Original scientific paper / Originalni naučni rad
DOI: https://doi.org/10.63356/gsf.2025.006

THE COST OF CROSSING: AN INITIAL ATTEMPT TO UNCOVER WILDLIFE VEHICULAR MORTALITY IN DODDABETTA, NILGIRIS (INDIA)

CIJENA PRELASKA: POČETNI POKUŠAJ OTKRIVANJA SMRTNOSTI DIVLJIH ŽIVOTINJA OD VOZILA U DODDABETTI, NILGIRIS

Elangovan Vignesh[1]*, Kesavan Rishi[1]*, Anbazhagan Abinesh[2], Nizamudheen Moinudheen[3], Sadiq Ali[4], Vijayakumar Rajgopal[4], Arockianathan Samson[5]

[1] Department of Zoology, Government Arts College, Ooty, Tamil Nadu, India
[2] Department of Ecology and Environmental Science, Pondicherry University, India
[3] Independent Biologist in Nilgiri Hills Tamil Nadu 643 001, India
[4] Wildlife and Nature Conservation Trust (WNCT) Udhagamandalam (Ooty), Tamil Nadu India
[5] Bombay Natural History Society, Vulture Programme, Vulture conservation Breeding center, Bhopal 462 044, Madhya Pradesh, India
*emails: vignesh040104@gmail.com; rishiintothewild27@gmail.com

Abstract

Roads pose a significant threat to wildlife, particularly in biodiversity-rich regions such as the Nilgiris (India). This preliminary study documents patterns of wildlife-vehicle collisions (WVC) in the Doddabetta region, focusing on taxonomic diversity, seasonal variation, and species-specific vulnerability. A total of 80 individuals from 19 species were recorded as roadkill across 60 randomly selected days, with reptiles especially the endemic *Salea horsfieldii* showing the highest incidence. The data suggest a strong correlation between roadkill events and seasonal activity patterns, particularly during breeding periods. Contributing factors include high vehicle speeds, roadside garbage that attracts prey species, and inadequate driver awareness. The study underscores the urgent need for mitigation measures such as wildlife crossings, dynamic signage, and impact assessments of existing and proposed roads. As the findings are based on limited, randomly timed surveys, we recommend future research with systematic seasonal monitoring during both day and night to better understand the broader ecological implications. This study provides baseline data for developing conservation strategies in high-risk zones like Doddabetta.

Key words: Breeding season, Endemic species, Herptofauna, Roadkill, Seasonal pattern, Shola habitat

1. INTRODUCTION / UVOD

The recent global assessment by Grilo et al. (2025) reports 208,570 wildlife roadkill incidents between 1971 and 2024, covering 2,283 species and subspecies across 54 countries and six continents, in which 126 were threatened species with a total of 4,570 records. Wildlife roadkill refers to the accidental death of animals caused by vehicle collisions has escalated with the global expansion of road networks, making roads one of the leading sources of human-induced mortality for many vertebrates and a major concern for ecological, economic, and social systems (Grilo et al., 2021; Hill et al., 2019; Medrano Vizcaíno et al., 2022; Schwartz et al., 2020; Sukhontapatipak et al., 2025). Unlike poaching or hunting, which generally target specific individuals, wildlife–vehicle collisions often involve healthy animals (Ontiveros et al., 2022; Pawgi et al., 2024). Such incidents can disrupt gene flow, contribute to population isolation and decline (Sutherland et al., 2010), and alter movement and distribution patterns (Desai & Baskaran, 1998; Sur et al., 2022). They may also increase inbreeding, lead to local extirpation (Quinn & Hastings, 1987), and even affect surrounding flora and fauna (Mazumdar & Gogoi, 2010). A high roadkill rate in any taxonomic group can directly disrupt the food chains of native wildlife species (Andersson et al., 2017; Hodson, 1966; Muñoz et al., 2015; Ray et al., 2023). India has a road network spanning over 600,000 km, making it the second largest in the world (Indian Road Industry Report, 2020; Pawgi, 2024; Sur et al., 2022; Sushanth et al., 2025) and over the past six decades, both the total road length and the number of automobiles in India have grown significantly.

Studies worldwide have revealed the massive scale of wildlife mortality caused by road traffic. In the United States, over a million vertebrates are killed daily, including between 89 and 340 million birds annually (Loss et al. 2014). Europe reports approximately 194 million bird and 29 million mammal deaths each year (Grilo et al., 2020), while Latin America sees an estimated 12.4 million birds and 5.1 million mammals killed annually (Medrano-Vizcaíno et al., 2022). Canada records 13.8 million bird deaths annually (Bishop & Brogan, 2013), Australia reports 5 million frogs and reptiles, and the Netherlands experiences the loss of 653,000 birds and 159,000 mammals each year. In Bulgaria, an estimated 7 million birds are killed annually on roads (Forman & Alexander, 1998). Similarly, in India, numerous studies have documented the widespread impact of road traffic on wildlife across diverse ecosystems (Baskaran & Boominathan, 2010; Bhupathy et al., 2011; Chhangani, 2004a, 2004b; Chittaragi & Hosseti, 2014; Choudhury & Ghosh, 2008; Das et al., 2007; Dutta et al., 2016; Gokula, 1997; Gubbi et al., 2012; Hat & Mubeen, 2019; Husain & Mehta, 2023; Islam & Saikia, 2014; Jeganathan et al., 2018; Kumara et al., 2000; Nagar et al., 2013; Pawgi et al., 2024; Pragatheesh, 2011; Rao & Girish, 2007; Ray et al., 2023; Samson et al., 2016, 2018; Santhoshkumar et al., 2016, 2017; Santhoshkumar & Kannan, 2017; Saxena et al., 2020; Seshadri et al., 2009; Seshadri & Ganesh, 2011; Siva & Neelanarayanan, 2020; Sundar, 2004; Sur et al., 2022; Sushanth et al., 2025; Vijayakumar et al., 2001). Accurately assessing the impact of wildlife-vehicle collisions (WVCs) on population persistence requires comprehensive knowledge of local species abundance, roadkill rates, and spatiotemporal collision patterns. Such understanding is crucial for identifying high-risk areas, informing mitigation strategies, and evaluating the broader ecological and socio-economic consequences (Bartonicka et al., 2018; Grilo et al., 2025; Gunson et al., 2009; Visintin et al., 2016). This study is an approach to quantify the diversity and scale of faunal mortality caused by vehicular collisions and to assess the seasonal variation in collision patterns.

