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Vehicular impact on *Varanus bengalensis* (Daudin, 1803) around the roads of Girnar Eco-Sensitive Zones

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Abstract- *Varanus bengalensis* a monitor lizard found all over India. The study focused on the threats faced by this species due to vehicle traffic. The study was conducted in Girnar Eco-sensitive zones and utilized two survey methods: Visual Encounter Survey (VES) to study habitat utilization and Nocturnal Road Cruising to collect road kill data for a year (Oct-21 to Sept-22). The study reveals that crossing road pose a significant risk to the species, with 18 individuals found dead on the road. Furthermore, 31 individuals were seen basking or wandering near the roadside, emphasizing the importance of preserving such habitats for their survival. The findings of this study suggests that further conservation efforts are necessary to protect this species from road mortality. This study emphasizes the importance of protecting this species and its habitats to ensure its long-term survival.

Key words: *Varanus bengalensis*, Eco-sensitive zones, Girnar wildlife sanctuary, Road kill.

INTRODUCTION

The Bengal monitor lizard, *Varanus bengalensis*, has exhibited remarkable ecological resilience by thriving in various habitats. The species has adapted well to anthropogenically modified environments and demonstrated adaptability in different natural landscapes. Its ability to persist and reproduce in diverse ecosystems, such as dense forests, sparsely wooded regions, open grasslands, and thorny scrublands, is particularly noteworthy. This diversity in *V. bengalensis* characteristics reflects the species adaptations to the varying environmental conditions, such as differences in temperature, precipitation, vegetation, and prey availability, which exist across its range.¹⁻³ The species is well adapted to live in various terrestrial habitats,^{2,4} and thrives in anthropogenic situations such as home gardens and homesteads, even

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occupying households and densely populated urban environments.⁵ *V. bengalensis* is a culturally and ecologically important top predator. It requires conservation efforts against habitat destruction, fragmentation, and roadkill mortality.

Roads are a significant threat to wildlife populations due to vehicle collisions, with approximately 25 million kilometers of new roads projected to be constructed by 2050, 90% of which will be in developing countries.^{6,7} Roads can also harm wildlife through oil leaks and noise-related stress,⁸ but the most severe impact is animal injury and mortality from vehicle collisions,⁹ which can be influenced by driver fatigue.¹⁰ Animal-vehicle collisions are linked to traffic flow, barriers, and speed,¹¹ causing alterations in the distribution of age, sex, and fecundity in animal populations.¹² The impact of the collision can cause serious injury or death to the animal, and can result in significant ecological consequences.¹¹ However, any animal that crosses the road can become a victim of a collision

with a vehicle. Herpetofauna were found to be the most affected group.¹³

Reptiles, particularly monitor lizards, are no exception to this threat. In recent years, there have been growing concerns about the impact of vehicular traffic on the population of *Varanus bengalensis*, particularly in areas where their habitats intersect with roads and highways. In this study, we investigate the occurrence and extent of road kill incidents involving the *Varanus bengalensis* species in the Eco-sensitive zones of Girnar Wildlife Sanctuary. We examine the response of monitor lizards to vehicular disturbance, their behaviour in seeking shelter, and the effectiveness of existing protective measures. This research aims to provide valuable insights into the impact of road traffic on the population of *V. bengalensis* and to suggest ways to minimize the damage to these ecologically significant creatures.

METHODS

Study area

The peripheral region encompassing the roads that surround the Girnar Eco-sensitive Zone, located in Junagadh, is estimated to cover an area of approximately 9,317.58 hectares. (Fig. 1) This region spans across 27 villages that fall under the jurisdiction of the Junagadh and Bhesan Talukas. The Eco-sensitive Zone itself has a radius of 0 to 5 kilometres, which is an area designed to preserve and protect the unique flora and fauna within it. The area is designated as an Eco-sensitive Zone due to its ecological significance and importance in maintaining the environmental balance of the surrounding regions. The protective measures within the zone help to conserve the natural resources and biodiversity of the area, ensuring their long-term sustainability.

