

## Roadkills of wild fauna in Indira Gandhi Wildlife Sanctuary, Western Ghats, India: Implications for management

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**Abstract** A study was conducted on the deaths of mammals and reptiles caused by vehicular traffic on a road in Indira Gandhi Wildlife Sanctuary, Anaimalai Hills, Western Ghats, India. Vehicles killed a wide variety of mammals and reptiles, many of which were of endangered species. Reptilian roadkills mostly occurred during the rainy season and in the wet forest region. Roadkills occurred most commonly at night. In order to reduce this impact, it is suggested that tourist traffic should be minimised during the rainy season and during the night. Steps should be taken to maintain canopy contiguity beside the road. When constructing any further roads within the sanctuary, the sensitive rainforest areas must be avoided.

**Key words:** roadkills, mammals, snakes, Uropeltids, Indira Gandhi Wildlife Sanctuary, Western Ghats

### INTRODUCTION

The Western Ghats hill ranges in southern India have been recognised as being a 'hot spot' of global biodiversity (WCMC 1988). This is due to the fact that these hills contain a variety of forest types (Pascal 1988) and harbour enormous diversity of wild fauna. More than 4,500 species of flowering plants, 158 species of fish, more than 120 species of amphibians, 190 species of reptiles, more than 55 species of major mammals and nearly 250 species of birds are found in these hills (Inger and Dutta 1987, Kumar 1997, unpublished personal observations). Furthermore, a high proportion of these species of flora and fauna are endemic to the Western Ghats. A large number of critical areas in these hills have been brought under the 'Protected Area Network' through establishment of Wildlife Sanctuaries and National Parks. Out of the total 78,386 km<sup>2</sup> area of the Western Ghats, 17,613 km<sup>2</sup>, amounting to about 22 %, now comes under one form of 'Protected Area' or another (Johnsingh 1986). Unfortunately, despite this degree of legal protection, wildlife in these hills still continues to suffer from several threats, particularly in areas of rainforest (see Karanth (1992) in particular for a discussion primarily relating to factors causing disturbance to the wildlife in the Western Ghats

of Karnataka state).

Indira Gandhi Wildlife Sanctuary in the Anaimalai Hills of the Western Ghats, in Tamil Nadu State, has a high potential for wildlife conservation. Most of the animals typical of the Western Ghats are present in these hills. The forests are rich in arboreal wildlife, specifically primates (Singh et al. 1997a, b). Unfortunately, a large tract of rainforest in these hills was cleared about 100 years ago for planting tea, and the felling of natural forest continued even until recently for the purpose of planting commercial tree species such as cinchona, Eucalyptus and teak. Fortunately, forest felling has been stopped since the area was brought under protection by declaring it a wildlife sanctuary. However, due to the region being within a high rainfall area, a number of dams have been constructed to store water, and several power generation stations have been built in the hills. Such construction, and past forestry practices, has resulted in many of the forests, especially the rainforests, becoming fragmented (Kumar et al. 1995).

Research carried out in these hills over the past several years indicates that one of the main threats to wildlife in the area is death as a result of accidents with vehicular traffic within the sanctuary. Reports on such mortality are rare in the literature on wildlife, therefore

in this paper we provide information on road killed wild fauna in the Indira Gandhi Wildlife Sanctuary, and discuss the implications of this mortality for wildlife management.

**STUDY AREA AND METHODS**

The study was conducted on the Aliyar-Valparai sector of the Indira Gandhi Wildlife Sanctuary (Fig. 1) in the state of Tamil Nadu, southern India. Details concerning the forest type and the wildlife of this sanctuary are reported elsewhere (Singh et al. 1997a, b). The particular area included in this study is crossed by a public road starting from Aliyar Forest Checkpost and running to the hill town of Valparai. The road (Fig. 2) is 40 km long and passes through 13 km of deciduous forest, 6 km of moist deciduous/semi evergreen forest, 9 km of rainforest, and 12 km of tea plantations

(Fig. 1). In addition, there is a further 70 km road network located mainly in rainforest, however this may not be used by the public at present. The altitude of the study area ranges from 370 m asl at Aliyar to 1,440 m asl at the road's mid-point and falls again to 1,000 m asl at Valparai. The average annual rainfall is about 700 mm in the lower, dry ranges and about 5,000 mm in the upper, wet ranges. These forests are rich in wildlife, and almost all of the animals found in this part of the sanctuary may be encountered by chance along the road.

