

# Wildlife Issues to Consider for Transportation Planning on Federal Lands

February 13, 2013



Photo Courtesy: Rob Ament

NOTE: US HWY 191 passing thru BLM lands near Pinedale, WY. This area now has 2 wildlife overpasses and 4 underpasses

Sponsored By:

**Great Northern  
Landscape Conservation  
Cooperative**



and

**Paul S. Sarbanes  
Transit in Parks  
Technical Assistance Center**



## Presented By:



**Rob Ament**  
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**Tony Clevenger**  
Senior Research Scientist



**Marcel Huijser**  
Research Wildlife Ecologist



**MONTANA**  
STATE UNIVERSITY

**Western  
Transportation  
Institute**

## Agenda

- Overview of the ways road infrastructure and traffic can negatively affect mammals, birds, herpetiles, and fish.
- Wildlife-vehicle collisions, their cost-benefits and both proven and potential new solutions for their reduction.
- Habitat connectivity and genetic exchange; questions to think about when developing plans, designs and monitoring programs.
- MAP-21's new wildlife and habitat connectivity provisions that are important for federal land managers.
- An update on the WGA's wildlife corridors and crucial habitats decision support system and their potential use for transportation planning and projects.

## 1. Effects of Road Infrastructure and Traffic on Wildlife

Tony Clevenger  
Senior Research Scientist

Road Ecology  
Western Transportation  
Institute



Photo courtesy of Tony Clevenger

## Effects of Roads

### Road System Network

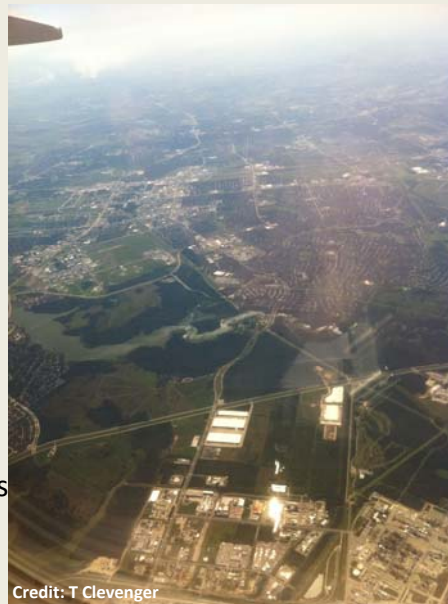
- A “Giant Net” on the natural landscape
- Easy movement and travel
- Slices and divides up nature

### Roads and Their Impacts

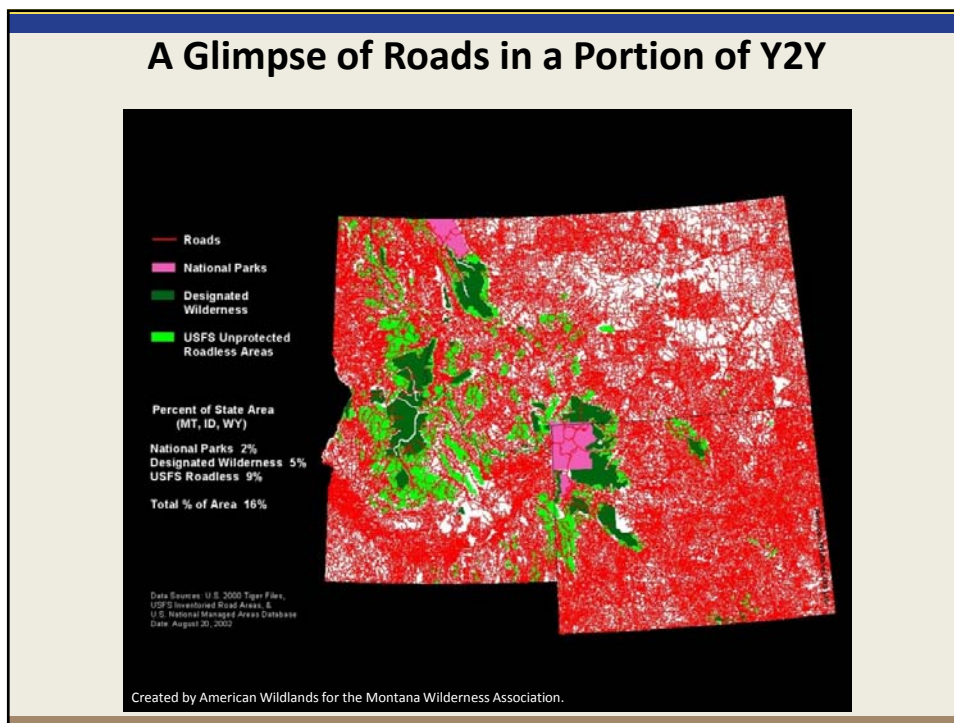
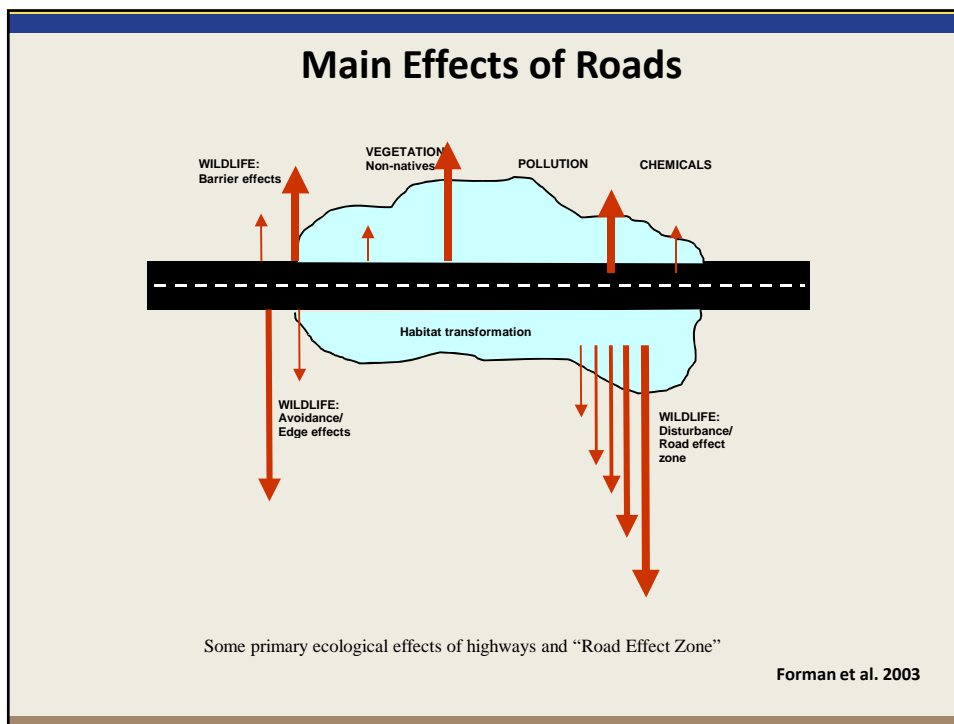
- “The Sleeping Giant”
- Road-kill overtook hunting as leading direct cause of wildlife mortality
- 15-20% of land impacted by roads

