TRAINING ON

Planning and Design of Smart Infrastructure for Biodiversity Protection

25–27 April 2022

Rhino Lodge, Sauraha, Nepal

Current practices and design for mitigating road impacts on wildlife populations

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WTI – Montana State University USA

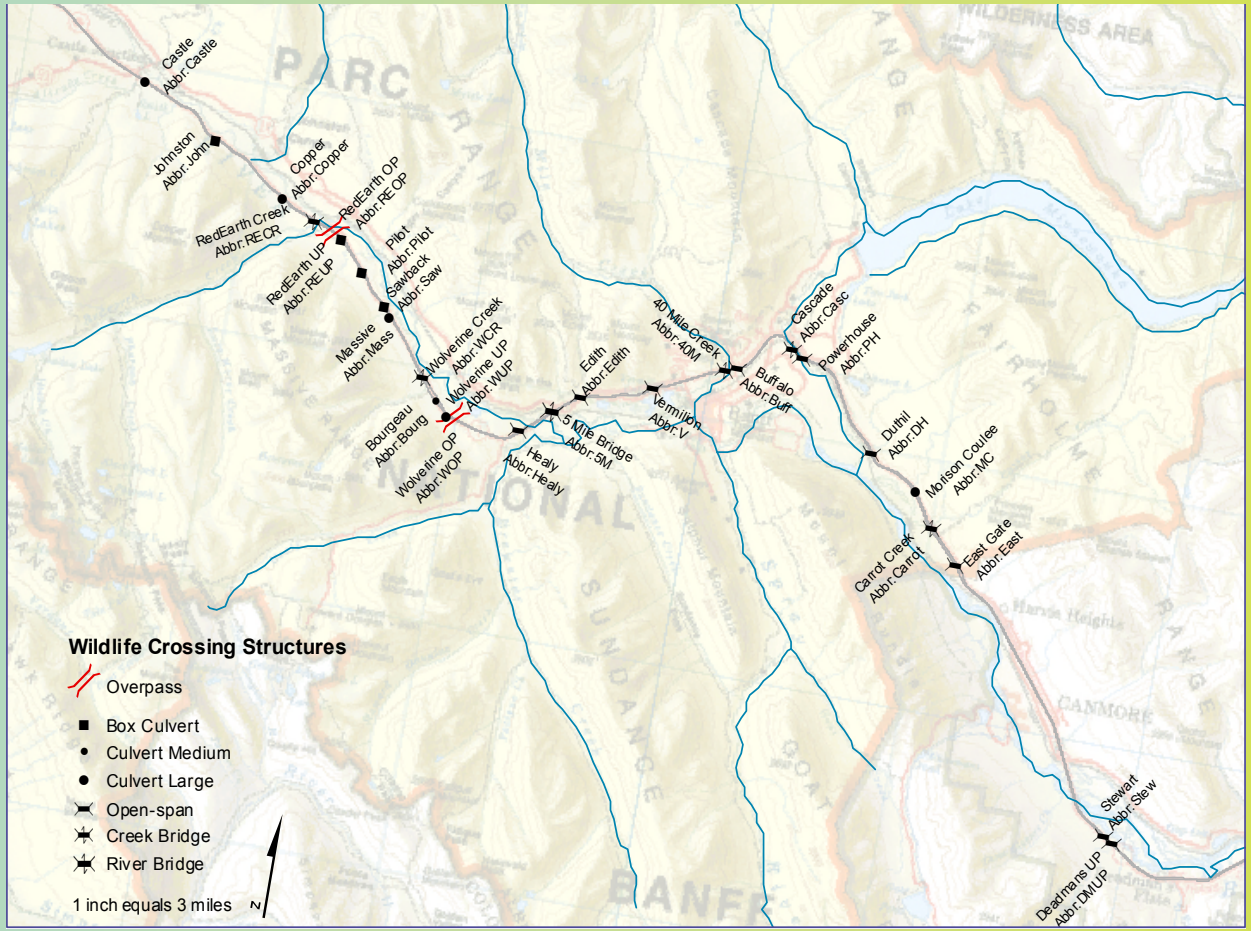
Ecological impact of roads on wildlife

- **Mortality (road-kill)**
- Habitat loss
- **Disruption of natural movement**
  - Habitat fragmentation
  - Populations isolation
  - Local extinction
- Other impacts
  - Human access from new roads
  - Noise, lighting, and pollution (distance effects)
  - Edge effect, microclimate changes

Planning mitigation - Keeping connections intact

- **Landscape corridors and wildlife crossings are key to maintaining landscape connectivity**

- **Large scale**: land securement and management
  - Corridors and protected area networks
- **Local scale**: site-specific measures



