



ICOET 2017 PROGRAM AGENDA

Salt Lake City, Utah
May 14-18, 2017

Update 04202017

SUNDAY May 14	
1:00pm – 6:00pm	Registration Open Posters Set-up Exhibitors Set-up (Upper Mezzanine and Room 255AD)
1:00pm – 5:00pm	Workshop: Basic Ecology for ICOET Participants (Room 254B. Pre-registration required.)
3:00pm – 4:30pm	ICOET Steering Committee Meeting (Room 259. By invitation.)
5:00pm – 7:00pm	Transportation Research Board ADC10 and ADC30 Committee Meetings (Rooms 258 and 259. Open to all participants. Seating is limited.)
	Dinner on your own
8:00pm – 9:30pm	“WILD WAYS” FILM SCREENING sponsored by YELLOWSTONE TO YUKON CONSERVATION INITIATIVE (Room 255B)

MONDAY May 15					
7:00am – 8:30am	Continental Breakfast (Room 255AD)				
7:00am – 3:00pm	Posters Set-up and Viewing (Upper Mezzanine)				
PLENARY 8:00am – 9:30am	OPENING SESSION (Room 355) Welcome Remarks, Invited Speakers, Special Presentations				
9:30am – 10:00am	Refreshment Break Visit Sponsor Exhibits View Posters				
PARALLEL SESSIONS 10:00am – 11:30am	Registration and Sponsor Exhibits Open	CROSSINGS AND CONNECTIVITY 1 Winning Support and Finding Solutions in Utah and Wyoming (Room 255B)	MITIGATION 1 If You Build It, Will They Come? (Room 255C)	PARTNERSHIP AND COLLABORATION 1 Solution Evolution (Room 255E)	TERRESTRIAL SPECIES 1 What Goes 40 kHz in the Night – Detecting and Protecting Bats (Room 255F)
11:30am – 1:00pm		KEYNOTE LUNCHEON (Room 355) Speaker: Utah Lieutenant Governor Spencer J. Cox			
PARALLEL SESSIONS 1:30pm – 3:00pm		NEW DIRECTIONS 1 GIS Applications in Action (Room 255B)	NEW DIRECTIONS 2 Roads and Wildlife – A Balancing Act (Room 255C)	SUSTAINABILITY AND RESILIENCE 1 The Changing Climate of Planning and Risk Assessment (Room 255E)	TERRESTRIAL SPECIES 2 Understanding Infrastructure Effects on Species Movement (Room 255F)
3:00pm – 3:30pm		Refreshment Break Visit Sponsor Exhibits View Posters			
PLENARY 3:30pm – 5:30pm	POSTER PRESENTATIONS (Upper Mezzanine)				
4:30pm – 5:45pm	US FWS Meeting (Room 258. By invitation.)				
6:00pm – 8:00pm	WELCOME RECEPTION (Upper Mezzanine)				



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TUESDAY May 16					
7:30am – 9:00am	Registration and Sponsor Exhibits Open	Continental Breakfast (Room 255AD)			
7:30am – 5:30pm		Posters Open for Viewing (Upper Mezzanine)			
PARALLEL SESSIONS 8:30am – 10:00am		CROSSINGS AND CONNECTIVITY 2 Sustainable Funding for Wildlife Crossings (Room 255B)	CROSSINGS AND CONNECTIVITY 3 Effectiveness of Detection and Mitigation Measures (Room 255C)	NEW DIRECTIONS 3 Large-Scale Thinking (Room 255E)	TERRESTRIAL SPECIES 3 Strategies for Permeability (Room 255F)
10:00am – 10:30am		Refreshment Break Visit Sponsor Exhibits View Posters			
PARALLEL SESSIONS 10:30am – 12:00pm		POLICY AND REGULATION 1 Defining Best-Practice Guidelines for Infrastructure in Developing Countries (Room 255B)	AQUATIC SPECIES 1 Amphibians, Reptiles, and Mussels – Oh My! (Room 255C)	PARTNERSHIP AND COLLABORATION 2 Achieving Conservation-Minded Infrastructure (Room 255E)	CROSSINGS AND CONNECTIVITY 4 Monitoring Use and Effectiveness of Crossing Structures (Room 255F)
12:00pm – 1:15pm		KEYNOTE LUNCHEON (Room 355) Speaker: Joe Riis, National Geographic Photojournalist			
PARALLEL SESSIONS 1:30pm – 3:00pm		PARTNERSHIP AND COLLABORATION 3 Programmatic for the Indiana Bat and Northern Long-Eared Bat (Room 255B)	STORMWATER AND WATER QUALITY MANAGEMENT Go With the Flow (Room 255C)	MITIGATION 2 Strategic Regional and National Approaches (Room 255E)	CROSSINGS AND CONNECTIVITY 5 Adding or Removing Barriers for Wildlife (Room 255F)
3:00pm – 3:30pm		Refreshment Break Visit Sponsor Exhibits View Posters			
PARALLEL SESSIONS 3:30pm – 5:30pm		VEGETATION MANAGEMENT 1 The Role of Roadsides in Promoting Pollinator Health (Room 255B)	NEW DIRECTIONS 4 Innovative Approaches for Transport Projects with Ecological Benefits (Room 255C)	PARTNERSHIP AND COLLABORATION 4 Aligning Transport Planning and Conservation Priorities (Room 255E)	LIGHTNING TALKS A Brainstorm on Ecology and Transportation (Room 255F)
		Dinner on your own			
5:30pm – 7:30pm	Group Meetings (by invitation of meeting organizers)				
PLENARY 7:30pm – 9:00pm	COLLABORATION AND INNOVATION IN UTAH Lightning Talks and Discussion (Room 255BC)				



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WEDNESDAY May 17				
6:00am – 9:00am	Continental Breakfast (<i>Upper Mezzanine</i>)			
6:00am – 7:30pm	FIELD TRIPS Lunch, snacks and refreshments provided for all trips. Check-in at Upper Mezzanine prior to boarding buses.			
	FIELD TRIP 1 <i>Boarding 7:30am</i> Departure 8:00am <i>Return 12:30pm</i> <i>Lunch provided on return to Convention Center.</i>	FIELD TRIP 2 <i>Boarding 8:15am</i> Departure 8:45am <i>Return 3:00pm</i>	FIELD TRIP 3 <i>Boarding 6:45am</i> Departure 7:15am <i>Return 5:30pm</i>	FIELD TRIP 4 <i>Boarding 6:00am</i> Departure 6:30am <i>Return 7:30pm</i>
	Dinner on your own			
6:45pm – 9:00pm	“BORN TO REWILD” FILM SCREENING sponsored by WILDLANDS NETWORK At Salt Lake City Library			

THURSDAY May 18					
7:00am – 8:30am	Continental Breakfast (<i>Room 255AD</i>)				
7:00am – 11:30am	Posters Open for Viewing (<i>Upper Mezzanine</i>)				
PARALLEL SESSIONS 8:00am – 9:30am	Registration and Sponsor Exhibits Open	PARTNERSHIP AND COLLABORATION 5 Eco-Logical at Ten Years – Looking Back to Move Forward <i>(Room 255B)</i>	PARTNERSHIP AND COLLABORATION 6 Public Engagement for Success <i>(Room 255C)</i>	AQUATIC SPECIES 2 Mitigating Impacts to Fish and Their Habitat <i>(Room 255E)</i>	CROSSINGS AND CONNECTIVITY 6 Over, Under, or Through – Finding the Best Fit for Wildlife <i>(Room 255F)</i>
9:30am – 10:00am		Refreshment Break Visit Sponsor Exhibits View Posters			
PARALLEL SESSIONS 10:00am – 11:30am	SUSTAINABILITY AND RESILIENCE 2 Increasing Resilience in the Transportation System <i>(Room 255B)</i>	POLICY AND REGULATION 2 Planning and Policy – Vantage Points for Conservation and Connectivity <i>(Room 255C)</i>	VEGETATION MANAGEMENT 2 Growing Concerns and Cultivating Solutions <i>(Room 255E)</i>	CROSSINGS AND CONNECTIVITY 7 Carcass Data Collection and Application <i>(Room 255F)</i>	
PLENARY 11:45am – 1:00pm	CLOSING SESSION Conference Wrap-Up <i>(Room 255B)</i>				
	End of Conference – Lunch on your own				
1:00pm – 4:00pm	Group Meetings (by invitation of meeting organizers)				

ICOET 2017 SESSIONS AND PRESENTATIONS

Updated 04/20/2017. This **preliminary** program agenda will be further updated as all presentations and authors are confirmed. Presentation summaries will be added when provided by the authors. Links to final abstracts, technical papers, and poster images will be posted on the conference website www.icoet.net when available.

Monday 8:00 AM Plenary Session

Welcome and Opening Remarks

Carlos Braceras, P.E., Executive Director, Utah Department of Transportation
Gregg Fredrick, P.E., Chief Engineer, Wyoming Department of Transportation
Ivan Marrero, P.E., Division Administrator, U.S. DOT Federal Highway Administration-Utah Division
Additional speakers to be announced.

Monday 10:30 AM Parallel Sessions

Crossings and Connectivity 1: Winning Support and Finding Solutions in Utah and Wyoming

Making Wildlife-Vehicle Collision Reduction Projects Happen in Utah/Wyoming and Key Design Considerations

Panel Session Organizers: Monte Aldridge and Randall Taylor (Utah Department of Transportation, United States); Tom Hart (Wyoming Department of Transportation, United States)

This session will include presentations that will focus on methodologies that have proven successful in winning support for constructing wildlife crossing systems in both Utah and Wyoming. In addition, results of observations from 6 underpasses and 2 overpasses recently installed by Wyoming Department of Transportation on U.S. Highway 191 in western Wyoming will be provided. These observations revealed species-specific preferences are an important consideration when mitigating roadway impacts with wildlife crossing structures.

Pronghorn and Mule Deer Use of Underpasses and Overpasses Along U.S. Highway 191

Authors: Hall Sawyer and Patrick Rodgers (Western Ecosystems Technology, Inc., Wyoming, United States); Tom Hart (Wyoming Department of Transportation, United States)

We evaluate migratory mule deer and pronghorn preferences to underpasses and overpass along US Highway 191 in Wyoming. Over the course of three

years we documented approximately 60,000 crossings, including 40,000 from mule deer and 20,000 from pronghorn. Most (~80%) mule deer chose to move underneath the highway, whereas most (~90%) of pronghorn used the overpasses. Our results highlight that species-specific preferences are an important consideration when mitigating roadway impacts with wildlife crossing structures.

Mitigation 1: If You Build It, Will They Come?

Effectiveness of Road Mitigation for Common Toads (*Bufo bufo*) in the Netherlands

Authors: Fabrice Ottburg and Edgar A. van der Grift (Wageningen Environmental Research, Netherlands)

The impacts of roads and traffic on amphibian populations is the result of amphibian road mortality. Measures have been developed to prevent road mortality. Although such measures are frequently applied across the world, only a few studies evaluated their effectiveness in reducing road-kill and facilitate safe movements across roads. This study focus on the effectiveness of mitigation measures taken for common toad population on a local road in the central parts of the Netherlands.

Evaluation of a Reptile Exclusion Fencing: Three Case Studies in Ontario, Canada

Author: Kari Elizabeth Gunson (Eco-Kare International, Ontario, Canada)

This talk summarizes results and lessons learned from designing, installing and monitoring reptile exclusion fencing for two Threatened species: Blanding's Turtle (*Emydoidea blandingii*) and Massasauga Rattlesnake (*Sistrurus catenatus*) in Ontario, Canada. Long-lasting fencing requires design and installation that considers environmental variations such as hydrology, and extreme hot and cold temperatures. Functional fencing needs to span the entire length of the habitat used by the target species to avoid a fence-end effect.

A Comprehensive Mitigation Plan for a Large Highway Project Developed Using an Interagency Approach

Authors: Alice Allen-Grimes (U.S. Army Corps of Engineers, Virginia, United States); Caleb Parks (Virginia Department of Transportation, United States); Nina O'Malley (Virginia Department of Environmental Quality, United States)

An interagency team composed of USACE, EPA, DEQ and VDOT worked collaboratively to identify an acceptable compensation plan for a proposed roadway

project with extensive impacts to streams and wetlands. The team conducted a functional assessment using modified Hydrogeomorphological Models to calculate performance of impacted wetlands, determine appropriate compensation for each wetland, and determine functional “lift” of proposed restoration sites. This innovative approach resulted in several positive outcomes for the agencies and VDOT.

New Mexico Meadow Jumping Mouse Habitat and Wetland Mitigation for the NM-434 Roadway Improvement Project

Authors: Maria Hirsch and Trent Botkin (New Mexico Department of Transportation, United States)

The NM 434 Roadway Improvement Project impacted wetlands and critical habitat for the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*). Impacts were minimized by coordinating with transportation engineers during project design. Private property adjacent to the project was acquired as mitigation for both wetlands and jumping mouse habitat. The NMDOT was able to acquire surplus mitigation, a first for the Department, and reserve it as Advanced Permittee-Responsible Mitigation to mitigate for future project phases.

Partnership and Collaboration 1: Solution Evolution

Dedication to Public Transportation and the Environment

Authors: Minmin Shu, Jim Watling, and Holly Vickers (Michigan Department of Environmental Quality, United States)

The presentation introduces our transportation resources permitting program – the effectiveness, cooperation and partnerships. The case studies demonstrate the team efforts on guarding the laws, supporting the refined project design, and achieving the practical solutions on the diverse issues for permitting the projects that meet the human needs also are ecologically sound.

Topanga, California: A Case Study in Dispute Resolution, Adaptive Environmental Management, and Agency/Community Partnerships

Authors: Fiona Nagle (Office of Los Angeles County Supervisor Sheila Kuehl, 3rd District, California, United States); Timothy Pershing (Office of State Assemblymember Richard Bloom, District 50, California, United States)

This presentation addresses two issues regarding a conflict over weed control among a state transportation agency, community groups, and government entities. First, it showcases the use of a roundtable forum that transformed long-term

disagreements and distrust into working relationships that benefit all parties. Second, it highlights key points in the development and subsequent evaluation of a consensus-based plan for vegetation management without herbicides, a plan supporting public safety, the local community, and the surrounding ecosystem.

The Use of Collaboration, Monitoring, Adaptive Management, and Phased Construction on State Highway 9, Colorado

Authors: Julia Kintsch (ECO-resolutions, Colorado, United States); Patricia Cramer (Consultant, Utah, United States); Michelle Cowardin (Colorado Parks and Wildlife, United States); Bryan Roeder (Colorado Department of Transportation, United States); Paige Singer (Rocky Mountain Wild, Colorado, United States)

This presentation will discuss the lessons learned from the first phase of wildlife/highway mitigation construction on State Highway 9 and how these lessons were applied to improve the design of mitigation features in the second phase of construction. Design alterations were developed for deer guards, escape ramps, and wildlife fencing. The concurrence in this project of phased construction, cross-disciplinary collaboration, and pre-completion monitoring proved fruitful for an adaptive management approach.