### Our Job

Reconnect Nature



Credit: T Clevenger



## How Roads Impact Wildlife

- Mortality (Road-kill)
- Loss of habitat
- Blocking of movements - “Barrier effect”
  - Habitat fragmentation (animals need to move)
    - Isolation
    - Local extinction
- Other impacts
  - Too much noise and lights
  - Pollution from vehicles - runoff!
  - Changes in water flow (streams),
  - microclimate



Photo Courtesy of ???

## Roads – Can't live without them...

Comparatively more detrimental than other types of fragmentation

Understanding mortality and fragmentation is central to finding solutions

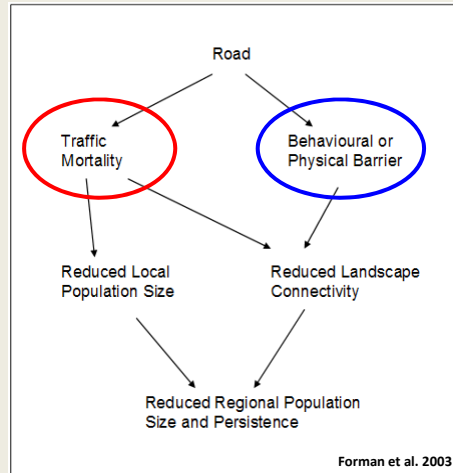


Credit: A Taylor



## Effects of Mortality and Barrier Effects on Population Viability

Greater effect on long-term viability →



## Keep Connections Intact

Landscape scale



Local scale



## 2. Addressing Wildlife – Vehicle Collisions (WVCs)

Marcel Huijser  
Research Wildlife Ecologist

Road Ecology Program  
Western Transportation  
Institute



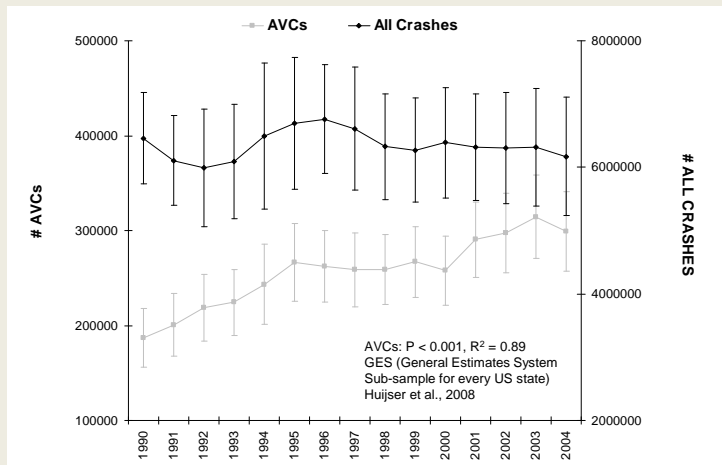
## Human Perspective

	US	Canada	Europe
Animal-vehicle-Collisions	1-2 million (deer)	± 28,000	507.000 (ungulates)
Human injuries	29.000	1,565	30.000
Human fatalities	211	18	300
Property damage	> 1 billion US\$	200 million CAN\$	> 1 billion US\$

This is per year  
.... and increasing

Conover et al., 1995; Cook & Daggett, 1995;  
Groot Bruinderink & Hazebroek, 1996;  
L-P Tardiff & Associates Inc. 2003;  
Huijser et al. 2008

