Assessing Wildlife Responses to Highway Wildlife Crossing Designs

Patricia Cramer, PhD

TRB 2018 Learning from Natural Experiments:
Evidence Based Decisions

Thank You to Research Sponsors

Overview

- Wildlife, Roads, Vehicles – Addressing Safety and Ecological Issues
  - The Problem – Safety, Wildlife Deaths, and Habitat Fragmentation
  - Why Research was Needed
  - Study Design, Methods
  - Findings – and the Value of Results

- What Was Learned About the Process of Researching Wildlife Along Transportation Corridors
  - New Approaches to Wildlife Movements and Roads
  - Information and Lessons Learned

Wildlife, Roads, Vehicles – Addressing Safety and Ecological Issues

The Problem

Motorists at Risk of Collision

Animals Killed

Habitat Fragmentation

Animals Avoid Road Areas

Ecological Effects – De-icing Salts, Air pollution, Sound Pollution

Decreased Connectivity

Record Dispersal Movement by South Dakota, Puma

Wildlife Need to Leave Home – Especially Large Carnivores

Map: Path of Connecticut Puma

2,897 kilometers

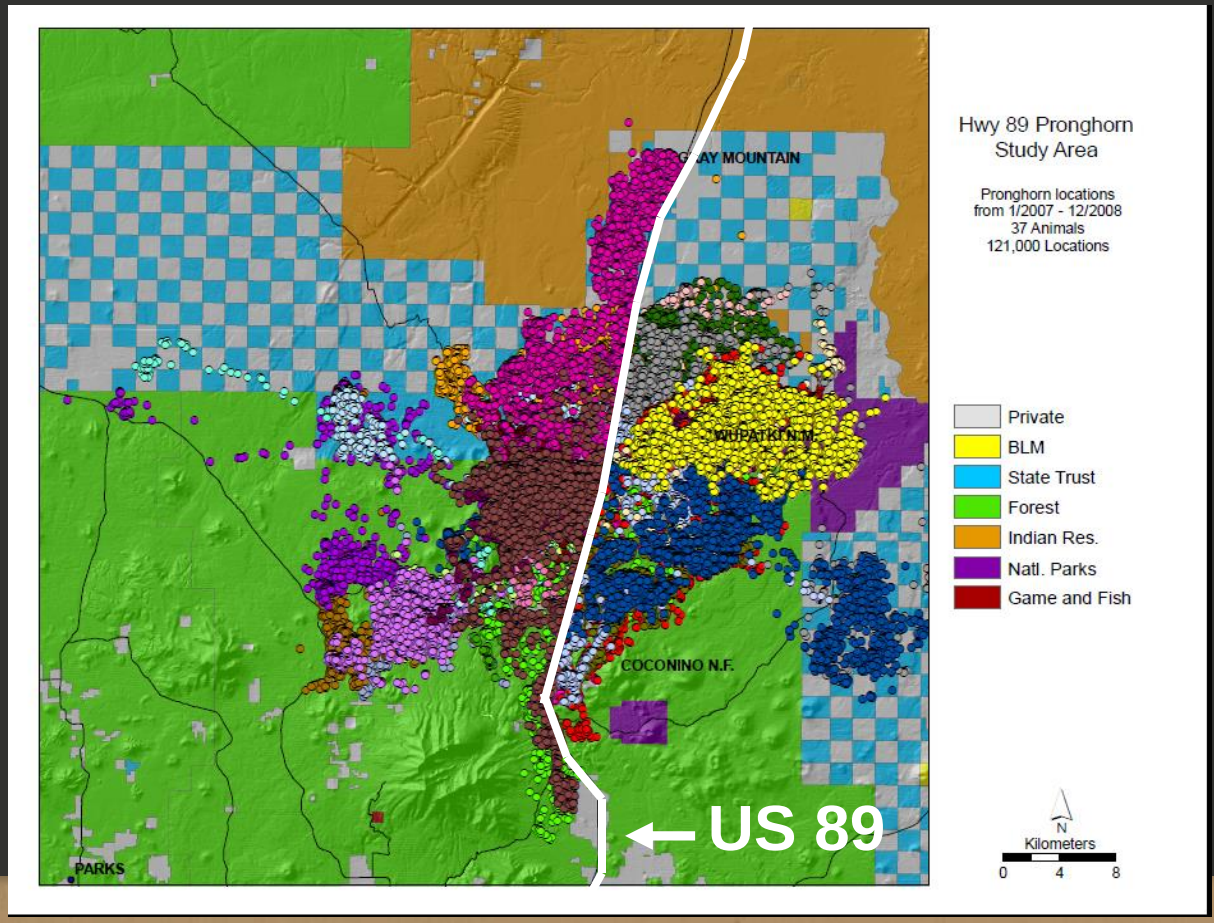
Thelma's Amazing Journey over 30 km each way out and back

