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Snakes on Trains: Railways May Sway Goa's King Cobra Distribution

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ABSTRACT

We provide the first detailed documentation on the distribution and natural history of the Western Ghats King Cobra, *Ophiophagus kaalinga*, in Goa State, India, and its interesting apparent interaction with railway infrastructure, which may influence its distribution. The combination of rescue records, verified sightings, local reports, and historical data allowed us to document a total of 47 georeferenced localities where *O. kaalinga* has been found in the state, with 18 localities in North Goa District and 29 in South Goa District. These data inform our study of the Goa Gap, a biologically significant region without obvious physical characteristics, and assess the suitability of this area for king cobras. Using a series of climate and vegetation variables, we were able to model the potential distribution of the species in Goa. It is noteworthy that the five king cobra records that fall along busy railway corridors had the lowest predicted probability, as predicted by our model. Combined with recent reports of snakes on trains in India and of *O. kaalinga* in a rail yard, entirely unsuitable reptile habitats, we propose the hypothesis that snakes, king cobras included, may inadvertently expand their ranges by accidental transport on trains.

सारांश

हम भारत देश के गोवा राज्य में पाए जाने वाली पश्चिमी घाट की किंग कोबरा प्रजाति, *ओफिओफैगस कालिंगा* (*Ophiophagus kaalinga*) के वितरण और प्राकृतिक इतिहास पर पहली बार विस्तृत जानकारी प्रस्तुत करते हैं, साथ ही इस प्रजाति के रेलवे प्रणाली से संभावित रोचक संबंध का उल्लेख करते हैं। बचाव (रेस्क्यू) रिकॉर्ड, स्थानीय सूचनाओं और ऐतिहासिक आँकड़ों के संयोजन के आधार पर, हमने *ओ. कालिंगा* के ४७ भौगोलिक रूप से संदर्भित स्थलों का दस्तावेजीकरण किया, जिनमें से १८ उत्तर गोवा जिले और २९ दक्षिण गोवा जिले में स्थित हैं। ये आँकड़े गोवा गैप जैसे जैविक रूप से महत्त्वपूर्ण, परंतु स्पष्ट भौगोलिक सीमाओं से रहित क्षेत्र के अध्ययन में सहायक हैं, और किंग कोबरा के लिए इस क्षेत्र की संभावित उपयुक्तता का मूल्यांकन करते हैं। जलवायु और वनस्पति से जुड़े अनेक पर्यावरणीय चरों का उपयोग करते हुए, हमने गोवा में इस प्रजाति के संभावित वितरण का मॉडल विकसित किया। उल्लेखनीय है कि पाँच रिकॉर्ड ऐसे स्थानों से थे जो मॉडल द्वारा पूर्वानुमानित उपयुक्त आवास से बाहर थे—और ये सभी व्यस्त रेलवे मार्गों के निकट स्थित थे। भारत में हाल के वर्षों में साँपों के ट्रेनों में देखे जाने की घटनाओं और रेलवे यार्ड जैसे पूरी तरह असंगत सरीसृप निवास स्थान में *ओ. कालिंगा* की उपस्थिति को देखते हुए, हम यह परिकल्पना प्रस्तुत करते हैं कि किंग कोबरा सहित साँपों की अन्य प्रजातियाँ अनजाने में ट्रेनों के माध्यम से आकस्मिक परिवहन द्वारा अपने वितरण क्षेत्र का विस्तार कर सकती हैं।.

1 | Introduction

The Indian subcontinent is a treasure trove of biodiversity, harboring a myriad of species that have long fascinated scientists and nature enthusiasts alike. Among these are king cobras, genus *Ophiophagus*, the world's longest venomous snakes. A recent taxonomic revision of these snakes, which had long been considered to be a single, widespread species,

revealed that the Western Ghats population was distinct at the species level (Das et al. 2024). This species, the Western Ghats King Cobra, *O. kaalinga* (Figure 1), is distributed along the mountainous spine of the Western Ghats in the Indian states of Goa, Karnataka, Kerala, Maharashtra, and Tamil Nadu (Whitaker and Captain 2008; Yadav and Yankanchi 2015; Uetz et al. 2025). While *O. hannah*, India's national reptile, is classified as a vulnerable species due to the threat of habitat destruction (Stuart et al. 2012; Uetz et al. 2025), the restricted range of *O. kaalinga* also makes this a species of elevated conservation concern.