### Trend Animal-Vehicle Collisions

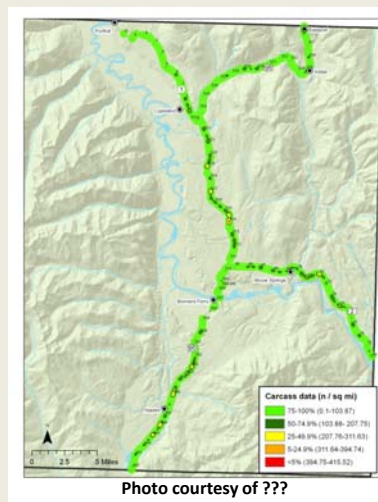


1-2 million ungulate-vehicle collisions / year in US (Huijser et al. 2008)

### Hotspot Analyses



Crash data



Carcass data



## When to Take Action?

- Human safety
- Sensitive or endangered species
- Population survival probability
- Negative effect on population level
- Mass mortality
- Loss or suffering of individuals



Photo courtesy of ???  
Alabama red-bellied turtle road kill

## Federally Listed Species

Species Group	Species Name
Amphibians	California tiger salamander ( <i>Ambystoma californiense</i> ), C. CA, S. Barb., Son. county
Amphibians	Flatwoods salamander ( <i>Ambystoma cingulatum</i> )
Amphibians	Houston toad ( <i>Bufo houstonensis</i> )
Reptiles	American crocodile ( <i>Crocodylus acutus</i> )
Reptiles	Desert tortoise ( <i>Gopherus agassizii</i> ), except in Sonoran Desert
Reptiles	Gopher tortoise ( <i>Gopherus polyphemus</i> ), W of Mobile/Tombigbee Rs.
Reptiles	Alabama red-bellied turtle ( <i>Pseudemys alabamensis</i> )
Reptiles	Bog turtle (Muhlenberg) northern population ( <i>Clemmys muhlenbergii</i> )
Reptiles	Copperbelly water snake ( <i>Nerodia erythrogaster neglecta</i> )

Species Group	Species Name
Reptiles	Eastern indigo snake, eastern indigo ( <i>Drymarchon corais couperi</i> )
Birds	Audubon's crested caracara ( <i>Polyborus plancus audubonii</i> ), FL pop.
Birds	Hawaiian goose ( <i>Branta sandvicensis</i> )
Birds	Florida scrub jay ( <i>Aphelocoma coerulescens</i> )
Mammals	Lower Keys marsh rabbit, ( <i>Sylvilagus palustris hefneri</i> )
Mammals	Key deer ( <i>Odocoileus virginianus clavium</i> )
Mammals	Bighorn Sheep, Peninsular CA pop. ( <i>Ovis canadensis</i> )
Mammals	San Joaquin kit fox ( <i>Vulpes macrotis mutica</i> )
Mammals	Canada lynx ( <i>Lynx canadensis</i> ), lower 48 states
Mammals	Ocelot ( <i>Leopardus pardalis</i> )
Mammals	Florida panther ( <i>Felis concolor coryi</i> )
Mammals	Red wolf ( <i>Canis rufus</i> ), except where XN

## Traditional Mitigation Measures



## Effective Measures

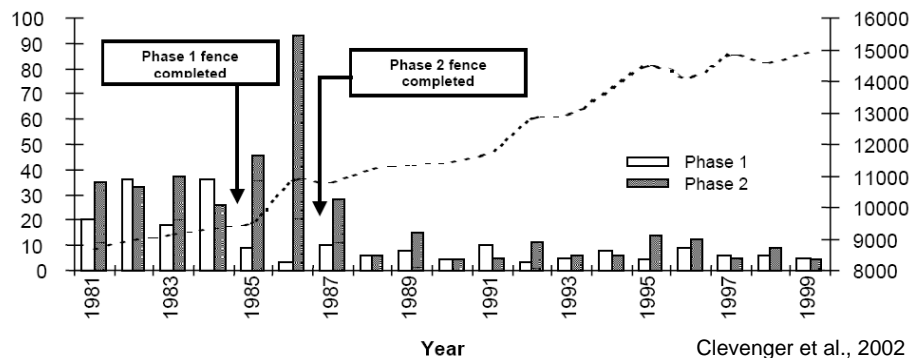
Mitigation measure	Effectiveness	Source
Seasonal wildlife warning sign	26%	Sullivan et al. (2004): 51%; Rogers (2004): 0%
Vegetation removal	38%	Jaren et al. (1991): 56%; Lavsund and Sandegren (1991): 20%
Fence, gap, crosswalk	40%	Lehnert and Bissonette (1997): 42%, 37%
Population culling	50%	Review in Huijser et al. 2007a
Relocation	50%	Review in Huijser et al. 2007a
Anti-fertility treatment	50%	Review in Huijser et al. 2007a
Fence (incl. dig barrier)	86%	Reed et al. (1982) 79%; Ward (1982): 90% Woods (1990): 94-97%; Clevenger et al. (2001): 80%; Dodd et al. (2007): 87%
Fence, underpass	86%	Reed et al. (1982) 79%; Ward (1982): 90% Woods (1990): 94-97%; Clevenger et al. (2001): 80%; Dodd et al. (2007): 87%
Fence, under- and overpass	86%	Reed et al. (1982) 79%; Ward (1982): 90% Woods (1990): 94-97%; Clevenger et al. (2001): 80%; Dodd et al. (2007): 87%
Animal detection system (ADS)	87%	Mosler-Berger and Romer (2003): 82%; Dodd and Gagnon (2008): 91%
Fence, gap, ADS	87%	Mosler-Berger and Romer (2003): 82%; Dodd and Gagnon (2008): 91%
Elevated roadway	100%	Review in Huijser et al. 2007a
Road tunnel	100%	Review in Huijser et al. 2007a