Slide courtesy of T. Edwards

Roads & Vehicles Don't Just Kill Wildlife – They Also Form Barriers

We also look at who is prevented from crossing roads

Slide Courtesy of Jeff Gagnon AZGFD



Solution Options

Human Side

Otter - Florida

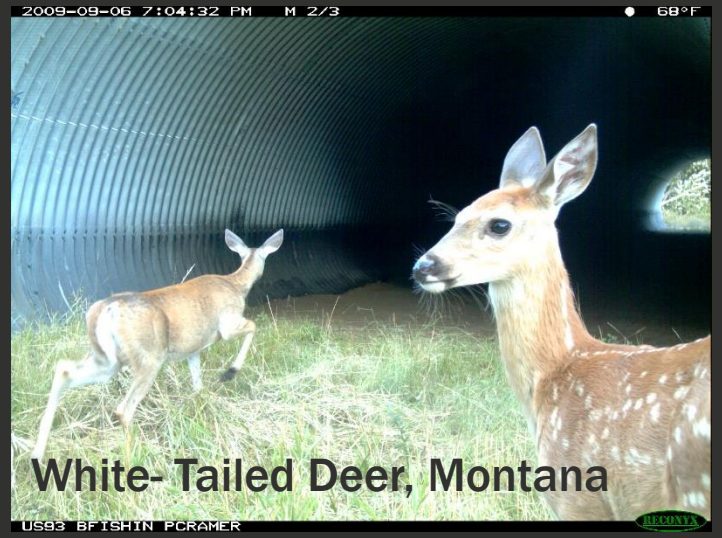
Wildlife Side

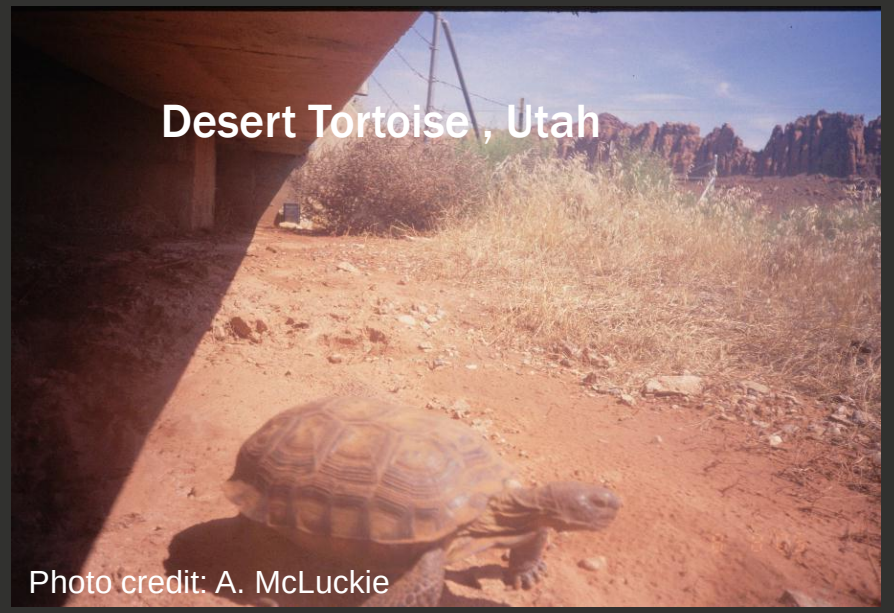
Transportation Planning

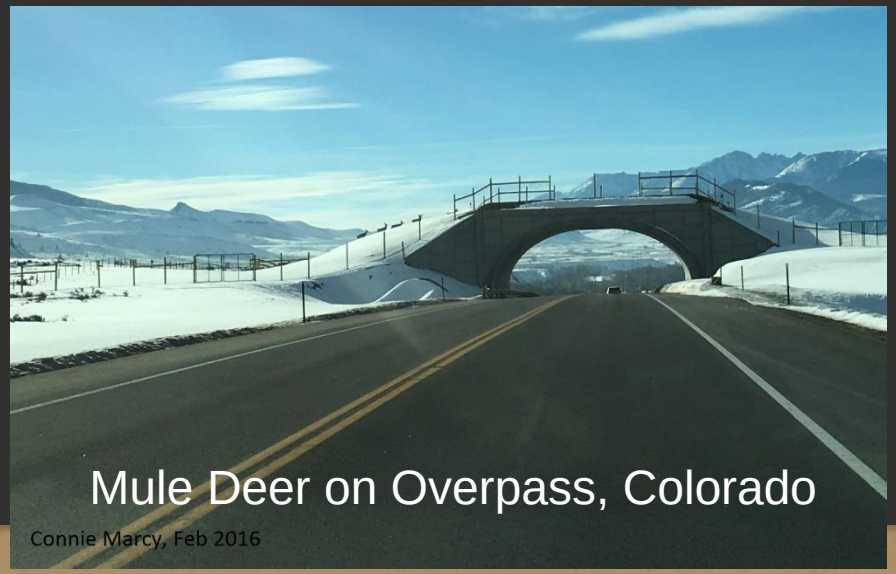
Driver Solutions

Addressing Human Responses

Wildlife Solutions







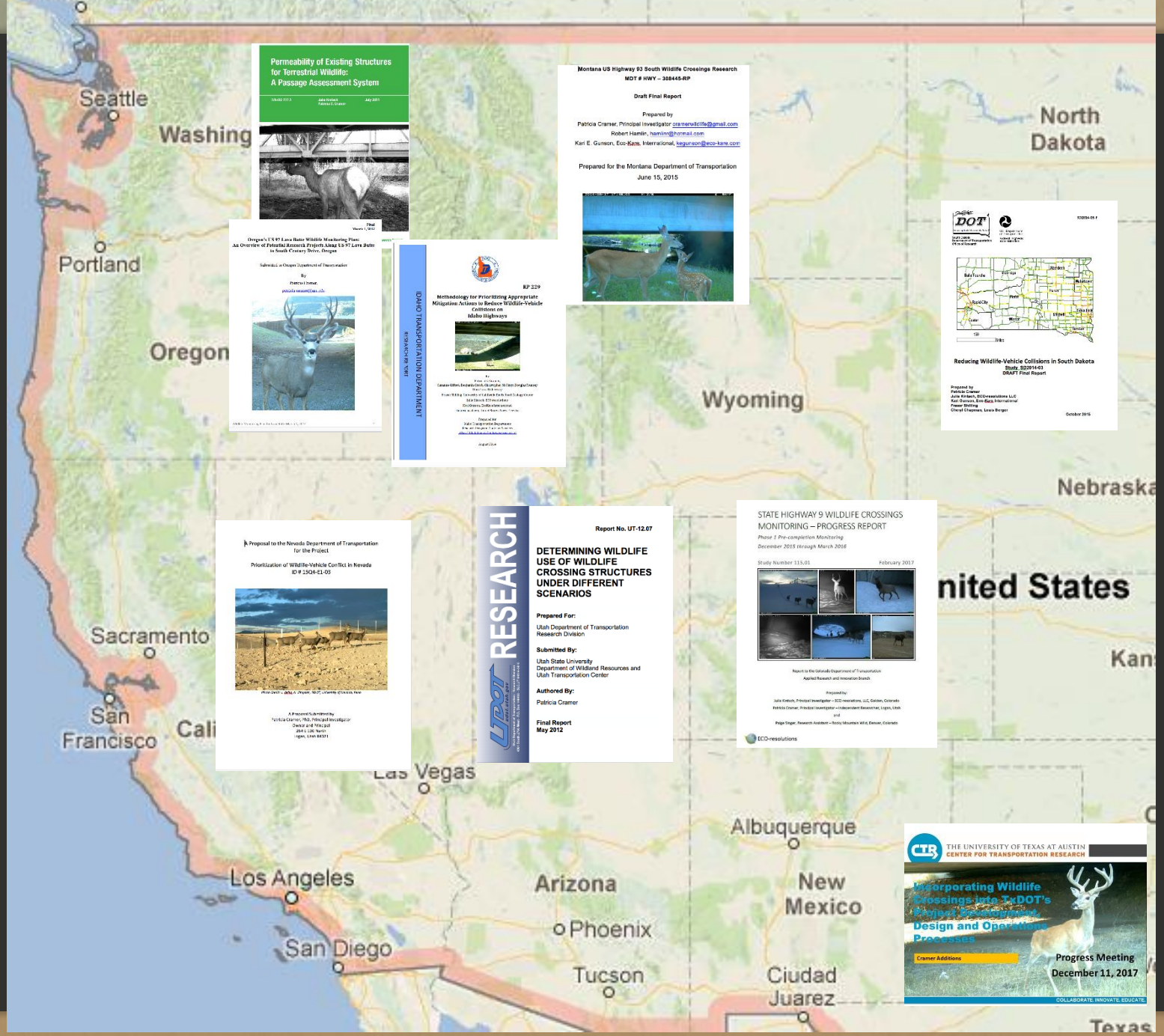
Wildlife, Roads, Vehicles – Addressing Safety and Ecological Issues

Why Research was Needed

Research Projects

Wildlife Use of Structures

Include Wildlife in Transportation Planning

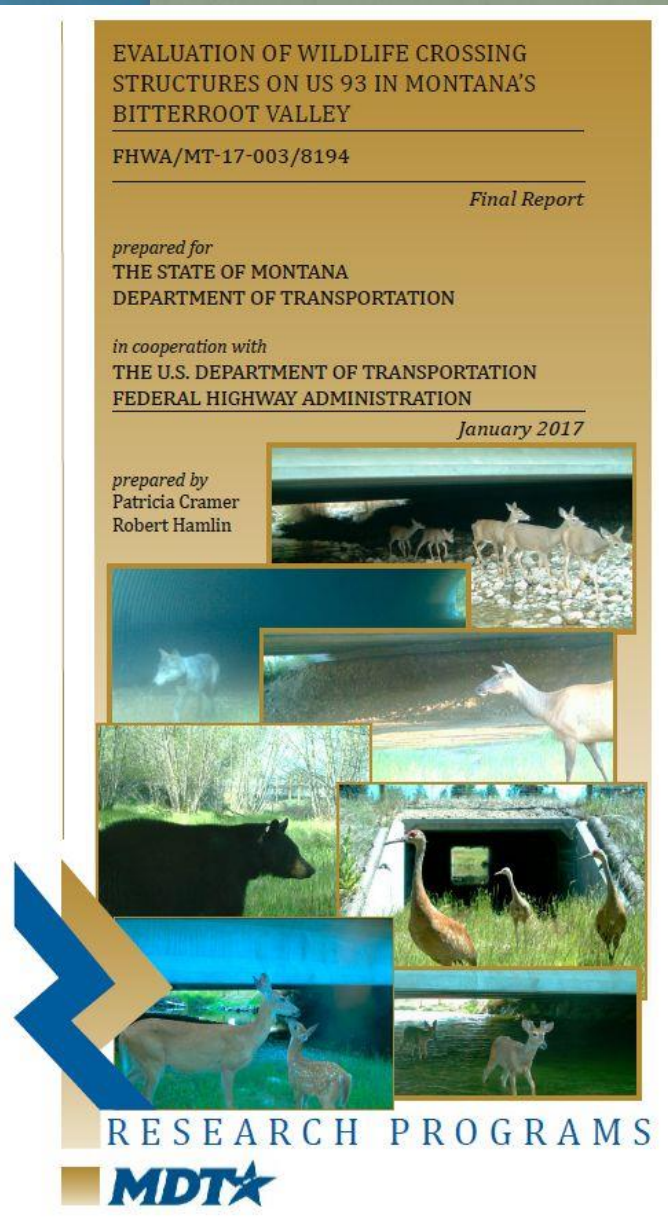


Wildlife, Roads, Vehicles – Addressing Safety and Ecological Issues

Study Design, Research Methods

Evaluation of Wildlife Crossing Structures on US 93 in Montana's Bitterroot Valley

