

Good practice guidance for infrastructure assessment and design

EXPERIENCES FROM INDIA

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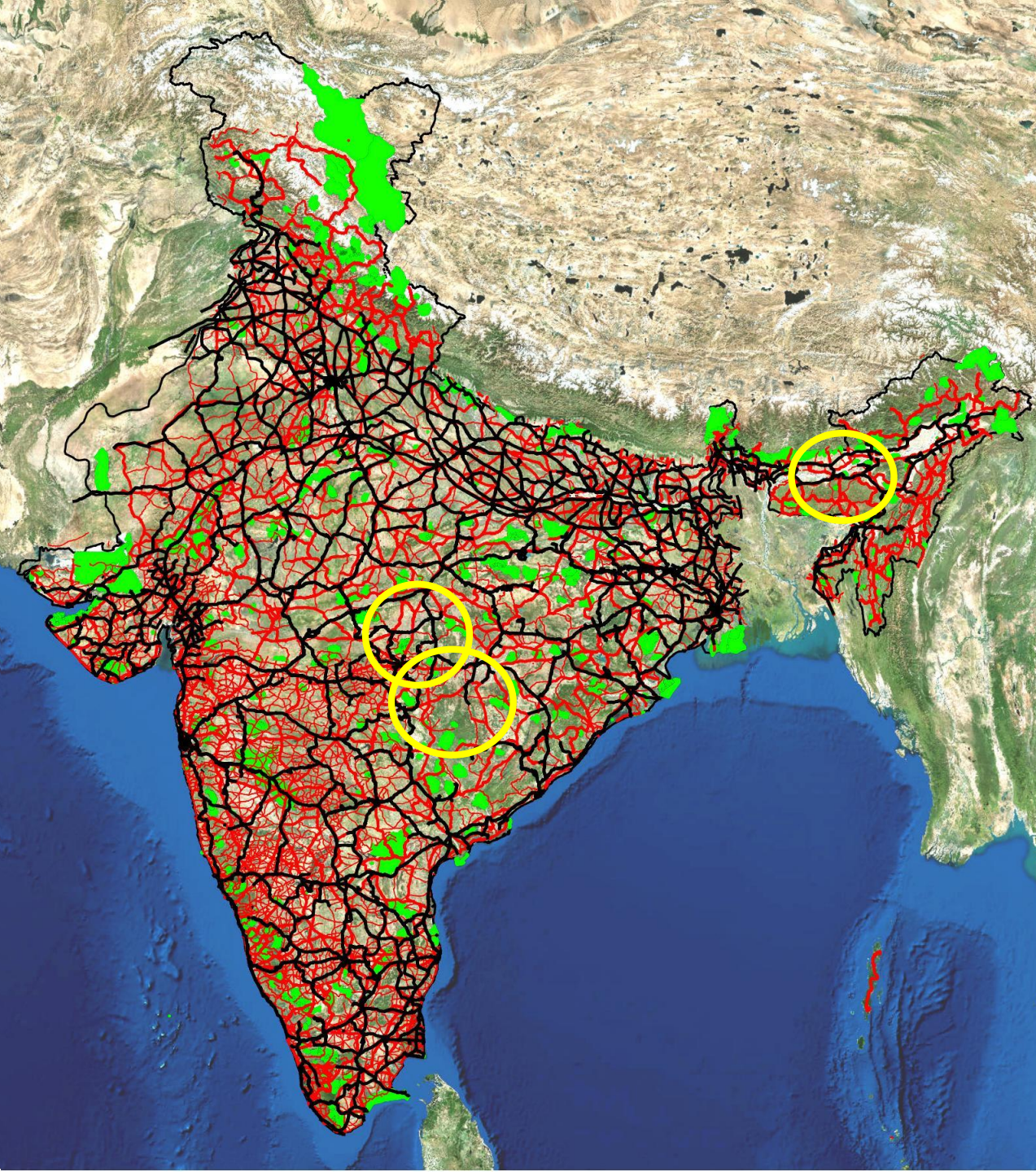
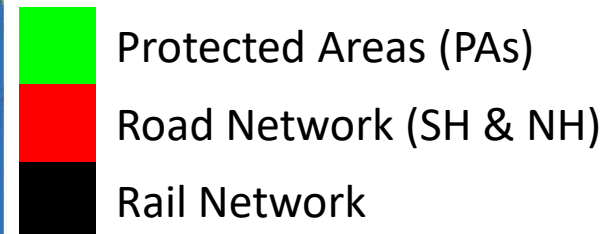
Protected Areas and Linear Infrastructure

5.2 Million Km

2nd largest road network in the world

3.0 Million Km

4th largest rail network in the world



A photograph of a paved road that curves gently to the right, disappearing into a dense forest. The road is flanked by tall, leafy trees that create a canopy overhead. The ground is covered in green grass and undergrowth. The text is overlaid in the lower half of the image.