## Fences in Combination with Crossing Structures



## Collision Reduction

86% reduction (79-99%)



## Cost-Benefit Analyses

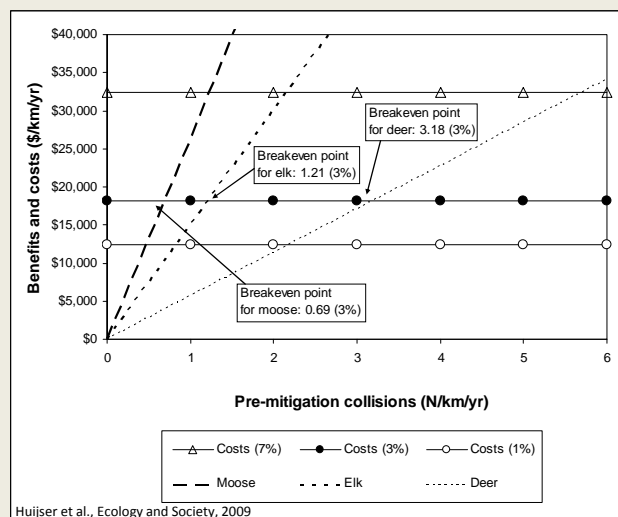
- Costs: Equipment, installation, construction, operation, maintenance, removal
- Benefits: Reduced costs collisions

Description	Deer	Elk	Moose
Vehicle repair costs per collision	\$2,622	\$4,550	\$5,600
Human injuries per collision	\$2,702	\$5,403	\$10,807
Human fatalities per collision	\$1,002	\$6,683	\$13,366
Towing, accident attendance and investigation	\$125	\$375	\$500
Hunting value animal per collision	\$116	\$397	\$387
Carcass removal and disposal per collision	\$50	\$75	\$100
<b>Total</b>	<b>\$6,617</b>	<b>\$17,483</b>	<b>\$30,760</b>

75 year long period

Discount rate:  
1%, 3%, 7%

## Break-Even Points (fencing, underpasses, jump-outs)

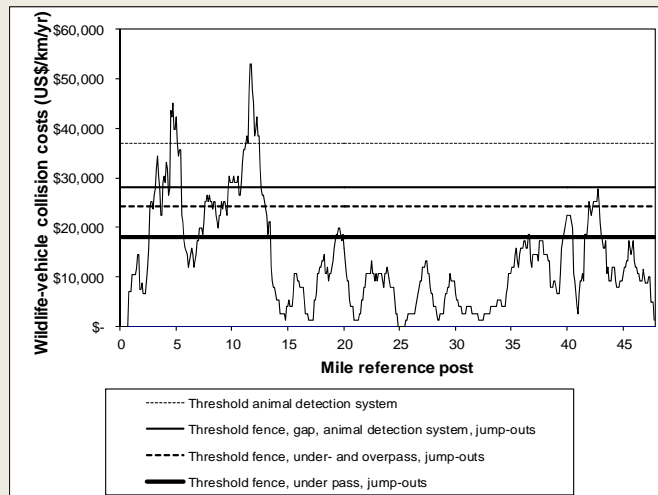


## ≥80% Reduction of WVCs

Threshold values	Discount rate	Fence	Fence, under pass, jump-outs	Fence, under, and overpass, jump-outs	ADS	Fence, gap, ADS, jump-outs	Elevated roadway	Road tunnel
\$/yr	1%	\$5,223	\$12,437	\$15,975	\$35,279	\$25,634	\$2,233,094	\$3,328,567
\$/yr	3%	\$6,304	\$18,123	\$24,230	\$37,014	\$28,150	\$3,109,422	\$4,981,333
\$/yr	7%	\$8,931	\$32,457	\$45,142	\$41,526	\$34,437	\$5,369,961	\$9,246,617
deer/km/yr	1%	0.92	2.19	2.81	6.13	4.45	337.48	503.03
deer/km/yr	3%	1.11	3.18	4.26	6.43	4.89	469.91	752.81
deer/km/yr	7%	1.57	5.70	7.93	7.21	5.98	811.54	1397.40
elk/km/yr	1%	0.35	0.83	1.06	2.32	1.69	127.73	190.39
elk/km/yr	3%	0.42	1.21	1.61	2.45	1.85	177.85	284.92
elk/km/yr	7%	0.59	2.16	3.00	2.73	2.26	307.15	528.89
moose/km/yr	1%	0.20	0.47	0.60	1.32	0.96	72.60	108.21
moose/km/yr	3%	0.24	0.69	0.92	1.38	1.05	101.09	161.94
moose/km/yr	7%	0.34	1.23	1.71	1.55	1.29	174.58	300.61

Huijser et al., Ecology and Society, 2009

## Example road section (MT Hwy 83, MT, USA)



Huijser et al., Ecology and Society, 2009

### 3. Addressing Habitat Connectivity and Genetic Exchange

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Photo courtesy of Tony Clevenger

### Mitigating impacts of roads with wildlife crossing infrastructure

1. Placement and planning
2. Design
3. Monitoring techniques
4. Evaluating performance
5. Resources available




Photo courtesy of ???