Patricia Cramer
Robert Hamlin



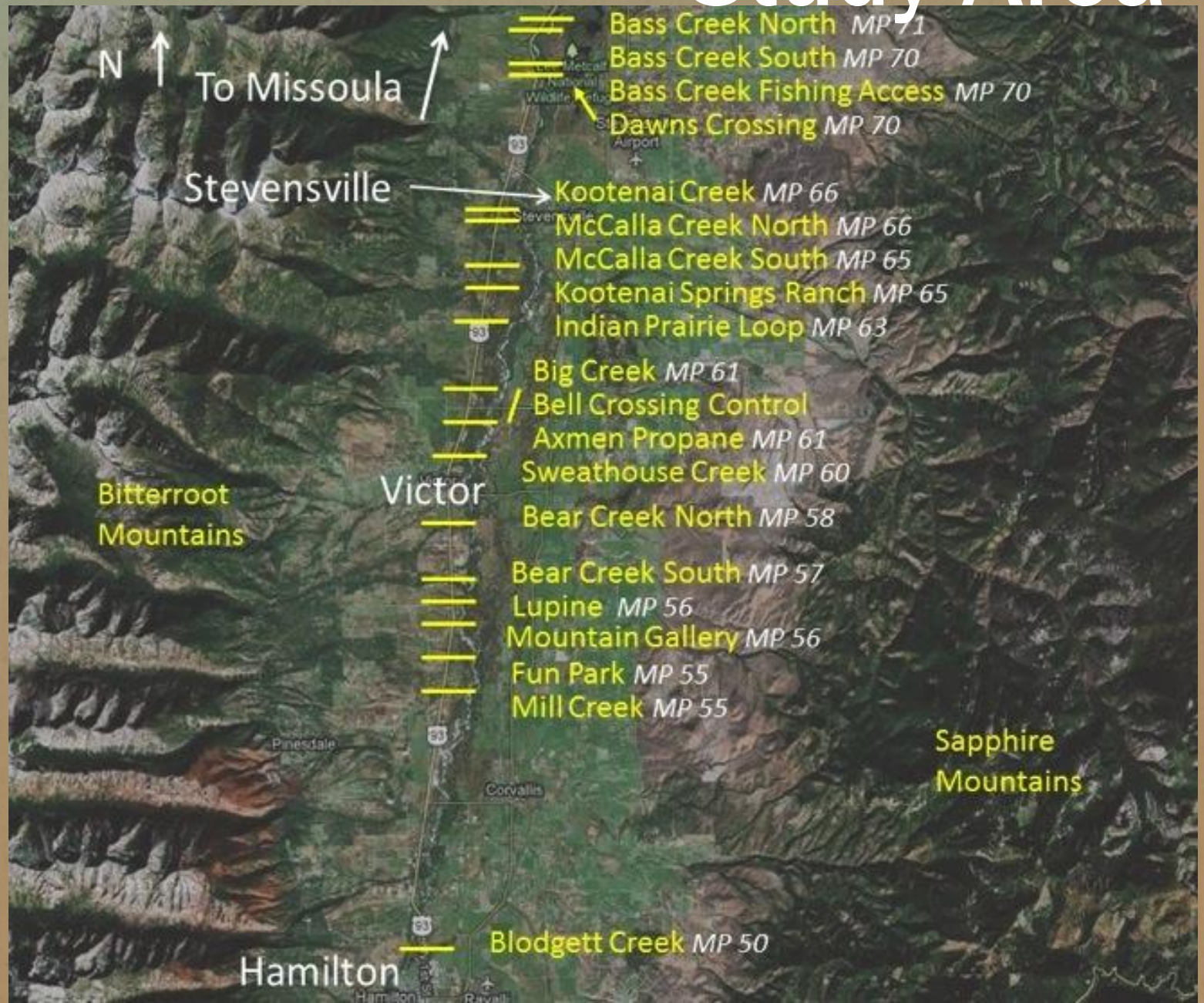
Objectives

1. White-tailed deer use of wildlife crossing structures and wildlife crossing sites;

2. White-tailed deer usage rates of wildlife crossing structures including height, width, length, and material;

3. Relationships between usage rates of wildlife crossing structures and landscape variables;

Study Area


N
To Missoula
Stevensville
Victor
Hamilton
Bitterroot Mountains
Sapphire Mountains
Bass Creek North MP 71
Bass Creek South MP 70
Bass Creek Fishing Access MP 70
Dawns Crossing MP 70
Kootenai Creek MP 66
McCalla Creek North MP 66
McCalla Creek South MP 65
Kootenai Springs Ranch MP 65
Indian Prairie Loop MP 63
Big Creek MP 61
Bell Crossing Control
Axmen Propane MP 61
Sweathouse Creek MP 60
Bear Creek North MP 58
Bear Creek South MP 57
Lupine MP 56
Mountain Gallery MP 56
Fun Park MP 55
Mill Creek MP 55
Blodgett Creek MP 50
Pinesdale
Corvallis