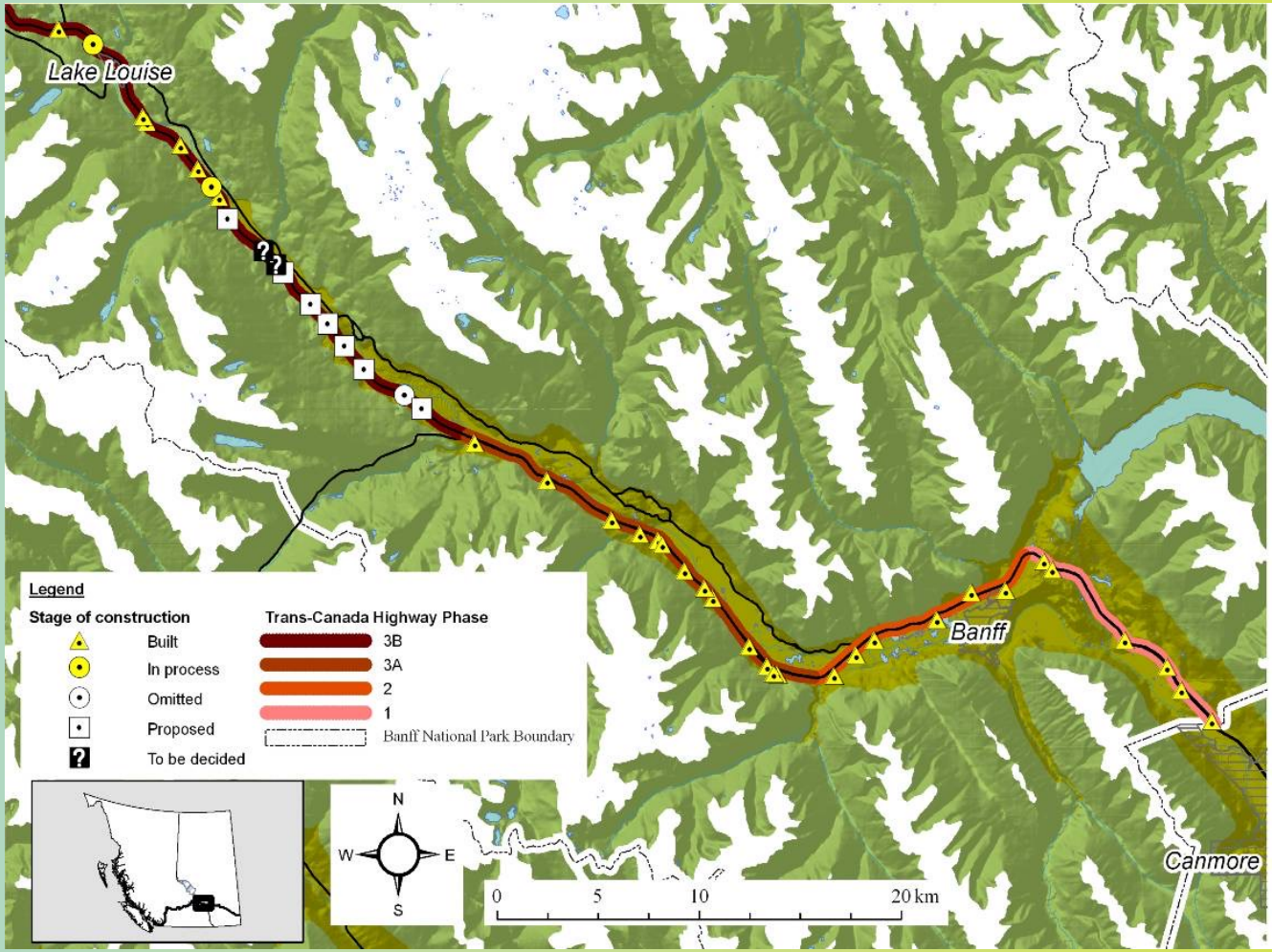
Planning mitigation measures - Scales

1. **LANDSCAPE OR SYSTEM SCALE**

- Intersection of broad transportation & ecological corridors
- Based on ecological integrity

2. **PROJECT OR LOCAL SCALE**

- Site level without ecosystem planning
- Based on species protection



Planning mitigation – key factors

SPACING OF CROSSINGS

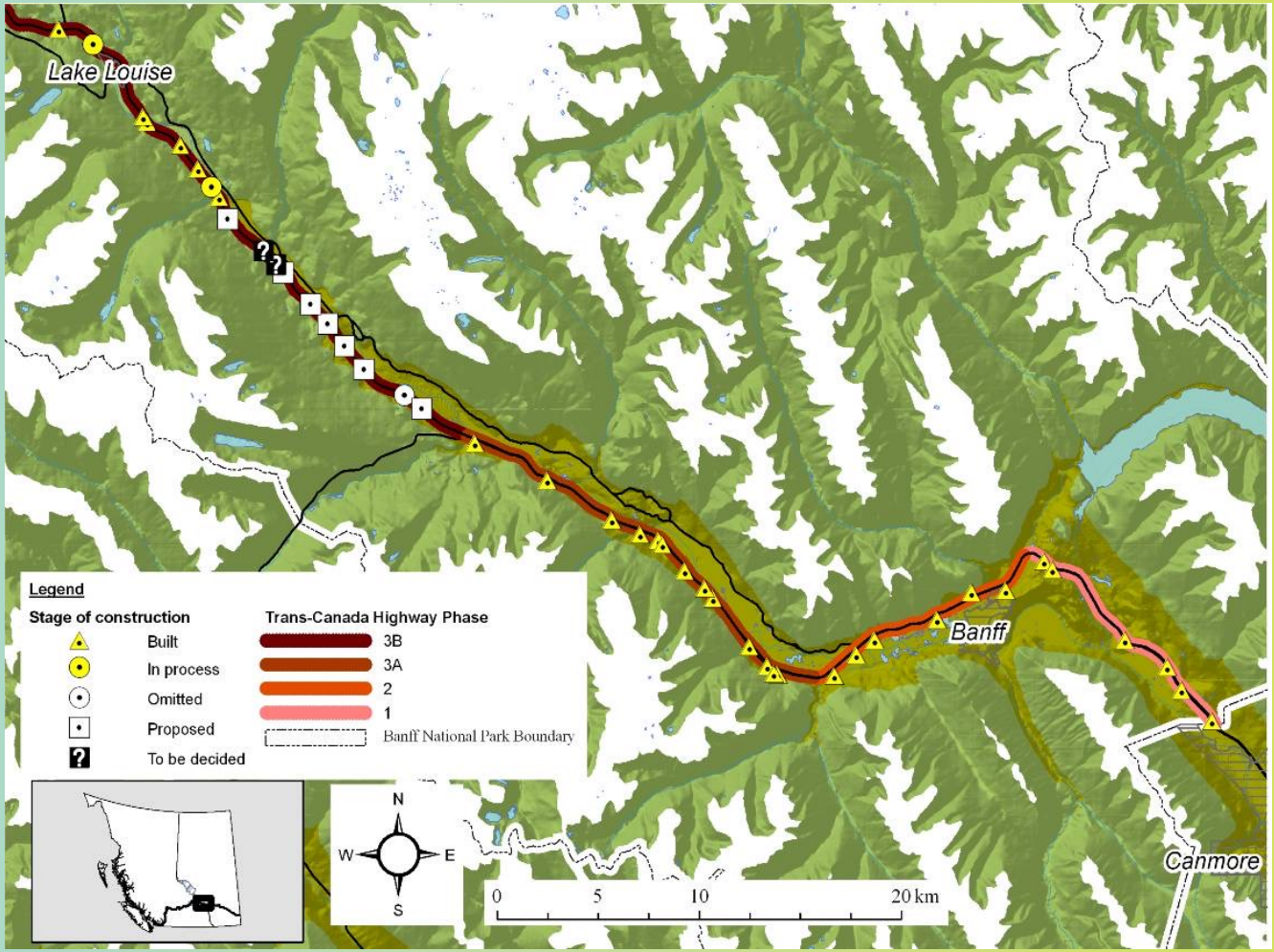
- How far apart?
- What interval for spacing?

