Importance of addressing threats of transport infrastructure to Asian elephant corridors

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Wildlife Trust of India
Sumatran Elephants - Critically Endangered

- CITES Appendix I
- IUCN Red List - Endangered
- CMS - *Elephas maximus indicus* included in Appendix I

Distributed across 13 countries spread over 500,000 km² (Sukumar 2011)

<table>
<thead>
<tr>
<th>Country</th>
<th>Wild Population (min-max)</th>
<th>Captive Population (min-max)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>South Asia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>289-437</td>
<td>96</td>
</tr>
<tr>
<td>Bhutan</td>
<td>605-761</td>
<td>9</td>
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<td>India</td>
<td>29,964</td>
<td>3467-3667</td>
</tr>
<tr>
<td>Nepal</td>
<td>109–145</td>
<td>215</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>5879</td>
<td>230</td>
</tr>
<tr>
<td><strong>South East Asia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambodia</td>
<td>400-600</td>
<td>70</td>
</tr>
<tr>
<td>China</td>
<td>300</td>
<td>243</td>
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<tr>
<td>Indonesia Sumatra</td>
<td>1724</td>
<td>467</td>
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<tr>
<td>Indonesia Kalimantan</td>
<td>60-80</td>
<td></td>
</tr>
<tr>
<td>Lao PDR</td>
<td>500-600</td>
<td>454</td>
</tr>
<tr>
<td>Malaysia Peninsular</td>
<td>1,223 – 1,677</td>
<td>92</td>
</tr>
<tr>
<td>Malaysia Sabah</td>
<td>2,040</td>
<td>23</td>
</tr>
<tr>
<td>Myanmar</td>
<td>2000-4000</td>
<td>5693</td>
</tr>
<tr>
<td>Thailand</td>
<td>3126-3341</td>
<td>3783</td>
</tr>
<tr>
<td>Vietnam</td>
<td>104-132</td>
<td>88</td>
</tr>
<tr>
<td><strong>Total (Min–Max)</strong></td>
<td><strong>48,323 – 51,680</strong></td>
<td><strong>14,930-15,130</strong></td>
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</tbody>
</table>
Human death due to elephants reported every year in Asia.
94.7% reported from South Asia.
About 400-450 elephants are killed due to man made reasons every year in Asia
60-65% (240-250) in Sri Lanka
23-24% (90-100) in India

Elephant mortality by man made reason in India
(1998-99 to 2016-17) N=1695

- Train accident: 52.04%
- Poisoning: 12.74%
- Electrocution: 6.19%
- Poaching: 29.03%
Habitat conversion and fragmentation drives HEC

- Elephants in Asia are competing for space—human population growth rate of 0.5% to 1.5% per annum in range states

- Wildlands constitute only 51% of the Asian elephant range, of which only 16% is legally protected (Leimgruber et al., 2003)

- Globally the annual rate of deforestation is estimated at 10 million ha between 2015 and 2020 (FRA 2020)

- Elephants squeezed into ever-decreasing pockets of forest surrounded by human settlements that often block traditional migratory routes/corridors
Deforestation has severed link between Tiger Reserves of Nilgiris BR and Bhadra TR and north of Nagarhole TR (Hassan District).

- Number of conflict highest within 4 km of PA boundary.

Western Ghats: support 8000+ elephants
Bhadra TR to Nilgiris Biosphere Reserve, India: from 1960s to 2000s (Puyravaud et al., 2019)

- 6,761 km² of elephant habitat lost, largely private forest
- 7,123 km² of natural ecosystems transformed into agricultural mosaics

Deforestation has severed link between Tiger Reserves of Nilgiris BR and Bhadra TR and north of Nagarhole TR (Hassan District).

- Number of conflict highest within 4 km of PA boundary.
LULC changes in Udalguri and Sonitpur district, Assam, India

- Large Scale deforestation and encroachment reported
- About 892 km² of forest area under encroachment in Sonitpur district
- More than 195.17 km² of forest lost in last 40 yrs
- Human death: 82 in Udalguri district and 41 in sonitpur (2016 to 2020)
- 62 elephant death in Udalguri district (2010 to 2019)

(Mahato et al., 2021)
Although elephants have adapted to a wide range of habitats ranging from evergreen to deciduous and dry thorn forests, the quality of fodder is a major concern for elephants driving them to look beyond forest.