**26,000 km of road
traversing the forest
areas**



GREENING?

Combining conservation science and road building for connectivity between natural areas.

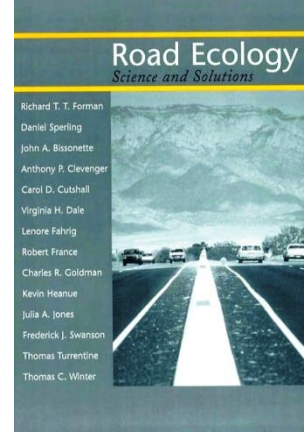
Improving the prospects of conserving biodiversity within the roaded landscapes wherever feasible.

Creating a crossroad for ecology and economy through development of wildlife-transportation corridors



How?

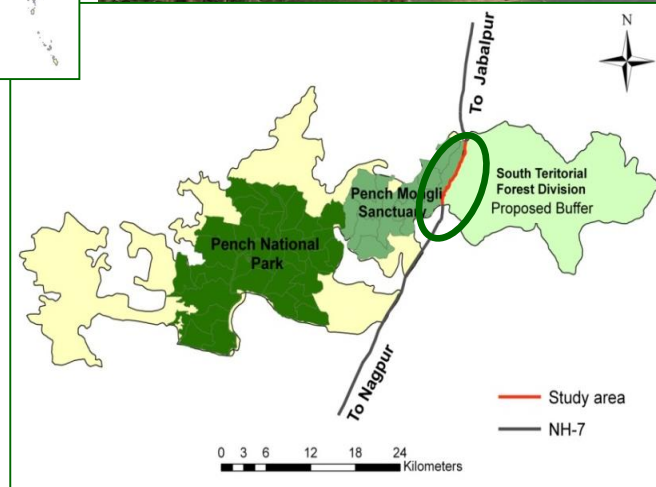
(Forman et al 2002)



1. Reduce rates of animal mortality
2. Maintain habitat connectivity
3. Maintain genetic interchange
4. Ensure biological requirements are met
5. Allow dispersal and recolonisation
6. Maintain metapopulation and ecosystem services
7. Ensure populations remain viable