Methods

19 Structures, 2 Cameras Each Structure
Right-of-way Cameras

Pre-Construction Cameras

WVC – Crash and Carcasses

Success Rates
Movement-per day

<u>Statistics</u>
ANOVA, Linear Regression, Mixed

White-Tailed Deer Use of Structures

Methods - Camera Placement

Pre-Construction Monitoring

Original Bridges, Habitat, ROW on 93 and CR 370

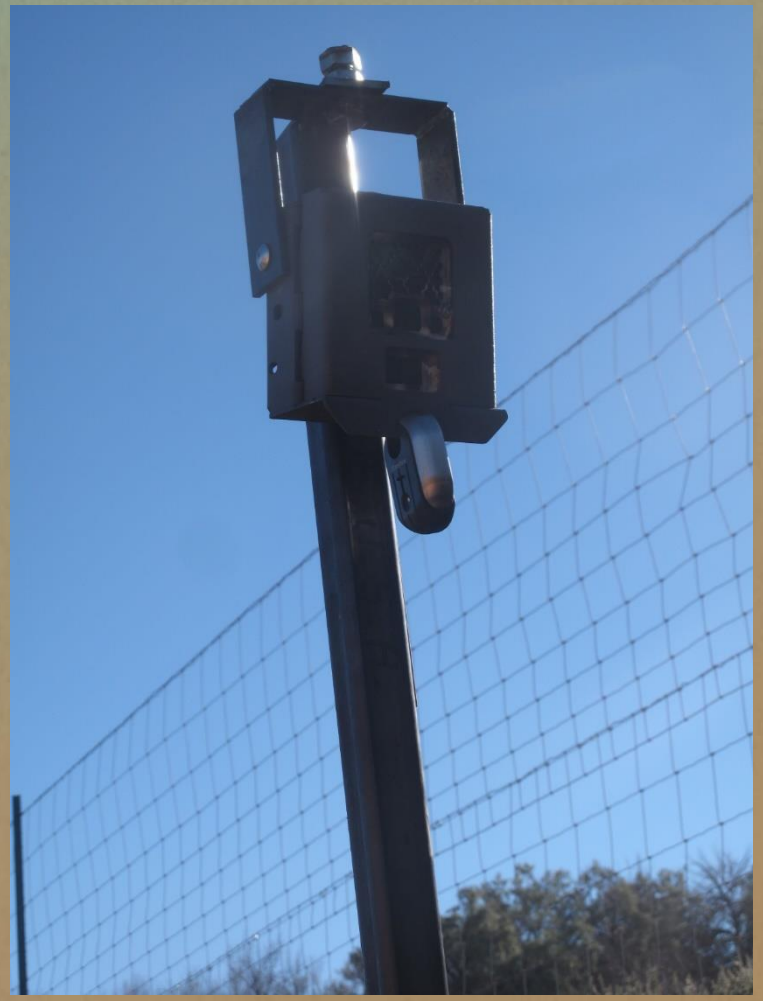
Control Cameras

ROW on CR 370

Post-Construction Monitoring

19 Structures

Camera Monitoring



Wildlife, Roads, Vehicles – Addressing Safety and Ecological Issues

Findings – and the Value of Results

Results – Creating Performance Measures

Pre-construction ROW cameras recorded white-tailed deer
With a 64 % success rate for moving over US 93 , repellency = 8%
With a 63% success rate for moving over CR 370, repellency = 5%

These values became the performance measures with which we evaluated the subsequent wildlife crossing structures.

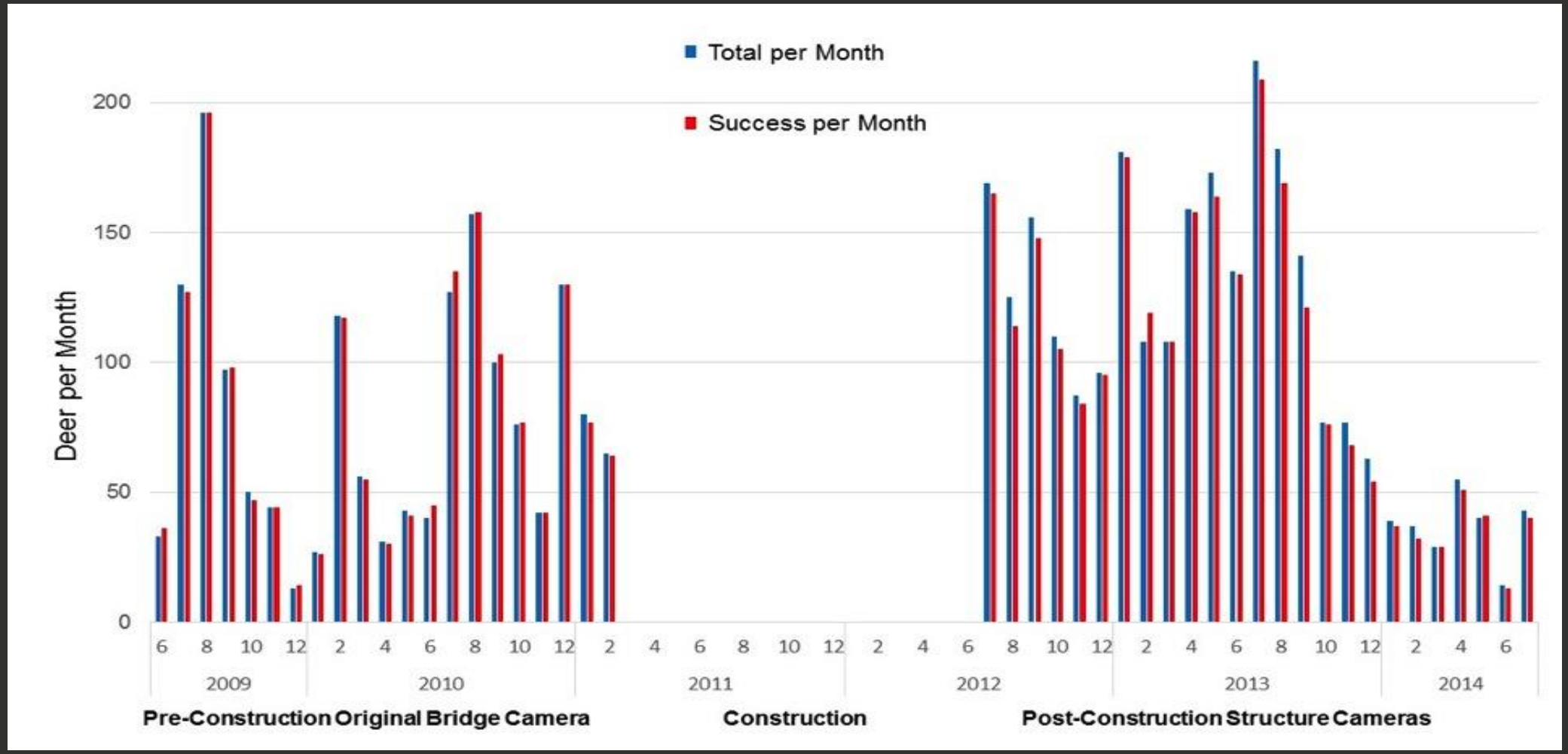
Minimum success rate = 60%
Repellency rate 10% or less.

Results

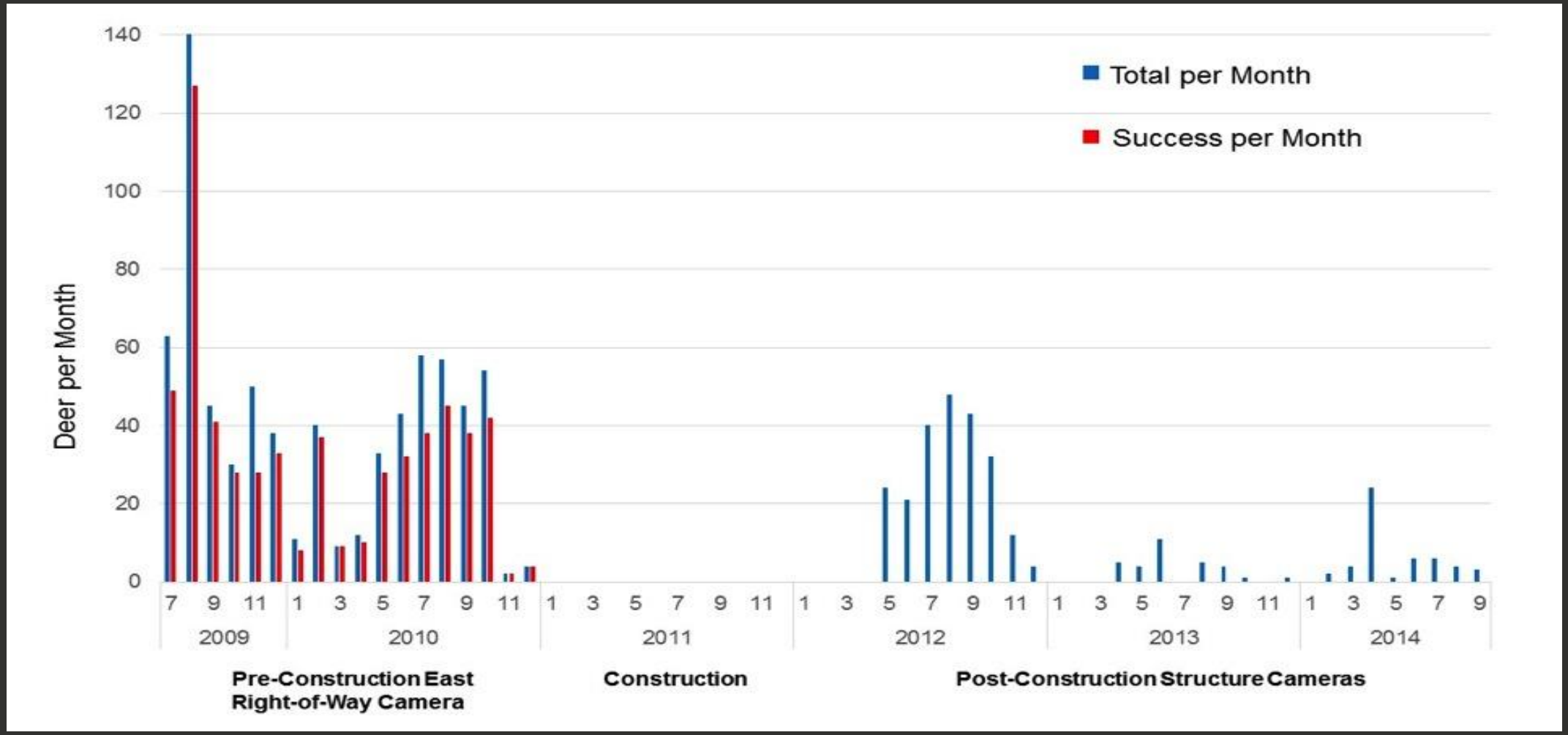
Top 9 Most Successful Wildlife Crossing Structures based on white-tailed deer success rate

