

## Wildlife Roadkill Patterns on a Major Highway in Kashmir Himalaya

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### ABSTRACT

In the face of increasing road networks in the Western Himalayas, road-kills of wildlife are increasing. In order to generate a baseline data, we carried a preliminary study from March to August, 2019 on 45 km stretch of the Srinagar–Leh National Highway NH-1 in northern India which connects the newly formed union territories of Jammu & Kashmir and Ladakh. The highway traverses through Sindh Valley and passing adjacent to Thajwas-Baltal Wildlife Sanctuary was surveyed to describe the patterns of roadkill. The survey of six months recorded roadkill of 64 individuals (0.14 roadkill km<sup>-1</sup>) comprising 19 species from different vertebrate groups, of which two species, domestic cat (*Felis catus*) and domestic dog (*Canis familiaris*), were domesticated species. Mammals constituted 37.5% (0.055 roadkill km<sup>-1</sup>), followed by birds 24% (0.034 roadkill km<sup>-1</sup>), reptiles 21% (0.032 roadkill km<sup>-1</sup>) and amphibians 17% (0.025 roadkill km<sup>-1</sup>). Excluding amphibians and reptiles, there were significantly more roadkill on road sections adjacent to the protected areas (59%) than in sections adjacent to non-protected areas. The study besides being a baseline for future studies revealed that the roads act as potential threat to wildlife.

**Key words:** Roadkill, Kashmir Himalaya, Thajwas-Baltal Wildlife Sanctuary, Sindh

### INTRODUCTION

Roads, besides having economic benefits, have a direct impact on wildlife and their negative effect have been rarely considered over a period of time (Gwilliam et al. 2008, van der Hoeven et al. 2009, Holdo et al. 2011, Williams et al. 2019). To devise effective strategies and their implementation, only a handful attempts have been garnered to find amiable solutions for this emerging threat (Caro et al. 2014). Roads have two impacts on wildlife: firstly, they may create unstable meta-populations by fragmenting habitat patches and thereby can hinder animal movement (Vos and Chardon 1998), and secondly, mortality of animals can occur as a result of collisions with the vehicles plying on them (Gunson et al. 2012, Kambourova-Ivanova et al. 2012).

Roadkill being heterogeneous, the damage occurs on the road stretches with dense vegetative cover, reducing the driver's visibility and the areas inhabited by wildlife which are in close proximity with roads

(Caro et al. 2000, Ansara 2004, Eloff and van Niekerk 2005). Recent studies reveal that the frequency of roadkill increases with higher traffic speed, and higher traffic volume acts as an obstruction for wildlife movement (Drews 2008, Smith-Patten and Patten 2008, Collinson 2013). Although traffic volume being less at night, the impact on nocturnal and crepuscular species is higher than diurnal species, as a result of low driver visibility (Braunstein 1998). The increased mortality due to roadkill has greatly impacted distribution pattern, movement, breeding, density and behavioral alterations in many species near roads and the areas with higher road densities (Reijnen et al. 1995, Santos et al. 2011). Although roadkill is thought to pose serious threats to many species (Ramesh et al. 2016), it is apparent that the stress accompanied with road-related disturbance and behavioral changes can therefore affect overall survivability for some species.

North America, Australia, Europe, and Africa have carried out tremendous work and have paid a huge

attention to assess the impacts of roads on wildlife (Rytwinski et al. 2016, Périquet et al. 2018), however, limited studies have been carried out in Asia (Baskaran and Boominathan 2010). A detailed scientific study is therefore, imperative to understand and mitigate the emerging threat of wildlife vehicle collisions and its possible effects on wildlife. As there is a need to balance conservation with development, our study was therefore aimed to target the roadkill incidences in the Sindh Valley of Kashmir Himalayan region to develop a reference data regarding the roadkill pattern and a baseline for further study and necessary mitigation. The area is critical for wildlife conservation partly as it is designated as an eco-sensitive zone which lies in the Zaskar mountain range of Himalayan Bio-geographical zone, and thus this work was carried out to determine the extent of wildlife mortalities through vehicle collisions on this Himalayan highway.