1

NH-7



Ecological effects of road through sensitive habitats

Implications for wildlife conservation



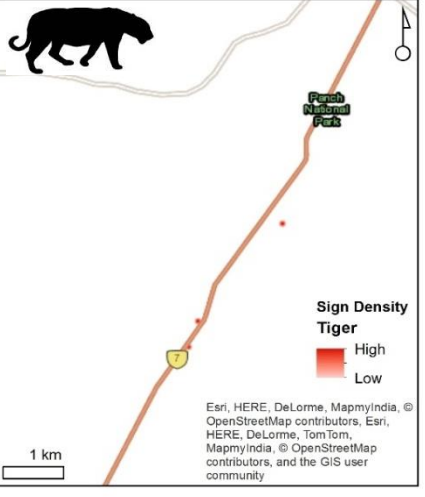
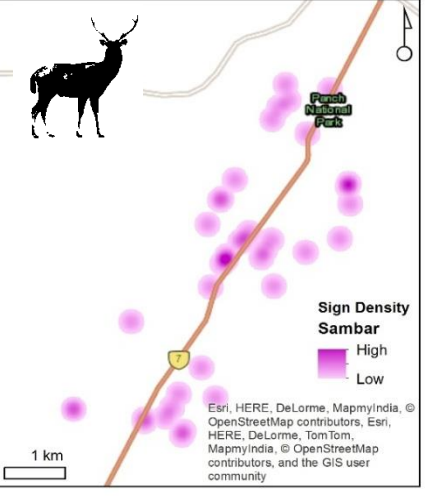
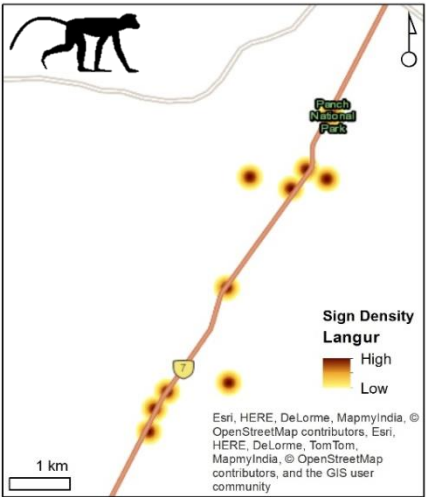
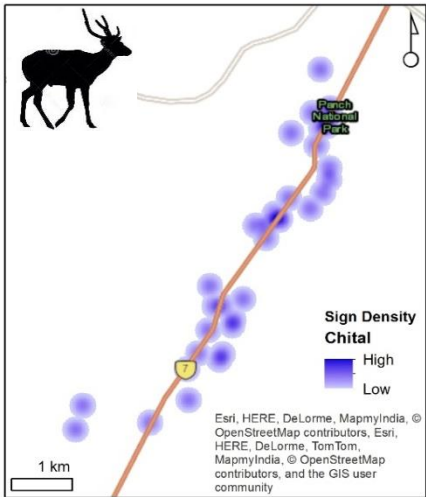
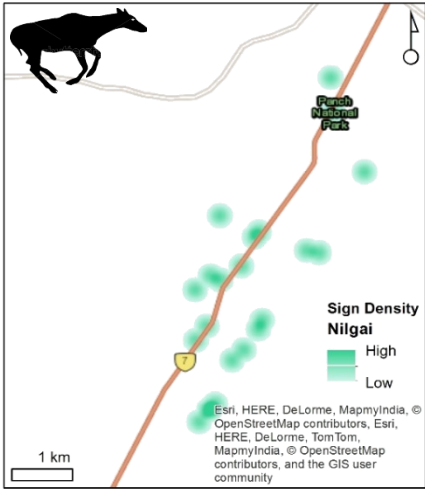
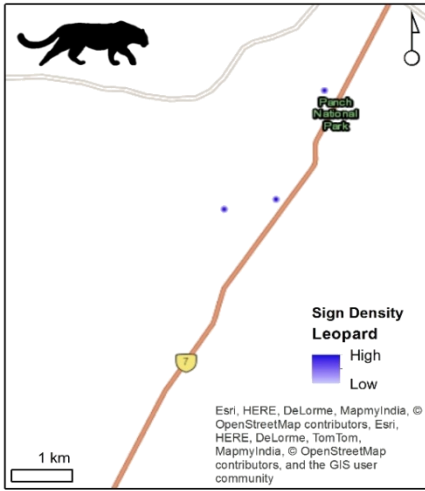
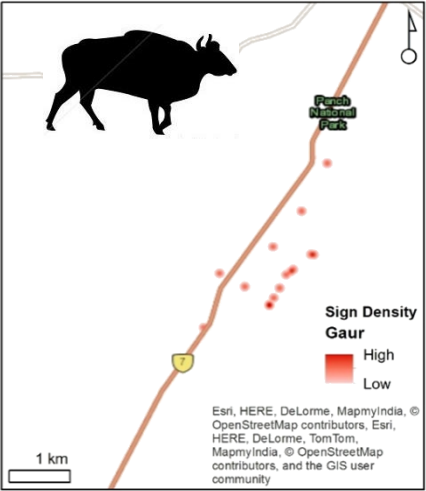
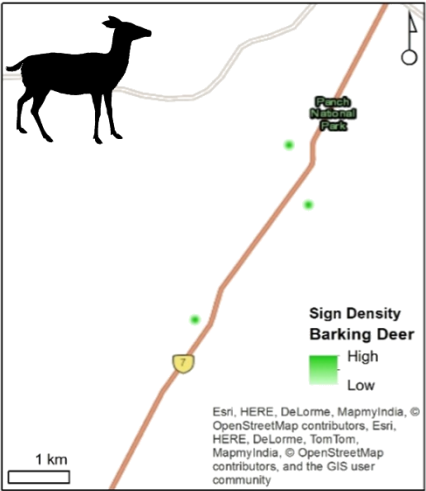
Wildlife Institute of India
2013

First study in the country that provided relevant insights for combining ECOLOGY with STRUCTURAL designs for planning animal friendly transports infrastructure