2. MATERIAL AND METHODS / MATERIJAL I METOD RADA

The study was conducted along a 1.75 km road transect stretching from Doddabetta Junction to Attabettu (Nilgiris, India) (Figure1). The area is characterized by dense forests and sub-alpine vegetation, including *Rhododendron* spp, coarse grasses, and flowering shrubs. Nilgiri district gets an average annual rainfall of 1920 mm (Samson et al., 2018). Along the transect, the left side of the road (from Doddabetta to Attabettu) is dominated by plantations and

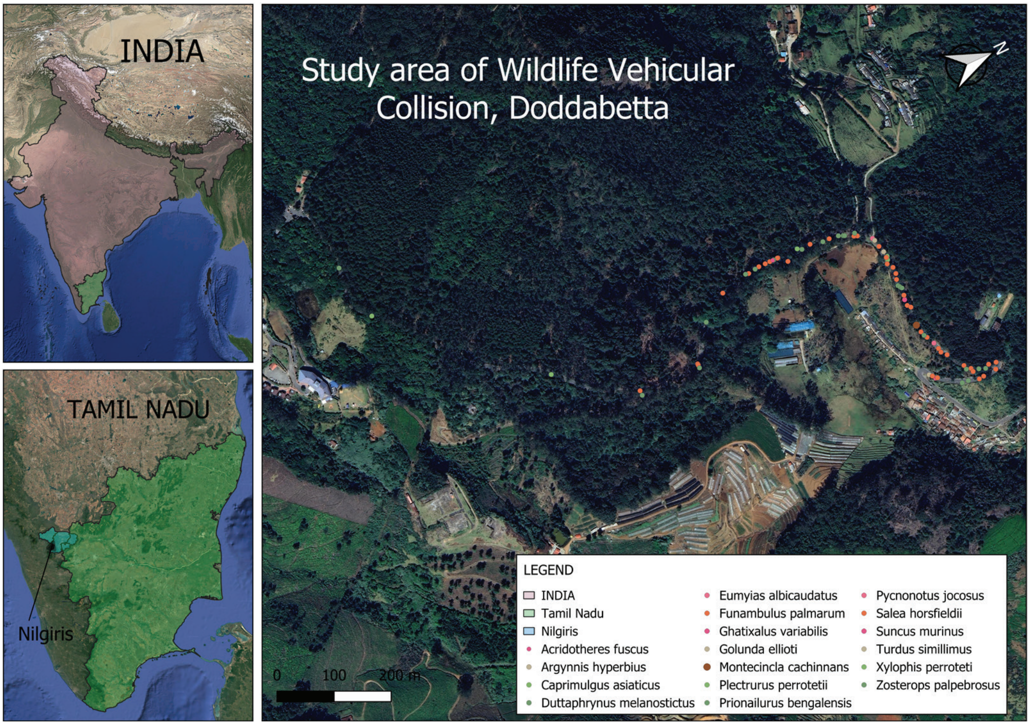

Figure 1. Map of the study area / **Slika 1**. Prikaz područja istraživanja

invasive species such as *Pinus sp., Eucalyptus sp., Cestrum aurantiacum, Acacia sp., Cupressus corneyana, Acacia melanoxylon, Cypressus macrocarpa, Ageratina adenophora,* and *Lobelia leschenaultiana*. The right side of the road is bordered by Shola forest for the first 830 meters, after which the vegetation resembles that of the left side making it a degraded ecotone region. Data were collected opportunistically by walking along the transect on randomly selected sunny and cloudy days over a five-month period, from February to June (2025). Data were analysed using R software12.0 (2020) using ggplot2, ggtext and dplyr, and mapping was visualized using QGIS version 3.32.0.

3. RESULTS / REZULTATI

A total of 60 days were randomly selected for the study, during which roadkill were recorded on 42 days. We documented 81 individuals representing 19 species ans subspecies killed due to vehicle collisions (Table 1, Figure 2). These included 2 species from the class Amphibia, 6 from Mammalia, 7 from Aves, 3 from Reptilia, and 1 from Insecta. The reptile *Salea horsfieldii* (Horsfield's Spiny Lizard) accounted for the highest number of roadkills, with 40 individuals, followed by the amphibian *Duttaphrynus melanosticus* (Asian common Toad) with 20 individuals. Other species such as *Zosterops palpebrosus* (Indian White-eye), *Suncus murinus* (Asian House Shrew), *Plectrurus perroteti* (Nilgiri Burrowing Snake), and *Xylophis perroteti* (Perrotet's Mountain Snake) were each represented by two individuals. The remaining species *Ghatixalus variabilis* (Variable Ghat Frog), *Eumyias albicaudatus* (Nilgiri Fly-

Table 1. Summary information about roadkill taxa / **Tabela 1**. Prikaz informacija o stradalim taksonima

Common name	Scientific name	Class	IUCN status	Distribution range	Total no of individuals
Indian toad	*Duttaphrynus melanostictus*	Amphibia	Least concern	South Asia and Indonesia	20
Variable ghat frog	*Ghatixalus variabilis*	Amphibia	Endangered	Endemic to southern western Ghats	1
Nilgiri flycatcher	*Eumyias albicaudatus*	Aves	Least concern	Endemic to western Ghats	1
Nilgiri Laughingthrush	*Montecincla cachinnans*	Aves	Endangered	Endemic to Nilgiris	1
Indian nightjar	*Caprimulgus asiaticus*	Aves	Least concern	Found in south Asia	1
Jungle myna	*Acridotheres fuscus*	Aves	Least concern	Found in south Asia	1
Indian white-eye	*Zosterops palpebrosus*	Aves	Least concern	Found in south Asia	2
Red-whiskered bulbul	*Pycnonotus jocosus*	Aves	Least concern	Found in South Asia and Indonesia	1
Indian blackbird	*Turdus simillimus*	Aves	Least concern	Found in India	1
Nilgiri fritillary	*Argynnis hyperbius hybrida*	Insecta	-	Endemic to Nilgiris	1
Indian palm squirrel	*Funambulus palmarum*	Mammalia	Least concern	Found in India	1
Leopard cat	*Prionailurus bengalensis*	Mammalia	Least concern	Found in Asia	1
Asian house shrew	*Suncus murinus*	Mammalia	Least concern	Found in India and other regions	2
Indian Bush Rat	*Golunda ellioti*	Mammalia	Least concern	Found in India	1
Jungle cat	*Felis chaus*	Mammalia	Least concern	Found in India and other regions	1
Indian grey mangoose	*Urva edwardsii*	Mammalia	Least concern	Found in India and other regions	1
Nilgiri spiny lizard	*Salea horsfieldii*	Reptilia	Least concern	Endemic to Nilgiris	40
Perrotet's mountain snake	*Xylophis perroteti*	Reptilia	Least concern	Endemic to Nilgiris	2
Nilgiri burrowing snake	*Plectrurus perroteti*	Reptilia	Least concern	Endemic to Nilgiris	2

catcher), *Acridotheres fuscus* (Jungle Myna), *Caprimulgus asiaticus* (Indian Nightjar), *Pycnonotus jocosus* (Red-whiskered Bulbul), *Montecincla cachinnans (*Nilgiri Laughingthrush), *Turdus simillimus* (Indian Blackbird), *Funambulus palmarum* (Indian Palm Squirrel), *Prionailurus bengalensis* (Leopard Cat), *Felis chaus* (Jungle Cat), *Urva edwardsii* (Indian Grey Mongoose), *Golunda ellioti* (Indian Bush Rat), and *Argynnis hyperbius hybrida* (Nilgiri Fritillary) were each recorded only once. Of the 19 species ans subspecies, two was classified as Endangered, one lacked an official conservation status, and the remaining 16 were categorized as Least Concern. Additionally, four species were endemic to the Nilgiris, while other two were endemic to the southern Western Ghats.