Photo: T Clevenger






**Placement approaches**  
*Where should crossing structures go?*

**Project Level**  
Site level without ecosystem planning

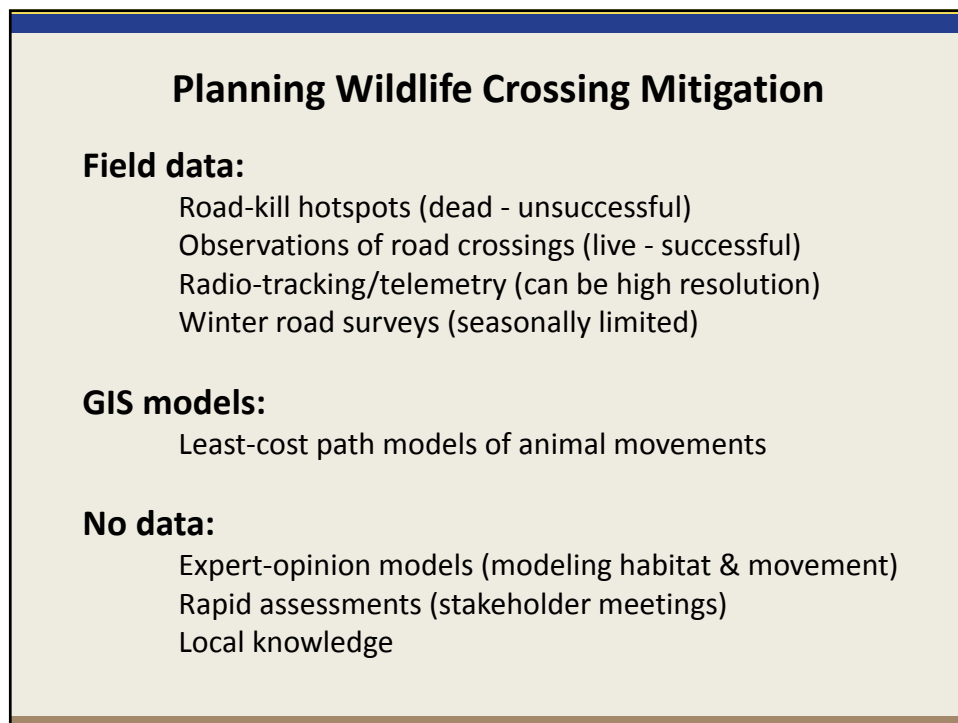
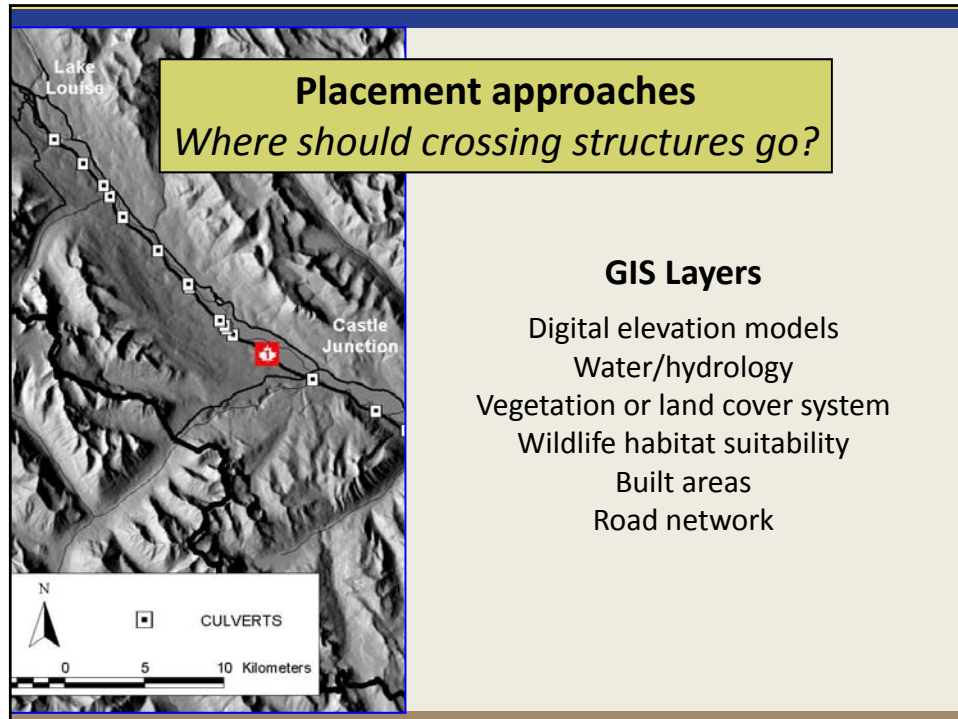
**Ecosystem-Level**  
Intersection of broad transportation & ecological corridors



**Placement approaches**  
*Where should crossing structures go?*

**Planning Data & Resources**

- Road network data
- Road-kill data
- Aerial photos
- Land cover/vegetation maps
- Topographic maps
- Landownership maps
- Wildlife habitat maps
- Empirical field data
- Wildlife movement model data



