

The Railway-Line Fence: A New Passive Elephant Barrier at Bannerghatta National Park, Southern India

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Introduction

India holds 60% of the population of Asian elephants (*Elephas maximus*) (Baskaran *et al.* 2011) with about 28,000 elephants distributed in approximately 3% of the land area of India (Lenin 2011). The southern population is the largest and represents 48% of the total population, of which the State of Karnataka harbours an estimated 6049 elephants (MOEF 2017). In Karnataka, about 60% of the elephants utilize areas outside protected areas (Malhotra 2015). Human-elephant conflict (HEC) is a major concern and to address this issue, many physical barriers have been set up on the boundaries of protected areas to prevent elephants moving out.

In Bannerghatta National Park (BNP), Karnataka, eight types of physical barriers namely, solar electric fences, elephant proof trenches, rubble walls, concrete walls, concrete moats, spike pillars, spike gates and mesh barriers have been constructed (Gayathri *et al.* 2016). These barriers border 200 km (70.42% of the BNP boundary) of BNP, with single barriers or multiple types of barriers located parallel to each other in sections of the boundary.

These efforts however did not alleviate HEC, either due to man-made breaches such as on paths created for grazing cattle, natural causes such as soil erosion impeding the effectiveness of elephant proof trenches, and elephants overcoming the barriers (Varma *et al.* 2009). A field survey conducted along the BNP boundary revealed that there was an average of 6 breakages per km along all types of barriers (Gayathri *et al.* 2016). In 2015, another physical barrier,

the 'railway line barrier' was constructed by the Karnataka government, using steel rails from old railway tracks. This was constructed parallel to the existing barriers. Such barriers have been implemented in South Africa at Addo National Park since 1951 (Studer 2014) and at Veeranhosahalli Range (33 km) in Nagarhole Tiger Reserve, India since 2015 (Kumar 2015).

The costs of some of the barriers per km are, elephant proof trenches – 6,777 US\$ (Tamil Nadu Forest Department 2013), solar electric fences – 5,911 US\$ (NABARD 2017), rubble walls – 194,047 US\$ (Nameer 2015) and railway line barriers – 90,312 US\$ (Nameer 2015). Considering the installation costs, though elephant proof trenches and solar electric fences are cheaper in comparison to railway line barriers, the trenches are ineffective near streams and sloping terrain, and fences require continual maintenance. This makes railway line barriers more economical in the long term and they are also more environmentally friendly compared to some of the other barriers (Nameer 2015).

We carried out a survey in the BNP from 8th July to 7th August 2017 to map land use patterns around the boundary, assess the efficacy of the railway line barriers and identify factors that potentially reduce their effectiveness.

Methods

BNP consists of 260 km² of fragmented tropical thorn and scrub forests located at the northern tip of Eastern Ghats. The railway barriers were implemented in the Bannerghatta and Kodihalli wildlife ranges of BNP. The assessment was

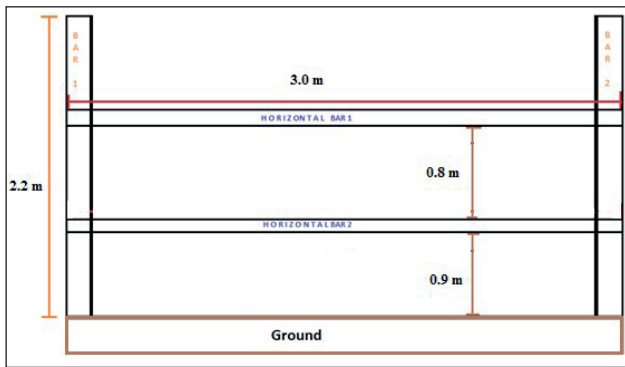


Figure 1. Structure of the railway line barrier.

conducted at Thattaguppe administrative beat of Bannerghatta wildlife range and Hanchuguli and Gowdahalli beats of Kodihalli wildlife range. Foot surveys were carried out along the railway line barriers and presence of human settlements, agricultural land, other vegetation and water bodies were documented every 100 m, within a visual range of 200 m. In addition, water channels and cattle trails across the fence were recorded to identify breakages or weak spots. Measurement of rail segments (Fig. 1) and other barriers that were alongside railway line barriers were conducted every 100 m, using a 15 m tape.

Results and Discussion

Specifications of the railway barrier system

Horizontal and vertical bars were connected by four nuts and bolts (Fig. 2), and vertical bars were buried about a metre in the ground. The total length of the barrier was 9.953 km (Fig. 3), with 7.585 km in the Thattaguppe beat of Bannerghatta Range and 2.249 km in and Kodihalli Range of



Figure 2. Horizontal bars are connected to the vertical bars with nuts and bolts.

which 0.119 km was in the Gowdahalli beat and remaining 2.130 km in the Hanchuguli beat. The fence was continuous in Thattaguppe and Hanchuguli, however, in the Gowdahalli beat, the barriers were placed to supplement other barriers where there were water channels (Fig. 4). It was implemented as 4 different segments of 12 m, 30 m, 32 m and 45 m lengths.

