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Caption: *Cyrtodactylus myntkyawthurai*, endemic to Myanmar. Medium: Water colours on watercolor sheet. © Aakanksha Komanduri



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SHORT COMMUNICATION

Wildlife at the crossroads: wild animal road kills due to vehicular collision on a mountainous highway in northwestern Himalayan region

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Abstract: Wildlife mortality due to vehicular collision is well known across the world and the number of such incidences is steadily rising in Himalaya as well. To assess the quantum of wildlife road kills, we conducted an intensive survey spanning 33 months along a mountainous National Highway 244 in the Union Territory of Jammu & Kashmir. Forty-nine wild animal carcasses of 13 species of higher vertebrates were observed lying on the road, shoulders, edges, and valley slopes. These included seven mammals, four birds, and two reptiles. This survey, first of its kind in this part of the Himalaya would be helpful in understanding the underlying reasons of the rising wildlife fatalities on the hill roads, identifying susceptible hotspots, and developing measures to address this new threat to Himalayan wildlife. We recommend creating wildlife passages, raising speed halts, and placing warning signages in vulnerable sections to reduce the road-related wildlife mortality in such mountainous highways.

Keywords: Carcasses, dumping sites, mammals, mortality, National Highway, non-protected areas, road kills, speed halts, wildlife fatalities, wildlife passages.

Roads are the leading cause of anthropogenic mortality after legal harvesting for many vertebrates world over (Hill et al. 2019). The effect of roads on wildlife is multidimensional, from habitat loss and fragmentation (Burnett 1992; Richardson et al. 1997; Carr & Fahring 2001), altering movement and distribution patterns (Newmark et al. 1996; Desai & Baskaran 1998), affecting breeding (Reijnen et al. 1995), and causing injury

and mortality by vehicular collisions (Das et al. 2007; Seshadri et al. 2009; Baskaran & Boominathan 2010; Hill et al. 2019; Schwartz et al. 2020). This barrier effect and wildlife-vehicular collisions are predicted to worsen as road network and traffic intensity rise internationally. The incidents of mammal-vehicle collisions have increased dramatically since the early 1970s (Hill et al. 2019).

India has the world's second largest road network, with a total road length of 6.2 million km (Ministry of Road Transport and Highways 2021). A country with such a massive road system puts animals that scurry or move across the highways in grave danger. The Union Territory (UT) of Jammu & Kashmir has seen a massive rise in national highway expansion, up about 194 percent from 823 km in 2003, to 2,433 km now, accounting for 1.8 percent of India's entire national highway network (Ministry of Road Transport and Highways 2021).

Indian Himalayan region with a wide range of habitats support unique arrays of biodiversity and ecosystem services both within and outside of the protected areas. The non-protected areas (Non-PAs) in the Indian Himalaya house a good number of wildlife species (Thapa et al. 2021) which are ecological generalists and

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possess good amount of behavioural plasticity (Buchi & Vuilleumier 2014; Gaynor et al. 2018). These non-PAs lack scientific monitoring and management strategies to conserve wildlife species which increases the risk of them coming in close proximity to human-dominated areas and thus becoming vulnerable to several fatalities including vehicular collisions. Apart from a few short-term studies on wildlife road kills (Gokula 1997; Sunder 2004; Das et al. 2007; Seshadri et al. 2009; Baskaran & Boominathan 2010; Bhupathy et al. 2011; Kumar & Srinivasulu 2015; Samson et al. 2016; Santhoshkumar et al. 2017; Hatti & Mubeen 2019), no major study has been conducted in India or in the western Himalaya, emphasizing the fact that very little attention is being paid to the impacts of roads and highways on wildlife. In order to assess the quantum of road kills in the region, we monitored wildlife road kills on National Highway 244 (NH-244), which connects Batote (Jammu) to Kashmir Valley, in the UT of Jammu & Kashmir. The highway creates a dangerous terrain for wildlife that live besides it, as evident by the number of road kill reports that have piled up over the years.

MATERIAL AND METHODS

To understand the frequency of road kills, their likely causes and the wild animal species exposed to the accidents, we carried out surveys on NH-244, connecting Batote (Jammu) to Kashmir Valley. Upgraded to a national highway in 2016, the road is currently undergoing upgrades, including widening of the lanes and construction of extensive tunnels. The highway, which is built into the mountainside, criss-crosses multiple perennial streams and runs the substantial length of the Chenab gorge. Located between 823 and 1,638 m, the corridor is characterized with a broad range of habitats, including sub-temperate broad-leaved mixed forests interspersed with pure conifer patches, dry open scrub, rocky slopes, villages and urban areas, supporting a rich biodiversity. Our study was limited to 120 km stretch on NH-244, from Batote, a sub-urban township to Kishtwar town (Figure 1). The highway was surveyed by car twice a month for a period of two years and nine months, from January 2018 to December 2019 and from December 2020 to August 2021. No surveys could be conducted during 2020 due to COVID-19 restrictions. The road kills sighted during the whole effort were identified up to the