Analysis of the monthly collision data (Figure 3) showed that June recorded the highest number of incidents (n = 24) followed by May (n = 23), March (n = 13), April (n = 12), and February (n = 9). In June, the most affected species was *Salea horsfieldii* (n = 10), followed by *Duttaphrynus melanostictus* (n = 3). Other species recorded in June included *Plectrurus perroteti, Xylophis perroteti, Suncus murinus* (n = 2), and *Ghatixalus variabilis, Golunda el-*

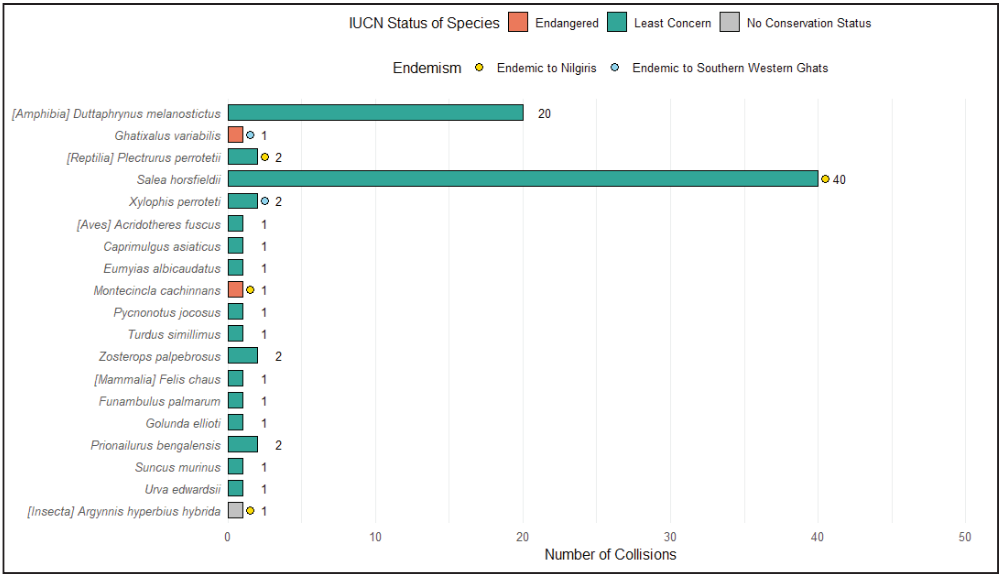

Figure 2. Trend of species WVC with their IUCN and Endemism status / **Slika 2**. Trend sudara vozila sa divljim životinjama (WVC) sa njihovim IUCN statusom ugroženosti i endemičnosti

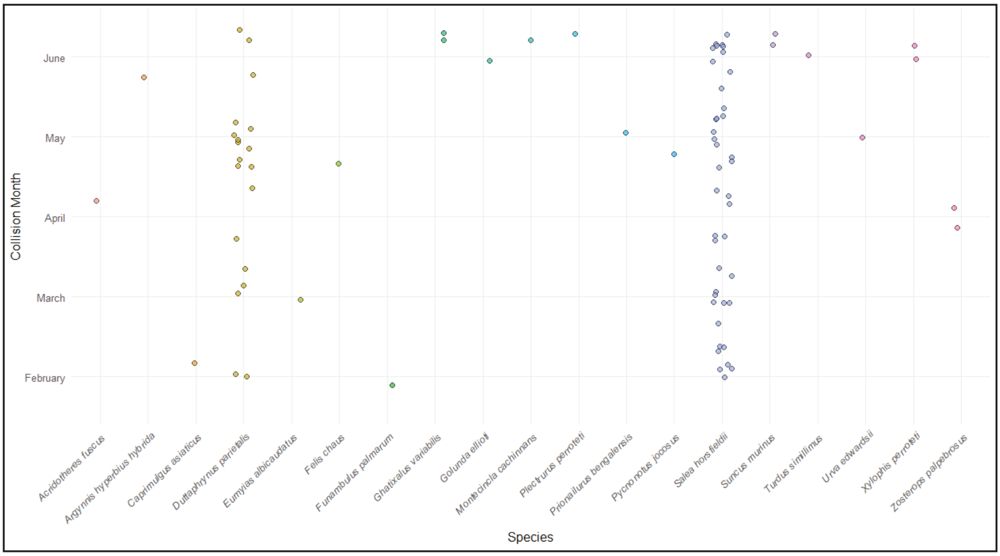

Figure 3. Month wise trend of WVC / **Slika 3**. Mjesečni trend sudara vozila sa divljim životinjama (WVC)

lioti, Turdus simillimus, Montecincla cachinnans, and an *Argynnis hyperbius* hybrid (each n = 1). In May, *Duttaphrynus melanostictus* had the highest number of collisions (n = 10), followed by *Salea horsfieldii* (n = 9), while *Felis chaus, Prionailurus bengalensis*, and *Pycnonotus jocosus, Urva edwardsii* were recorded once each (n = 1). In March, *Salea horsfieldii* was the most frequently recorded species (n = 9), followed by *Duttaphrynus melanostictus* (n = 3), and *Eumyias albicaudatus* (n = 1). April accounted for n = 12 collisions, with *Salea* *horsfieldii* (n= 7) followed by *Duttaphrynus melanostictus* and *Zosterops palpebrosus* contributing (n = 2 each), and *Acridotheres fuscus* recorded once (n = 1). February showed *Salea horsfieldii* (n = 5), followed by *Duttaphrynus melanostictus* (n = 2) while *Caprimulgus asiaticus, Funambulus palmarum* had one record each (n = 1).

Analysis of weather conditions (Figure 4) revealed that sunny days accounted for the majority of roadkill incidents (n = 58), followed by rainy conditions (n = 22), and cloudy weather (n = 1). Among the sunny records, may had the highest number of incidents (n = 17), followed by June (n = 14), March (n = 13), April (n = 9), and February (n = 5). Under rainy conditions, the number of incidents was comparatively lower (n = 22), with the highest recorded in June (n = 8), followed by May (n = 7), April (n = 5), and February (n = 2) and only one incident occurred during cloudy weather (n = 1).