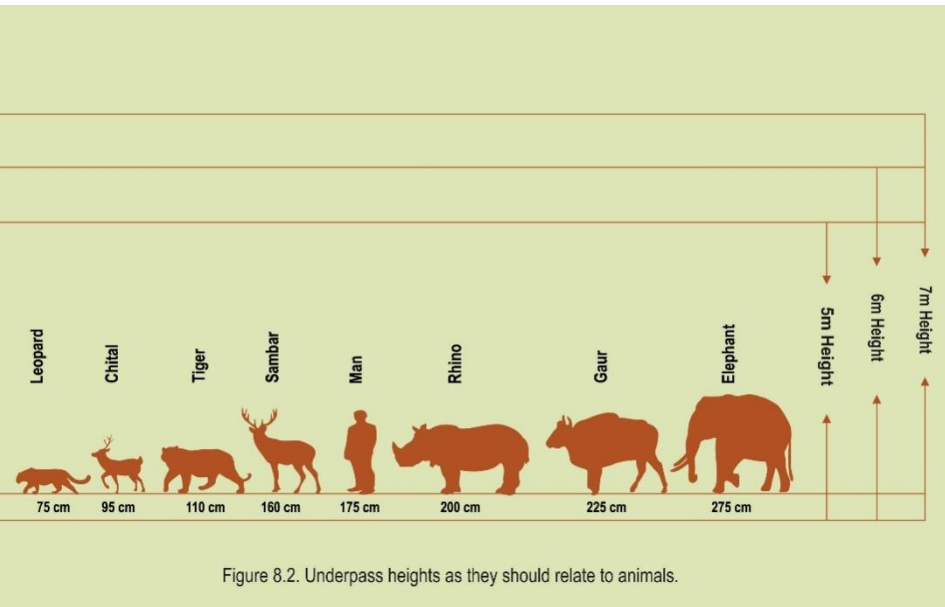
Animal presence



Crossing zones on NH-7



Design considerations in mitigation infrastructure



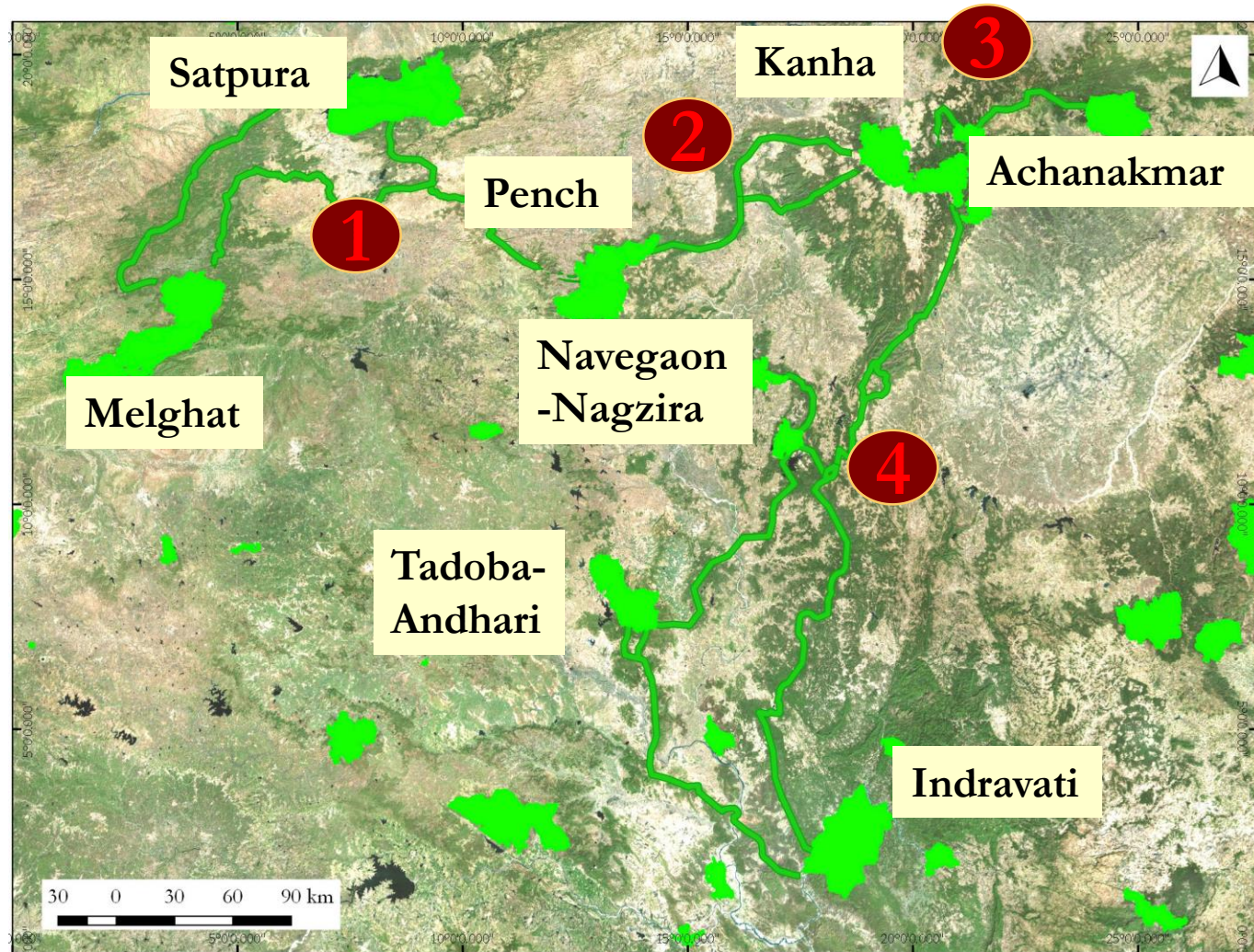
STRUCTURE TYPE	WIDTH (m)	NUMBER
Underpasses	300-1200	6
Small underpasses	50-100	6
Minor bridges (extension)	65-80	3





