

A team funded by FHWA and working for ICF, including staff from the Oregon Institute for Natural Resources, NatureServe, the Willamette Partnership, U.C. Davis Road Ecology Center, and Venner Consulting is developing three "course of action" frameworks that any DOT or MPO can use to begin the work of establishing a crediting system. Tailored for various different circumstances and scenarios encountered by DOTs and many of the MPOs across the country, these frameworks will enable crediting approaches to be more accessible and feasible, regardless of level of experience, type of resource, or information availability.

Each framework will include a list of recommended services to consider, based on regulatory issues and available markets in the region. The recommendations will be tailored to DOT or MPO circumstances, issues, available data and potential partners. Two factors that contribute to the successful implementation of a crediting system are the amount of experience the implementing agency has in crediting and programmatic agreements, and the extent to which the implementing agency is motivated by regulatory or social drivers. DOTs increasingly have experience with programmatic approaches. The motivation or the importance of creating a crediting system will generally be a result of an agency having more common or widespread regulatory issues with the Endangered Species Act (ESA) or Clean Water Act (CWA) regulations, or some widespread capacity or maintenance needs. The three frameworks are:

Framework I will be developed for the states and MPOs with little experience with crediting and no ongoing programs in the crediting and alternative mitigation area. Based on the Willamette Partnership's *general accounting protocol*, we will develop a framework, template and a set of clearly defined steps that address both regulated and important non-regulated resources through a functioning integration of multiple conservation priorities. This framework might also incorporate aspects of the general statewide programmatic agreement between the North Carolina DOT, the Department of Environment and Natural Resources, and US Army Corps of Engineers to establish the Ecosystem Enhancement Program (EEP). The framework will include guidelines on how it can be adapted to address local issues, geography, and political needs.

Framework II will be a more extensive framework that moves toward developing multi-service crediting programs for DOTs and MPOs with more experience with crediting for wetlands, endangered species or 303d issues, but lacking an integrated statewide program (e.g. Colorado, Maryland, Massachusetts, Michigan, Minnesota, Montana, and Oregon or MPOs with some crediting background or experience). Framework II will focus on creating viable crediting programs by showing how to use the Integrated Ecological Framework's (IEF) collaboration and planning steps (IEF steps 1-5) with available information on crediting protocols and tools. In developing this framework, we might draw on the methods used by the Maryland Resource Registry, a project headed by the Army Corps of Engineers and Environmental Protection Agency in the region to gather, integrate and evaluate information to assist in developing priorities for restoration, conservation and mitigation.

Framework III will be developed for states with exceptionally complex issues and a large number of ongoing programs – such as California, Florida, Texas and Virginia. We propose to focus on involving the statewide planning portions of the agencies to help drive the development of integrative crediting programs. This framework will be piloted in California where arguably the most complex issues and barriers occur, and where many ongoing crediting and trading programs exist.

Along with identifying available protocols and providing templates to assist transportation agencies in developing and implementing crediting programs, this project will define a set of additional partnerships that agencies can develop to help crediting programs succeed. These include agencies with expertise that can assist in the development of information which can overcome credit-related barriers, such as university faculty, state Departments of Natural Resources, Natural Heritage Program or US Fish and Wildlife Agency staff with an interest in implementing functional crediting systems and broad-scale ecosystem conservation agreements.

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Path of the Pronghorn:
Leading to New Passages Part 3

By Jeff Burrell, Wildlife Conservation Society

[This is the third installment of a multi-part blog from the field at Trapper's Point, Wyoming by WCS Scientists working to protect the Path of the Pronghorn.]

For more than a decade, scientists from the Wildlife Conservation Society have conducted research and worked with partners to protect pronghorn migration to and from Grand Teton National Park along a more than 100-mile long migration corridor known as the Path of the Pronghorn. The animals migrate along this corridor between summer range in and around Grand Teton National Park and winter range in the Upper Green River Valley south of Trapper's Point in western Wyoming. If this migration corridor is severed, pronghorn will be lost from Grand Teton National Park.

Pronghorn (Figure 1) must overcome many obstacles during their migrations. Some, like steep cliffs and fast moving rivers, are found in nature. Others, including subdivisions, fences, and highways, are human-made. Trapper's Point is at a natural bottleneck along the Path of the Pronghorn where the Green River and New Fork River pinch together. At this location, houses, fences, and US highway 191 further constrict an already narrow portion of the Path (Figure 2).