Wildlife Crossing Structure	Success	Repel-lency	Parallel	Total Movements	Success Rate (%)	Rate of Repel-lency (%)	Parallel Rate (%)
Dawns Crossing Bridge	5204	65	94	5363	97	1	2
Bass Creek Fishing Access Culvert	3257	118	21	3396	96	3	1
Bear Creek South Bridge	2554	30	113	2697	95	1	4
Sweathouse Creek Bridge	2419	61	102	2582	94	2	4
Blodgett Creek Bridge	1037	25	36	1098	94	3	3
Kootenai Creek Bridge	2470	150	97	2717	91	5	4
Big Creek Bridge	2769	237	317	3323	83	7	10
McCalla Creek North Bridge	2058	142	265	2465	83	6	11
Mill Creek Bridge	1036	117	283	1436	72	8	20

Results – High Performing, Bear Creek South Bridge



Results - No Use, Fun Park Culvert



Study Found:
Bridges and Large Culverts work best for White-tailed Deer

Dimensions: Width most important

Results - Relationships Between Usage Rates and Explanatory Variables

Usage Rates

Success Rate
Rate of Repellency
Parallel Rate
Success per Camera day

Explanatory Variables

Structure Type
Structure Height
Structure Width
Structure Length
Structure Openness
Fence, Guardrail, Humans, Grass, Forbs, Shrubs, Trees, Bare Ground, Water, Fecal Pellets

Results and Methods

Generalized Linear Models were Used to Analyze Relationships

- Generalized Mix Linear Model with a binomial response for rates related to structure types
- One Way ANOVA was used for success per camera day
- Linear Regression for success rate and explanatory variables
- Two-sample test used for bridges vs culverts and explanatory variables

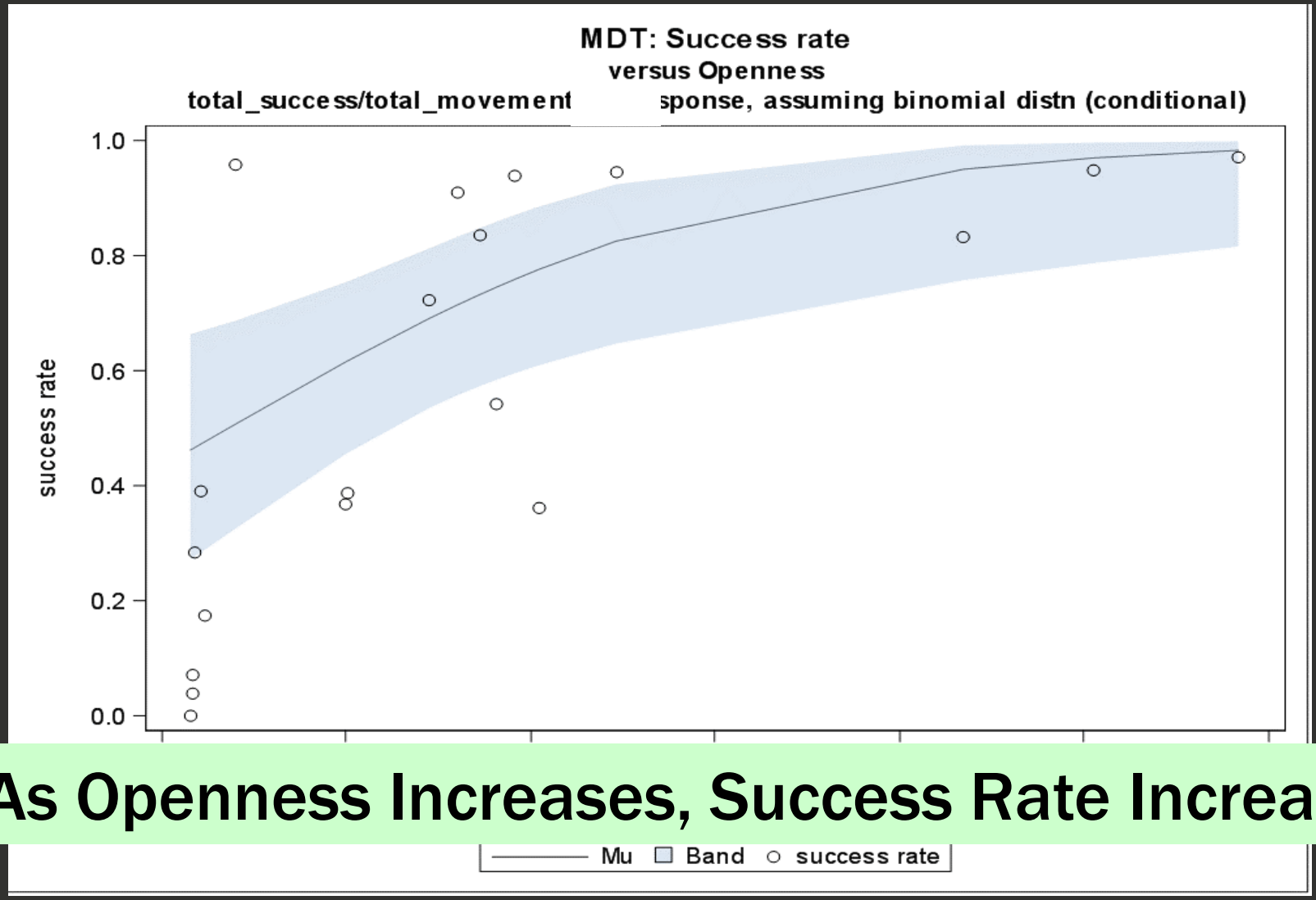
Chapter 3 Statistical Test Results

	Success per Day	Success Rate	Rate of Repellency	Parallel Rate	Type of Structure
Type of Structure B: bridge C: culvert	p = 0.08 B: 0.92 C: 0.23	p = 0.005 B: 81% C: 16%	p = 0.19	p = 0.01 B: 12% C: 57%	
Height	p = 0.70	p = 0.20	p = 0.01 Slope = -0.56	p = 0.28	p = 0.26
Width	p = 0.0008 Slope = 0.03	p = 0.01 Slope = 0.08	p = 0.10 Slope = -0.02	p = 0.006 Slope = -0.09	p < 0.001 B: 26.8 C: 3.8
Length	p = 0.09 Slope = -0.02	p = 0.04 Slope = -0.06	p = 0.25	p = 0.03 Slope = 0.06	p < 0.001 B: 26.0 C: 52.0
Openness	p = 0.0007 Slope = 0.24	p = 0.009 Slope = 0.74	p = 0.009 slope= -0.28	p = 0.009 Slope = -0.86	p < 0.001 B: 2.5 C: 0.2
Fence	p = 0.45	p = 0.63	p = 0.98	p = 0.59	p = 0.56
Guard rail	p = 0.21	p = 0.04 Slope = 0.004	p = 0.02 Slope = -0.004	p = 0.04 Slope = -0.004	
Humans per day	p = 0.54	p = 0.80	p = 0.63	p = 0.84	p = 0.10 B: 0.15 C: 0.06
Grass	p = 0.37	p = 0.81	p = 0.39	p = 0.68	p = 0.74
Forbs	p = 0.15	p = 0.90	p = 0.95	p = 0.89	p = 0.21
Shrubs	p = 0.21	p = 0.10 slope= 0.13	p = 0.04 Slope = -0.07	p = 0.12	p = 0.53
Trees	p = 0.99	p = 0.23	p = 0.38	p = 0.24	p = 0.62