The data on the roadkills of mammals was gathered during April 1995 and December 1998, and on roadkills of reptiles during December 1997 and November 1998. All information on roadkills was gathered during our visits (average three days each week) to these areas for other research studies. The mammals were taken to represent the megafauna and the reptiles were taken

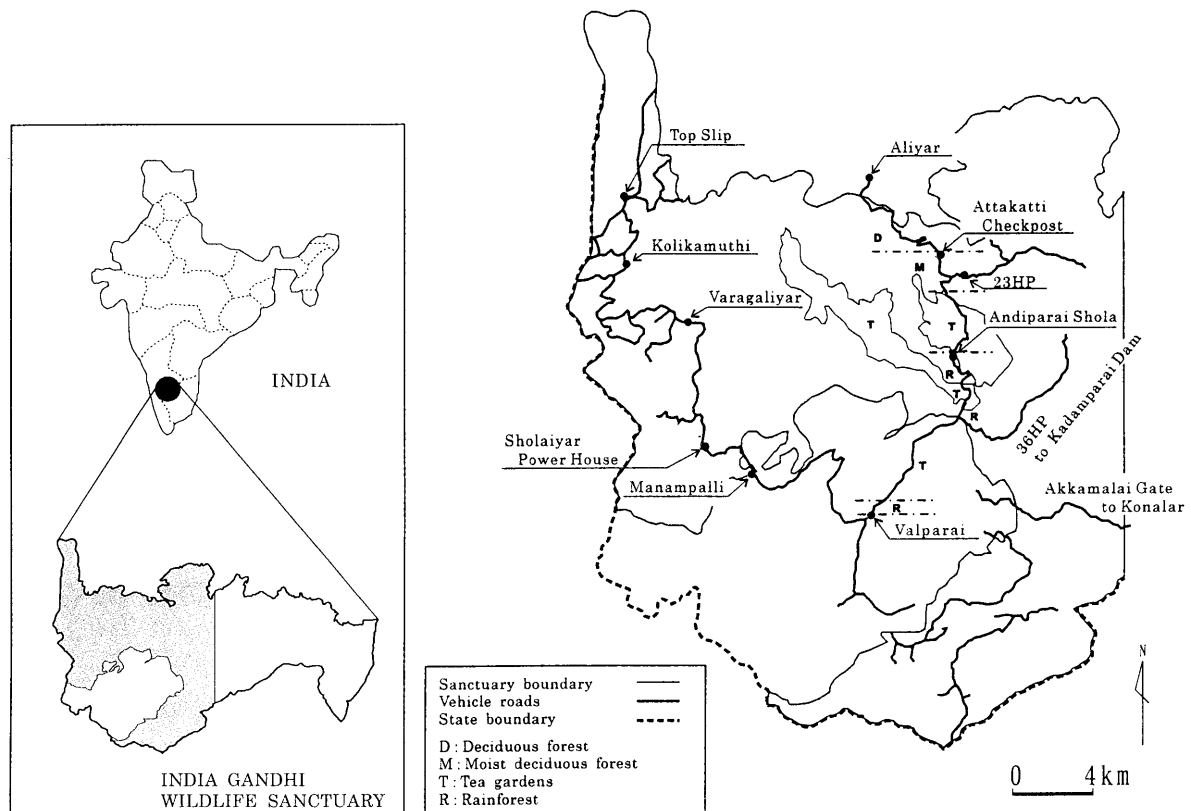


Fig. 1. Map of Indira Gandhi Wildlife Sanctuary showing the Aliyar (1) to Valparai (6) road where the roadkills were recorded. The forest types recorded along the road are indicated as follows: D = Deciduous forest; M = Moist deciduous forest; T = Tea plantations; R = Rainforest.