## Basic Principles

- Movements are associated with topographic features
- Design and manage for multiple species
- Agencies need to coordinate in short- and long-term
- Structures must be integrated into larger network



Photo: M Huijser

## Design

### Overpass Design:

1. Landscape bridge
2. Wildlife overpass
3. Multi-use overpass
4. Canopy crossing



Credit: T Clevenger

### Underpass Design:

5. Viaduct/flyover
6. Large mammal underpass
7. Multi-use underpass
8. Underpass with water flow
9. Small/medium-sized mammal underpass
10. Modified culvert design
11. Herpetile tunnel

## FHWA Wildlife Crossing Structure Guidelines

(Clevenger & Huijser 2011)

Type	Usage	Species/groups	Minimum dimensions	Recommended dimensions
<b>Wildlife Overpass</b>	Wildlife only	Large mammals Lo mobility medium mammals Hi mobility medium mammals Small mammals Reptiles Amphibians (adapt)	W: 130-165' (40-50 m)	W: 165-230' (50-70 m)
<b>Multi-use Overpass</b>	Wildlife & human activities	Same as above	W: 32' (10 m)	W: 50-130' (15-40 m)

Clevenger, A.P. & M.P. Huijser. 2011. Wildlife Crossing Structure Handbook, Design and Evaluation in North America, Publication No. FHWA-CFL/TD-11-003. Department of Transportation, Federal Highway Administration, Washington D.C., USA.

## FHWA Wildlife Crossing Structure Guidelines

Type	Usage	Species/groups	Minimum Dimensions	Recommended Dimensions
<b>Large mammal underpass</b>	Wildlife only	Large mammals Lo mobility medium mammals Hi mobility medium mammals Small mammals Reptiles Semi-arboreal (adapt) Semi-aquatic (adapt) Amphibians (adapt)	W: 23' (7 m) H: 13' (4 m)	W: >32' (>10 m) H: >13' (>4 m)
<b>Multi-use underpass</b>	Wildlife & human activities	Same as above	W: 16.5' (5 m) H: 8.2' (2.5 m)	W: >23' (>7 m) H: >11.5' (>3.5 m)

Clevenger, A.P. & M.P. Huijser. 2011. Wildlife Crossing Structure Handbook, Design and Evaluation in North America, Publication No. FHWA-CFL/TD-11-003. Department of Transportation, Federal Highway Administration, Washington D.C., USA.

## Design of North American Wildlife Crossings

### *Species and Species Groups*

#### Ungulates:

Moose, Elk, Deer sp., Pronghorn,  
Mtn sheep, Mtn goat

#### Carnivores:

Black bear, Grizzly bear, Wolf,  
Coyote, Fox1, Fox2, Cougar, Bobcat  
Lynx, Wolverine, Fisher, Marten,  
Weasel, Badger

Low mobility medium-sized mammals

Semi-arboreal mammals

Semi-aquatic mammals

Small mammals

Amphibians

Reptiles

## Design of North American Wildlife Crossings

### **Recommendation categories:**

1\_Recommended/Optimum solution

2\_Possible if adapted to local conditions

3\_Not recommended

4\_? Unknown, more data are required

5\_Not applicable

### Slide 37

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**AK12** what is purpose of this slide?  
Angela Kociolek, 9/28/2011

### Slide 38

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**AK13** what is purpose of this slide?  
Angela Kociolek, 9/28/2011



## Developing and measuring performance

What's a successful crossing structure ?  
What do we mitigate for ?  
What taxa ?  
Single species, multiple species, communities ?



## Developing & Measuring Performance

1. Genetic interchange
2. Biological requirements met
3. Dispersal of subadults, recolonizations
4. Population redistribution with environmental change
5. Long-term maintenance of metapopulations, community stability, and ecosystem processes



## Monitoring techniques

### Overpasses



## Monitoring Techniques

### Underpasses



## Monitoring Techniques

### Underpasses – Small Fauna

Infrared cameras



Credit: T Clevenger



Credit: T Clevenger

Sooted track-plates



Credit: Hans Bekker

Mark-recapture

## Customizing Transportation Needs

### **Different agencies require different information**

Operations, Landscapes, Wildlife

### **National Guidelines for Crossing Structures**

Broad-based, but applicability at regional scale ? ?

### **Customizing needs**

Proper scale and boundaries

Agency or Park (province/state/federal)

Ecological/ Transboundary

Hans Bekker

## 4. New Legislation and New Wildlife Information: MAP-21 and WGA's Wildlife Corridors Initiative

Rob Ament  
Road Ecology  
Program Manager

Western Transportation Institute



Photo courtesy of ???