ITTECOP: A Framework for Research on Infrastructure, Biodiversity and Landscape

Author: Yannick Autret (Ministry of Environment, Energy and Sea, France)

Since 2008 ITTECOP, an integrated research program dedicated to infrastructure effects on landscapes and biodiversity, seeks to produce scientific responses and methods directly from lab to land.

Terrestrial Species 1: What Goes 40 kHz in the Night – Detecting and Protecting Bats

Where to Find Them and How to Look: Understanding the Factors that Contribute to Detection Probability and Occupancy of a Threatened Bat Species

Authors: Zac Warren, Michael Whitby, Baxter Seguin, and Allen, Craig (Nebraska Cooperative Fish and Wildlife Research Unit, United States)

Artificial Nighttime Lighting Reduces the Use of Wildlife Crossing Structures by Insectivorous Bats in Southeast Australia

Authors: Manisha Bhardwaj and Jose Lahoz-Monfort (University of Melbourne, Australia); Kylie Soanes (Australian Research Centre for Urban Ecology, Australia); Lindy Lumsden (Arthur Rylah Institute, Department of Environment, Land, Water and

Planning, Australia); Rodney van der Re (*Ecology and Infrastructure International, Australia*)
 Artificial night-time lighting may amplify the barrier effect of roads in nocturnal species such as insectivorous bats. In this study, we introduced light to underpass crossing structures to evaluate if the presence of light alters the activity of bats within and above the structures. Preliminary results suggest bat activity is lower when lights were introduced in crossing structures and that when structures were lit, there was higher than usual activity above the structure at the road.

Assessing Methods to Evaluate Bat Roosting in New England Bridges

Author: Scott Civjan (University of Massachusetts, United States)

A recent project evaluated the potential for bat roosting in New England bridges. Methods included visual inspection, acoustic monitoring, thermal imaging and guano testing. A project overview will be presented, highlighting observations on staining characteristics, useful evaluation and inspection tools, guano identification and acoustic data results. Existing assessment forms and a proposed supplemental form will be discussed. Thirteen known bridge roosts and two suspected have been documented by regional DOT's or the project team.

Recent Innovations in Threatened Microbat Mitigation on Road Projects in New South Wales, Australia

Author: Josie Stokes (New South Wales Roads and Maritime Services, Australia)

Bridge and culvert replacement projects can result in local extinctions of threatened microbats through habitat loss. To mitigate this, we have conducted studies on roosting and breeding habitat in an effort to incorporate habitat features into new and existing structures. This presentation details the evolution of microbat mitigation in NSW, and highlights recent innovations on road projects. We report on ecological monitoring that demonstrates successful uptake and breeding events in purpose-built permanent microbat habitat.

Washington State Department of Transportation developed three GIS based models that rank, by half-mile segment, the 7,000 mile state highway system in Washington. Each one-half mile segment is ranked for its potential value as Monarch habitat, pollinator habitat, and urban gateway pollinator habitat. The presentation will discuss the source data, model development, and the results of the prioritization.

Using Web-Based GIS Interactive Maps to Engage Citizens to Improve Planning in Transportation, Local Development, and Resource Protection

Author: David Rutter (Ohio-Kentucky-Indiana Regional Council of Governments, Ohio, United States)

The Federal Highway Administration requires metropolitan planning organizations to incorporate a review of environmental considerations into their transportation planning. The OKI Regional Council of Governments, utilizing their extensive GIS capabilities, created an online, web based mapping tool to aid in this requirement. However, the tool is finding additional powerful applications by local officials, planners, and citizens beyond transportation projects.

Developing GIS Tools to Facilitate Complex ESA Consultations

Author: Jeff Dreier (Washington State Department of Transportation, United States)

Transportation projects often require activities to occur over long distances through areas that support listed species. Biologists conducting environmental review for these projects face challenges identifying suitable habitat due to the large areas to be evaluated. A GIS tool was developed based on existing habitat models, experienced biologists, and federal agency input. The tool was applied to meet the challenges of mapping suitable habitat adjacent to transportation projects to facilitate Section 7 consultations.

Invasive Species Management and the Washington State Department of Transportation

Authors: Marion Carey and Ray Willard (Washington State Department of Transportation, United States)

While invasive species management is not normally thought of as something DOTs do, invasive species plays a big role in how the DOTs manages their facilities and completes their work. This presentation will discuss the role that WSDOT plays in invasive species management – from controlling West Nile virus carrying mosquitos in stormwater facilities to mapping the locations of invasive species to decontaminating maintenance equipment that was used in waters contaminated with New Zealand Mud Snails.

**Monday 1:30 PM
 Parallel Sessions**

New Directions 1: GIS Applications in Action

Pollinator Habitat Ranking GIS Model

Authors: Stacey Plumley, Marion Carey, and Kelly McAllister (Washington State Department of Transportation, United States)

New Directions 2: Roads and Wildlife – A Balancing Act

Engineering Protection for Pergrine Falcons (*Falco pergrinus*) on Major Bridge Rehabilitation Projects in Pennsylvania and New Jersey

Author: Kevin Keith (JMT, Inc., Pennsylvania, United States)

Through case studies the participants will learn about the success the Pennsylvania Game Commission and the New Jersey Department of Environmental Protection have had protecting resident Peregrine Falcons during major bridge rehabilitation projects. The presentation will highlight the importance of both rebuilding bridges and protecting falcons, summarize the typical design process, present case studies of successful projects, and give design and construction strategies that show it is possible to balance construction and protection.

Ecosystem Services Provided by Soundscapes Link People and Wildlife: Evidence from Mitigation Studies in a Protected Natural Area

Authors: Mitchell Levenhagen and Jesse Barber (Boise State University, Idaho, United States); Clint Francis, Crow White, and Alissa Petrelli (Cal Poly State University, California, United States); Peter Newman, Derrick Taff, and Lauren Abbott (Penn State University, Pennsylvania, United States); Kurt Frstrup (National Park Service, Colorado, United States); Shan Burson and Jennifer Newton (National Park Service, Wyoming, United States); Chris Monz (Utah State University, United States)

Managers of protected natural areas face difficult decisions in balancing visitor access with management actions implemented to protect resources. In this adaptive management study, we experimentally altered speed limits with educational signage in Grand Teton National Park, Wyoming to explore the potential coupling of human and natural systems. We investigate changes in background sound levels, influences on avian abundance, and visitors' trade-off willingness for management actions proposed to reduce noise and increase positive soundscape experiences.

Mammals at Risk of Extinction and Spatial Patterns of Critical Areas in Brazil Due to Road Mortality: New Approach for Decision-Makers

Authors: Clara Grilo, Flávio Ferreira, Michely Coimbra (Universidade Federal de Lavras, Brazil); Ana Ceia-Hasse (German Centre for Integrative Biodiversity Research/CIBIO/InBio University of Porto, Portugal); Alex Bager (Centro Brasileiro de Estudos em Ecologia de Estradas, Brazil); Luis Borda-de-Água (CIBIO-InBio University of Porto/CEABN-InBio University of Lisbon, Portugal)

We used age-structured stochastic models to identify species in risk due to additional road mortality and

spatially explicit models to find critical areas (high road density) for populations persistence. Maned wolf (*Chrysocyon brachyurus*) and little spotted cat (*Leopardus tigrinus*) populations are expected to be at risk of extinction with the observed road-kill rates. We also predicted that road densities above 0.29 and 0.35km/km² are critical for maned wolf and little spotted cat populations persistence.

Road Ecology in the Kingdom of Bhutan—Balancing New Roads with High Biodiversity Preservation

Authors: Norris Dodd (AZTEC Engineering Group, Arizona, United States); Karma Chogyel (ENGEO Consultancy, Bhutan)

The biodiversity-rich Himalayan Kingdom of Bhutan is constructing a new southern highway which may cross three protected areas supporting tremendous wildlife biodiversity and intact rainforests. We conducted field assessment for a proposed segment crossing Phipsoo Wildlife Sanctuary, comparing impacts of 3 alignments on biodiversity (27 IUCN T&E species). One alignment along the Indian border had existing human-impacted habitats and significantly lower biodiversity. Our “model” road and conservation strategy would yield a net biodiversity benefit.

Sustainability and Resilience 1: The Changing Climate of Planning and Risk Assessment

Zoning the Roadside: A Valuable Alternative to Reducing Road Impact on Biodiversity

Author: Esteban Payan (Panthera, Colombia)

Roads pose a threat to biodiversity by transforming large-scale habitat tracts, causing fragmentation and creating a barrier effect to connectivity. They enable penetration of humans, degrading habitat quality and decimating animal populations. I argue that there is a valuable element that can help limit barrier to connectivity, fragmentation and animal road collisions on developing countries with a lower price tag: zoning the roadside; the main conclusion from the first integral road ecology project in Colombia

Transportation System Vulnerability in Ohio

Authors: Robert Chamberlin (RSG, Inc., Utah, United States); Matt Perlik and Noel Alcalá (Ohio Department of Transportation, United States)

The Ohio Department of Transportation has assessed the vulnerability of the state's transportation infrastructure – bridges, highways, and drainage structures -- to long-term climate change effects. Vulnerability is a composite measure of exposure, sensitivity, and adaptive capacity. The assessment identifies transportation assets that are most vulnerable to climate change, and for which an adaptation response is warranted. Adaptation could include regulatory adaptations, revised maintenance

schedules, modified pavement mixes, or new design standards.

Embracing Environmental Resources in Project Planning and Design—The 112th Avenue & Second Creek Open Space and Infrastructure Project

Author: Keith Hidalgo (Felsburg Holt & Ullevig, Colorado, United States)

This presentation will discuss the effect that ecological site planning had on the development of a community recreation center by Commerce City. The results of this effort ended with complete avoidance of important ecological resources by the necessary recreation, transportation, and utility development to support the recreation center. This process was a successful collaboration between the City, other regulatory agencies, and landowners under the City's Capital Improvement Projects program.

Creative Sustainable Solutions for Multi-Use Pathway Bridges

Authors: Linda Figg (FIGG Engineering Group, Florida, United States)

A sustainable and resilient transportation system must serve users by including multi-modal elements. As pedestrian opportunities expand in new and exciting parklands and urban environments, the design and construction of multi-use pathway bridges can enhance the mobility experience. This presentation shares the latest in sustainable, resilient shared-use bridges through case studies that include multi-purpose materials (solar, nanotechnologies, LED lighting, vegetation, land use interactions) and their transformative capabilities to connect, engage, and celebrate the natural environment.

Terrestrial Species 2: Understanding Infrastructure Effects on Species Movement

Terrestrial Wildlife, Interstate Highways, and Connectivity

Author: Cecilia Hennessy (Eureka College, Illinois, United States)

We explored the effects of interstate highways for six species of mammals, which represent a range of behavioral differences and dispersal ability. Site characteristics, such as road width, drainage culverts, and bridges, were considered when comparing differences in genetic connectivity. Five of the species exhibited reduced connectivity. Our results demonstrate that the barrier effects of high-traffic roads vary depending on the study species and potential existing crossing points, such as bridges and drainage culverts.

Habitat Connectivity Along Interstate Highway I-89 through Vermont's Green Mountains

Author: Jed Merrow (McFarland Johnson, New Hampshire, United States)

The movement of wide-ranging mammals along the I-89 corridor through the Green Mountains was studied using trail cameras and winter tracking. Results showed most species occur throughout the corridor, but abundance varied with distance from the highway. There was much greater movement through the forest matrix and across local roads than there was across the highway. Those animals crossing the highway used the highway surface more than culverts or bridges. Wildlife crossing "hotspots" were identified.

Effects of Transportation Infrastructure on Wolverine Dispersal, Gene Flow and Genetic Connectivity

Authors: Michael Sawaya (Sinopah Wildlife Research Associates, Montana, United States) and Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada)

Incorporating Habitat Use and Movement Patterns of Focal Species into Wildlife Mitigation Strategies for Highways on the Kenai Peninsula, Alaska

Authors: James Begley and William Gaines (Washington Conservation Science Institute, United States); Lowell Suring (Northern Ecologic LLC, Wisconsin, United States)

The Alaska Department of Transportation and Public Facilities and the Federal Highway Administration were seeking to improve the Sterling Highway to rural principal arterial standards. We conducted an evaluation of the movement patterns of brown bear, black bear, wolverine, Canada lynx, moose, Dall sheep to form a basis for mitigation during reconstruction of the Highway. Using Resource Selection Functions, Bayesian Networks, Least Cost Corridors, and Circuit Theory we characterized crossing points for all focal species.

**Monday 3:30 PM
Poster Session**

Poster Presentations

Traffic Noise Alters Tadpole Behavior, but Does Not Affect Growth

Authors: Molly Grace and Reed Noss (University of Central Florida, United States)

Traffic noise negatively affects many wildlife species. Frogs often lay their eggs in predator-free roadside ditches, leaving tadpoles exposed to noise until they metamorphose. In a series of lab experiments, we tested the impact of traffic noise on tadpole feeding

behavior, activity, and growth rate. Noise exposure significantly reduced the amount of food consumed by tadpoles and increased their activity level. However, this did not result in altered growth rate or timing of metamorphosis.

Influence of Underwater Noise from Pile Driving on the Behavior of Gulf Sturgeon

Authors: Peter Maholland, Mary Mittiga and Adam Kaeser (U.S. Fish and Wildlife Service, Florida, United States)

Pile driving associated with bridges and similar structures produces underwater acoustic energy that can change behavior, or cause injury or death in fish. Underwater noise levels were monitored to determine if thresholds were exceeded for injury or harm to the endangered Gulf sturgeon (*Acipenser oxyrinchus desotoi*). Levels were below thresholds for injury, but above the threshold for behavioral disturbance. Sturgeon avoided the construction area, indicating underwater noise below established injury thresholds may exert behavioral effects.

The Hunter Station Bridge Replacement: Effective Salvage and Relocation Methods for Endangered and Non-Listed Freshwater Mussels

Authors: Ryan Schwegman and Greg Zimmerman (EnviroScience, Inc., Ohio, United States); Autumn Kelley (Pennsylvania Department of Transportation, United States); Robert Anderson (U.S. Fish and Wildlife Service, Pennsylvania, United States); Jordan Allison (Pennsylvania Fish & Boat Commission, United States); Eric Chapman (Western Pennsylvania Conservancy, United States); Sandra Doran (U.S. Fish and Wildlife Service, New York, United States)

This Pennsylvania Department of Transportation / U.S. Federal Highways Administration project impacted the largest known populations of two endangered freshwater mussel species. We will present the project regulatory challenges and successes, conservation and recovery measures developed for endangered species, multi-state/agency cooperation, cost savings realized through teaming partners, and the logistics of physically relocating and monitoring 160,000 endangered species to 20+ locations. Keywords: USFWS Section 7 consultation, endangered mussel salvage and relocation, endangered species recovery

Providing Aquatic Organism Passage in the Intermountain Region of the U.S. Forest Service

Author: Daniel Duffield (U.S. Forest Service, Utah, United States)

The Intermountain Region of the U.S. Forest Service assessed road culverts for aquatic organism passage in 2003 - 2008. A total of 1249 culverts were assessed on the National Forests of Idaho, Nevada, Utah, and Wyoming. Of these, 87 % were barriers to juvenile trout and salmon. Since 2008, a total of 30

culverts were replaced to provide aquatic passage with an investment of over \$ 7 million which connected 201 miles of aquatic habitat.