In this study, we explore the distribution of king cobras in Goa, India's smallest state, using snake rescue data, verified sightings, and species distribution modeling. While species distribution models (SDMs) have been applied to king cobras in other regions, these studies focused on *O. hannah* and different environmental contexts (Marshall and Strine 2019; Mukherjee et al. 2024). Clearly, ecological drivers shaping the distribution of *O. kaalinga* in Goa may differ, and by focusing on this montane endemic, we address a gap in understanding how local habitat, climate, and ecological factors influence its distribution. These data lead us to hypothesize that *O. kaalinga* may be transported unwittingly via the railway system, with implications for both snake and human safety.

2 | Methods

2.1 | Species Records

We compiled 47 snake rescue records of *O. kaalinga* from Goa collected over 22 years (2002–2024; Table S1). All individuals were rescued by members of Animal Rescue Squad, Goa (ARSG), a non-governmental organization, and all records were cross-referenced with locality descriptions. Where GPS coordinates were missing, georeferencing was performed using Google Maps with an estimated spatial uncertainty of ±250 m. We acknowledge the potential for some spatial bias due to the nature of human-centric rescue efforts, but given the population density of Goa, we consider this of minor importance. We used 42 unique records from suitable habitat (see below) throughout Goa to build our distribution model.

In order to broaden our understanding of the distribution of king cobras in Goa, we also used the rescue events as an opportunity to informally interview local residents about the general presence of king cobras in villages or surrounding areas (e.g., forests, agricultural plots). While these observations are anecdotal, this type of communication allows for some insights into the potential for human-snake conflict and helps raise awareness.