Biophysical factors determine spacing:

- Terrain
- Habitat type
- Human disturbance

Planning mitigation – data needs

- Road/rail network data
- **Road**(rail)-**kill data**
- Aerial photos
- Land cover/vegetation maps
- Topographic maps
- Land ownership maps
- Wildlife habitat maps
- **Empirical field data**
- **Wildlife movement model data**



Wildlife crossing structures, Trans-Canada Hwy, Banff NP, Canada

Data collection – Using reliable science-based data

Camera trap

Modeling

Roadkill surveys

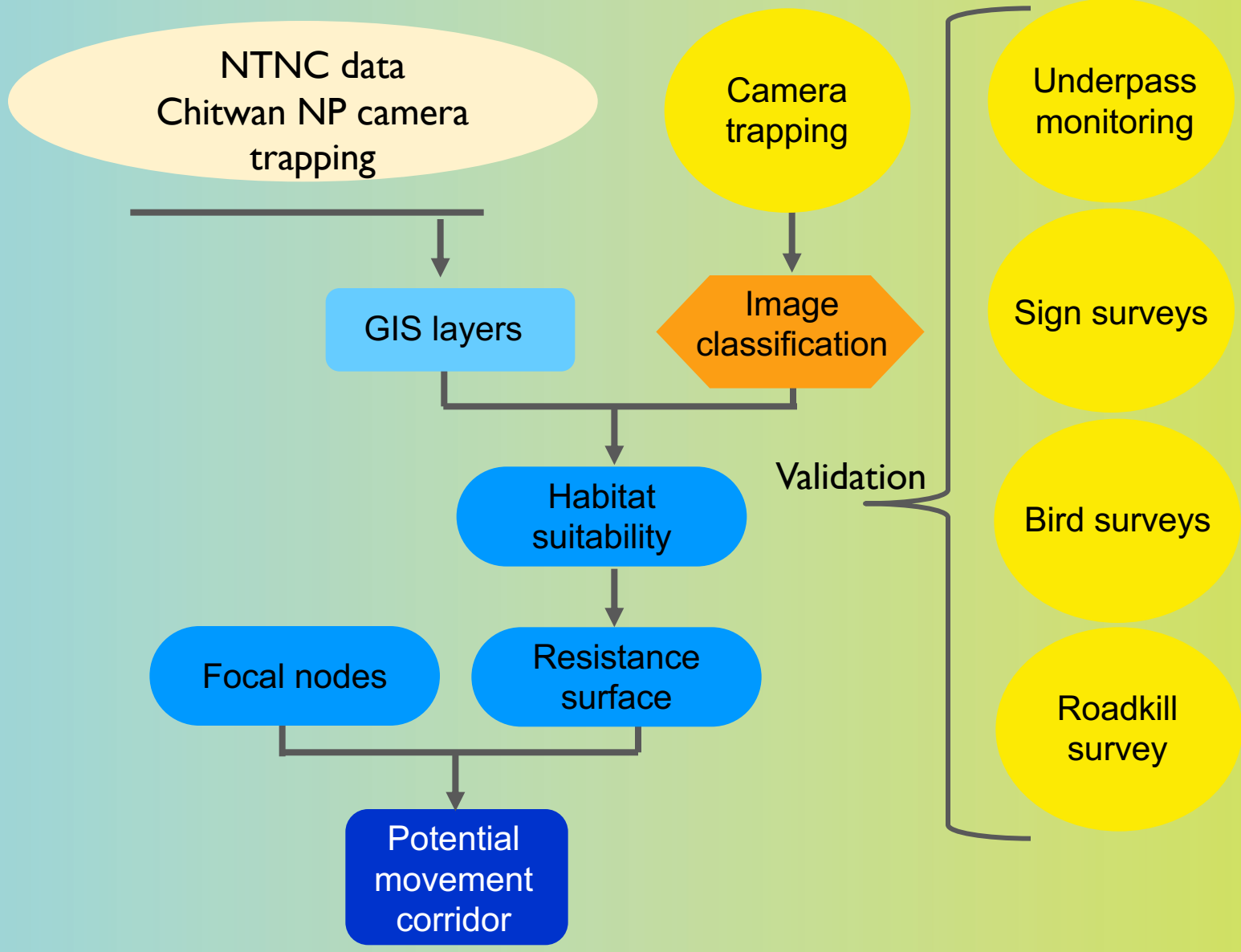
- **Data:** Reliable, Sci-based

- **Identify** what impacts & where
  - ✓ *Mortality ?*
  - ✓ *Fragmentation: Genetics ? Demographic ?*
  - ✓ *All the above ??*