Native Trout Responses to Culvert Removal in Small Streams Crossing Interstate 90 in Washington State

Authors: Paul James, Ashton Bunce and Charles Lawson (Central Washington University, United States)

We evaluated newly constructed stream channels at culvert/bridge replacement sites along Interstate 90 in the Cascade Mountains of Washington state to determine their use by native cutthroat trout and bull trout. Electrofishing surveys found that cutthroat trout re-colonized the new channels within one year of completion. Snorkel surveys found that both cutthroat trout and bull trout used new log structures as cover in one of the streams within two years of completion.

Amphibian Responses to Crossing Structures in the Snoqualmie Pass Area of Interstate Highway I-90 in Washington State

Author: Jason Irwin (Central Washington University, United States)

This project focuses on the effectiveness of improved crossing structures, both completed and planned, on the movement of amphibians across I-90 in the Snoqualmie Pass area. Species under study include Western toads, Pacific giant salamanders, and Coastal tailed frogs. Frogs are breeding in newly created ponds, but with mixed success. Pacific giant salamanders have extensively colonized new streambeds with rocky substrates. Surveys at other mitigation sites are ongoing, as are studies of preconstruction areas.

A Comprehensive Approach to Wetland Restoration and Enhancement

Authors: Mark Marseglia and Jeremy Willcox (Connecticut Department of Transportation, United States)

Mitigation Strategies for a Proposed Bridge Crossing in a Suburban Floodplain Environment

Authors: Mike Salter and Christopher Samorajczyk (Connecticut Department of Transportation, United States); Matt Arsenault and Simon Hildt (Stantec Consulting Services, Inc, Maine, United States); Jeffrey Simmons (Stantec Consulting Services, Inc, South Carolina, United States)

This poster examines the environmental challenges encountered during planning and design for a bridge crossing of a major floodplain in a suburban landscape. Among the many issues were rare plants, sensitive aquatic life and other ecological concerns, and archaeological sites. The project team identified a variety of mitigation strategies to avoid and

minimize impacts, protecting the long-term viability of existing ecological and cultural resources.

How an Audit Promotes Better Understanding of the Stormwater Program and How it Can Help Promote Better Environmental Outcomes

Author: Todd Williams (Michael Baker International, Arizona, United States)

This poster presentation will discuss lessons learned by State Departments of Transportation (DOTs) that were audited by the Environmental Protection Agency and/or their respective State regulators. DOTs audited have resulted in greater staff, greater resources and better environmental outcomes. Positive aspects to the audits have included a renewed emphasis on funding, personnel and an increased regulatory understanding of operations and challenges from both the regulator and permittee perspectives.

Technology of Collection, Storage and Utilization on Topsoil Resources in Highway Construction in China

Author: Ti Wang (China Academy of Transportation Sciences, China)

In order to protect the topsoil resources, the long-term technical tests have been conducted for many years in several highway constructions in China. After this a series of technologies of topsoil protection in the whole process of construction have been implemented finally. This technologies which based on 3S technology mainly including three important aspects such as topsoil collection, storage and utilization this technology. This technology could be widely accepted as a means to protect topsoil.

Effects of Arbuscular Mycorrhizal Fungi on the Plants Growth of Road Slope in the Qinghai-Tibetan Plateau

Author: Xinjun Wang (China Academy of Transportation Sciences, China)

Arbuscular mycorrhizal fungi (AMF) were used for vegetation restoration in the Qinghai-Tibetan Plateau (QTP) featured with extreme weather and fragile ecological system. AMF increased the uptake of nitrogen, phosphorus and potassium by plants. Therefore, plant growth and resistance were improved by mutualistic symbiosis between plants and AMF. The results show great promise for vegetation restoration of highway slope in QTP by AMF.

Roadside Revegetation and Native Plant Materials in National Parks

Author: Robin Gregory and Ken Stella (National Park Service, Colorado, United States)

Roads in National Parks travel through some of the nation's most scenic and ecologically diverse landscapes. The Park Service's mission is to provide public access to lands in a manner that preserves ecosystems in an unimpaired condition. NPS

transportation program has worked for over 30 years to develop and implement methods for roadside revegetation using native plant materials, topsoil conservation, seed collection, and seed increase. The future of revegetation on NPS lands will include climate change and pollinator health considerations.

Coastal Scrub Vegetation Restoration on the Devil's Slide Tunnel Project—Pacifica, California

Authors: Kristina Bischel and Kristin Tremain (AECOM, California, United States)

Caltrans constructed a double bore tunnel and adjoining bridges along the California coast, and the disturbed site was re-planted with native vegetation. Surveys were conducted monthly and annually for 5 years documenting plant survivorship and percent cover. Despite prolonged drought conditions and changing site hydrology, the site met criteria for native percent cover and survivorship of planted species. This project presents an example of a successful, closely monitored revegetation effort after a major transportation project.

An Assessment of the Impact of Alien Invasive Plants on Biodiversity Within Road Verge in the Mutale Local Municipality Within the Vhembe Biosphere Reserve

Authors: Siphon Glen Mbambala (University of Venda, South Africa); Wendy Collinson (The Endangered Wildlife Trust, South Africa)

Alien invasive plant species increase poverty and threaten development through their impact on agriculture, forestry, fisheries and natural systems, which are an essential basis of people's livelihoods in developing countries. It can be argued that roads are necessary for the development of a country, but they often facilitate invasion by alien invasive plant species which threaten biodiversity. *Calotropis procera* is an alien invasive plant species that is invading natural vegetation on road sides.

Seeking Roadkill Data Through Public Awareness, Partnerships and Citizen Science

Authors: Wendy Collinson, Claire Patterson-Abrolat, Samantha Page-Nicholson, Amos Letsoalo and Lizanne Roxburgh (The Endangered Wildlife Trust, South Africa); Thandiwe Rakale and Miles le Roux (N3 Toll Concession, South Africa); Charmaine van Wyk and Christopher Mothapo (Bakwena Platinum Corridor Concessionaire, South Africa)

In January 2014 we launched a national public awareness campaign to report WVC sightings utilizing a number of social-media platforms for reporting, and the launch of a cellphone app called 'Road Watch'. As a result, almost 13,000 roadkill data points have been collected with the assistance of over 150 volunteers from across the country. In addition, training for data collection and species identification are provided for road patrol agencies to allow regular data submissions.

A Preliminary Survey on Roadkill in a Highway, South China

Authors: Qi-Lin Li, Chi-Xian Lin and Liang-Zhi Huang (Hainan Tropical Ocean University, China); Yun Wang (China Academy of Transportation Sciences, China); Alison Berry, (University of California, United States)

This paper provides an initial survey result of roadkill in Hainan Island, one of the places which have highest biodiversity in China. Among the seven orders, anura suffered most and Spectacled Toad took up most proportion. August had the roadkill peak while September had the lowest point. Low traffic volume, speed and different modes of transportation might be the reasons of low mortality rate. Two ecological factors count: distance from bodies of water and human/residential areas when analyzed with correlation. Consecutive investigation are needed for more concise statistics and deeper analyze.

Protecting Spirit of Place: Reconstructing US 93 through the Flathead Indian Reservation, Montana

Author: Whisper Camel-Means (Confederated Salish & Kootenai Tribes, Montana, United States)

The Flathead Indian Reservation, Montana is land preserved for the exclusive use and benefit of the Salish, Pend d'Oreille, and Kootenai people agreed to in the 1855 Treaty of Hell Gate. Protecting Spirit of Place; tribal culture, natural resources and the flow of energy across the landscape, is paramount. The history of the 56-mile, US Highway 93 reconstruction project from will be discussed from a Tribal perspective.

Effectiveness of Wildlife Fencing and Crossing Structures in Reducing Collisions with Large Mammals and Providing Habitat Connectivity for Deer and Black Bear Along U.S. Highway 93 North, Montana

Authors: Marcel Huijser, Elizabeth Fairbank, Jeremiah Purdum, Tiffany Allen and Amanda Hardy (Western Transportation Institute, Montana State University, United States); Whisper Camel-Means (Confederated Salish & Kootenai Tribes, Montana, United States)

The Effectiveness of Fences and Culverts in Providing Connectivity for Turtles Along U.S. Highway 83, Valentine National Wildlife Refuge, Nebraska

Authors: Marcel Huijser and Elizabeth Fairbank (Western Transportation Institute, Montana State University, United States); Kari Elizabeth Gunson (Eco-Kare International, Ontario, Canada)

Examining the Viability of Maned Wolf Populations Under Different Roadkill Risk and Barrier Effect Scenarios: Implications on Mitigation

Authors: Priscilla Barbosa and Clara Grilo (Universidade Federal de Lavras, Brazil); Nathan Schumaker (U.S. Environmental Protection Agency, Oregon, United States); Alex Bager (Centro Brasileiro de Estudos em Ecologia de Estradas, Brazil)

Spatially-explicit individual based models were performed to analyze the effects of roads on the maned wolf (*Chrysocyon brachyurus*) population in Brazil. We analyzed scenarios of different behaviors towards roads and identified road segments with high road-kill likelihood. We observed a reduction on the population size that ranged from 10 to 23%. Around 0.6% of the road network show high probabilities of road-kill events. We identified 6 locations to apply road mitigation measures.

From Local to National: Estimates of Wildlife Mortality on Roads in Brazil

Authors: Flávio Ferreira, Fernando Pinto, Priscilla Barbosa, Rafaela Cerqueira and Clara Grilo (Universidade Federal de Lavras, Brazil); Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada)

We quantified wildlife mortality on roads in Brazil based on published literature and determined which type of roads and land use classes contribute to high road-kill. Highest rates were associated with two-lane roads, croplands (birds) and forests (mammals). On average, 1.9 million birds and 2.3 million mammals are killed on roads annually. Road mitigation schemes in Brazil should be strategically focused. Information on high rates of road mortality should help inform planning at multiple scales.

Critical Areas for Population Persistence of Giant Anteaters (*Myrmecophaga tridactyla*) Using Mortality and Habitat Fragmentation Due to Roads

Authors: Fernando Pinto, Priscila Lucas, and Clara Grilo (Universidade Federal de Lavras, Brazil); Alex Bager (Centro Brasileiro de Estudos em Ecologia de Estradas, Brazil); Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada)

We used a spatially-explicit model to find critical areas (above the maximum road density and below the minimum habitat patch size) for giant anteater (*Myrmecophaga tridactyla*) population's persistence in Brazil. The most optimistic scenario show areas with road density above 0.55 km/km² and patch size below the 193km² are critical for population persistence. These findings represent that between 32% to 36% of the species range are critical for giant eater persistence.

How Does Landscape Connectivity Explain Road Mortality Risk for Felids?

Authors: Rafaela Cerqueira and Clara Grilo (Universidade Federal de Lavras, Brazil); Lucas Gonçalves da Silva (Pontifícia Universidade Católica do Rio Grande do Sul, Brazil); Alex Bager (Centro Brasileiro de Estudos em Ecologia de Estradas, Brazil); Jochen Jaeger (Concordia University, Québec, Canada)

We assessed road mortality risk for puma (*Puma concolor*) and ocelot (*Leopardus pardalis*) in Brazil (using Maximum Entropy algorithm) and measured landscape connectivity (using Circuit Theory). The relationship between road mortality and landscape connectivity was investigated through regression analysis. Models predicted high probability of road mortality on 2661 km of roads for puma and on 982 km for ocelot. Road mortality risk was not explained by connectivity for either felid species.

The Importance of Environmental Licensing for Implementing Wildlife Crossing Structures Along Highways in São Paulo State, Brazil

Authors: Talita de Cássia Glingani Sebrían and Camilo Fragozo Giorgi (CETESB, Brazil); Pedro Umberto Romanini (ARTESP, Brazil)

Environmental licensing is an instrument to control economic activities that may affect natural resources and it has been obligatory in Brazil since 1983. Although Brazil currently does not have laws regarding wildlife crossing structures, São Paulo State has required their implementation along highways licensed since the early 2000's. Environmental licensing process has led to closer collaboration between agencies and toll road companies and it has resulted in more and better wildlife considerations in highway projects.

A Comparison Between Official Animal-Vehicle Collision Data and Data Reported by Volunteers

Authors: Michal Bil, Jan Kubecek, Jirí Sedoník and Richard Andrášik (Transport Research Centre, Czech Republic)

We have launched an AVC report application to provide an overview on roadkill on Czech roads. The data is visualized in the form of maps, graphs or tables. The application is currently used by more than 450 users and contains more than 40.000 records, 75 % of which are roadkill of mammals (75 % roe deer and 15 % wild boar). We will discuss differences between official and volunteer data and existing obstacles.

What are the Traffic Intensities of Crashes with Animals?

Authors: Michal Bil, Jan Kubecek, Jirí Sedoník and Richard Andrášik (Transport Research Centre, Czech Republic)

The annual average daily traffic (AADT) is commonly used in regression models to explain the number of

animal-vehicle collisions (AVC). However, the majority of AVC occurs during night hours. We found out that AADT does not represent traffic intensities during night hours properly. We present results which were distorted by using AADT instead of the actual traffic intensities. Furthermore, we focus on facts which argue against the use of AADT in AVC modelling.

Assessing Connectivity Improvements Across an Interstate Highway by Testing Use of Habitat Features by Small Mammals

Authors: Lindsay Millward and Kristina Ernest (Central Washington University, United States)

Small mammals may be particularly vulnerable to highway effects, yet the success of wildlife crossing structures for these species is not well documented. We present a study design to test small mammal use of habitat features placed in a wildlife underpass along I-90 in Washington State. Using live trapping, track plots, and IR cameras we will compare use of habitat features by different species, evaluate crossing structure success, and suggest habitat improvements for small mammals.

Using Available Existing Data for Analysing Temporal Patterns of Traffic Collisions Related to Large Ungulates

Authors: Maris Kruuse, Sven-Erik Enno and Tõnu Oja (University of Tartu, Estonia)

Ungulate-vehicle collisions (UVCs) create a rising concern both for ecological consequences and traffic safety. During 2004-2013, 19 533 collisions related mostly to roe deer, moose and wild boar were registered in Estonia. Proper knowledge about patterns of UVCs is essential to improve measures for reducing the collision numbers. While collecting collision data, it is useful to inspect available existing databases. In this study we analyse temporal patterns of UVCs, using data obtained from several authorities.