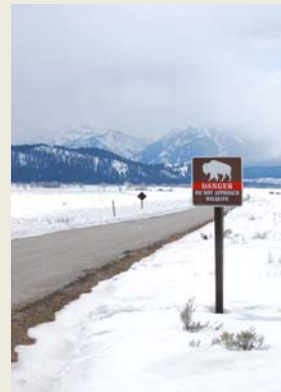


## Moving Ahead for Progress in the 21<sup>st</sup> Century or MAP-21

### A "BIG DEAL" FOR WILDLIFE

First national transportation law to weave throughout its programs authority and use of program dollars to reduce Wildlife – Vehicle Collisions and address Ecological Connectivity

- FHWA
- federal land management agencies
- State DOTs
- Metropolitan Transportation Organizations
- Tribal roads program
- Researchers



Callahan, R. and R. Ament 2012.  
[http://www.climateconservation.org/images/Papers\\_and\\_Reports/MAP-21-Synopsis-of-Wildlife-Provisions.pdf](http://www.climateconservation.org/images/Papers_and_Reports/MAP-21-Synopsis-of-Wildlife-Provisions.pdf)



## Sec. 1119 Federal Lands Transportation Program

( \$300 Million/Year)

Funding from this program can be used to pay for environmental mitigation in or adjacent to Federal land open to the public to improve public safety and:

- reduce vehicle-caused wildlife mortality while maintaining habitat connectivity;
- mitigate damage to wildlife, aquatic organism passage, habitat, and ecosystem connectivity, including the costs of constructing, maintaining, replacing, or removing culverts and bridges.
- Cap of \$10,000,000 per fiscal year for these activities.



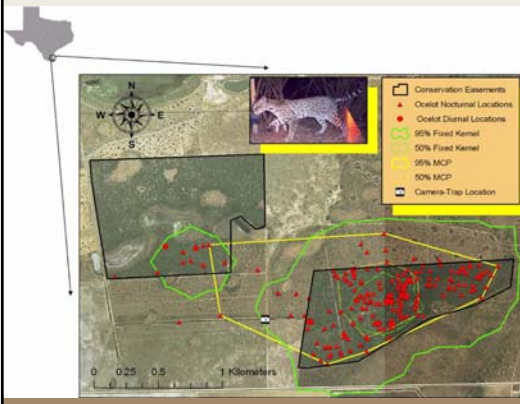
Image courtesy of [www.arc-solutions.org](http://www.arc-solutions.org)

Callahan, R. and R. Ament 2012. [http://www.climateconservation.org/images/Papers\\_and\\_Reports/MAP-21-Synopsis-of-Wildlife-Provisions.pdf](http://www.climateconservation.org/images/Papers_and_Reports/MAP-21-Synopsis-of-Wildlife-Provisions.pdf)

## Sec 1119. Federal Lands Access Program

(\$250 Million/Year)

“Funding from this program can be used to pay for environmental mitigation in or adjacent to Federal land to improve public safety and reduce vehicle-caused wildlife mortality while maintaining habitat connectivity.”



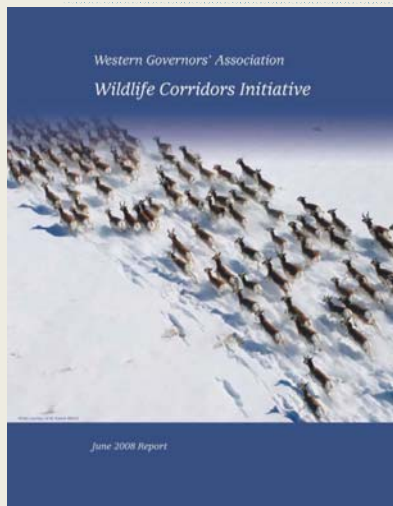
**Example:**  
South Texas NWR Complex  
Ocelot Crossings

Haines et al. 2006. First ocelot (*Leopardus pardalis*) monitored with GPS telemetry. *EuWildRes* (2006) 52: 216–218

## **SEC. 1311. PROGRAMMATIC MITIGATION PLANS (NEW)**

- States or Metropolitan Planning Organizations
- Regional, ecosystem, watershed, or statewide scale
- May encompass:
  - multiple environmental resources
  - a specific resource: i.e., parkland, wildlife habitat, aquatic resources
- Federal agencies with jurisdiction must be consulted