Green Boxes Show Strong Evidence of Relationship

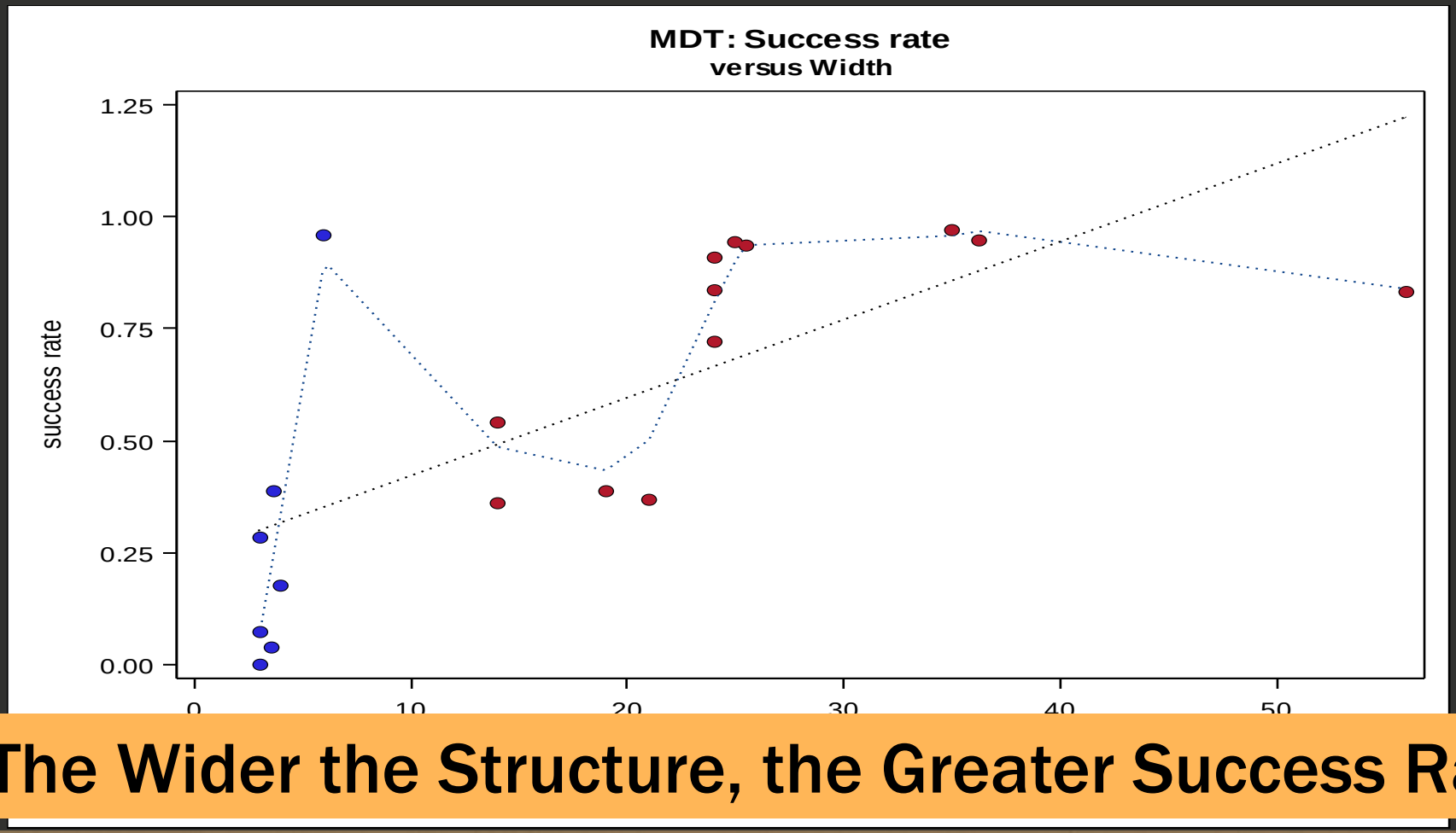
Light Green Boxes Show Uncertain Evidence

White-Tailed Deer Success Rate with Openness



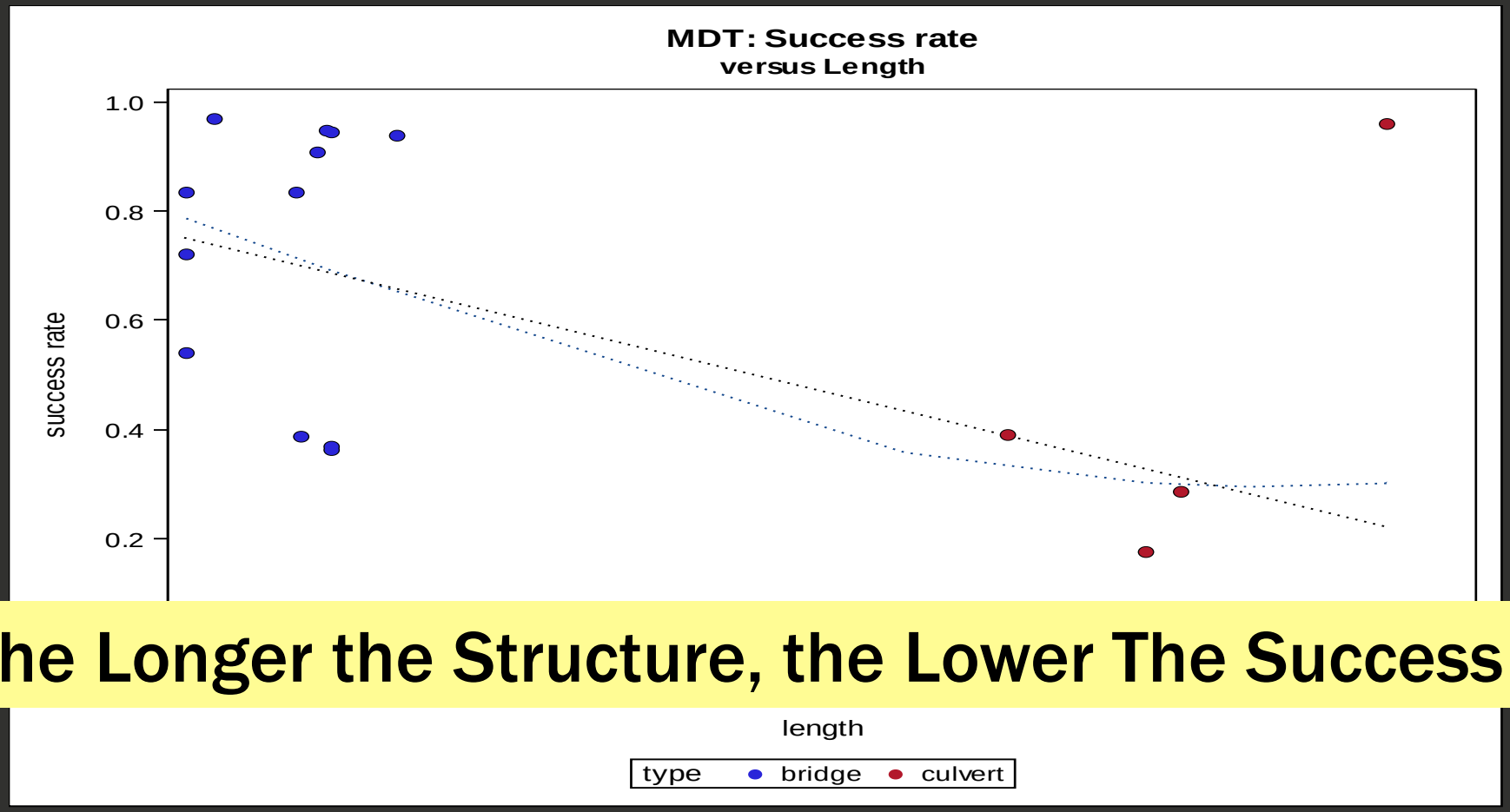
As Openness Increases, Success Rate Increases

