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Cover: Parts of *Vachellia nilotica*, medium - watercolours. © P Kritika

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ARTICLE

The need for rigorous peer-review of Environmental Impact Assessments: a case from the Western Ghats, India

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Abstract: Environmental Impact Assessments (EIAs) are vital exercises for evaluating the effects of proposed activities on the environment and human well-being. In many countries, including India, they often suffer from incomplete biodiversity information and data manipulation. These issues are compounded by a lack of scientific rigour, independent review, and sufficient public participation—problems that are especially critical in biodiversity hotspots. This paper examines a 'Cumulative Impact Assessment' by the Wildlife Institute of India (WII) published in 2025, for the double-tracking of an existing railway line passing through Bhagwan Mahavir Wildlife Sanctuary and National Park in Goa, and Kali Tiger Reserve in Karnataka—both part of the Western Ghats, a global biodiversity hotspot. The WII EIA was compared with the Indian Institute of Science's (IISc) 'Biodiversity and Environmental Assessment' study that was previously prepared in 2017 for the same project. It was found that while the new EIA by WII addressed some of the gaps of the previous EIA, it failed to make a comprehensive assessment of projected biodiversity loss, leaving out some important taxonomic groups such as freshwater fish, insects, arachnids, and fungi, and failing to address its own study objectives, such as identifying critical wildlife habitats. It also neglected social impacts, despite widespread public opposition in Goa. The WII EIA fundamentally functions as an incomplete species inventory with mitigation measures, implying a conditional approval for the railway project. It does not assess loss in landscape-level connectivity, fragmentation of wildlife corridors, changes in human–wildlife interactions, and impacts on human health. This comprehensive review supports the call put forth by other scientists globally for the need for rigorous, independent peer reviews of EIAs, especially for projects with severe ecological and socio-economic consequences, planned in biodiverse and irreplaceable landscapes.

Keywords: Biodiversity assessments, biodiversity hotspot, forest governance, linear intrusions, mitigation measures, protected areas, railway, social impact assessments, tiger reserve, wildlife conservation.

Konkani (Devanagari script): प्रस्तावित आशिल्ल्या विकास कामांखातीर, पर्यावरण आनी मनीस कल्याणाचेर जावपी परिणामांचें मूल्यमापन करपाक अत्यंत महत्त्वाची प्रक्रिया आसा. भारता वांगडाच हेर कितल्याशाच देशांनी हीं मूल्यमापनां चडशा वेळार जैवविविधते विशयीच्या अर्धवट म्हायती, आनी आकडेमोडींन फेरफार जावप अशा समस्यांनी ग्रस्त आसता. ह्या समस्यां वांगडा वैज्ञानिक नदरेतल्या काटेकोरपणाचो अभाव, स्वतंत्र पुनरावलोकनाचो अभाव आनी लोकसहभागाचे अपुरेपण अश्या समस्यावांगडा जोडिल्ल्यो आसतात . चड करून ह्यो समस्या जैवविविधतेच्या नदरेतल्यान अती संवेदनशील भागानी चड गंभीर आसतात. ह्या शोधनिबंधांन 2025 वर्सा "वाइल्डलाइफ इन्स्टिट्यूट ऑफ इंडिया (WII)" हाणीं प्रकाशित केल्ल्या एका एकत्रित परिणाम मूल्यांकनाच्या (Cumulative Impact Assessment) अभ्यासाचें परीक्षण केल्ले आसा. हो अभ्यास गोयांतल्या "भगवान महावीर वन्यजीव अभयारण्य आनी राष्ट्रीय उद्यान" आनी कर्नाटकांतल्या " काळी व्याघ्र राखीव क्षेत्र " हांगाच्यांन वचपी विद्यमान रेल्वेमार्गाचें दुपदरीकरण (double tracking) करपाच्या प्रस्तावाक लागून तयार केल्लो. हे दोनूय वाठार जागतिक स्तराचो जैवविविधता हॉटस्पॉट आशिल्ल्या अस्तम घाटाचे वाठार आसात. WII च्या EIA ची तुलना ह्याच प्रकल्पाखातीर 2017 ह्या वर्सा "इंडियन इन्स्टिट्यूट ऑफ सायन्स (IISc)" हाणीं तयार केल्ल्या "जैवविविधता आनी पर्यावरणीय मूल्यांकन" (Biodiversity and Environmental Assessment) अभ्यासा वांगडा केल्ली. नव्या WII , EIA न आदल्या EIA तल्यो कांय उणिवो भरून काडपाचो यत्न केल्लो, पूण प्रस्तावित जैवविविधता नुकसानाचें सर्वसमावेशक मूल्यमापन करपांत ते अपुरे पडला. हाका लागून गोड्या उदकातले माशे, किडे, आठ पायांचे जीव(arachnids) आनी बुरशी (fungi) ह्यासारखे महत्त्वाचे घटक , गृहित धरुकना तशेच आपणाल्या अभ्यासा उद्देशांत समाविष्ट आशिल्ल्या महत्त्वाच्या वन्यजीव अधिवासांची वळख पटोवप हें उद्दिष्ट फळादीक जावंक ना. गोयांन रेल्वे प्रकल्पाविरोधांन व्यापक लोकविरोध आसूनलेगीत ह्या EIA न सामाजिक परिणामांचेर पूर्णपणान दुर्लक्ष केलां. WII चो EIA मुळसातत्यान नियंत्रीत करपाच्या उपायावांगडा (mitigation measures) , तयार केल्ली एक अपुरी प्रजाती सूची (species inventory) अशा रितीची भूमिका निभायता आनी अप्रत्यक्षपणान रेल्वे प्रकल्पाक अटींचेर आधारीत मान्यता सुचयता. तातून भूदृश्य पातळी वयल्या (landscape-level) जोडणीचो ऱ्हास, वन्यजीव मार्गांचें तुकडे करपाक (fragmentation), मनीस - वन्यजीव परस्पर संवादांतले बदल, आनी मनशाच्या भलायकीचेर परिणाम हांचें मूल्यमापन केल्लें ना. हें सर्वसमावेशक पुनरावलोकन जगभरांतल्या हेर वैज्ञानिकांनी माणिलल्या मागणीक पाठबळ दिता की, विशेष करून जैवविविधतेन समृद्ध आनी खाशेल्या प्रदेशांत प्रस्तावित, गंभीर पर्यावरणीय आनी सामाजिक-आर्थिक परिणाम घडोवपी प्रकल्पांच्या पर्यावरणीय परिणाम मूल्यांकनांचें कठोर, स्वतंत्र आनी समकक्ष तज्ज्ञांकडून (peer review) पुनरावलोकन जावप गरजेचें आसा.

INTRODUCTION

The global ecological crisis, marked by unprecedented biodiversity loss and accelerating climate change, has led to calls for a more urgent and reflective ecological praxis (Pettorelli et al. 2025). India is highly vulnerable to the impacts of climate change, particularly in its biodiversity-rich regions such as the Western Ghats (MoEFCC 2021; IPCC 2022). Increasing and maintaining canopy cover and safeguarding the network of Protected Areas (PAs) are recognised as key nature-based solutions for both climate mitigation and ecosystem resilience (Ravindranath & Sukumar 1998; Balaji et al. 2022). Within this context, Environmental Impact Assessments (EIA) have become a widely adopted tool for evaluating the potential impacts of infrastructure projects on the natural environment. The EIA is a procedural and scientific mechanism used to predict, assess, and mitigate the potential socio-environmental impacts of proposed development activities before they are implemented. However, despite its near-universal application, research has underscored significant limitations in its effectiveness and has called for reforms to make the process more rigorous and ecologically responsive (Laurance 2022).

Studies have shown that EIA processes frequently fall short across multiple dimensions, including their underlying scientific methodology and rigour (Hughes et al. 2024). In India, these limitations of biodiversity assessments, mitigation studies, and environmental impact studies are particularly stark. The country's environmental governance and auditing frameworks have undergone significant changes in recent years with a greater emphasis on 'ease of doing business', catalysing infrastructural and industrial expansion (Dharmadhikary 2023). As a consequence, the rate of granting forest clearances has significantly increased. Since 2014, fewer than 1% of forest clearance proposals have been rejected (Joshi 2020). The rate of granting wildlife clearances for projects such as mining within PAs and Eco-sensitive Zones by the Standing Committee of the National Board for Wildlife (SC NBWL) has shown a similar increase (Srivastava & Singh 2026). Menon & Kohli (2015) have argued that fast-tracking clearance processes in the name of industrialisation and urban development have fundamentally reshaped forest governance in India. However, this acceleration has faced resistance, particularly through an increase in the number of Public Interest Litigations (PILs), which, as Menon & Kohli (2015) observe, function as a crucial

check on governance mechanisms (Dilay et al. 2019).

