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Human-Wildlife Conflict on Roads: Factors Contributing to Animal Deaths and Possible Mitigation Measures

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Abstract

In the developing country India Road networks and transportaton have expanded rapidly in recent decades, increasing interactions between humans and wildlife. Human beings are totally depends on natural resources for their survival value and degradation of wildlife habitat resulted in conflict. One major consequence is road kill the accidental killing of animals due to vehicle collisions. This study explores the factors contributing to wildlife mortality on roads, including habitat fragmentation, traffic density, animal behavior, and seasonal movement. It also examines and evaluate ecological impacts and proposes scientifically supported mitigation measures such as wildlife crossings, fencing, signage, and community awareness. The research highlights the urgent need for integrated conservation strategies to reduce animal deaths and maintain ecological balance for sustainable development.

Keywords: Human–wildlife conflict; Roadkill; Wildlife–vehicle collision; Habitat fragmentation; Road ecology; Mitigation measures; Biodiversity conservation; Sustainable development

Introduction

Road transportation is essential for human development, yet it has serious ecological consequences. India has a road network of over 600,000 km, making it the second largest in the world. There are also around three million registered vehicles in India. In 2021, the number of traffic accidents increased by an average of 12.6% compared to the previous year, 2020 (MoRTH 2022). Among these, wildlife mortality due to vehicle collisions (commonly called roadkill) is a growing conservation concern. Roads fragment habitats, disrupt animal movement, and expose wildlife to the risk of fatal accidents. In zoology, understanding the interaction between animal behavior and road ecology is crucial for designing effective mitigation strategies. This paper investigates key factors causing roadkill and suggests practical solutions.

Factors Contributing to Animal Deaths on Roads

1. Habitat Fragmentation

Human civilization and road construction divides continuous ecosystems into isolated patches, limiting access to food, water, and mates. Animals often cross roads to meet basic biological needs, during the time chance of collisions. The death of animals while crossing roads for breeding and other purposes is a major global conservation problem, a phenomenon widely referred to as roadkill or wildlife-vehicle collisions (WVCs). Roads act as "death traps" that fragment natural habitats and disrupt essential animal movements, leading to significant mortality and the potential isolation of populations.

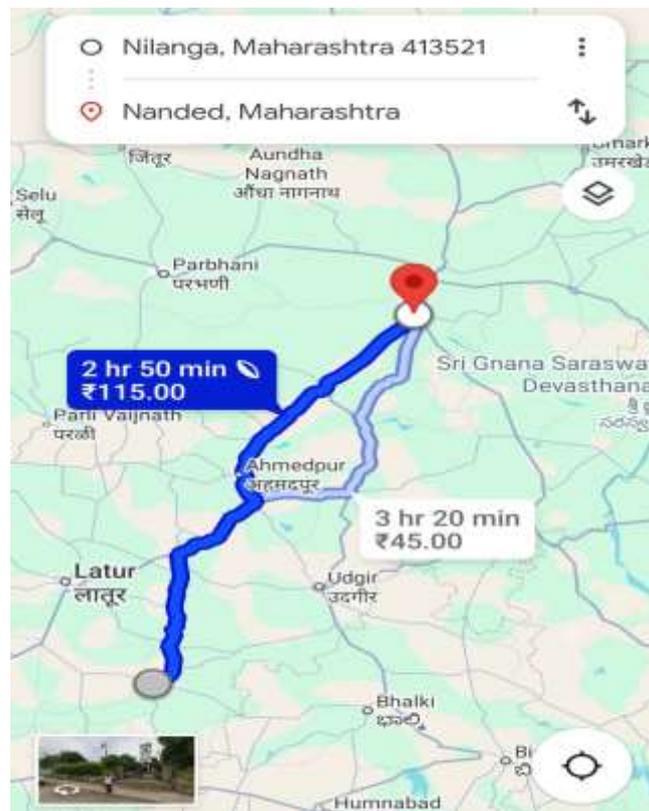
2. Traffic Density and Vehicle Speed

Due to heavy transportation and High-speed vehicles reduce reaction time for both animals and drivers. Both traffic density (volume) and vehicle speed significantly responsible to animal deaths on roads, but their relationship to the number of roadkills is complex and often non-linear. The risk depends on animal behavior biological need and road environment. This expectation is based on the observation that paved roads facilitate higher vehicle speeds and greater traffic volumes, both of which are positively associated with increased wildlife mortality (Gunson et al. 2011; Rendall et al. 2021). Busy highways with transportation witness a higher rate of wildlife mortality compared to rural roads. Deceased Coucal bird due to vehicle collision.