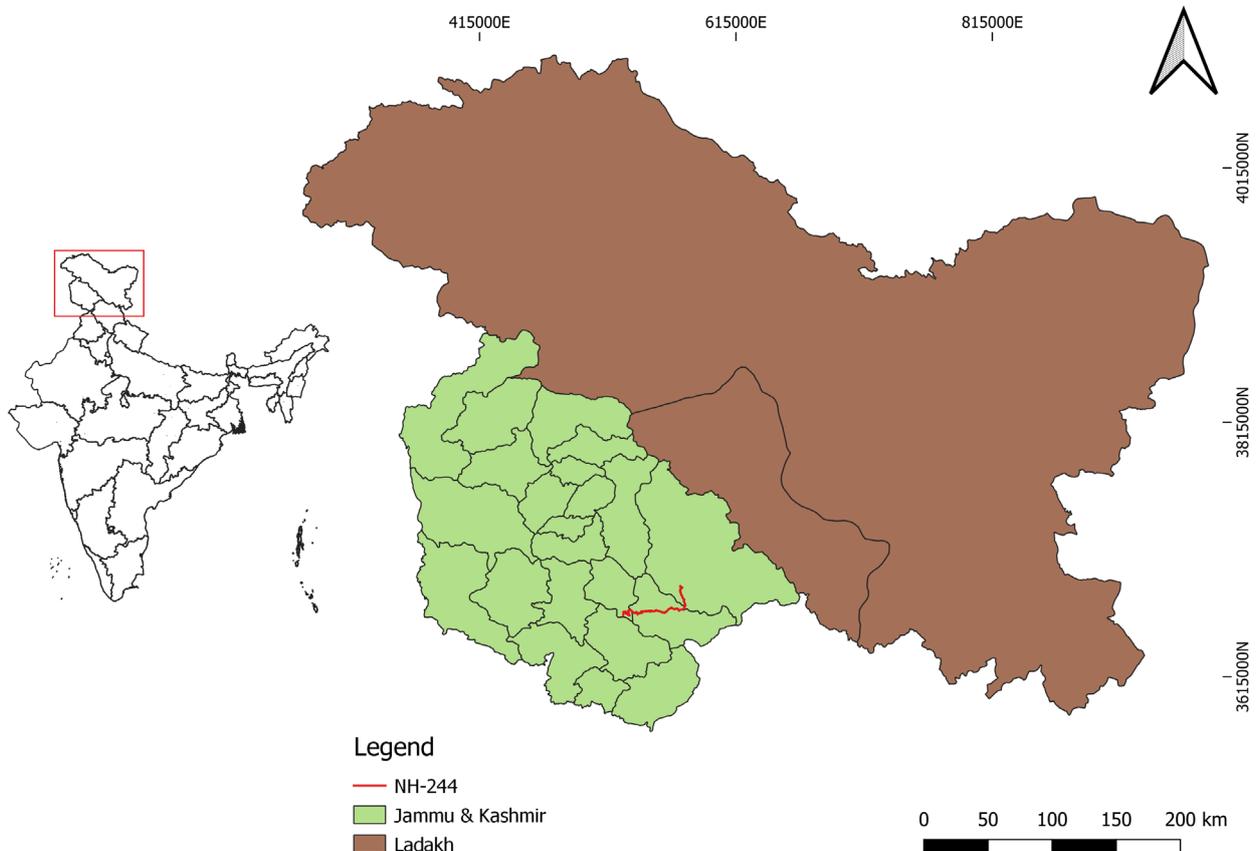


Figure 1. Location of NH-244 in the UT of Jammu & Kashmir, India.

species level (except for reptiles). The spatial attributes of the accident site were recorded and the carcasses were removed from the road to avoid repetitive counts. No specimens were collected during the survey.

RESULTS AND DISCUSSION

During the surveys, we recorded 49 road kills involving 13 species of higher vertebrates (Table 1; Image 1a-g), including seven species of mammals, four species of birds, and two species of reptiles. Golden Jackal *Canis aureus*, Rhesus Macaque *Macaca mulatta*, and Red Fox *Vulpes vulpes* suffered the most fatalities among the mammals (Table 1). Two carcasses each of globally threatened Common Leopard *Panthera pardus* and Himalayan Vulture *Gyps himalayensis* were also observed during the surveys. The data analysis revealed an encounter rate of 0.40 road kills/km and most of the road kill aggregations were found near Batote, a vital junction intersecting the Jammu-Srinagar National Highway (NH-44). The location of carcasses found during the surveys is shown in Figure 2.