Multiple stakeholders take part in an EIA, including project developers, EIA consultants, regulatory government authorities, politicians, affected citizens, scientists, media, and civil society. Given the diversity of stakeholders, each with a different agenda, the EIA process may be subject to manipulation through falsifying or exaggerating data, withholding information, undervaluing or overvaluing impacts, intentionally presenting confusing information and by bribing developers or consultants (Enríquez-de-Salamanca 2018). Kopas et al. (2022) demonstrated how corrupt local-level political networks led to an increase in the approval of new environmental clearances, particularly in the coal sector. Although their analysis extends only until 2014, they anticipate a worsening trend under the current political climate. The impacts of linear infrastructure projects, for instance, extend to speculative property markets (Balakrishnan 2019) and abrupt disruptions to local livelihoods (Bathla 2024). These consequences underscore a broader failure to adequately account for the social dimensions of environmental decision-making (Dilay et al. 2019; Hegde et al. 2022).

In India, the Ministry of Environment, Forest and Climate Change (MoEFCC), established in 1985, has served as the primary regulatory body overseeing projects with potential environmental and forest-related impacts. The EIA Notification, initially introduced in 1994 under the Environment (Protection) Act, 1986 and subsequently revised in 2006, outlines the procedures for reporting, engaging consultants, and the appraisal of such projects (Lin & Zaidi 2025). The EIA has become a highly contested terrain. Repeated amendments to the notification have, over time, diluted environmental protection and shifted the balance towards commercial interests (Menon & Kohli 2009). Furthermore, compliance with EIA norms remains weak, with little follow-up data to assess effectiveness (Ghosh 2013). EIA procedures have been reduced to tokenistic exercises, serving more as procedural hurdles than substantive assessments aimed at environmental protection. These systemic deficiencies in EIA processes have contributed to the unchecked degradation of ecologically sensitive areas, the displacement of indigenous communities, and a lack of meaningful public participation in environmental decision-making (Balaton-Chrimes 2015).

In this study, the current ecological and environmental information associated with the double-tracking of an existing railway line through Bhagwan Mahavir Wildlife Sanctuary and National Park (BMWS & NP) in Goa and the adjacent Kali Tiger Reserve (KTR) in Karnataka were analysed. The project has been the focus of significant social contestation, with widespread concerns raised over its potential socio-ecological impacts (Singh 2022). Since the project involves the expansion of a railway line, it remains outside the purview of the EIA Notification, 2006 (MoEFCC 2025b). Hence, decision-making hinges on the wildlife clearance process, despite concerns of significant cumulative environmental impacts (Lin & Zaidi 2025).

Notably, the Goa State Board for Wildlife (SBWL) initially rejected the proposal in 2013, and the Hon'ble Supreme Court of India later revoked the wildlife clearance previously granted for the project within Goa's largest PA and the adjoining tiger reserve in Karnataka. Elaborating on this context, particularly in relation to the EIAs and associated studies, the following sections focus on identifying the gaps in expert appraisals, primarily related to biodiversity, within the current structural framework of the EIA. While, the EIA process itself is discussed, a detailed critique of the legal tenets of EIAs and systemic issues in implementation is beyond the scope of this paper.

STUDY SITE AND PROJECT BACKGROUND

The state of Goa has a well-documented precedent of citizen appraisals on issues of land dispossession and EIAs, with civil society employing various mechanisms to challenge procedural lapses (Nielsen 2017). In 2020, public concern escalated when the Standing Committee of the National Board for Wildlife (SC-NBWL) granted clearances to three large-scale linear infrastructure projects passing through BMWS & NP in Goa—part of the Western Ghats biodiversity hotspot and a UNESCO World Heritage Site. Punjabi et al. (2020) undertook a comprehensive peer-reviewed analysis of the initial impact assessments for each of these projects, highlighting their ecological implications. Among them, the railway double-tracking project emerged as a particularly contentious development, galvanising widespread public opposition across Goa.

The Hon'ble Supreme Court of India upheld the recommendations made by the Central Empowered Committee (CEC) regarding the railway doubling project segment passing through BMWS & NP in Goa and contiguous forests of KTR in Karnataka in its order dated 09 May 2022 (Supreme Court of India 2022). In its report, the CEC stated that it "does not find any justification for undertaking a project of this nature which will destroy

the fragile ecosystem of the Western Ghats, which is an internationally recognised biodiversity hotspot and also one of the most important wildlife corridors of the country" (CEC 2021, page 59). The Committee noted that the project would only marginally enhance the capacity of a relatively inefficient railway section while causing irreversible ecological damage. Nevertheless, while the Hon'ble Supreme Court order cancelled the clearances, it allowed the project proponent, Rail Vikas Nigam Limited (RVNL), to reapply for wildlife clearances. Meanwhile, the forest clearances issued for the railway track inside the PAs were held in abeyance through an order by the MoEFCC. Since then, the government of Goa on behalf of the South Western Railway and the RVNL, has made several attempts to get the abeyance order vacated. The last of these attempts was deferred by the Regional Empowered Committee (REC) in its meeting dated 26 March 2026 (REC 2026). The detailed project timeline, from 2013 to March 2026, is presented in Figure 1.

The doubling of the Tinaighat–Kulem railway line forms part of a broader 342 km expansion project aimed at enhancing rail connectivity between the industrial regions of Hospet–Tinaighat in Karnataka and the port of Vasco da Gama in Goa. This existing line is the Hospet-Tinaighat-Vasco line. Of this, approximately 26 km of track falls within the BMWS & NP. The alignment traverses ecologically sensitive areas, including semi-evergreen forests in KTR—and the section from the Goa–Karnataka border to Kulem, which lies within BMWS & NP. According to the project proposal, the total number of trees to be felled in this stretch is 19,182 (MoEFCC 2025a).

The study area includes two PAs: BMWS & NP in Goa, and KTR in Karnataka (Figure 2). These PAs lie within the northern Western Ghats, a UNESCO World Heritage Site and global biodiversity hotspot, renowned for high levels of species endemism and ecological significance (Myers et al. 2000). The Western Ghats play a vital role in climate regulation through carbon capture and storage (Lo Seen et al. 2010; Ramachandra & Bharath 2020). These forests also offer crucial hydrological services like water provisioning and fisheries (Krishnaswamy et al. 2009; Pownkumar et al. 2022). BMWS & NP—Goa's largest and oldest PA—spans 240 km², with 133 km² designated as a Wildlife Sanctuary and 107 km² as a National Park. KTR, formerly the Dandeli–Anshi Tiger Reserve, comprises the Dandeli Wildlife Sanctuary and Anshi National Park, encompassing a total area of 1,346 km². Both BMWS & NP and KTR are governed under the Wild Life (Protection) Act, 1972 (WPA), which prohibits diversion of land within national parks and sanctuaries for non-forest purposes without stringent scrutiny and high-level clearances.

The All-India Tiger Estimation reports affirm the ecological value of both BMWS & NP and KTR, identifying them as critical tiger habitats and ecological corridors connecting tiger populations across Karnataka and Goa (Qureshi et al. 2023). Additionally, KTR serves as a refuge for the bulk of the elephant population of northern Karnataka (Menon et al. 2017).

METHODS

The team comprises researchers from both the natural sciences and the social sciences including entomology, ornithology, ichthyology, herpetology, mammalogy, and human geography, and practitioners from conservation and implementation research, and embedded citizen-led efforts.

The technical report prepared by the Wildlife Institute of India (WII) was submitted under the collective title Cumulative Environmental Impact Assessment on Wildlife Habitat and Ecological Values Due to Proposed Doubling of Railway Track from Tinaighat to Kulem in Northern Western Ghats. The reports were published in two parts; an assessment of biodiversity (WII 2025a), and mitigation measures (WII 2025b). This was commissioned in response to the Hon'ble Supreme Court order (I.A. No. 61370 of 2021 in Writ Petition (Civil) No. 202 of 1995), which revoked the wildlife clearance granted earlier by the SC NBW (Supreme Court of India 2022). Our present study focuses on Part I of the cumulative EIA (i.e., WII 2025a), and will henceforth refer to this document simply as EIA. The previous biodiversity assessment conducted by the Indian Institute of Science (IISc), was peer-reviewed by Punjabi et al. (2020). We draw on their assessment to reference relevant limitations across studies. In this document, we adopt the shorthand of EIA to mean WII (2025a) and IISc EIA to distinguish between the two. It must be noted, that while we refer to the WII report as an 'Environmental Impact Assessment', it is to retain consistency with the title and the normative expectations about such an exercise. However, purely in legal terms, the report serves essentially as a biodiversity assessment and is not linked with an environmental clearance process under the EIA Notification, 2006 (MoEFCC 2025b).