## STUDY AREA

The study was conducted on a 45 km stretch of the Srinagar-Leh National Highway-1, located in Singh Valley, district Ganderbal of Kashmir Himalayan region (Fig. 1). The road passes through areas comprising of crop and livestock farming, human

settlements and highly rich biodiversity areas of Sindh in the Zaskar Range. A portion of the highway also passes in close proximity with the Thajwas-Baltal Wildlife Sanctuary (WLS). The sanctuary harbors the wild population of globally concerned species including snow leopard (*Panthera uncia*), Himalayan brown bear (*Ursus arctos*), Asiatic ibex (*Capra sibirica*), Himalayan serow (*Capricornis sumatraensis*), Kashmir musk deer (*Moschus cupreus*), Himalayan red fox (*Vulpes vulpes*) and common leopard (*Panthera pardus*).

The Sindh Valley is flanked by the large snow laden peaks of Sonamarg, the Thajwas glacier, and the Sindh River, which is famous for its trout and mahseer populations. Sonmerg is an important tourist destination, visited by thousands of tourists in the summer months and thus there is an increase in the vehicular movement on this major highway. The surveys were conducted on three stretches with a total transect length of 18 km on this national highway during summer (June-August).

## METHODOLOGY

### Roadkill assessment on Srinagar-Leh Highway

Roadkill data were collected weekly during spring (March – May) and summer (June- August) in 2019