Wildlife's Usage of Different Highway Crossings for Migration—Data Collected in West Nevada

Author: Hao Xu (University of Nevada, United States)

An area with high wildlife-vehicle crashes in Nevada is in Elko County between Wells and Wendover along Interstate 80. The Nevada Department of Transportation (NDOT) and the University of Nevada, Reno (UNR) collected data of wildlife crossing different highway crossing-structures in this area in 2015 - 2016. Statistical analysis was performed to learn patterns of wildlife migration crossing at the structures and understand how wildlife-crossing activities are influenced by different factors.

The Effectiveness of Wildlife Fencing Along Existing Isolated Underpasses

Author: Bridget Donaldson (Virginia Center for Transportation Innovation and Research, Virginia, United States)

This presentation summarizes the research that led to the addition of wildlife fencing along certain existing underpasses used by deer and other wildlife. One 1 mile of 8-ft high fencing was recently constructed at two underpasses. Two years of pre-fencing camera monitoring data, collected at underpasses and the adjacent roadside, will be compared to 2 years post-fencing camera monitoring data.

Preliminary Results From an Evaluation of Statewide Wildlife Escape Measures and Wildlife Crossing Guards in Arizona

Author: Jeffrey Gagnon, Chad Loberger, Scott Sprague, Kari Ogren, and Raymond Schweinsburg (Arizona Game and Fish Department, United States)

Wildlife crossing structures connected with funnel fencing to reduce wildlife-vehicle conflict and promote habitat connectivity is becoming commonplace. When fencing is implemented, escape measures to allow egress of incidentally trapped wildlife, and wildlife crossing guards to allow vehicular access while limiting wildlife access are essential. Little is known about the effectiveness of various designs for different species. We share preliminary results from an Arizona study focused on elk, deer, and bighorn sheep.

Extensive Community Partnerships Lead to a Successful Wildlife Overpass and Underpass on the Edge of the Highly Urbanized Tucson, Arizona Region

Authors: Kathleen Kennedy (Coalition for Sonoran Desert Protection, Arizona, United States); Jeffrey Gagnon (Arizona Game and Fish Department, United States)

In March 2016, with the help of extensive community partnerships, a large wildlife overpass and underpass were finished on the edge of the highly urbanized Tucson, Arizona region, the first of their kind in the Sonoran Desert. The Arizona Game & Fish Department has finished the first of four years of post-construction monitoring. This poster provides an overview of the project from start to finish, including preliminary monitoring results.

Use of Wildlife Underpasses by Mojave Desert Tortoises (*Gopherus agassizii*), Clark County, Nevada

Author: Florence Gardipee (U.S. Fish and Wildlife Service, Nevada, United States)

Yellowstone to Yukon: Making Roads Safer for Both Human Travel and Wildlife Movement in the Y2Y Corridor

Authors: Lacy Robinson (Yellowstone to Yukon Conservation Initiative, Idaho, United States); Michael Lucid and Casey McCormack (Idaho Department of Fish and Game, United States)

Yellowstone to Yukon (Y2Y) and its partners have made progress on over 1,000 miles of highways across Idaho, Montana, Wyoming, and Alberta, making them safer for wildlife and people. These efforts include outreach, research, and implementation of wildlife under- and overpasses and associated fencing. Y2Y has effectively harnessed local and regional efforts into a cohesive, overarching strategy to implement wildlife mitigation in human transportation corridors on a state and landscape scale.

How Registering and Analysing Clusters of Traffic Accidents Involving Wild Boar is Helping the Application of Effective Mitigation Measures

Authors: Carme Rosell and Marina Torrellas (Minuartia, Spain)

Road Mortality Mitigation: The Effectiveness of Animex Fence Versus Mesh Fence

Authors: John Carlos Milburn Rodriguez (Animex Fencing, Spain); Steve Béga (Animex Fencing, United Kingdom)

An animal behavioural study conducted in Ontario, Canada that investigates the reactions of snakes, turtles and frogs when confronted with 2 types of commonly used exclusion and drift fencing; Steel mesh and solid plastic Animex. This study was to determine which fencing material is best suited to be used as a mitigation measure for herpetofauna and highlight potential risks associated with any of these fencing materials.

An Appropriate Language for an Expansive Streamlined Defragmentation in Spain

Author: Georgina Alvarez (Ministry of Agriculture, Fisheries, Food and Environment, Madrid, Spain)

A specific language scheme has been successfully implemented as the basis for a collaborative, coherent and streamlined action process for habitat defragmentation in Spain. As a core tool used by the Spanish Working Group of Habitat Fragmentation caused by Transport Infrastructure it helps to develop a common understanding and a cohesive cross-disciplinary community of practice. It drives a collective designing and making-decision system. Some key methodological features and outcomes are illustrated.

Increasing Accessibility to Road Construction Guidelines and Standards from Around the World

Author: Rodney van der Ree (Ecology and Infrastructure International, and School of BioSciences, Victoria, Australia)

90% of new roads on earth will be built in developing countries and most will lack adequate ecological safeguards. To help remedy this, we are seeking ecological and environmental guidelines on all aspects of road planning, design, construction and maintenance from around the world to make freely available on a website. To register for updates, and to submit guidelines, email Rodney at rvdr@unimelb.edu.au. This simple initiative has the potential to transform road construction globally.

A Generalized Predictive Model for Wildlife-Vehicle Collision Risk with Large Mammals

Authors: Casey Visintin and Michael McCarthy (University of Melbourne, Australia); Fraser Shilling (Road Ecology Center, University California Davis, United States); Rodney van der Ree (Ecology and Infrastructure International, and School of BioSciences, Australia)

Wildlife-vehicle collision risk models do not generalize well to other geographic areas or species thus making it difficult to develop management tools. Using two large analogous species on different continents, we demonstrate a broadly applicable model that satisfies contrasting needs of management. By using publicly-accessible data and open-source methods, our modelling framework enables managers to simulate risk and calculate overall reductions in expected collisions across large transportation networks, irrespective of locality, spatial scale, or species.

School Kids Addressing Wildlife-Vehicle Conflict

Author: Fraser Shilling (Road Ecology Center, University California Davis, United States)

I will discuss K-12 students' increasing involvement in environmental sciences, including road ecology studies. I worked with 2 high school classes on public education, solutions to collisions, scavenging of roadkill carcasses, and carcass necropsies. I also advised 6 teams in the 2016-17 First Lego League (FLL; <http://firstlegoleague.org/>) challenge on "Animal Allies". The teams focused on roadkill prevention as their topic, employing animal reporting, detection, wildlife deterrence, and driver alerts as tools to prevent conflict.

Impact of Transportation on Mammalian Fauna of Rajaji Tiger Reserve, Uttarakhand, North India

Author: Abhishek Srivastava (Hemvati Nandan Bahuguna Garhwal Central University, Utter Pradesh, India)

The study assesses mammalian fauna mortality on inter-state National Highways-74 and an ancillary road running across the Rajaji National Park, North

India. Field data on wildlife mortality was collected from January to June 2016. A total of 104 road kills which are belonging to 7 species of mammals during a study period of six months were found dead on the National highways 74, which is passing across Rajaji Tiger Reserve, Uttarakhand, North India.

High-Risk Zones for Ungulate-Vehicle Collisions During Montana's Fall Migration Season

Authors: Tyler Creech, Meredith McClure and Renee Callahan (Center for Large Landscape Conservation, Montana, United States)

Increased driver awareness of the heightened risk of collisions with ungulates during fall migration season could help reduce wildlife-vehicle collisions (WVCs) in Montana, but spatially explicit information on WVC risk is not widely available. To fill this gap, our study identified fall "high-risk zones" using wildlife carcass data as a proxy for WVCs. We found large variation in fall WVC risk across the state, and the public and media were highly receptive to this information.

Wildlife Roadkill Abundance and Disappearance Rate on a Major Highway in Northern Tanzania

Authors: John Kioko and Christian Kiffner (School for Field Studies, Tanzania); Taylor Philips (Muhlenberg College, Pennsylvania, United States); Catherine Siefert (Gonzaga University, Washington, United States)

Despite expanding road network in many parts of Africa, little is known about their effects on wildlife. We present a case study on roadkill abundance and disappearance rate in Northern Tanzania. Amphibian (54.4%), mammals (18%), birds (16.2%), and reptiles (11.4%) were the dominant roadkill. Most of the roadkill (92%), disappeared within 24 hours. Our data is useful in arguing for enhanced mitigation of the effects of roads on wildlife in road planning in Tanzania.

Networked LiDAR for Ecosystem Protection

Author: Faezeh Haghghat Mesbahi, Zachary Weingarten, Luke Nichols, Ryan Integlia (Florida Polytechnic University, United States)

Introducing a new application of networked LiDAR for animal detection. The network they are connected through is a wireless Ad-Hoc Mesh network called Protomesh allowing various expansions in regards to sensors and network capability. In this LiDAR detection unit multiple LiDAR will be mounted on stands detecting animal movement so once they notice it, they can notify drivers with various sound and light deterrents saving lives of animals and humans by avoiding collisions with cars.

Big City, Big Bridge, and Fast Birds

Author: Michael Robson (Bergmann Associates, New York, United States)

Do Artificial Areas on Infrastructure Linear Provide a Potential Habitat for Urban Biodiversity? Case Study of a Forest Park in the Paris Suburbs Crossing by Rail and River Infrastructure

Author: Laura Clevenot (LADYSS, Pantheon-Sorbonne University, France)

The Poudrierie forest park, in the greater Paris area, identified as a hotspot of biodiversity at the local scale, is crossed by two transport infrastructures. The comparison of three old maps, proving the historical continuity of afforestation, and the application of the Index of Potential Biodiversity (IPB) demonstrated that an artificial embankment, resulting from the construction of the two infrastructures, can be a dispersal corridor for number of plants and tree species ecologically interesting.

Short-term and Long-term Mitigation Solutions for Reducing Wildlife Vehicle Collisions in a Suburban Environment

Authors: Francesca Tordonato (Colorado Department of Transportation, United States); Julia Kintsch (ECO-resolutions, Colorado, United States); Sandy Beazley (HDR, Colorado, United States)

The Colorado Department of Transportation and the City of Golden have implemented short-term mitigations and are developing long-term solutions to address an area with one of the highest rates of wildlife-vehicle collisions in the Denver metropolitan region. This poster session illustrates the opportunities, constraints, and ongoing adaptive management for improving safety and wildlife permeability in a corridor located at the interface of suburban development and open space.

Facilitated Collaboration to Produce a Meaningful Partnership

Author: Bryant Kuechle (The Langdon Group, Inc., Idaho, United States)

The health of Idaho's wildlife and their habitat is critical to both the Idaho Department of Fish & Game and Idaho Transportation Department. With an interest in taking a fresh look at roles, responsibilities and how to best work together, the two agencies hosted professionally facilitated "world café" style workshops throughout the state for their staff. The resulting Memorandum of Understanding set forward processes to build and maintain a lasting, productive and efficient relationship.

Creative Partnership for Columbian White-Tailed Deer Conservation through a Section 7 Consultation

Authors: Mark Bakeman, Kelly McAllister and Marion Carey (Washington State Department of Transportation, United States)

ESA Section 7 consultations typically avoid and minimize project impacts at the project level. A recent Section 7 consultation for Columbian white-tailed deer

developed a habitat connectivity model across the entire range of the deer, considered all features that might affect deer connectivity, and was made available to the public. By using a landscape level approach, the model has greater utility for a broader audience, and will help support recovery for the Columbia white-tailed deer.

Investing in Wildlife Research Partnerships to Measure Success on Connectivity Projects

Authors: Mark Norman and Josh Zylstra (Washington State Department of Transportation, United States)

The Washington State Department of Transportation partners with researchers, resource managers, and citizen scientists to assess the performance of connectivity investments on the I-90 Snoqualmie Pass East Project as part of a robust monitoring program. The department is unequipped to implement such as program alone. Our partners provide an interdisciplinary forum for information exchange and collaboration, and leverage our limited resources to achieve results that would be otherwise unattainable.

Partnerships and Collaborative Approaches to Provide Overall Benefit to Species at Risk Impacted by Ministry of Transportation Highway Projects

Author: Cathy Giesbrecht (Ontario Ministry of Transportation, Canada) Ministry of Transportation of Ontario (MTO) highway projects may impact species at risk (SAR) protected under Ontario's Endangered Species Act and require an 'overall benefit' permit, which must improve the circumstances for the species. A highway culvert rehabilitation project impacted two aquatic SAR. There was not space to provide 'overall benefit' in the highway row-of-way. MTO partnered with the local Conservation Authority and contributed funding to their upstream sediment control project, which improved water quality.

The Staying Connected Initiative: Linking People and Nature Across Two Nations

Authors: Jessica Levine (TNC Canada, an affiliate of The Nature Conservancy, Québec, Canada); Phil Huffman (The Nature Conservancy in Vermont, United States)

The Staying Connected Initiative (SCI), a program of Two Countries, One Forest, is a binational collaboration of over thirty public and private organizations working together since 2009 to sustain forested landscape connections across the Northern Appalachian-Acadian region, for the benefit of nature and people. To meet this mission, SCI uses an innovative, multi-pronged approach that blends conservation science, land protection, land use planning, local engagement, transportation mitigation, and policy advocacy.

Evaluation of Bridges and Culverts as Bat Roosting Habitat in Nebraska

Authors: Melissa Marinovich and Zach Cunningham (Nebraska Department of Roads, United States)

Very little is known about northern long-eared bats (*Myotis septentrionalis*) (NLEB) use of roadway structures for roosting. As a federally threatened species, NLEB could cause delays in construction if bridges and culverts are used for maternal roosting. The Nebraska Department of Roads surveyed hundreds of roadway structures to determine if bats use bridges and culverts in Nebraska for maternity roosts and/or hibernacula. The results have implications for prediction of use and impact avoidance strategies.

The Undervaluation of Culverts as Alternative Bat Habitat

Authors: Holly Smith and Justin Stevenson (RD Wildlife Management, New Mexico, United States)

Culverts are critically undervalued as bat roost habitat. This undervaluation, coupled with an oversimplification of "suitability," unquestionably causes oversights with respect to occupancy. To date, our investigations consistently document bats using culverts with characteristics that controvert existing measures of suitability. In opposition to bridges, which frequently have structurally-integral locations amenable to bats, roosting locations within culverts predominantly overlay structural defects. Therefore, conducting routine maintenance without an appropriate, preliminary survey, can easily entomb bats.

Partnerships to Streamline Project Delivery and Protect Bats on Transportation Infrastructure Projects

Authors: Carrie Straight (U.S. Fish and Wildlife Service, Georgia, United States); Michelle Lewis (Georgia Department of Transportation, United States); Katy Allen (U.S. DOT Federal Highway Administration, Georgia, United States); Katrina Morris (Georgia Department of Natural Resources, United States)

The economic growth is tied maintenance and development of transportation infrastructure. Transportation projects also have the potential to impact at-risk species. Through the use of partnerships, conservation strategies, and programmatic agreements among Georgia Department of Transportation, U.S. Fish and Wildlife Services, Federal Highway Administration, U.S. Army Corps of Engineers, and Georgia Department of Natural Resources, we can address the conservation of at-risk species while providing assurances and streamlining consultation required under the Endangered Species Act.