In the following sections, we present general conceptual concerns observed with the surveys across taxa in the WII EIA, followed by specific notes on each

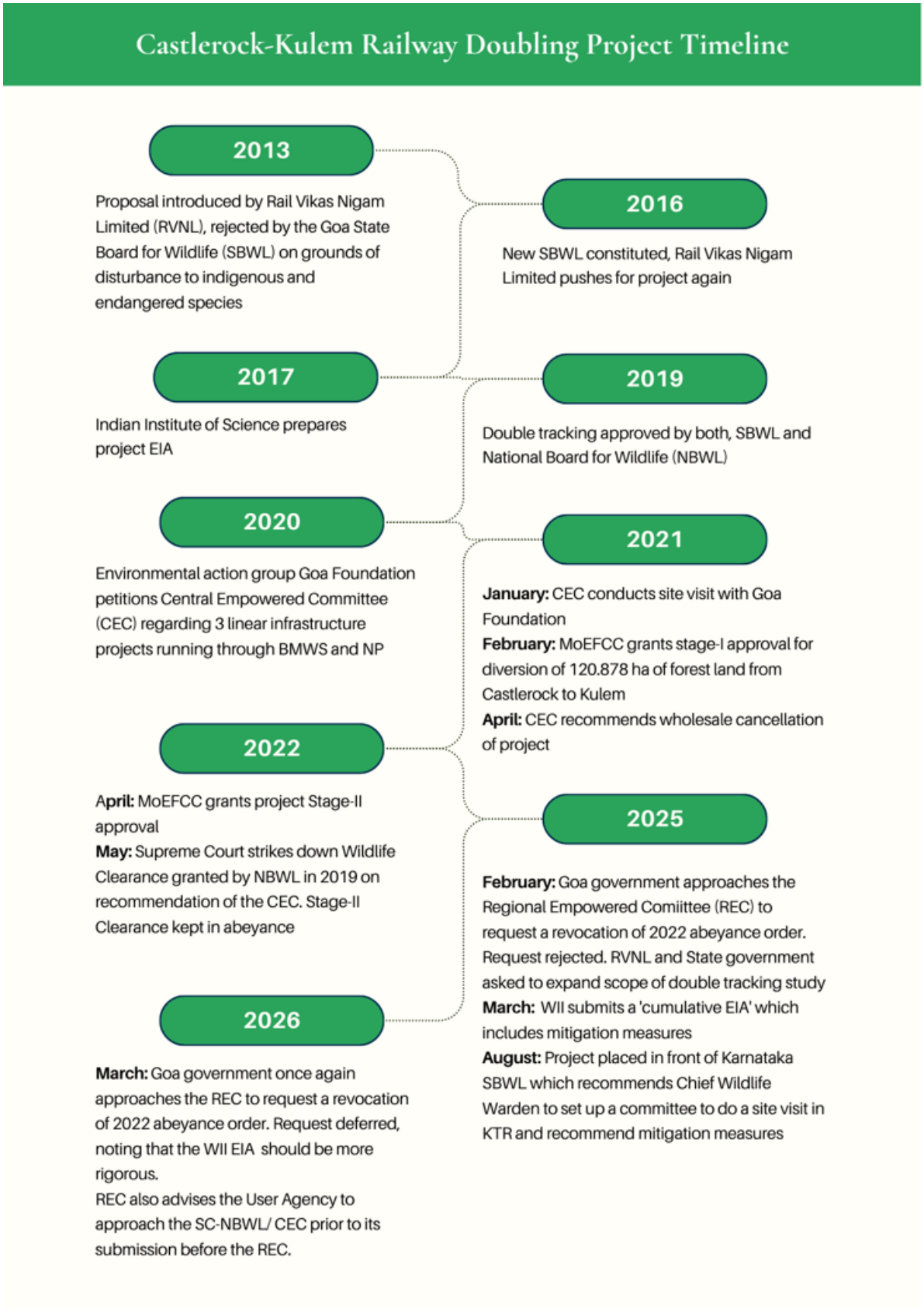

Figure 1. Timeline of the railway double-tracking project through Bhagwan Mahavir Wildlife Sanctuary and National Park in Goa (BMWS & NP) and Kali Tiger Reserve (KTR) in Karnataka.

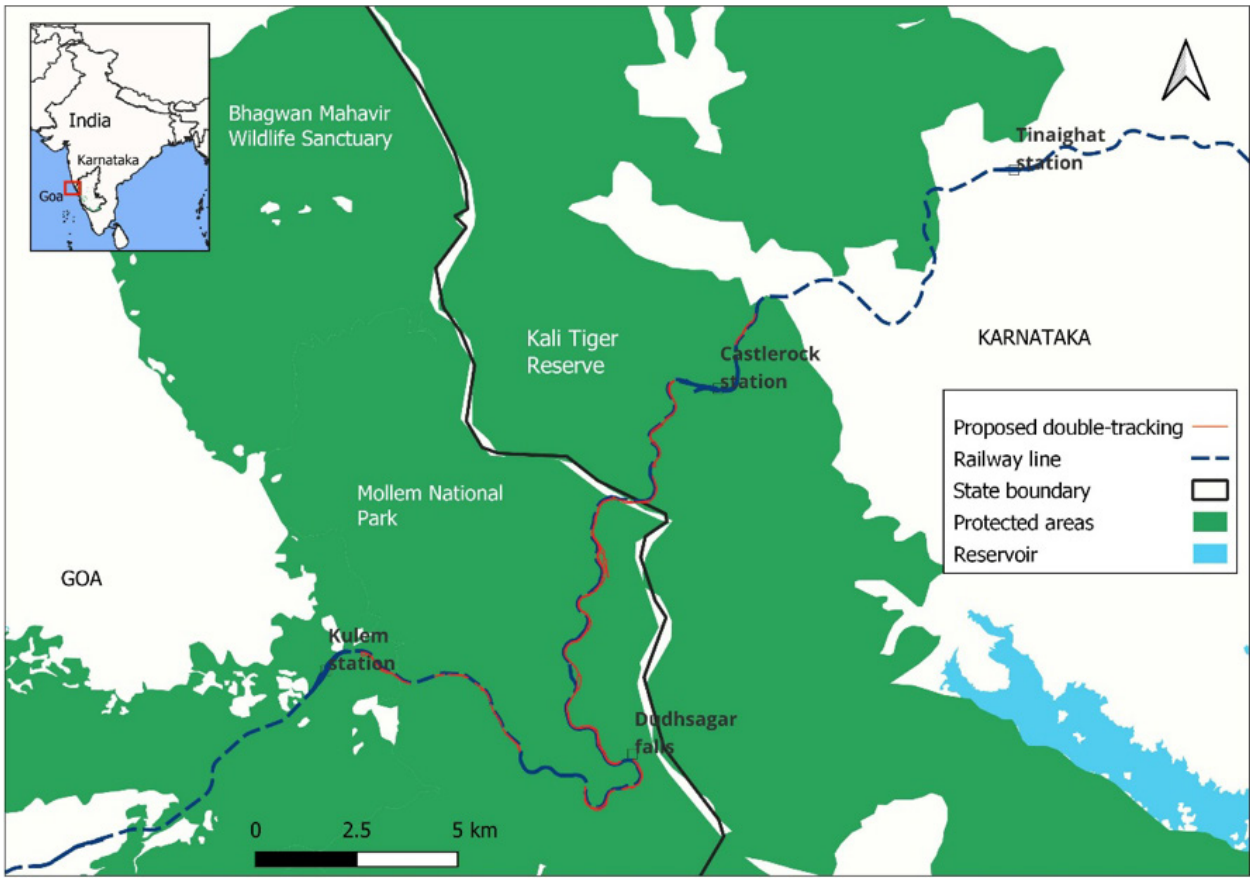

Figure 2. The extent of the proposed railway double-tracking through Bhagwan Mahavir Wildlife Sanctuary and National Park (formerly known as Mollem National Park) and Kali Tiger Reserve (formerly known as Anshi Dandeli Tiger Reserve). Project related information has been obtained from the project proponent's application uploaded to the Parivesh website (MoEFCC 2025a).

taxon in question, particularly threatened or poorly known species deemed to be important for an EIA of this nature. This is followed by a section reviewing social impacts. Finally, a table summarizing the salient observations in the WII EIA vis-à-vis the IISc EIA, along with additional missing information is revealed by its our own literature review.

To expand on the study by Punjabi et al (2020), a list of newly described species from the landscape between 2021 and 2025 is provided. The continued emergence of new scientific findings across taxa highlights the urgent need to undertake comprehensive, systematic studies across the region to better understand the full extent of its biological diversity and the ecological roles these species play in this critical landscape. Furthermore, we gathered records of large mammal rail kills along the existing Hospet-Tinaighat-Vasco railway line using online English news reports from 2015 to 2025.

RESULTS

The review of the WII EIA (WII 2025a) for the proposed railway expansion through BMWS & NP and KTR reveals significant deficiencies in baseline ecological data and methodological rigour.

The EIA begins by stating its project objectives aligned with the Terms of Reference (ToR) issued by project proponents (WII 2025a, page 10), yet it fails to articulate all ecological impacts and their magnitude. Objective 14 states that an "Environmental Management and Monitoring Plan" will be created to monitor the project during its construction and operation phase. Further, Objective 15 mentions that a "Biodiversity Impact Action Plan" will be created for both the PAs (WII 2025a, page 11). This appears to imply the pre-approval of the railway double-tracking project even before the biodiversity assessments were conducted. This raises critical questions about the integrity and independence of this EIA.