As traffic volume along US 191 has substantially increased, collisions between vehicles and pronghorn trying to cross the highway have likewise increased. As we reported in our first two blogs, the Wyoming Department of Transportation committed almost $10 million to construct fences, two overpasses and six underpasses to allow pronghorn, mule deer and other wildlife to move across the highway safely.

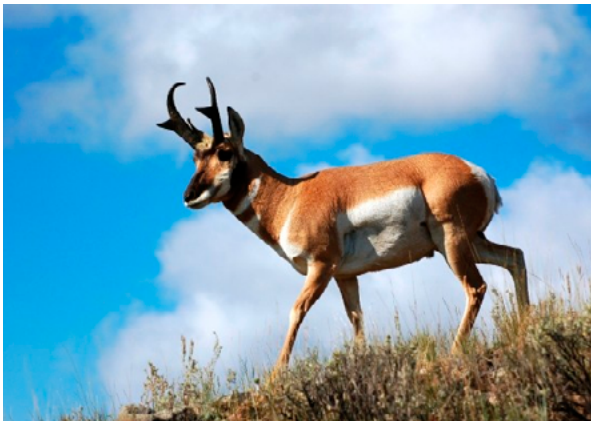

*Figure 1. Pronghorn (*Antilocapra americana*) are unique to the grasslands and sagebrush steppe of western North America — they are found nowhere else in the world. This pronghorn buck shows the characteristic pronged horns that gives this species its common name. Jeff Burrell ©WCS*

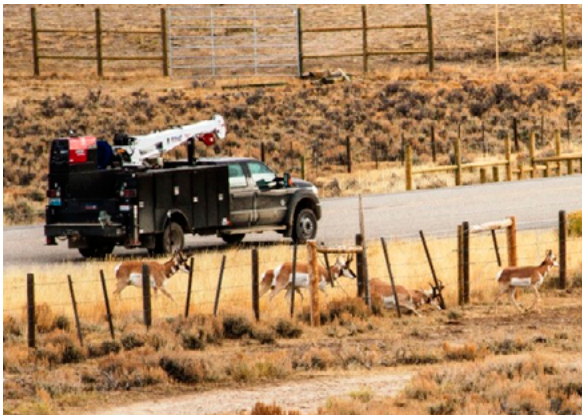

Figure 2. Prior to the Trapper's Point overpass, to cross US 191 pronghorn had to crawl under one fence, dodge traffic and then crawl under another fence. Jeff Burrell ©WCS

As part of WCS's long term effort to protect the Path of the Pronghorn (the only federally-designated wildlife migration corridor in the United States) my colleagues Renee Seidler, Jon Beckmann, and I are combining data gathered from GPS collars worn by pronghorn with direct observations to assess how well the crossings are working. WCS research as well as photo-documentation work conducted by the group Western Ecosystems, Inc. will help us to improve these crossings and future wildlife crossing structures in other locations.

We set as our original goal to learn the answers to two questions: 1) Would construction activities disrupt pronghorn migrations; and 2) How well would pronghorn use the overpasses and underpasses? As we previously reported, while construction did sometimes cause confusion and stress for pronghorn, the migration was not disrupted. When pronghorn came to the new 8-foot high woven wire fence, they first tried to find a way under it. The fence worked as designed and blocked pronghorn from going onto the highway. Not finding a way under the fence, pronghorn sought another path, and the only path open to them was the new overpass. While pronghorn herds would sometimes take hours before using the overpass, they did all eventually use it to cross safely over US 191 as they continued their fall migration last year (Figure 3). Construction was completed in early October 2012.

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Figure 3. Shortly after the overpass was completed in fall 2012, pronghorn began using it to cross safely over US 191 while traffic moved beneath them. Jeff Burrell ©WCS

We did also observe a few pronghorn reluctantly use one of the underpasses. This reluctance was as expected since pronghorn depend upon their incredible speed and equally incredible long-distance vision to keep them safe; going through a tunnel limits both. Mule deer on the other hand are comfortable going through underpasses and readily used both underpasses and the overpass.

We returned to Trapper's Point for the spring 2013 migration. Some groups would move directly to and cross over the overpass, but others would again try their old route, be successfully blocked by the new fence, and only then find and use the overpass. Fortunately, all eventually did use the overpass.

This brings us to fall 2013. Would we see a repeat of the spring pattern or would pronghorn move directly to and use the overpass? We can now report the latter. Groups numbering from a few to more than 200 all directly moved to and used the overpass with little hesitation and little apparent stress or concern.