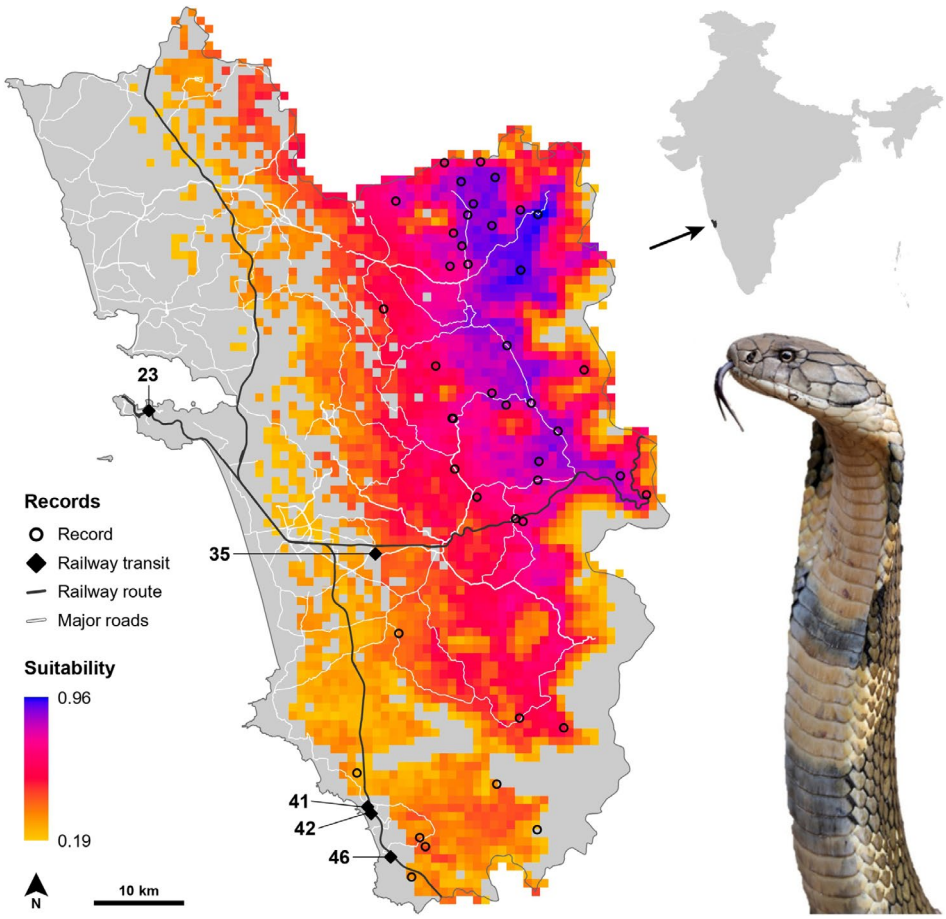

FIGURE 1 | Predicted distribution of the Western Ghats King Cobra, *Ophiophagus kaalinga*, in Goa State, India. The map was generated from 47 localities where the species was rescued during 2002–2024 using a MaxEnt approach. Darker colors indicate higher habitat suitability. Black diamonds indicate five rescue localities that are model outliers and for which railway transit is a possibility. Numbered localities are listed in the text. The map is overlaid with roads (depicted in white) and railway routes (in black), illustrating the transport network across Goa. Inset photograph of *O. kaalinga* by Mehul N. Thakur.

2.2 | Climate and Vegetation Data

Bioclimatic information was obtained using WorldClim v2.0 (Fick and Hijmans 2017) for 19 predictors with a spatial resolution of 30 arc sec. Additionally, we included the human footprint in Goa (Mu et al. 2022) as a proxy for anthropogenic disturbance, noting that these data span 2000–2018 and do not fully overlap with our 2000–2022 species records. Two temporal transformations of the Enhanced Vegetation Index (annual mean and annual range) were derived from MODIS datasets at 8-day (MOD11A2) and 16-day (MCD43B4) temporal resolution (Mu et al. 2007; Scharlemann et al. 2008). The WorldClim data represent long-term averages for 1970–2000. While these temporal mismatches may not substantially affect model outputs, we acknowledge them as potential limitations of the study.

2.3 | Variable Selection

To minimize the multicollinearity of predictors, we computed pairwise Spearman rank coefficients (ρ) and selected from the pairs only those variables that were putatively more relevant to the ecology of the species ($\rho^2 > 0.75$). Each variable was initially selected based on its presumed relevance to *O. kaalinga* (e.g., thermal and precipitation extremes or vegetation productivity would clearly have an impact on a large snake). The final model included the following 11 predictors: BIO5 (highest temperature in the warmest month), BIO7 (annual temperature range), BIO10 (mean temperature in the warmest quarter), BIO11 (mean temperature in the coldest quarter), BIO16 (precipitation in the wettest quarter), BIO17 (precipitation in the driest quarter), BIO18 (precipitation in the warmest quarter), BIO19 (precipitation in the coldest quarter), ED1515_bio1 (annual mean of the Enhanced Vegetation Index), ED1515_bio7 (annual range of the Enhanced Vegetation Index), and hfp2010.Goa (human footprint in Goa in 2010).

2.4 | Developing Species Distribution Models (SDMs)

We used customized R scripts (see Noori et al. 2025: Table S1) to optimize and run MaxEnt v3.4.4 (Phillips et al. 2017), a presence-pseudoabsence method that allows an estimation of potentially suitable habitats (Elith et al. 2011) and frequently has superior performance compared to other algorithms—even if the sample size is relatively small (Elith et al. 2006; Hernandez et al. 2006). To define an environmental background, we selected the political boundaries of Goa. MaxEnt allows fine-tuning of model parameters to optimize transferability and predictive accuracy via a selection of classes of different response functions (termed "feature classes") and regularization multipliers (Elith et al. 2011), wherein the corrected Akaike Information Criterion (AICc; Akaike 1973) can be used to select the most parsimonious settings (Warren and Seifert 2011). We followed the procedure suggested by Ginal et al. (2022) for selecting the optimal settings across 651 different feature class combinations and regularization multipliers, with each combination tested across 100 replicates using an 80/20% data split for model training and evaluation using a bootstrap approach. The following R packages were used for model optimization: *ENMeval* (Kass et al. 2021), *raster* (Hijmans 2025a), and *terra* (Hijmans 2025b). The optimal settings were a regulation multiplier of 3.5 and linear and hinge features, resulting on average in nine parameters and an AICc of 527.4.