Road Infrastructure through the Central Indian Landscape

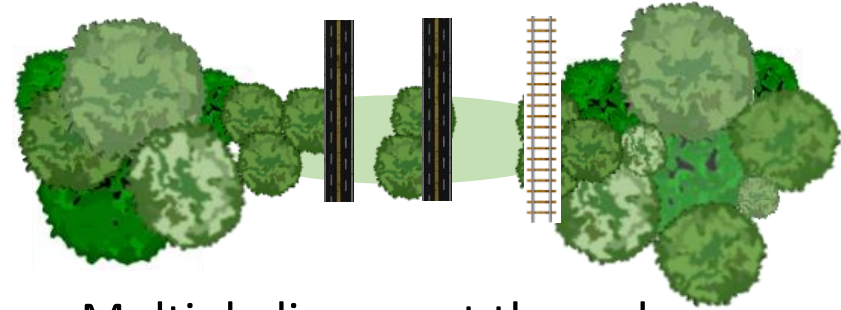
4 Important wildlife corridors harbour 688 tigers in 19 Tiger Reserves and Protected Areas (Jhala et al., 2014).



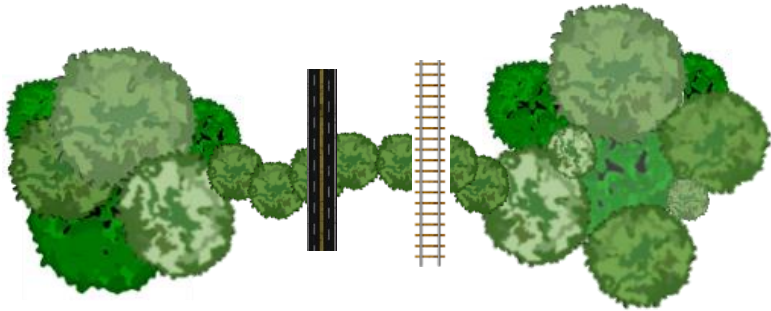
Types of Corridors



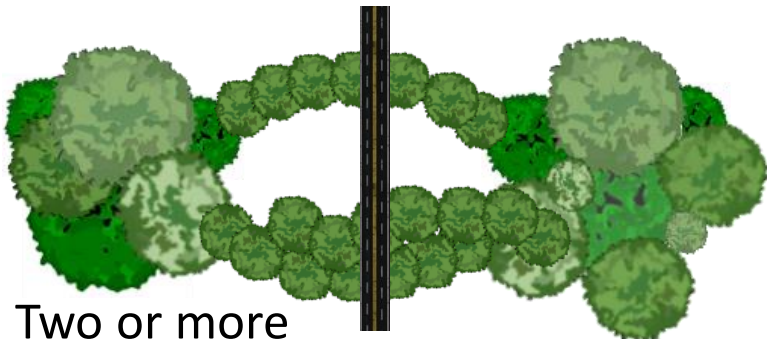
Multiple cut through a healthy corridor



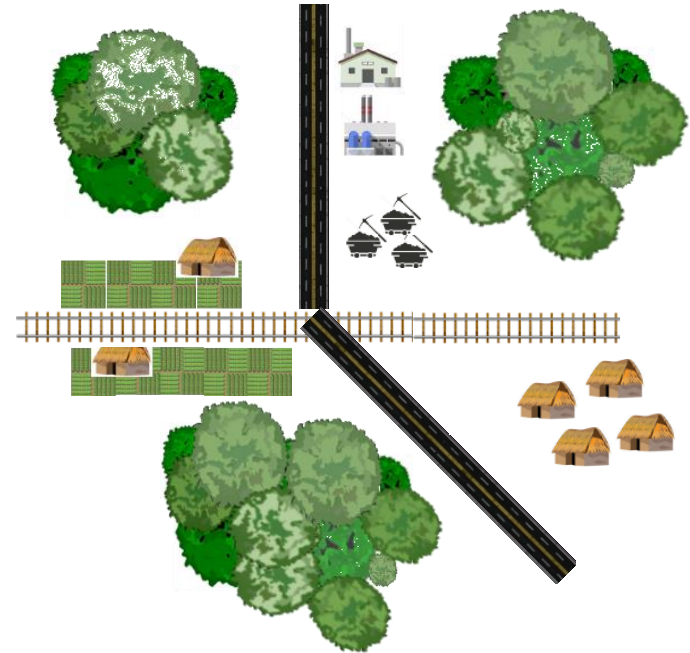
Multiple linear cut through a "stepping-stone" corridor