Land use patterns

There were approximately 320 houses without agricultural land, inside the protected area in Bannerghatta Range in the first km of the railway line barrier. Along the remaining extent, it was forested with no other land-use. Outside the fence there were no houses and 3/4th of the land-use

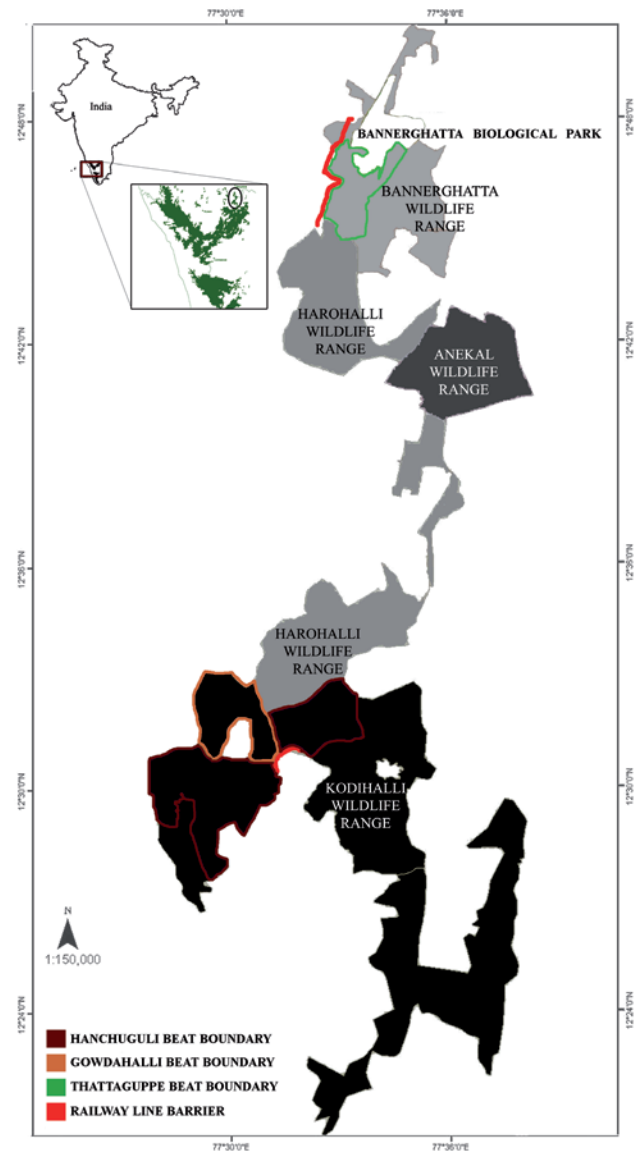


Figure 3. Position of the railway line barrier along the BNP boundary.



Figure 4. Railway line barrier used for supplementing solar electric fence along water channels in Gowdahalli Beat, Kodihalli Range.

was agriculture with other vegetation and bare land consisting of the remaining. In Kodihalli Range, there were no houses on either side of the railway line barrier. Inside the protected area, it was completely forested. Outside the barrier half of the land-use was agriculture with the remaining being covered by other natural vegetation or bare land. Twelve water bodies were found along the railway line barrier in BNP out of which 3 were in Hanchuguli beat and one was in Gowdahalli beat of Kodihalli Range, and the other 8 were in Thattaguppe beat of Bannerghatta Range. All the water bodies were on the protected area side along the railway line barrier except for one in Thattaguppe beat.

Effectiveness of the railway barrier system in comparison to other barriers

Elephant-proof trenches were found along 7.6 km of the rail barrier and had 14 breaches amounting to a length of 0.971 km. Most (85%, n = 12) of the breaches were due to natural causes such as sludge, silt or debris deposition that reduced the depth of the trench. There was one breach from



Figure 5. Railway line barrier with integrated electric fencing.

elephant breakage and another from communities laying bamboo sticks across the trench.

Solar electric fencing was found along 6 km of the rail barrier. We recorded a total of 11 breakages in solar electric fencing (10 in Kodihalli Range and 1 in Bannerghatta Range). In Kodihalli, fencing was broken by elephants, amounting to a damage extent of 1.0 km. The fence was broken by humans at 9 locations, for facilitating the movement of cattle and fuel wood collection. A 5 km length of the rail barrier had an integrated solar electric fence, which did not have any breakages (Fig. 5).

Rubble walls and concrete walls parallel to the constructed railway line barrier were observed in an extent of 2 km and 0.4 km, respectively. They were found to be frequently broken, with 13 breaches in the rubble wall and 4 in the concrete wall.

There were 2 damages in the railway line barrier. One was caused by elephants in Gowdahalli beat extending to about 22 m. According to the field staff, the breakage had occurred in one of the vertical bars that had two segments welded to a single pole. The other was in Thattaguppe beat where one of the horizontal bars was slightly bent as it was challenged by an elephant but was not breached.

Errors in construction of the rail barrier seemed to be considerably high. A total of 43 bolts connecting horizontal and vertical bars were missing, with 37 in Bannerghatta Range and 6 in Kodihalli Range. The soil below vertical bars



Figure 6. A boulder that possibly decreases the effectiveness of the railway line barrier.

was found to be eroded extending to about 15 to 40 cm, at 5 places, 4 in Bannerghatta Range and 1 in Kodihalli. Boulders were found at the barrier on 5 locations in Bannerghatta Range (Fig. 6).

The damages in the railway line barrier were considerably low in comparison to the other barriers. Construction errors such as welding two segments and, missing nuts and bolts, could make the barrier susceptible to breakage by elephants. There were no breakages in the railway line barrier for a continuous stretch of 7.58 km in Thattaguppe, suggesting that the railway line barrier is effective against elephant breakage. However, elephants have been seen by the locals to have crossed over the railway line barrier once and to have passed between the horizontal bars once, in 2018, both in Thattaguppe beat.

A structure constructed with 3 horizontal rails fixed at 0.6 m, 1.35 m and 2.1 m from the ground supported by 3 m tall vertical bars every 1.8 m as per the proposal of the Kerala State Forest Department (Nameer 2015), could prevent elephants from crossing over, between or under the horizontal bars. Alternatively, we strongly recommend the use of solar fence integrated with the railway line barrier in order to maximize the efficacy of these physical barriers and make it completely elephant-proof.

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