Using the optimal settings, the final model was computed using the 80/20% data split for model training and evaluation via the Area Under the receiver operating characteristic Curve (AUC; Swets 1988) using 100 replicates. Averages across all replicates were projected to current environmental conditions using the complementary log–log (cloglog) output format, which is recommended for estimates of the probability of occurrence and may perform better than the logistic output format (Phillips et al. 2017). The minimum predicted probability at the locations where the species has been recorded was selected as the presence-absence threshold.

2.5 | Dealing With Outliers

Our SDM results allowed us to extract environmental suitability values ranging from 0 to 1 for each king cobra occurrence from the habitat suitability map, with higher values indicating greater probability of occurrence based on environmental suitability. These values revealed that a subset of our king cobra rescues occurred in areas predicted to be below the minimum probability in the training records and hence may be unsuitable for these snakes. We therefore conducted a Mann–Whitney *U*-test to determine whether there was a significant difference in the probability of occurrence based on environmental suitability values.

3 | Results

3.1 | King Cobras in Goa

We were able to confirm 47 localities (18 in North Goa, 29 in South Goa) where 120 *O. kaalinga* were rescued during 2002–2024 by Animal Rescue Squad Goa (ARSG). Our informal questioning revealed that while local residents readily reported king cobra encounters in the village and forested areas, we received no reports from agricultural plots or paddy fields.

3.2 | Distribution Modeling

The average performance of the SDMs across 100 bootstrap replicates was $AUC_{Training} = 0.844 \pm 0.027$ (mean ± SD) and $AUC_{Test} = 0.803 \pm 0.072$. Variable contributions to the final average model were derived from MaxEnt's percent contribution metric. For example, BIO18 (precipitation in the warmest quarter) had the highest average contribution (41.5% ± 19.4%). Other variable contributions, in descending order of their respective contribution, were: BIO5 (29.8% ± 20.5%), hfp2010.goa (14.9% ± 9.0%), BIO19 (3.7% ± 4.7%), BIO16 (3.3% ± 15.3%), BIO7 (2.7% ± 4.0%), ED1515_bio7 (1.6% ± 3.6%), BIO10 (1.3%), (0.6% ± 6.4%), ED1515_bio1 (0.6% ± 2.2%), and BIO17 (0.2% ± 6.1%). The surveyed sites were at elevations of 10–870 m, encompassing coastal areas, lateritic plateaus, riparian zones, and moist deciduous to semi-evergreen forests. Higher elevations (> 500 m) represent the interior hill slopes and escarpments characteristic of the Western Ghats.

The two top contributing variables (BIO18, BIO5) indicate that a combination of high temperature and high precipitation is important for *O. kaalinga*, with the non-natural human footprint variable (hfp2010.goa) contributing strongly. Based on our SDMs, king cobras in Goa are most likely to be found in the interior of the state (i.e., away from coastal zones), where they are expected to be found predominantly in forested areas and riparian zones. Riparian zones are areas immediately adjacent to rivers or streams, where vegetation cover is dense, prey availability is high, and movement corridors for snakes exist. Snake habitat overlaps with human population centres, with areas of high plant productivity attractive to both humans and snakes.

3.3 | King Cobra Distribution Outliers

Our model identified the eastern, inland part of Goa as highly suitable for king cobras, with areas along the coast, a narrow southern east–west gap, and some areas in the southeast unsuitable (Figure 1). Mapping our snake rescue records onto the model revealed that five observations fall outside the predicted suitable habitat. For example, king cobras are not expected to occur in Chandor Village, South Goa (Locality 35; Figure 1), but one individual was rescued at the Chandor railway station (Figure 2a). This snake (Figure 2c) was initially spotted at night by labourers living in tents flanking the station (Figure 2b). They contacted one of us (RG), who rescued the snake and transferred it to the forest department for release into a suitable natural habitat. Four additional sites outside the modeled distribution (Localities 23, 41, 42, 46; Figure 1) are also in close proximity to railway installations (distances of 200, 330, 220, and 270 m, respectively).