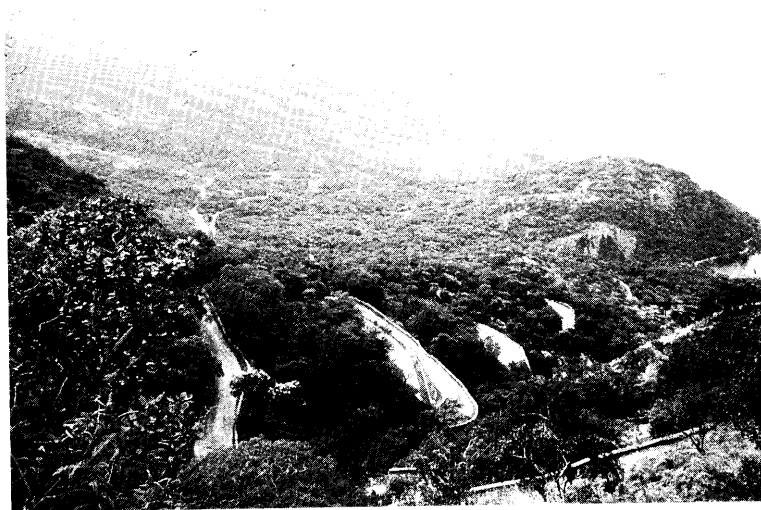


Fig. 2. Winding mountain vehicle roads in Indira Gandhi Wildlife Sanctuary.

to represent the microfauna. The identification of reptiles was made by referring to Wall (1923), Smith (1931-43), Whittaker (1978), Daniel (1983) and Rajendran (1985). The number of animals killed on the road reported here refers only to those found by us incidentally and not the total number of animals killed. This lack of systematic sampling does not permit us to do any calculations regarding rates of mortality. Neither does it allow us to extrapolate as to how many total animals are killed on this road or on the other roads in the sanctuary. However, systematic notes were maintained whenever a roadkill was observed. Furthermore, in order to avoid repeated counts, a road killed

animal was always removed after it had been identified. We do not have year round information on the amount of traffic using the road, however, 14 random hour-long studies, and two periods of 24 hours each spent at the check posts, led to an estimate that about 500 vehicles use the road everyday.

#### OBSERVATIONS AND DISCUSSION

The most frequently killed mammal species by vehicles were bonnet macaques followed by Indian porcupines (Table 1). The most striking observation, however, was that a wide variety of mammal species, both

Table 1. Number of roadkills of mammalian species recorded along the main Aliyar-Valparai road, Indira Gandhi Wildlife Sanctuary, between April 1995 and December 1998.

Common name	Latin name	Status	Roadkills sighted	Forest types
Bonnet macaque	<i>Macaca radiata</i>	Abundant	12	Dry & moist deciduous
Lion-tailed macaque	<i>Macaca silenus</i>	Endangered	1	Rainforest
Hanuman langur	<i>Presbytis entellus</i>	Abundant	1	Deciduous
Nilgiri langur	<i>Presbytis johnii</i>	Endangered	2	Rainforest
Sambar	<i>Cervus unicolor</i>	Abundant	2	Deciduous
Barking deer	<i>Muntiacus muntjac</i>	Common	3	Dry & moist deciduous
Mouse deer	<i>Tragulus meminna</i>	Data deficient	1	Rainforest
Nilgiri tahr	<i>Hemitragus hylocrius</i>	Endangered	1	Deciduous
Wild pig	<i>Sus scrofa</i>	Abundant	1	Tea garden
Small Indian civet	<i>Viverricula indica</i>	Data deficient	6	Moist & rainforest
Common palm civet	<i>Paradoxurus hermaphroditus</i>	Common	1	Deciduous
Indian porcupine	<i>Hystrix indica</i>	Common	8	Moist & rainforest; Tea garden

Table 2. Number of roadkills of snakes recorded along the main Aliyar-Valparai road, Indira Gandhi Wildlife Sanctuary, between December 1997 and November 1998.