Analysis of canopy cover and weather conditions (Figure 5) revealed a significant influence on collision frequency. The highest number of collisions occurred under 70% canopy cover (n = 24), followed by 0% canopy cover (n = 19),

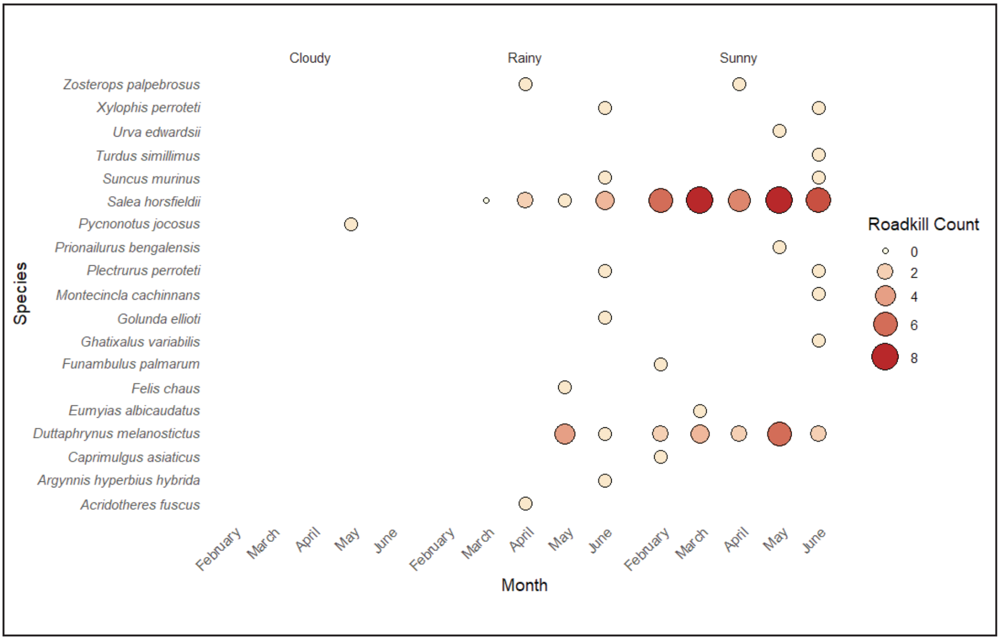

Figure 4. Month wise and season wise trend analysis of WVC / **Slika 4**. Analiza mjesečnog i sezonskog trenda sudara vozila sa divljim životinjama (WVC)

60% canopy cover (n = 11), 80% canopy cover (n = 9), 75% canopy cover (n = 7), 65% canopy cover (n = 6), and 75% canopy cover (n = 5). In terms of weather, sunny conditions accounted for the majority of incidents across canopy types (n = 55). Notably, 70% canopy recorded the highest number of sunny day collisions (n = 16), followed by 0% canopy (n = 14), 60% canopy (n = 8), 75% canopy (n = 6), 80% canopy (n = 5), and 65% canopy (n = 3). Under rainy conditions, a total of 25 collisions were recorded: 70% canopy (n = 13), 0% canopy (n = 4), 80% canopy (n = 3), 75% canopy (n = 2), 60% canopy (n = 2), and 65% canopy (n = 1). Only one collision occurred under cloudy weather, which was recorded at 0% canopy (n = 1).

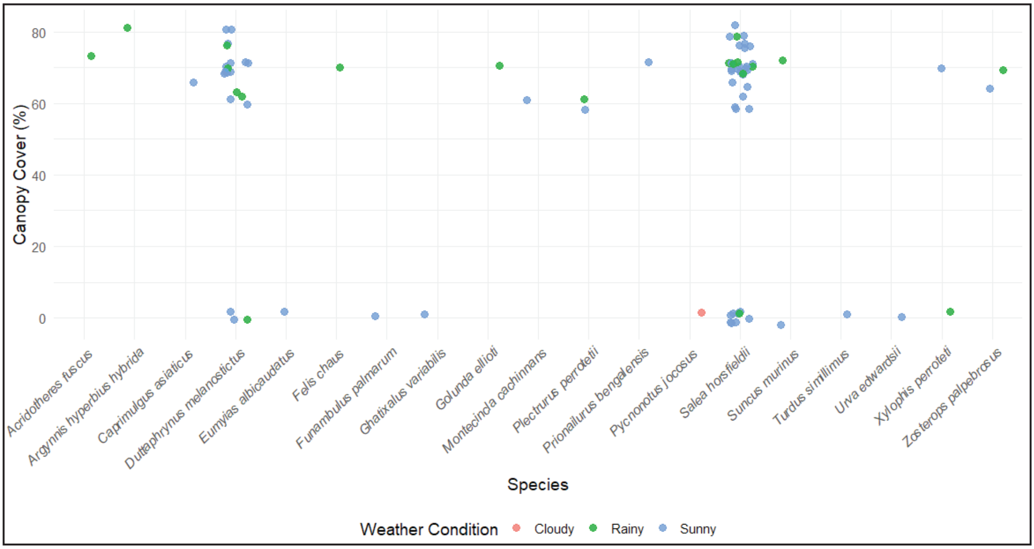

Figure 5. Relationship between species roadkill and canopy cover / **Slika 5**. Veza između vrsta i stepena sklopa kod sudara vozila sa divljim životinjama (WVC)

4. DISCUSSION / DISKUSIJA

This study highlights the significant threat vehicular traffic poses to wildlife in the Nilgiris, as demonstrated by 81 roadkill incidents involving 19 species and subspecies recorded over just 42 days. While the majority of these species are currently classified as Least Concern, the presence of one Endangered species and multiple endemics including three restricted to the Nilgiris and another three to the southern Western Ghats raises serious conservation concerns. Month wise analysis revealed that June and May recorded the highest number of collisions, likely due to increased animal movement during this period and a surge in tourist activity around Doddabetta, which sees peak visitation in these months.

Reptiles, in particular, are highly vulnerable due to their tendency to use roads for thermoregulation (Andrews & Gibbons, 2005; Sushanth et al., 2025), their slow movement, and foraging habits (Brehme et al., 2013). The highest number of roadkill incidents in this study involved *Salea horsfieldii* (Horsfield's Spiny Lizard), followed by *Duttaphrynus melanostictus*. *S. horsfieldii*, an agamid lizard endemic to the Western Ghats, typically inhabits elevations of 1,600–2,500 m in the Nilgiri Hills (Abinesh & Vishnu, 2022; Daniel, 2002; Santhosh Kumar et al., 2017). It is commonly found on low bushes, tree trunks, and rocks, particularly along the edges of shola-grassland mosaics (Deepak et al., 2022). These transitional habitats are ecologically important, especially during the dry season (October to May), which aligns with the species' breeding period (Bhupathy & Nixon, 2004). Frequent use of these edge areas during courtship and oviposition increases the species' exposure to roads. Notably, several dead females were found with extruded eggs, suggesting that collisions often occur during or shortly after laying, further highlighting their vulnerability during reproduction. The second most affected species, *Duttaphrynus melanostictus*, faces a high risk of road mortality, likely due to its extended breeding season from February to November, with peak activity during the monsoon. Our findings align with previous studies suggesting that roadkill incidents tend to increase during seasonal migrations to breeding habitats, particularly in the rainy season, when amphibian's cross roads in large numbers, thereby increasing their risk of collisions with vehicles (Sukhontapatipak et al., 2025; Sur et al., 2022).