Data collection methods

Asian Development Bank (ADB) Project Example:

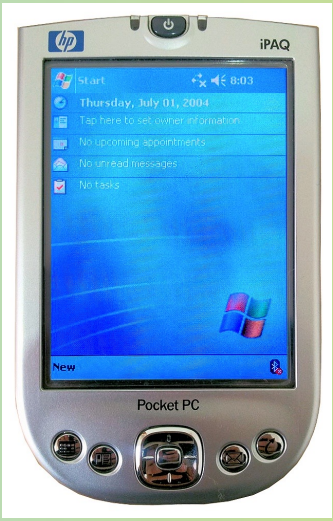
NHP Road, Nepal



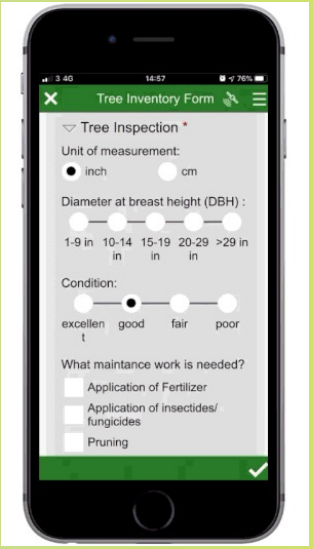
FIELD DATA COLLECTION

Notebooks (paper, pencil)

Voice Recorder



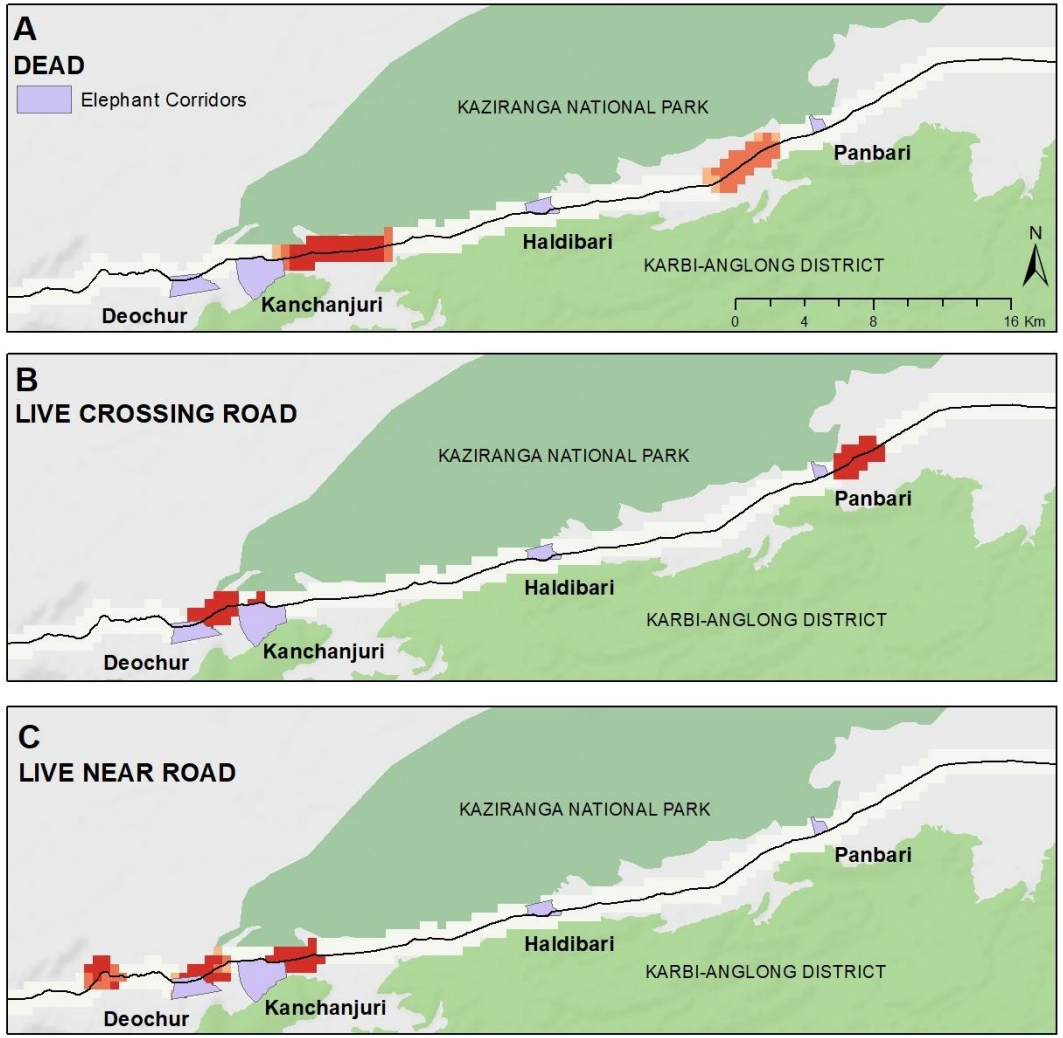
PDA – Personal Data Assistant



Smartphone App (next part of module)

