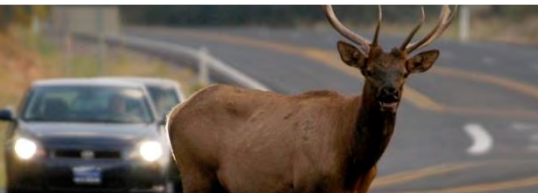




International Conference on Ecology and Transportation

ICOET 2013

Canyons | Crossroads | Connections



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Co-Hosted by the Arizona Department of Transportation
and the Arizona Game and Fish Department

Supported by the US DOT Federal Highway Administration

June 23-27, 2013 | Scottsdale, Arizona, USA

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Debra Nelson

*Strategic Policy Advisor
New York State Department of Transportation*

Welcome to the seventh biennial International Conference on Ecology and Transportation in Scottsdale, Arizona. We are pleased to have you join the conversation with experts from around the world sharing knowledge and best practices on the interrelationship of ecology and transportation.

You will get out of this conference what you put into it – I think you will find an energy and excitement that is rivaled by few conferences. Take it in! You may find yourself chatting with some of the world leaders in the field, or you may find you have something to offer someone just getting into this field. You will hear accents from several languages, and learn what is happening on different continents. Such exchange is what makes ICOET what it is today – the foremost conference on ecology, sustainability, and transportation.

You will learn much and contribute to the science as you take in the most cutting edge and progressive material on the topic of ecology and transportation. The range of topics and presentations outlined in the conference program allows you to customize your experience. More than 150 technical papers and posters from 21 countries and tribal organizations will be presented at ICOET 2013. This global perspective is vital as we address ecological issues associated with transportation. We are honored to welcome pioneering conservation biologist Dr. Michael Soulé, and Arizona conservationist John Graham, President and CEO of Sunbelt Holdings in Scottsdale, Arizona, as our keynote luncheon speakers.

Thanks to our co-host state agencies, the Arizona Department of Transportation and the Arizona Game and Fish Department, you will be introduced to their unique region known for its spectacular landscape. The three scheduled field trips will give you a glimpse of Arizona’s diverse geologic, topographic, and botanical beauty of desert and mesa, forests and mountains, valleys and canyons, all within a day’s drive. You will be introduced to some of Arizona’s natural treasures and learn of the exceptional work of ADOT and AZGFD and their partners. Each of the three field trips will showcase sustainable solutions to the ecological impacts of transportation; the trips have different focus areas, but each is sure to be a grand experience.

Canyons, Crossroads, and Connections is our 2013 conference theme. In the Grand Canyon state of Arizona, ICOET provides the crossroads and the connections to work together to meet today’s challenges with innovative science and sustainable solutions. It’s a tall order, but we can do it best by sharing our experiences and considering local, regional, national and international perspectives. Thanks to the many people, organizations, and sponsors that helped to organize and bring us together at ICOET 2013, the next four days is sure to provide us with that opportunity to share.

I hope you find the 2013 International Conference on Ecology and Transportation a rewarding and memorable experience. Enjoy the conference!

Debra Nelson
ICOET 2013 Conference Chair

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ICOET is honored to welcome these outstanding keynote speakers for our 2013 conference.

MONDAY June 24

Michael E. Soulé, PhD

*Professor Emeritus of Environmental Studies
University of California, Santa Cruz, CA*



Dr. Michael Soulé is best known for his pioneering work in conservation biology. Earning his PhD in Population Biology at Stanford University under Dr. Paul R. Ehrlich, Michael was a founder and first president of the Society for Conservation Biology and the Wildlands Network, and is currently its vice president for science. He has written and edited nine books on biology, conservation biology, and the social and policy context of conservation and has published over 175 articles on population and evolutionary biology, fluctuating asymmetry, population genetics, island biogeography, environmental studies, biodiversity policy, nature conservation, and ethics. Michael continues to do research on ecosystem regulation by strongly interactive (keystone) species, speaks and writes on ethics and conservation, serves on the boards of several conservation organizations, and consults internationally on nature protection. He describes himself as a "possibilist" about the future of biodiversity.

ICOET extends our thanks to the staff and members of the Society for Conservation Biology for their support in bringing Michael to this year's conference.



Society for Conservation Biology

TUESDAY June 25

John W. Graham

*President and CEO, Sunbelt Holdings, Scottsdale, AZ
Board of Directors, The Nature Conservancy in AZ*



John Graham joined Sunbelt Holdings in 1982 and became its president in 1990. Sunbelt is involved in a wide variety of real estate activities in the southwestern United States including development of land, commercial properties, and award-winning master planned communities. John's background is in asset management, development and real estate investment, with an economics degree from Stanford University. Under his direction, Sunbelt has become a dominant force in both community affairs and real estate activities. John's commitment to conservation efforts is demonstrated through active affiliations with many community and national groups including The Nature Conservancy (TNC) and the Urban Land Institute (ULI). John is former chair of the ULI Arizona District Council, and past chair of the TNC Arizona Board of Directors. In 2009, he received TNC Arizona's Oakleaf Award for Support of Conservation.

ICOET extends our thanks to the staff of The Nature Conservancy in Washington, DC their assistance in bringing John to this year's conference.



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SUNDAY June 23

8:30am – 5:00pm	Western Transportation Institute ARC Forum – Culture and Crossings <i>(Room: Tribal – by invitation)</i>
2:00pm – 6:00pm	Registration Open Exhibit Set-up for Sponsors Presenter Set-up for Poster Session 1 Sponsor Organization Meetings <i>(to be announced)</i>
	Dinner on your own
5:30pm – 7:00pm	ICOET Steering Committee Meeting <i>(Room: Powell – by invitation)</i>
SPECIAL SESSION 7:00pm – 8:30pm	PANEL SESSION 100 Random Acts or Global Agenda? A Strategic Discussion on Research for Ecology and Transportation <i>(Room: Trailblazer AB)</i>

MONDAY June 24

7:00am – 8:30am	Continental Breakfast			
7:00am – 3:00pm	Presenter Set-up for Poster Session 1 <i>(Room: Kierland 3)</i>			
PLENARY 8:00am – 10:00am	OPENING SESSION Welcome Remarks and Invited Speakers <i>(Room: Kierland 1 & 2)</i>			
10:00am – 10:30am	Refreshment Break Preview Posters Sponsor Exhibits			
PARALLEL SESSIONS 10:30am – 12:00pm	SESSION 101 Effectiveness of Wildlife Crossing Structures <i>(Room: Trailblazer AB)</i>	SESSION 102 Taking the High Road to Sustainability <i>(Room: Trailblazer C)</i>	SESSION 103 Construction, Maintenance, and Small-Scale Projects <i>(Room: Trailblazer DE)</i>	SESSION 104 Measuring Benefits, Costs, and Effectiveness <i>(Room: Kierland 4)</i>
12:00pm – 1:15pm	Luncheon with Keynote Speaker Michael E. Soulé, PhD <i>(Room: Kierland 1 & 2)</i>			
PARALLEL SESSIONS 1:30pm – 3:00pm	SESSION 105 Landscape Perspective for Ecological Decisions <i>(Room: Trailblazer AB)</i>	SESSION 106 Partnerships for Success <i>(Room: Trailblazer C)</i>	SESSION 107 Tips, Tools, and Training: Doing It Better and Smarter <i>(Room: Trailblazer DE)</i>	PANEL SESSION 108 Invasive Species Management in Highway Rights-of-Way <i>(Room: Kierland 4)</i>
3:00pm – 3:30pm	Refreshment Break Preview Posters Sponsor Exhibits			
PLENARY 3:30pm – 5:30pm	POSTER SESSION 1 <i>(Room: Kierland 3)</i>			
6:00pm – 8:00pm	Welcome Reception at Marshall’s Outpost Pavilion <i>(The Westin Kierland)</i>			
6:30pm – 10:00pm	Presenter Set-up for Poster Session 2 <i>(Room: Kierland 3)</i>			

Registration and Sponsor Exhibits Open

TUESDAY June 25					
7:00am – 8:30am	Registration and Sponsor Exhibits Open	Continental Breakfast			
7:00am – 8:30am		Sponsor Organization Meetings (to be announced)			
7:00am – 3:00pm		Presenter Set-up for Poster Session 2 (Room: Kierland 3)			
PARALLEL SESSIONS 8:30am – 10:00am		SESSION 201 Under and Over: Getting Wildlife Across the Road <i>(Room: Trailblazer AB)</i>	SESSION 202 It All Adds Up: Considering Investments for the Future <i>(Room: Trailblazer C)</i>	SESSION 203 Working Together for a Common Good <i>(Room: Trailblazer DE)</i>	PANEL SESSION 204 Resolution of Wildlife-Highway Conflicts in Arizona: Challenges, Solutions, Partnerships, and Politics <i>(Room: Kierland 4)</i>
10:00am – 10:30am		Refreshment Break Preview Posters Sponsor Exhibits			
PARALLEL SESSIONS 10:30am – 12:00pm		SESSION 205 Planning to Stay Connected <i>(Room: Trailblazer AB)</i>	SESSION 206 Addressing Wildlife-Vehicle Collisions and Driver Safety <i>(Room: Trailblazer C)</i>	SESSION 207 Habitat Protection and Management Solutions for Bats <i>(Room: Trailblazer DE)</i>	SESSION 208 From the Ground Up: Ecological Solutions for Planning, Design, and Construction <i>(Room: Kierland 4)</i>
12:00pm – 1:15pm		Luncheon with Keynote Speaker John W. Graham <i>(Room: Kierland 1 & 2)</i>			
PARALLEL SESSIONS 1:30pm – 3:00pm		SESSION 209 Wildlife Crossings: Global Issue, Local Solutions <i>(Room: Trailblazer AB)</i>	SESSION 210 Challenges in Mitigation <i>(Room: Trailblazer C)</i>	SESSION 211 Wildlife Accommodations: Adding and Removing Barriers to Protect Habit <i>(Room: Trailblazer DE)</i>	PANEL SESSION 212 Integrated Strategies for Resource Protection, Transportation and Stewardship at Grand Canyon National Park <i>(Room: Kierland 4)</i>
3:00pm – 3:30pm		Refreshment Break Preview Posters Sponsor Exhibits			
3:30pm – 5:30pm		POSTER SESSION 2 <i>(Room: Kierland 3)</i>			
	Dinner on your own				
5:30pm – 7:30pm	TRB ADC30 Committee Meeting <i>(Room: Cushing – open to all attendees)</i>				
5:30pm – 10:00pm	Sponsor Organization Meetings (to be announced)				

WEDNESDAY June 26			
6:00am – 7:30am	Continental Breakfast		
6:00am – 9:00pm	FIELD TRIPS hosted by ADOT and AZGFD Lunch and snacks provided for each field trip. Bring Your Ticket. Check-in and Board Buses at Culturekeepers Hall South Terrace.		
	FIELD TRIP 1 AZ State Route 260: Safety and Connectivity <i>Boarding 6:30am</i> <i>Departure 7:00am</i> <i>Return by 6:00pm</i>	FIELD TRIP 2 Sedona: Outstanding Waters and Context Sensitivity <i>Boarding 7:00am</i> <i>Departure 7:30 am</i> <i>Return by 6:00pm</i>	FIELD TRIP 3 Grand Canyon: Sustainability and Preservation <i>Boarding 6:00am</i> <i>Departure 6:30am</i> <i>Dinner stop in Flagstaff, AZ</i> <i>Return by 9:00pm</i>
	Dinner on your own		
SPECIAL SESSION 7:30pm – 9:00pm	PANEL SESSION 300 Highway Wilding: A Documentary Film – Screening and Panel Discussion <i>(Room: Trailblazer AB)</i>		

THURSDAY June 27			
	Breakfast on your own		
7:30am – 12:30pm	Registration and Sponsor Exhibits Open		
PARALLEL SESSIONS 8:30am – 10:00am	Registration and Sponsor Exhibits Open	SESSION 401 Wildlife Connections: Big or Small, It All Matters <i>(Room: Trailblazer AB)</i>	SESSION 402 Designing Crossings for Wildlife and Automobiles <i>(Room: Trailblazer C)</i>
SESSION 403 Integrating Ecology in Planning and Design <i>(Room: Kierland 4)</i>			
10:00am – 10:30am		Refreshment Break Sponsor Exhibits Open	
PLENARY 10:30am – 12:00pm		PANEL SESSION 404 Lanes, Landscape and Life: Integrated Transportation Planning for Eco-Conscious Highways <i>(Room: Trailblazer AB)</i>	
PLENARY 12:00pm – 12:30pm	CLOSING SESSION Conference Wrap-Up <i>(Room: Trailblazer AB)</i>		
	End of Conference – Lunch on your own		
1:00pm – 4:00pm	Sponsor Organization Meetings <i>(to be announced)</i>		

PANEL SESSION 100 | 7:00pm–8:30pm | Trailblazer AB

Panel Presentation and Discussion Workshop

Random Acts or Global Agenda? A Strategic Discussion on Research for Ecology and Transportation

Organizer and Moderator: **Paul Wagner**, Environmental Services Office, Washington State DOT, United States

Panelists: **Lars Nilsson**, Environmental Director, Swedish Transportation Administration; **Rodney van der Ree**, Deputy Director, Australian Research Centre for Urban Ecology; **Alex Levy**, Senior Ecologist, ARCADIS U.S.

The study of Ecology & Transportation is a relatively new field with many emerging questions, new avenues of inquiry and much to learn. There is rich opportunity for end users of research to apply new knowledge on projects and facilities as infrastructure is operated and improved. Research in this area has been supported by transportation organizations, research entities like the National Academies of Sciences and Transportation Research Board, resource agencies, as well as through private sector, NGO and academic efforts.

Research can provide significant benefits, but it often does not reach its full potential value for end users for many reasons including: 1) limited resources spread over a many different areas of study; 2) lack of awareness or coordination between those with similar research interests; 3) scope/scale of studies not reflecting many user's needs; 4) focus on individual project proposals, rather than an overall organized strategy; and 5) isolated efforts with disconnected funding and selection process. How can we get the most benefit from the investment in Road Ecology research?

This discussion-based workshop will help familiarize participants with the context of current research, how it comes to be and what are the important priorities, needs, gaps and trends. This workshop will seek input from participants on what would be the most useful future directions. The workshop goals are to: 1) increase awareness among attendees of the needs and priorities for research in Road Ecology; 2) gain input from the group (as a community of practice) on what areas of study would be the most useful; and 3) create a summary of ICOET Participant input from discussion and from attendee survey results. The ultimate objective is to offer input to various efforts where research is supported (i.e. ICOET, IENE, TRB, AASHTO, CEDR etc.) to help identify and promote work in areas of mutual interest in a strategic manner.

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OPENING SESSION | 8:00am–10:00am | Kierland 1 & 2

Plenary

Welcome Remarks and Invited Speakers**Debra A. Nelson**, *ICOET Conference Chair, New York State DOT, Albany, NY, United States***James B. Martin, P.E.**, *Associate Director, Center for Transportation and the Environment, Raleigh, NC, United States***John S. Halikowski**, *Director, Arizona DOT, Phoenix, AZ, United States***Larry D. Voyles**, *Director, Arizona Game and Fish Department, Phoenix, AZ, United States***Karla Petty**, *Division Administrator, US DOT Federal Highway Administration – Arizona, Phoenix, AZ, United States***Anders Sjölund**, *National Coordinator for Nature, Trafikverket / The Swedish Transport Administration, and Steering Committee Chair, IENE – Infra Eco Network Europe***SESSION 101 | Does It Work? Effectiveness of Wildlife Crossing Structures**

10:30am–12:00pm | Trailblazer AB

Moderator: Ray Schweinsburg, Arizona Game and Fish Department

Wildlife Crossing Structures: Can We Predict Effects on Population Persistence?**Edgar van der Grift**, *Alterra - Wageningen University and Research Centre, Province Gelderland, The Netherlands*

Wildlife crossing structures are important means to mitigate road impacts. While empirical studies that examine population-level effects of crossing structures are rare, monitoring the use of crossing structures has become a routine in many countries. Our objective is to explore – through population modeling – whether empirical data on crossing structure use can be used to assess to what extent the impacts of roads on population persistence have been mitigated. We develop general guidelines on how many crossings should take place per year to maintain viable populations and what this implies for the number and type of crossing structures.

Activity Patterns of Wildlife at Crossing Structures as a Measure of Adaptability and Performance**Anthony Clevenger**, *Western Transportation Institute, Montana State University, Harvie Heights, Alberta, Canada*

Human activity can strongly influence wildlife behavior and activity patterns. Wildlife behaviour may be used as an indicator of how wildlife responds to crossing structures. We describe activity patterns of large mammals at crossing structures as a measure of adaptation and performance. Specifically, we assess whether wildlife activity at crossing structures is different from control areas without effects of transportation corridors. We analyse a multi-year dataset obtained from camera traps at 39 wildlife crossing structures (n=49 cameras) along the Trans-Canada Highway. These data are compared with data obtained from camera traps (n=42) located in the backcountry of Banff National Park.

Evaluation of Desert Bighorn Sheep Overpasses along U.S. Highway 93 in Arizona**Jeffrey Gagnon**, *Arizona Game and Fish Department, Phoenix, Arizona, United States*

We evaluated the effectiveness of wildlife overpasses, bridges, culverts and fencing in reducing desert bighorn sheep (*Ovis canadensis nelsoni*) collisions while maintaining habitat connectivity. We saw a reduction of 82% in sheep-vehicle collisions by the second year, once we completed appropriate modifications to escape ramps. Overpasses were used substantially more than bridges and culverts with 1742 sheep using the three overpasses, 179 sheep using the two bridges, and 4 sheep using the three culverts. Preliminary data indicates overpasses, when combined with funnel-fencing, are a better option for desert bighorn sheep. Monitoring will continue through 2015 to determine trends over time.