To sum up our findings to date, these highway crossings structures are a success. During the past year, these structures have allowed thousand of pronghorn and mule deer to cross US 191 – saving wildlife and preventing collisions. Credit for this success certainly goes to the Wyoming Department of Transportation for their decision to commit a sizable amount of funding for this work, and for contracting engineering firms for their outstanding wildlife overpass design and construction.

A group of pronghorn does and fawns move easily across the Trapper's Point overpass during the fall 2013 migration. For these and other fawns making their first migration, the overpass, this strange hill with the tunnel underneath, will now be a familiar part of their Path of the Pronghorn. Jeff Burrell ©WCS

We'll be back at Trapper's Point for the spring 2014 migration to continue our study and assessment of the effectiveness of the crossing structures.

Jeff Burrell is the Northern Rockies Program Coordinator for the Wildlife Conservation Society. WCS efforts to protect the Path of the Pronghorn are supported by grants from the National Fish and Wildlife Foundation. For more information visit: http://www.youtube.com/watch?v=FjU44eVYJis

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Past TRB funded research has shown that improved information on the distribution, status, and priority for restoration of many regulatory drivers, such as wetlands, impaired streams, and listed or proposed species, will help in developing statewide or regional programmatic agreements. These agreements can be important drivers of crediting and progressive mitigation programs. In particular, it will be important to identify regional issues (e.g. the listing of the greater sage grouse) that are both likely to significantly impact transportation and have tremendous potential to aid in developing crediting programs and large-scale programmatic agreements. The team also proposes to identify specific national tools used by agencies (e.g. IPaQ or Wetland Rapid Assessment Protocols) that can be either the basis of these agreements, or the basis of a restoration strategy, and partners that can help improve the ability of these tools to assign credits for transportation impacts and funded improvements to natural resources.

Roadside Camera Monitoring to Determine Strategic Animal Crash Mitigation

By Bridget Donaldson,
Senior Research Scientist, Virginia Department of Transportation, Virginia Center for Transportation Innovation and Research

Introduction

The Virginia Department of Transportation tasked its research division, the Virginia Center for Transportation Innovation and Research, with developing recommendations for mitigating collisions between vehicles and deer and black bear along a 15-mile segment of I-64 in Virginia. Constructing new wildlife underpasses was considered too costly and disruptive to the heavily traveled interstate.

A series of site visits and a review of police crash reports revealed possible strategic mitigation options to consider, including adding fencing to existing large underpasses constructed for drainage or other purposes but known to be used by deer and black bear. Although research has shown that connecting a series of underpasses with fencing increases the use of the underpasses, this was not feasible along I-64 given the long distances between viable underpasses. Research was needed to determine the optimal extent/length of fencing extending from either side of isolated underpasses and then to determine whether the addition of fencing reduced collisions and increased the use of the underpasses. Another mitigation option includes the use of animal detection driver warning systems at forested drainage corridors that intersect I-64 but have no viable underpasses for large animals. Deer trails in the area indicated travel to and from stream corridors and their intersections with I-64. If research determines that deer and black bear activity are highest at these intersections, animal detection driver warning systems could be considered for deployment.

Mitigation Options at Three Study Sites

Two mitigation options were considered in the study: (1) fencing along either side of isolated large underpasses, and (2) wildlife detection driver warning systems at drainage corridors with no viable underpasses. These two options were considered at three study sites: (1) a bridge underpass, (2) a large box culvert, and (3) a forested drainage corridor.

In March 2013, 56 cameras were deployed along the I-64 study area at the three sites. The cameras were positioned to photograph wildlife that approached the shoulder of the interstate. At the first two sites, cameras were placed immediately off the interstate shoulder at regular intervals up to 0.5 mile on either side of the underpasses (Figure 1). Cameras were also placed beneath the bridge and at the box culvert openings. At the third site, cameras were placed at the intersection of the drainage corridor and the interstate and at regular intervals up to 0.25 mile on either side of the drainage corridor (Figure 1).