Observations made in suitable habitat, as predicted by our SDM, had higher average environment suitability values (0.84, range 0.77–0.91; $n = 42$) than those made in marginal/unsuitable habitat (0.48, range 0.45–0.52; $n = 5$). Results from the Mann–Whitney *U*-test showed that the difference between these values for king cobras rescued in suitable habitat vs. marginal/

FIGURE 2 | Do Western Ghats King Cobras, *Ophiophagus kaalinga*, take the train? (a) View of Chandor Station, Goa, India, from below the platform, showing the vegetation and the concrete pillars, where the snake was found. This location is atypical and unsuitable for king cobras. (b) Labourer accommodations lie just a dirt path away from the concrete pillars where the king cobra was recorded. (c) The snake emerged from beneath a pile of railway tracks stored at the site for ongoing railway maintenance and repair. (d) An Indian Cobra (*Naja naja*) on a windowsill in the moving Lokshakti Express train near Valsad, Gujarat State, India. Photos by Dikansh S. Parmar (a, b), Sourabh Yadav (c), and Sameer Lakhani (d).

unsuitable sites (i.e., railway-related environments) was statistically significant ($U = 0$; $p \leq 0.001$). Furthermore, the effect size (r) is 0.53. With $r > 0.5$, the effect is considered large (Cohen 1988). A box plot (Figure 3) provides a rather dramatic pictorial of this distinction.

4 | Discussion

4.1 | Topography and Elevation

The primary topographic and environmental influence on the distribution of king cobras in Goa and also on our model in the Western Ghats, the most important biodiversity hotspot in South Asia (Gadgil 2012). This 1600-km-long narrow mountain chain along the west coast of India reaches elevations > 2000 m, and most of eastern Goa falls within the climatic influence of these mountains. Our king cobra rescue data independently confirm that the areas identified by our model indeed appear to be those most suitable for king cobras in the state. Habitat suitability and rescue frequencies decrease dramatically over the state's 60-km east-to-west extent, and low-elevation, dry coastal landscapes and beaches in western Goa are clearly not good king cobra habitat. Both habitat suitability and rescue frequencies are highest in mid-to-high elevation regions, particularly in moist deciduous forests. Elevation interacts with other environmental variables, including precipitation and canopy cover, which are generally higher in elevated forested areas, creating favorable microhabitats that likely explain the observed distribution patterns. Given that these snakes are generally associated with forested hills and valleys (e.g., Whitaker and Captain 2008), our model matches the distribution of these snakes well.

There is also a stretch of apparently unsuitable habitat that nearly bisects moderately suitable areas in the southernmost part of Goa (Figure 1). While there is no obvious set of geophysical characteristics that make this area a gap for king cobras, it is interesting to note that the Western Ghats have another

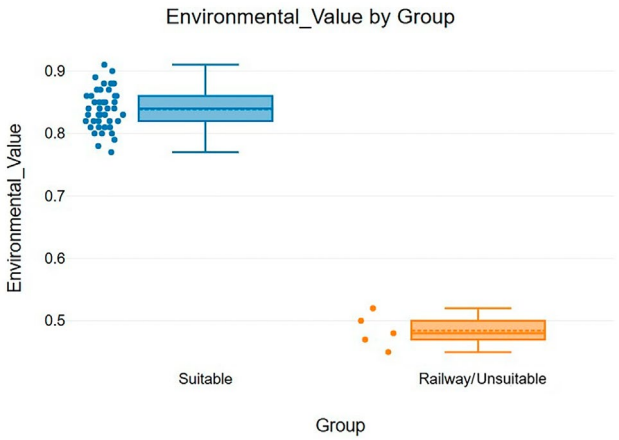

FIGURE 3 | Environmental suitability of king cobra (*Ophiophagus kaalinga*) habitats in Goa State, India. The boxplot shows that inland suitable habitats ($n = 42$) have significantly higher predicted average environmental suitability values (0.84) compared to unsuitable habitats ($n = 5$; 0.48). A Mann–Whitney U-test confirms this difference as statistically significant ($U = 0$, $p < 0.001$), indicating that railway/coastal areas are suboptimal for the species.