A Decade of Arizona Wildlife-Highway Research: A Synthesis of What We've Learned**Norris Dodd**, *AZTEC Engineering, Phoenix, Arizona, United States*

The Arizona Game & Fish Department has conducted a decade of wildlife-highway interactions research on 8 highways employing consistent methodologies allowing direct comparison of highway permeability and wildlife-vehicle collision (WVC) patterns across all highways and 5 ungulate species. The effectiveness of wildlife passage structures and fencing was researched on 4 highways, while GPS telemetry and WVC research on 6 highways helped to develop strategies to address wildlife needs. GPS-telemetry along highways with AADT ranging from 1,240 to 20,650 vehicles/day provided insights into traffic and permeability relationships. This research has increased our understanding of wildlife-highway relationships and fostered new technologies.

SESSION 102 | Taking the High Road to Sustainability

10:30am–12:00pm | Trailblazer C

Moderator: Kristen Busby, Arizona Department of Transportation

Mobility for Humans and Wildlife: Cost-Effective Ways Forward*Lars Nilsson, Swedish Transport Administration, Borlänge, Dalarna, Sweden*

The Conference of European Directors of Roads has published a report on wild-life and traffic. One success factor in integrating wild-life and traffic is an area-oriented approach where the spatial planning authorities and other stakeholder agree on the land use. This leads to coordinated actions and less work ad hoc. The approach must be based on good ecological skill in the national road administration and better follow-up on contractor's performance. European cooperation is of utmost importance for better scientific bases for strategies; standardization of mitigation measures and guidelines. A pan-European research program is presently planned to fulfill these needs.

Hawaii Statewide Sustainable Landscape Master Plan and Roadside Design Guide*Charlie Scott, Jones & Jones Architects + Landscape Architects + Planners, Seattle, Washington, United States*

Concurrent with ongoing initiatives to take a contextual or "Context Sensitive Solutions" (CSS) approach to highway design and construction, there is an increasing emphasis on engaging a broad set of issues related to environmental and social sustainability in developing and improving highways. The Hawaii Statewide Highways Sustainable Landscape Master Plan and associated Roadside Design Guide represent a concerted effort to make the state of Hawaii's roadways and roadside landscapes more sustainable and contextual. The documents are intended to make highways, and those who plan and design them, more respectful of the sensitive landscapes and local culture of the Islands.

Building Coalitions and Leaders in Sustainability: NYSDOT's Actions to Interweave Sustainability and Asset Management*Debra Nelson, New York State DOT, Albany, New York, United States*

It is easy to see how investing in transportation infrastructure creates jobs and how transportation improvements improve the quality of our lives. But making the right decisions about transportation investments, decisions that will support economic competitiveness, meet the peoples' mobility needs and increase safety, all while protecting and enhancing the environment, is a more complex and challenging endeavor. This presentation addresses how NYSDOT is incorporating sustainability into its investment decisions through its organizational structures, asset management and management of its capital program, and explores how NYSDOT is moving to integrate sustainability into its everyday culture.

SESSION 103 | Getting It Done: Construction, Maintenance, and Small-Scale Projects

10:30am – 12:00pm | Trailblazer DE

Moderator: LeRoy Brady, Arizona Department of Transportation

A Get-R-Done Approach for Construction and Maintenance Project Actions*Timothy Cramer, Idaho Transportation Department, Rigby, Idaho, United States*

Transportation projects affect the environment. Most transportation projects require permits and approvals by regulatory agencies before construction. Obtaining these permits and approvals often takes considerably longer than the actual construction project. A partnership was developed between the Idaho Transportation Department and federal regulatory agencies to review the road maintenance and construction program in Idaho. The result of the partnership was a Programmatic Biological Assessment (PBA) document. Using the PBA the Endangered Species Act consultation can be completed in 30 days or less and for a process that previously could take six months to several years.

Large-Scale Mitigation for Small-Scale Projects: A Case Study*Judy Gates, Maine DOT, Augusta, Maine, United States*

MaineDOT's experience with state-wide, single applicant mitigation banking provides a case study on the process of providing proactive mitigation on a broad scale for smaller scale capital and maintenance projects. This presentation will review the decision-making on the restoration of Sherman Marsh, a tidal salt marsh in Midcoast Maine, beginning with in-the-moment decision-making about whether to reconstruct the dam following its catastrophic failure in 2005 to the negotiation with regulatory and resource agencies about adding this site to MaineDOT's statewide federal mitigation bank.

Monitoring Vegetation on Railway Embankments: Supporting Maintenance Decisions*Roger G. Nyberg, Edinburgh Napier University, Borlänge, Dalarna, Sweden*

National railway administrations in Northern Europe mainly resort to manual inspections to control vegetation growth along railways, which is slow and time consuming. Another aspect is that human observers are often unable to estimate the true cover of vegetation on railway embankments, also when there are several observers they often tend to disagree. Lack of proper techniques to identify the true cover of vegetation even result in the excess usage of herbicides; seriously harming the environment. Hence this study has investigated aspects relevant to human variation and agreement to be able to report better inspection routines by use of computer vision.

SESSION 104 | Is It Worth It? Measuring Benefits, Costs, and Effectiveness

10:30am–12:00pm | Kierland 4

Moderator: Scott Sprague, Arizona Game and Fish Department

Measuring What Matters: Sustainability and Environmental Compliance for California's High-Speed Rail Program**Karl Fielding and Margaret Cederoth, Parsons Brinckerhoff, Sacramento, California, United States**

The California High-Speed Rail Authority is currently executing one of the most visionary and challenging infrastructure projects in California's history. With stringent environmental requirements and commendable sustainability goals, the Authority is tasked with managing a diverse amount of data to ensure its objectives are met. Karl Fielding and Margaret Cederoth with the Authority's program management team will discuss the challenges facing the agency and also introduce attendees to EMMA, the environmental compliance system developed by the Authority.

Trans-Canada Highway and Dead Man's Flats Underpass: Is Highway Mitigation Cost-Effective?**Tracy Lee, Miistakis Institute, University of Calgary, Alberta, Canada**

A study of a 39 kilometer section of the Trans-Canada Highway (TCH) directly east of Banff National Park in Alberta, Canada evaluated the best locations to mitigate the effect of the TCH on the local wildlife populations and provide for reductions in wildlife-vehicle collisions (WVCs). In addition, the study conducted cost-benefit analyses to show where investments in mitigation may provide a net savings to society. Lastly, the study evaluated the cost savings associated with the development of an underpass and fencing within the study area using 6 years of pre and post construction data.

Cost Justification and an Example of Cost-Benefit Analyses of Mitigation Measures Aimed at Reducing Collisions with Capybara in São Paulo State, Brazil**Marcel Huijser, Western Transportation Institute, Montana State University, Bozeman, Montana, United States**


We conducted cost-benefit analyses for wildlife fencing and three differently sized culverts aimed at reducing collisions with capybara (*Hydrochoerus hydrochaeris*) along a highway in São Paulo State, Brazil. The spatially explicit analyses illustrated that the costs associated with capybara-vehicle collisions on specific locations along the highway exceed the threshold values for the mitigation measures. We believe the cost-benefit model presented in this paper can be a valuable decision support tool to help select locations and implement mitigation measures that improve human safety, are likely to benefit nature conservation, and are economically justified even when based on very conservative cost-benefit analyses.

On the Road Again: Measuring the Effectiveness of Mitigation Structures for Reducing Reptile Road Mortality and Maintaining Population Connectivity**James Baxter-Gilbert, Laurentian University, Sudbury, Ontario, Canada**


Roadways pose a serious threat to many wildlife populations, directly through mortality and indirectly through habitat fragmentation and destruction. It is important for mitigation to be used to off-set these negative effects, however it is equally important to thoroughly test the effectiveness of these mitigation measures to insure that they are cable of achieving the desired results. Along a section of Highway 69/400 in central Ontario Canada, which bisects an area of high reptile biodiversity, mitigation measures were installed during a highway expansion. A Before-After-Control-Impacted-Paired (BACIP) study was conducted to assess if exclusion structures (e.g. fences) could be used to reduce reptile abundances on the roadway, which would lead to a reduction on road mortality. Concurrently, 1) radio telemetry, 2) wildlife cameras, 3) automated PIT-tag readers and 4) a behavioral 'willingness to utilize experiment' were used to examine the effectiveness of population connectivity structures (e.g. eco-passages). Finally genetic information was collected during the course of this study to create a population genetic 'snapshot' of the area pre-construction and pre-mitigation which would allow for future study to examine the long-term population effects of this newly mitigated highway.

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SESSION 105 | Landscape Perspective for Ecological Decisions

1:30pm–3:00pm | Trailblazer AB

Moderator: Daniel Leavitt, Arizona Game and Fish Department

Ecologically Regenerative Development Around a Proposed Highway Corridor**Charles Budinger**, *Arizona DOT, Prescott, Arizona, United States*

Natural resource planning for large-tract development provides the local jurisdiction with high quality lifestyle opportunities for their citizens and visitors, including leaving viewscapes in tact; use of inter-modal transportation options to maintain air quality; collection of rain water for riparian preservation; preserving and maintaining native grass and tree species to prevent erosion and reduce fire hazard; and enhancing wildlife habitat in and around human habitation. The area north of Prescott and Prescott Valley, Arizona was chosen by the Ecosa Institute as a study area for ecologically regenerative development around a proposed highway corridor. Incorporating all major elements of the Yavapai County Comprehensive Land Use Plan, the resulting plan formulated by Ecosa Institute integrates the ecological components of the undeveloped land into the human needs for housing and transportation.

Biodiversity Information for Decision-Makers: A Conservation Partnership in New York**John Schmid**, *New York Natural Heritage Program, Albany, New York, United States*

The New York Natural Heritage Program (NYNHP) tracks rare and endangered species and significant natural ecosystems in New York State in a complex tabular and spatial database. Most partners that use NYNHP data for planning and conservation do not have technical science training. As such, sharing raw NYNHP data with them is not necessarily providing the information they really need for effective action. NYNHP has therefore partnered with the New York State Department of Transportation to develop interpreted information that DOT planners and project managers can use to further conservation of New York's most imperiled animals, plants, and ecosystems.

ENPARTS: A European-wide Initiative to Protect Herpetofauna from Transport Systems**Silviu Petrovan**, *Froglife Trust, Peterborough, Cambridgeshire; and Tom Langton*, *Road Transport Ecology Services (HCI Ltd.), Bramfield, Halesworth, Suffolk, United Kingdom*

In Europe amphibians represent as much as 80% of road carcasses and several populations have recently become extinct due to unsustainable traffic mortality. Mitigation measures often suffer from badly designed or implemented solutions probably exacerbated by insufficient monitoring or inadequate targets. In 2012 organisations from 12 European countries have initiated the creation of a network that can bring together best scientific practice and advice named ENPARTS- European Network for the Protection of Amphibians and Roads from Transport Systems. It aims to reduce herpetofauna road mortality, habitat fragmentation, promote restoration and creation of new wetlands and clean freshwater areas.

Best Practice for Implementing Biotope Networks in Highly Fragmented Landscapes: The Safety Net for the European Wildcat**Burkhard Vogel and Thomas Mölich**, *BUND/ Friends of the Earth Germany, Erfurt, Thuringia, Germany*

The NGO Friends of the Earth Germany/BUND is developing a net of corridors between isolated forests for the endangered European wildcat (*Felis silvestris silvestris*). Migration routes were calculated combining a habitat model with cost-distance analyses. First corridors have been realized. Funded by German Federal Ministry for Environment (BMU), five new corridors are scheduled. Collecting DNA samples from ten monitoring regions throughout Germany a genetic database is being created, to characterize the population and the function of corridors.

SESSION 106 | Partnerships for Success

1:30pm–3:00pm | Trailblazer C

Moderator: Julia Manfredi, Arizona Department of Transportation

Statewide Environmental Management System (SEMS): A Tennessee DOT's "SMART Delivery" Approach**Sangeeta Reddy**, *PMP, GISP, Data Transfer Solutions, LLC (DTS), Murphy, Texas, United States*

"SMART Delivery" is a Tennessee DOT's (TDOT) approach to providing transportation services to the driving public in Tennessee through a streamlined, manageable, accountable, responsible and transparent (SMART) project delivery process. TDOT in 2006 began paving the way to accomplish SMART Delivery through various initiatives focused on improving performance without compromising environmental stewardship and while enhancing stakeholder involvement. The Statewide Environmental Management System (SEMS) is one of these initiatives envisioned to be a comprehensive group of processes that will streamline TDOT's project delivery process by connecting the stakeholders in each phase of project development from Long Range Planning to Maintenance. SEMS will deploy a shared Geographic Information System (GIS) with analysis tools, a workflow/tracking application for the transportation decision-making processes, and the organizational change management initiatives to facilitate the implementation of the new processes throughout TDOT and in partnership with the appropriate local, state and federal agencies.

NYS DOT's Plan for Sustainable Transportation in the Adirondack Park

Edward Frantz, New York State DOT, Utica, New York, United States

The Adirondack Park is the largest state park in the contiguous United States comprising over 6 million acres of lands with 1,100 miles of state highways. It is no overstatement to say that a safe, efficient and environmentally sound transportation network in the Adirondack Park is critical to the Park's economy. NYS DOT is continuing this synergistic understanding with implementation of a planning effort that's vision is for sustainable transportation. Through this process the functional needs of the transportation system will strive to enhance or maintain the associated social, economic and environmental needs as future transportation projects and activities are progressed in the Park.

Nebraska's "The Matrix Reloaded!": Joint Regulatory Compliance and Agency Collaboration for Streamlined Transportation Project Delivery and Effective Environmental Resource Protection

Jason Jurgens and Melissa Marinovich, Nebraska Department of Roads, Lincoln, Nebraska; and **Brooke Stansberry**, US Fish and Wildlife Service, Grand Island, Nebraska, United States

This presentation will provide an overview of the next revolutions to Nebraska's Matrix Programmatic Process. Part of the presentation will discuss our methods and findings on the effectiveness and implementation of the previous "Matrix." Additionally, the steps we have taken with our state and federal partners to streamline and comply with additional regulations such as the Migratory Bird Treaty Act, Bald and Golden Eagle Act, and the Fish and Wildlife Coordination Act (with Section 404 of the Clean Water Act) will also be presented as part of our "Matrix Reloaded" effort. These jointly developed compliance procedures will be amended to the existing "Matrix" agreement upon their completion. Our work is a good example of how transportation and the resource agencies can work cooperatively in a collaborative manner to achieve conservation of natural resources.

An Arizona Success Story: A Four-Agency Partnership that Promotes Ecological Success

Todd Williams, Arizona DOT, Phoenix, Arizona, United States

This presentation will focus on a successful partnership between the Arizona Department of Transportation, the Federal Highway Administration, the Bureau of Land Management, and the United States Forest Service. Highlights of this presentation will include the Memorandum of Understanding, the Guidelines document "Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands", the use of multidisciplinary teams, the use of an Executive Steering Committee and an annual meeting that highlights successes and lessons learned. This partnership integrates resource management concerns into the interdisciplinary process of planning, development, construction, maintenance and operations in a context sensitive manner.

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SESSION 107 | Tips, Tools, and Training: Doing It Better and Smarter

1:30pm–3:00pm | Trailblazer DE

Moderator: Wendy Terlizzi, Arizona Department of Transportation

Better Biological Assessments for Transportation Projects: Training and Guidelines for Authors**Jeff Dreier and Mark Bakeman**, Washington State DOT, Olympia, Washington, United States

Efficient and detailed preparation of Endangered Species Act (ESA) Section 7 biological assessments (BAs) is critical to any state or local transportation agency. The combination of federally funded or permitted transportation projects and the presence of ESA species typically results in the preparation of a BA. The Washington State Department of Transportation provides training, guidance, and a dedicated internet site to teach individuals how to complete a quality BA. Using a standardized approach and training, other transportation agencies in the United States can improve BA quality, and tailor BA preparation to address existing and emerging ESA issues within their jurisdictions.

Tools for Researchers and Research Program Management**Anne Ellis**, Arizona DOT, Phoenix, Arizona, United States

This presentation was developed by the AASHTO Research Advisory Committee (RAC) and TRB Conduct of Research Committee Task Force on Collaboration and Coordination to help researchers find what they need. The presentation will review some of the tools available to help transportation researchers and research managers find funding, locate opportunities for collaboration with other researchers, search the literature, write effective problem statements, and manage research projects (whether one or a portfolio). Communities of Practice are discussed and considered in the context of collaborative agencies and partners including FHWA, RITA, TRB, AASHTO, University Transportation Centers (UTCs), and others.

Standardization of the Design and Construction of Aquatic Compensation Measures**Paul Draycott**, Morrison Hershfield Limited; and **April Marton**, Ontario Ministry of Transportation, Toronto, Canada

The Ontario Ministry of Transportation's continuous use of project-specific operational constraints and item specific mitigation and compensation measures has resulted in a proliferation of inconsistent, unproven and often expensive aquatic compensation methods. This has left the Ministry, the regulatory agencies, as well as design consultants and construction contractors, all with a significant level of uncertainty. The challenge was to design a series of standardized design and construction protocols to ensure that those measures identified as standards can be designed and implemented with certainty of effectiveness and cost, while streamlining the regulatory process for implementing aquatic compensation measures.

Streamlining Endangered Species Act Reviews for Transportation Projects: A Programmatic Biological Opinion for Transportation Projects in Washington State**Mike Lisitza**, Washington State DOT and NOAA Fisheries, Seattle, Washington, United States

The National Marine Fisheries Service, the Washington State Department of Transportation, and the Federal Highway Administration developed a programmatic biological opinion to reduce consultation timelines, reduce staff effort, and increase the conservation benefits for listed species. We have covered five projects this year. The average approval time for the five projects was 1.2 days. Collectively, the projects restored listed-species access to over 10 miles of stream habitat and provided stormwater treatment for 16 acres of previously untreated impervious surface. My presentation will cover the keys to developing a successful programmatic using examples from Washington State.