Biodiversity documentation is incomplete and taxonomically biased. While partial lists are provided for mammals and birds, several ecologically important, protected and endemic species across plants, fungi, insects, arachnids, fish and herpetofauna from the region are minimally represented, raising concerns about the EIA's reliability as a foundation for impact prediction or mitigation planning. Crucially, the report fails to contextualize the landscape's ecological functions, including its role as a tiger corridor, and omits discussions of habitat connectivity and ecosystem services.

General conceptual gaps

- The EIA focuses solely on species richness, often limited to checklists. It overlooks deeper dimensions of biodiversity, particularly phylogenetic and functional diversity, which are critical to understanding ecosystem integrity and resilience (Flynn et al. 2011). While we acknowledge that such studies might need longer duration and may not fit within the purview of an EIA, there is no mention even of the essential aspects of ecosystem persistence. The species reported in the study site have high phylogenetic and functional diversity, performing a range of ecological roles such as pollination, seed dispersal, or decomposition (Wordley et al. 2017; Bose et al. 2019; Naniwadekar et al. 2025). The proposed project would impact the phylogenetic and functional diversity of multiple taxa in the study site, besides introducing barriers in the movement of wide-ranging species (Jayadevan et al. 2020). The absence of such considerations renders the EIA ecologically inadequate.
- The EIA lacks rigorous inquiry into certain conceptual frameworks that are integral to conservation. While the impacts of linear infrastructure are noted (e.g., mortality, desiccation), there is no mention of edge and barrier effects, functional connectivity, or seasonal movement and metapopulation collapse due to linear intrusions (Laurance et al. 2009; Cumming & Tavares 2022). Forman & Alexander (1998) provide foundational concepts of roads as genetic barriers, while Cushman (2006) focuses specifically on amphibians, synthesizing evidence for population isolation and reduced connectivity due to habitat fragmentation caused by human-made linear features.

Gaps in taxon-specific surveys

Plants and Fungi

- The EIA study employs a biased sampling regime to enumerate vascular plants. Although they use the point-centred quarter (PCQ) method that mandates random selection of points to ensure no sampling bias (Mitchell 2010), the study fails to make an unbiased selection. The report itself states that "the locations of PCQ were chosen neither randomly nor in a systematic fashion", due to accessibility issues. Instead, the points should have been selected randomly (Mitchell 2010), and the ones that were logistically difficult to access could have been replaced with other points to ensure that the vegetation is sampled appropriately.
- Grasses, orchids and ferns need to be sampled more extensively in the zone of influence, a fact acknowledged in the study (WII 2025a, page 35).
- Even without a comprehensive assessment of plant diversity, the study still finds 26 threatened species as per the International Union for Conservation of Nature (IUCN) Red List along with 135 endemic and geographically restricted species (including 61 species endemic to the Western Ghats), and 18 records new to the state of Goa (WII 2025a, page 36). Given this, the study itself states that "no mitigation measure will help in reducing the negative impact of the proposed railway line on the native vegetation" (WII 2025a, page 42).
- The study finds that invasive species, particularly *Chromolaena odorata*, are most prevalent along the railway line, and concludes that these species will invade further and replace native vegetation during the construction of the new railway line (WII 2025a, page 39).
- The study failed to record any fungal diversity and no impact assessment was done for this taxon. While the report provides detailed assessments of vegetation, it does not address fungal diversity—including mushrooms and symbiotic fungi such as arbuscular mycorrhizal fungi and ectomycorrhizal fungi—which are integral to ecosystem functioning in the Western Ghats (Sridhar & Karun 2019). This omission highlights a broader knowledge gap in biodiversity assessments that often overlook fungi despite their crucial roles in nutrient cycling, soil stability, and plant health (Amaral-Silva et al. 2025).

Insects and Arachnids

- The EIA does not include any assessment of insect and arachnid diversity in the study area. Several key arthropod groups such as lepidopterans, odonates, hymenopterans, and arachnids have been left out of the study despite their ecological importance and potential sensitivity to habitat alteration. Insects play an important role in EIAs due to their diversity, sensitivity to environmental changes and essential functions in ecosystems (Rosenberg et al. 1986). Insects are major

contributors to biodiversity; their exclusion can lead to underestimation of biodiversity loss, and lack of insect data can result in ineffective or misdirected mitigation measures (Crenna et al. 2017; Topping et al. 2020).

- The EIA omits the presence of legally protected butterflies in the landscape (such as Malabar Tree Nymph *Idea malabarica*) as per the WPA, 1972 (MoEFCC 2022). Punjabi et al (2020) documented the presence of 218 butterfly species from BMWS & NP.
- The odonate fauna (dragonflies and damselflies) of Goa is comparatively well documented, with 87 species recorded (Rangnekar et al. 2010). Notably, Goan Shadow Dancer *Idionyx gomantakensis* is a newly described, regionally endemic dragonfly recorded from Kulem, adjacent to the existing railway track (Subramanian et al. 2013). Punjabi et al (2020) documented 80 species of odonates from BMWS & NP. Among these, the dragonflies *Heliogomphus promelas* and *Megalogomphus hannyngtoni* are listed as 'Near Threatened' in the IUCN Red List (Kakkasery 2011; Subramanian 2011a), while the damselfly *Protosticta sanguinostigma* is listed as 'Vulnerable' (Subramanian 2011b).
- The compilation of new species discoveries in the last five years shows an addition of 14 arthropod species comprising nine species of wasps, two species of beetles, one species of gall midge, one species of crab and one species of katydid to the species list of BMWS & NP and KTR further underscoring the ecological significance of these PAs (Appendix I).
- Train-related noise and vibrations can disrupt insect communication, behaviour, and physiology. The EIA does attempt to assess the effects of train noise pollution (WII 2025a, pages 89–94) and train vibrations on insects (WII 2025a, page 99), but these conclusions are not substantiated, due to a lack of suitable baseline data on the diversity of this taxon in the study area.

Fish

- The EIA review has overlooked the impact of the railway alignment on the region's freshwater fish fauna, a critical component of aquatic biodiversity. The Western Ghats' freshwater fish are one of the richest in terms of their sheer biodiversity and endemism compared to any other region in India (Daniels 2002). A recent study documented 325 freshwater fish species in the Western Ghats (including 223 endemics) (Shukla et al. 2026). Since this study subject is not extensively studied yet, it is likely that many species remain undocumented to this date (Dahanukar et al. 2004; Raghavan et al. 2014). Several perennial streams intersect the proposed railway track. Even minor alterations to stream habitats can have adverse effects on habitat-specialist, threatened, and endemic fish species (Punjabi et al. 2020).
- Unregulated deposition of debris and sediments during construction could damage spawning grounds of migratory and resident cyprinid fishes such as stream loaches (e.g., *Schistura* spp.), carps, minnows, and catfishes (Atkore 2017).
- The Dudhsagar River serves as a headwater habitat for cyprinid species such as the Deccan Mahseer (*Tor khudree*) and Nash's Barb (*Osteochilichthys nashii*) (Image 1), both of which utilize this habitat for spawning and feeding during multiple seasonal migrations. Sensitive taxa such as *Bhavania australis* and *Balitora mysorensis* that prefer high-velocity riffle habitats are particularly vulnerable to tunnel construction and other habitat modifications (Atkore 2017).

Amphibians and Reptiles (Herpetofauna)

- The EIA recognises several key threats to herpetofauna due to the railway doubling. Nevertheless, studies indicate that infrastructure-related stress is often underestimated due to sampling biases and inadequate baseline data (Forman & Alexander 1998). Similarly, the collection of roadkill data can be influenced by infrastructure and landscape characteristics, potentially underrepresenting actual mortality rates (Sushanth et al. 2025). Further, amphibian sampling has been shown to exhibit significant geographic and temporal biases in tropical habitats such as the Amazon, often due to infrastructure and accessibility constraints (Penhacek et al. 2025). The EIA does not explicitly acknowledge or account for sampling biases and the limitations in detectability, spatial bias, and baseline data adequacy in tropical herpetofauna surveys.
- According to the EIA, a total of 62 species of herpetofauna (reptiles and amphibians) are recorded along the rail track in BMWS & NP and KTR, comprising 28 amphibians and 34 reptiles (WII 2025a, page 172). The Second Global Amphibian Assessment (GAA2) notes that the Western Ghats of India harbour 232 amphibian species, with 69% of these species endemic (Luedtke et al. 2023). This highlights that the EIA records represent a fraction of the region's amphibian diversity, underscoring the need for more comprehensive surveys.
- The EIA briefly mentions the infectious disease Chytridiomycosis and its impact on more than 500 species (WII 2025a, page 45). However, its impacts are not further explored in the study, despite evidence indicating that habitat loss can exacerbate disease vulnerability among amphibians due to increased stress

and isolation (Scheele et al. 2019).