physically invisible biogeographical gap, the Goa Gap (15.8° N). This is the most recently formed biological disconnectedness (65–80 Mya) in these mountains, nestled where three states (Goa, Maharashtra, Karnataka) meet. Other gaps, such as the Palghat Gap (10°–11° N) and the Shencottah Gap (8°–9° N), are physically visible (Biswas and Karanth 2021). It appears that king cobras are able to bridge both visible and invisible habitat gaps, as their range shows a continuity across all of these. We see these patterns as evidence for the fact that elevation, forest type, and local climatic conditions jointly shape the habitat suitability for *O. kaalinga*, and that the SDM predictions accurately reflect these ecological preferences.

Additionally, phylogenetic studies on Western Ghats squamates, including *Ahaetulla* (Mallik et al. 2020) and *Dravidogecko* (Chaitanya et al. 2019), have demonstrated lineage divergence across major gaps such as the Palghat and Shencottah Gaps, highlighting the role of these gaps in shaping species distributions. In contrast, *O. kaalinga* exhibits a continuous distribution in the Western Ghats up to the Goa Gap in the north. Beyond this gap, the species is restricted to limited adjacent areas in Maharashtra and is entirely absent from the northern Western Ghats in Maharashtra and Gujarat, indicating that habitat unsuitability, including vegetation, temperature, and other ecological factors, likely limits its distribution beyond the Goa Gap. These patterns suggest that, while *O. kaalinga* bridged broader physical biogeographic gaps (e.g., Palghat and Shencottah) from the southernmost Western Ghats to parts of the northern Western Ghats, a strong biological barrier like the Goa Gap defines the species' northernmost extent within the Western Ghats. Moreover, local ecological factors—including forest type, elevation, and climatic conditions—strongly influence its fine-scale distribution locally, even in its distribution range, as reflected in the SDM predictions.

4.2 | Climate and Vegetation

Goa's higher-elevation regions, where most of the suitable king cobra habitat exists, have cooler, rainier weather and dense forests, in contrast to the low-lying, dry, less vegetated western region. Our data highlight the strong association of king cobras with a climate that produces densely forested habitats with relatively stable microclimates. As highlighted by Joshi and Janarthanam (2004), these climatic differences significantly affect the distribution of many species, with inland habitats supporting flora and fauna adapted to stable, cooler, and more humid conditions that contrast with the harsher, more variable conditions found along the coast. In addition, both coastal and agricultural zones might have fewer snake species and lower prey densities, and living in the lowlands may force king cobras to adopt a non-optimal diet.

Gowri Shankar et al. (2013) studied king cobras in the Western Ghats near Agumbe, Karnataka (13.5090° N, 75.0966° E, elevation 557 m), and reported that these snakes foraged in rice paddies and other human-modified areas in search of prey, particularly other snakes that may be attracted to rodents. While this shows that king cobras are somewhat adaptable when it comes to environmental changes brought on by humans, we received no reports of king cobras foraging in rice paddies in Goa,

even though they do occasionally enter human settlements in search of prey.

4.3 | Human Influence and Habitat Fragmentation

Goa is home to six wildlife sanctuaries and one national park, all but one (the Salim Ali Bird Sanctuary) located in the Western Ghats. The areas less and least suitable for *O. kaalinga* in our model are located at greater distances from the Western Ghats and are characterized by urbanization and proximity to tourist hotspots. Those areas also have a higher level of habitat fragmentation due to human activities (e.g., road construction, mining).

Aside from the distribution of *O. kaalinga* in Goa, our study shows that snake-rescue NGOs not only play a role in saving snakes and human lives but also in long-term species monitoring. Collaboration between rescuers and researchers, as demonstrated here, illustrates how rescue data can inform the research on vulnerable taxa so that species management decisions are based on all available evidence.

4.4 | King Cobras on Trains?