Although birds are generally less susceptible to road mortality due to their ability to fly and their visual and auditory awareness of oncoming vehicles (Husby & Husby, 2014), eight bird fatalities involving six species were recorded. High vehicle speed appears to be the primary contributing factor (Erritzoe et al., 2003; Husain & Mehta, 2023; Saxena et al., 2020; Sur et al., 2022). Among them *Montecincla cachinnans (*Nilgiri Laughingthrush) and *Eumyias albicaudatus* (Nilgiri Flycatcher), were endemic species of the Nilgiris, highlighting that even avian species are not entirely insulated from road threats. Reptiles with restricted ranges and specialized habitats, such as *Plectrurus perroteti* and *Xylophis perroteti*, appear especially susceptible to road mortality. Nightjars are particularly susceptible to road mortality due to their nocturnal habits and behavior. They often feed on insects attracted to streetlights and may rest or incubate eggs on warm road surfaces during the breeding season, making them vulnerable to vehicle collisions. Sudden exposure to headlights can disorient them, preventing escape (Erritoze et al., 2003; Hernandez, 1988; Husain & Mehta, 2023).

For instance, a single roadkill incident of *Plectrurus perroteti* was documented in June, a period closely aligned with its reproductive season. As a viviparous species known to give birth between July and August (Santhoshkumar et al., 2016; Smith, 1943; Wall, 1919), such incidents raise serious concerns that additional roadkills during this critical phase could further jeopardize population viability. Similarly, *Argynnis hybrida*, the Nilgiri Fritillary, an endemic butterfly species restricted to the Nilgiri Hills, has also been recorded as roadkill. The loss of such localized and conservation-sensitive taxa underscores the urgent need for mitigation strategies along roads intersecting biodiverse habitats.

Multiple studies across protected areas in India have reported roadkill incidents involving several mammal species of conservation concern (Rajvanshi et al., 2001). A key contributing factor is that mammals often become disoriented or temporarily blinded by the glare of vehicle headlights, making them more susceptible to collisions (Sur et al., 2022). In the present study, small mammal species such as the Indian palm squirrel (*Funambulus palmarum*),

Figure 6. Nilgiri marten (left) observed crossing the road during the study period, and Indian Bush Rat (right) feeding on discarded sweet corn along the roadside / **Slika 6**. Kuna iz Nilgirija (levo) primijećena kako prelazi put tokom perioda istraživanja i indijski žbunski pacov (desno) koji se hrani odbačenim kukuruzom šećercem pored puta

leopard cat (*Prionailurus bengalensis*), Asian house shrew (*Suncus murinus*), Indian bush rat (*Golunda ellioti*), jungle cat (*Felis chaus*), and Indian grey mongoose (*Herpestes edwardsii*) were recorded as roadkill, highlighting the widespread impact of vehicular traffic on diverse mammalian fauna.

Other observations (Figure 6) included sightings of *Martes gwatkinsii* (Nilgiri marten) crossing the road, and low-flying endemic birds such as *Sholicola major* (Nilgiri blue robin), *Ficedula nigrorufa* (Black-and-orange Flycatcher), and *Culicicapa ceylonensis* (Grey-headed Canary-flycatcher), all at heightened risk of vehicular collision due to their proximity to roads. We also observed *Golunda ellioti* feeding on sweet corn discarded by tourists, indicating that human food waste may be altering wildlife behaviour. Additionally, garbage dumping along roadsides especially near shola forest edges by both locals and tourists poses a significant threat to biodiversity by attracting wildlife closer to roads and degrading natural habitats. The litter provides an easy food source for rodents and other animals, increasing their presence near roads and, consequently, their risk of vehicle collisions (Samson et al., 2016).

5. CONCLUSION / ZAKLJUČAK

Despite being conducted in a relatively small area, the study revealed a considerable number of roadkill incidents, particularly among range-restricted and ecologically sensitive taxa. These findings highlight the disproportionate impact of vehicular traffic on such vulnerable species, underscoring the urgent need for species-specific mitigation measures and long-term monitoring. The collision data from Doddabetta, including spatial and temporal trends, offer valuable baseline insights for shaping future mitigation strategies. Given that the present study is based on preliminary data collected at irregular intervals, future research should focus on systematic, year-round monitoring both during the day and at night to gain a more comprehensive understanding of roadkill patterns across broader spatial and temporal scales. Integrating habitat connectivity into infrastructure development is critical to reducing wildlife-vehicle collisions and preserving essential ecological corridors. Mitigation strategies for high-risk species should include the construction of wildlife overpasses and underpasses, enforcement of speed limits in sensitive zones, and targeted public awareness campaigns promoting wildlife conservation (Sushanth et al., 2025). Improvements in road infrastructure such as the use of reflective surfaces, speed bumps, and protective barriers can also help minimize collision risks. Additionally, rotating road signage locations may enhance driver attentiveness, as static signs tend to lose their effectiveness over time (Husain & Mehta, 2023; Sullivan et al., 2004).

References / Literatura

Abinesh, A., & Vishnu, S. N. (2022). Rapid color change in a Horsfield's spiny lizard (*Salea horsfieldii*) in Nilgiris, India. *Reptiles & Amphibians, 29*(1), 187–188. https://doi.org/10.1761/randa.v29i1.16435

Andrews, K. M., & Gibbons, J. W. (2005). How do highways influence snake movement? Behavioral responses to roads and vehicles. *Copeia, 2005*(4), 772–782.

Bartonicka, T., Andrasik, R., Dula, M., Sedonik, J., & Bil, M. (2018). Identification of local factors causing clustering of animal-vehicle collisions. *Journal of Wildlife Management, 82*(5), 940–947. https://doi.org/10.1002/jwmg.21467

Baskaran, N., & Boominathan, D. (2010). Road kill of animals by highway traffic in the tropical forests of Mudumalai Tiger Reserve, southern India. *Journal of Threatened Taxa, 2*(3), 753–759. https://doi.org/10.11609/JoTT.o2101.753-9

Bhupathy, S., & Nixon, A. M. A. (2004). Impact of habitat alterations on the reptile diversity in the higher altitudes of Nilgiri Biosphere Reserve, Western Ghats, India. Sálim Ali Centre for Ornithology and Natural History.