PANEL SESSION 108 | 1:30pm–3:00pm | Kierland 4

Panel Presentation and Discussion

Invasive Species Management in Highway Rights-of-Way: Success and ChallengesCo-Organizer and Moderator: **Shahin Ansari**, SWCA Environmental Consultants, Honolulu, Hawaii, United StatesCo-Organizer and Panelist: **Christopher Dacus**, Hawaii DOT, Kapolei, Hawaii, United States

Panelists: **Justin White**, Roadside Resources Program Manager, Arizona DOT; **Patti Fenner**, Noxious Weed Program Manager, USDA Forest Service, Tonto National Forest; **LeRoy Brady**, Arizona DOT, Phoenix, Arizona; and **Ed Frantz**, Adirondack Park and Forest Preserve Manager, New York State DOT, Utica, New York, United States

Got weeds? Whether you manage roadside vegetation for a state department of transportation, conservation agency, or are a private land owner; your answer is a quick and simple, yes! However, the answer to how to mitigate the introduction and spread of weeds in transportation corridors is a lot more complex. Session panelists from distinct and diverse regions of Hawaii, Arizona, and New York will share their successes and challenges in not just using an integrated approach to vegetation management but also working collaboratively with stakeholders to develop creative solutions to the problem of invasive species in highway rights-of-way.

Spatially Explicit Simulations Indicate that Roadkill has Clear Consequences for Genetic Diversity**Karl Jarvis**, Northern Arizona University, Flagstaff, Arizona, United States

Many studies suggest that roads have effects on the genetics of most types of wildlife populations. However, little is known about the specific effects of roadkill on genetic diversity. We tested the hypothesis that populations divided by roadkill would develop lower levels of genetic diversity in neighborhoods near a road than would populations that simply avoid a road. To test our hypothesis, we simulated a range of scenarios, independently varying levels of roadkill, avoidance, and landscape resistance to movement. We found that populations divided by roadkill have a different pattern of genetic diversity than do populations separated by road avoidance. **[Poster P-01]**

Spatial Factors Influencing Mammal Road-Kills in Southeastern Brazil**Carlos Henrique de Freitas**, University Center of Araxá, Minas Gerais; and **Eleonore Zulnara Freire Setz**, UNICAMP – State University of Campinas, Campinas, São Paulo, Brazil

Mammals are victims of road kills in Brazilian roads and this imposes a crescent threatened to species and drivers safety. We focuses on spatial factors that affect mammal's vehicle collisions and presents a useful tool that can helps the correct enforcement of mitigation measures, design and built new ways. **[Poster P-02]**

A Model of Road Effect Using Line Integrals and a Test of the Performance of Two New Road Indices Using the Distribution of Small Mammals in an Atlantic Forest Landscape**Simone Freitas**, Universidade Federal do ABC (UFABC), Santo Andre, Brazil

We combined GIS and Differential Calculus to introduce two new road effect indices (Integral Road Effect, IRE; and, Average Value of the Infinitesimal Road Effect, AVIRE), and evaluated their performance compared to other models to explain small mammal abundance. AVIRE obtained the best performance of forest specialist species. The nearest road distance obtained the best performance to generalist species. AVIRE allows for separating the effect of roads to the effect of habitat. Authors note: This work was previously published in *Ecological Modelling*. **[Poster P-03]**

Conceptual and Computational Model of the Road Effect Zone for Transportation Planning**Hye-Jin Cho**, Korea Institute of Construction Technology, Gyeonggi-Do, Republic of Korea; and **Fraser Shilling**, University of California, Davis, California, United States

Transportation agencies are required to assess the potential and actual environmental impacts of existing and proposed infrastructure. The only meaningful meme that has been developed to fully conceptualize these impacts has been the Road Effect Zone (REZ; Forman et al., 2005, "Road Ecology"). We describe a way to use existing tools and knowledge to computationally estimate the extent and characteristics of the REZ and thus evaluate potential and actual impacts of infrastructure and traffic on natural and human environments. Effective use of the REZ by transportation agencies and others has planning, regulatory, and stewardship implications and uses. **[Poster P-04]**

A Conceptual Model of Transportation Impacts as a Communication and Planning Tool**Jan Olof Helldin**, Calluna AB, Stockholm, Sweden

This presentation describes a conceptual model that gives a comprehensible view of the diverse impacts of transport infrastructure on Swedish biodiversity. The model is intended as a tool for communication and planning, by describing the ecological sustainability of the transport infrastructure in a glance, and providing basis for priorities in nature conservation efforts and research. The model development *per se* has worked as a forum for in-depth discussion among specialists from different fields, and is on its way to create a unified understanding of the complex impact of transport infrastructure on biodiversity.

[Poster P-05]

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Barrier Effects of Roads on an Endangered Forest Obligate: Role of Forest Structure**Hsiang Ling Chen and John Koprowski**, *The University of Arizona, Tucson, Arizona, United States*

Roads, especially highways have been shown act as barriers for many species by restricting individual movements to one side of a road. However, do you know narrow, dirt roads with traffic volume < 200 vehicles/day can be barriers for forest dependent species as well? We use red squirrel as a model to understand barrier effects of roads and traffic on forest obligate. We will present results of our study that answers the following questions: Do squirrels avoid roads because of road edges, clearing areas, vehicles or traffic disturbances? How to improve road permeability to maintain population connectivity among forested patches? **[Poster P-06]**

Motorways and Roads Affect Foraging Movements of Diurnal Raptors at Different Spatial Scales: General and Species-Specific Responses**Aimara Planillo**, *Universidad Autónoma de Madrid, Spain*

Little is known about the reaction of raptors toward roads or motorways. These are landscape feature that can affect the territory use of raptors. The more human tolerant species could be attracted by these structures as sources of prey and carcasses, while other species would avoid them. Understanding the general trends and the reaction of each species will help us to address future conservation problems, such as increased traffic mortality for species selecting roads, or decrease of habitat available for species avoiding them. **[Poster P-07]**

Restoring Connections Across Existing Transport Infrastructures in Spain**Georgina Álvarez Jiménez**, *Ministry of Agriculture, Food and Environment, Madrid; and Carme Rosell*, *Minuartia Environmental Consultants, Sant Celoni – Barcelona, Spain*

From 1994 till the present time, a wide variety of defragmentation measures have been implemented along existing roads and railways in Spain. These actions include the construction of new fauna passages to reestablish connections between both sides of the roads and other measures aim to reduce road mortality, restore ecological connectivity, and mitigate edge effects and any other impacts associated with habitat fragmentation. Coordination between transport and wildlife administration bodies is needed to carry out such actions. The quantitative and qualitative implementation of effective measures is being increased in the framework of a National Working Group on Habitat Fragmentation due to Transport Infrastructures, which is a “working together” project. **[Poster P-08]**

Annual Trends in the Number of Wildlife-Vehicle Collisions on the Highways of Hungary**Janos Farkas**, *Eötvös Loránd University, Budapest, Hungary*

The number of wildlife-vehicle collisions constantly grows. The road traffic also rose in recent years. Over the decade 1999-2008 the volume of road transport increased in Europe: for road freight transport by over 30 % and for passenger car transport by over 10 %. In respect to EU-27 states, the index of inland freight transport grew by 22%, but by 70% in Hungary. 537-101 large animals were killed annually on highways, respectively regards to the last decade in Hungary. Our results imply the population, traffic, speed of vehicles and weather are factors standing in the background of the observed trends. **[Poster P-09]**

Correspondence Among Population Density and Wildlife-Vehicle Collisions in Highways and Railways in Hungary**Flora Pokorni**, *Eötvös Loránd University, Budapest, Hungary*

The wildlife-vehicle collisions (WVCs) trends are determined by a combination of many factors, among which the population density, the traffic volume, the speed of vehicles and the weather were proved decisive. In our analysis the role of population density could not be demonstrated directly. However, the correlations among WVCs occurred on highways and railways indirectly shows that population density nevertheless is an important factor. WVCs becoming more frequent by the rising mean temperature predict that if the climate change will amount to warming and we cannot reduce game populations adequately, further increase must be expected in the trends of WVCs. **[Poster P-10]**

A Landscape-Based Approach for Delineating Hotspots of Wildlife-Vehicle Collisions**Nathan Snow**, *Michigan State University, East Lansing, Michigan, United States*

Previous methods for delineating hotspots of wildlife-vehicle collisions have involved arbitrary decisions and lack of independence among collision locations. We developed a new technique using kernel density estimation and attributes of the surrounding landscape to inform the delineation of hotspots. We demonstrated the utility of our approach for 3 species of wildlife that were characterized by varying degrees of landscape complexity and spatial scale. Our approach delineated hotspots in a meaningful manner, eliminated arbitrary decisions, and ensured independent hotspots. This method can be useful for identifying boundaries around the highest risk hotspots. **[Poster P-11]**

How Did the Alkali Bee Cross the Road? Assessing Transportation Impacts to Alfalfa Seed Production in the Walla Walla Valley

Amber Vinchesi, Washington State University, Prosser, Washington, United States

The Washington State Department of Transportation is proposing safety improvements to US Highway 12 near the town of Touchet, Washington. The improvements include realignment to the north in order to accommodate a wider roadway and avoid impacting Touchet. The proposed realignment route is within an area critical to alfalfa seed production. The most efficient pollinators of alfalfa are alkali bees, native ground-nesting bees raised in bee beds by farmers. Relocation of the highway will bisect several bee beds and alfalfa fields. WSDOT contracted with Washington State University entomologists to conduct a four-year study on alkali bee populations and flight paths. **[Poster P-12]**

Impact of Road Construction on Biodiversity in Ghana

James Amenu, Green Earth Organization, Kokomlemle, Accra, Ghana

The objective of the project is to bring to the fore the effect of road construction on biodiversity in Ghana. The method used included focus group discussion, use of existing formation interviews and survey. The result of this project is to be used for advocacy to enable government to consider biological diversity impact assessment in road construction planning to mainstream the necessary measures. **[Poster P-13]**

Primary Investigation on the Impact of the Sino-Pakistan Karakoram Highway on the Eco-Environment Along the Road

Jiding Chen, China Academy of Transportation Sciences, Beijing, China

Roads, especially highways have been shown act as barriers for many species by restricting individual movements to one side of a road. However, do you know narrow, dirt roads with traffic volume < 200 vehicles/day can be barriers for forest dependent species as well? We use red squirrel as a model to understand barrier effects of roads and traffic on forest obligate. We will present results of our study that answers the following questions: Do squirrels avoid roads because of road edges, clearing areas, vehicles or traffic disturbances? How to improve road permeability to maintain population connectivity among forested patches? **[Poster P-14]**

Arizona's Wildlife Features Inventory System: Tracking and Maintaining What We've Built

Justin White, Arizona DOT, Phoenix, Arizona, United States


ADOT has implemented numerous comprehensive projects to mitigate the impact of highway construction on wildlife and promote highway safety and landscape connectivity. With the number and diversity of its wildlife improvements growing, ADOT was challenged with tracking and maintaining asset functionality to meet intended mitigation objectives, especially under tightening maintenance budgets. To address this need to track and manage its inventory of wildlife assets and develop a proactive approach to ensuring that needed maintenance is accomplished, we employed ADOT's GIS-based *Features Inventory System* to conduct a statewide inventory of wildlife assets, assess asset condition, and prioritize maintenance needs. **[Poster P-15]**

Wildlife-Road Observation System (WROS): A Globally-Accessible Technology for Mitigating Wildlife-Road Impacts

Les Misch, WROS Global, Waterloo, Ontario, Canada

WROS (Wildlife-Road Observation System) is a globally-accessible website and database integrated with mobile technology that can be used to collect, store, and obtain wildlife-road observation data in North America, Europe, Australia and other regions of the world. WROS was designed to assist transportation and natural resource managers; private consultants and industry; conservation organizations; researchers; citizen scientists; and, the general public to help reduce wildlife-vehicle collisions, improve road safety and conserve wildlife populations locally and globally. WROS offers many advantages and benefits, which are presented with focus on one major advantage – improved efficiency and time savings in data collection and management. **[Poster P-16]**

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New Web Resources for Connectivity Practitioners

Patrick Crist, NatureServe, Boulder, Colorado; and **Jimmy Kagan**, Oregon State University, Portland, OR, United States

NatureServe and North Carolina State University have collaborated on two new web resources for wildlife connectivity practitioners. The NatureServe site (*landscape.org*) provides step-by-step guidance for new practitioners to approach the technical tasks of characterizing, assessing, and planning for wildlife connectivity. That guidance is integrally linked to a breadth of resources on NC State University's *conservationcorridor.org* site that provides the scientific background, library, digests, and examples. Together these integrated websites provide an unparalleled resource to understand the issues, approaches, and solutions for maintaining and restoring wildlife connectivity. This presentation will provide a brief overview of the transportation issues around wildlife connectivity and will demonstrate the use of the web resources for obtaining information and guidance. **[Poster P-17]**

Evaluation of a Wildlife Fencing Retrofit Along Interstate-17 in Arizona

Chad Loberger, Arizona Game and Fish Department, Phoenix, Arizona, United States

While road reconstruction offers an opportunity to integrate wildlife crossing structures and ungulate proof fencing to reduce wildlife-vehicle collisions, reconstruction is often a long term, funding dependent endeavor that may take decades to become an on-the-ground reality. A expedient, temporary, and relatively inexpensive solution may be retrofitting the roadways existing 1.2 meter (4') right-of-way fence with an additional 1.2-m (4') of vertical fencing. Our research along a high elk-vehicle collision section of Arizona's Interstate 17 found that retrofitted right-of-way fencing reduced elk-vehicle collisions by 100% and increased the number of elk and deer using existing roadway bridges by 120% and 83% respectively. **[Poster P-18]**

Operational Field Trial of a Retrofitted Fence to Mitigate Deer-Vehicle Collisions

Jim Stickles, University of Georgia, Athens, Georgia, United States

Using a before-after design, we are investigating the effectiveness of a 1.2-m woven wire fence, retrofitted with a 0.6-m outrigger angled at 45° away from the highway and strung with five strands of high tensile wire, at mitigating deer-vehicle collisions. If effective in a field setting, this fence design may provide an alternative to the standard 2.4-m ungulate-proof fencing. **[Poster P-19]**

Large Mammal Management in Algonquin Provincial Park, Ontario in Relation to Logging Road Ecology

Hillary Roulston, University of Waterloo, Ontario, Canada

This study examines the presence of large mammal species on two types of logging roads in Algonquin Provincial Park, Ontario. Transects were driven to collect local-level data and in-lab GIS data was used to supplement a landscape scale approach. Both spatial scales were used to determine what variables were important in determining mammal use on the primary or branch logging roads. Overall, branch logging road use was higher and had greater significance of the landscape-level variables. This economic and timesaving method has the potential to answer key questions for large mammal management and road ecology. **[Poster P-20]**

Acceptance of Large Mammal Underpasses by White-Tailed Deer and Mule Deer

Jeremiah Purdum and **Marcel Huijser**, University of Montana, Missoula, Montana, United States

This study explores the use of a relatively new method to determine the suitability of crossing structures for target species. Instead of focusing on absolute use, this study focuses on the use of acceptance rates, measured by recording the total number of attempted crossings of the structure by a species and calculating the percentage of these approaches that actually result in a road crossing using that same structure. We argue that recommendations for a particular type of structure and its dimensions should include the acceptance rates of the structure by the target. **[Poster P-21]**

Effectiveness of Wildlife Guards as a Barrier to Wildlife at Access Roads

Tiffany Allen and **Marcel Huijser**, Western Transportation Institute, Montana State University, Bozeman, MT, United States

Wildlife fencing can greatly reduce wildlife access to the road corridor, especially for ungulates. However, in developed areas, gaps in fences are necessary to allow vehicles access to and from main roadways. Wildlife guards, similar to cattle guards, appear to be an interesting mitigation for such gaps. This poster presents a field study that investigated how effective a particular type of wildlife guard design was in keeping mule deer, white-tailed deer, black bear, and coyotes from accessing the right-of-way along a fenced section of U.S. Highway 93 in Montana. **[Poster P-22]**

Evaluation of the Reliability and Effectiveness of an Animal Detection System Along Highway 3 Near Ft. Jones, California

Marcel Huijser, *Western Transportation Institute, Montana State University, Bozeman, Montana, United States*

We investigated the reliability and effectiveness of a microwave break-the-beam animal detection system (ICx Radar Systems), along State Hwy 3 (SR-3) near Ft Jones, northern California, USA. At least 74% of all detections were “correct” and vehicles reduced speed by 5.5% . We recommend improving the reliability of the system by installing sensors for vehicles at access roads that prevent the warning lights from turning on when a vehicle turns on or off the highway, reducing potential downtime and operation and maintenance costs, improving the warning signs, and to implement an extensive communication program with drivers and the general public. **[Poster P-23]**

A Comparison of Two “No Glow” Motion-Triggered Cameras at Opposite Ends of the Cost Range

Kelly McAllister, *Washington State DOT, Olympia, Washington, United States*

Motion-triggered cameras are among the best tools for monitoring wildlife use of crossing structures. A fast trigger, ability to take bursts of multiple images, night time functionality with “no glow” illumination, and high resolution images are all desirable. We compared Reconyx PC900 (\$650) and HC600 (\$550) cameras to the Bushnell Trophy Cam HD Max (\$250). As might be expected based on price, the Reconyx cameras performed better in almost every category. The Bushnell camera has a couple of potential advantages in sensitivity settings and video capability that are worth considering. **[Poster P-24]**