NH-37

Kaziranga National Park
Assam, India



Service Layer Credits: Sources: Esri, USGS, NOAA

ROaDS

USAID
FROM THE AMERICAN PEOPLE

Data outputs

2 Main Types of Data:

1. Road-kill hot spots/clusters

- Species occurrence
- Location
- Severity of Impact

2. Species Occurrence (Camera/Sign surveys)

- Distribution
- Corridors
- Modelling Connectivity

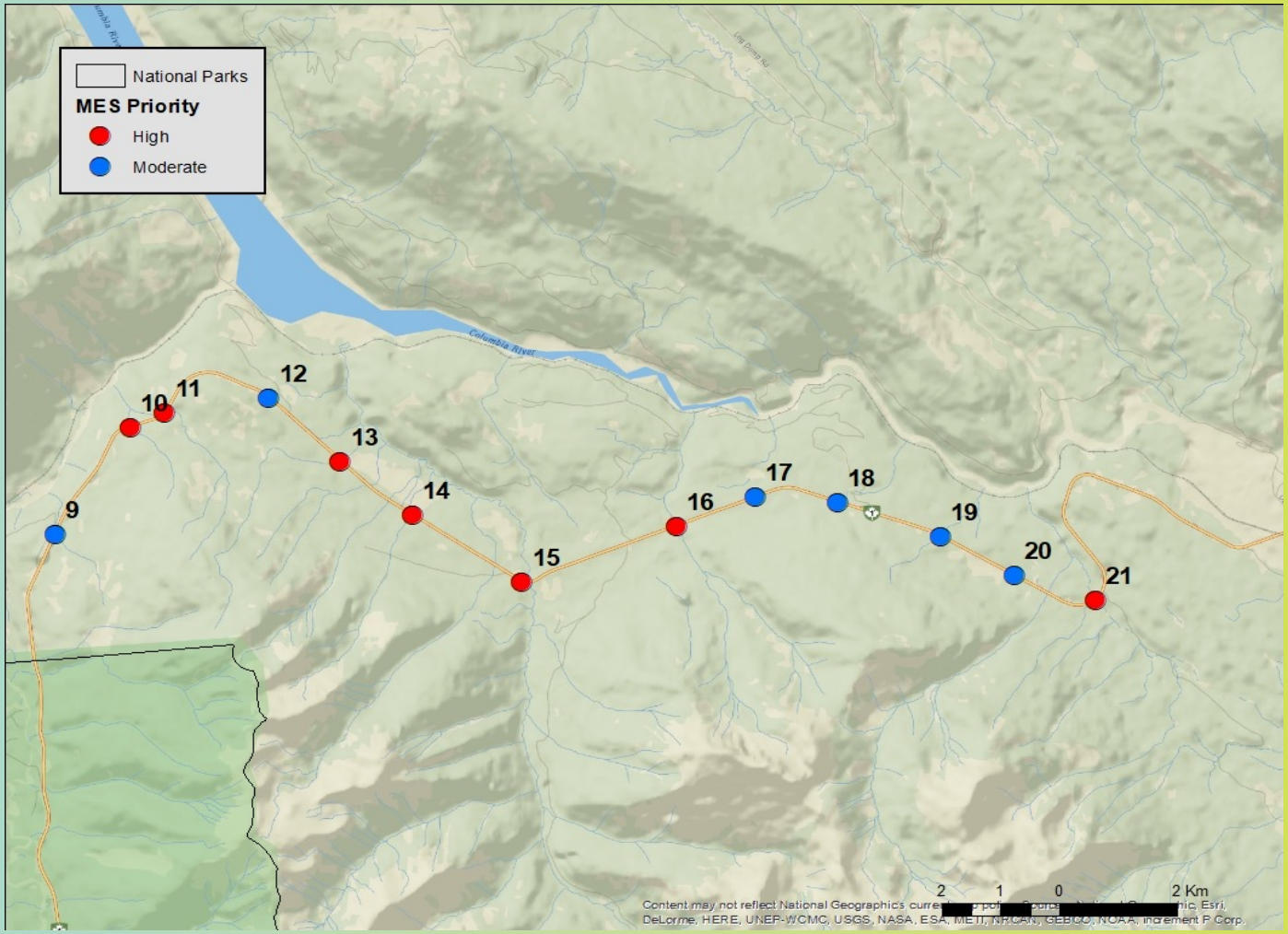
These data types can be "layered" --- inform WHERE mitigation is needed

Merging and synthesis

LOCATIONS (“candidate”)

- Locations identified
- Prioritization of sites*

**Not all sites have same conservation value*



Merging and synthesis

Prioritization of locations & CS categories:

