Hamadryad Vol. 39, pp. 37–42, 2022.

Mortality rates of snakes on the roads of Vazhachal Forest Division, Kerala, Southern-Western Ghats, India.

P. Bharath Simha Yadav [1*], L. Prakash[2], P. Karthik[2]

[1]Department of Botany, Botanical Research Centre, The Madura College (Autonomous), Madurai-625 011, India

[2]D. No.2. Kandhasamy Muthaliar Street, Vettaikaranpudur, Pollachi, Coimbatore-642129, Tamil Nadu, India

[3]No 49, 11th Sengulam East Street, Thirumangalam, Madurai-625706, Tamil Nadu, India.

*Corresponding author: bharathpochamoni@gmail.com

CITATION. Yadav, P.B.S., Prakash, L. and Karthik, P. (2022). Mortality rates of snakes on the roads of Vazhachal Forest Division, Kerala, Southern-Western Ghats (SWG), India. *Hamadryad*, in press.

ABSTRACT. Vehicular mortalities have a significant impact on wildlife, and pose a substantial threat to biodiversity. Several national highways (NH) bisect important reserve forest patches in India, resulting in severe habitat fragmentation. This study records snake mortalities between from June 2019 to November 2019, on State Highway 21, covering a ca.80km stretch adjoining the Vazhachal forest division. A total of 18 species belonging to five families and 18 genera were recorded. The families are Uropeltidae with one genus (1 sp.), Pythonidae with one genus (1 sp.), Colubridae with 11 genera (11 spp.), Elapidae with 3 genera (3 spp.) and Viperidae with 2 genera (2 spp.). Of these, three are endemic to Western Ghats, one species is near threatened, one species is vulnerable, and one species is listed as endangered. This region is a potential habitat to endemic species, and also home to many faunal species. Hence, a lower speed limit would be advisable to protect wildlife and mitigate future threats.

KEYWORDS. snake, highway, mortality, conservation, protected forest

Introduction

Road networks and vehicular traffic play a crucial role in wildlife mortality (Plante et al. 2019). Often, the highways pass through the protected forest zones which affect the native fauna's movement and survival (Shepard et al. 2008). Subsequently, the studies from across the globe have been highlighting the adverse impacts of the road networks on wild animals, and the consequent mortality across invertebrates and higher vertebrates (Fahriget al. 1995; Clarke et al. 1998; Mackenzie et al. 2001; Erritzoe et al. 2003).

The Western Ghats harbours about 30% of India's biodiversity, and is one of the 34 biodiversity hotspots of the world (Rodgers & Panwar 1988, Mittermeier et al. 2005). A total of 193 species of reptiles have been documented from the Western Ghats (Srinivasulu et al. 2014). In India, there is a dearth of information on vehicular mortalities of wildlife, and its ecological implications (Sundar 2004). Hence, small-scale investigations have been carried out on the road mortality of organisms ranging from soil invertebrates to amphibians, reptiles, birds, and mammals (Gokula, 1997; Vijayakumar et al. 2001; Boominathan et al. 2008; Bhupathy et al. 2011; Santhoshkumar et al. 2017; Prakash & Karthik 2020). Therefore, the present study attempts to record snake mortality on State highway 21, adjoining the Vazhachal forest division.

Materials and Methods

Study area. The sampling was performed on State Highway 21 (SH 21), covering an 80 km stretch, which passes through Vazhachal forest division (Fig. 1). The Vazhachal forest division spans 414 km^2 and includes five forest ranges (Athirapally, Charpa, Kollathirumedu, Sholayar, and Vazhachal), all of which are located on either side of SH 21. The temperature ranges from ca. 23 °C to 31 °C, and the elevation varied from 200 m to 1300 m asl. The heaviest rainfall typically occurs in the months of June and July, and the habitat type is mostly tropical wet evergreen forests, tropical semi-evergreen forests, and tropical moist deciduous forests. The forest division and either side of highway road is rich in floral and faunal diversity (Bachan, 2010)