- A number of important taxa within this group are missing from the results. Sampling was restricted to the July–August months, thus ignoring the post-monsoon emergence and breeding of key stream-dwelling amphibians (*Micrixalus* spp., *Nyctibatrachus* spp., *Raorchestes* spp.) that are active later in the monsoon or post-monsoon period (Biju et al. 2014; Mudke et al. 2020). Some of these species including *Micrixalus* spp. are highly stream-dependent and threatened, and their absence from the displacement dataset (WII 2025a, page 48) likely skews the interpretation of barrier effects.
- A recent study on *Ophiophagus kaalinga* (Western Ghats King Cobra) in Goa highlights how railways and trains may act as unintended conduits for snake movement drawing individuals into areas that are ecologically unsuitable, thereby increasing conflict and mortality risk. This information underscores the need for landscape-level movement analysis in impact assessments of rail infrastructure (Parmar et al. 2025).
- Further, the EIA sampled "frogs of selected genera (*Indosylvirana*, *Hydrophylax*, *Rhacophorus*, *Minervarya*)" as model amphibians to understand amphibian movement and its disruption due to the railway expansion, excluding several other genera that exhibit distinct ecologies and evolutionary histories and stand to lose from an incomplete EIA (Cushman 2006).
- Among freshwater turtles, the report has mentioned only the Indian Black Pond Turtle *Melanochelys trijuga* included amongst the other reptiles (WII 2025a, pages 50 and 172). There has been no assessment of the project impact on turtles.
- In the rail kill survey (WII 2025a, pages 133–139) carried out between July to October 2023, the EIA mentions a "6 fold increase in amphibian mortality and a 2 fold increase in reptile mortality". Since the survey was conducted in a single season, the list is likely to be incomplete.
- Several herpetofaunal species such as *Draco dussumieri*, *Lycodon* cf. *travancoricus* *Micrixalus uttaraghati*, *Sphaerotheca* sp., *Uperodon mormorata*, *Rhabdops olivaceus*, and *Boiga thackerayi*, among others, depend on specific habitats and move across habitats using the forest floor, subcanopy and streams for survival and breeding. The EIA does not reflect refugia dependence of any of the herpetofauna species and does not present a quantitative analysis of microhabitat variable (leaf litter depth, canopy cover, sub-canopy moisture, and stream parameters) use across seasons (Spranger et al. 2024). The failure to measure refugia use and mortality across seasons presents a limited picture of the overall impacts of railway doubling on endemic herpetofauna.
- The EIA relies heavily on generic mitigation measures, such as fencing, culverts, amphibian underpasses and canopy bridges. However, studies often show poor effectiveness of such interventions, especially in complex tropical forest ecosystems, with diverse herpetofauna assemblages and high microhabitat specificity (Beebee 2013; van der Ree et al. 2015).

Birds

- Bird surveys were conducted using point count methods along the pre-existing railway track between Kulem and Tinaighat (WII 2025a, page 61). However, this methodology is insufficient to assess the impact of additional forest loss associated with the double-tracking project. Although surveys were conducted during the winter migration months and represented an improvement from the IISc EIA, the total survey effort and duration remain unreported. Each point location is reported with one value of abundance (count), with no further details as to how this number was obtained. This suggests each point may have been sampled only once across two years, with data pooled, reducing temporal resolution and leading to methodological ambiguity. Radius of the point counts is unspecified, raising concerns about variation in species detectability (Raman 2003). The distance data collected using range finders has not been incorporated in the analysis, with no explanation given. Other covariate data (forest type, terrain, canopy cover, temperature, humidity) were reportedly collected but have not been reported. These shortfalls and inconsistencies have made interpreting the data and the results a rather futile effort.
- The bird surveys also fail to fulfil Objective 10 (WII 2025a, page 11), which recognizes the need to identify critical habitats along the railway track. Further, no attempt has been made to document nesting and roosting sites.
- Legal conservation status under the WPA, 1972 is not reported. Of the 125 valid species observed (out of 135 reported), 18 (14.4%) fall under Schedule I and 105 (84%) under Schedule II of the WPA.
- Many of the reported species have geographic distributions that differ considerably from the region in question, as detailed in the following examples. Six individuals of Fork-tailed Drongo *Dicrurus adsimilis* were reported (WII 2025a, page 65); this is an Afro-tropical species. Three individuals of Greater Flameback *Chrysocolaptes lucidus* were recorded (WII 2025a, page 67); *C. lucidus* is however endemic to the Philippines

(Winkler & Christie 2020), and for the Western Ghats, the correct taxa would be *Chrysocolaptes socialis* Malabar Flameback, as per the updated Clements/eBird taxonomy (del Hoyo et al. 2023). Four individuals of Long-tailed Minivet *Pericrocotus ethologus* were reported (WII 2025a, page 65); this species has no known distribution south of Madhya Pradesh (Taylor 2020). Indian Yellow Tit *Machlolophus aplonotus* was assigned *Periparus ater* (WII 2025a, page 64), which refers to the Himalayan Coal Tit (Gosler & Clement 2023), not a species known from Goa. Square-tailed Bulbul *Hypsipetes ganeesa* was listed as *Hypsipetes leucocephalus* (WII 2025a, page 67), a name assigned to the Himalayan Black Bulbul (Fishpool & Tobias 2020; Jha 2024). Green Warbler *Phylloscopus nitidus* and Greenish Warbler *Phylloscopus trochiloides* were both listed with high counts (279 and 393 individuals, respectively) but assigned the same scientific name, *Phylloscopus nitidus* (WII 2025a, page 66), indicating misidentification or reporting error (Clement 2020; Clement & Sharpe 2020).

- Notably absent were common species such as the Malabar Barbet *Psilopogon malabaricus* and Jungle Babbler *Turdoides striata*. Reports of 49 individuals of Coppersmith Barbet *Psilopogon haemacephalus* and seven individuals of Yellow-billed Babbler *Turdoides affinis* suggests possible misidentification between morphologically or acoustically similar species.
- Five species were each recorded twice under different common names but with the same scientific name, possibly due to inconsistent checklist usage (e.g., Grimmett vs. Clements/eBird) or failure to synchronize taxonomy across years.

Mammals

- The mammal survey reported in the EIA was conducted using a single method, that is, camera trapping adjacent to the proposed railway alignment. As a result, the inventory is likely to be incomplete. Only 23 mammalian species were recorded, which does not reflect the full mammalian diversity expected in BMWS & NP and KTR, both located within a globally recognised biodiversity hotspot (Myers et al. 2000).
- The exclusive reliance on camera traps likely means that a number of nocturnal, arboreal, fossorial, and small-bodied species are likely underrepresented or entirely missed. Notably absent are the 'Near Threatened' Grey Slender Loris *Loris lydekkerianus*, canopy-dwelling rodents, and bats, despite one of the stated objectives of the EIA being to assess the distribution and abundance of arboreal mammals (Objective 3; WII 2025a, page 10). In contrast, Punjabi et al. (2020) compiled a list of 81 mammalian species from BMWS & NP alone, including the 'Endangered' Indian Pangolin *Manis crassicaudata* and two 'Vulnerable' species of otters, the Small-clawed Otter *Aonyx cinereus* and the Smooth-coated Otter *Lutrogale perspicillata*.
- Interestingly, despite methodological limitations, the species richness observed through camera traps is relatively high, with most records originating from the Kulem-Sonalium and Castlerock-Tinaighat stretches (WII 2025a, page 78). Many of the detected species are listed under Schedule I of the WPA, 1972. The EIA documents two IUCN Endangered species—the Bengal Tiger *Panthera tigris tigris* and the Dhole *Cuon alpinus*—as well as three 'Vulnerable' species: Leopard *Panthera pardus fusca*, Gaur *Bos gaurus*, Sloth Bear *Melursus ursinus*, and Bonnet Macaque *Macaca radiata*. Tiger cubs and Sloth Bear cubs were captured in multiple locations, underscoring the significance of the area as a breeding habitat. A total of eight independent photographic captures of tigers were reported, highlighting the ecological value of this region for large carnivores.
- An additional claim in the EIA mentions the camera-trapping of the Nilgai *Boselaphus tragocamelus* on two occasions (Table 7.2; WII 2025a, Page 78). No photographic evidence is provided. If verified, this would represent a novel mammalian record for the state of Goa and warrants further scrutiny. The only other Nilgai record reported from the Western Ghats is from the Muthodi range in Bhadra Tiger Reserve (Bhardwaj 2018). The EIA states that the Ruddy Mongoose is endemic but does not specify the area to which it is endemic to, that is, the Indian sub-continent. It also omits the Western Ghats endemic status of the Brown Palm Civet (Mudappa et al. 2024), despite including a photo of it (WII 2025a, Page 87), but not mentioning the species in the results (WII 2025a, Page 77).
- The 2022 National Tiger Conservation Authority (NTCA) report has stated that KTR is the only tiger reserve in the Western Ghats that showed an increase in tiger numbers even though there was a significant decrease in tiger occupancy in the border regions of Karnataka and Goa (Mollem-Mhadei-Anshi Dandeli complex). This statistic helps reiterate the ecological and conservation importance of KTR (Qureshi et al. 2023). The impact of doubling a track that already divides KTR, essentially fragmenting the reserve, will have a negative impact on the growing tiger population, preventing dispersal and isolating the populations. Maintaining connectivity between Karnataka and Goa is vital for tiger dispersal, territorial fidelity, and population stability. Dispersal,

driven by territory establishment, competition, and habitat conditions, especially among males, follows contiguous forest, higher elevations, and rugged ridges (Joshi et al. 2013; Krishnamurthy et al. 2016; Singh et al. 2021). The Karnataka–Goa belt thus serves as a natural corridor enabling routine gene flow, rather than one-off stress-induced movement. As dispersal is hindered by human settlements and roads, KTR's role as a source population must be maintained (Joshi et al. 2013; Sharma et al. 2013).