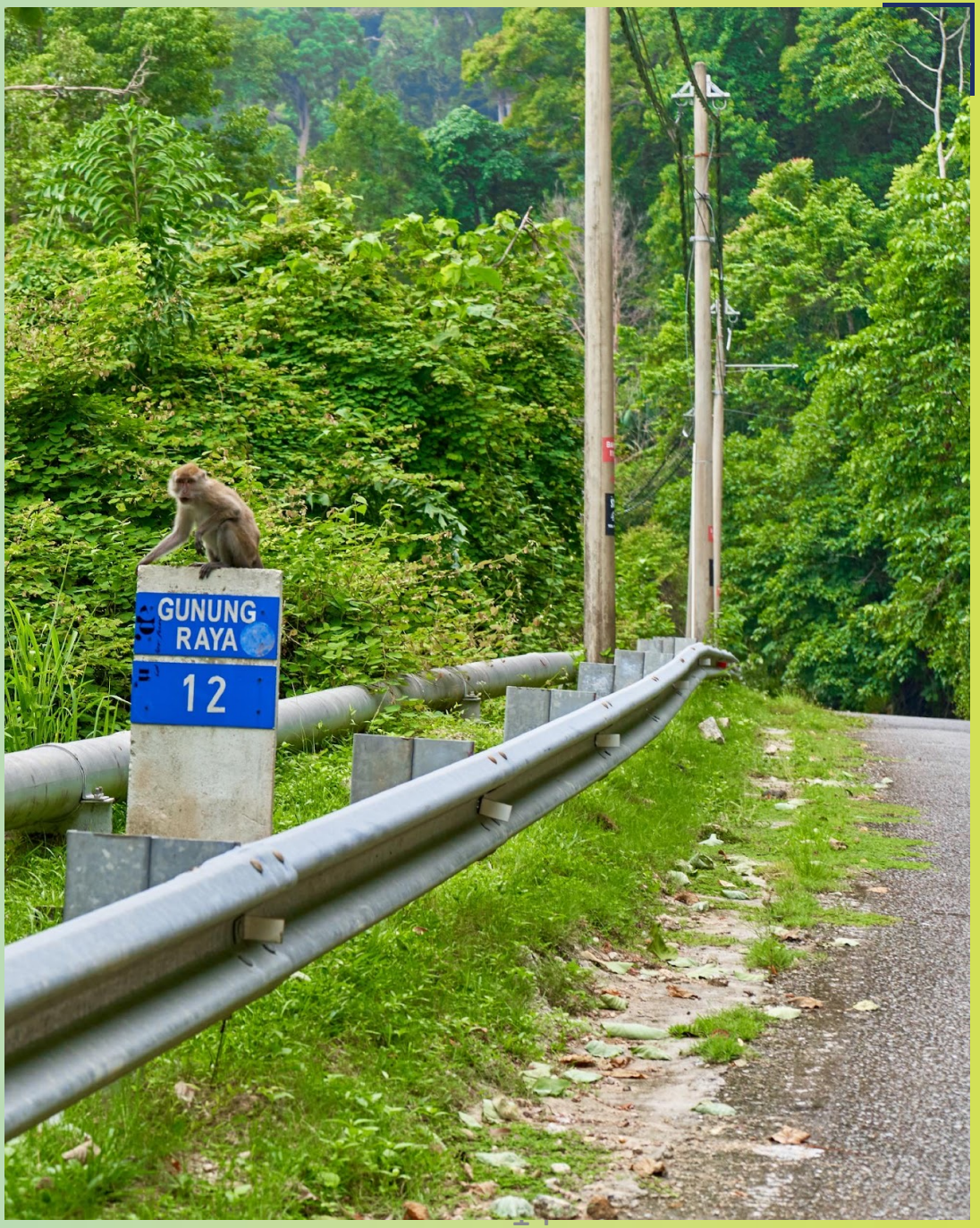
Primary – Secondary – Tertiary

Criteria (and scoring):

- Land security
- Connectivity
- Constructability
- Roadkill Severity

“Layering” of mitigation recommendations

1. Large/iconic species (conservation concern)
2. Arboreal/canopy dwellers
3. Small/medium terrestrial vertebrates



Design

OVERPASS DESIGN

1. Landscape bridge/tunnel

2. Wildlife overpass

3. Multi-use overpass

4. Canopy crossing

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. Herptile tunnel

BASIC PRINCIPLES

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

FLYOVER - VIADUCT

CONSIDERATIONS

Designed for
Wildlife Community

– Habitat Intact

- Human use/disturbance

- Habitat changes

USE OF EXISTING STRUCTURES – "RETROFITS"

- Very low cost
- Natural travel corridor
- Modify to enhance use
- Compliment a corridor network

Riparian crossing structure with travel path

WILDLIFE CROSSING STRUCTURES: PLANNING AND COSTS

- New road project
- Existing road upgrade – lower costs
  - Unpaved to paved
  - Added lane expansion

THE CASE FOR WILDLIFE CROSSINGS

METHODS FOR MONITORING MITIGATION MEASURES

Cameras

Track beds

Hair/DNA sampling

EVALUATION OF PERFORMANCE

ARE THEY FUNCTIONAL?

ARE THEY MEETING THE DESIRED OBJECTIVE?

- Increasing animal movements
- Reducing mortality

EVALUATION OF PERFORMANCE

30 YEARS OF WILDLIFE CROSSING STUDIES:

Individual-level studies:

- What species?
- How frequently are the crossings being used?

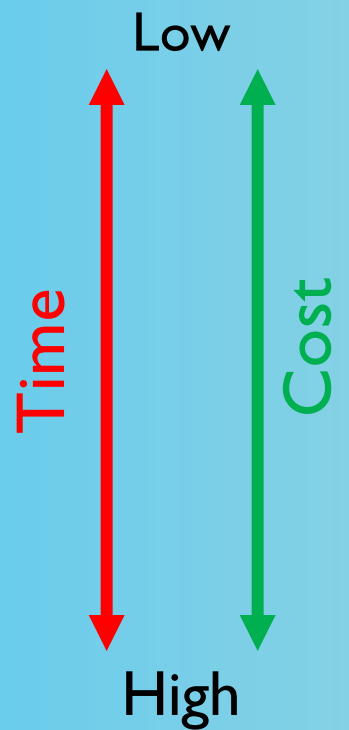
Demographic benefits?