Bhupathy, S., Srinivas, G., Kumar, N. S., Karthik, T., & Madhivanan, A. (2011). Herpetofaunal mortality due to vehicular traffic in the Western Ghats, India: A case study. *Herpetotropicos, 5*(2), 119–126.

Bishop, C. A., & Brogan, J. M. (2013). Estimates of avian mortality attributed to vehicle collisions in Canada. *Avian Conservation and Ecology, 8*(2), Article 2. https://doi.org/10.5751/ACE-00604-080202

Brehme, C. S., Tracey, J. A., McClenaghan, L. R., & Fisher, R. N. (2013). Permeability of roads to movement of scrubland lizards and small mammals. *Conservation Biology, 27*(4), 710–720. https://doi.org/10.1111/cobi.12081

Campioni, L., Marengo, I., Román, J., & D'Amico, M. (2022). Mud-puddling on roadsides: A potential ecological trap for butterflies. *Journal of Insect Conservation, 26*(1), 131–134. https://doi.org/10.1007/s10841-022-00391-5

Chhangani, A. K. (2004a). Frequency of avian road-kills in Kumbhalgarh Wildlife Sanctuary, Rajasthan, India. *Forktail, 20*, 110–111.

Chhangani, A. K. (2004b). Killing of Hanuman langur in road accidents in Kumbhalgarh Wildlife Sanctuary, Rajasthan, India. *Primate Report, 69*, 49–57.

Chittaragi, J. B., & Hosetti, B. B. (2014). Road kill mortality of snakes (Squamata: Serpentes) in different land cover areas of Semi-Malnad region, Mid Western Ghats, Shimoga, India. *Current Biotica, 8*(1), 7–65.

Choudhury, K., & Ghosh, S. (2009). Mortality of butterfly fauna due to vehicular traffic and their conservation in Ripu-Chirang Reserve Forests of western Assam, India. In *Proceedings of the 2nd Asian Lepidoptera Conservation Symposium*. Penang, Malaysia.

Daniel, J. C. (2002). *The book of Indian reptiles and amphibians*. Bombay Natural History Society & Oxford University Press.

Das, A., Ahmed, M. F., Lahkar, B. P., & Sharma, P. (2007). A preliminary report of reptilian mortality on road due to vehicular movement near Kaziranga National Park, Assam, India. *Zoos' Print Journal, 22*(7), 2742–2744. https://doi.org/10.11609/JoTT.ZPJ.1541.2742-4

Deepak, V., Narayanan, S., Das, S., Rajkumar, K. P., Pal, S., Gerard, J. D., & Gower, D. J. (2022). *Snakes and lizards of the sky islands of the Western Ghats*. Ashoka Trust for Research in Ecology and the Environment.

Desai, A. A., & Baskaran, N. (1998). Ecology of Malabar giant squirrel (*Ratufa indica*) in Mudumalai Wildlife Sanctuary, South India. *Technical Report, Bombay Natural History Society, 3*(7), 1885–1960.

Dutta, S., Janab, H. P., Sahac, S., & Mukhopadhyay, S. (2016). The cause and consequences of road mortality of herpetofauna in Durgapur, West Bengal, India. *Russian Journal of Ecology, 47*(1), 88–95.

Erritzoe, J., Mazgajski, T., & Rejt, L. (2003). Bird casualties on European roads—A review. *Acta Ornithologica, 38*(2), 77–93. https://doi.org/10.3161/068.038.0204

Forman, R. T., & Alexander, L. E. (1998). Roads and their major ecological effects. *Annual Review of Ecology and Systematics, 29*, 207–231. https://doi.org/10.1146/annurev.ecolsys.29.1.207

Gokula, V. (1997). Impact of vehicular traffic on snakes in Mudumalai Wildlife Sanctuary. *Cobra, 27*, 26–30.

Grilo, C., Borda-de-Água, L., Beja, P., Goolsby, E. W., Soanes, K., le Roux, A., Koroleva, E., Ferreira, F. Z., Gagné, S. A., Wang, Y., & González-Suárez, M. (2021). Conservation threats from roadkill in the global road network. *Global Ecology and Biogeography, 30*(11), 2200–2210. https://doi.org/10.1111/geb.13375

Grilo, C., Koroleva, E., Andrášik, R., Bíl, M., & González-Suárez, M. (2020). Roadkill risk and population vulnerability in European birds and mammals. *Frontiers in Ecology and the Environment, 18*(6), 323–328.

Grilo, C., Molina-Vacas, G., Fernández-Aguilar, X., Rodriguez-Ruiz, J., Ramiro, V., Porto-Peter, F., Ascensão, F., Román, J., & Revilla, E. (2018). Species-specific movement traits and specialization determine the spatial responses of small mammals towards roads. *Landscape and Urban Planning, 169*, 199–207. https://doi.org/10.1016/j.landurbplan.2017.09.014

Grilo, C., Neves, T., Bates, J., le Roux, A., Medrano-Vizcaíno, P., Quaranta, M., Silva, I., Soanes, K., Wang, Y., & Data Collection Consortium. (2025). Global Roadkill Data: A dataset on terrestrial vertebrate mortality caused by collision with vehicles. *Scientific Data, 12*, 505. https://doi.org/10.1038/s41597-024-04207-x

Gubbi, S., Poornesha, H. C., & Madhusudan, M. D. (2012). Impact of vehicular traffic on the use of highway edges by large mammals in a South Indian wildlife reserve. *Current Science, 102*(7), 1047–1051.

Gunson, K. E., Clevenger, A. P., Ford, A., Bissonette, J. A., & Hardy, A. (2009). A comparison of data sets varying in spatial accuracy used to predict the occurrence of wildlife-vehicle collisions. *Environmental Management, 44*(2), 268–277.

Hat, S. S., & Mubeen, H. (2019). Roadkill of animals on the road passing from Kalaburagi to Chincholi, Karnataka, India. *Journal of Threatened Taxa, 11*(7), 13868–13874. https://doi.org/10.11609/jott.4292.11.7.13868-13874

Hernandez, M. (1988). Owl (*Athene noctua*) in Spain. *Journal of Raptor Research, 22*(3), 81–84.

Hill, J. E., DeVault, T. L., & Belant, J. L. (2019). Cause-specific mortality of the world's terrestrial vertebrates. *Global Ecology and Biogeography, 28*(5), 680–689. https://doi.org/10.1111/geb.12881

Hodson, N. L. (1966). A survey of road mortality in mammals (including data for the grass snake and common frog). *Journal of Zoology, 148*(4), 576–579.