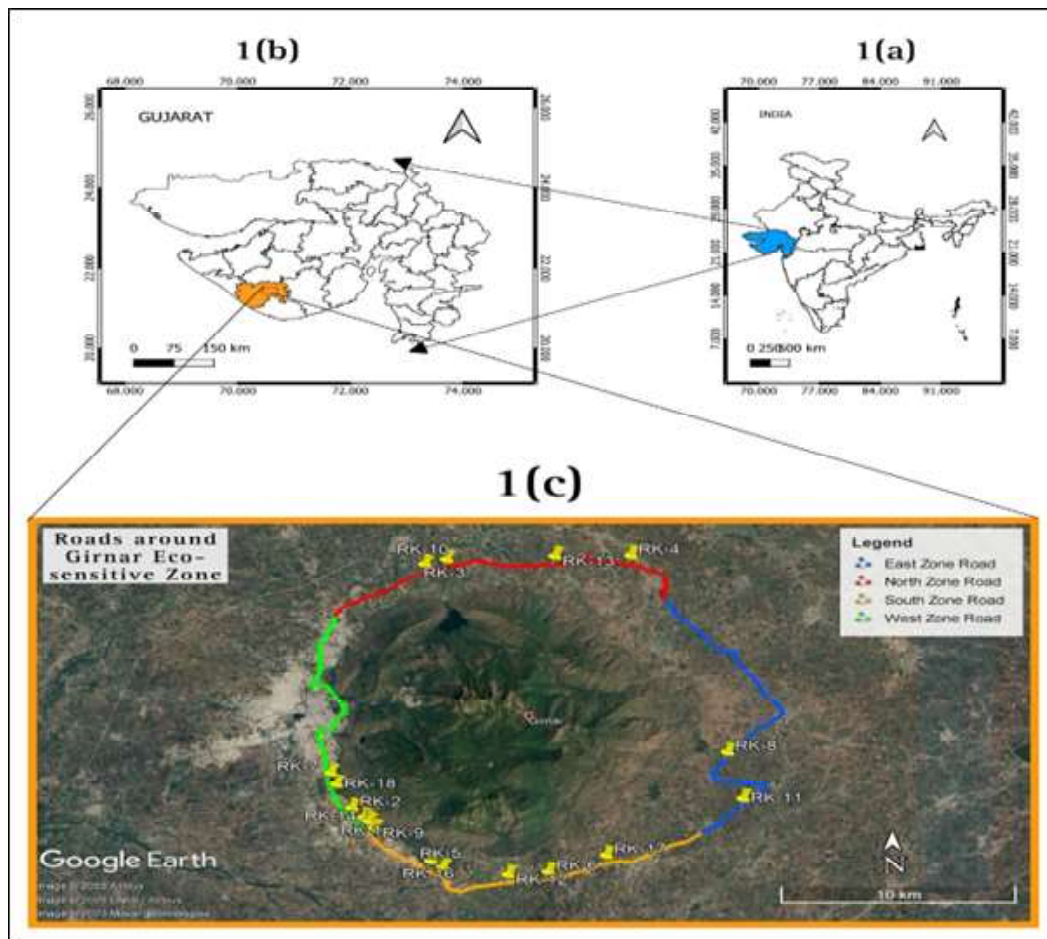


Fig. 1, 1(a): Map of India; 1(b): Map of Gujarat; 1(c): Road around Girnar Eco-sensitive zone divided into four different zones denoted by different colours, (North zone road – Red; East zone road – Blue; South zone road – Orange; West zone road – Green). RK denotes geo-location of road kill specimen found during the study period. (Image Source: Google Earth)

Data collection

During the period of October 2021 to September 2022, we conducted a comprehensive study to collect data on the occurrence and distribution of *V. bengalensis* around the roads in the Eco-sensitive zones of Girnar Wildlife Sanctuary. For the road kill survey, a Nocturnal Road cruising approach was employed to gather data. In addition, the Visual Encounter Survey (VES) method,¹⁴ was utilized to perform a field survey of the lizard populations in the study area. We also surveyed an area of 5-10 meters around the roads to detect any basking lizards. The use of both data collection methods increases the accuracy and reliability of the obtained results in our study.