A Paperless, Programmatic Approach for Endangered Species Act (ESA) Sec. 7 Consultations with NOAA Fisheries on the West Coast: Fast Track Replacement of Culverts to Implement the tribal Culvert Case

Author: Michael Grady (National Oceanic Atmospheric Administration Fisheries, Washington, United States)

The programmatic biological opinion helps Washington State replace over 700 impassable culverts, per the Tribal Culvert Case. Biological assessments are not required. This paperless process reduces consultations from 9 months to one day, saving the State up to \$3 million in 2017; savings devoted to culvert replacements. This innovative tool is supported by the Northwest Indian Fish Commission, the Governor's Office and the state Legislature and has received national awards from FHWA and NOAA.

The ODOT's Programmatic Ecological Assessment and Coordination: Conservation 1, Bureaucracy 0

Author: Matthew Perlik (Ohio Department of Transportation, United States)

Beyond Disaster and Resilience: Emerging Perspectives of the Process of People

Author: Cook, Heather (HECO Public Health Consulting, Colorado, United States)

To have the creativity and endurance needed to tackle the complex challenges that we face in fostering resilient and sustainable transportation systems while honoring the environment, we must pause to re-examine our personal and organizational perspectives. Drawing from the theories of Holling and Gunderson's ecology resilience dynamics, engineering's graceful failure, and psychology's resilience, participants will reflect on their internal processes with the intention to create space for emerging, innovative possibilities and solutions.

Integrating Transportation and Conservation Planning at the Regional Scale: An Example from Florida

Authors: Daniel Smith (University of Central Florida, United States); Stephen Tonjes and Tom Roberts (E Sciences, Florida, United States)

Connecting Freight and Land Use Planning through a Regional Freight Priority Network

Author: Christine Sherman (RSG, Inc., Virginia, United States)

The Albany Region's Freight and Goods Movement Study targeted the integration of freight and land use planning. The study team developed five freight-related land use typologies to highlight areas where major freight activities occur based on land use patterns and plans. These typologies were then the foundation for creating the region's Freight Priority

Network (FPN). FPN designation brings roadways that carry and connect critical freight and goods movements to the forefront in freight-related investment decisions.

New Directions in Modeling and Communicating Noise Pollution in National Parks

Author: Kathryn Nuessly (National Park Service, Colorado, United States)

No Wetland Bank? No Problem: Pursuing In-house Advance Wetland Mitigation for Federal Compliance

Authors: Alissa Salmore and Nik Sterbentz (Idaho Transportation Department, United States)

Commercial wetland banks provide credits for federally-mandated wetland mitigation on construction projects, but they are not available everywhere. Idaho Transportation Department secured federal funds to purchase two 75+ac (30+ha) properties in two watersheds to create in-house advance wetland mitigations. ITD will develop restoration master plans for each property in accordance with federal mitigation rules. This will provide wetland mitigation for future highway projects on a more cost-effective and ecologically-coherent scale.

Tuesday 8:30 AM Parallel Sessions

Crossings and Connectivity 2: Sustainable Funding for Wildlife Crossings

A Bigger Bang For Your Buck: Sustainable Funding For Wildlife Crossings

Panel Session Organizers: Maggie Ernest (Wildlands Network, North Carolina, United States); Renee Callahan (Center for Large Landscape Conservation/ARC Solutions, Montana, United States)

Among the various challenges surrounding roads and wildlife, one of the least discussed is how to secure funding for mitigation. Although many transportation departments support implementation of wildlife crossings, as a practical matter, the additional costs often create a barrier to deployment. In this panel discussion, we will provide an overview of public and private funding sources and present three unique case studies from Arizona, California, and Colorado that utilized innovative funding methods.

Crossings and Connectivity 3: Effectiveness of Detection and Mitigation Measures

The Reliability and Effectiveness of a Radar-Based Animal Detection System and Road Crossing Behaviour of Large Ungulates

Authors: Marcel Huijser (Western Transportation Institute, Montana State University, United States); Brice Sloan (Sloan Security Technologies, Inc., Idaho, United States); Fernanda Abra (Universidade de São Paulo, Brazil)

How Effective is Road Mitigation at Reducing Roadkill? A Meta-Analysis

Authors: Trina Rytwinski and Lenore Fahrig (Carleton University, Ontario, Canada); Kylie Soanes (Australian Research Centre for Urban Ecology, Australia); Jochen Jaeger (Concordia University, Québec, Canada); C. Scott Findlay (University of Ottawa, Ontario, Canada); Jeff Houlahan (University of New Brunswick at Saint John, Canada); Rodney van der Ree (Ecology and Infrastructure International, Australia); Edgar A. van der Griff (Wageningen Environmental Research, Netherlands)

We present an analytical review of the effectiveness of road mitigation measures in reducing road-kill. Our results demonstrate that: (1) mitigation should include fencing; (2) for large mammals, current animal detection systems can reduce road-kill, though not as effectively as fencing; (3) if the goal of a crossing structure includes reducing road-kill, fences must be included; (4) there is little evidence that other measures aimed at affecting driver or animal behavior (e.g., reflectors) reduce road-kill.

Promise and Limitations of Roadside Animal Detection Systems

Authors: Molly Grace, Daniel Smith, and Reed Noss (University of Central Florida, United States)

Roadside Animal Detection Systems (RADS) attempt to prevent collisions but often malfunction. We used a driving simulator to assess the effectiveness of RADS on crash risk and found that the system reduces crashes through reduced driver speed and earlier braking times. We then evaluated a real-life RADS built on U.S. Highway 41 in Florida, U.S.A. and found that drivers reacted similarly in the field. However, we also found that local drivers acclimated to the system.

Driver Responses to the Wildlife Hazard Warning System (WildHAZ)

Author: Leonard Sielecki (University of Victoria, British Columbia, Canada)

The Wildlife Hazard Warning System (WildHAZ) was developed to advise drivers of the spatial and temporal aspects of wildlife hazards on roads and highways. The system uses a risk matrix-based, color-coded hazard rating system. A survey of over 500 drivers indicates the majority of drivers understand the fundamentals of the WildHAZ system and virtually all would modify their driving behavior to reduce their potential for wildlife-vehicle collisions and/or reduce the potential severity of such collisions.

New Directions 3: Large-Scale Thinking

Developing and Implementing a Programmatic Threatened and Endangered Species Evaluation for Common Department of Transportation Actions—A Case Study

Author: Alex Pulley (Felsburg Holt & Ullevig, Colorado, United States)

This presentation will discuss the recent Programmatic Biological Assessment (PBA) of the effects of most common Colorado Department of Transportation (CDOT) actions on federally listed Threatened, Endangered, Candidate, and Proposed species (T&E species). This programmatic approach reduces the time needed for US Fish and Wildlife (USFWS) review for the vast majority of projects. It also results in efficient use of reduced project funds and can accommodate ever compressed project schedules.

Highway Crossings Structures for Wildlife: Benefits of a National Commitment to Increase Driver and Animal Safety

Authors: Sandra Jacobson (U.S. Forest Service, California, United States); Renee Callahan (ARC Solutions, Montana, United States); Robert Ament (Western Transportation Institute, Montana State University, United States); Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada); Steven Suder (U.S. Fish and Wildlife Service, Virginia, United States)

This presentation provides an overview of the *Highway Crossing Structures* report, with the goal of increasing awareness of its availability, the history behind its creation, and how practitioners can use it to build support for an integrated national approach to deploying wildlife crossing structures. The paper is the first in a series of forthcoming special publications by ARC Solutions, an interdisciplinary partnership promoting new thinking, new methods, new materials and new solutions for crossing structures.

Collecting and Sharing Environmental Events to Support Transportation Decisions

Authors: David Waetjen and Fraser Shilling (Road Ecology Center, University of California Davis, United States)

Planning for reduced impacts of transportation on natural and human communities depends on adequate collection, management, and analyses of environmental event data. We provide an informatics-based solution for sharing environmental event data, discuss how these data can be shared in a standardized manner both as distributed and federated structures, and base our findings on several data portals we created and are managing. These standardized, web-based approaches will improve road ecology as a discipline.

Is there a Place for Road Ecology in Transportation Planning?

Authors: Fraser Shilling (Road Ecology Center, University of California Davis, United States); Kimberly Andrews (University of Georgia, United States)

The intention of road ecology (RE) has been to foster scientific research on the effects of roads on surrounding habitats. To understand the position of road ecology in transportation planning, we analyzed state transportation plans/budgets and participation in ICOET and IENE. We found that environmental issues do not feature prominently in state transportation priorities and that RE conferences are dominated by transportation organizations. We suggest substantial incorporation of road ecology into state transportation priorities.

Terrestrial Species 3: Strategies for Permeability

The Impact of Traffic on Wildlife Use of a Crossing Structure

Authors: Leslie Bliss-Ketchum and Catherine de Rivera (Portland State University, Oregon, United States)

With a unique opportunity to monitor a crossing structure before, during and after a road closure, we were able to measure road-avoidance behaviors, finding that many species are less active when traffic is present, which could partially limit the utility of crossing structures for habitat connectivity. To enhance mitigation efforts, crossing structure designers could employ unique ways to “shield” wildlife from traffic impacts, such as noise and visual cues, to dampen the avoidance response.

Effects of Highway Reconstruction on Grizzly Bear Habitat Selection in the Cooke City Basin, Montana

Authors: Dan Tyers (U.S. Forest Service, Montana, United States) and Joao Rossi (Montana State University, United States)

Multi-year construction projects in the Cooke City Basin, Montana, had minimal measurable effects on grizzly bears. Sign data records on transects didn't indicate a significant change in grizzly bear habitat use during 2 years of mine reclamation and 3 years of road reconstruction compared to periods of predictable human activity. Notably, project sites and quality grizzly foraging areas were spatially discrete. No bear-human conflicts were documented during construction, likely because project activities were strategically mitigated.

Landscape Connectivity at Foxcatcher Farm: Efficacy of 50-80 Year Old Crossings on Private Land turned Public Land

Author: Paul Drummond (Design Collective, Maryland, United States)

This investigation into Foxcatcher Farm documents the design, construction, and efficacy of crossings built from 1929-1965 on a former du Pont estate in Fair Hill, Maryland. Originally intended to stitch together du Pont's 8,000 acre estate across public roadways, the crossings connected the fractured landscape, and continue to presently. This session explores the versatile and innovative use of crossing infrastructure to connect the needs of many users, past and present.

Using Environmental Features to Model Highway Crossing Behavior of Canada Lynx in the Southern Rocky Mountains

Authors: John Squires, Lucretia Olson, and Elizabeth Roberts (U.S. Forest Service, Montana, United States); Jacob Ivan (Colorado Parks and Wildlife, United States)

Melbourne/ANET, Australia); Andreas Seiler (Swedish University of Agricultural Sciences, Sweden); Anders Sjolund (Swedish Transport Administration and IENE, Sweden); Elke Hahn (Federal Ministry for Transport, Innovation and Technology and IENE, Austria); Carme Rosell (Minuartia and IENE, Spain)

Transportation infrastructures are essential for sustainable development, but often have deleterious impacts on biodiversity. The trends show that 90% of 25 million lane-kilometers of new roads are planned in non-OECD countries by 2050 and most of them will be constructed in high biodiversity value areas. In our Session, we will discuss the international policy framework that joins transportation and ecology towards to development of a Strategy for efficient and ecologically sensitive transportation in developing countries.

Aquatic Species 1: Amphibians, Reptiles, and Mussels – Oh My!

Citizen Science Reveals Negative Effects of Roads and Road Traffic on Amphibians Across Spatial Scales and Regions in the Eastern United States

Authors: Tom Langen (Clarkson University, New York, United States); David Marsh (Washington & Lee University, Virginia, United States); Bradley Cosentino (Hobart and William Smith Colleges, New York, United States)

NAAMP is a citizen science program for which volunteers do frog call surveys along specified routes. Classes at nine universities examined the effects of habitat composition and configuration, and roads and traffic, on anurans in the eastern US. Our results indicate that the negative effects of roads on amphibians occur across the region, affecting even common species, and demonstrate the scientific value of well-designed citizen science programs, and the educational value of multi-university collaborative learning.

Integrating Ecology, Novel Technology, and Human Dimensions for Understanding the Effects of Coastal Causeways on Diamondback Terrapins

Authors: Kimberly Andrews (University of Georgia/Georgia Sea Turtle Center, United States); David Zailo, Brian Crawford (University of Georgia, United States); Terry Norton and Michelle Kaylor (Georgia Sea Turtle Center, United States)

Coastal causeways along the eastern United States can have negative ecological consequences, such as landscape fragmentation and wildlife mortality. These effects are dramatic for turtle species inhabiting bordering marshes as they are attracted to the road shoulders to test. Therefore, we are developing solutions that will both reduce mortality and enhance

**Tuesday 10:30 AM
Parallel Sessions**

Policy and Regulation 1: Defining Best-Practice Guidelines for Transportation Infrastructure in Developing Countries

Defining Strategy and Contents with Specific Terminology for International Guidelines for Environmentally-Friendly Transportation Infrastructure in Developing Countries

Panel Session Organizers: Lazaros Georgiadis (IENE, Greece); Rodney van der Ree (University of

quality nesting habitat. We use an integrated approach of road monitoring, rehabilitation of injured animals, ecological research using technology, and citizen awareness and engagement.

The Effectiveness of Mussel (*Unionidae*) Relocation as Mitigation For Bridge Construction Projects

Author: Michael Hoggarth (Otterbein University/Stone Environmental, Ohio, United States)
Freshwater mussels are essentially immobile. Bridges cross rivers where mussels live. Since all species of mussels are protected in Ohio, mussels are relocated prior to bridge construction. The Ohio Mussel Survey Protocols specify relocation methods for construction projects that impact streams. Different species of mussels respond differently to relocation. Slack-water species do not survive relocation as well as fast-water species. Relocation salvage areas should be reassessed depending on the mussel species present in a stream.

The Hunter Station Bridge Replacement: How PennDOT Completed (and Paid For) the Largest Endangered Species Relocation Project in the World and May Have Saved These Species in the Process

Authors: Greg Zimmerman (EnviroScience, Inc., Ohio, United States); Autumn Kelley (Pennsylvania Department of Transportation, United States); Robert Anderson and Jennifer Kagel (U.S. Fish and Wildlife Service, Pennsylvania, United States); Jordan Allison (Pennsylvania Fish & Boat Commission, United States); Eric Chapman (Western Pennsylvania Conservancy, United States)

Partnership and Collaboration 2: Achieving Conservation-Minded Infrastructure

Embracing and Incorporating the Watershed Approach to Wetland Mitigation: U.S. Highway 36 Environmental Impact Statement Wetland Mitigation Design and Construction

Author: Alex Pulley (Felsburg Holt & Ullevig, Colorado, United States); Francesca Tordonato (Colorado Department of Transportation, United States)

This presentation focuses on the multi-agency, watershed approach used to mitigate wetland impacts for the US36 corridor in Colorado from permitting through construction. This process was a successful collaboration between many federal, state, and local agencies that resulted in a unique product for the Colorado Department of Transportation. The mitigation project involves the restoration of a 22-acre site that through creation of wet meadow

habitat, wetland enhancement through riparian/upland buffer, and noxious weed mitigation.