Husain, K., & Mehta, P. (2023). Vertebrate road kills on State Highway 26 in Khandwa Forest Division, central India. *Journal of Threatened Taxa, 15*(4), 23016–23028. https://doi.org/10.11609/jott.8128.15.4.23016-23028

Husby, A., & Husby, M. (2014). Interspecific analysis of vehicle avoidance behavior in birds. *Behavioral Ecology, 25*(2), 504–508.

Husby, M. (2016). Factors affecting road mortality in birds. *Ornis Fennica, 93*(3), 212–224.

Islam, M., & Saikia, P. K. (2014). A study on the roadkill herpetofauna of Jeypore Reserve Forest, Assam. *NeBIO, 5*(1), 78–83.

Jeganathan, P., Mudappa, D., Kumar, M. A., & Raman, T. R. S. (2018). Seasonal variation in wildlife roadkills in plantations and tropical rainforest in the Anamalai Hills, Western Ghats, India. *Current Science, 114*(3), 619–626. https://doi.org/10.18520/cs/v114/i03/619-626

Kumar, G. C., & Srinivasulu, C. (2015). Impact of vehicular traffic on Kashmir rock agama *Laudakia tuberculata* near Kalatop-Khajjiar Wildlife Sanctuary, Himachal Pradesh, India. *Reptile Rap, 17*, 44–47.

Kumar, P. S., Princy, J. L., & Kannan, P. (2017). Opportunistic feeding behaviour of an endemic lizard *Salea horsfieldii*. *Zoo's Print, 32*(3), 20–21.

Kumara, H. N., Sharma, A. K., Kumar, A., & Singh, M. (2000). Roadkills of wild fauna in Indira Gandhi Wildlife Sanctuary, Western Ghats, India: Implications for management. *Biosphere Conservation, 3*(1), 41–47.

Li, P., Zhang, H., Lundholm, J., Wang, Y., & Ren, M. (2020). The relative importance of green infrastructure as refuge habitat for pollinators increases with local land-use intensity. *Journal of Applied Ecology, 57*(8), 1494–1503.

Loss, S. R., Will, T., & Marra, P. P. (2014). Estimation of bird-vehicle collision mortality on US roads. *Journal of Wildlife Management, 78*(5), 763–771. https://doi.org/10.1002/jwmg.721

Mazumdar, K., & Gogoi, L. (2010). Rescue/release of blue-capped rock thrush *Monticola cinclorhynchus*. *Zoos' Print Journal, 25*(2), 21–22.

Medrano-Vizcaíno, P., Grilo, C., Pinto, F., Carvalho, W. D., Melinski, R. D., Schultz, E. D., & González-Suárez, M. (2022). Roadkill patterns in Latin American birds and mammals. *Global Ecology and Biogeography, 31*(9), 1756–1783. https://doi.org/10.1111/geb.13557

Muñoz, P. T., Torres, F. P., & Megías, A. G. (2015). Effects of roads on insects: A review. *Biodiversity and Conservation, 24*(3), 659–682. https://doi.org/10.1007/s10531-014-0831-2

Nagar, P., Meena, S. M., & Dube, P. (2013). Mortality data of reptilian fauna due to vehicular traffic in southeastern Rajasthan, India. *Bioscience Biotechnology Research Communications, 6*(2), 196–198.

Ontiveros, Y., Cappa, F. M., Andino, N., Campos, C. M., Borghi, C. E., & Giannoni, S. M. (2022). Mammal and bird diversity in a system of protected areas in Argentina. *Biodiversity, 23*(1–2), 61–71. https://doi.org/10.1080/14888386.2022.2099463

Pawgi, M., Joshi, Y., Deshmukh, S., Purohit, A., Pawgi, K., & Yosef, R. (2024). Monitoring roadkill in Amravati, India: A citizen science project. *European Journal of Ecology, 10*(2), 8–20. https://doi.org/10.17161/eurojecol.v10i2.21597

Pragatheesh, A. (2011). Effect of human feeding on the road mortality of rhesus macaques on

National Highway-7 routed along Pench Tiger Reserve, Madhya Pradesh, India. *Journal of Threatened Taxa, 3*(4), 1656–1662.

Quinn, J. F., & Hastings, A. (1987). Extinction in subdivided habitats. *Conservation Biology, 1*(3), 198–208. https://doi.org/10.1111/j.1523-1739.1987.tb00033.x

Rajvanshi, A., Mathur, V. B., Teleki, G. C., & Mukherjee, S. K. (2001). *Roads, sensitive habitats and wildlife: Environmental guidelines for India and South Asia*. Wildlife Institute of India.

Rao, R. S. P., & Girish, M. K. S. (2007). Road kills assessing insect casualties using flagging methods. *Current Science, 92*(6), 881–887.

Ray, S. D., Quadros, G., Dey, P., Pramod, P., & Singh, R. P. (2023). Wildlife casualties from the road-stretches adjacent to two national parks of Assam, North-East India. *Asian Journal of Conservation Biology, 12*(2), 314–325. https://doi.org/10.53562/ajcb.80636

Samson, A., & Princy, J. L. (2023). An inventory of roadkills of nocturnal mammals in Coonoor Ghat Highway NH 67, the Nilgiris, Western Ghats, India. *Proceedings of the Mordovia State Nature Reserve*.

Samson, A., Ramakrishnan, B., & Leonaprincy, J. (2020). A threat assessment of three-striped palm squirrel *Funambulus palmarum* from roadkills in Sigur Plateau, Mudumalai Tiger Reserve, Tamil Nadu, India. *Journal of Threatened Taxa, 12*(10), 16347–16351. https://doi.org/10.11609/jott.3378.12.10.16347-16351

Samson, A., Ramakrishnan, B., Karthick, S., Santhosh Kumar, P., Ilakkia, M., Chitheena, A., Beulah Bha, J., & Ravi, P. (2018). Diversity and status of avifauna in Doddabetta hills and surrounding areas, Nilgiris Plateau, Western Ghats, India. *Zoo's Print, 33*(3), 23–36.