White-Tailed Deer Success Rate Compared with Structure Width



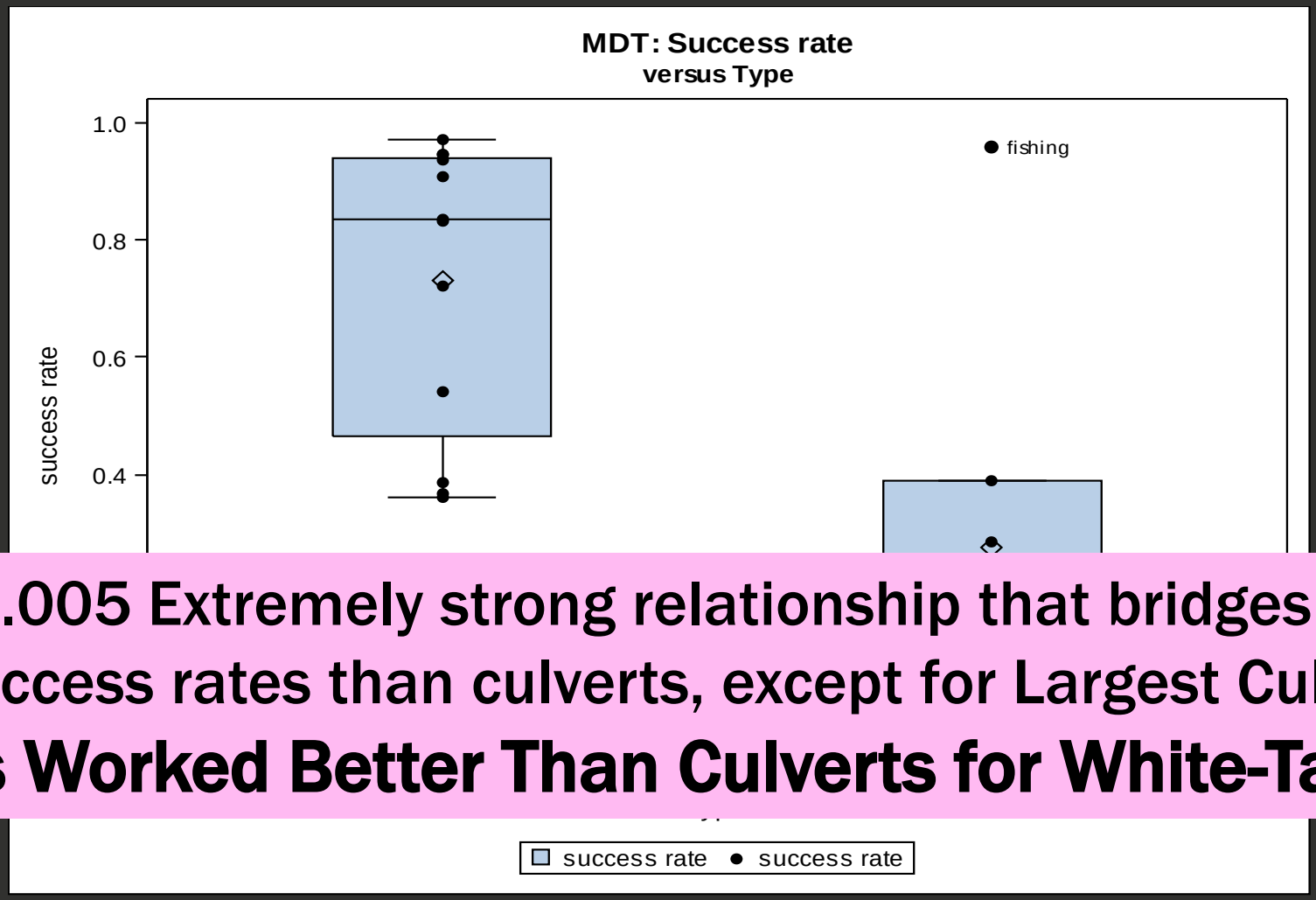
The Wider the Structure, the Greater Success Rate

White-Tailed Deer Success Rate Compared with Length of Structure



The Longer the Structure, the Lower The Success Rate

White-Tailed Deer Success Rate with Bridges & Culverts



P-value-0.005 Extremely strong relationship that bridges have higher success rates than culverts, except for Largest Culvert -

Bridges Worked Better Than Culverts for White-Tailed Deer

Recommendations

Wildlife crossing structures should be designed with high openness ratios. High openness ratios are easier to achieve with bridges than with culverts.

Length should be minimized
Width (span) should be maximized and
Height should be maximized

These studies help design the most cost effective structures

What Was Learned About the Process of Researching Wildlife Along Transportation Corridors

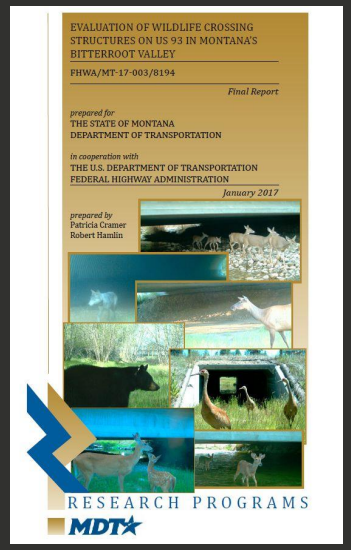
New Approaches to Wildlife Movements and Roads

The Study helped establish

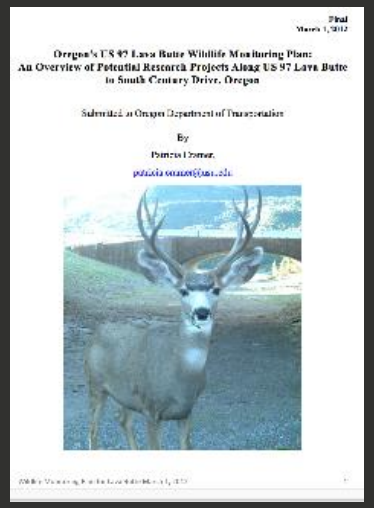
- That pre-construction monitoring is important to strength of science and recommendations
- Performance measures can be created with control and pre-construction monitoring
- Document pre-condition variables

What Was Learned About the Process of Researching Wildlife Along Transportation Corridors

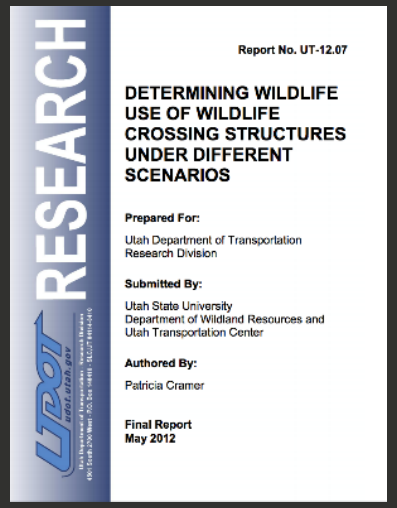
Consistent strong scientific methods allow comparisons and application across states