A Long-Term Evaluation of an Animal Activated At-Grade Wildlife Crossing in Arizona

Jeffrey Gagnon, *Arizona Game and Fish Department, Phoenix, Arizona, United States*

We evaluated the effectiveness of an animal-activated at grade wildlife crossing combined with wildlife fencing linking together existing bridges intended to serve as wildlife underpasses. Following six years of evaluation we realized a 97% decrease in elk-vehicle collisions and single-vehicle accidents dropped 64%. Motorist reduced speeds 9 miles/hr (14 km/hr) and 68% of motorists braked when the signs were activated versus only 8% when not activated. GPS collared elk movements across the highway decreased 70%. Under the right circumstances, innovative solutions like crosswalks provide viable options to reduce wildlife-vehicle collisions, while allowing access to essential resources. **[Poster P-25]**

Use of a Driving Simulator to Evaluate the Effectiveness of a Roadside Animal Detection System on U.S. Highway 41, Collier County, Florida

Molly Grace, *University of Central Florida, Orlando, Florida, United States*

We are evaluating a Roadside Animal Detection System (RADS) installed along U.S. Highway 41 through Big Cypress National Preserve in Florida. The system is intended to reduce collisions between vehicles and large wildlife and increase road permeability for these species. The ability of the system to detect wildlife will be tested in the field. We are also employing a novel approach: using a driving simulator to test whether or not the RADS changes human behavior (improved response time/ alertness). Because RADS do not keep animals off the roadway, they cannot be considered effective unless they positively affect human behavior. **[Poster P-26]**

MBTA Greenbush Line Wildlife Crossing Structure Study

Adrianna Ortiz, *CR Environmental, Inc., East Falmouth, Massachusetts, United States*

In April 2012 and 2013, remotely triggered wildlife cameras were installed at five wildlife crossing structures (pictured below) at the Massachusetts Bay Transportation Authority’s (MBTA) Nantasket Junction in Hingham, MA. The purpose of the study was to confirm and document utilization of the wildlife crossings by the formerly state- listed spotted turtle (*Clemmys guttata*) utilizing wetland pools on opposite sides of the Greenbush Line right-of-way (ROW), as well as, other local wildlife. **[Poster P-27]**

Effectiveness of Road Mitigation for Preserving a Common Toad Population

Fabrice Ottburg and Edgar van der Griff, *Alterra – Wageningen University and Research Centre, Wageningen, Province Gelderland, The Netherlands*

On the edge of the city of Ede, one of the largest populations of the common toad in the Netherlands is bisected by a two-lane road. To prevent massive roadkill of toads during spring migration, two amphibian tunnels and drift fences were installed. Our study objective was (1) to see whether the amphibian tunnels are used by the toads, (2) whether crossing rates of toads in the tunnels equal the number of toads that used to be helped across the road by the volunteers, and (3) if population numbers post-mitigation are similar to population numbers before the mitigation took place. **[Poster P-28]**



Photo © Suzanne Mathia | Arizona Highways Photo Workshop

How Much Does Size Matter? Tunnel Size Significantly Influence Amphibian Crossings at Parassapuszta, Hungary According to Mid-Term Monitoring used to Delineate Mitigation Measure Improvement Plans

Miklós Puky, *Hungarian Academy of Sciences, Göd, Hungary*

The amphibian migration in the Parassapuszta area is well-known in Europe due to a nearly three decade-long toad rescue operation including approximately 5,000 people from 20 countries. The migrating part of the local amphibian community may reach 50,000 individuals in years with rainy spring. In 2006 a 1.2 km mitigation measure including twelve tunnels of different sizes (40 and 60 cm in diameter) and previously built culverts of 160 and 170 cm height were constructed without consultation with relevant experts. Statistically significant differences were found among the crossing ratio in the three main tunnel types. **[Poster P-29]**

The Effectiveness of a Wildlife and Fish Passage Crossing Structure in South Central Washington State

Jon Peterson and Kelly McAllister, *Washington State DOT, Olympia, Washington, United States*

The Washington State Department of Transportation (WSDOT) recently constructed an innovative combination wildlife connectivity & fish passage project at Butler Creek on US 97 near Goldendale, Washington. A round corrugated metal culvert that was 2.8 meters (9 ft) in diameter and a complete wildlife & fish passage barrier was replaced with a 19.8 meter bridge (65 ft) in 2012 -13. WSDOT will monitor use by wildlife with motion triggered cameras. We anticipate that future data should show a decline in white tail deer and vehicle collisions from this point forward around Butler Creek. Check back with us! **[Poster P-30]**

Implementing Wildlife Crossing Infrastructure: Understanding the Culture of U.S. State Departments of Transportation

Angela Kociolek and Rob Ament, *Western Transportation Institute, Montana State University, Bozeman, MT, United States*

Currently, the decision to implement wildlife crossings remains with individual state Departments of Transportation (DOT), tribal governments, or federal land management units; whereas large-scale habitat connectivity for wildlife would likely improve with systemic implementation at regional or national scales. The purpose of this interview and survey effort was to better understand the role of DOT culture in the consideration of wildlife crossings. Three main themes emerged as the primary barriers to overcome for widespread implementation. Findings from this study may inform the promotion of new solutions so that wildlife crossings become a standard practice across the US road network. **[Poster P-31]**

Spiny Softshell Turtle Monitoring Results from the Missisquoi Bay Bridge Project

Jed Merrow, McFarland Johnson, *Concord, New Hampshire, United States*

Vermont state-threatened spiny softshell turtle (*Apalone spinifer*) hibernation, basking, and movements were monitored before, during, and after construction of a new bridge over Missisquoi Bay in northern Lake Champlain. Monitoring showed that construction activities and new bridge infrastructure influenced hibernation and basking locations, but spiny softshells continued to hibernate and bask in the bridge project area. Temporary basking platforms deployed during construction were successful in attracting turtles, but a permanent platform has been less successful. An inter-agency monitoring team was established which advised on permit amendments and monitoring, facilitating a flexible and adaptive approach to mitigation and monitoring. **[Poster P-32]**

Estimating the Probability of Illegal Desert Tortoise Collection Along Roadways in the Sonoran Desert

Hillary Hoffman, *Arizona Game and Fish Department, Phoenix, Arizona, United States*

The impact of road expansion throughout Sonoran desert tortoise habitat has raised concerns about mitigation. While direct impacts, namely road mortality and habitat loss, have been well documented, indirect impacts such as illegal collection have been insufficiently addressed. By conducting a decoy study, we estimated the probability of tortoise collection along 2-lane paved, maintained gravel, and non-maintained gravel roads to evaluate whether collection probabilities correlated to road type. Detection and collection probabilities by motorists were highest on maintained gravel roads. These results have implications for comprehensive mitigation strategies, such as creating crossing structures and increasing public education. **[Poster P-33]**

Turtle Underpass on the New England Central Railroad: A Simple and Cost-Effective Solution Providing Habitat Connectivity for a Population of Endangered Turtles

James Brady and Chris Slesar, *Vermont Agency of Transportation, Montpelier, Vermont, United States*

The Vermont Agency of Transportation (VTrans), Vermont Department of Fish and Wildlife (VDF&W), and The New England Central Railroad (NECR), were presented with the opportunity to reconnect vital spotted turtle habitat in southern Vermont during construction of a multi-state American Recovery & Reinvestment Act (ARRA) high-speed rail upgrade project. VTrans, VDF&W and NECR committed to finding a solution to provide turtles with safe passage across the tracks, while keeping design and construction costs low, and not impacting the project schedule. Fifteen low-cost crossings were incorporated into a 700 foot (213.4 meter) section of track that bisects this important wetland complex. **[Poster P-34]**

SESSION 201 | Under and Over: Getting Wildlife Across the Road

8:30am–10:00am | Trailblazer AB

Moderator: Chad Loberger, Arizona Game and Fish Department

Creating Resilient Wildlife Undercrossings with Interlocking Pavement Blocks**Brian Johnson**, Nebraska Department of Roads, Lincoln, Nebraska, United States

The purpose of this research was to determine whether an improved undercrossing can mitigate deer-vehicle collisions (DVCs) and thus reduce the need for large-scale exclusionary fence projects. By using low-cost, weather-resistant interlocking pavement blocks within the wildlife undercrossing, transportation designers can provide habitat connectivity with the benefits of reduced long-term maintenance costs and reduced DVCs. One year after the wildlife undercrossings were in place, woven-wire and Electrobraided deer fences were constructed to connect the bridges and funnel deer to the undercrossings. Monitoring of the undercrossings and a comparative analysis of the deer fences was conducted over three years.

Wildlife Fencing Escape Ramp Monitoring: Preliminary Results for Mule Deer in Southwest Colorado**Jeremy Siemers**, Colorado State University, Fort Collins, Colorado, United States


Animal-vehicle collisions have negative impacts to human safety and wildlife populations and are therefore a topic of great concern to transportation and wildlife managers. To allow escape for wildlife, earthen ramps are often constructed from inside of the right-of-way, which creates a sharp drop outside the fence allowing wildlife to jump to safety. We provide preliminary results for a monitoring effort focused on mule deer and elk of 11 escape ramps in southwest Colorado. We report on 9 months of monitoring and our results include information on mammal activity and ramp characteristics influencing successful escapes by mule deer.

An Evaluation of Pronghorn (*Antilocapra Americana*) Permeability Associated with Transportation Right-of-way Fence Characteristics in Northern Arizona**Scott Sprague**, Arizona Game and Fish Department, Phoenix, Arizona, United States


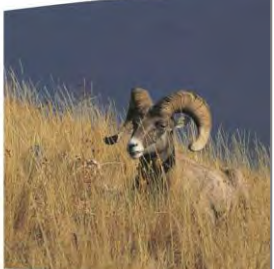
With a goal of increasing landscape permeability for pronghorn through fence improvements we considered the implications of modifying range fence structure, moving right-of-way fence away from highways, and eliminating right-of-way fence altogether. With over 171,000 locations from 37 GPS collared pronghorn, we compared fence crossing utilization to availability of fence with attributes such as high or low bottom wire height. We documented that pronghorn do indeed cross a highway much more frequently when right-of-way fence is removed. We also found the fence to highway distance at which improved and peak pronghorn crossing rates occurred.

Effects of Landscape Characteristics on Roadkill of Mammals, Birds and Reptiles in a Highway Crossing the Atlantic Forest in Southeastern Brazil**Simone Freitas**, Universidade Federal do ABC (UFABC), Santo Andre, Brazil

We propose a community approach to identify priority sites to apply road kill mitigation measures. This work aims to evaluate the effects of adjacent landscape characteristics on vertebrate roadkills. The 3 years-study was done in the BR-040 highway, in Brazil. The landscape characteristics around each road kill were quantified, and the distance to the nearest river was also measured. River proximity and herbaceous vegetation cover were associated to most road killed vertebrate groups. The association between river proximity and road kill may indicate that rivers are the preferential route for vertebrates in the region.





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SESSION 202 | It All Adds Up: Considering Investments for the Future

8:30am–10:00am | Trailblazer C

Moderator: Kristin Gade, Arizona Department of Transportation

Ecology in Motion: Using Transportation Funds for Watershed Management**Brian Bidolli**, *Greater Bridgeport Regional Council, Bridgeport, Connecticut, United States*

Implementation of watershed improvement projects faces many challenges, especially in how to finance work. Learn how the construction of the Pequonnock River Shared-use Trail and coordination with the Pequonnock River watershed management plan became a way to implement projects consistent with the watershed plan and improve water quality. While transportation projects often place stresses on the natural environment, this project illustrates that an alternative transportation mode can achieve both mobility and ecological resiliency.

Florida Department of Transportation's Wetland Mitigation Portfolio: Investing Today for Tomorrow's Transportation Needs**David Bogardus and Ann Broadwell**, *Florida DOT District 4, Fort Lauderdale, Florida, United States*

The Florida Department of Transportation (FDOT), District Four, has identified an emerging need to purchase wetland and endangered species mitigation in advance of transportation projects in order to satisfy National Environmental Policy Act (NEPA) coordination. FDOT recognizes that early resolution of mitigation issues streamlines the federal and state coordination process which is paramount to project scheduling and budgeting. The portfolio approach results in FDOT meeting project schedules, reducing project cost, benefitting the environment, achieving watershed restoration goals, and meeting the criteria of state laws. The approach also removes the uncertainty from mitigation success and allows for purchasing mitigation credits at a competitive rate for a range of habitat types and locations.

An Analytical Framework for Sustainability Analysis of Transportation Investments Across the Triple Bottom Line Using the Universal Metric**Gary McVoy**, *Parsons Brinckerhoff, Washington, DC, United States*

The U.S. National Highway System is approaching build out and a broader perspective on sustainability is emerging within the transportation industry. As commonly practiced, the U.S. National Environmental Policy Act (NEPA) is rightly focused on impact avoidance, minimization and mitigation; but other tools are becoming increasingly important as maintenance of the existing system becomes more of a focus. Landscape scale approaches such as Eco-logical, and green rating systems such as INVEST, Envision™, STARS, GreenLITES, and others can help identify and highlight a range of impacts and opportunities that are more in keeping with a system wide look at sustainability. Analysis of this range of system wide impacts and opportunities can be approached using Benefit Cost type analyses that monetize a range of Triple Bottom Line sustainability factors using dollar equivalents as a first approximation to communicate and quantify values. This paper will present a review of these tools and feature an example from Minnesota DOT illustrating how Triple Bottom Line Valuation can contribute to the transparent and objective assessment of project prioritization on a programmatic basis.

At the Crossroads of Ecology, Economics, and Society: Measuring Sustainability in Transportation**Benjamin Cotton**, *US DOT / VOLPE Center, Cambridge, Massachusetts, United States*

INVEST is a tool developed by the Federal Highway Administration to help transportation agencies learn about, implement, and evaluate best practices in highway sustainability. In the autumn of 2012, FHWA launched Version 1.0 of INVEST after a significant pilot testing process. This paper highlights the outcomes of the pilot test and describes some of the features – many of which were developed as a direct result of pilot test feedback – that have been incorporated into INVEST 1.0.

SESSION 203 | Working Together for a Common Good

8:30am–10:00am | Trailblazer DE

Moderator: Estomih Kombe, Arizona Department of Transportation

A Public-Private-Academic Partnership to Conserve Grizzly Bear Populations in Banff and Yoho National Parks, Canada**Kris McCleary**, *Parks Canada, Radium Hot Springs, British Columbia; and Ken Roberge*, *Canadian Pacific, Calgary, Alberta, Canada*

In 2011, Parks Canada and Canadian Pacific launched a new partnership to address the challenge of grizzly bear mortality on the rail line in Banff and Yoho National Parks. At the heart of this partnership is a competitive research grant program to fund academic research on the root causes of bear-train collisions toward the development of effective mitigations. Each organization has a unique role to play in this work: Canadian Pacific provides the bulk of the funding for the research and related infrastructure, knowledge of rail operations, experience with railway-bear mortalities and is responsible for ensuring reliable, safe rail service while minimizing impact on the environment; Parks Canada provides bear behavior and project management expertise; while universities lead independent empirical research. We believe that this model will deliver long-term mitigations for grizzly bear mortality in a cost-effective fashion.

TIGER by the Tail: The Interstate-15 Bridge No. 6 Environmental Assessment**Betsi Phoebus**, *Jacobs, Phoenix, Arizona, United States*

An Environmental Assessments (EA) for a complex project can typically take from 18 months up to 2 years to complete. How did the Arizona Department of Transportation and the Federal Highway Administration publish a Draft EA in six months and develop the Final EA in just over seven months? The saga of Interstate 15 and Virgin River Bridge No. 6 involves federal money with a tight schedule, cooperating agency review of 19 reports and memoranda, formal biological consultation, mitigation of impacts to one of Arizona's distinctive perennial rivers, a stretch of highway with national and exceptional significance...and more.

Building Bridges – An Innovative Public-Private Partnership to Reconnect the Rockies**Paige Singer**, *Rocky Mountain Wild, Denver, Colorado*; and **David Singer**, *Colorado DOT, Golden, CO, United States*

The I-70 Wild Byway project is a public-private partnership with the Colorado Department of Transportation, Rocky Mountain Wild and many other interested agencies, organizations and individuals across the region. Its goal is to promote the construction of the first wildlife overpass over I-70 in the state of Colorado at Vail Pass. It is our hope that building this first overpass with a combination of public and private funding will provide the needed incentive to build, monitor and evaluate additional wildlife crossing structures across the state, leading to a system of crossing structures built both over and under I-70.

Ungulate Responses to Pathway Construction and Use in a National Park Transportation Corridor**Amanda Hardy**, *Wildlife Conservation Society, Bozeman, Montana, United States*

We conducted a Before-After-Control-Impact assessment of elk (*Cervus canadensis*) and pronghorn antelope (*Antilocapra americana*) responses to recreational pathway construction and use in an existing transportation corridor in Grand Teton National Park, USA. Results suggest elk were tolerant of construction and use of the pathway. Numbers of pronghorn and their behaviors did not differ in the treatment relative to the control; however, pronghorn shifted farther from the road after construction in the treatment, indicating pronghorn avoided pathway activities. Despite this outcome, pathway construction did not reduce visitor opportunities to see elk and pronghorn in the travel corridor.