**Elephant Home Range: Function of habitat availability**
Critical to secure Wildlife Corridors

1. Access to larger space and mix of foraging habitats
2. Access to breeding partners and maintains genetic flow
3. Decrease vulnerability to stochastic events and decreases their extinction probability
Elephant habitat impacted by transport Infrastructures

Major challenge is how to balance and harmonize the challenge of economic growth and development and the protection of environment
Impacts of Transport Infrastructure

- Fragmentation & degradation of habitat
- Conduits for invasive alien species
- Hindrance to animal movement
- Genetic isolation on animals
- Wildlife mortality/ injury
- LI as ecological traps/ attractants
- Affects animal behaviour (habituation)
- Makes human intrusion easier in otherwise difficult terrain- creating circumstance
101 Elephant Corridors identified in India

2/3rd of corridors have highways

1/4th have railway lines
130-140 Elephants death reported due to train hit in last 20 yrs in **Sri Lanka**

Cause: Speed of train, visibility, terrain, WL connectivity
In India, 339 deaths since 1987 by train hits

Elephant mortality due to train in India
(1987- Dec 2021)
Most critical section between Ettimadai - Walayar and Walayar- Kanjikode (Km 510- 513 on B line and Km 511-513 on A line)

Ettimadai – Walayar: A & B line from KM 505 – 508

Seasonality: June- November (monsoon & Agriculture); most accidents between 21.00- 02.15 hrs

25 elephant death (17 accidents) between 1978 and December 2021
<table>
<thead>
<tr>
<th>Accident prone sections</th>
<th>Length of track (in Km)</th>
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<tbody>
<tr>
<td>21-25</td>
<td>4 Km</td>
</tr>
<tr>
<td>30-33</td>
<td>3 Km</td>
</tr>
<tr>
<td>41-42</td>
<td>1 Km</td>
</tr>
<tr>
<td>51-52</td>
<td>1 Km</td>
</tr>
<tr>
<td>66-70</td>
<td>4 Km</td>
</tr>
<tr>
<td>123-124</td>
<td>1 Km</td>
</tr>
<tr>
<td>127-131</td>
<td>4 Km</td>
</tr>
<tr>
<td>138-139</td>
<td>1 Km</td>
</tr>
<tr>
<td>151-163</td>
<td>12 Km</td>
</tr>
<tr>
<td>Total</td>
<td>31 Km</td>
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</table>

**North West Bengal, India**

80+ elephant death by train hit
Most of them in corridor areas and elephant habitat
Annual trend of elephant mortality due to train accidents in Rajaji National Park, Uttarakhand (N=28)

Proportion of elephant mortality by train hit in different Ranges of Rajaji NP (N=25)
**Bangladesh**: Chittagong (Dohazari) – Cox’s Bazar Railway under construction

**103 Km Railway line** in southern Bangladesh with almost **27 Km passing through 3 PA - all elephant habitats**
Myanmar plans to expand its Railway connectivity

- Myanmar – Thailand Railway Link
- Mandalay – Muse New Railway Line (Myanmar border with China)
- Mandalay – Tamu New Railway Line
Impact: China’s belt and road Initiatives
Pan Borneo Highway, Sabah Malaysia will pass through 25km of elephant range
Planning linear Transport Infrastructures

1. Landscape planning keeping into consideration the biodiversity of the area, natural services and impact of linear infrastructures

2. Robust Policy on linear intrusions adopting the principles

- Avoid/Prevention
- Minimise/Realign
- Mitigate
- Compensate
3. **Comprehensive Environment and Social Impact assessment**

- Impact on habitat
- Impact of focal species of flora and fauna
- Impact on wildlife connectivity/pollinations
- Impact of social well being of the people
- Impact on ecological resources and services
- Direct, indirect and cumulative impacts of the structure