Multiple linear infrastructure through a narrow corridor



Two or more corridors connect PAs



Multiple forms of infrastructure fragment the landscape

Most critical corridors for connecting key wildlife habitat



Vulnerability assessment of the roaded segments



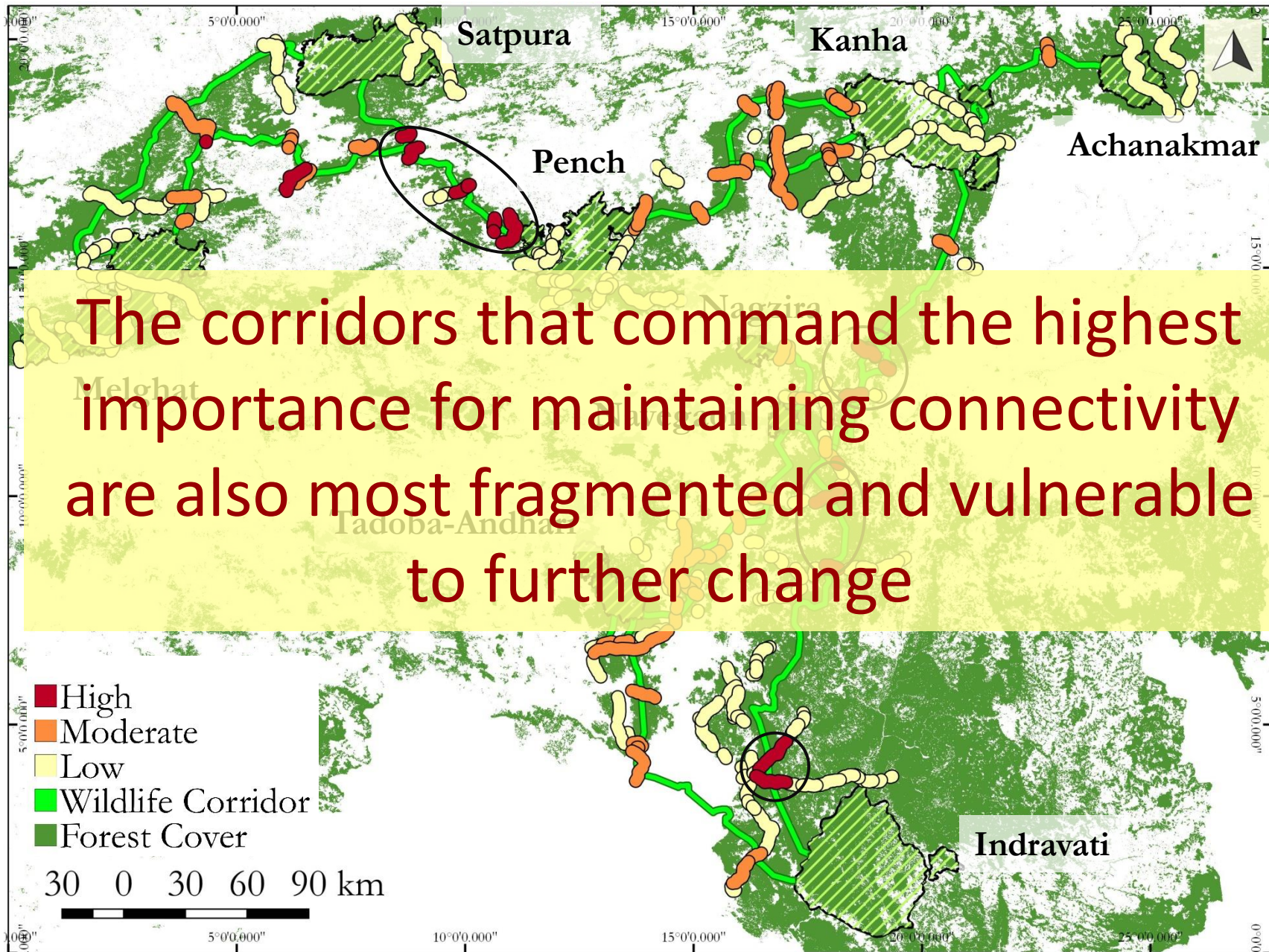
Anthropogenic variables

- Road density (km/sq.km)
- Rail density (km/sq.km)
- Canal density (km/sq.km)
- Population density (persons/sq.km)
- Built-up area (%)
- Cropland (%)
- Plantation (%)