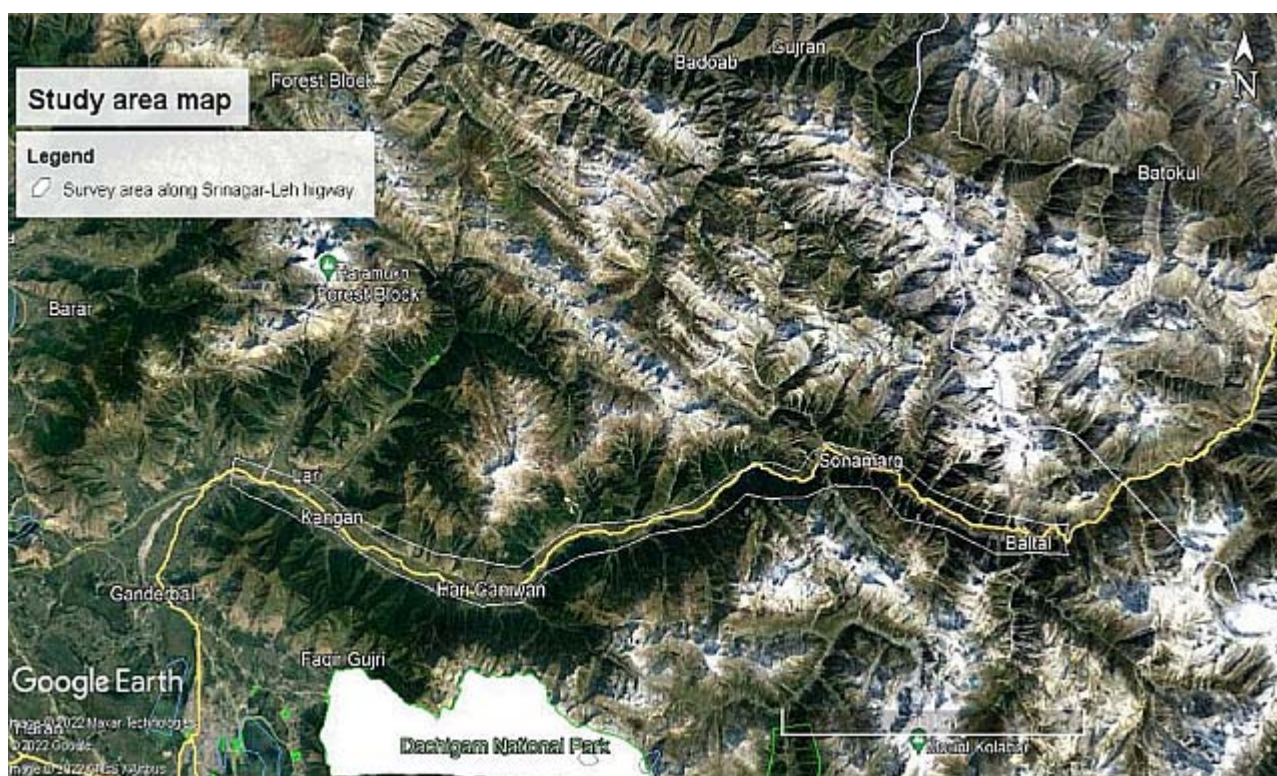


Figure 1. Map of the study area

along the 45 km route. Sampling was done early in the morning from 07:30 to 09:30 hrs on two transects of length three kilometers, inter-separated by a length of 250 m in three stretches (total transects= six, total survey length 18 km). Roadkill locations, both on the road and on the road verge were recorded using a GPS. In addition, habitat type and protection status of each road segment were recorded. Roadkill were removed in order to avoid recounts.

### Roadkill from other areas of Kashmir

Social media (Facebook) and other sources (local daily newspapers) were also accessed in order to avail information pertaining to recent roadkill data from other parts of the Kashmir Valley for year 2019 and 2020.

## RESULTS

### Species composition of roadkill

In total, 432 km were driven and 64 roadkill events (0.14 roadkill km<sup>-1</sup>) were recorded during the survey (Table 1, Fig. 2). The highest percentage of roadkill

among the four taxa was found to be constituted by mammals 37.5% (0.055 roadkill km<sup>-1</sup>), followed by birds 24% (0.034 roadkill km<sup>-1</sup>), reptiles 21% (0.032 roadkill km<sup>-1</sup>), and amphibians 17% (0.025 roadkill km<sup>-1</sup>).

Of the eight recorded bird species, black-eared kite *Milvus migrans* (n=4) was relatively most common roadkill species. Golden jackal *Canis aureus* (n=8) was the most commonly encountered among six mammalian species. Four reptilian and one amphibian species were also recorded in road kills.

### Relationship between the occurrence of roadkill and animal activity

Diurnal species were found to constitute the majority of the roadkill (79%) as compared to nocturnal species.

### Effect of protection status on roadkill occurrence

Excluding reptiles and amphibians, there were significantly more roadkills on road sections adjacent to the protected areas (59%) than in sections adjacent



Figure 2. Some images of roadkills recorded during surveys (A) Golden jackal, (B) Himalayan Trinket, (C) Golden oriole, (D) Black-eared kite)

Table 1. Roadkills recorded from Sindh Valley portion of Srinagar-Leh National Highway during spring and summer seasons in 2019.

Taxon group	Common Name	Scientific Name	Number of roadkills detected	Roadkills km <sup>-1</sup>
Mammals	Golden jackal	<i>Canis aureus</i>	8	0.018
	Red fox	<i>Vulpes vulpes</i>	3	0.006
	Indian crested porcupine	<i>Hystrix indica</i>	4	0.009
	Domestic dog	<i>Canis lupus</i>	5	0.011
	Mongoose	<i>Herpestes</i> sp.	3	0.006
	Domestic cat	<i>Felis catus</i>	1	0.002
Sub-total			(24) 37.5%	
Birds	Yellow-billed blue magpie	<i>Urocissa flavirostris</i>	2	0.004
	Black kite	<i>Milvus migrans</i>	4	0.009
	Himalayan bulbul	<i>Pycnonotus leucogenys</i>	1	0.002
	Rock pigeon	<i>Columba livia</i>	2	0.004
	House sparrow	<i>Passer domesticus</i>	2	0.004
	Streaked laughing thrush	<i>Trochalopteron lineatum</i>	2	0.004
	White wagtail	<i>Motacila alba</i>	1	0.002
	Golden oriole	<i>Oriolus kundoo</i>	1	0.002
Sub-total			(15) 24.43%	
Reptiles	Himalayan trinket	<i>Orthriophis hodgsoni</i>	5	0.011
	Laventine viper	<i>Macrovipera lebentina</i>	1	0.002
	Kashmir agama	<i>Laudakia tuberculata</i>	6	0.013
	Himalayan ground skink	<i>Scincella himalayanus</i>	2	0.004
Sub-total			(14) 21.87%	
Amphibians	Frog	Unidentified	11	0.025
Sub-total			(11) 17.18%	
<b>Total roadkills</b>			<b>64</b>	<b>0.148</b>