Methods. The road mortality survey sampling was performed between from June 2019 to November 2019, on the road stretch of SH 21 (Fig. 1). The study followed the fortnight sampling method in Boominathan et al. (2008), and the vehicle driving method followed Das et al (2007). A total number of sampling days were 48(N = 48), and each survey covered aca. 50 km stretch. Thus, the sampling was carried out over a ca. 2400 km, and was a two-man effort. Furthermore, the survey was carried out through reserve forests (Athirapally to Malakkapara) and human settlements (Chalakudy to Athirapally). The sampling was restricted to snake-mortalities, and observations were made during mornings (0700–1000 h) and late evenings (1600–1800 h). While sampling, the road carcasses were examined and identified to the species level using available literature (Daniel 2002). Also, the dead carcasses were removed from the road to avoid multiple counts, and photographs were taken for documentation. Apart from that, the survey collected the following variables: family name, species name, observed individuals, venomous or non-venomous, conservation status (IUCN & endemic). The location of each road kill was marked with a GPS and mapped (Fig. 1).The study did not involve collecting any samples for preservation or lab purposes.

Table 1. The road-kill observation on the Chalakudy to Valparai State Highway (SH 21) through the Vazhachal Forest Division.

S. No.	Family	Species Name	# Indi.	Venomous /Non-Venomous	IUCN status
1	Uropeltidae	*Rhinophistravancoricus**	1	N-V	EN
2	Phythonidae	*Python molurus*	3	N-V	NT
3	Colubridae	*Ahaetullaisabellina*	2	M-V	LC
4		*Rhabdophisplumbicolor*	4	V	NA
5		*Amphiesmastolatum*	2	N-V	NA
6		*Oligodonaffinis**	1	N-V	LC
7		*Ptyas mucosa*	2	N-V	NA
8		*Boiga trigonata*	1	M-V	NA
9		*Coelognathushelenamonticollaris*	1	N-V	NA
10		*Dendrelaphis tristis*	5	N-V	NA
11		*Fowlea piscator*	3	N-V	NA
12		*Hebiusbeddomei**	1	N-V	LC
13		*Lycodonaulicus*	1	N-V	LC
14	Elapidae	*Najanaja*	2	V	LC
15		*Bungarus caeruleus*	3	V	NA
16		*Ophiophagus hannah*	3	V	VU
17	Viperidae	*Hypnalehypnale*	1	V	LC
18		*Daboia russelii*	3	V	NA

*# N-V denotes non-venomous, V denotes venomous, M-V denotes mildly venomous, * indicates the species endemic to the Western Ghats.*

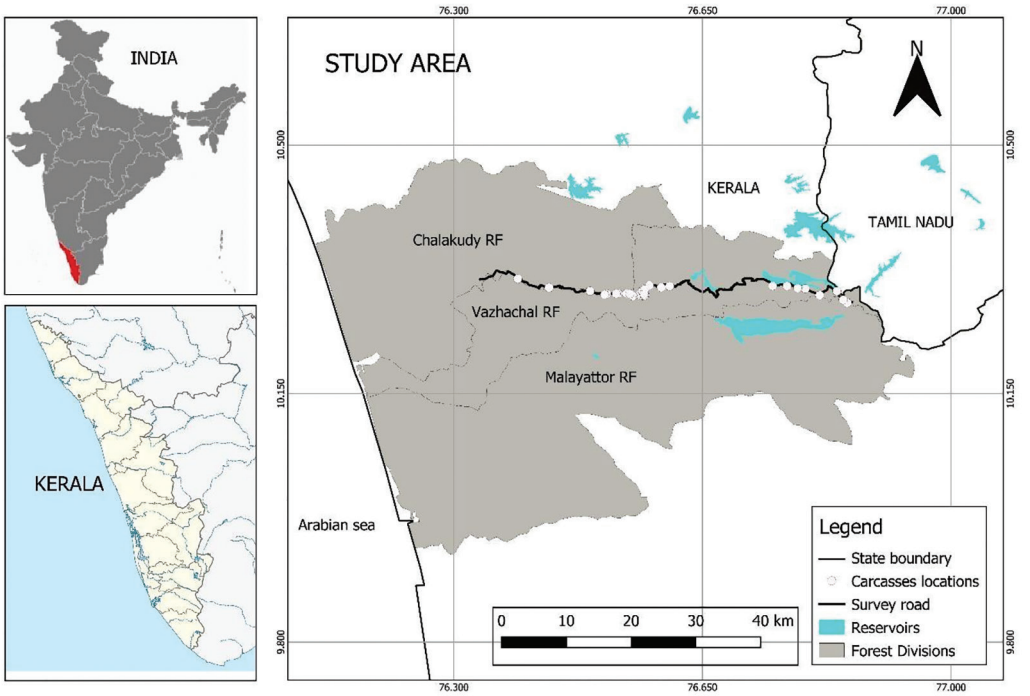

Figure 1. Map showing surveyed highway SH 21 road lane with carcass sighting locations.