4. **Spend more time on drawing Board understanding the impact of the linear infrastructure and adopt mitigation measure**

5. **Monitoring mitigation measures**
Realigning the east west railways in Nepal

- Recommended alignment between Tamrariya and Simara shorter by 5.4km even after considering 42 km long Tamsariya -Bharatpur line of section -7.
- Tunneling requirements on recommended alignment would be 2.75 km against 35km on alternate alignment.
- Recommended alignment travels on south of Royal Chitwan Park while alternate alignment runs along East-West Highway.
Factors responsible for accidents

- **Ecological** (food, water, shelter, vegetation and movement of elephants)
- **Physical factors** (steep embankments and turning)
- **Technical** (speed of train, frequency and time, unmanaged disposal of the edible waste and garbage)
- **Lack of awareness of among** drivers, passengers and planners
- **Lack of coordination** between the railways and the forest department is the reason for lack of any sustained mitigation measure.

The above mentioned factors are not mutually exclusive and operate in tandem to increase the potential for elephant and train collisions.
Mitigation measures should depend on what the issues are in a landscape

Mitigation Measures – Landscape Management

Steep embankments

Effect of steep embankments on elephant mortality. Elephants are trapped when trains approach and have no way out (left), and long-term mitigation by reducing steepness of embankments by cutting them, to allow elephants to quickly move away when trains approach (right)
Elevated tracks

Effect of raised railway tracks on elephant mortality. Elephants attempting to cross over find it difficult to scale these elevations and thus move away quickly when trains approach (Left). Long term measures by adding shallower inclines on either side, where elephant movement is prevalent, would allow elephants to cross over much more rapidly (right).

Certain sections of railway tracks where elephant movement is present, the tracks are raised high on the grounds often with small underpasses which do not allow elephants to move below the tracks. Such sections form barriers to elephants and forces them to cross over railway tracks (left). Long term mitigation measures also propose expansion of some of these underpasses to allow for elephant movement (right).
C. Clearing vegetation along tracks for increased vision

D. Joint patrolling of track in accident prone area

E. Sensitizing Train drivers, guards and station masters

F. Preventing food waste disposal in forest area through sensitization

G. Coordination meeting between Forest Dept and India Railways
Old Rail barriers @ Wildlife Trust of India

In open area, have underpass or sensors to detect animal
H. Technology for effective detection and alert

Infra ray (IR) based sensors

Seismic Sensing

Wireless Intranet Early Warning System with IR Detectors, Night Vision Cameras, Geophones, AI Image Processing & Analytics

Functioning Flow Chart (left) and ADS Sensory Device to detect animal intrusion

Infra ray (IR) based sensors
National Board of WL, India mandates that all linear infrastructures projects passing through PA, buffer zones or ESZ seeking clearance should have **Animal Passage plan**

- Building Green Infrastructures

*Underpass in Chilla Motichur corridor (@ WWF)*

*Viaducts at Gerik, Perak, P. Malaysia*
NH-209 BRT, India

Pipe culvert (1x1.20) Reconstruction
Pipe culvert 1.2 m radius (one No)

Current: Pipe culvert 2 x 4ft wide (NHAIV has no plan for this culvert)
Box culvert of HxW 6m x 8m (2 Nos)

Box culvert of HxW 2.5m x 4.5m (one No)

Culvert IX (near 269+000)
Current: Box culvert about 7ft height and 5-7ft width
NHAIV: Box culvert 1 x 3.0, Reconstruction
Suggestions: Box culvert of HxW 3m x 4.5m (one No)

New EUP (near 269+100)
Current: None, but important elephant crossing and a good suggestion
NHAIV: EUP 2 x 30, new construction
Suggestions: EUP 2 Nos of HxW 8m x 30 m each

Mark that this should be open for animals to see forest on other side
Underpass for wildlife movement on NH 152 near Manas NP

PROTECTING ASIAN ELEPHANTS FROM LINEAR TRANSPORT INFRASTRUCTURE
The Asian Elephant Transport Working Group's introduction to the Challenges and Solutions
Thank You