PANEL SESSION 204 | 8:30am–10:00am | Kierland 4

Panel Presentation and Discussion

Resolution of Wildlife-Highway Conflicts in Arizona: Challenges, Solutions, Partnerships, and Politics**Organizers: Carolyn Campbell and Kathleen Kennedy**, *Coalition for Sonoran Desert Protection, Tucson, Arizona*; and **Todd Williams**, *Arizona DOT, Phoenix, Arizona, United States***Presenters and Panelists: Norris Dodd**, *AZTEC Engineering*; **Ray Schweinsburg**, *Arizona Game and Fish Department*; **Robin Raine**, *Arizona DOT*; **Rick Ellis**, *Pima County DOT*; **Jim DeGrood**, *Pima County Regional Transportation Authority*; and **Karen Howe**, *Tohono O'odham Nation*

Over the last decade, Arizona has produced a series of innovative projects that seek to resolve highway-wildlife conflicts. Beginning with an overview of statewide efforts, this panel session will then focus on Pima County, Arizona, where a regional conservation plan and a unique local funding source totaling \$45 million are protecting Sonoran Desert wildlife linkages. This funding is being used for the construction of wildlife linkage infrastructure along major regional roadways, new research, and monitoring. A diverse selection of agency, jurisdictional, and non-governmental representatives will discuss two of these projects along State Routes 77 and 86, addressing challenges and lessons learned.

PRESENTATION: A Decade of Proactive Progress in Resolving Highway-Wildlife Conflicts – Norris Dodd

Since building its first wildlife underpasses a decade ago, Arizona has gained notoriety for its major reconstruction projects that address wildlife. ADOT funded a decade of research along 8 highways, and led efforts on a statewide linkage assessment. However, ADOT faces challenges as construction funding dwindles. Retrofitting small widening projects to address wildlife may become a focus; 2 projects along SR 86 and SR 77 were funded by the Pima County Regional Transportation Authority, which may serve as a model for future funding. We provide an overview of ADOT efforts and lay the foundation for the panel discussion to follow.

PRESENTATION: Visionary Conservation Planning and Community Support Brings \$45 million in Assured Funding to Wildlife Linkage Infrastructure in Pima County, Arizona – Kathleen Kennedy

In Pima County, Arizona, local jurisdictions are successfully building a broad portfolio of wildlife linkage protection projects, based on a regional conservation plan and utilizing a unique and innovative local funding source totaling \$45 million. This presentation will cover a history of regional conservation planning efforts, open space acquisition efforts, and the development of a local funding source for wildlife linkages protection. An overview of funded wildlife linkage projects, including wildlife crossings, research, and monitoring, will lead into the panel discussion to follow.

PANEL DISCUSSION: Arizona State Routes 77 and 86: Successes and Challenges of Implementing Wildlife Connectivity Projects at the Edge of a Highly Urbanized Metropolitan Area – Kathleen Kennedy (Moderator)

This panel discussion will present a case study of the first two major wildlife crossings projects in the Sonoran Desert, both of which were funded by a local funding source totaling \$45 million dedicated to wildlife linkages protection. Session objectives will include discussing the many significant challenges that have been overcome; highlighting unique aspects of the projects related to their location in a semi-urban "gateway" area; discussing the unique ecological, land-use, and transportation issues in the project areas; and presenting a varied list of lessons learned from the different perspectives of the presenters that can be applied in other communities.

SESSION 205 | Planning to Stay Connected

10:30am–12:00pm | Trailblazer AB

Moderator: Mark Ogonowski, Arizona Game and Fish Department

Reducing Habitat Fragmentation Related to the Widening of State Road 40 in the Ocala National Forest and State of Florida Public Lands*Tom Roberts, E Sciences, Inc., DeLand, Florida, United States*

The session presenters will discuss the Project Development & Environment Study (PD&E) used to evaluate the proposed improvements to SR 40, including the process and methods used to establish the location, size, interior and exterior features, fencing, and maintenance of wildlife crossings. In addition, the multiple ancillary benefits of the project, including significant improvement of motorist safety, improved management of public lands, secondary economic benefits of reconnecting wildlife metapopulations, and land acquisition efforts will be detailed.

Convergence of Green- and Blueprints: Integrating Long Range Transportation Planning and Landscape Connectivity*Patrick Huber, University of California, Davis, California, United States*

We present an example of an integration of connectivity and other conservation needs assessments (“greenprint”) with long range transportation planning (“blueprint”) by the California Department of Transportation (“Caltrans”). To identify a regional greenprint, we integrated the results of several extensive connectivity models, as well as other conservation planning datasets and biological data. To create early project buy-in, we convened several stakeholder meetings in the region. Next we integrated the current road network and planned road projects into a comprehensive transportation blueprint. The greenprint and blueprint were then overlaid and places of overlap were identified and categorized.

Habitat Connectivity in Arizona: A Tool for Planners*Chip Young, Arizona Game and Fish Department, Phoenix, Arizona, United States*

Habitat fragmentation arising from the development which accompanies human population growth is one of the largest challenges facing wildlife managers today. To address this, the Arizona Game and Fish Department (AGFD) has developed several datasets to help inform developers on where issues of landscape permeability are of the greatest concern. Using a wide array of spatial data incorporating as many anthropocentric impacts to the landscape as possible, AGFD collaborated with researchers at the University of Arizona to develop a statewide landscape integrity (LI) index. From that data, unfragmented blocks of land were delineated and important connectivity zones were modeled. The end result is meant to depict general zones where actions may be needed to ensure or restore a connected landscape.

Critical Linkages II: Assessing Regional Scale Landscape Connectivity for Transportation Planning in Massachusetts*Scott Jackson, University of Massachusetts, Amherst, Massachusetts, United States*

Phase II of the Critical Linkages project utilized a hybrid of the resistant kernel estimator approach and a graph theoretic approach to assess connectivity at a regional scale. We used a random low-cost path analysis based on resistant surfaces to compute a conductance index for each cell in the landscape. The core of the Critical Linkages II analysis is the assessment of the potential contribution of wildlife passage structures to regional connectivity. A small number of road segments account for a large proportion of potential increase in regional connectivity, suggesting the payoff for a strategic approach could be large.

SESSION 206 | Addressing Wildlife-Vehicle Collisions and Driver Safety

10:30am–12:00pm | Trailblazer C

Moderator: Tim Wade, Arizona Game and Fish Department

Prioritizing Mitigation for Interstates Using Wildlife Movement Information*Fraser Shilling, University of California, Davis, California, United States*

Many California interstates provide commuter traffic and goods movement among regions and cities through wild, protected areas. Collisions between wildlife and vehicles occur frequently, which has prompted Caltrans to seek assistance in assessing the nature, extent, and solutions to potential conflict between traffic and animals. The objectives of the study were to understand how wildlife were currently using available under-crossing structures, how wildlife in general and mule deer (*Odocoileus hemionus*) in particular interact with the highway and adjacent habitat, and to develop mitigation for risk reduction.

Animal-Vehicle Collisions: A New Cooperative Strategy Is Needed to Reduce the Conflict*Carme Rosell, Minuartia Environmental Consultants, Sant Celoni - Barcelona, Catalonia, Spain*

Animal-vehicle collisions are a major issue for traffic safety. Despite the measures applied to reduce the conflict, the numbers of accidents involving wildlife (mainly deer and wild boar) are still increasing in many European countries, especially on secondary roads. The strategy for managing the risk of animal-vehicle accidents in the Catalan road network is based on improving data recording and analysis and on a new action plan to improve road safety at hotspots. The road administration leads the plan, and a cooperative approach involving traffic managers, policy-makers, wildlife managers, hunters and drivers is a key factor to achieve the goal.

Saving Lives and Training the Next Generation: State Route 101 Wildlife Corridor Safety Project

Nancy Siepel, California DOT, San Luis Obispo, California, United States

State Route 101 near San Luis Obispo, California is a regional highway with high traffic volumes. It also bisects a major wildlife corridor in the Los Padres National Forest, leading to animal-vehicle collisions involving black bear, mule deer, and mountain lion. To address the problem, a wildlife fence was constructed in a roadkill hotspot. The project includes electric mats at unfenced intersections to prevent bear and deer from entering the roadway and jump-out ramps to allow wildlife to escape from the road corridor if necessary. Post-construction monitoring is documenting the fence's effectiveness at reducing accidents while maintaining regional wildlife connectivity.

Communicating the Risk of Wildlife Hazards to New Drivers in the United States and Canada with State and Provincial Driver Manuals and Handbooks

Leonard Sielecki, University of Victoria, British Columbia, Canada

As road and highway systems of the United States and Canada have expanded and encroached on wildlife habitats over the last century, and the number of drivers and motor vehicles has increased steadily, the incidence of wildlife-vehicle collisions has grown dramatically. The ability of drivers to deal effectively with wildlife hazards is largely dependent on driving skills, knowledge, experience and awareness of the hazards. For decades, the driver manuals and handbooks published by US state and Canadian provincial authorities have historically been the primary formal source of educational materials for new drivers. A review of official driver manuals and handbooks published over the last 80 years examines the information provided with respect to the fundamental characteristics of wildlife, the hazards wildlife represent, and basic driving techniques necessary to reduce the likelihood and severity of wildlife collisions. The evolution of wildlife-related information in these publications is traced through the decades, and the presentation of critical safety issues, such as wildlife hazard awareness and wildlife collision avoidance or collision severity reduction manoeuvres is evaluated. Recommendations are made for improving state and provincial driver manuals and handbooks to protect both drivers and wildlife.

SESSION 207 | Habitat Protection and Management Solutions for Bats

10:30am – 12:00pm | Trailblazer DE

Moderator: Shawn Lowery, Arizona Game and Fish Department

Echoes from a Midsummer's Night: Conducting Acoustic Surveys for Protected Bats in Georgia

Alexander Levy, ARCADIS, Atlanta, Georgia; and **Melissa Bridendall**, ARCADIS, Lakewood, CO, United States

In April 2012 a federally endangered Indiana bat (*Myotis sodalis*) was tracked to the southern Appalachian Mountains of northern Georgia. The first Georgia-documented occurrence for the species in over 40 years, the discovery comes as a fungal epidemic – white-nose syndrome – is extinguishing many cave-dwelling bat species in the eastern US. With government agencies rushing to understand the bat's status, active transportation projects in northern Georgia were directed to be reevaluated for the presence of suitable summer habitat of the imperiled bat. ARCADIS leveraged its expertise from wind farm studies to conduct region-wide surveys on over 45 miles of roadway corridor.

Environmental Factors Influencing the Status and Management of Bats Under Georgia Bridges

Arthur Cleveland, California Baptist University, Riverside, California, United States

This research focused on 540 bridges in Georgia. There were 55 bridges identified as occupied by roosting bats. Bridge construction and surrounding habitat characteristics of roost and non-roost bridges were compared to identify bat roosting preferences. Bridge construction techniques and materials, elevation of bridge, age of bridge, distances from water, surrounding habitat and evidence of habitation by bat colonies were considered. Recommendations were made on maintenance and construction activities on bridges supporting existing and future bat roosts. It was further recommended that, when demolition of roost bridges is required, alternative roosting habitat be provided to avoid displacing established bat colonies.

BrandenBark™ Artificial Bark Designed for Roost Use by Indiana Bats (*Myotis sodalis*)

Mark Gumbert, Copperhead Environmental Consulting, Inc., Paint Lick, Kentucky, United States

The Federally Endangered Indiana bat (*Myotis sodalis*) is a concern for development projects in 23 states. Indiana bats roost and rear young in trees with exfoliating bark, which puts them at risk of adverse impacts from projects that require tree clearing. We developed BrandenBark™, an artificial roost structure, which mimics the natural roosting preferences of the Indiana bat. BrandenBark™ has been shown to be used extensively by an Indiana bat maternity colony in central Kentucky and has been approved as a mitigation technique for linear tree clearing projects by USFWS.

The Thermal Environment of a Concrete Bridge and Its Influence on Roost Site Selection by Bats (*Mammalia chiroptera*)

Justin Stevenson, RD Wildlife Management, Los Lunas, New Mexico, United States

Worldwide, road infrastructures provide critical habitat for bat communities. Nearly 70% of North America's bat species use highway bridges as substitutes for natural roosts. Yet, bridges without "bat-friendly" roosts are continually replacing those that function as important roost sites. Learn about the micro-structures bat prefer, why they choose them, and how we can reestablish and improve roosting opportunities for these incredibly important mammals.

SESSION 208 | From the Ground Up: Ecological Solutions for Planning, Design, & Construction

10:30am–12:00pm | Kierland 4

Moderator: Chuck Howe, Arizona Department of Transportation

Implementing Environmental Commitments and Requirements into Drilled Shaft and Pile Test Program for the Controversial Minnesota/Wisconsin St. Croix River Bridge Project*Dwayne Stenlund, Minnesota DOT, St Paul, Minnesota, United States*

This paper describes the regulatory issues, environmental impacts prevention and construction process plan development for drilled shaft and pile test program within the St. Croix river for completing engineering studies of foundation design. Implementation of the environmental commitments were developed using the NPDES Construction Storm water pollution prevention discharge permit framework that incorporates plan narratives, detail drawings for contractor installation of best management practices and rapid plan amending methods based on field conditions. Lessons learned in the drill and test shaft operations are being applied to the actual bridge construction plan for contractor implementation.

Alkali Sinks, Riparian Corridors, and Sloughs, Oh My! Interagency Collaboration to Correct Past Resource Impacts and Address Future Transportation Needs in California's Central Valley*Clifton Meek, US Environmental Protection Agency, San Francisco, California, United States*

The State Route 180 Westside Expressway project in the Central Valley of California is a proposed 50 mile expressway corridor that would traverse some of the valley's most sensitive and rare habitats. In 2011, Caltrans released a Draft Tier 1 EIS analyzing 3 proposed alternatives, all of which had significant impacts to waters and habitat. Through agency coordination, a new alternative was created that proved to be transformative for the project, changing the focus to potential environmental benefits that could result. Through several design improvements, the project is now proposing a preferred alternative that addresses historic resource impacts and avoids additional fragmentation of natural habitats and prime farmland, while also allowing for expansion to address future facility needs.

Road Construction in Wetlands, an Opportunity to Help Increase an Endangered Amphibian Population in Mexico: A Case Study on Lerma, Mexico*Norma Fernandez Buces, Grupo Selome SA de CV, Mexico City, Mexico*

Road construction affects animal populations due to habitat fragmentation and organism loss. Nevertheless, when compensation measures include habitat restoration and *ex situ* reproduction programs to increase population numbers, endangered species can strongly benefit from a road project. When there are not enough economic resources to develop conservation programs, the opportunity to acquire such resources on behalf of the construction budget proved to be a useful way to get a win-win situation; such is the case of the Lerma Salamander (*Ambystoma lermaense*; Taylor, 1940) and the Lerma-3 Marias toll highway in Mexico.

Incorporating Pedology into Transportation-Related Coastal Restoration and Mitigation Projects*L. Rex Ellis, University of Florida, Gainesville, FL, U.S.*

Coastal mitigation and shoreline restoration are a part of Florida transportation activities. Soils-based information could improve success if incorporated into the planning and the design of mitigation/restoration projects. Pedology is a soil science discipline focused on soil formation and soil/landscape relationships. The Florida Department of Transportation has partnered with the University of Florida Soil and Water Science Department to expand pedology into subaqueous environments, and has funded several pedological research projects in Florida coastal waters. Subaqueous soil mapping in the Gulf of Mexico provided a proof-of-concept which lead to investigations of coastal restoration and mitigation sites in the Indian River Lagoon and Florida Keys. Geospatial patterns of soil and vegetation provided valuable insight which will improve future site designs and vegetative monitoring.



Photo © Suzanne Muthel / Arizona Highway's Photo Workshop

SESSION 209 | Wildlife Crossings: Global Issue, Local Solutions

1:30pm–3:00pm | Trailblazer AB

Moderator: Joyce Francis, Arizona Game and Fish Department

Using GIS Models to Conserve Habitat Connectivity for Wildlife: San Francisco Peaks – Mogollon Rim Linkage Design**Mark Ogonowski**, Arizona Game and Fish Department, Flagstaff, Arizona, United States

GIS models can help mitigate habitat fragmentation by identifying multispecies movement areas to guide siting of crossing structures and other actions. The Arizona Game and Fish Department with Coconino County developed a linkage design for an area of conservation priority in northern Arizona. We identified optimum movement areas using focal species and least-cost modeling and validated our model with empirical data. In collaboration with Arizona Department of Transportation, AGFD research biologists are using our model in conjunction with telemetry studies to guide future siting of crossing structures along Interstate Highway 40, including species for which movement data are not available.

Wildlife Passages and Land Use: Coordination Required**Tamar Achiron-Frumkin**, Mevasseret Zion, Israel


Careful design and the adoption of environmental standards are just the first stage towards a successful connectivity solution. Sometimes the interaction between road impacts, the dynamics of other human activities, and their joined impact on wildlife make it difficult to determine how effective mitigation measures are and what can be done to improve performance. This case study, presenting monitoring results from Cross-Israel Highway (road no 6), demonstrates a complex picture of human-wildlife interactions and points to the need to look at the large-scale picture.

Exemplary Environmental Initiative Award Winner: Lava Butte U.S. 97 Wildlife Crossings in Bend, Oregon**Leslie Bliss-Ketchum**, Portland State University, Portland, Oregon, United States

The Lava Butte US97 wildlife crossings project is an example of collaborative cross-agency planning efforts and unique solutions to habitat connectivity and animal-vehicle collisions. This project relied on the Oregon Wildlife Movement Strategy and research on migration and mortality to inform the need for crossing structures. Interagency collaboration was a key element. These efforts resulted in the selection of Lava Butte as an Exemplary Ecosystem Initiative winner by the Federal Highway Administration and highlights Lava Butte as an example project. This paper highlights features that resulted in Lava Butte receiving this award and provides lessons learned to inform future projects.