- The EIA fails to fully develop or integrate an argument for the role of KTR in supporting Elephant connectivity, despite Objective 9 (WII 2025a, page 11) explicitly stating this as one of the goals of the assessment. The Dandeli Elephant Reserve was notified by the Karnataka Forest Department in 2014. The reserve covers some parts of KTR and includes the Tinaighat area (WII 2023). Objective 9 of the EIA refers to the need for evaluating land cover change and assessing connectivity for movement of tigers and elephants under pre- and post-construction scenarios (WII 2025a, page 11). However, no data or modelling to support this objective are presented.
- The EIA's rail kill survey acknowledges that the fauna mortality rates caused by railway collisions are an underrepresentation of the true mortality rates in the landscape (WII 2025a, page 138). Through a collation of news reports on rail kill records from the existing Hospet-Tinaighat-Vasco railway line, we gathered six news articles in the last 10 years (Appendix II). Amongst these, the highest number of rail kills was of the Gaur (Image 2). This underscores the failure of any mitigation measures on existing railway lines passing through BMWS & NP and KTR and the broader central Western Ghats landscape.
- Critical components such as animal behavioural responses to railway infrastructure, effectiveness of existing mitigation structures (e.g., underpasses) and landscape-level connectivity analysis (e.g., continuity with larger tiger corridors) are either not addressed or only superficially mentioned. Consequently, the compatibility of the railway doubling project with long-term wildlife conservation remains insufficiently examined.

Social impact

The new EIA by WII does not include a social impact evaluation of the railway double-tracking project. The ToR issued by the project proponents makes no mention of a social impact assessment. This points to the limitation of not just the technical report submitted by WII but also a larger policy gap in which large-scale linear projects, such as the railways, are not mandated to conduct public consultations, as per the EIA Notification, 2006. In the following section, we demonstrate why public consultations are necessary in evaluating infrastructure projects, especially in the context of the expansion of the railway line.

- Public participation is a crucial element of evaluating environmental and ecological impact (O'Faircheallaigh 2010). It plays an important role in a democratic process (Thayyil 2014). In Goa, public consultation and impact assessment are particularly important. Civil society has been actively involved in tracking environmentally damaging projects, which are often related to the contentious tourism industry (Routledge 2001; Nielsen 2017; da Silva et al. 2020). While the initial EIA by IISc did present a social impact study in 2017, Punjabi et al. (2020) already noted the shortcomings of the so-called socio-economic assessment, including survey sample size, location, timeline, and bias in the content of the survey focusing on transport. However, no such assessments seem to exist for the 2025 EIA.
- The CEC highlighted the problems of the topographical difficulties regarding this route, such as the steep inclination (1:37 gradient), potential impact on biodiversity of levelling more land for this purpose and finally the flaws in the economic argument that does not justify the impacts on an eco-sensitive zone (CEC 2021, pages 52-55). The fact that the line was being used to transport coal beginning at Mormugao Port Trust in Goa, deposited into Karnataka, and returning empty, did not justify an economic argument for the erosion of the forest area (CEC 2021, page 56). In this regard, the proposal for double tracking does not take into consideration existing mandates against coal handling in the state (see, for details, D'Mello 2015). Correia (2018) links the double tracking to other such infrastructure projects as part of the controversial Sagarmala project, asserting a need for a cumulative impact assessment of all related projects.
- Coal handling and transportation, as well as increased railway activity, are likely to exacerbate detrimental effects on the population's health and well-being directly through coal dust particles in the air (Sharma & Patil 2016) and as it seeps into farmlands (Li et al. 2018). This has long-term implications for the population residing close to the tracks, as proven in other parts of India (Mishra & Das 2017). A comprehensive assessment of the human populations living in the vicinity of the proposed railway expansion

Table 1. A comparison between the old EIA report prepared by IISc titled 'Biodiversity and Environmental assessment of proposed doubling of railway track between Kulem and Castlerock in Goa-Karnataka' (2017) with the new EIA by WII titled 'Cumulative Environment Impact Assessment on wildlife habitat and ecological values due to proposed doubling of railway track from Tinaighat to Kulem in the northern Western Ghats. Part I: Assessment of Wildlife habitat and ecological values around railway track' (2025).

Study subject	Biodiversity assessment by IISc (2020)	Cumulative EIA by WII (2025)	Scientific sources
Plants and fungi	255 species of flowering plants (Page 64).	416 species of plants including 409 species of flowering plants (Page 36).	722 species of flowering plants in BMWS & NP (Datar & Lakshminarasimhan, 2013).
Plants and fungi	Neither EIA has assessed the diversity and abundance of fungi in the study area and the impact of the project on fungi.		148 species of ectomycorrhizal fungi reported from the Western Ghats itself (Sridhar & Karun 2019).
Insects and arachnids	Butterflies, dragonflies and damselflies are studied, but moths excluded (Pages 87, 101). No study on other insect groups and arachnids.	No study of insects and arachnids.	At least 418 species of moths reported from the northern Western Ghats (Shubhalaxmi et al. 2011). An initial survey revealed 6 scorpion species, 1 species each of whip scorpions and whip spiders and 16 species of spiders in BMWS & NP (Bastawade & Borkar 2008). The first definitive record of the Whip Scorpion (*Labochirus tauricornis*) for Goa was reported near BMWS & NP (Borkar 2018).
Fish	23 fish species. No assessment of project impact on the fish community (Page 116).	No study of freshwater fish.	A study of the Mhadei sub-basin (which includes BMWS & NP) reveals 49 fish species with 18 endemic species from the Western Ghats (Atkore 2017). Alterations in the stream environment such as changes in water quality or flow by anthropogenic pressures have negative impacts on fish guild composition (Atkore 2017; Atkore et al. 2020; Bhavan et al. 2025).
Amphibians and Reptiles	Survey carried out during the inactive season of reptiles i.e., winter due to which the impact on reptiles could not be assessed properly (Page 139).	Sampling restricted to two brief seasonal periods (dry: February–April; wet: July–August, 2023), taxonomically narrow, and did not include broader ecological or pathogen risk evaluations.	52 reptiles and 36 amphibians, collectively, 88 species have been recorded in BMWS & NP (Punjabi et al. 2020).
Birds	Two-day bird surveys conducted in September 2014 and May 2015 which enumerates only 35 bird species.	Surveys done in December to January of 2022–23 and 2023–24. Exact number of survey dates not reported. Each survey point was visited only once. A total of 135 species reported, of which 125 are valid entries.	A comprehensive checklist reveals 236 species of birds recorded in BMWS & NP (Rahmani et al. 2016).
Birds	Migratory birds are underrepresented in the survey as it was not conducted during the migratory season. (October to March)	Surveys were conducted during two months of the winter migratory season (October–March). Some winter migrants such as Blyth's Reed Warbler, Grey Wagtail, *Phylloscopus* Warblers recorded. No survey during summer and monsoon migration seasons.	A total of 57 migratory species from the different migration seasons are recorded from the BMWS & NP Important Bird Area (IBA) on eBird (eBird 2024; State of India's Birds 2024).
Mammal	23 mammal species were documented (Page 153). The EIA fails to explicitly mention the presence of the tiger in the study area. The study was affected by species misidentification; it recorded the Large Indian Civet *Viverra zibetha* in the Western Ghats, a species found in northeastern India.	23 mammal species were documented (Page 75). Tigers with cubs were photographed in 5 locations along the railway line. The study records the presence of a Nilgai in the Western Ghats (Page 78), a species that avoids dense forests and prefers dry areas.	Punjabi et al. (2020) compiled a list of 81 mammalian species from BMWS & NP.
Social impacts	The EIA carried out a social impact survey with 60 families in four villages. There is no mention of how selection of the villages and those interviewed were done. Questions were leading, focusing on transportation needs in the region. Panchayat concerns were noted by Punjabi et al. (2020) as not incorporated and did not include consultation with the wider public.	No social impact was considered.	A submission to the CEC (D'Silva et al. 2021) highlights a number of villages and structures of socioeconomic and cultural importance along the proposed railway line in Goa. The impact far exceeds that considered by the WII study. The people of the region have actively resisted coal handling in the area (Correia 2018).
Public health	The potential health effects of air pollution caused by coal transportation on residents of villages in the study area were not considered.		Air pollution can impact respiratory functioning (Sharma & Patil 2016) and also contaminate farmlands and water through particles that may be distributed (Li et al. 2018).
Traditional ecological knowledge	The study lists out medicinal plants and minor forest produce (Page 170) but fails to assess the impacts of the project on these species and broader impacts on human-nature relationships. In the 'public consultation' meeting conducted by the IISc team for the old EIA, members of the Kulem Gram Panchayat raised concerns about the threat to medicinal plants as a result of double-tracking (Page 191).	There has been no consideration of the use of medicinal plants by people within the region or other such traditional ecological knowledge nor have there been efforts to collect data on the same and incorporate it within the biodiversity assessments.	Sawant & Rodrigues (2015) documented traditional knowledge of 50 medicinal plant species from 20 families and 46 genera in Goa alone.