The case of the king cobra at the Chandor railway station prompted us to more closely investigate how this snake might have made its unlikely trip into ecologically hostile territory. While this village is not particularly remote in terms of its position vis-à-vis more suitable habitat (Locality 35; Figure 1), it is at a point where trains from the excellent king cobra habitat at Castle Rock, Karnataka State, India, a village surrounded by dense forests within the Dandeli Tiger Reserve (elevation 621 m), stop before they enter Goa's low-lying, more arid coastal areas. A second instance that aroused our curiosity was recorded in September 2021, when a king cobra was rescued from Vasco da Gama (Locality 23; Figure 1) by an ARSG volunteer (Kerkar 2021). This snake was found ca. 200 m from the railway station, in a habitat well outside of areas predicted by our model. Three additional king cobra rescues fell outside the predictions of our model (Loliem, Locality 46; Patnem Cancona, Locality 42; Palolem, Locality 41; Figure 1). These three are distances of 270, 220, and 330 m away from railroad tracks, with the latter two a short distance from Cancona Station (900 and 330 m, respectively).

Ramakrishnan et al. (2018) previously associated king cobras with railway infrastructure, but their report dealt with train track mortality. More recently, a newspaper report from Uttarakhand (with associated video evidence; Jain 2019) documented the rescue of a king cobra from a train. In 2023, a snake catcher from Gujarat State took a striking image of an Indian Cobra, *Naja naja* (Linnaeus, 1758), sitting in a train window, Figure 2d, which corroborates the first author's own cobra rescue on a crowded train in 2017. Clearly, a train journey provides a dispersal opportunity, but what would prompt a king cobra to "take the train"?

With the increased global availability of low-cost smartphones and social media in recent years, the number of reports of snakes on and around trains in India has increased, with three incidents recorded in a 30-day period (e.g., *Coelognathus helena*—Kaur 2024; unidentified snake—Singh 2024; *Python molurus*—Chouhan 2024), and many more emerging on social media. Thus, a combination of prey availability (snakes, rodents), shelter, and serendipity would allow a king cobra to enter a goods train at a location with suitable habitat (such as Castle Rock) to travel 85 km to Chandor, 120 km to Vasco, or to the other three localities in unsuitable habitat. Of course, time will tell how well our train-travel hypothesis can be confirmed.

Our hypothesis that king cobras may disperse via the railway system in India places their ecology firmly into a context of human-mediated dispersal. Parmar et al. (2024) recently presented strong evidence for human-mediated dispersal of the Eastern Bronzeback, *Dendrelaphis proarchos*, in India, when they reported this snake from Surat, Gujarat State, a distance of over 1700 km (by air) from its previously known documented Indian occurrence in Darjeeling. This location is in turn more than 1800 km from the snake's easternmost locality in Vietnam. Through combined morphological and genetic verification, Parmar et al. confirmed the species' identity and linked its occurrence in Gujarat to plant import activities. Remarkably, they documented not just one or two cases, but numerous individuals, with additional snakes appearing over the last 7 years. This long-term pattern also indicates that *D. proarchos* has established itself as an invasive population in Gujarat.

The topic of human-mediated introductions is often discussed in terms of invasive species transported via global shipping, with the "flowerpot snake" (*Indotyphlops braminus*) perhaps the best-known example (Wallach 2009; Zamora-Camacho 2017). Human-mediated dispersal is also a potential factor for native species within their range, and the role of linear infrastructure may be particularly relevant. For instance, Jones et al. (2022) demonstrated that roads and associated culverts could act as dispersal corridors for *O. hannah* in Thailand. Our findings suggest a different, more passive mechanism: railways may act not just as corridors for active movement, but as high-speed conduits. This contrasts with the typically negative impact of roads, which often function as barriers or significant mortality sinks for snakes. The potential for railways to inadvertently connect populations across otherwise unsuitable habitats represents a novel and underappreciated aspect of human-wildlife interaction. This form of passive transport, facilitated by shelter and prey availability in rail yards, could have significant implications for gene flow, population dynamics, and human-snake conflict in unexpected locations, as seen in Chandor Village.