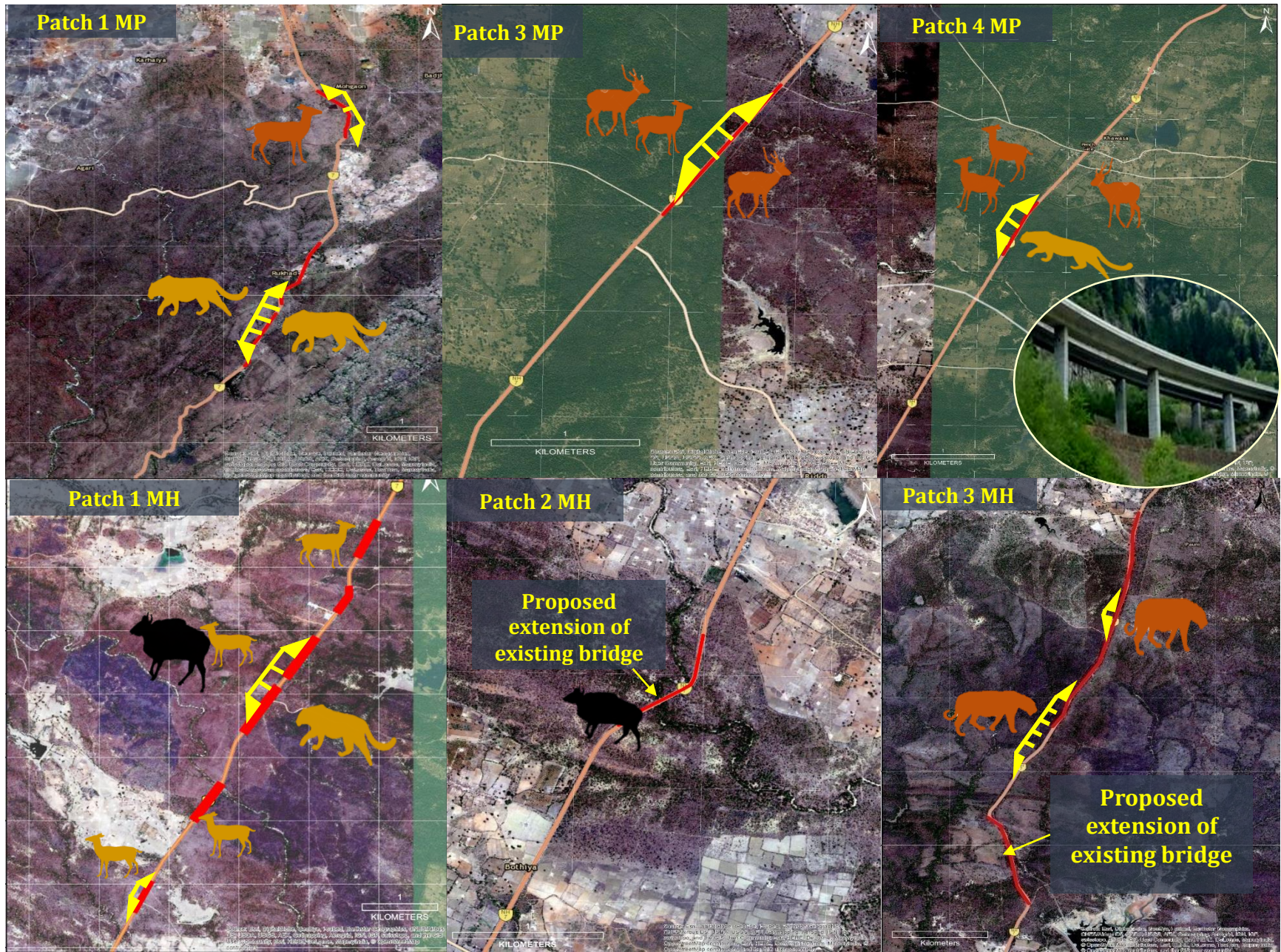
Natural variables

- Patch density (%)
- Patch richness density
- Forest cover (%)
- Wasteland (%)
- Waterbody (%)

Most vulnerable corridor segments



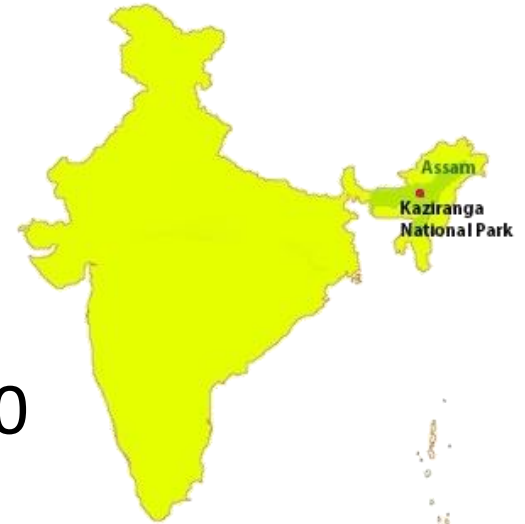
Structural designs to mitigate impacts of NH-7



3

Natural World Heritage Site

2/3 rd of world's one horned rhinos population (approx. 2200)



4

Retrofitting canopy connectivity impaired by a rail line in gibbon habitats

Two recognized species :

Western hoolock (*H. hoolock*)