Common name	Latin name	Dry season			Rainy season			Total
		Dry forest	Rain-forest	Tea garden	Dry forest	Rain-forest	Tea garden	
Large scaled green pit viper	<i>Trimeresurus macrolepis</i> *	0	4	0	0	9	0	13
Malabar pit viper	<i>Trimeresurus malabaricus</i> *	0	0	0	2	2	0	4
Wolf snake	<i>Lycodon</i> sp.	0	3	0	1	10	0	14
Green keelback	<i>Macropisthodon plumbicolor</i> *	0	0	2	0	1	0	3
Buffstriped keelback	<i>Amphiesma beddomi</i> *	0	2	0	0	1	0	3
Rat snake	<i>Ptyas mucosus</i> *	1	0	0	0	0	0	1
Slender coral snake	<i>Calliophis melanurus</i> *	0	0	0	2	0	0	2
Striped coral snake	<i>Calliophis nigreseens</i> *	0	1	0	0	1	2	4
Cat snake	<i>Boiga</i> sp.	0	0	0	0	0	1	1
Keelback	Keelback sp.	0	5	0	0	3	0	8
Total		1	15	2	5	27	3	53
		0.05/km	1.66/km	0.16/km	0.26/km	3.0/km	0.25/km	1.32/km

\*Lower risk-near threatened

Road section lengths: 19 km for dry forest, 9 km for rainforest, 12 km for tea garden.

small and large die as a result of traffic accidents. Furthermore, the animals killed included not only the terrestrial mammals such as ungulates, but also primarily arboreal mammals such as primates. The loss of canopy contiguity due to the existence of the road, is a significant problem for arboreal animals. At many places, along the road there are hill slide land slips. As a result, many large trees fall and break the canopy contiguity. In such places, arboreal animals must cross the road to reach the other side of the forest. Both langurs and rare lion-tailed macaques have been killed only under such circumstances. The mammal species that had been killed included not only abundant and common species, but also vulnerable and endangered species. There appeared to be no relationship between season, or forest type, and the species or numbers of mammals killed.

Since very little information about either the ecology or the status of Uropeltid snakes is available, we have presented the data on these kills separately (see Tables 2 and 3). A total of 156 dead Uropeltids were recorded along the road, most of which were found during the rainy season ( $n = 141$ ) rather than during the dry season ( $n = 15$ ) ( $\chi_1^2 = 101.77$ ,  $p < 0.001$ ). Further-

more, highest mortality occurred in the rainforest region ( $n = 141$ ) as against the deciduous forest region ( $n = 5$ ) or the tea plantations ( $n = 10$ ) ( $\chi_2^2 = 228.7$ ,  $p < 0.001$ ). It is clear that a wide range of reptilian species is killed by vehicles. Many of the microfaunal species, such as amphibians, pit vipers, Uropeltids and lizards are habitat specialists; some of them are even microhabitat specialists. The pit vipers that are found in India all occur in forests, thus any disturbance to forested areas, especially rainforests, risks significantly reducing their population (Whittaker 1978). The Uropeltids all live in burrows beneath the soil, under fallen logs or beneath flat stones. If such microhabitats become water logged during the rainy season, these animals crawl out even during the day (Rajendran 1985) and may be flushed on to roads along with the rainwater. They are then exposed to vehicular traffic. Under normal conditions, these species are mainly active at night and are more active during the rainy season. The data on roadkills indicates, although indirectly, that these species occur in rather high densities in these hills, but with a localised pattern of distribution, with a particular abundance in rainforest. Vehicular traffic may be a serious threat to such fauna.

Table 3. Number of roadkills of Uropeltids along the main Aliyar-Valparai road, Indira Gandhi Wildlife Sanctuary, between December 1997 and November 1998.