Generally from Nilanga Nanded highway 161 circumference highway In the range of 100 km per day more than 2 to 3 dogs and birds and other wildlife are victim of road accident.



3. Animal Behavior and Ecology

Animal behavior and ecological factors are major cause to road accident through latur Nanded highway. various factors, including animals crossing roads to access resources like water, food, or mates, and nocturnal or crepuscular animals being more vulnerable at dawn and dusk. Road infrastructure can fragment habitats, pushing animals into dangerous zones, while their own behavior, such as being startled by headlights or becoming disoriented, increases their risk of collision. Nocturnal animals (e.g., civets, rodents) are frequently hit due to low visibility during crossing road.

Migratory species cross roads seasonally.

Slow-moving animals (e.g., turtles, snakes) are at greater risk of collision and become mortal.

Understanding species-specific behavior is essential in zoological research.

4. Availability of Food Near Roads

Roadside waste or vegetation can attract animals, increasing their presence on highways eg. Dogs, crow, squirrel monkeys, deer, fox wolf wildcat and other species.

5. Seasonal and Climatic Factors

Natural seasons and climatic factors play vital role in the movements of animals .Breeding seasons, monsoons, and temperature enhance the animal movements. For example, amphibians migrate to breeding grounds during rains, making them highly vulnerable.

Ecological Impacts of Road kill

- Road kill affects ecosystems in multiple ways:
- Decline in wildlife populations, especially for threatened species.
- Disruption and imbalance of food chains, affecting predators and scavengers lifestyle mode.
- It effects on genetic isolation because fragmented populations disable interbreed and species production.
- There is loss of biodiversity in sensitive habitats and collapse the ecosystem.
- From a zoological perspective, these impacts can lead to long-term ecological imbalance.

Mitigation Measures

1. Construction of Crossings Eco-bridges and Underpasses

For the safely cross to complete their biological needs Constructed bridges or tunnels must be suitable to animals . These structures are highly important in reducing roadkill.

2. Roadside Fencing and other measures.

Fences can guide for safe movement of animals and prevent them from entering high-speed traffic zones.

3. Warning Signboards

Placing animal-crossing signs and boards in high-risk areas to alerts drivers and encourages slower speeds and prevent collision of animals .

4. Vehicle Speed Regulation

At the wildlife-prone zones Speed breakers or reduced speed limits in order to decrease collision chances an avoid wildlife death.

5. Habitat Restoration

Habitat restoration is one of the best way to avoid road kill of animals Maintaining natural Resources ,vegetation and creating buffer zones reduces the need for animals to cross roads.

6. Awareness and Education

- Local communities, tourists, and drivers should be educated and awared about the importance of wildlife safety and their role in ecosystem.
- **Early Warning and Detection Systems:** Use of motion-sensor cameras and GPS tracking system can monitor animal movements and trigger flashing lights or sound systems to alert both drivers and animals.
- **Effective Signage:** Clear, reflective warning signs depicting representative animals can alert drivers to high-risk crossing areas, especially when combined with speed limits.
- **Speed Control Rules:** Enforcing and inculcate speed limits in wildlife hotspots is crucial for driver and animal safety.
- **Scientific Land Use Planning:** Integrating conflict mitigation into development planning and performing thorough environmental impact assessments (EIAs) before new road construction helps avoid fragmenting critical habitats
- If a collision is unavoidable, apply the brakes firmly and remain in your lane. Swerving to avoid an animal can often cause a more serious crash or result in drivers losing control of vehicles.
- **Cautious Transportation at dawn and dusk.** The favorable time for most animals, especially deer, tend to be more active early in the morning and at dusk.
- **Scan the road and shoulders ahead of you:** Looking ahead helps provide enough reaction time if an animal is spotted. Also, remember some animals move in groups, so when there is one, there are usually more in the area.

Conclusion

Human–wildlife conflict on roads is a significant conservation issue. Understanding the zoological and biodiversity conservation aspects of animal movement and behavior is essential to reduce road kill incidents. For the safe movement and survival of wildlife effective mitigation requires collaboration between wildlife biologists, engineers, policymakers, and local communities. By implementing and constructing eco-friendly road line designs and enhancing awareness, it is possible to protect wildlife populations while supporting human sustainable development.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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