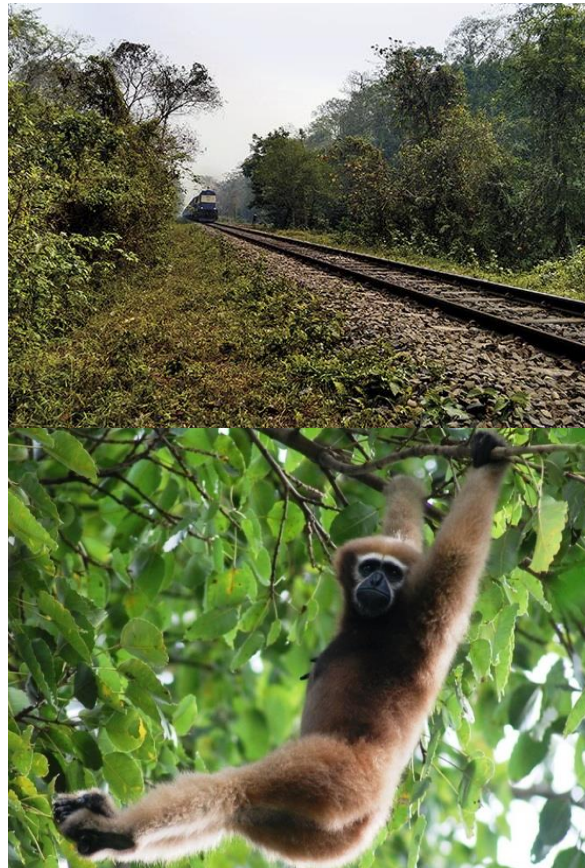
Eastern hoolock (*H. leuconedys*)

One of the 25 most endangered primates

90% decline in Western hoolock numbers (100,000 to less than 5,000 individuals)

Mostly arboreal

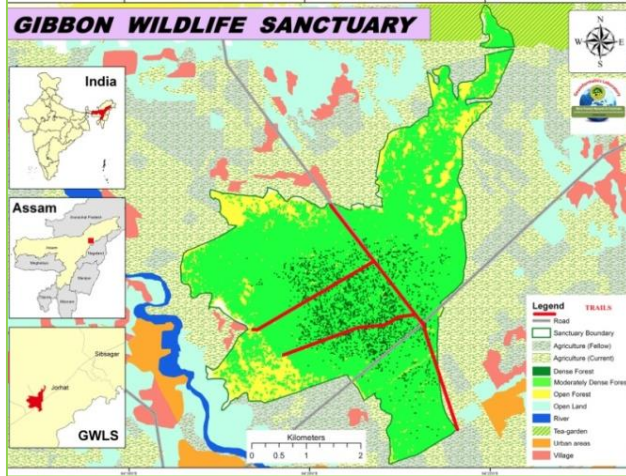
Mostly arboreal
Brachiates at speeds up to 55 km/hr, covering up to 6m in just one swing!



<http://www.natgeotraveller.in/tag/hoolongapar-gibbon-sanctuary/>







Hoolongappar Gibbon
Sanctuary spread across 20.98 sq. km

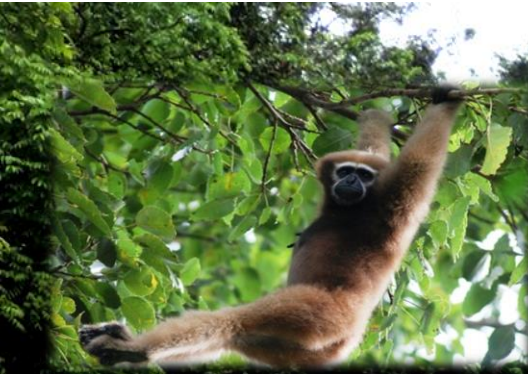
Meleng railway line laid in 1919,
divides the gibbon sanctuary in two
halves.

Major impacts: Impairment of
gibbon movement across the
railway line resulting in inbreeding
among the group

Mitigation option: Construction
of “canopy bridges” over the
railway line which the gibbons
can use to move across



Country's first crossing structure to mitigate impacts on arboreal species



Construction of Iron bridge 10.5 m high and 9.5 m wide in 2015

Total cost = USD 14000

OUTCOME: As the inputs of ecologists were not sought at the design stage, the approach ropes used were very thin for gibbons to get on to the bridge



Iron ropes were tied on both sides of the bridge to the trees on either side of the track to serve as approach way to the bridge.



Lessons and discussion points

- Adequate guidance- *available?*
- Greening of transport infrastructure- *have we moved beyond concepts and practice codes*
- Successful examples –*Are these visible?*
- Sensitive design planning- *critical for efficacy*
- Convergence among road planners, building agencies and conservation community- *Is it happening?*
- Combined impacts on landscape integrity- *Can SEA help?*
- **Is the cost of mitigation infrastructure becoming a deterrent for good practice approaches?**

Acknowledgement

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THE FUTURE
is not something we enter.

THE FUTURE
is something we create.



Thank you