Samson, A., Ramakrishnan, B., Veeramani, A., Santhosh Kumar, P., Karthick, S., Sivasubramanian, G., Ilakkia, M., Chitheena, A., Princy, L., & Ravi, P. (2016). Effect of vehicular traffic on wild animals in Sigur Plateau, Tamil Nadu, India. *Journal of Threatened Taxa, 8*(9), 9182–9189. https://doi.org/10.11609/jott.1962.8.9.9182-9189

Santhoshkumar, P., & Kannan, P. (2017). Impacts of roads on the mortality of endemic striped narrow-headed snake *Xylophis perroteti* in Nilgiris, Tamil Nadu. *Russian Journal of Herpetology, 24*(2), 87–90. https://doi.org/10.30906/1026-2296-2017-24-2-87-90

Santhoshkumar, P., Kannan, P., Ramakrishnan, B., Veeramani, A., Samson, A., Karthick, S., Princy, J. L., Nisha, B., Dineshkumar, N., Abinesh, A., Vigneshkumar, U., & Girikaran, P. (2016). Road kills of the endemic snake Perrotet's shieldtail *Plectrurus perrotetii* in Nilgiris, Tamil Nadu, India. *Journal of Threatened Taxa, 8*(11), 9375–9376. https://doi.org/10.11609/jott.2494.8.11.9375-9376

Saxena, A., Chatterjee, N., Rajvanshi, A., & Habib, B. (2020). Integrating large mammal behaviour and traffic flow to determine traversability of roads with heterogeneous traffic on a Central Indian highway. *Scientific Reports, 10*, 75810. https://doi.org/10.1038/s41598-020-75810-2

Schwartz, A. L. W., Shilling, F. M., & Perkins, S. E. (2020). The value of monitoring wildlife roadkill. *European Journal of Wildlife Research, 66*(1), 18. https://doi.org/10.1007/s10344-019-1357-4

Secco, H., Ratton, P., Castro, E., Lucas, P. S. D., & Bager, A. (2014). Intentional snake road-kill: A case study using fake snakes on a Brazilian road. *Tropical Conservation Science, 7*(3), 561–571. https://doi.org/10.1177/194008291400700313

Seshadri, K. S., & Ganesh, T. (2011). Faunal mortality on roads due to religious tourism in protected areas: A case study from South India. *Forest Ecology and Management, 262*(9), 1713–1721.

Seshadri, K. S., Yadev, A., & Gururaja, K. V. (2009). Road kills of amphibians in different land use areas from Sharavathi river basin, central Western Ghats, India. *Journal of Threatened Taxa, 1*(11), 549–552. https://doi.org/10.11609/JoTT.o2148.549-52

Siva, T., & Neelanarayanan, P. (2020). Impact of vehicular traffic on birds in Tiruchirappalli District, Tamil Nadu, India. *Journal of Threatened Taxa, 12*(10), 16352–16356. https://doi.org/10.11609/jott.5532.12.10.16352-16356

Smith, M. A. (1943). *The fauna of British India, reptiles and amphibia. Vol. III. Serpentes.* Taylor & Francis.

Sukhontapatipak, C., Saralamba, C., Piyapan, P., Duangta, P., Klubchum, T., & Sawangproh, W. (2025). Global wildlife roadkill research: A bibliometric synthesis of historical trends, thematic gaps, and future directions. *Urban Ecosystems, 28*(1), 130. https://doi.org/10.1007/s11252-025-01747-x

Sullivan, T. L., Williams, A. F., Messmer, T. A., Hellinga, L. A., & Kyrychenko, S. Y. (2004). Effectiveness of temporary warning signs in reducing deer-vehicle collisions during mule deer migrations. *Wildlife Society Bulletin, 32*(3), 907–915. https://doi.org/10.2193/0091-7648(2004)032[0907:EOTWSI]2.0.CO;2

Sundar, G. K. S. (2004). Mortality of herpetofauna, birds and mammals due to vehicular traffic in Etawah District, Uttar Pradesh, India. *Journal of the Bombay Natural History Society, 101*(3), 392–398.

Sur, S., Saikia, P. K., & Saikia, M. K. (2022). Speed thrills but kills: A case study on seasonal variation in roadkill mortality on National Highway 715 (new) in Kaziranga-Karbi Anglong Landscape, Assam, India. *Nature Conservation, 47*, 87–104. https://doi.org/10.3897/natureconservation.47.73036

Sushanth, S., Praphul, G., Kumara, H. N., Ganesh, S. R., & Singh, M. (2025). Impact of linear infrastructure and landscape characteristics on wildlife roadkill in the Nelliyampathy Hills, Western Ghats, India. *Scientific Reports, 15*, 25333. https://doi.org/10.1038/s41598-025-10402-6

Sutherland, R. W., Dunning, P. R., & Baker, W. M. (2010). Amphibian encounter rates on roads with different amounts of traffic and urbanization. *Conservation Biology, 24*(6), 1626–1635. https://doi.org/10.1111/j.1523-1739.2010.01570.x

Vaahan Parivahan Dashboard. (n.d.). Indian Ministry of Road Transport and Highways. https://vahan.parivahan.gov.in/vahan4dashboard/

Vijayakumar, S. P., Vasudevan, K., & Ishwar, N. M. (2001). Herpetofaunal mortality on the roads in the Anamalai Hills, southern Western Ghats. *Hamadryad, 26*(2), 265–272.

Visintin, C., van der Ree, R., & McCarthy, M. A. (2016). A simple framework for a complex problem? Predicting wildlife–vehicle collisions. *Ecology and Evolution, 6*(17), 6409–6421. https://doi.org/10.1002/ece3.2306

Wall, F. (1919). Notes on a collection of snakes made in the Nilgiri Hills and the adjacent Wayanad. *Journal of the Bombay Natural History Society, 26*(3), 552–584.

Sažetak

Putevi predstavljaju značajnu pretnju divljim životinjama, posebno u regionima bogatim biodiverzitetom kao što je Nilgiris (Indija). Ova preliminarna studija dokumentuje obrasce sudara vozila sa divljim životinjama (WVC) u regionu Doddabeta, fokusirajući se na taksonomski diverzitet, sezonske varijacije i ranjivost specifičnu za vrstu.

Zabeleženo je ukupno 81 jedinka iz 19 vrsta kao žrtve saobraćaja tokom 60 nasumično odabranih dana, pri čemu su gmizavci, a posebno endemska vrsta *Salea horsfieldii*, pokazali najveću učestalost.

Podaci ukazuju na jaku korelaciju između događaja stradanja na putevima i sezonskih obrazaca aktivnosti, naročito tokom perioda razmnožavanja. Faktori koji doprinose tome uključuju velike brzine vozila, smeće pored puta koje privlači vrste plena i nedovoljnu svest vozača. Studija naglašava hitnu potrebu za merama ublažavanja kao što su prelazi za divlje životinje, dinamička signalizacija i procene uticaja postojećih i predloženih puteva. Budući da su nalazi zasnovani na ograničenim, nasumično tempiranim istraživanjima, preporučujemo buduća istraživanja sa sistematskim sezonskim praćenjem tokom dana i noći, kako bi se bolje razumele šire ekološke implikacije. Ova studija pruža osnovne podatke za razvoj strategija očuvanja u zonama visokog rizika poput Doddabeta.

Ključne riječi: endemska vrsta, herpetofauna, *s*ezona razmnožavanja, sezonski obrazac, stradanje na putu, stanište Šola

Figure 7. Some of the WVC images during the survey / **Slika 7**. Fotografije posljedica nekih sudara sa divljim životinjama tokom istraživanja