Wildlife Road Crossing and Mortality as Input to Road Design to Lower Ecological Impact in Colombia**Esteban Payán Garrido**, Panthera Colombia, Bogota, Colombia

A study on vertebrate road mortality and wildlife road crossing was undertaken to influence the design of a highway upgrade in Colombia. A survey of a total of 2,753 km yielded 340 wild vertebrates (an estimated 1,201 kg of biomass) killed by vehicle collisions from at least 32 species. Estimated annual kill rates averaged 45/ind/km. Relative road kill rates ranged 0.05-0.21/km. Mammals were the most prevalent victims with prevalent species being tamanduas, common opossum and crab-eating foxes. We identify the need to create seven new underpasses, adapt 123 existing ones and propose the creation of wildlife friendly segments along the road.



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SESSION 210 | Challenges in Mitigation

1:30pm–3:00pm | Trailblazer C

Moderator: Justin White, Arizona Department of Transportation

Identifying and Implementing a Refined Mitigation Approach for Transportation Projects in Coastal Habitats**Brandon Howard**, NOAA National Marine Fisheries Service, West Palm Beach, Florida, United States

Mitigation in the coastal environment can be difficult. The Florida Department of Transportation (FDOT) has taken a proactive approach to identifying mitigation needs for upcoming transportation projects that included seagrass beds, tidal freshwater, and mangrove wetlands. By implementing mitigation projects up front, the federal permitting process is streamlined and money is saved due to reduced time lag and risk. FDOT analyzes their work program to identify region specific mitigation needs and presence of unique coastal habitats. This may occur one to five years before a permit application is submitted for the construction projects. The presentation will discuss this refined method.

Cross-Testing Transferability of National Mitigation Planning Tools with California's Regional Advance Mitigation Planning (RAMP) Framework on a New Pilot Region (450 miles of U.S. 101)**James Thorne and Jackie Bjorkman**, University of California, Davis, California, United States

Regional advance mitigation planning (RAMP) incorporates regional planning principals and environmental considerations early in the process of the transportation project review. This method of projecting impacts from multiple projects is more efficient than conventional mitigation because it permits the acquisition of larger areas which is generally more biologically effective, less expensive and can be integrated into larger, regional sustainability designs. This project has two objectives: 1) examine the transferability of methods from completed RAMP projects in California to a pilot area of Highway 101, and 2) test a national geospatial tool developed by the Strategic Highway Research Program II using our pilot area.

Hurricane Recovery: The Challenge of Implementing an Ecologically Sensitive Solution After a Natural Disaster on the North Carolina Outer Banks**Mike Sanderson**, North Carolina DOT, Raleigh, North Carolina, United States

North Carolina Highway 12 traverses a series of narrow sand barrier islands along the east coast of the state, passing through sensitive ecological habitat that is home to many federally listed threatened and endangered species. The highway is a crucial travel corridor for residents, businesses, and tourism. Hurricanes in 2011 and 2012 destroyed parts of the highway, breaching it in several locations and ripping gaps in the asphalt hundreds of feet wide. NCDOT was tasked with providing emergency transportation access to thousands of residents and tourists, repairing and re-opening the road quickly, while managing unique ecological, design, and engineering challenges in an environmentally sensitive and physically dynamic area. This presentation will include dramatic photographs and footage of the Hurricane aftermath to highlight the recovery efforts by NCDOT and its partnership with multiple state and federal environmental agencies. Constant collaboration with all agencies involved allowed NCDOT to succeed and build a model for future disaster response.

ADOT's Environmental Stewardship in Relation to Winter Storm Management of Arizona State Highways**Ed Latimer**, AMEC Environment & Infrastructure, Inc., Phoenix, Arizona, United States

The Arizona Department of Transportation (ADOT) has a well-defined Winter Storm Management (WSM) program. In the fall of 2011, ADOT contracted a research project to establish initial application rate guidelines of anti-icing and de-icing chemicals to minimize potential environmental impacts through soils, biotic and water analytical information from samples collected in the field over a two-year period (collected before and after WSM activities). The objective is to identify trends indicating the accumulation of winter maintenance chemicals along transportation corridors. The anticipated benefit of this research project is to minimize impacts to water quality and roadside vegetation, including trees, while maintaining desired roadway safety.

SESSION 211 | Wildlife Accommodations: Adding and Removing Barriers to Protect Habit

1:30pm–3:00pm | Trailblazer DE

Moderator: Julie Alpert, Arizona Department of Transportation

A Wildlife Barrier Fence North of Wenatchee, Washington: Learning Experiences Involving Rugged Country and Custom-Designed Wildlife Guards and Jumpouts**Kelly McAllister**, Washington State DOT, Olympia, Washington, United States

U.S. 97 Alternate Route, north of Wenatchee, has had a Mule Deer and Bighorn Sheep collision problem for years. Wildlife advocate conceived a nine mile highway fencing project in 2004. After a considerable amount of political lobbying and fund-raising, the Washington Department of Transportation saw the project through three phases of construction during 2009, 2010, and 2011. The challenges involved with building fence on steep rock, designing effective wildlife guards and other aspects of the project will be described.

Wildlife Permeability Analyses of Roads and Railroads for Strategic Mitigation Planning in Sweden

Andreas Seiler, Swedish University of Agricultural Sciences (SLU), Riddarhyttan, Uppsala, Sweden

We present an analysis of existing infrastructure barriers on larger wildlife in Sweden and the occurrence of existing, conventional bridges that provide a potential passage. Based on previous studies on deer-vehicle collisions, barrier effects and passage use, we developed a set of evaluation criteria to identify deficiencies in infrastructure permeability. Combined with a landscape wide connectivity analysis, these deficiencies provide input to the strategic mitigation plan of the Swedish Transport Administration. We discuss evaluation criteria, the fundamental assumptions and implementation constraints that may enforce rather pragmatic results.

Implementation of an Effective Migratory Bird Nesting Protection Program for a 49-Mile, New Location Toll Road Construction Project in Central Texas: Nest Protection Measures and Results over Three Nesting Seasons

Edward Rashin, Hicks & Company, Austin, Texas, United States

There is often a potential for road construction projects to interact with migratory bird nesting activity, and protection of migratory bird nests is required by law. Imagine a project where one 15-mile segment of new road construction involved implementation of protection measures for over 30 active bird nests, and two thirds of these were ground-nesting birds that established their nests on freshly graded ground within active construction zones. This project provided an intensive if not somewhat unique opportunity to develop and evaluate the elements of an effective migratory bird nest protection program.

Innovative Approach to Recovery of San Joaquin Kit Fox

Mary Gray, Parsons, Sacramento, California, United States

San Joaquin kit fox in Bakersfield, California have adapted to the urban environment where industrial and residential development have expanded and replaced native plant communities. Unlike elsewhere within their range, the kit fox in Bakersfield rely primarily on anthropogenic habitats in which natural ecological processes are nonexistent or substantially altered. Most kit fox dens in Bakersfield are earthen, but kit fox can also exploit a variety of anthropogenic structures for denning. Proposed roadway improvement projects in the city will result in temporary and permanent loss of habitats known to support the San Joaquin kit fox. To mitigate this loss, an artificial den strategy for kit fox was developed collaboratively by local, state, and federal agencies to provide long-term protection of artificial dens within the city limits in City-owned sumps (i.e. storm-water drainage basins).

PANEL SESSION 212 | 1:30pm–3:00pm | Kierland 4

Panel Presentation and Discussion

Landscape and Legacy: Integrated Strategies for Resource Protection, Transportation and Stewardship at Grand Canyon National Park

Organizer and Moderator: **Vicky Stinson**, National Park Service, Flagstaff, Arizona, United States

Panelists: **Jan Busco**, Grand Canyon National Park; **Andy Dufford**, Chevo Studios, Denver, Colorado; and **Jason Fann**, Fann Contracting, Inc, Prescott, Arizona

This case study follows planning, design and construction processes utilized to resolve pressing transportation issues at Grand Canyon's South Rim. The goal of solving transportation issues was achieved; unanticipated, however, was how this transportation 'fix' evolved into a legacy project that fundamentally changed how millions of visitors experience the Grand Canyon. From the perspectives of a Project Manager, Horticulturalist, Artist and Contractor learn how holistic transportation solutions can increase user capacity and efficiency while enhancing landscape environments; use of native materials can inspire beautiful, enduring designs; and, collaboration between contractors, artists, engineers and resource specialists results in high quality outcomes.



Photo courtesy Grand Canyon National Park

A Trifecta of Insight: Merging Field Biology, Infrastructure Planning and Aboriginal Community Knowledge to Design Successful Highway Mitigation for At-Risk Reptiles

Julia Riley, Magnetawan First Nation, Britt, Ontario, Canada

The Georgian Bay coast in Ontario, Canada is an area of high reptile biodiversity. Paralleling the Georgian Bay coast is Highway 400/69, which is currently undergoing an expansion project. Magnetawan First Nation recognized the threat roads pose to reptile populations, and formed a partnership with Laurentian University, and the Ontario Ministry of Transportation to collect baseline abundance and spatial ecology data on reptile species at risk that will be used to inform highway mitigation measures. This case study is an example of how a multi-partner approach to road design may create ecologically- and community-friendly infrastructure. **[Poster P-35]**

The Nexus of Transportation and Ecology: Improving Resiliency of Urban Ecosystems by Increasing Landscape Connectivity for Wildlife through Informed Transportation Planning

Namrata Shrestha-Bajimaya, Toronto and Region Conservation Authority, Toronto, Ontario, Canada

This poster provides an overview of the study that used the fundamental concepts of wildlife movement ecology and road ecology in conjunction with spatial analysis techniques to develop a multi-scale spatially explicit model that identifies ecologically strategic locations for enhancing landscape connectivity for urban wildlife. Specifically, using a case study of spring peeper (*Pseudacris crucifer*) representing wetland-forest low mobility movement guild of wildlife for defining local and regional connectivity, this study highlights the translation of science into operational tools that facilitates sustainable transportation infrastructure planning in an urban and peri-urban landscape. **[Poster P-36]**

Linking Landscapes for Massachusetts Wildlife: A Wildlife-Transportation Agency Partnership

Timothy Dexter, Massachusetts DOT, Boston, Massachusetts, United States

The Massachusetts Department of Transportation Highway Division and the Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program have an Interdepartmental Service Agreement to streamline transportation-related project reviews under the Massachusetts Endangered Species Act and to collaborate proactively in the field of road ecology. The partnership has successfully facilitated early project coordination, reduced review timeframes, and has led to innovative environmental mitigation solutions, and MassDOT projects have become more cost-effective and environmentally sensitive. The partners also collaborate outside of the regulatory context to mitigate the effects of transportation infrastructure on wildlife and ecosystems in Massachusetts. **[Poster P-37]**

Wildlife Linkage Design in Cochise County, Arizona: Using Collaborative Efforts to Model and Incorporate Wildlife Linkage Designs into Local Transportation Projects

Sara Sillars and Jessica Lambertson-Moreno, Sky Island Alliance, Tucson, Arizona, United States

Interstate-10 poses a significant barrier to north-south wildlife movement in Cochise County, Arizona. The Arizona Department of Transportation (ADOT) proposes to conduct a climbing lane and traffic interchange reconstruction project on Interstate-10 along 15 miles of Interstate between the Dragoon, Winchester and Galiuro mountains, providing an opportunity to improve connectivity for wildlife. With input from local biologists and planners, we modeled movement corridors that are biologically the best fit using a multi-species approach. The final cartographic product includes planning and road mitigation recommendations and serves as a model for future wildlife linkage designs and transportation projects in Cochise County. **[Poster P-38]**

The Development and Implementation of a Successful Wildlife Corridor Through a Public-Private Partnership in Norfolk, Virginia: A Case Study

Stephanie Downs, Voolla.org, Washington, DC; and Stephanie Boyles Griffin, The Humane Society of the United States, Gaithersburg, Maryland, United States

In 2009, a private citizen of Norfolk, Virginia discovered a wildlife-vehicle collision hotspot along a four-lane causeway between a naval base and Lake Whitehurst where at least 150 aquatic turtles and tortoises were killed every year. To reduce annual death toll, the citizen worked with City of Norfolk, the U.S. Navy, multiple for-profit businesses, and a team of volunteers to create safe passage for wildlife through the design and installation of funnel systems and wildlife ladders. As a result, we estimate that over 420 turtles and tortoises have been spared to date. **[Poster P-39]**

Integral Plan for Ecological Restoration, Slope Stabilization and Wildlife Crossing for Construction Affected Sites: A Case Study in Sinaloa, Mexico

Norma Fernandez Bucos, Grupo Selome SA de CV, Mexico City, Mexico

Environmentally authorized road projects in Mexico are conditioned to the execution of mitigation, restoration and compensation measures. Their realization must be coordinated with construction program within a Mitigation Management Plan; however sometimes construction due program urges actions that cannot be adequately mitigate and therefore emergency restoration activities need to be implemented. Such is the case of a highway project "Durango-Mazatlan", fragments El Salto-Concordia and Villa Unión-Concordia, in Sinaloa, México; where a MMP was developed and executed to restore affected vegetation, stabilize slopes and enable wildlife crossing, using construction residues and native vegetation for optimal economical and ecological results. **[Poster P-40]**

Seeding the Slippery Slopes of the Southern Tier

Pauline Burnes and Ed Frantz, *New York State DOT, Hornell, New York, United States*

Extensive environmental studies and collaboration between Pennsylvania DOT and the New York State DOT were necessary to select an alignment for the reconstruction of US Route 15. The 6-mile long, 4-lane highway project crosses hills with rounded shoulders and steep slopes. Hilltops are generally level and crowned by fields or pasture. Mixed deciduous forests cover the steep hillsides while agriculture and communities vie for the level valley floor. The resulting highway alignment was selected to avoid, minimize, and mitigate impacts to natural, agricultural, cultural and scenic resources. Erosion and sediment control, stormwater management, and various seed types were used to protect natural resources and enhance upland wildlife habitat for pollinators, birds, amphibians, reptiles and small mammals. **[Poster P-41]**

Can Highway Rights-of-Ways Slow Down Climate Change?

Bill Dunn, *Ecosystem Management, Inc., Albuquerque, New Mexico, United States*

We studied the potential of state highway rights-of-ways (ROW) in New Mexico to mitigate climate change through sequestration of carbon (i.e., soil organic carbon (SOC)). The Upper Montane biome contained the highest density, but the Prairie biome had the highest amount of SOC because of extensive ROWs. Precipitation, clay, grass, and litter were associated with SOC levels. Planting legumes, imprinting soils to capture water and nutrients, and retaining live biomass through reduced mowing will be tested to determine their efficacy to enhance carbon sequestration within ROWs. **[Poster P-42]**

Avoiding the Tragedy of the Commons: An Arizona DOT Example

Wendy Terlizzi, *Arizona DOT, Phoenix, Arizona, United States*

The 'tragedy of the commons' is a term coined by scientist Garrett Hardin in 1968 describing what can happen in groups when individuals act in their own best self-interests and ignore what's best for the whole group. In an agency as large and diverse as the Arizona Department of Transportation (ADOT) there are multiple opportunities for this to occur. The development of a standard format for Facility Pollution Prevention Plans is the primary way ADOT was able to avoid the 'tragedy of the commons' at its facilities. **[Poster P-43]**

Mitigation Monitoring Reporting System (MMRS): An Improved Approach to Data Management and Reporting

Robert Carson, *Mason, Bruce and Girard, Inc., Portland, Oregon, United States*

MB&G is completing year 5 of a 10-year mitigation program management contract for ODOT. The MMRS provides improved overall management efficiency for this complex program. MMRS is an enterprise web application that provides a common interface to program GIS data and program management documents. The application is intuitive and requires no special training or software—all that is needed is an internet connection and a browser. The MMRS has improved communication among biologists, maintenance crews, ODOT, and regulatory agency staff by allowing for "virtual site visits" conducted via the Web. Come to the poster session for a live demo! **[Poster P-44]**

The Highway-Runoff Database: A Data Warehouse and Preprocessor for the new FHWA-USGS Stochastic Empirical Loading and Dilution Model (SELDM)

Gregory Granato, *US Geological Survey, Northborough, Massachusetts, United States*

The USGS, in cooperation with the FHWA developed the Highway Runoff Database (HRDB) as a data warehouse and preprocessor for the new Stochastic Empirical Loading and Dilution Model (SELDM). The latest version of the highway runoff database includes 54,384 event-mean concentrations, from 4,186 storm events monitored at 117 study sites across the country. The HRDB includes data for 194 highway-runoff constituents. Ready availability of this highway-runoff data in a standard format and the ease of use of the graphical user interface should provide information to improve project delivery without compromising environmental protection. **[Poster P-45]**

Social and Economic Benefits from Increased Flood Resilience of Stream Simulation Designs: Examining Tropical Storm Irene Impacts in Vermont

Nat Gillespie and Marjorie Apodaca, *US Forest Service, Washington, DC, United States*

A retrospective case study of the survival and failure of road-stream crossings was conducted in the upper White River watershed and the Green Mountain National Forest (GMNF) in Vermont following record flooding from Tropical Storm Irene in August 2011. Damage was largely avoided at two road-stream crossings where stream simulation was implemented and extensive at multiple road-stream crossings constructed using traditional, undersized hydraulic designs. Cost analyses suggest that relatively modest increases in initial investment to implement stream simulation designs yield substantial societal and economic benefits. Recommendations are presented to help agencies and stakeholders improve road-stream crossings. **[Poster P-46]**

Innovative Solutions to Reducing Permanent Impacts to Waters of the United States: Case Study on the Interstate-15 La Mesa/Nisqualli Interchange Project, Victorville, California

Stephanie Oslick, *Parsons Brinckerhoff, Orange, California, United States*

The Interstate 15 La Mesa/Nisqualli Interchange Project (High Desert Region of San Bernardino County) had the potential to permanently impact 3.85 acres of the Oro Grande Wash, a tributary to the Mojave River and Water of the United States. By incorporating some creative "out of the box" engineering solutions with minimal cost implications, the project team was able to reduce impacts by over 78 percent (to 0.84 acres), a significant reduction to jurisdictional areas. With mitigation tied to the "permanent impact acreage", this reduction also resulted in a significant decrease in the acreages and costs associated with mitigation and construction. **[Poster P-47]**