Image 1. Some species representing the taxa that were not studied in Wildlife Institute of India's EIA in Bhagwan Mahavir Wildlife Sanctuary and National Park and Kali Tiger Reserve (from left to right): Nash's Barb *Osteochilichthys nashii* and Deccan Mahseer *Tor khudree* (© Vidyadhar Atkore) and bioluminescent fungi, Painted Bats *Kerivoula picta*, Asiatic Long-tailed Climbing Mouse *Vandeleuria oleracea*, a Scorpion *Hottentotta* sp. and Autumn Leaf Butterfly *Doleschallia bisaltide* (© Omkar Dharwadkar).

area is essential. This should provide a thorough understanding of the communities, including their socio-economic conditions, existing infrastructural assets, and the potential socio-economic, cultural, and infrastructural impacts (both positive and negative) of the development. Additionally, the assessment should detail the nature of public consultations conducted and outline the recommendations derived from those engagements.

- Impact on infrastructure, including heritage homes and other spaces of social, cultural and economic importance across the entire railway expansion project has not been considered at all. A submission to the CEC (D'Silva et al. 2021) highlighted that the existing railway line from Vasco to Castlerock in Goa passes through 36 villages and will impact a minimum of 132 structures of socioeconomic and cultural importance. The study used a zone of influence of 200 meters on each side of the railway line. They identified commercial and business sites (37), places of worship (38), public services (27, specifically education and health-related), parks and recreational spaces (15), natural places of interest, including rivers (9) and residential structures with potential heritage status (minimum 6). The report also identified human settlements along the track. The impact far exceeds that considered by the IISc study, which was carried out in merely four villages inside BMWS & NP.
- There has been no acknowledgement of forest-dwelling communities in the EIA. In KTR, there has been an ongoing relocation of families from the tiger reserve, including concerns regarding the breaching of recognition of rights under the Forest Rights Act, 2006. Any assessment for this project must give due consideration to the status of pending claims of forest dwellers under the Forest Rights Act 2006, who face compounded harm, losing access to both forest-based livelihoods and their habitation, whether from 'inviolate areas' or infrastructure projects. Failure to conduct social research is harmful, given the impact that climate change has on marginalised communities (Sultana 2022). It is imperative to adhere to the rigour required of social research around informed consent to understand or assess issues of social justice and human rights of the communities whose livelihoods are dependent on the region to be affected, as failure to do so erodes the rigour of ecological studies more broadly (St. John et al. 2014).
- There has been a complete omission of how the proposed project impacts human-nature relationships and ecosystem services. For example, there is no mention of how the construction of the railway line will affect water quality and the subsequent impacts on river-based livelihoods and subsistence fishing.

Comparison of the EIAs by IISc and WII

The new EIA by WII addresses some gaps in the old EIA conducted by IISc, such as in the vegetation survey, but introduces even more gaps in biodiversity assessments due to methodological deficiencies (Table 1). For example, in their review of the old EIA, Punjabi et al. (2020) pointed out that the methods used in the mammal survey do not account for issues with species detection. However, in the new EIA, the mammal survey continues to ignore this. In another example, the old EIA mentions the use of medicinal plants in the region but fails to assess the railway's impact on these plants, despite concerns for their protection being raised by members of the Kulem Panchayat during a public consultation with the EIA team. The new EIA fails to mention the use of medicinal plants by people within the area.

DISCUSSION

A fundamental flaw in the environmental governance process is that an independent, scientific peer review of EIAs or Biodiversity Assessments is not legally mandated, even though the decision-making process depends on a rigorous assessment of environmental and socio-economic risks of the proposed project. An independent, scientific peer review can act as an important safeguard to prevent biased and poorly applied science from causing irreversible environmental and human harm (Hughes et al. 2024). The paper provides an example of a rigorous peer review of an EIA for the proposed railway double-tracking project through BMWS & NP in Goa and KTR in Karnataka— both part of the Western Ghats biodiversity hotspot. This is the second peer review of the same project; the first one was conducted by Punjabi et al. (2020), for the previous IISc EIA.

Although positioned as a more comprehensive EIA, the 2025 WII EIA repeats many critical shortcomings of the 2017 IISc EIA while introducing new gaps. Across taxa, assessments remain fragmentary and inconsistent: fungi, insects, arachnids, and freshwater fishes are entirely excluded; herpetofauna, bird, and mammal surveys are temporally restricted and taxonomically narrow; and ecosystem-level perspectives like connectivity, functional diversity, and barrier effects are absent. Social impacts, including public health concerns, receive no attention,

Image 2. Sambar and Gaur rail kill photos from the railway line near Tinaighat along the existing railway line in Karnataka, sourced through a Right to Information (RTI) application to the Karnataka Forest Department (Belagavi division) in 2021.

despite being flagged in the earlier EIA by Punjabi et al. (2020). A critical omission is an acknowledgement of the likely harmful impacts of air pollution, particularly caused by the expansion of coal transportation through the study area. Moreover, the EIA was funded by the project proponent, creating an inherent conflict of interest. Such arrangements risk biasing the study to favour approval, as seen in recommendations for mitigation, despite evidence of irreversible ecological damage. Independent assessments are critical to ensure objectivity and accountability.

These findings mirror widespread critiques that EIAs often fail due to weak baseline biodiversity assessments and superficial social impact analysis. Poor scientific design and negligible regulatory effect of baseline studies have been reported in Brazil (Dias et al. 2022). Canadian EIAs show low biodiversity content and mitigation rigour (Gannon 2021), while EIAs for the Great Barrier Reef have been criticized for lacking serious science and robust baselines (Sheaves et al. 2016). Social dimensions are frequently inadequate and lack rigour (Burdge 2002), and systemic inaccuracies and failures remain common in biodiverse regions (Laurance 2022). In India, such concerns were highlighted previously, and with regard to this specific infrastructure project by Punjabi et al. (2020) yet were unaccounted for in the WII EIA. Poor quality EIA studies have also been reported from other irreplaceable, biodiverse parts of India, like the Dibang Valley (Sheth et al. 2020) and the Great Nicobar Island (Perincherry 2022).

Although the WII EIA begins by stating "a pressing need for conservation and development to go hand in hand, complementing—rather than conflicting with each other" (Page 7), its subsequent neglectful analyses appear heavily skewed in favour of ecologically destructive development. This reflects the limitations of the exercise, given that railway projects, like several linear projects, are not mandated to conduct cumulative social or environmental impact assessment studies (Ghosh 2020). The goal of a technical report such as the WII EIA then is found to be restricted to suggestions of mitigation measures even when they themselves caution that their efficacy is subject to complete compliance to these measures. Interestingly, in the vegetation survey, the authors state: "If a new railway line is built parallel to the existing alignment, then it will certainly have a negative impact on the population of endemic and threatened species, most of which are trees and other woody lifeforms such as climbers and shrubs. Since the proposed alignment will be laid by clear felling the strip of vegetation along this stretch, no mitigation measure will help in reducing the negative impact of the proposed railway line on the native vegetation (WII 2025a, page 42)". However, they go on to recommend restoration in another degraded forest patch to "offset" the effects of the doubling project (WII 2025a, page 43). Similarly, in the herpetofauna survey, the authors argue that the railway line between Tinaighat to Kulem drastically impacts amphibians and reptiles throughout the year but go on to suggest mitigation measures in the construction phase (WII 2025a, page 56).

The push for mitigation measures, despite their own evidence regarding the detrimental implications of the project, reflects a global precedent that projects that undergo EIA studies are rarely rejected and are often approved with conditions for mitigation (Fonseca & Gibson 2021). This is concerning amidst globally acknowledged needs to reduce environmental degradation and climate change impacts, and at the least, towards sustainable development. Notably, in its

recent meeting dated 26 March 2026, the REC reviewed the WII EIA and observed that the assessment was solely focused on proposing mitigation measures and failed to include a comprehensive analysis of the project's impact on the biodiversity and ecology of the PAs (REC 2026).