The animal carcasses so observed indicated that

these species were struck or overrun by speeding vehicles especially during night as most of victims were nocturnal. During the night, animals can be seen roaming around the marketplaces and rubbish dumps in search of food. Predators also make their way down the mountainside in search of water and food sources. As a result, these animals are subjected to rash and reckless driving and end up in road mishaps. Our study found that mammals are affected more than other taxa, mostly including nocturnal animals. In many instances, the authors observed that species like Red Fox and Golden Jackal get traumatized in front of the high beam lights of vehicles and get transfixated on the road and ultimately fall victim to speeding vehicles. Another vulnerable group is the scavengers that are drawn to the roadside dead animal carcasses and eventually get killed. Although the numbers of these taxa seem to be very small, such loss is insufferable considering their slow life histories and low population densities (Baskaran & Boominathan 2010). The secondary information obtained as a result of casual conversation with regularly plying drivers substantiates an increase in wild animal sightings, notably vultures,



Figure 2. Image showing the location of road kills observed on NH 244.

Table 1. Road kills recorded on NH-244 during the sampling period.

Species	Common name	IUCN status	Number	Habitat type	Altitude (in m)
Mammals					
1. <i>Panthera pardus</i>	Common Leopard	VU	2	PF, BD	1000–1415
2. <i>Vulpes vulpes</i>	Red Fox	LC	3	PF, BD, OS	1224–1580
3. <i>Canis aureus</i>	Golden Jackal	LC	12	PF, BD, OS, UR	990–1332
4. <i>Paguma larvata</i>	Himalayan Palm Civet	LC	2	PF, BD	890–940
5. <i>Viverricula indica</i>	Small Indian Civet	LC	2	OF, UR	934–1244
6. <i>Macaca mulatta</i>	Rhesus Macaque	LC	7	PF, BD, OS, UR	910–1310
7. <i>Eoglaucomys fimbriatus</i>	Kashmir Flying Squirrel	LC	2	PF	1100–1246
Birds					
8. <i>Gyps himalayensis</i>	Himalayan Vulture	NT	2	PF	1250
9. <i>Milvus migrans</i>	Black Kite	LC	3	OS, UR	1140–1402
10. <i>Pycnonotus cafer</i>	Red-vented Bulbul	LC	2	OS	1016–1456
11. <i>Acredotheres tristis</i>	Common Myna	LC	3	OS, UR	944–1113
Reptiles					
12. Snake sp.	-	-	2	UR	943–1105
13. Calotes sp.	-	-	7	OS, UR	946–1510

VU—Vulnerable | NT—Near Threatened | LC—Least Concern | PF—Pine forests | OS—Open Scrub | BD—Broadleaved mixed | UR—Urban areas.

kites, civets, jackals and common leopards in recent years.

The wildlife in the Himalaya is subjected to many threats including the one under discussion that needs to be seriously addressed and appropriately dealt with. Assessment of wildlife vehicular mortality is important to understand road impacts, effects on local population of wildlife, to decipher the accident-prone hotspots, and identify the factors underlying the animal road fatalities (Carvalho & Mira 2010; Taylor & Goldingay 2010). Our survey may not have reported all the road kills as many of the carcasses remain hidden beneath structures or foliage, or are removed by other motorists, authorities, or scavenger animals before being discovered (Dickerson 1939; Vestjens 1973; Coulson 1982; Taylor & Goldingay 2003), like an incident of setting afire a leopard carcass near Batote. The study revealed a major road kill cluster around Batote township, which may be because of the presence of open waste dumping site located by the side of the road as well as a water channel fulfilling feeding and water demands of wild animals. Given the current grim situation and foreseeing the highway expansion that would exacerbate already existing threats, necessitates call for scientifically-based mitigation measures. These include construction of wildlife passages at vulnerable sections especially the below-road crossing structures like culverts for larger species and drainage pipes for small size species (Chen et al. 2021), maintaining a wide field of view for drivers and wildlife, widening shoulders

to facilitate wait and go calls, planting caution boards and laying speed breakers near water bodies and dumping sites, sensitizing the drivers and organising citizens to build a reliable dataset for better analysis.

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Image 1a. Common Leopard © Muzaffar A Kichloo



Image 1b. Golden Jackal © Asha Sohil



Image 1c. Red Fox © Muzaffar A Kichloo



Image 1d. Himalayan Palm Civet © Neeraj Sharma



Image 1e. Rhesus Macaque © Asha Sohil



Image 1f. Black Kite © Muzaffar A Kichloo



Image 1g. Snake sp. © Muzaffar A Kichloo

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