While our 'snakes on a train' hypothesis is based on some compelling correlative and anecdotal evidence, it is a proposition that should be tested. Potential avenues for direct testing include: (1) Targeted monitoring at key source and destination stations, accomplished by using camera traps and by collaborating with trained railway staff to log sightings within the rail infrastructure. While camera trapping has a high cost, it would be more reliable than direct observation. In either case, it might take a long time period to obtain a suitable sample size. (2) Genetic forensics could be employed to determine if outlier individuals found in unsuitable habitats genetically match populations from distant, suitable habitats connected by rail. While this is an indirect method to obtain evidence, it is a proven technique. The

downside is that new samples are required, which would take time to assemble. (3) A stable isotope analysis of snake tissues may allow determination of geographic origin and of any contradiction of their rescue location. (4) Telemetry studies could be employed to track the movements of king cobras injected with RFID transmitters, which can get scanned at locations around rail infrastructure. Of these four options, those involving direct monitoring would be ideal tests of the hypothesis while those using genetics or chemistry would provide strong indirect (i.e., non-circumstantial) evidence. Regardless, we believe our hypothesis opens up a fascinating new line of ecological investigation into how linear infrastructure may not only act as a barrier but also, inadvertently, as a conduit for wildlife movement.

Nevertheless, the dispersal of king cobras into villages or towns where the species may be unknown poses a serious threat to both snakes and humans. Unlike for other land elapids, there is no specific antivenom available for king cobras in India, and a bite can be fatal within 15 min. Conversely, threatened humans may attempt to kill the snake, leading to risky exposure. ARSG is mitigating these issues by raising awareness, especially in places like Chandor, where king cobras do not naturally occur.

With the recent division of Indian populations of *Ophiophagus* into two species, the conservation status of king cobra populations in and around the Western Ghats, including in Goa, requires attention. By synthesizing existing knowledge and presenting new insights gained from research like ours, perhaps by involving other snake rescue NGOs and a citizen science network of local residents, we hope that this iconic snake can be better understood as it faces existing and emerging environmental challenges.

Author Contributions

Dikansh S. Parmar (D.S.P.) led the study and was responsible for conceptualization, data curation, formal analysis, field investigation, project administration, supervision (field operations), visualization, writing – original draft, writing – review and editing, and overall coordination and communication among collaborators. Dennis Rödder contributed to software, methodology, computational support, data visualization, writing – review and editing, finalization of the manuscript, and provided supervision in the form of scientific guidance and project oversight. Hinrich Kaiser worked on manuscript structuring, figure reorganization, writing, review and editing, finalization of the manuscript, and offered supervision through scientific guidance and mentoring. Amrut Singh contributed resources, participated in field investigation, assisted with data curation, and provided ethical oversight and rescue coordination. As an Honorary Wildlife Warden and President of the Animal Rescue Squad Goa (ARSG) NGO, he supervised the rescue and release operations, ensuring compliance with Forest Department regulations. Rinku Gupta contributed resources, participated in Field investigations, and shared critical local knowledge on the Chandor King Cobra, facilitating site access for follow-up investigations to the author D.S.P.

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Disclosure

Biosecurity: There were no biosecurity concerns or dual-use risks associated with this study.

Cultural and heritage: All cultural and local sensitivities were respected throughout the work.

Artificial intelligence generated content: No Artificial Intelligence Generated Content (AIGC) was used in the preparation of this manuscript. AI was used solely and only for the creation of the graphical abstract; no other part of the manuscript involved AI.

Ethics Statement

This study is based on routine snake rescue operations conducted by the registered NGO Animal Rescue Squad Goa (ARSG), Registration No. 228/Goa/01, which is authorized to carry out such activities. All rescue and release operations were conducted under the supervision of author Amrut Singh, President of ARSG and Honorary Wildlife Warden of Goa, appointed by the Forest Department. No special permits were required, as the study did not involve handling, examination, captivity, or collection of snakes. Only rescue locations were recorded, and all animals were released immediately into suitable habitats under the supervision of Honorary Wildlife Warden Amrut Singh. No animals were harmed or retained for research purposes.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data and code that support the findings of this study are available on request from the corresponding author. The Editor-in-Chief has waived the required archiving due to privacy or ethical restrictions.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** btp70157-sup-0001-AppendixS1.docx. *Ophiophagus kaalinga* localities in Goa State, India, obtained from 22 years of snake rescues. Localities are ordered from north to south in North and South Goa Districts.