A Collaborative Approach to Endangered Species Act Section 7 Consultations on Highway Infrastructure Projects in Arizona

Authors: Robert Lehman and Brenda Smith (U.S. Fish and Wildlife Service, Arizona, United States); Joshua Fife, Kristin Gade, and Justin White (Arizona Department of Transportation, United States)

In this paper, we review Endangered Species Act section 7 formal and informal consultations on highway infrastructure projects completed since June 2015 by the U.S. Fish and Wildlife Service in collaboration with the Arizona Department of Transportation and Federal Highway Administration. We have worked together to avoid or reduce potential effects of intersection and shoulder improvements, pavement preservation, rockfall mitigation, vegetation clearing, bridge repairs, and new bridge construction on over 15 threatened and endangered species.

Implementation of the Environmental Guide: Wildlife-Friendly Roads on 62-Mile Road Expansion in Costa Rica to Reduce the Impact on Wildlife

Author: Esther Pomareda Garcia (Centro Rescate Las Pumas, Costa Rica); Esmeralda Arevalo Huevo (Universidad Latina, Costa Rica); Daniela Araya-Gamboa (Panthera, Costa Rica)

Costa Rica recently introduced a tool to reduce road impact of a comprehensive manner incorporating topics of legislation, wildlife roadkills and sightings data, methodology for monitoring and recommendations on specific environmental measures; The Environmental Guide: "Wildlife Friendly Roads". The objective of this research is implementation of this Guide in an expansion project of Route 32, in the Atlantic Zone of Costa Rica, a road of 62 miles and will pass from two lanes to four.

Securing Connectivity for Jaguars Along Expanding Highways of the Sky Islands of Mexico

Authors: Juan Carlos Bravo (Wildlands Network, Mexico); Mirna Manteca and Samantha Hammer (Sky Island Alliance, Arizona, United States); David Theobald (Conservation Science Partners, Colorado, United States); José Manuel Pérez (Cuenca Los Ojos, Arizona, United States); Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada); Robert Ament (Western Transportation Institute, Montana State University, United States); Jan Schipper (Arizona Center for Nature Conservation—The Phoenix Zoo, United States)

Wildlands Network seeks to prevent jaguar deaths resulting from collisions with vehicles on the borderlands of Sonora, Mexico and to reduce jaguar

habitat fragmentation caused by roads, by convening key stakeholders from both Mexico and the U.S. and coordinating with Mexican Transportation Authorities to implement wildlife crossings. We provide a framework for partners to engage by compiling and disseminating regional research along with tools for facilitating, mapping and communicating.

Crossings and Connectivity 4: Monitoring Use and Effectiveness of Crossing Structures

Evaluation of Wildlife Crossing Structures on U.S. Highway 93 in Montana's Bitterroot Valley Utilizing a Before-After-Control-Intervention Monitoring Design

Authors: Robert Hamlin (Consultant, Utah, United States); Patricia Cramer (Consultant, Utah, United States); Patrick Basting (Jacobs Engineering Group, Colorado, United States)

A Before-After-Control-Intervention (BACI) monitoring design was used to evaluate wildlife crossing structures on US 93 in Montana's Bitterroot Valley. In a seven-year study, 19 wildlife crossing structures were monitored pre and post construction with motion-detection cameras to determine white-tailed deer use rates. Deer success rates crossing the pre-construction two-lane highway and control sites were used to set performance measures for the post-construction four lane highway with wildlife crossings. Nine of the structures exceeded the performance measures.

Wildlife Crossing Structure Use by Jaguars and Other Mammals Along the Nuevo Xcan-Playa Del Carmen Highway, Quintana Roo, Mexico

Author: Alberto Gonzalez (INECOL, Mexico)
Since the Nuevo Xcan-Playa del Carmen highway began its operation (September 2013) a total of 22 jaguar crossings have been registered across wildlife underpasses. Along with the jaguar, at least 18 other mammal species have been using the available crossing structure options (underpasses, concrete culverts, concrete pipes). Differential use by the mammal community is dependent on species size, behavior and structure. This study is crucial for further mitigation measures in highways along the jaguar's distribution.

Wildlife Use of Highway Underpasses in Southern Bhutan

Authors: Karma Chogyel (ENGEO Consultancy, Bhutan); Norris Dodd (AZTEC Engineering Group, Arizona, United States); Karma Yangzom (Asian Development Bank, Philippines)

The Royal Government of Bhutan has constructed five road segments along the southern border as a part of the overall development of the southern east-west highway. Stretches of these segments have passed through areas exhibiting high biodiversity and

harboring several IUCN threatened and endangered species. On two segments of new road, five wildlife underpasses were constructed in 2014-2015 to promote passage across the highway corridor; Bhutan's first wildlife crossings.

A Contribution Toward Standards in the Use of Motion-Triggered Cameras for Quantifying Wildlife Crossings Using Highway Structures

Authors: Kelly McAllister and Marion Carey (Washington State Department of Transportation, United States)

Trail cameras collect detailed information on wildlife interactions with bridges and culverts. Based on our experience in Washington State, we recommend some methods for collection and analysis of camera data that will allow comparisons across projects. Our focus is on deploying cameras to maximize detections, collecting data over full annual cycles, and defining terms and metrics that describe performance in a consistent way.

Tuesday 1:30 PM Parallel Sessions

Partnership and Collaboration 3: Programmatic Consultation for The Indiana Bat and Northern Long- Eared Bat – A Rangelwide Approach

Implementing a Rangelwide Programmatic: The Indiana Bat and Northern Long-Eared Bat Programmatic Consultation in Practice

Panel Session Organizers: Julianne Schwarzer (U.S. DOT Volpe Center, Massachusetts, United States); Brian Yanchik (U.S. DOT Federal Highway Administration, South Carolina, United States); Forest Clark (U.S. Fish and Wildlife Service, Indiana, United States)

This panel will bring together members of the inter-agency team that developed Indiana Bat and Northern Long-Eared Bat Range-wide Consultation and Conservation Strategy under Section 7 of the Endangered Species Act, along with practitioners who have used the programmatic in a dynamic conversation about the process and specificities of the consultation, the upcoming in-lieu fee program, and the experience of using the programmatic.

Stormwater and Water Quality Management: Go With the Flow

A Comprehensive Approach to Erosion and Sediment Control and Stormwater Management During Construction of a Mega Highway Project

Author: Grant Kauffman (LGL Limited, Ontario, Canada)

Highway 407 East is a 70 km greenfield transportation corridor which contains multi-lane freeway, transitway and transportation support facilities in Durham Region, Ontario, Canada. The Highway was developed in two phases: One followed the Ontario Ministry of Transportation standard approach to erosion and sediment control; Two followed a comprehensive approach to erosion and sediment control and stormwater management. The two approaches will be described and compared to demonstrate the enhanced environmental protection that was achieved.

Stream Restoration Toward TMDL Compliance and SHA Implementation Examples

Author: Joshua Gilman (Stantec Consulting Services, Inc., North Carolina, United States)

By sharing experiences from recent project examples (specifically, Jabez Branch watershed planning and Hollands Branch stream restoration), this presentation will put into context the practice of quantitative watershed assessment and subsequent stream restoration as measures toward optimizing water quality benefits. This talk aspires to encourage dialogue outside of the mitigation box, toward the water quality mandates as a means to more efficiently promote cumulative water quality benefits over time.

Re-Plumbing Roadside Ditch Networks: The Unrecognized Driver of Flooding, Water Pollution, and In-Stream Erosion and Habitat Degradation

Authors: Rebecca Schneider, David Orr, Sara Davis, Roxanne Marino, and Nathan Baker (Cornell University, New York, United States)

Roadside ditches parallel every road, forming extensive networks across the landscape. Our New York research demonstrates that ditches intercept ~20% of the runoff from every ~25 km² watershed. It is rapidly shunted to nearby streams where the discharge contributes directly to floods and water pollution, disrupts the natural hydrologic regime, and degrades aquatic ecosystems. Improved ditch management is critical for restoring stream health, but necessitates training and resources to town and county highway departments.

When Opportunity Knocks: Opportunistic Stormwater Treatment Banking to Meet Endangered Species Act Stormwater Management Requirements

Author: William Fletcher (Oregon Department of Transportation, United States)

The Oregon Department of Transportation and the National Marine Fisheries Service have developed criteria for generating stormwater treatment credits from projects with "excess" treatment for use by projects that have a treatment shortfall. Essential elements include defining "excess" treatment, conditions for use of credits, service area, equivalence between credit and debit sites, and durability of the credits. These criteria can be the basis for a more deliberate stormwater banking program.

Mitigation 2: Strategic Regional and National Approaches

Creating National Species Distribution Data for All Federally Listed Species

Author: Jimmy Kagan (Institute for Natural Resources, Oregon, United States)

This presentation describes a project from 11 U.S. public universities and NatureServe to develop species distribution models and maps showing the likely occupied habitat for all of the listed species occurring in the lower 48 states. Proposed as an interagency effort between federal agencies, Pesticide Manufacturers, and states, this data could replace current county-level data used in iPAQ and would support Eco-Logical. Maps from pilots in New York, Virginia, Florida, and Oregon are shown.

Advanced Mitigation Credits for Wildlife Crossings: Pilot Project on the Central Coast of California

Author: Nancy Siepel (California Department of Transportation, United States)

The Highway 17 Wildlife Crossing Project will be the first wildlife crossing constructed in California under the auspice of advanced mitigation to offset highway impacts to wildlife movement. Caltrans collaborated with the California Department of Fish and Wildlife to develop an advanced mitigation crediting system that would allow the California Department of Transportation to use the credits for future transportation projects requiring mitigation for impacts to wildlife movement under the California Environmental Quality Act (CEQA).

Hit and Run! Reducing Wildlife-Vehicle Collisions in Protected Areas

Authors: Wendy Collinson, Lizanne Roxburgh, Megan Murison, and Harriet Davies-Mostert (The Endangered Wildlife Trust, South Africa)

Reports from various social-media platforms have indicated public concern for WVCs inside protected areas. Consequently, in 2014 we assessed driver behavior and their response to a fake snake placed on the road within selected protected areas in South Africa. We found that the majority of drivers were not looking at the road, but scanning the bush for wildlife whilst 49.6% (n=201) hit the fake snake. Trials using different roadside signage are currently being assessed.

Utah Department of Transportation Region 4 Wildlife Impact Mitigation

Authors: Eric Hansen and Larry Johnson (Utah Department of Transportation, Utah, United States)

Transportation improvement projects along Utah's state highway system have the potential to impact protected plant and wildlife species. The presentation summarizes recent challenges faced by the Utah Department of Transportation in Southern Utah to maintain and improve transportation infrastructure while furthering conservation. Discussed are recently-implemented conservation measures developed to protect populations of Dwarf Bear Poppy, Desert Tortoise, Utah Prairie Dog, and Colorado Pikeminnow - and their habitat.

Crossings and Connectivity 5: Adding or Removing Barriers for Wildlife

Data, Planning, Action! Using Data to Include Wildlife Concerns in Transportation Planning

Authors: Patricia Cramer (Consultant, Utah, United States); Robert Hamlin (Consultant, Utah, United States); Fraser Shilling (Road Ecology Center, University of California Davis, United States); Kari Elizabeth Gunson (Eco-Kare International, Ontario, Canada); Julia Kintsch (ECO-resolutions, Colorado, United States); Timothy Cramer (Idaho Transportation Department, United States)

The five major steps in the use of data to inform transportation planning with respect to wildlife will be presented. They include: 1. Collect and map Wildlife-Vehicle Collision data; 2. Incorporate wildlife habitat maps into an analysis; 3. Evaluate effectiveness of wildlife mitigation to evaluate with performance measures; 4. Perform benefit-cost analysis, and 5. Create a statewide transportation planning process with respect to wildlife to identify state and district priority areas for wildlife mitigation.

Cougar Safe Trek: Leading the Next Generation of Wildlife Protection Along Highways—The Case of State Route 241 Wildlife Fence in Orange County, California

Authors: Doug Feremenga and Valarie McFall (Transportation Corridor Agency, California, United States); T. Winston Vickers (Wildlife Health Center University of California Davis, United States); Patrick

Huber (Road Ecology Center, University of California Davis, United States)

This presentation describing the State Route 241 Wildlife Protection project illustrates how wildlife undercrossings and exclusionary fences along transportation corridors can be effectively used to: reduce wildlife-vehicle collisions; help maintain connectivity; and minimize habitat fragmentation. The presentation includes an in-depth discussion of the background, planning, designing, financing, construction, and monitoring results, which have shown a significant reduction in roadkill and an increase in the use of undercrossings in the project area.

Fences and Beyond: The Importance of Addressing Fence-End Effects in Roadkill Reduction Studies

Author: Edgar A. van der Grift (Wageningen Environmental Research, Netherlands)

Roads may result in increased mortality of wildlife through wildlife-vehicle collisions. Fencing appears to be one of the more effective ways to reduce such road-kill. Most studies, however, do not address possible fence-end effects, i.e. elevated road-kill immediately adjacent to fence-ends. If such effects occur the effectiveness of fences in reducing road-kill may be overestimated. We demonstrate the importance of data collection at fence-ends in evaluation studies to make correct inferences about road mitigation effectiveness.

Connecting to the Future: How the California High-Speed Rail Program is Using Innovative Modeling Techniques for Locating Wildlife Crossings

Authors: William Goggin (Cordoba Corporation, California, United States); Barbara Marquez, (California High-Speed Rail Authority, United States); Scott Fleury (Biodiversity Conservation Planning, California, United States); John Ko, LSA, California, United States)

In order to quantify potential project effects to wildlife movement and permeability, a Wildlife Connectivity Assessment (WCA) was completed. Analyses use least cost path to identify areas with highest permeability (lowest cost to movement) for nine focal species. We considered three different scenarios: (1) Existing Conditions; (2) Project without wildlife crossings; and (3) Project with wildlife crossings. Resulting analyses demonstrates that with the addition of dedicated wildlife crossing structures, impacts on movement would be reduced.

**Tuesday 3:30 PM
Parallel Sessions**

Vegetation Management 1: The Role of Roadsides in Promoting Pollinator Health

The Role of Roadsides in Promoting Pollinator Health: Maintenance, Inventories, Landscape Design, and Revegetation

Panel Session Organizer: Jennifer Hopwood (Xerces Society for Invertebrate Conservation, Oregon, United States)

Roadside vegetation can provide much needed habitat for managed and wild pollinators. This session will provide information about steps transportation professionals can take to manage roadsides to support pollinators, and will include discussion of future steps. The session will include five presentations from researchers, practitioners, and federal agency representatives, as well as a panel of Department of Transportation maintenance and revegetation experts. Subtopics will include roadside vegetation inventories, roadside revegetation, and maintenance adjustments.