In EIAs, mitigation should follow a clear hierarchy of avoid, minimise, restore, and compensate (Arlidge et al. 2018). Impacts must be avoided by reassessing alignments and design options to bypass ecologically sensitive stretches. Only if avoidance is demonstrated to be unfeasible, impacts should be minimised through reduced clearing, seasonal restrictions on construction and introduction of early warning systems to facilitate wildlife crossings, slope-stabilisation and drainage measures to limit erosion and habitat fragmentation (Muliya et al. 2026). Compensatory measures such as biodiversity offsets or compensatory afforestation should be employed only after all avoidance, minimization and restoration options have been demonstrated to be unfeasible. The EIA has failed to propose any avoidance measures, even when their findings caution of irreversible damage. This again points to a policy gap, since the mitigation hierarchy is not codified to the environmental legislation, thereby creating a loophole where conditional approvals for projects can be granted solely by proposing mitigation measures.

In their report, the CEC had observed that "the railway line cuts across the most important animal corridor in the Western Ghats landscape between Karnataka and Maharashtra through the State of Goa and will be a serious impediment for movement of long-ranging animals like tiger and elephant (CEC 2021, page 58)". The objectives of the EIA have not been met as it does not quantitatively predict or assess key anticipated impacts, including loss of landscape connectivity, fragmentation of wildlife corridors, changes in human–wildlife interactions, impacts on human health, impairment of hydrological systems, or increased risks of landslides and erosion in a topographically complex and rainfall-intense region (Karlson et al 2014). The absence of such predictive assessments limits the report's ability to inform decision-making, particularly for a linear infrastructure project traversing a biodiverse and socially inhabited landscape (Cumming & Tavares 2022). While a comprehensive evaluation of these dimensions lies beyond the scope of the present paper, their omission underscores the need for EIAs to move beyond species inventories and towards a robust, integrative impact assessment.

CONCLUSION

The analysis reveals serious scientific shortcomings, including species misidentifications and inaccurate reporting, which raise deep concerns about the credibility and integrity of the assessment process. This paper highlights broader systemic issues like the absence of a legal mandate for including social impact assessments in railway projects and compliance with the mitigation hierarchy. This paper serves as a local response, grounded in field-based observations and contextualized within the broader ecological and societal challenges associated with linear and mega-infrastructure developments—particularly within PAs.

The review of the WII EIA for the railway double-tracking project in BMWS & NP, Goa and KTR, Karnataka raises broader questions around environmental justice as the authors in this paper find themselves contending with the same problem raised five years ago (see Punjabi et al. 2020). Commitments to environmental protection need to be rooted in scientific rigour, accountability and transparency. As scientists and citizens of India, we are also gravely concerned by the inadequacy of the EIA reports, which lack rigour in terms of the science presented.

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Appendix I. New species records from Bhagwan Mahavir Wildlife Sanctuary and National Park and Kali Tiger Reserve (January 2021–August 2025).
The list is compiled from peer-reviewed journal articles and government reports.

	Name	Scientific name	Reference
1	Chalcid Wasps	*Antrocephalus dividens*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
2	Chalcid Wasps	*Hockeria manii*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
3	Chalcid Wasps	*Kriechbaumerella pulvinata*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
4	Chalcid Wasps	*Psilochalcis carinigena*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
5	Chalcid Wasps	*Brachymeria bengalensis*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
6	Chalcid Wasps	*Brachymeria euploeae*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
7	Chalcid Wasps	*Brachymeria jambolana*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
8	Chalcid Wasps	*Brachymeria megaspila*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
9	Chalcid Wasps	*Dirhinus anthracia*	Gawas, S.M. & A. Gupta (2024). Taxonomic studies on chalcid wasps (Hymenoptera: Chalcidoidea: Chalcididae) of Goa, India, with an illustrated key to genera and species. *Journal of Natural History* 58(9–12): 342–381. https://doi.org/10.1080/00222933.2024.2315671
10	Gall Midge	*Lasioptera sharma*	Vasanthakumar, D., R. Loganathan & P. Senthilkumar (2024). *Lasioptera sharma*, a new species of gall midge (Diptera: Cecidomyiidae) feeding on *Leea indica* (Vitaceae) in India. *Journal of Threatened Taxa* 16(6): 25465–25469. https://doi.org/10.11609/jott.9036.16.6.25465-25469
11	Lichen	*Malmidea upretii*	Adhikari, R., R. Ngangom, K.K. Ingle, S. Joseph & S. Nayaka (2024). New species and additional records in the lichen genus Malmidea from India. *The Lichenologist* 56(2–3): 47–59. https://doi.org/10.1017/S0024282924000082
12	Lichen	*Pyrenula dissimulans*	Randive, P., G.K. Mishra, S. Nayaka, D.K. Upreti & M. Janarthanam (2021). Pyrenocarpous lichens in Goa with five new records to India. *Plant Science Today* 8(4): 889–899.
13	Beetle	*Sandracottus mixtus*	Deb, R. & K.A. Subramanian (2023). New Record of *Sandracottus* Species (Coleoptera: Dytiscidae) from Western Ghats of India. *Uttar Pradesh Journal of Zoology* 44(21): 10–15.
14	Beetle	*Sandracottus dejeanii*	Deb, R. & K.A. Subramanian (2023). New Record of *Sandracottus* Species (Coleoptera: Dytiscidae) from Western Ghats of India. *Uttar Pradesh Journal of Zoology* 44(21): 10–15.
15	Orchid (Orchidaceae)	*Zeuxine seetharamii*	Betageri, S. & K. Kotresha (2025). *Zeuxine seetharamii* (Orchidaceae): a new species from the Western Ghats, India. *Asian Journal of Research in Botany* 8(1): 152–163 . https://doi.org/10.9734/ajrib/2025/v8i1251
16	Crab	*Ghatiana dvivarna*	Pati, S.K., T. Thackeray, P.P. Bajantri & G.D. Hegde (2022). A new species of the freshwater crab genus *Ghatiana* Pati & Sharma, 2014 (Brachyura: Gecarcinucidae) from the Central Western Ghats, India. *Nauplius* 30: 1–10. https://doi.org/10.1590/2358-2936e2022019
17	Katydid	*Ducetia rohinii*	Banerjee, D., C. Raghunathan, A.N. Rizvi & J. Sengupta (2024). Animal discoveries 2023: new species and new records. Zoological Survey of India, Kolkata, 356 pp.

Appendix II. Large mammal rail kill records from the existing railway line (Hospet-Tinaighat-Vasco). This list was compiled using online news reports in English from the year 2015 to 2025.

Date	News article title	Species	No. of animals	Location	Link
21.ix.2015	Rail lines becoming a death trap for wild animals	Elephant calves	2	near Nagargali and Tavaragatti, Belagavi	https://www.thehindu.com/news/national/karnataka/rail-lines-becoming-a-death-trap-for-wild-animals/article7672505.ece
17.iv.2016	No action on animal Kills on railway tracks	Gaur	`6	Londa-Tinaighat railway line	https://timesofindia.indiatimes.com/city/%20hubballi/no-action-on-animal-kills-on-%20railway-%20tracks/articleshow/51859697.cms
10.x.2017	Elephant dies after being hit by train	Adult elephant	1	near Tavargatti, Belagavi	https://timesofindia.indiatimes.com/city/%20hubballi/elephant-dies-after-being-hit-%20by-train/articleshow/61015190.cms
26.vii.2018	Five animals killed on railway tracks in five years at Mahavir Sanctuary	Sloth Bear, Leopard, Gaur	5	Collem, Bhagwan Mahavir Wildlife Sanctuary	https://timesofindia.indiatimes.com/city/goa/five-animals-killed-on-rly-tracks-in-five-years-at-mahavir-sanctuary/articleshow/65140679.cms
01.iv.2021	Sloth bear found dead on rail tracks	Sloth Bear	1	near Dudhsagar Falls, Mollem National Park	https://timesofindia.indiatimes.com/city/goa/sloth-bear-found-dead-on-rail-tracks/articleshow/81793258.cms
14.iii.2025	Indian gaur killed in rail accident near Londa	Gaur	1	near Londa, Belagavi	https://www.deccanherald.com/india/karnataka/indian-gaur-killed-in-rail-accident-near-londa-3447130

Author contributions: M.M.C. conceived the study, initiated the manuscript, coordinated the overall collaboration and contributed to writing and revisions. S.D. conceived the study and contributed to early development, writing and revision of the work. M.M. co-coordinated the collaboration, expanded the author team, and helped with writing and revision. N.V. conceived the study, provided mentorship and inputs to manuscript development and writing. A.R., N.B., V.A., R.S., J.D., A.K., A.D., A.P., A.G., K.T. contributed thematic expertise, literature synthesis, and drafted specific sections of the manuscript. G.K., P.B., A.B., K.F., O.D., and P.R. contributed thematic expertise.

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