## **WGA Wildlife Corridors Initiative**

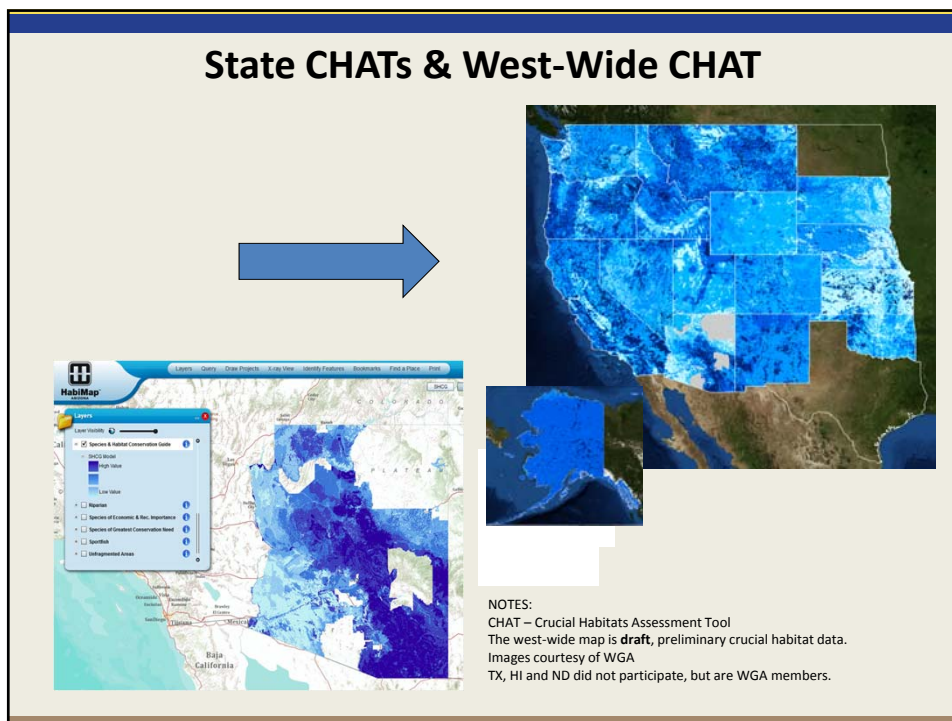


<http://www.westgov.org/wga/publicat/wildlife08.pdf>

- Identify key wildlife corridors and crucial habitats, and develop and coordinate policy options and tools for preserving those landscapes.
- Provide a user friendly online tool for parties to access consistent wildlife information across political boundaries to better inform land use planning.



## State CHATs & West-Wide CHAT



## CHAT: Benefits Across Scales

- Proactive efforts on threatened/endangered species
- Planning energy corridors/transmission lines
- Responding to climate adaptation needs
- Implementation of USFS national planning rule



- Broad energy development plans
- *Environmental Impact Statements*
- Resource management/land use plan revisions
- *Mitigation/restoration priorities*

Guides more detailed discussions about:

- *Infrastructure development*
- Wildlife corridor /movement needs
- Conservation easements
- Land acquisitions/exchanges

## Available State CHATs

- **California** Areas of Conservation Emphasis (ACE)
- **Montana** Crucial Areas Planning System (CAPS)
- **Washington** Priority Habitat Species (PHS On Line)
- Five-state **Southern Great Plains** CHAT - Lesser Prairie Chicken
- HabiMap™ **Arizona**
- **Wyoming** Interagency Spatial Database & Online Management (WISDOM)



## References

- Ament, R., Clevenger, A.P., Yu, O., and A. Hardy. 2008. An assessment of road impacts on wildlife populations in U.S. national parks. *Environmental Management*, 42(3):480-96.
- Beckmann, J. P., Clevenger, A.P., Huijser, M. and J. A. Hilty (eds). 2010. *Safe Passages: Highways, wildlife and habitat connectivity*.
- Callahan, R. and R. Ament. 2012. Policy Paper: Wildlife provisions from MAP-21's surface transportation programs, plans and projects. Center for Large Landscape Conservation, Bozeman, MT, 13 pp.
- Huijser, M.P., P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A.P. Clevenger, D. Smith & R. Ament. 2007. Wildlife-vehicle collision reduction study. Report to Congress. U.S. Department of Transportation, Federal Highway Administration, Washington D.C., USA.
- Huijser, M.P., Duffield, J.W., Clevenger, A.P., Ament, R.J. and P. T. McGowen. 2009. Cost-benefit analyses of mitigation measures aimed at reducing collisions with large ungulates in North America; a decision support tool. *Ecology and Society* 14 (2):15.
- Huijser, M.P., J. Fuller, M.E. Wagner, A. Hardy & A.P. Clevenger. 2007. Animal-vehicle collision data collection. NCHRP Project 20-05/Topic 37-12. Prepared for the Transportation Research Board of the National Academies, Washington, DC, USA.
- National Research Council. 2005. *Assessing and managing the ecological impacts of paved roads*. The National Academies Press, Washington, D.C.

## Resources Available

FHWA manuals

[Best Practices Manual: Wildlife vehicle collision reduction study](#)

[Wildlife crossing structure handbook](#)

National Training Center USFWS

Websites: FHWA, TRB, AASHTO, Critter Crossings, ARC Solutions, etc.

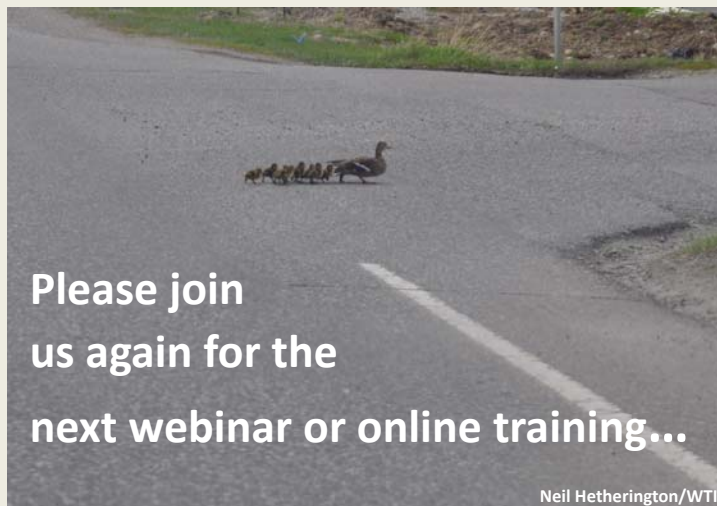
[www.arc-solutions.org](http://www.arc-solutions.org)

Key List-serve: Wildlife-Transportation (NCSU)

Conferences: Transportation & Ecology – International

Professional Societies: SCB, TWS, IALE ESA, SER

## Thank you for participating



Please join  
us again for the  
next webinar or online training...

Neil Hetherington/WTI

## Contact the TRIPTAC!



Paul S. Sarbanes Transit in Parks Technical  
Assistance Center

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