New Directions 4: Innovative Approaches to Delivering Transportation Projects with Ecological Benefits

Shared-Uses: A Collaborative Case Study in Innovative Planting Design for Infrastructure Projects

Author: Michael Smith and Marjorie Woodbury (Landscape Architecture Bureau, Washington, DC, United States)

Driven by a desire to benefit the local community and ecology, multiple teams of experts collaborated on the design of a 1.5 mile long access road in Washington, DC. The planned roadway relieves congestion and connects to a large federal campus. This presentation covers the team's collaborative design method, with a focus on innovation in infrastructure planting design that provides a rich and compelling end-user experience with native groupings of plant species.

Planning For Urban Area Ecological Connectivity Investments: A Tiered and Modular Approach

Authors: Craig Broadhead and Jason Smith (Jacobs, Washington, United States)

Analyzing the effectiveness and potential for investments in ecological connectivity is not new science – unless it is within Bellevue, Washington

State's third largest city! This presentation will explain how the city of Bellevue worked with Jacobs Environmental Science Team to analyze their existing parks and open space for future investments that consider ecological connectivity for the City planning and policy toolbox for development.

Managing Expectations in an Unpredictable Ecological Environment: How Design Build is Shaping Policies to Minimize Impacts to Bats, Birds and Biological Habitat

Panel Session Organizer: Stephanie Blanco (Parsons Infrastructure, California, United States)

Design-Build Delivery of transportation projects can result in quicker design and construction but has the challenge of implementing measures that protect biological resources. On the State Route 91 Corridor Project in California, the team had to be agile and creative in implementation of bat panels, bird exclusion, and protection of habitat. From this session, hear from the environmental manager and project biologists on how this design-build experience is impacting future environmental requirements and permit measures.

Partnership and Collaboration 4: Aligning Transportation Planning and Conservation Priorities

Regional Conservation Investment Strategies: A New Tool for Conservation and Mitigation Investments

Author: Elizabeth O'Donoghue (The Nature Conservancy, California, United States); Patrick Huber (Road Ecology Center, University of California Davis, United States)

Agencies, conservationists and others are seeking landscape-scale advance mitigation tools to meet conservation and transportation goals. While support exists for advance mitigation, implementation remains challenging. California's AB2087 establishes a conservation planning tool (Regional Conservation Investment Strategy) to guide conservation and infrastructure investments. AB2087 authorizes advance mitigation and credit for habitat enhancements such as connectivity projects. Attendees will learn about the new law and its application in the San Francisco Bay Area.

Leveraging for Success: Arizona Game and Fish Department and U.S. Fish and Wildlife Service's Wildlife Restoration Programs Intrastate and Interstate Collaborations to Address Habitat Fragmentation and Wildlife-Vehicle Conflicts

Author: Jeffrey Gagnon and Scott Sprague (Arizona Game and Fish Department, United States)

State wildlife agencies are provided funds through the US Fish and Wildlife Service's Wildlife Restoration

Act (or Pittman-Robertson (PR) Act of 1937) which places an excise tax on guns and ammunition. This funding is an essential resource for wildlife conservation. Arizona Game and Fish Department has worked closely with partners to leverage PR funds to conduct research and monitoring of habitat fragmentation and wildlife-vehicle conflict mitigation efforts over the past 15 years.

Sharing Best Practices for Aligning Transportation Planning and Conservation Priorities: Eastern and Western Partnerships to Promote Ecological Connectivity at Landscape Scales in North America

Panel Session Organizers: Renee Callahan (Center for Large Landscape Conservation, Montana, United States); Jessica Levine (TNC Canada, an affiliate of The Nature Conservancy, Québec, Canada)

This session highlights regional collaborative efforts and partnerships to increase ecological connectivity, with a focus on comparing work in Eastern and Western landscapes in North America and their policy-making Governors and Canadian Premiers. Panelists representing state agencies and conservation organizations from the East and West will share lessons learned and facilitate a discussion with audience members to identify new opportunities to improve ecological connectivity at multiple scales during transportation planning, project design and other efforts.

Lightning Talks: A Brainstorm on Ecology and Transportation

Bridging the Gap in Bridge Construction Impacts: Ecological Assessment from Design through Construction

Author: Chris Goodson (Georgia Department of Transportation, United States)

Ever wonder how a bridge is actually built? Assessments of the ecological impacts of bridge building are typically based on design plans, and may not consider the potentially important impacts associated with construction methods and access needs. Learn how the Georgia Department of Transportation's Office of Environmental Services partnered with the Offices of Bridge Design and Construction to develop a strategy that takes into account the ecological impacts of the construction process.

RoadWatchBC: Making Highway 3 Safer for People and Wildlife

Author: Candace Batycki (Yellowstone to Yukon, British Columbia, Canada)

RoadWatchBC is a three-year citizen science project aimed at addressing biodiversity loss in the Rocky Mountains of southeastern BC. Our proprietary GPS-based smartphone application allows vehicle

passengers to upload roadside wildlife sightings and collisions to our on-line database, generating a spatially precise dataset that is shared with agencies, scientists, organizations and communities. Our open source application and enhanced web-based data summarization and display tools are shareable and scalable.

Predicting Wildlife-Vehicle Collisions Using Occupancy Models

Authors: Fernando Ascensão, Mário Ferreira and Rafael Barrientos (CIBIO-InBIO, Portugal); Rodrigo Santos (University of Brasília-UnB, Brazil); Henrique Pereira (German Centre for Integrative Biodiversity Research (iDiv), Germany)

We suggest using occupancy models in roadkill research assuming occupancy as the probability of individuals using the immediate vicinity of a road section or using it for crossing (roadkill risk); and detectability as the combination of the probability of an individual being hit by a vehicle and, if so, its carcass being detected during a roadkill survey. We used this approach to assess the roadkill risk for a collection of species in Brazil.

Application of GPS Satellite Collars to Understanding Large Mammal Interactions with Roads

Authors: Kelly McAllister, Marion Carey, Jeff Dreier and Paul Wagner (Washington State Department of Transportation, United States)

Proximity sensing GPS telemetry collars can precisely define wildlife crossings of roads. These collars listen for signals from transmitters mounted along the road and, when detected, start collecting frequent locations. They go back to a less frequent schedule when the animal has moved away from the road, saving battery life. See examples of how this technology has allowed Washington to better understand elk crossings of a highway in the Skagit River Valley.

The Importance of Within-Species Wildlife Behavior on Mitigating Mortalities and the Barrier-Effect of Highways

Authors: Eric Abelson and Sandra Jacobson (U.S. Forest Service, California, United States)

Landscaping of a New Wildlife Overpass: Small Changes Make Big Differences to Benefit Biodiversity

Authors: Carme Rosell (MINUARTIA, Spain); Josep Armengol (ABERTIS, Spain); Francesc Molné (INNAT, Spain)

Stormwater Ponds and Biodiversity: A Potential Compatibility Between Technical and Ecological Features

Author: Laura Clevenot (LADYSS, Pantheon-Sorbonne University, France)

Highway stormwater ponds, artificial and potentially polluted sites, paradoxically appear to be attractive for amphibians. Although some characteristics of ponds designate them as ecological traps, others allow us to conclude that these ponds could be new breeding sites for amphibians, especially in highly man-made landscapes. The research also suggests that the management of these ponds can have an important role to play to better accommodate amphibians and that studies on this subject are necessary.

Towards an All-Ireland Scheme to Create Pollinator Highways Along its Road Networks

Authors: Aoife McAleenan, David Woodward, and Phillip Millar (Ulster University, United Kingdom)

The aim of this presentation is to introduce the 2015 All-Ireland Pollinator Plan and how new research at Ulster University will support and build upon Action A.28 “the adoption of an All-Ireland scheme to create pollinator highways along its’ road networks”. The research will compare floral and Bumblebee abundance and diversity across three contrasting road-side verge “treatments” to help develop a best practice manual for road design and maintenance.

Georgia Aster Candidate Conservation Agreement: Phase I

Author: Anna Yellin (Georgia Department of Natural Resources, United States)

Georgia aster (*Symphotrichum georgianum*) is in decline across its range in the Southeast US. Instead of listing under the ESA, the species is a pioneer of a partnership between state agencies, utilities, and NGOs. This Candidate Conservation Agreement (CCA), signed in May 2014, is voluntary. As of mid-November 2016, Phase I has ended. This talk will focus on positive results we have seen from this agreement as well as problems that have been revealed.

Environmental Conflict Resolution: Finding Common Ground

Author: Karen Hallberg (U.S. Fish and Wildlife Service, Ohio, United States)

A recommendation to contract an Environmental Conflict Resolution (ECR) expert can invoke a defensive reaction from agency personnel. This lightning talk will summarize one agency’s experience in moving through the ECR process from an initial defensive position to a successful outcome. Insights gained and lessons learned will be shared with the audience.

Influencing International Transportation Policy and Practice for More Wildlife-Friendly Roads

Author: Robert Ament (Western Transportation Institute, Montana State University, United States)

The International Union for Conservation of Nature, comprised of over 180 countries, has launched the Connectivity Conservation Specialist Group to develop guidance for a new type of conservation area, Connectivity Conservation Area (CCA). As part of the CCA process, a Transport Working Group (TWG) has been formed to provide direction regarding transportation infrastructure so it avoids, minimizes and/or mitigates impacts to wildlife movement and mortality within CCAs. The TWG is seeking interested individuals to help.

Identifying Collaborative Opportunities to Incorporate Wildlife Connectivity Components into the Existing Transportation Infrastructure

Authors: Rob Nelson (Arizona Game and Fish Department, United States)

Little has been achieved in Arizona addressing wildlife connectivity concerns on smaller transportation related projects. One success occurred along the main highway entering the Grand Canyon where wildlife-vehicle collisions are frequent. 15 miles of right-of-way fencing will be replaced in 2018 with game fence, which include strategic crossings installed for deer, elk, and pronghorn. Without this early collaboration between agencies, no modifications to the existing right-of-way fence and the future game fence would have occurred.

**Tuesday 7:30 PM
Plenary Session**

Collaboration and Innovation in Utah

Collaboration and Innovation in Utah— Lightning Talks and Discussion

Panel Session Organizers: Patricia Cramer (Consultant, Utah, United States); Ashley Green (Utah Division of Wildlife Resources, United States)

This lightning session will focus on the collaborative partnerships within Utah, and the innovative approaches agencies and researchers have taken to build effective wildlife and fish mitigation across the state. State and federal agencies, a university, and counties and non-profit organizations found ways to contribute to truly multi-partner approaches and projects that not only make roads safer for motorists, but help wildlife move beneath the road in culverts and bridges made specifically for them.

Wednesday Field Trips

Field Trip 1: Mill Creek Culvert Replacement and Restoration

This half-day tour (4.5 hours round-trip) will take participants along the Mill Creek in Utah, which has undergone restoration in its upper nine miles and one lower mile of Porter Fork. Participants will examine a newly replaced culvert and an older culvert to be replaced. Discussions will address the difficulties of culvert replacement in this mountainous canyon near an urban area. Fisheries biologists and engineers will be on site to discuss the project from their perspectives, including the removal of fish species, stocking of native fish species, removal of man-made barriers and planting riparian vegetation. Lunch will be provided at the conclusion of this field trip when you return to the Convention Center. See Page 3 of this agenda for trip departure and return times.

Field Trip 2: Wetland Mitigation Bank and Deer Creek Restoration

This day tour (6 hours round-trip) will feature three sites displaying a variety of resource mitigation measures. First, participants will visit UDOT's largest wetland mitigation bank, located near Utah Lake. Discussions will address the physical process of creating the wetland, monitoring and maintenance, and UDOT's partnership with the U.S. Army Corps of Engineers and other agencies to make this project a reality. The second stop is at the Deer Creek stream restoration site in Provo Canyon. Participants will learn how the stream restoration efforts have improved transportation in the canyon. The final stop will be at a new corrugated steel plate culvert wildlife crossing, also located in Provo Canyon. This field trip will include lunch, snacks and additional rest stops. See Page 3 of this agenda for trip departure and return times.

Field Trip 3: Wellsville Wildlife Crossings and Legacy Nature Preserve

This full-day tour (10 hours round-trip) will highlight wildlife crossings and critical habitats for migratory birds. The first stop will be at the Wellsville Wildlife Crossings, where participants will visit two existing crossings and one interchange retrofit under construction. These crossings include corrugated steel plate culverts, wildlife fencing and escape ramps. At the Bear River Migratory Bird Refuge, participants will have lunch and take in the exhibits and nature trails. The tour concludes at the Legacy Nature Preserve, which provides crucial habitat for over 250 species of migratory birds. Located along the Great Salt Lake, the Preserve was developed to offset the projected impacts of the Legacy Parkway. This field trip will include lunch, snacks and additional rest stops. See Page 3 of this agenda for trip departure and return times.

Field Trip 4: Nugget Canyon and Trapper's Point, Wyoming

This extended-day tour (13 hours round-trip) will travel through the spectacular landscape of high-elevation sagebrush steppe habitat along the Wyoming Range, Gros Ventre Range, and Wind River Range mountains in southwestern Wyoming. The first stop is Nugget Canyon, where U.S. Highway 30 bisects crucial winter range and migration routes for several animals, including pronghorn, mule, deer and elk. At this site, participants will observe wildlife crossing structures that have benefited several wild game species. Trapper's Point, the second stop, is a well-known pronghorn migration bottleneck. Here participants will observe overpasses, underpasses and game fence designed to safely move wild game across the highway. This field trip will include lunch, snacks, and additional rest stops. See Page 3 of this agenda for trip departure and return times.

Thursday 8:00 AM Parallel Sessions

Partnership and Collaboration 5: Eco-Logical at Ten Years – Looking Back to Move Forward

Ten Years of Implementing Eco-Logical: Looking Back at Landmark Interagency Collaboration and Discussing the Path Forward Towards Healthy Ecosystems and Accelerated Project Delivery

Panel Session Organizers: Julianne Schwarzer (U.S. DOT Volpe Center, Massachusetts, United States); Michael Ruth and David Williams (U.S. DOT Federal Highway Administration, Washington, DC, United States)

Through this session participants will learn how each of the Eco-Logical signatory agencies has independently and collaboratively worked to foster an ecosystem approach; and explore the experiences of the audience, to understand, the successes of and challenges to, implementing ecosystem landscape scale approaches. It will conclude with a summary of plans on the horizon for each agency, and an opportunity for audience members to share their vision for the future of Eco-Logical.

Partnership and Collaboration 6: Public Engagement for Success

Visualizing Landscape Biogeography in Transportation Planning to Enhance Adoption of Ecologically Informed Enhancement Strategies by Rural Stakeholders

Author: Julia Badenhope (Iowa State University, United States)

A workshop method will be presented using maps to teach rural communities about relationships among hidden and visible landscape processes that influence built ecology, used in the context of rural transportation planning. In facilitating authentic discovery of the effects and functional relationships of land, water, and habitat with town patterns, residents situate ecological knowledge within their understanding of community. This situated knowledge supports the ultimate decision making and design solutions for more ecologically performative systems.