A field study was undertaken from October 2021 to September 2022, to investigate roadkill incidents on a designated road segment. A total of 48 systematic road trips were conducted during the study period. Data collection was conducted at specific times, with 07:00 h to 10:00 h during winter and 06:00 h to 09:00 h in summer being the

standard times, selected based on visibility. The motor vehicle travelled at a constant speed of 20-40 kmph. All carcasses or individuals encountered were identified to the species level, and the geographic coordinates of road-killed specimens were recorded using Google Maps to enable accurate geo-referencing.

RESULT & DISCUSSION

The current study unveils the *V. bengalensis* is highly vulnerable to road kill incidents during the summer (March to June), with eight recorded cases, followed by the monsoon (July to October), which saw seven incidents. This pattern can be attributed to the species higher levels of foraging activity during these periods. However, the impact is most pronounced in the west and south zones road, where high vehicle transportation and the presence of the main highway from Junagadh to Bilkha have resulted in elevated road kill rates of 34% and 33%, respectively (Fig. 2). Although some of incidents may have missed out due to eaten by other animals or collected by humans.

Table 1. Number of individuals that were found dead on the roads throughout the study period and its geo-location. Each specimen is denoted by “RK = Road Kill”

Road kill data of <i>Varanus bengalensis</i>				
Month	No. of Kills	Specimen no.	Latitude	Longitude
Oct-21	1	RK-1	21°27'35.85"N	70°28'50.89"E
Nov-21	1	RK-2	21°27'53.87"N	70°28'33.50"E
Dec-21	0	-	-	-
Jan-22	1	RK-3	21°35'55.62"N	70°30'54.04"E
Feb-22	1	RK-4	21°36'2.70"N	70°35'27.69"E
Mar-22	1	RK-5	21°25'58.82"N	70°30'48.31"E
Apr-22	2	RK-6	21°25'50.42"N	70°33'25.33"E
		RK-7	21°29'1.82"N	70°28'1.89"E
May-22	2	RK-8	21°29'42.27"N	70°37'51.21"E
		RK-9	21°27'14.27"N	70°29'7.63"E
Jun-22	3	RK-10	21°35'46.48"N	70°30'21.90"E
		RK-11	21°28'12.01"N	70°38'14.41"E
		RK-12	21°25'45.02"N	70°32'25.50"E
Jul-22	2	RK-13	21°36'1.84"N	70°33'35.16"E
		RK-14	21°27'27.17"N	70°28'58.75"E
Aug-22	2	RK-15	21°27'29.92"N	70°28'56.40"E
		RK-16	21°26'11.76"N	70°30'30.38"E
Sep-22	2	RK-17	21°26'22.86"N	70°34'51.40"E
		RK-18	21°28'39.18"N	70°28'10.51"E
Total = 18				