- Lacking

Population-level/genetic benefits?

- Lacking

CRITERIA FOR MEASURING PERFORMANCE



1. Movement within populations
2. Biological requirements met, genetic interchange
3. Dispersal of subadults, recolonization
4. Population redistribution with environmental change
5. Long-term maintenance of metapopulation, community stability, and ecosystem processes

Levels of biological organization

Individuals

Species-populations

Communities-ecosystems

National WVC Reduction Study

Mitigation measure	Cost ($/km/yr)	% DVC Reduced
Deer reflectors and mirrors	$495	0%
Deer whistles	$23.5	0%
Standard warning signs	$18	0%
Seasonal wildlife warning signs	$27	26%
Vegetation removal	$500	38%
Fence with gap and crosswalk	$5,585	40%
Population culling	$2,508	50%
Relocation	$10,260	50%
Anti-fertility treatment	$61,702	50%
Animal detection systems (ADS)	$31,300	82%
Fence (including dig barrier)	$3,760	87%
Fence with gap and ADS	$9,930	82%
Fence with underpasses	$5,860	87%
Fence with overpasses	$26,485	87%
Fence with under- and overpasses	$7,510	87%
Long tunnels or long bridges	$1,500,000	100%
<u>No Information on Effectiveness (so far)</u>		
Enhanced wildlife warning signs	$249	???
On-board animal detectors	$2,225	???
Boulders in right of way	$2,461	???

Huijser et al. 2007

What are Effective Measures ?

PLOS ONE

RESEARCH ARTICLE

How Effective Is Road Mitigation at Reducing Road-Kill? A Meta-Analysis

Trina Rytwinski[1]*, Kylie Soanes[2¤], Jochen A. G. Jaeger[3], Lenore Fahrig[1], C. Scott Findlay[4], Jeff Houlahan[5], Rodney van der Ree[2], Edgar A van der Grift[6]

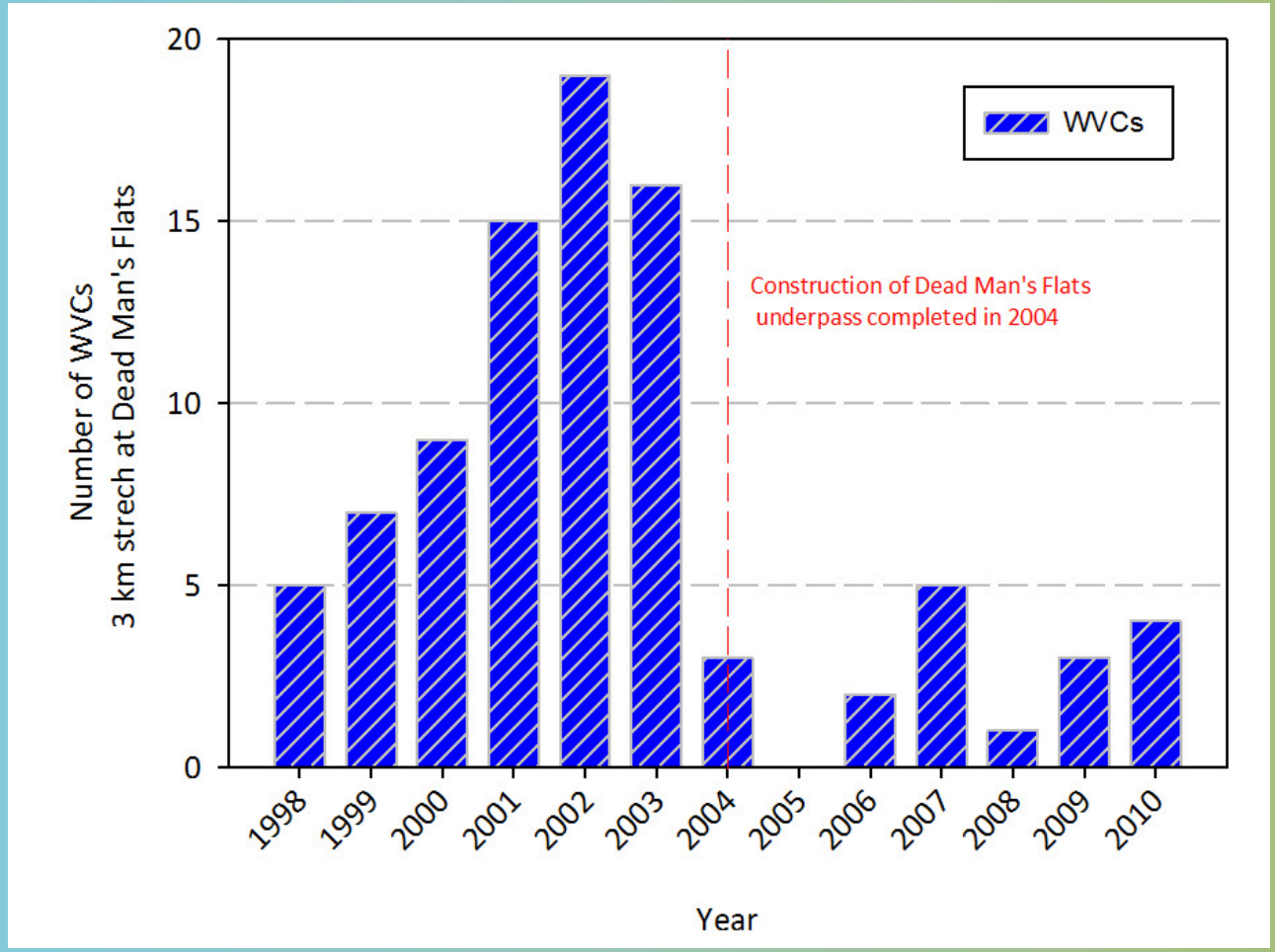
Nov 21, 2016

50 + research papers

"the combination of fencing and crossing structures led to an 83% reduction in road-kill of large mammals,
compared to a 57% reduction for animal detection systems, and only a 1% for wildlife ***reflectors".***