No Sport for the Short-Winded: Implementing a Successful Wildlife Crossing Project from the Grassroots

Authors: Chris Slesar (Monkton Conservation Commission, Vermont, United States)

A case study of the grassroots effort that conceptualized, funded, designed, and constructed two wildlife crossing structures. Designed to facilitate

the safe crossing of a regionally significant and diverse amphibian population in Addison County, Vermont, the structures are exceeding expectations and performing extraordinarily well - providing safe passage to thousands of amphibians, as well as many small- to medium-sized mammals.

Safe Wildlife Passage in Teton County, WY— Citizen Involvement to Implementation

Panel Session Organizer: Kim Trotter (Yellowstone to Yukon Conservation Initiative, Idaho, United States)

Safe Wildlife Crossings for Jackson Hole illustrates how human safety and wildlife connectivity can be improved through locally-led initiatives. Since 1994, diverse stakeholders have worked together to reduce wildlife vehicle collisions and build strong relationships with local and regional decision-makers. Community involvement influenced Teton County to fund a Wildlife Crossings Master Plan and WYDOT to install ungulate underpasses in an upcoming highway expansion. We will discuss successes and lessons learned in these partnerships.

Aquatic Species 2: Mitigating Impacts to Fish and Their Habitat

Identifying Culvert Replacement Priorities to Maintain Connectivity of Cold Water Streams in the Face of Climate Change

Authors: Scott Jackson, Brad Compton, and Kevin McGarigal (University of Massachusetts Amherst, United States)

We used the Conservation Assessment and Prioritization System (CAPS), a model that incorporates biophysical and anthropogenic data to evaluate ecological integrity, to assess changes in the aquatic connectivity for culvert replacement projects in the northeastern United States. We then used the methodology to address connectivity specifically for cold-water fish habitat, assessing the potential for restoring connectivity for cold-water streams under current conditions and when taking into account the impacts of climate change on stream temperatures.

Fish Creek Public Infrastructure Project: Designing Long-Term Stream Resiliency and Fish Passage

Authors: Sirena Brownlee and Sandy Beazley (HDR, Inc., Colorado, United States); Brandon Parsons (THK Associates, Inc., Colorado, United States)

After devastating floods destroyed significant portions of Fish Creek Road, trails and utilities in Estes Park, Colorado, the project design team was faced with numerous coordination and engineering challenges that required a creative approach to meet the needs of the community and regulatory agencies. The design team incorporated innovative and experimental design features to retrofit existing culverts for fish passage and designed other

enhancements to Fish Creek for future resiliency against flood events.

Towards Achieving Overall Benefit for Species at Risk Related to a Mega Transportation Corridor

Author: April Currie and Darlene Proudfoot (Ministry of Transportation, Ontario, Canada)

Highway 407 East is a new highway that traverses three watersheds and twelve watercourse crossings that are home to Redside Dace (*Clinostomus elongatus*), an endangered species protected under the Ontario Endangered Species Act. Under this legislation, Redside Dace receives species and habitat protection. This presentation will highlight the measures applied to avoid and minimize construction and operational impacts through mitigation and restoration of aquatic ecosystems. Lessons learned during the project will also be presented.

Noise Attenuation Effectiveness and Drivability of New Double-Walled Pile Technology

Authors: Per Reinhall (University of Washington, United States); Julie Hampden (Marine Construction Technologies, Washington, United States); Marion Carey (Washington State Department of Transportation, United States)

Impact pile driving of steel piles in aquatic environments produces extremely high underwater sound levels. Current noise attenuation techniques provide limited noise reduction due to the unconstrained propagation of Mach sound waves directly from the sediment into the water. Marine Construction Technologies in collaboration with University of Washington, and Washington State Department of Transportation has developed a novel double-walled pile that decreases the total noise transmitted into the water while maintaining drivability and capacity.

Crossings and Connectivity 6: Over, Under, or Through – Finding the Best Fit for Wildlife

Pre- and Post-Construction Monitoring for American Pika Connectivity across Interstate Highway I-90 in Washington State

Authors: Kristina Ernest (Central Washington University, United States); Carly Wickhem (Harris Environmental, Inc., Washington, United States); Jill Hooghkirk (Warner Pacific College, Oregon, United States); Raychel Parks (Washington Department of Fish and Wildlife, United States); Patricia Garvey-Darda (U.S. Forest Service, Okanagan-Wenatchee National Forest, Washington, United States)

The American pika (*Ochotona princeps*) is a low-mobility species with limited dispersal and specialized habitat requirements. We monitored populations over the past 9 years to understand how

pikas respond to an interstate highway corridor (I-90) near Snoqualmie Pass, Washington State. We used multiple approaches, including occupancy surveys of both natural and anthropogenic habitat, habitat assessments, radio-telemetry, and diet choice experiments. Pikas showed unexpected resilience to habitat modifications, and have started to colonize recently-completed construction areas.

Evidence-Based Development of an Arboreal Wildlife Bridge to Prevent Habitat Fragmentation and Isolation

Authors: Ian White (People's Trust for Endangered Species, United Kingdom); Sophie Hughes (Animex International, United Kingdom)

The ever-increasing global transport network has the potential to fragment and isolate arboreal habitats, prompting the need for evidence-based, effective mitigation solutions. Although many wildlife bridges have been installed, most have proven to be expensive or ineffective, highlighting the requirement for further research. Here we explore the development of an affordable bridge that has been proven, through dedicated research, to effectively enable arboreal species to traverse fragmented habitats in both the United Kingdom and Japan.

Wildlife Movement Through Culverts and Bridges in Vermont: Influences of Structure and Site Characteristics

Author: Paul Marangelo (The Nature Conservancy, Vermont, United States)

We assessed wildlife use of culverts and bridges to clarify relationships between structural dimensions and frequency of wildlife use of transportation structures in a Northern Appalachians setting. While site use varied substantially, species use patterns/structure size relationships were consistent with a modified "movement guild" framework, and local structural connectivity of forest habitat explained use variation between sites. Our results suggest how site and structure characteristics can be modified to improve habitat connectivity across road corridors.

Lessons Learned From a Combined Large Wildlife and Endangered Species Mitigation System on Highway 69

Authors: Andrew Healy (Ontario Ministry of Transportation, Canada); Kari Elizabeth Gunson (Eco-Kare International, Ontario, Canada)

Implementing mitigation measures for large wildlife and endangered species within the same location has led to innovations in creating one combined mitigation system. Examples of new design techniques include combined large wildlife / reptile fencing, reptile escape opportunities, and multi-species crossing structure design. Post-construction monitoring continues to highlight the successes and challenges with the mitigation system, and ensures that design

modifications are implemented into new construction contracts as highway expansion continues.

Thursday 10:00 AM Parallel Sessions

Sustainability and Resilience 2: Increasing Resilience in the Transportation System

Green Infrastructure: Nature-Based Approaches to Increasing Resilience in the Transportation System

Panel Session Organizer: Robert Hyman (U.S. DOT Federal Highway Administration, Washington, DC, United States)

Green infrastructure (also called natural and nature-based solutions) presents opportunities to increase the resilience of the US's 60,000 miles of coastal roads to storm surge and sea level rise, while simultaneously enhancing roadside coastal ecosystems. This session introduces FHWA's green infrastructure pilot program and presents three real-world case studies from agencies developing ecosystem-based approaches such as living shorelines, vegetated berms, and other concepts to protect coastal roads in New England, the Gulf Coast, and California.

Policy and Regulation 2: Planning and Policy – Vantage Points for Conservation and Connectivity

An Objective Road Risk Assessment Method for Multiple Species: Ranking 166 Reptiles and Amphibians in California

Authors: Cheryl Brehme and Robert Fisher (U.S. Geological Survey, California, United States)

We describe a method to risks of negative road impacts to wildlife populations and species, applied to over 160 species in California. Risk scores were based on a suite of life history and space-use characteristics associated with negative road effects. Species were grouped into categories ranging from very low to very high risk. This decision support tool is designed to help inform and prioritize road mitigation efforts, including the need for wildlife barriers and crossings.

Optimizing Locations and Management of Road Underpasses on a 4-Lane Highway in Central Georgia to Mitigate Impacts on Black Bears and Reduce Construction Costs

Authors: David Jared (Georgia Department of Transportation, United States); Michael Hooker,

Michael Chamberlain, Karl Miller, and Robert Warren (University of Georgia, United States)

This presentation describes how Georgia DOT and university researchers used road-crossing and habitat-use data collected during three years from 63 GPS-collared black bears to modify the proposed locations of underpasses and fencing on a road-widening project. Georgia DOT estimated a savings of \$1.18 million in future construction costs because of these modifications, while also helping to mitigate the potential negative effects of the future 4-lane highway on black bears in the area.

The Road Beyond: Highway Mitigation and Landscape Connectivity Planning in Two Colorado Counties

Authors: Julia Kintsch (ECO-resolutions, Colorado, United States); Paige Singer (Rocky Mountain Wild, Colorado, United States); William Ruediger (Wildlife Consulting Resources, Montana, United States); Ashley Nettles (U.S. Forest Service, Colorado, United States); Adam Palmer (Eagle County, Colorado, United States)

Wildlife connectivity assessments were conducted in Eagle and Summit Counties, Colorado. These multi-species landscape connectivity plans identify compatible land use and land management in addition to mitigation at the roadway interface. This approach employed habitat-based modeling and a systematic expert process to develop a common vision for protecting and restoring connectivity for wildlife, transcending ownership and jurisdictional boundaries, and engaging the department of transportation, land managers, county and town planners, ski areas and other stakeholders.

Long-Term Research to Address Restoration of Ecological Connectivity at Multiple Scales: Interstate Highway I-90 Snoqualmie Pass East Case Study

Author: Anthony Clevenger (Western Transportation Institute, Montana State University, Alberta, Canada)

The I-90 transportation corridor is a critical area for demographic connectivity of wildlife populations throughout the Pacific Northwest. We describe how connectivity restoration areas were identified and prioritized, and a tiered approach to address ecosystem-based research at three spatial scales. To reach this goal a unique consortium of research groups were formed to conduct collaborative, long-term research in the corridor. We explain the monitoring framework and guidelines to assess whether project connectivity objectives were met.

Vegetation Management 2: Growing Concerns and Cultivating Solutions

What County Engineers and Roadside Managers Think About Integrated Roadside Vegetation Management

Authors: Kristine Nemeč, Andrew Stephenson and Mary E. Losch (University of Northern Iowa, United States)

Integrated roadside vegetation management is voluntary at the county level in Iowa and over half of Iowa counties do not have IRVM programs. Social science approaches such as community-based social marketing offer promising methods for fostering sustainable behaviors in communities. We surveyed county engineers and roadside vegetation managers to understand perceived barriers and benefits to using IRVM, and how IRVM is being implemented. Results will be used to encourage non-participating counties to implement IRVM.

Tracing the Highway Contributions to Carbon and Nitrogen Deposition Using Plant Biomonitors and Soil

Author: Noreen Khalid (G.C. Women University Sialkot, Pakistan)

This presentation describes the vehicular contribution of carbon and nitrogen pollution along roadside areas. The level of total carbon (C) and total nitrogen (N) was studied in a variety of wild plant species and soils taken from different sites along M-2 road in Pakistan. The effect of seasonal variation on C and N levels was also studied. Besides increasing pollution along roadsides, vehicular caused high level of C and N could also affect the vegetation growing nearby roads.

Evaluation of Effectiveness and Cost-Benefits of Woolen Roadside Reclamation Products

Authors: Robert Ament (Western Transportation Institute, Montana State University, United States) and Monica Pokorny (WTI-MSU and USDA Natural Resources Conservation Service, Montana, United States)

Results of this research project for the Montana Department of Transportation and the Center for Environmentally Sustainable Transportation in Cold Climates will be shared regarding the development of two types of roadside reclamation products: woolen erosion control blankets and wool incorporated into wood fiber compost at a 40:1 ratio (compost-wool, by weight). The wool ECBs were the most promising, outperforming standard straw-coconut ECBs by having better vegetation establishment and cover and fewer weeds.

Pollinator Diversity and Habitat Requirements: How Roadside Management May Impact Different Pollinator Groups

Author: Robert Jean (Environmental Solutions & iInnovations, Inc., Indiana, United States)

Pollinators include many species many which can be found on roadsides. Concern due to declines of

pollinators have led to executive actions and best management practices for pollinators and their habitat. These policies are aimed to protect pollinators but little is known about their effects. This talk introduces the diversity of pollinators and their habitat requirements. Implications of planting locations, management techniques and suggestions for prioritized research on pollinators and roadsides will be presented.

Crossings and Connectivity 7: Carcass Data Collection and Application

A Meta-Analysis of Carcass Disappearance Field Experiments in Conservation Biology with Guidelines For Future Trials

Author: Rafael Barrientos (CIBIO—Research Center in Biodiversity and Genetic Resources, Portugal)

The exponential development of human infrastructures causes mortality in thousands of wildlife species. In order to evaluate its impact in population dynamics, we need to control for bias in carcass persistence. Here we review the main drivers influencing carcass persistence that limit the estimation of wildlife mortality rates in different infrastructures and suggest guidelines for correct planning of future trials.

Collision and Movement Data Together Inform Highway Mitigation Priorities for Migratory Mule Deer in Western Wyoming

Author: Corinna Riginos (Northern Rockies Conservation Cooperative, Wyoming, United States)

Transportation managers have long relied on collision and carcass records to identify where ungulates are impacted by roads and to prioritize those areas for mitigations. We compared these locations in Wyoming to ungulate migration routes derived from GPS collar data. Together both sources of data paint a more complete picture than either source alone and highlight the multitude of factors that need to be considered in deciding where to prioritize mitigations.

Every Mile Counts of Roadkill Across California's Road System

Authors: Gregg Treinish and Aisling Force (Adventure Scientists, Montana, United States); Fraser Shilling and David Waetjen (Road Ecology Center, University of California Davis, United States)

Comprehensive, large-scale roadkill surveys are non-existent, even though wildlife-vehicle conflict impact the economy, human safety, and wildlife health. We propose to develop a repeatable method for complete roadkill accounting across California's 156,000 km paved road system. We will recruit and deploy 1,600 teams of cyclists to conduct careful surveys along roadways on a quarterly basis. They will use a newly-available, one-click app, suitable for

cycle-surveying, which will send data to the California Roadkill Observation System.

Use of a Smartphone Application to Collect Animal Carcass Data Along Highway 63 in Alberta, Canada

Author: Sandra MacDougall (Red Deer College, Alberta, Canada)

The *Alberta Wildlife Watch (AWW)* smartphone application was developed to gather accurate and timely animal carcass data, and live wildlife sighting information to improve analysis and reporting capabilities within the province of Alberta, Canada. This presentation summarizes the results of phase one and two testing from May 2014 to November 2016 and discusses four key areas critical to successful implementation of a cellphone-based reporting system: training, user engagement, user error, and app design considerations.