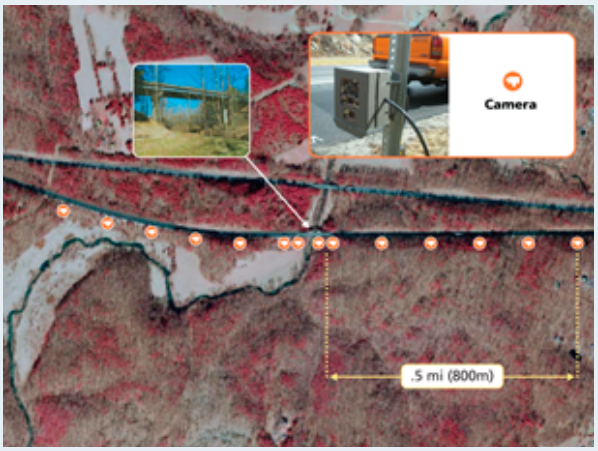

Figure 1. Camera locations on either side of the bridge underpass (left) and the forested drainage corridor (right).

In the first 8 months of deployment, cameras have captured photographs of more than 4,000 deer and hundreds of other wildlife species, including black bear, coyote, fox, and bobcat (see Figure 2). In addition to answering the primary research questions, data collected by the cameras will be used to determine whether deer and bear density and behavior (e.g., foraging, bedding) can influence road crossing rates and animal collisions. The data will also help determine the optimum length of mitigation and serve as pre-mitigation data to determine the effectiveness of any future mitigation installation. Camera data collection will continue through 2014, followed by final data analyses and recommendations. Daily carcass removal data (i.e., location and species) are also being supplied by the contact highway staff.

Figure 2. Deer and black bear approaching interstate

Road Ecology Research Update for China Academy of Transportation Sciences

By Xinjun Wang, Yun Wang, Shuangcheng Tao, Ti Wang, Yaping Kong, Jiding Chen,

China Academy of Transportation Sciences

To balance the need for roads and environmental protection, China's Ministry of Transport has funded many research projects to protect the environment during road construction. A team of 70 scientists, engineers, ecologists, landscape architects, planners and others in the Ministry's Chinese Academy of Transportation Sciences (CATS) is working to implement environmental solutions essentially from the beginning of the development of an expressway system. The group published a book, ***Chinese Road Ecology*** in 2008 based on Chinese national conditions and the book by Dr. Richard T.T. Forman ***Road Ecology: Science and Solutions***. Here are some examples of research progress in land resource protection and wildlife conservation that have been implemented by CATS.

1. Research on Soil Quality of Different Land Use Types

With the rapid development of highway construction in China, the conflict between the land needed for highway construction and preservation of natural resources is becoming increasingly evident. Protecting land resources and improving their sustainability are important scientific issues in road construction. Soil stripping and stockpiling is currently an important way to save land resources (Figures 1 and 2). Research is needed on methods to collect and preserve topsoil and the most appropriate depth of soil removal based on land use type.

Figure 1. Topsoil stripping. Copyright by Ti Wang

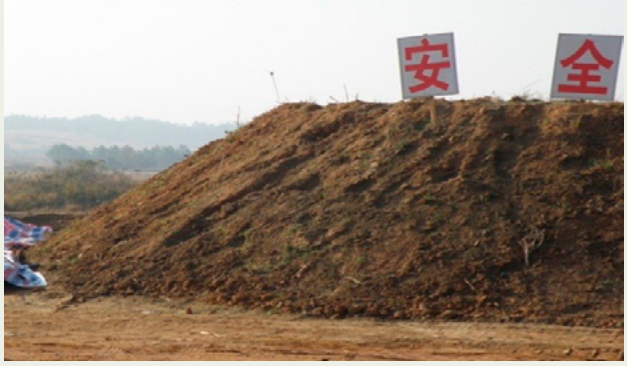

Figure 2. Piling up Topsoil. Copyright by Shuangchen Tao

Soil quality as indicated by its chemical properties was analyzed for three depths of topsoil (0-10 cm, 10-20 cm, 20-40 cm) in three typical land use types (forest land, upland and paddy field) along the Yinchengzi to Songjianghe highway in Jilin province. The soil quality level was evaluated by the integrated soil quality index and SPSS was used for statistical analyses.

The results showed that chemical properties of soil profiles varied greatly among the different land uses. In the top (0-10 cm) layer, paddy fields had the highest soil quality, followed by upland, then forest. In the 10-20 cm layer, soil quality was highest in forest, followed by upland, then paddy field. Soil quality in the deepest soil layer tested (20-40 cm) was highest in the paddy field, followed by forest, then upland. Based on these results, the top 40 cm of topsoil of paddy field and forest should be removed to preserve soil quality, while in upland, only the top 20 cm topsoil need be stripped. This study provides a scientific basis for topsoil stripping and has great significance for sustainable use of topsoil in highway construction.