Analyses of the Runoff Glacial Meltwater Characteristics Along the Karakoram Highway

Shuangcheng Tao, China Academy of Transportation Sciences, Beijing, China

Karakoram Highway is located in the northern part of the Islamic Republic of Pakistan, starting in the north of the Pakistani capital of Islamabad, end at Chinese Kashgar. In 2006 Pakistani government decided to rehabilitation of the Karakoram Highway from Raikot bridge to Kunjirap pass. However, more than 90% of the Highway companied with the Indus, Gilgit River, Hunza River and Kunjirap River. In order to study the environmental characteristics of runoff glacial meltwater, and to provide good protection of water in the process of improvement of Karakoram Highway, the samples were collected at Indus, Hunza River, Gilgit River and Kunjirap River along the Karakoram Highway from September 2008 to October 2011. **[Poster P-48]**

Efficacy of Roadway Stormwater and other Drainage Facilities as Suitable Wood Stork Forage Habitat in Central Florida

Kristin Caruso, Scheda Ecological Associates, Inc., Tampa, Florida, United States

The wood stork (*Mycteria americana*) is a federally endangered species which forages predominately in wetlands with shallow water areas with open canopies, high prey densities, and calm water. While natural wetlands are commonly utilized, the species is also known to forage in artificial impoundments and ditches. Impacts to wood stork foraging habitat are subject to wood stork biomass foraging assessment and mitigation compensation requirements. We are evaluating three common forms of roadside drainage facilities: stormwater management facilities (SMF), floodplain compensation (FPC) sites, and roadside ditches. We seek to ascertain if their characteristics are similar to those found in natural wetlands to determine if the designed facilities provide suitable foraging habitat for the species, and ultimately to incorporate them into a mitigation plan and minimize mitigation credit cost. **[Poster P-49]**

A Synthesis of Road Ecology in Ontario, Canada: Emerging Issues and New Directions

Kari Gunson, Eco-Kare International, Peterborough, Ontario, Canada

Ontario harbours the highest biodiversity and road kilometers in Canada. As a consequence, road-kill is an obvious and well-documented phenomenon for many large and small wildlife species. These road impacts, increased world-wide attention to road ecology, and the Endangered Species Act (2007), have contributed to a progressive shift to integrate research into planning over the past decade. Several key mitigation and monitoring projects with multi-agency collaborations are reviewed, e.g. Long Point Causeway, and Ontario's first wildlife overpass. A synthesis with conclusions, and lessons learned will be summarized to facilitate new research directions with practical application to road mitigation solutions. **[Poster P-50]**

The Evolution of the Transportation Ecology Discipline: An Analysis of Ten Years of ICOET Proceedings

Ann Hartell, Vienna University of Economics & Business, Vienna, Austria; and **Eugene Murray**, Center for Transportation and the Environment, North Carolina State University, Raleigh, North Carolina, United States

This poster presents an overview of the history of ICOET and a content analysis of a decade's worth of ICOET proceedings. The analysis provides insights into the topics, research methods, and taxa represented in the proceedings as well as the locations and affiliations of authors. Using a 'sociology of science' perspective to evaluate the evolution of this community of researchers and practitioners, the authors identify initiatives that can strengthen and sustain transportation ecology as a unique, cross-disciplinary, applied community of research and practice. **[Poster P-51]**

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Outreach Matters! Highway Wildlife Mitigation Outreach Activities on the Flathead Indian Reservation and Surrounding Areas, Montana

Kylie Paul, People's Way Partnership, Missoula, Montana; **Whisper Camel-Means**, Confederated Salish and Kootenai Tribes, Pablo, Montana; and **Marcel Huijser**, Western Transportation Institute, Montana State University, Bozeman, Montana, United States

The People's Way Partnership is a unique and effective collaboration of tribal biologists, road ecologists, transportation department members, and a wildlife conservation organization. Our mission is to effectively communicate the conservation value of the 41 wildlife mitigation measures along US 93 North in Montana. We have undertaken outreach efforts to generate support for wildlife-highway mitigations. We led a fun and valuable drawing contest that engaged 950 children, with 340 (adorable) posters submitted. We've designed informational signs at rest stops along US 93 for the travelling public, and we've developed other exciting outreach materials to tell the story of roads and wildlife. **[Poster P-52]**

Broadening the Scope of what Citizen Science and Non-Invasive Wildlife Monitoring can Provide to Transportation Planning: Stories of Success from the Sky Island Region

Jessica Moreno, Sky Island Alliance, Tucson, Arizona, United States

Conservationists and planners can mutually benefit from close partnership to connect fragmented landscapes and reduce wildlife-vehicle collisions through short and long range transportation planning. Sky Island Alliance gives examples of citizen science wildlife monitoring efforts and collaboration that have facilitated effective transportation planning and implementation by helping planners avoid fatal flaws, proactively clear roadways for construction, and develop effective mitigation strategies for sensitive species and identified wildlife linkages. **[Poster P-53]**

The Highway 89 Stewardship Team: Mitigation, Research and Education to Improve Wildlife Passage

Sara Holm, California Department of Fish and Game, Rancho Cordova, California, United States

The Highway 89 Stewardship Team is a grassroots collaboration of passionate professionals from federal, state and local levels working on a long term strategy to address wildlife movement across highways. The Team uses a 3-pronged approach of mitigation, research and education to reduce wildlife mortality and establish innovative solutions to wildlife passage. Member contributions and outside grants have funded the Team's outreach program, permanent camera array, deer collaring project, and three wildlife underpasses with fencing. **[Poster P-54]**

Two New Instructional Videos: Innovative Approaches to Wildlife and Highway Interactions, and Avoiding Animal/Vehicle Collisions

Sandra Jacobson, US Forest Service, Davis, California, United States

Two new instructional videos are presented. Innovative Approaches to Wildlife and Highway Interactions is a 60-minute video of the wildlife crossings segment of the 3-day training course offered by the US Forest Service. The video was produced by US FWS at locations across North America. Avoiding Animal/Vehicle Collisions is a 20-minute safety video targeted towards people who work in areas of high animal / vehicle collisions. It uses research results on animal behavior to help drivers avoid collisions by reducing risk factors. Both videos are available for no cost at the poster session and after the conference. **[Poster P-55]**

Highways and Wildlife: An Infographic

Rachelle Haddock, Miistakis Institute, University of Calgary, Alberta, Canada

Highways & Wildlife is a communications tool to elevate the conversation on building or expanding highways with both wildlife and people in mind. The infographic was created to clearly convey why wildlife crossing structures are important, how they work, and their cost effectiveness. Its purpose is to debunk some of the myths surrounding wildlife crossing structures. The infographic features road ecology research and monitoring completed by Dr. Tony Clevenger, the Western Transportation Institute and the Miistakis Institute. It is freely available for non-commercial educational purposes. The infographic can be previewed at www.rockies.ca/files/HW_InfographicScreenVersion.pdf. **[Poster P-56]**

Beyond Westway and Post 9/11: The Route 9A Project – A Model in Multimodal Sustainability

Lisa Weiss and Debra Nelson, New York State DOT, New York, New York, United States

NYSDOT's Route 9A Project in NYC epitomizes how transportation supports a sustainable society. A crumbling 1930's elevated highway has been transformed into a first-class, tree-lined urban boulevard with one of the most heavily-used bikeways in the country. This presentation illustrates Route 9A's history from its beginning stages to today, showcasing the project's extensive public outreach and partnering philosophy and illustrating how a transportation project approached from an environmental stewardship perspective can be the catalyst for economic competitiveness, social equity and community vitality. **[Poster P-57]**

Defining Sustainability Through Accountability and Performance: One Transportation Agency's Experience

Leigh Lane and Ted Mansfield, Center for Transportation and the Environment at North Carolina State University, Raleigh, North Carolina, United States

The North Carolina DOT set out to develop a sustainability blueprint which culminated in a framing device to demonstrate performance-based accountability. NCDOT embarked upon a two year process to understand what sustainability means to the agency through establishing principles, objectives, performance metrics and strategies. This poster will outline the process used by NCDOT to develop its "Blueprint for Sustainability" accountability framework. Lesson learned will be presented to provide useful insights for how to integrate sustainability into a department's strategic direction and policy framework. **[Poster P-58]**

Using System Dynamics Analysis for Evaluating the Sustainability of "Complete Streets" Practices

Nicholas Flanders, US Environmental Protection Agency, Research Triangle Park, North Carolina, United States

System dynamics analysis seeks to trace the interrelated causes and effects of any given quantifiable measure, which are represented by causal-loop diagrams and mathematical formulas. This poster applies system dynamics to the question of whether and how a given human neighborhood can use "complete streets" design elements to enhance its environmental, social, and economic sustainability. Through several causal-loop "arrow" diagrams, the poster reveals unobvious impacts of street-design decisions and hints at preconditions that are necessary for some impacts to be manifested. It also highlights the limitations of system dynamics in assessing unique local or regional circumstances. **[Poster P-59]**

Regional Scale Planning: A Missing Link in Infrastructure-Related Programmes? Importance of the Framework Convention on the Protection and Sustainable Development of the Carpathians

Miklós Puky, Hungarian Academy of Sciences, Göd, Hungary

Large-scale infrastructure-related decisions are nearly exclusively made at the federal/European Union or national/state level. However, smaller geographical units may have similar environmental needs over several national/state borders in the planning, construction and operational phase of transport infrastructure. The Framework Convention on the Protection and Sustainable Development of the Carpathians was signed by the governments of four European Union and two neighbouring countries. From 2011 the Protocol on Sustainable Transport and Infrastructure has been on the agenda and Infra Eco Network Europe was invited as a consulting, advisory body to participate in the formation of the document. **[Poster P-60]**

Social Ecology (SE) of Adaptive Infrastructure: A Transportation Corridor Synthesis System Model Development Project

Charles Beck, Synthesis Three, Globe, Arizona, United States

This project's objective is the development of social ecological infrastructure models through the application of 10 guiding principles: 1) A Social-Ecology Stewardship; 2) The recognition of Matter Energy, Space, Time and Information (MESTI) as Global Resources; 3) Connectivity ;4) Interchangeability; 5) Multi-scale Transboundaries; 6) Open Access to Knowledge; 7) Reciprocity; 8) Global Asset Building; 9) Transparency; and 10) Synthesis. The project goals are to: a) Develop interchangeable models for SE infrastructure projects at any scale and any ecosystem; b) Incorporate open source collaboration; c) Contribute to the open access World Knowledge Center development; and d) Explore development of a Social-Ecological pattern language. **[Poster P-61]**

From Ecological Barrier to Green Route: An Adaptive Management Approach Toward Sustainable Highways in Taiwan

Yu-Ping Chen, Observer Ecological Consultant Co., Ltd., Taipei, Taiwan

We propose a strategic approach for highway management that drew ecologists and engineers together in planning and execution of ecological impact mitigation plans on a national scale. A spatial analysis on habitat sensitivity supplemented by flora and fauna survey facilitated decision making on priority sites for animal crossings and habitat conservation, whereas the ecological investigation on roadside plantation and the roadkill survey along the highway system enabled sound solutions to be developed and monitored. Overall we successfully raised stakeholder engagement and public awareness. **[Poster P-62]**

Applying Rapid Ecological Assessment to Road Engineering in Taiwan

Chia-Yu Tsai, Observer Ecological Consultant Co., Ltd., Taipei, Taiwan

We tried to apply REA for a roadway feasibility study project in South Taiwan. In this project, we practiced large scale REA and tried to find an eco-friendly corridor. We mapped ecological sensitive areas with Geographic information system (GIS), proceeded several topical surveys to confirm the indefinite problems further. In this REA procession, the workshop provides a communication platform for ecologists, engineers, scholars, and NGOs. The map of ecological sensitive areas also has great contribution for REA team to analyze the ecological problems and access impact treatments for roadway plans. **[Poster P-63]**

Identifying Sustainable Dust Control for Low-Volume Roads: Phase Three Field Tests of the USGS/USFWS Collaboration

Bethany Williams, *US Geological Survey, Columbia, Missouri, United States*

Although millions of gallons of dust suppressant products are applied to unpaved roads each year, the short- and long-term effects of these applications on roadside plant and animal communities are virtually unknown. We identified several non-toxic dust control products through laboratory toxicity tests and are now evaluating products under real-world conditions. Road sections treated with three low-toxicity products (cellulose-based, synthetic fluid, and enhanced magnesium chloride) at Hagerman National Wildlife Refuge in Texas are being monitored for product performance and environmental safety. This project will help Federal and other road managers select safe, effective road products while protecting natural resources. **[Poster P-64]**

South Africa: The Road Ahead

Wendy Collinson, *Endangered Wildlife Trust and Rhodes University, Johannesburg, South Africa*

South Africa is the third most biologically diverse country on Earth comprising eight World Heritage Sites and 19 national parks, with 6.9% of the country under formal protection. The extensive road network is linked to economic development and growth, with mining and tourism being the two main revenue earners. The country's transport network is under increasing pressure to meet these expansions, with little consideration of the costs to biodiversity. Research on the impacts of roads on wildlife has been slower in South Africa than elsewhere in the world, and mitigation of such impacts is yet to be fully considered during road construction. **[Poster P-65]**

Factors Affecting Animal Non-Identification Rates in Aviation Strike Reporting

Tara Conkling, *Mississippi State University, Mississippi State, Mississippi, United States*

A primary concern for human-wildlife interactions is the potential impacts resulting from wildlife strikes (primarily birds) with aircraft. Identification of avian species responsible for collisions, along with regional, seasonal, or temporal patterns in strikes, is necessary for airport management to develop effective strategies to reduce bird strikes. We analyzed U.S. civil aviation strike records from 1990–2010 in the Federal Aviation Administration's (FAA) National Wildlife Strike Database to examine patterns of collisions involving unidentified birds. By identifying areas and time periods with the greatest amount of unidentified strikes, we will help foster sound management and personnel training. **[Poster P-66]**

Effects of Transportation Project Pile Driving on Fish, Birds and Marine Mammals in Washington State

Mark Bakeman, *Washington State DOT, Olympia, Washington, United States*

Pile driving is a common feature of transportation projects in freshwater and marine environments. In Washington State, piles are used for bridge piers, ferry terminals, and temporary over-water structures. Underwater sound waves produced by pile driving affect fish, marine mammals, and diving sea birds. A complex set of underwater noise thresholds for these taxa have been established by federal regulatory agencies, and consultation and permitting may be needed under the Endangered Species Act and the Marine Mammal Protection Act. We review the various monitoring zones that might be needed for different taxa on a pile driving project. **[Poster P-67]**

Streamlining Endangered Species Act Consultations for Transportation Projects in Washington State

Marion Carey and Mark Bakeman, *Washington State DOT, Olympia, Washington, United States*

The numbers of species listed under the Endangered Species Act (ESA) has dramatically increased within Washington State. These listing have had a significant impact on the ability of transportation projects to complete their ESA Section 7 consultations. In response, the Federal Highways Administration, Washington State Department of Transportation, U.S. Fish and Wildlife Service, and NOAA Fisheries, developed a team approach to facilitating consultations which involved upper level managers. The team developed and implemented both short term solutions focused on meeting ad dates and long term solutions focused on developing appropriate analytical methods for complicated effects analysis. **[Poster P-68]**

Technological Achievements of Changbai Mountain Area Highway Landscape Construction

Jian Zhou, *China Academy of Transportation Sciences, Beijing, China*

Great emphasis was placed on the introduction of advanced design concepts and technologies during the construction of the Changbai Mountain area highway. We have gained valuable experience in ecological protection, resource uses, vegetation restoration and landscape design through demonstration and practices. The Changbai Mountain area highway landscape design reflects the concepts of flexibility, tolerance and humanization in both ideas and details. It also achieves the overall goal of longer life, better environment, more comfortable driving and more investment savings. These practices are worthy of further exchanges and spreads. **[Poster P-69]**

Tusayan Enhancement Project

Stephen Monroe and Chuck Howe, *Arizona DOT, Flagstaff, Arizona, United States*

Located a few minutes south of the South entrance to Grand Canyon National Park, this small community receives in excess of 3 million visitors annually. The project, which was recently completed, addressed multiple issues from pedestrian safety, traffic calming, and transit shelters. The context sensitivity of this community, in addition to the need for safety improvements provided a unique project. **[Poster P-70]**

Three concurrent field trips will be conducted Wednesday to visit various transportation project sites that demonstrate successful ecological and environmental solutions. Our field trips are hosted by the Arizona Department of Transportation, Arizona Game and Fish Department, and their regional partner organizations. Lunch and snacks will be provided. Please note the specific Boarding, Departure, and estimated Return Times for each trip. **Check-in and board buses at the Culturekeepers Hall South Terrace.**



Photo courtesy Jeff Gagnon | AZGFD

Field Trip 1: State Route 260 – Safety and Connectivity

Boarding 6:30am | Departure 7:00am | Return 6:00pm

This tour examines the corridor upgrade of 17 miles of Arizona's State Route 260 highway, located northeast of the city of Phoenix, which began in 2000 and is scheduled for completion in 2013. The tour will explore how wildlife-vehicle collisions and habitat connectivity are an integral part of improving public safety and wildlife permeability of the highway. Tour stops will include visiting wildlife crossing structures as well as an animal-activated detection system to learn about the adaptive management and challenges involved. Partnerships, research results and lessons learned are the primary focus of this field trip.