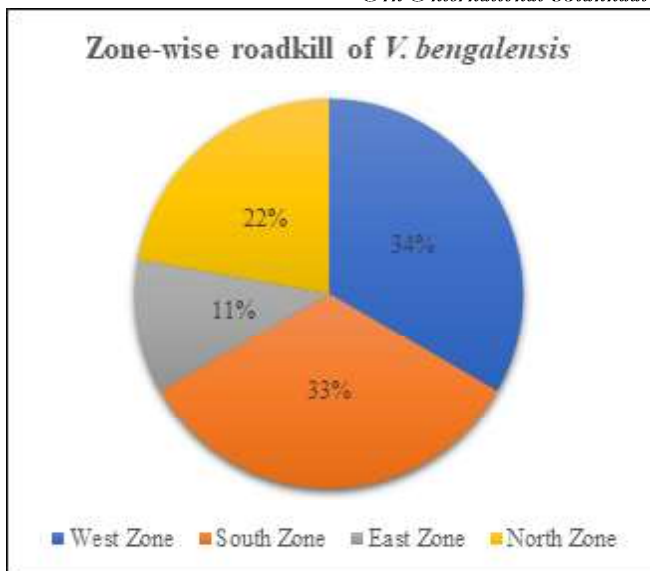


Fig. 2. Zone-wise roadkill of *Varanus bengalensis* around the Girnar Eco-sensitive Zone

According to the findings of the survey conducted in the study area, a total of 49 Bengal monitor lizards were recorded. Out of these, a concerning number of 18 individuals (Table 1) were found dead on the road, indicating the devastating impact of vehicular traffic on the species. On the other hand, 31 individuals were observed basking or roaming near the roadside, suggesting their tendency to utilize this area for foraging, thermoregulation, or other activities. (Fig. 3, 4)

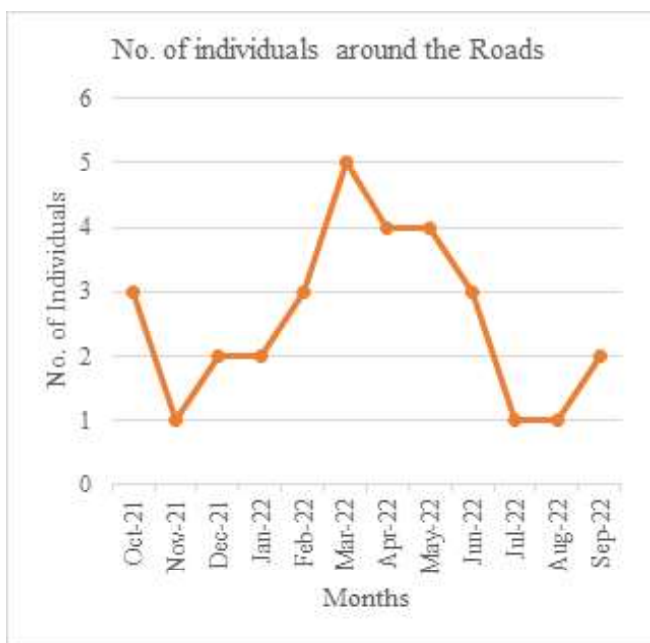


Fig.3. Individuals that are observed basking and roaming near the roadsides



Fig. 4. Road-killed *V. bengalensis* sighted during the study period.

The loss of a *Varanus bengalensis* due to roadkill is a blunt reminder of human impact on wildlife. These lizards maintain ecological balance by controlling populations of smaller animals. Even a single loss can have far-reaching consequences for the local environment, emphasizing the need for action to reduce negative human impact. To mitigate roadkill, measures like creating wildlife crossings and reducing speed limits are necessary. Promoting awareness and encouraging conservation actions is crucial for harmonious coexistence with nature. Citizen science databases have potential benefits for improving roadkill data.¹⁵

These findings highlight the need for urgent conservation measures to mitigate the impact of human activities, particularly road infrastructure development and vehicular traffic, on the Bengal monitor lizard population. Such measures may include creating wildlife crossings or underpasses, reducing speed limits in areas known to be frequented by the species.

CONCLUSION

Based on the present study, vehicular impact on *V. bengalensis* involves direct effects such as injury or mortality, as well as indirect effects such as habitat loss, fragmentation and alteration. Such changes may influence the behavior, survival, growth and reproductive success of individual animals. The findings of these research highlight the importance of taking action to protect the Bengal monitor lizard from the threat of habitat loss and road mortality. We need to develop and implement strategies to manage human-wildlife conflict and mitigate the impact of urbanization on these animals. This study can serve as a basis for further research and conservation efforts to safeguard the Bengal monitor lizard and other species facing similar threats.

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