ROAD-KILL EVALUATION

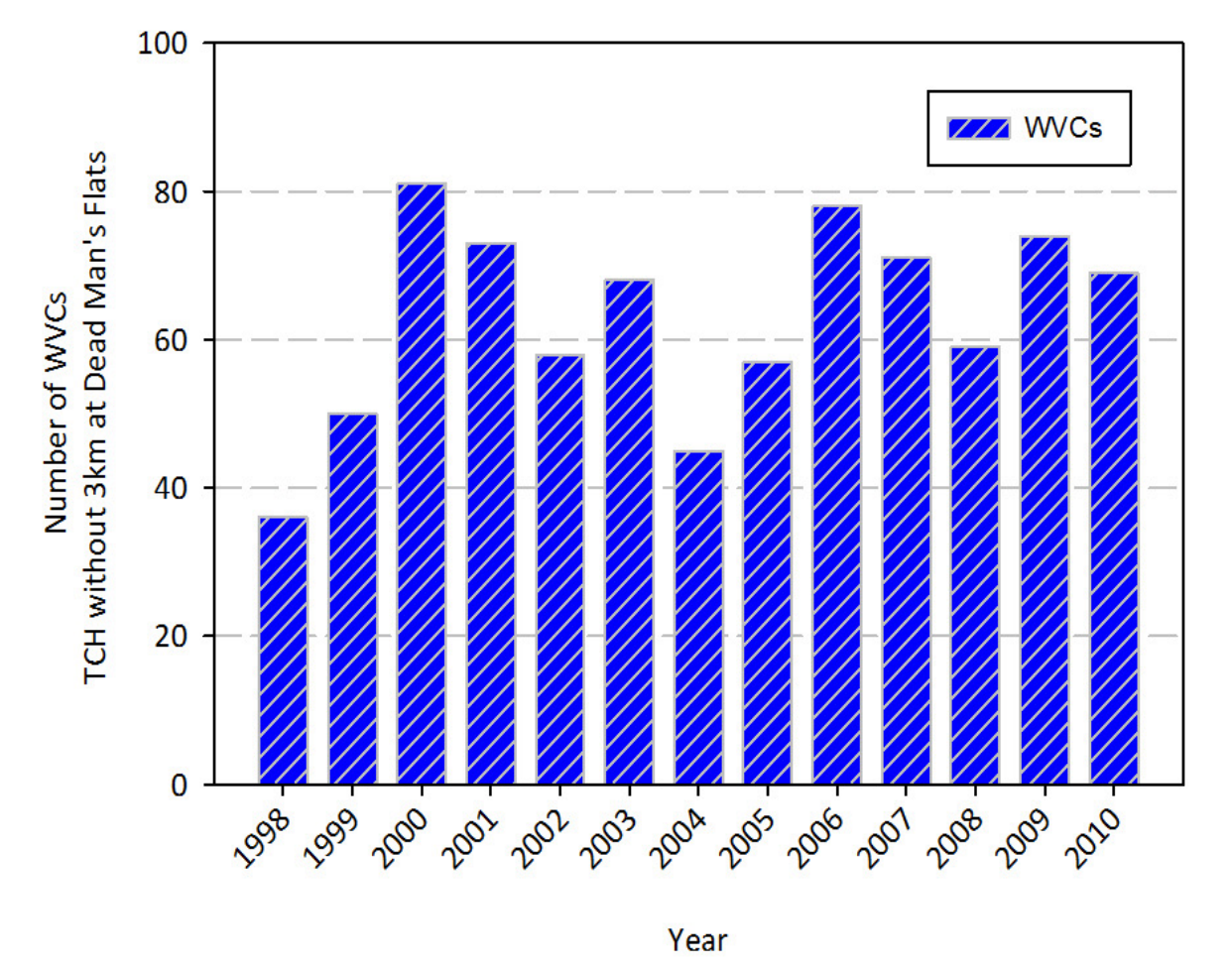
Number of WVCs per year on Treatment section



Lee et al. 2012
G8 Legacy Report

ROAD-KILL EVALUATION

Number of WVCs per year on Control section



Lee et al. 2012
G8 Legacy Report

Wildlife crossings in asia – looking forward

1. LITERATURE REVIEW: Few studies to date
2. GROWING NUMBER OF CROSSING PROJECTS
3. INCREASED KNOWLEDGE – Designs & performance
4. ENSURE FUNDING FOR EVALUATIONS
5. KNOWLEDGE BASE: Build and adapt future projects;
6. REVISE TECHNICAL GUIDELINES: Share "Lessons learned"

Summary

1) Crossing structures: a **key strategy** for wildlife conservation.
2) Crossing structures need to **connect to a larger corridor network**.
3) Scale is important: **project and landscape level**.
4) Planning needs to look **beyond highway** corridor.
5) Research & monitoring is critical to inform design.
6) Technical guidelines are needed.
7) Construction costs are reduced if part of larger project.
8) National scale assessment will allow for prioritization of projects.

धन्यवाद
THANK YOU

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