2. Application of Topsoil for Ecological Restoration of Gentle Slopes in Highway Construction

Ecological restoration of disturbed slopes can be enhanced by applying topsoil. Five representative gentle slopes along the Pengze-Hukou highway in Jiangxi Province of China were selected as experimental sites. Topsoil at 7-10 cm depth was applied along with

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broadcasted plant seeds while adjacent areas were left untouched (Figure 3). Plant growth and community structure were investigated one year later using the line transect method.

Figure 3. With (left) and without (right) Topsoil. Copyright by Shuangchen Tao

All five sites showed satisfactory results (Figure 4). The plant community structure on the slopes reached the initial stage of succession after one year, with higher Simpson diversity index (average 0.80) and Pielou evenness index (average 0.84) and significantly higher biomass accumulation (averagely 446 g•hm-2) and woody importance value index (average 14.5). Application of topsoil and seeding was a successful approach for the stability and continuity of plant community structure on the gentle slopes.

Figure 4. Soil spray sowing (left) and (right) artificially broadcasted plant seeds with topsoil. Copyright by Shuangchen Tao

3. Road-effect Zone for Wildlife along the Changbai Mountain Scenic Ring Highway, China

The Changbai Mountain Nature Reserve, one of China's highest-profile, nationally-protected natural areas, is a perfect study site to investigate the road-effect zone for mammals and birds found along the Changbai Mountain Scenic Ring Highway. From May 2010 to February 2012, five sampling transects were established perpendicular to the highway. The transects were located 500m apart on each side of the highway. Each month, field investigations for scat, footprints, feeding, roosting and resting sites of all species were conducted in 100 m segments. Based on the climatic regime characteristics observed, the period investigated was divided into two seasons: a snow season, from October to April, and a non-snow season, from May to September. Parameters that were analyzed included species richness and animal activity. Traffic volume increased between 2010 and 2011, which also affected wildlife distribution.

The results of the investigation indicated road-effect differences on species richness and activity over the study period. In the snow seasons of 2010 and 2011, distance from the highway had no clear effect on species richness of mammals and birds. However, between 2010 and 2011, the distribution of birds changed from being concentrated to within 200 m of the road to having no pattern. In the non-snow season, no clear effects on species richness of mammals and birds relative to distance from the highway were observed in either 2010 or 2011. However, the field signs of mammals changed from activities concentrated along within 100m of the roadside in 2010 to road avoidance within 100 m in 2011. The field signs of birds changed from activities concentrated 200m along roadside in 2010 to no clear distinct tendency in 2011. It was also observed the number of species of birds in the snow season in 2011 decreased significantly in contrast to 2010. Both the species richness and field signs of mammal and bird activity in non-snow season decreased significantly in 2011 in comparison to 2010.

The investigation focused particularly on roe deer (*Capriolus pygargus*), which is one of the key prey species for the Amur tiger (*Panthera tigris altaica*). Although, roe deer exhibited no road avoidance tendencies in 2010, they avoided the 100 m zone located adjacent to the road in 2011 (Figure 5). Increasing traffic volume was determined to be the main factor influencing the road-effect zone for roe deer.

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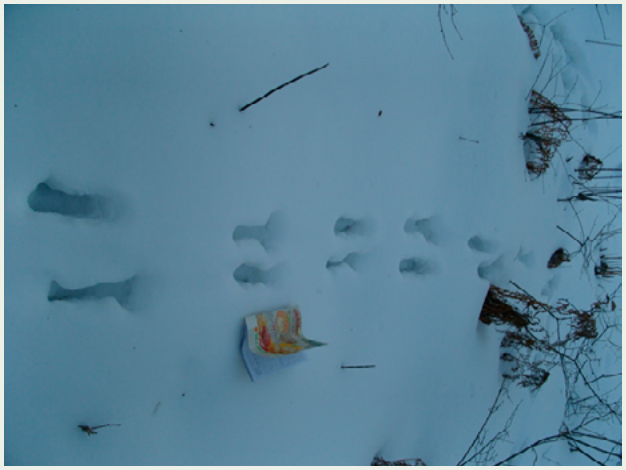

Figure 5. Tracks of Roe Deer. Copyright by Yun Wang

This research documented the road-effect zone of the Changbai Mountain Scenic Ring Highway for mammals and birds. The width of the zone appears to fluctuate with time. According to the preliminary results of this investigation, it is recommended new highway development should avoid roe deer habitat by at least 100m. Further research on the road-effect zone for other species of wildlife found along the Changbai Mountain Scenic Ring Highway is required.