to non-protected areas and the difference was statistically significant ( $\chi^2= 15.43$ ,  $df=3$ ,  $p < 0.001$ ).

### Roadkills from other areas of Kashmir

In a worrying situation, large mammals such as Asiatic black bear (*Ursus thibetanus*) and Grey wolf (*Canis lupus*) were also found to be victims of vehicular collisions. Since the areas were not regularly monitored therefore, we might have missed many other roadkills. The data presented in Table 2 include only mammals and other taxa were not included.

### DISCUSSION

One of the most apparent and direct effect of roads on wildlife is the faunal mortality and injury due to

collisions with vehicles (Pons 2000, Erritzoe et al. 2003). The situation is quite serious in India (Raman et al. 2011). A wide variety of species are affected, ranging from invertebrates and herpeto-fauna, to many birds and mammals, including large mammals such as Asian elephants (*Elephas maximus*), sambar (*Rusa unicolor*) and carnivores such as tiger and leopard (Raman et al. 2011). Our brief study also supports these results proving that all the animal groups like birds, mammals, reptiles and amphibians are killed through these road kills and the frequency or the rates of road kill are not that low to be ignored. However, there is neither the count of such deaths nor any measures taken to reduce them. Seshadri et al. (2009) reported that during monsoon, amphibian kill rate on roads averaged about 10 kills/km per day on the National Highway in Sharavathi river basin.

Table 2. Roadkills recorded from other areas of the Kashmir Valley

S.No.	Common name	Scientific name	Area
1	Asiatic black bear	<i>Ursus thibetanus</i>	Tral Wildlife Sanctuary
2	Golden jackal	<i>Canis aureus</i>	Bandipora, Kupwara, Baramulla, Anantnag
3	Red fox	<i>Vulpes vulpes</i>	Bandipora,
4	Tibetan wolf	<i>Canis lupus chanco</i>	Hirpora Wildlife Sanctuary
5	Common leopard	<i>Panthera pardus</i>	Anantnag
6	Leopard cat	<i>Prionailurus bengalensis</i>	Baramulla
7	Indian crested porcupine	<i>Hystrix indica</i>	Bandipora, Budgam, Hirpora Wildlife Sanctuary

Since some of wounded animals flee the road and some may also be consumed by scavengers and humans, the recorded road kills are therefore always lesser than the actual kills (Raman et al. 2011). Our brief study also supports these results proving that all the animal groups like birds, mammals, reptiles and amphibians are killed by vehicles.

## CONCLUSIONS AND MANAGEMENT IMPLICATIONS

As a first to document the roadkill, an average of 10.6 kills/month were recorded during the six month survey on the 45 km Section of Srinagar- Leh highway. This brief study suggests long term effects of roads in the Kashmir Himalayan region and highlights the need for roadkill monitoring in other key wildlife areas of Himalayas. It is evident that the unplanned developmental activities especially the increase in network of roads may prove detrimental to wildlife in the long term. Therefore, mitigation measures prior to and during the developmental processes, especially roads should be taken based on the scientific solutions of road ecology to reduce the nocuous effects on wildlife.

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**Conflict of interest:** Authors declare that we don't have any conflict of interest.

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