Montana



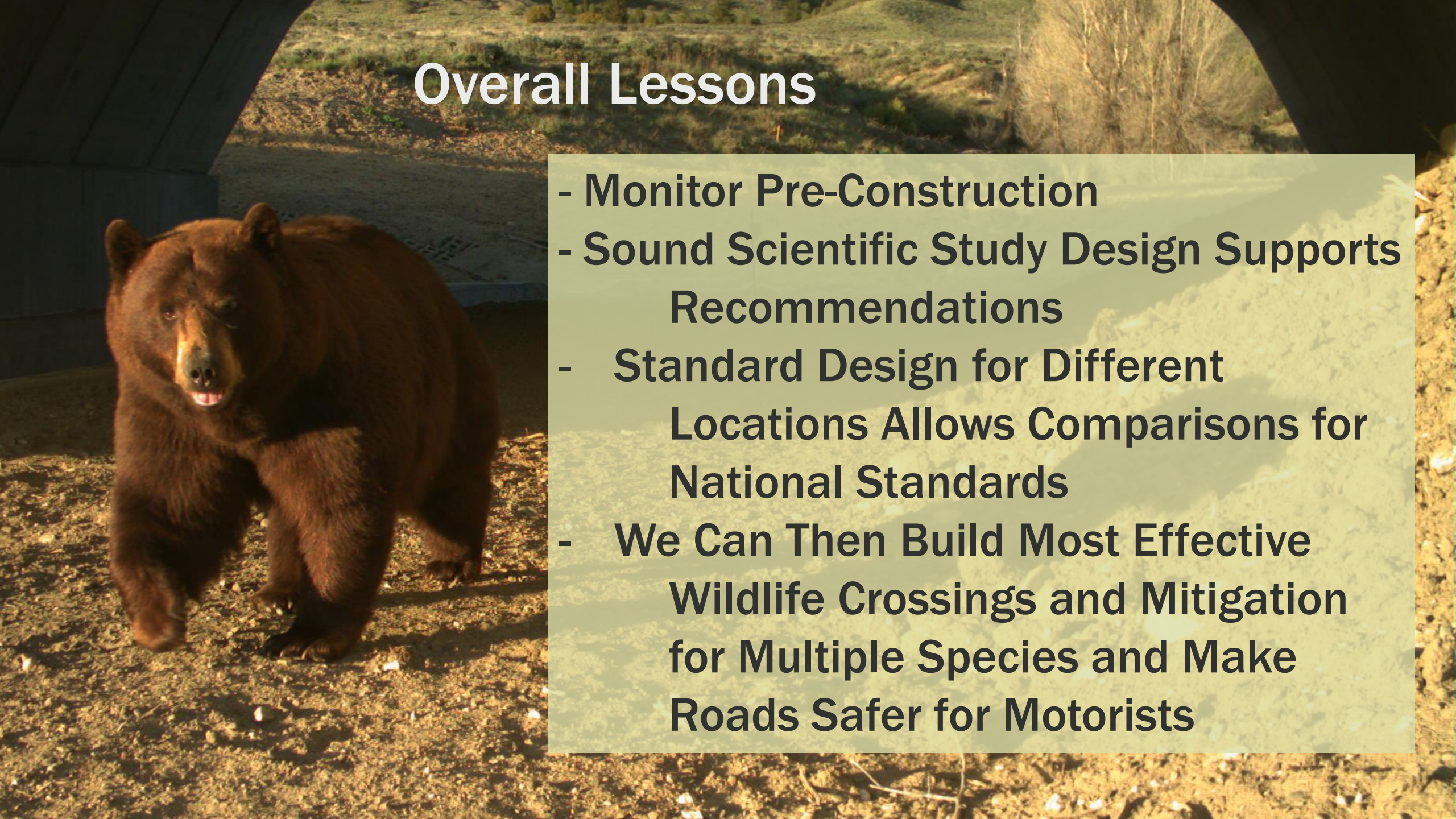
Oregon



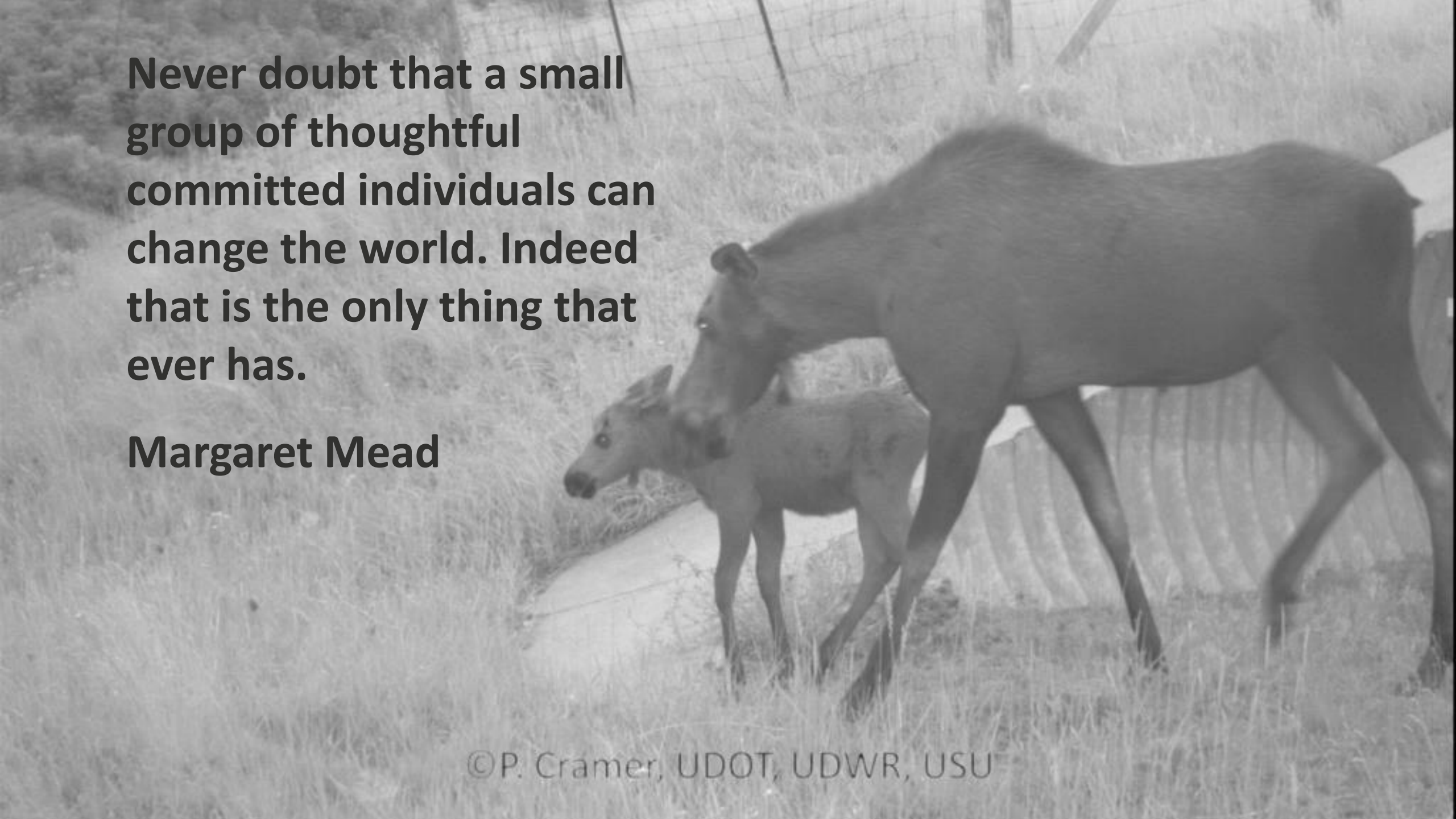
Utah

Colorado

Overall Lessons



- Monitor Pre-Construction
- Sound Scientific Study Design Supports Recommendations
- Standard Design for Different Locations Allows Comparisons for National Standards
- We Can Then Build Most Effective Wildlife Crossings and Mitigation for Multiple Species and Make Roads Safer for Motorists


Never doubt that a small group of thoughtful committed individuals can change the world. Indeed that is the only thing that ever has.
Margaret Mead
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