Species	IUCN status	Dry season			Rainy season			Total
		Dry forest	Rain-forest	Tea garden	Dry forest	Rain-forest	Tea garden	
<i>Melanophidium bilineata</i>	DD	0	1	0	0	5	0	6
<i>Brachyophidium rhodogaster</i>	EN	0	0	0	0	0	1	1
<i>Uropeltis phipsoni</i>	LR-nt	0	1	0	0	3	0	4
<i>Uropeltis rubromaculata</i>	EN	1	3	0	0	4	0	8
<i>Uropeltis ellioti</i>	DD	1	0	0	3	0	0	4
<i>Uropeltis ocellatus</i>	LR-lc	0	1	0	0	48	1	50
<i>Uropeltis ceylanicus</i>	LR-lc	0	7	0	0	58	8	73
Uropletid sps.		0	0	0	0	10	0	10
Total		2	13	0	3	128	10	156
		0.10/km	1.44/km	-	0.16/km	14.22/km	0.83/km	3.9/km

DD – Data deficient

EN – Endangered

LR-nt - Lower risk-near threatened

LR-lc - Lower risk-least concern

Road section lengths: 19 km for dry forest, 9 km for rainforest, 12 km for tea garden

The above observations are important because little attention has been paid so far to the occurrence of roadkills, especially of microfauna. The death of wild animals caused by vehicles inside the forest area is a serious problem faced in many wildlife reserves, and it may have serious implications for endangered species. Struhsaker (1998), for example, reported that endangered red colobus monkeys fall victim to careless drivers in the forests of Zanzibar. In another study, Singh et al. (1999), reported the deaths of endangered slender loris caused by vehicles in the forests of the Dindigul region in Tamil Nadu, India.

The data presented here, reveals that vehicles on a road inside an important wildlife sanctuary kill a wide variety of mammals and reptiles, of all sizes. In addition, various amphibians, diurnal terrestrial birds and nocturnal birds are also killed by vehicles. Most of the deaths of reptiles occurred during the rainy season and in the wet forest region. Although our data did not permit us to calculate the quantitative extent of the effect of roadkills on wildlife, it has certain implications for management.

As far as mammals, especially terrestrial mammals, are concerned, they do not occur in very high densi-

ties in sanctuaries that are mountainous and contain considerably large areas under rainforests. Consequently, any roadkills may have a direct effect on the populations of such animals. A few species such as Nilgiri tahr, lion-tailed macaque and Nilgiri langur found in Anaimalai Hills are endangered or vulnerable. Even the deaths of a few individuals from a small population may have an appreciable effect on such species.

It must be emphasised that many wildlife sanctuaries exist not only to preserve wildlife but also as a recreations resource for people in the form of wildlife tourism, thus the traffic on such roads cannot be totally avoided. The peculiar situation in the Anaimalai Hills is that tea is cultivated commercially in the upper region and generates a high traffic volume on the only approach road from Aliyar to Valparai. In addition, there is year-round vehicular activity by the Irrigation and Power Generation Departments in these hills; this is also largely unavoidable. Despite the unavoidable volume of traffic, several major lessons can be learnt from the present data leading to a better conservation and management strategy of the area.

In order to reduce the level of wildlife mortality along the road, the first step is to minimise the tourist traffic

along the road during the rainy season. Only the vehicles necessary for the commercial activity in the tea plantations should be permitted to travel. Even the movement of such necessary vehicles should be restricted to the daytime alone, and night-time traffic during should be restricted to the absolutely unavoidable limit. There are a few critical points on this road such as areas near monkey falls, 23HP and Andiparai Shola that are regularly used by animals for road crossing. Speed controls through erection of road humps should be enforced in such critical places. A network of ropes connecting the canopies of the trees on both sides of the road at a few critical places may help the movement of primates through the canopy, thus reducing the risk of them being forced to cross the road at ground level. The upper side of the road on slopes can be paved with stones throughout so that the incidence of landslides will be minimised and the canopy contiguity retained.

There are several places in the Anaimalai Hills that are critical for wildlife. All of these places have a forest road network of about 70 kilometres passing through them. These roads include the road from 36HP to Kadamparai Dam, from Akkamalai Gate to Konalar, and from Kolikamuthi to Sholaiyar Power House. These roads pass through fragmented patches of rainforest. At present, however, neither commercial nor private vehicles are permitted on these roads. In the light of the mortality of mammals on the current open road, these roads should never be opened for public use, and the vehicular traffic during the rainy season even by the Government Departments should be kept to an absolute minimum. If any new roads are planned, then they should be limited to the regions with dry deciduous forests only, and should be used mainly during the daytime and during the dry season.

Similar strategies of management can also be applied in all other protected areas of similar nature.

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