Field Trip 2: Sedona – Outstanding Waters and Context Sensitivity

Boarding 7:00am | Departure 7:30am | Return 6:00pm

This tour highlights the operational challenges associated with a highway traversing a National Forest and adjacent to an exceptionally scenic yet impaired waterway (Oak Creek). As the tour progresses out of the conifers and into the red rock country of the city of Sedona, stops will address considerations in design and construction of the highway through this destination community. The final leg of the tour will discuss the considerations and adaptive changes made to accommodate a tremendous diversity of wildlife species in this urban/arid ecosystem interface.



Photo courtesy Eugene Murray | CTE



Photo courtesy Grand Canyon National Park

Field Trip 3: Grand Canyon – Sustainability and Preservation

Boarding 6:00am | Departure 6:30am | Dinner stop | Return 9:00pm

This extended-day tour journeys through Arizona's tremendous ecological diversity from the lower Sonoran desert, up the Mogollan rim, into the Ponderosa pine stands around the city of Flagstaff, and through the Pinyon/Juniper woodlands on the edges of the Colorado Plateau. In route to the Grand Canyon, tour stops will describe proven and experimental practices being implemented to increase permeability of high-volume highways while improving motorist safety. Presentations at Grand Canyon National Park will emphasize efficient, sustainable transportation solutions being implemented to preserve one of the world's most famous landmarks. The return trip will travel through the western edge of the Navajo Indian Reservation along the Little Colorado River with spectacular views of the San Francisco Peaks. Includes a stop for dinner (*own your own*) in historic Flagstaff, Arizona.

PANEL SESSION 300 | 7:30pm–9:00pm | Trailblazer AB

Film Screening and Panel Discussion

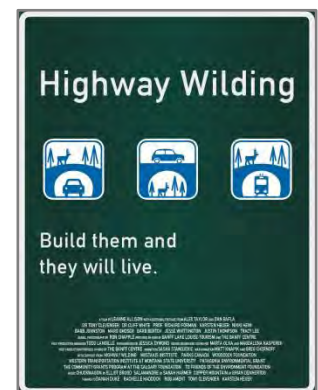
Highway Wilding: A Documentary Film

Organizer: **Rachelle Haddock**, *Miistakis Institute, Calgary, Alberta, Canada*

Panelists: **Leanne Allison**, *Filmmaker, Necessary Journeys, Alberta, Canada;*

Rob Ament and **Tony Clevenger**, *Western Transportation Institute – Montana State University, Bozeman, Montana, United States;* and **Tracy Lee**, *Miistakis Institute, Calgary, Alberta, Canada*

Build them and they will live. That is the simple message in this 22-minute documentary that looks at the issue of highways, and some of the pioneering solutions that exist to prevent road kill and reconnect landscapes across highways. In the Rocky Mountains we have one of the last best chances in the world to maintain a fully functioning ecosystem with all the native large carnivores, but roads are a major problem. Everything from grizzly bears to wolverines and ducks to salamanders need to get across roads safely for breeding, to find food, adapt to climate change, or to migrate. The Highway Wilding film screening will be followed by a panel discussion on the film including the filmmaker (via Skype) and road ecology researchers featured in, or involved with, the creation of the film.



SESSION 401 | Wildlife Connections: Big or Small, It All Matters

8:30am–10:00am | Trailblazer AB

Moderator: Thor Anderson, Arizona Department of Transportation

Mitigation of Impact of National Highway-58 on Indian Primate, Hanuman Langur (*Presbytis Entellus*) in Uttarakhand Himalayas**Ramesh C. Sharma**, HNB Garhwal University, Srinagar-Garhwal, Uttarakhand, India

National Highway-58, a strategically important highway passing through Uttarakhand connects Delhi with Tibet and China. It caters the need of high volume of pilgrims to the world famous Indian shrines – Badrinath, Kedarnath and Hemkund Saheb. An Indian primate, Hanuman Langur (*Presbytis entellus*), a sacred animal treated as Hanuman God has significant population near NH-58. Vehicle-collisions with Hanuman langur is a serious problem due to high volume of traffic flow on NH-58. Viable appropriate mitigation measures including the use of innovative vegetative overpasses, speed reduction and adequate sign boards on sharp turns have been suggested for minimising vehicle – animal collisions.

Ecological Infrastructure: How to Plan for Low Profile Animals and Minimize High Profile Problems**Priya Nanjappa**, AFWA/PARC, Washington, DC; and **Kimberly M. Andrews**, University of Georgia and Jekyll Island Authority, Aiken, South Carolina, United States


Small animals are low profile because they are literally small and less visually obvious to drivers, thus presenting reduced human safety or economic damage risk. Therefore, these taxa receive little attention in transportation planning, even where mortality rates exceed those of other vertebrates. By considering ecological infrastructure, the connections among habitat components (nesting, foraging, overwintering) that are necessary for life history processes (breeding, dispersal), we can reduce conflicts between human infrastructure and ecological infrastructure. We present information from our upcoming book on how proactive and collaborative solutions to address low profile animals can minimize high profile problems.

Effect of Cover on Small Mammal Movement Through Wildlife Underpasses on U.S. Highway 93 North**Hayley Connolly-Newman and Marcel Huijser**, University of Montana, Missoula, Montana, United States


Previous research has focused on cover at or near the entrance of underpasses and culverts for small mammals, but not completely through large US wildlife underpasses. The study measured the effect of cover on small mammal presence and movement in 10 wildlife underpasses on US Highway 93 North, between Evaro and St Ignatius, Montana. Course woody debris was added to 5 randomly selected treatment structures in January of 2012. Sherman live traps then recorded presence and movement in the 10 structures in fall 2012.

Maine Audubon Wildlife Road Watch: Not Just Chickens Cross the Road**Barbara Charry**, Maine Audubon, Falmouth, Maine, United States


Collecting large amounts of data would not be possible without volunteers. Using a statewide online reporting system, citizen scientist volunteers contribute observations of either dead or live animals observed along roads. The data collected by volunteers is being used to identify animal movement 'hotspots', and assess habitat and roads for common characteristics associated with wildlife crossings. In addition to providing information to most effectively guide implementation of solutions to animal-vehicle collisions and habitat fragmentation, volunteer involvement creates a constituency of knowledgeable and supportive citizens for the implementation of solutions. We will share data analysis results to date and lessons learned.




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SESSION 402 | Designing Crossings for Wildlife and Automobiles

8:30am–10:00am | Trailblazer C

Moderator: Jeff Gagnon, Arizona Game and Fish Department

Design Recommendations from Five Years of Wildlife Crossing Research Across Utah**Patricia Cramer**, *Utah State University, Logan, Utah, United States*

How do you get an elk to move through any type of crossing structure? Can you move moose through culverts? What are the best designs for wildlife crossings that pass mule deer? Results are presented from a five year study across Utah on the wildlife crossings that were most successful in passing mule deer, elk, moose, and other wildlife. Recommendations for optimal structural lengths, heights, and widths for passing mule deer, elk, and moose will be given. The presentation will also show really cool pictures and videos of wildlife.

A Better Solution for Photo-Classification, Automatic Storage and Data Input of Camera Data From Wildlife Crossing Structures**Mirjam Barrueto**, *Miistakis Institute, University of Calgary, Banff, Alberta, Canada*

Camera use in ecological field studies is rapidly increasing worldwide. However, digital cameras can record large numbers of photographs, which have to be downloaded and interpreted before analysis. There have been few attempts to develop photo-classification database programs to aid in the process of interpretation and storage of photographs from digital cameras. Our application allows for a quick and efficient classification of photographs, automatically inputs the classified data into a master database, and stores the photographs in an archived photograph folder. The system is user-friendly and citizen scientists can be trained to use it in a few hours.

Multiple-Use Crossing Structures for Providing Wildlife Habitat Connectivity**William Ruediger**, *Wildlife Consulting Resources, Missoula, Montana, United States*

Despite increasingly constrained funding for wildlife crossings, there are still numerous opportunities to provide wildlife connectivity across highways. These opportunities are available in every state for existing highways as well as those undergoing reconstruction. The authors will explore options for utilizing structures whose primary purpose is for other purposes. For example, there is an on-going requirement to rebuild aging highway bridges. The current inventory for bridge replacements is 30,000 to 40,000 structures. The cost of providing habitat connectivity for structures designed for other purposes is usually a fraction of single-purpose wildlife crossings.

Sustainable Bridge Solutions: Environmental Context, Design, Connection**Linda Figg**, *FIGG, Tallahassee, Florida, United States*

Designing and building sustainable bridge solutions is paramount to the environmental and economic success of communities. One in four U.S. bridges is rated as deficient. As our aging infrastructure is replaced, a dynamic of environmental awareness and new materials provides opportunity to transform the future of the way we connect. Through environmental context, design, and connection, bridges can truly be a celebration of our natural landscape. New environment friendly technologies, such as solar energy, pollution reducing nano-technologies, and recycled materials, can be incorporated in bridges. Technologies and specialized materials provide sustainable benefits for the environment today and in the future. A series of bridge case studies will be presented.

SESSION 403 | Integrating Ecology in Planning and Design

8:30am–10:00am | Kierland 4

Moderator: Paul Langdale, Arizona Department of Transportation

Best Practices for the Shennongjia-Yichang Ecological Highway Upgrading Project**Xueping Chen and Jiding Chen**, *China Academy of Transportation Sciences, Beijing, China*

The Shennongjia-Yichang Highway is a demonstration eco-highway project in China. It runs along the Fragrant Creek in a narrow canyon, and its terminal point is close to the Shennongjia National Nature Reserve, a member of MAB. This paper reviews the best practices taken to mitigate the environmental impact during the highway upgrading, contributing to an understanding the on-going efforts of natural conservation in China. The practices involves the measures adopted to optimize the route design, landscape evaluation and improvement, the innovative and integrated re-vegetation technologies for the slopes.

Freeways as Corridors for Plant Dispersal: A Case Study from Central Arizona**Kris Gade**, *Arizona DOT, Phoenix, Arizona, United States*

This study focuses on the functional traits that allow plants to disperse along highways in arid regions. Field methods included soil nitrogen sampling, seed bank sample collection and germination, vegetation surveys, and seed trapping. Seed trapping showed that wind and air currents related to traffic play a major role in seed dispersal. Ongoing maintenance regimes and dry nitrogen deposition influence species composition and distribution along highways over the long term. Using a functional trait approach to studying roadside plants will allow us to better understand the ecological effects of design and maintenance practices on roadside plant communities.

Roadsides as Habitat for Pollinators: Management to Support Bees and Butterflies

Jennifer Hopwood, *Xerces Society for Invertebrate Conservation, Hickory Corners, Michigan, United States*

Pollinators contribute an essential ecosystem service, providing pollination for 85% of flowering plants worldwide and 35% of global crop production. Recent declines of pollinators may impact the stability of natural ecosystems and agricultural productivity. Roadsides managed with pollinators in mind could have a significant impact on pollinator conservation. Best management practices include consideration of timing and frequency of mowing, spot spraying rather than broadcast use of herbicides, and surveys to identify existing roadside habitat that provides native plant resources for wildlife. Roadside managers can develop a management strategy that addresses safety concerns while also benefiting wildlife such as pollinators.

Incorporating Ecosystem Services into Roadway Planning and Mitigation

Laura Jackson, *US Environmental Protection Agency, Research Triangle Park, North Carolina, United States*

The web-based EnviroAtlas is an easy-to-use mapping and analysis tool built by the U.S. Environmental Protection Agency and its partners to provide information, data, and research on the relationships between ecosystems, built infrastructure, and societal well-being. EnviroAtlas is designed to inform decision alternatives in management sectors including transportation, public health, water supply, recreation, and environmental conservation. With this tool, the locations of continuous wildlife habitat, natural riparian buffers, and other valuable “green infrastructure” can be considered early in the transportation planning process to avoid important large- and fine-scale environmental assets and identify where mitigation can elicit maximum societal benefits.

PANEL SESSION 404 | 10:30am–12:00pm | Trailblazer AB

Panel Presentation and Discussion

Lanes, Landscape and Life: Integrated Transportation Planning for Eco-Conscious Highways

Organizers: **Carlee Brown**, *Western Governors' Association, Denver, Colorado*; **Julianne Schwarzer**, *US DOT Volpe Center, Cambridge, Massachusetts*; **Marlys Osterhues** (Moderator), *US DOT Federal Highway Administration, Washington DC*; and **Gregg Servheen**, *Idaho Department of Fish and Game, Boise, Idaho, United States*

Panelists: *Julianne Schwarzer*; *Gregg Servheen*; **Fraser Schilling**, *University of California, Davis, California*; **Deb Wambach**, *Montana Department of Transportation, Helena, Montana*; and **Laura Canaca**, *Arizona Game and Fish Department, Phoenix, Arizona, United States*

This session will examine the ways that the large-scale approaches offered through the U.S. Federal Highway Administration's (FHWA) Eco-Logical approach and the Western Governors' Association's Crucial Habitat Assessment Tool (CHAT) can inform transportation decision-making and conserve critical environmental resources and will draw connections between the related efforts. The session will feature a panel of experts and will inform attendees of the ways in which they can become involved in Eco-Logical and CHAT, as well as the resources and technical support available. Discussion with panelists will address the potential for both initiatives to work collaboratively and efficiently.



Photo courtesy George Andrejko | AICFD

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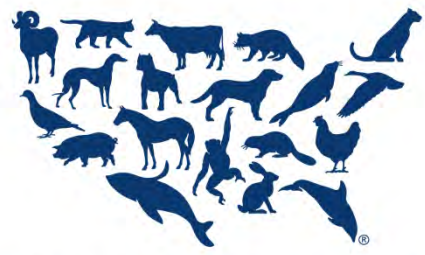
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AICP Certification Maintenance (CM) credits have been requested from the American Planning Association for several ICOET 2013 sessions – a listing of the sessions that are eligible for CM credits is available at the conference Registration Desk and on the ICOET website www.icoet.net under the tab ‘Professional Development.’ Participants will be notified following conference when CM credits have been awarded. More information about the AICP CM program can be found on the APA website at www.planning.org/cm.



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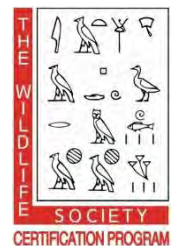
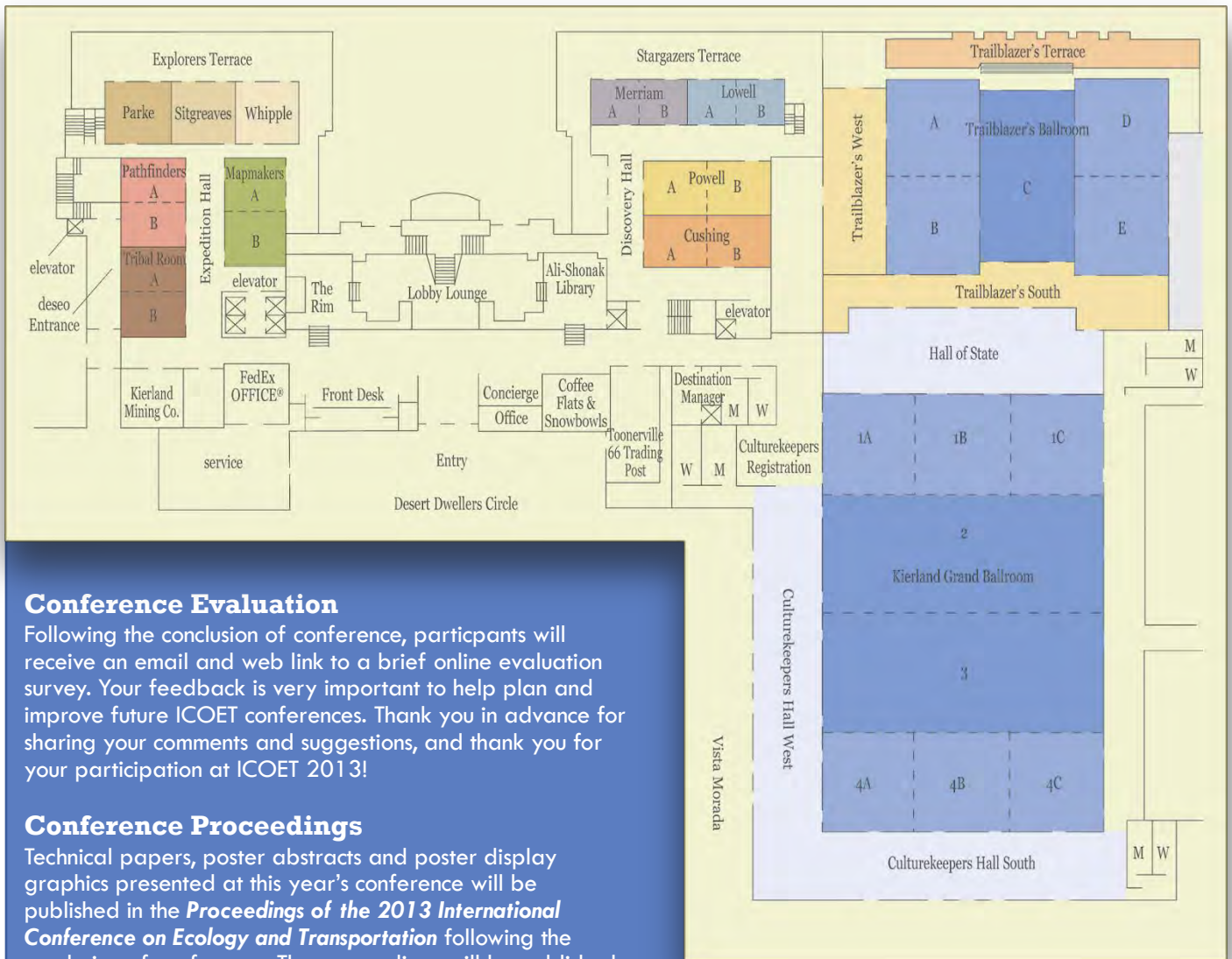


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