4. Road Mortality of Wildlife along Changbai Mountain Scenic Highway

Wildlife roadkill has been one of the main factors causing population decreases of many species. Most reports are from western countries while few are from China. A field investigation was conducted to assess the magnitude, composition, and temporal patterns of road mortality of native vertebrates on the Ring Changbai Mountain Scenic Highway in northeast China from 2009 to 2012 and its relationship with traffic volume.

The results indicated 3,475 kills of 63 species were recorded. Amphibians were the most affected taxon (86.21%), followed by mammals (5.70%), birds (5.24%), and reptiles (2.85%). In terms of the number of species, birds had the highest mortality (31 species), followed by mammals (16 species), reptiles (10 species), and amphibians (6 species). Three of the species were second-class protected species in China (Ural Owl (*Strix uralensis*, Figure 6), Hazel Grouse (*Tetrastes bonasia*, Figure 7), and Common Buzzard (*Buteo buteo*). The four species most prone to roadkill were the Siberian frog (*Rana amurensis*, 1826 individuals), Oriental fire-bellied toad (*Bombina orientalis*, 853 ind.), Chinese toad (*Bufo gargarizans* , 186 ind.), and Siberian chipmunk (*Tamias sibiricus*, 143 ind.).

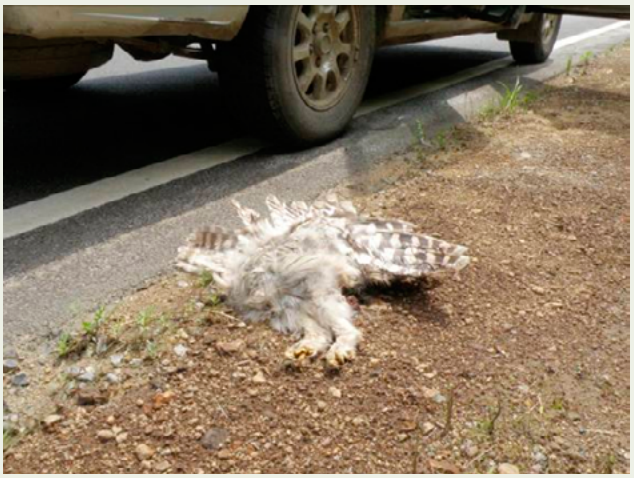

Figure 6. Ural Owl Copyright by Yun Wang

Figure 7. Hazel Grouse (Tetrastes bonasia) remains by roadside Copyright by Yun Wang.

Road mortality in April, June, and August (about 60-80 ind./ 100km) was higher than other months (10-35 ind./100 km). The number of species killed from May to September (more than 20) was higher than other months, including more than 10 bird species from May to August and about 10 mammal species in September. Amphibians make up the highest proportion of wildlife mortality from April to September. Amphibian mortality gradually decreased after June and was replaced by reptile mortality. Traffic volume was lowest in April (384 vehicles/day) and highest in August (1,171 vehicles/day). There was significant correlation between traffic volume and mortality of mammals, birds, reptiles and number of reptile species.

This research recommends limiting traffic volume in April to September, strictly limiting speed (60km/h), creating a wildlife crossing structure for amphibians and small-sized mammals to reduce the road mortality along Ring Changbai Mountain Scenic highway to reduce mortality of all wildlife.

Save the Date!

The 6th Biennial Northeastern Transportation & Wildlife Conference will be held September 21-24, 2014 at the Sheraton Hotel & Conference Center, Burlington, Vermont. See you there!

NORTHEASTERN TRANSPORTATION and WILDLIFE CONFERENCE

ADC30 meetings and sessions at the 2014 TRB Annual Meeting:

289 Emerging Topics in Ecology and Transportation
Mon 1/13/2014 10:15am-12:00pm
Hilton, Jefferson West

469 Innovative Practices in Wildlife Crossings
Mon 1/13/2014 7:30pm- 9:30pm
Hilton, Columbia Hall 6

571 Environment and Public Health Poster Sessions
Tue 1/14/2014 10:45am-12:30pm
Hilton, International Center

Ecology and Transportation Committee
Tue 1/14/2014 1:30pm- 3:15pm
Hilton, Columbia Hall 1

667 Programmatic Approaches to Environmental and Historic Preservation Review
Tue 1/14/2014 3:45pm- 5:30pm
Hilton, Jefferson East

Animal-Vehicle Collision Joint Subcommittee, ANB20(2)
Wed 1/15/2014 10:15am-12:00pm
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