Results

Over 48 sampling days, and approximately 2400 km, the study recorded road-kills of 18 species of snakes belonging to 18 genera and five families (Table 1). A total of 39 freshly killed individuals were observed during the sampling hours, of which a few are locally endemic. Of these, six (33.33%) species are venomous; two (11.11%) species are mildly venomous, and ten (55.55%) species are non-venomous (Table 1). However, in comparison to other family members, the family Colubridae is relatively abundant (11 spp. and 23 individuals), followed by families Elapidae (3 spp. and 8 individuals), Viperidae (2 spp. and 4 individuals), Pythonidae (1 sp. and 3 individuals) and Uropeltidae (1 sp. and 1 individual). However, the species *Dendrelaphis tristis* and *Rhabdophis plumbicolor* had the highest carcass rate among the 39 individuals. Furthermore, the snake species *Hebius beddomei, Oligodon affinis* and *Rhinophis travancoricus* are endemic to the Western Ghats. Based on the IUCN Red-list categories (2021), one endangered (*Rhinophis travancoricus*), one near threatened (*Python molurus*) and one vulnerable species (*Ophiophagus hannah*) were also recorded. The species *Rhinophis travancoricus* and *Oligodon affinis* are highly elusive and rare (Srinivasuluet al. 2014). Also, the species *Ophiophagus hannah*islisted in schedule II category (acc. WPA 1972) and appendix II (acc. CITES). Therefore, negligence in enforcing conservation measures is also impacting conservation priority species such as *Ophiophagus hannah*.

Discussion

Vijayakumar et al. (2001) have observed a total of 49 individuals during a road kill survey, in which most of carcasses fall in the family Colubridae (n = 22). The present study observations corroborate the observations made by Vijayakumar et al. (2001). Snakes play an intrinsic role in nature, particularly in food webs and other ecological aspects (Andrews & Gibbons 2005). This study highlights a few critical factors that threaten animals: (a) people's ignorance about lower vertebrates, (b) feeding wild animals, and (c) food garbage thrown in roadside bushes (Spellerberg 2002). Tourists throw food trash on the roadside, attracting rodents and other small animals. Snakes, while chasing these prey end

Figure 2. A) *Ophiophagus hannah*, B) *Rhinophis travancoricus*, C) *Oligodon affinis*, D) *Hebius beddomei*, E) *Fowlea piscator.*

up as road-kill (Secco et al. 2014). Snakes are also known to be poikilothermic. Therefore, to regulate their body temperatures, the snakes tend to move towards tar roads for heat, and end up getting run over.

Conclusion

Over one hundred million snakes have been killed in the United States by vehicles, and this is attributed to snakes resting or coiling on the roads for heat (Rosen & Lowe 1994). In India, there are numerous road lanes running through

protected zones, which cause a significant effect on wildlife fauna (Baskaran and Boominathan 2010). Emphasising the importance of conservation of lower vertebrates, here is a small attempt to quantify snake mortality on roads. To mitigate the impact of vehicle mortality on wild animals, these road lanes should be monitored prudently, along with strict guidelines to protect wild animals (Karthik et al. 2018). The results indicate that such stretches need strict guidelines on vehicle movements, with vehicle speeds on the highways that passes through the forests being limited to 30 km per hour. Also, speed mounds can be constructed at regular intervals to ensure that speed limits are adhered to (Glista et al. 2009; Seshadri& Ganesh 2011), and signboards indicating wildlife crossing zones can be installed (Samson et al. 2016; Prakash & Karthik 2021).

Acknowledgments

We thank Sálim Ali Centre for Ornithology & Natural History for the great opportunity and the Kerala Forest Department for funding and logistical support. We also thank Dr. P. Balasubramanian (Retd.), and Dr. P.V. Karunakaran, for their encouragement and support. We thank Dr. S. Jeevith for photo plate preparation and anonymous editor for the critical comments on the manuscript.

References

ANON., (1972) The Indian Wildlife (Protection) Act. Ministry of Environment and Forests, Government of India, New Delhi. pp30.

ANDREWS, K.M. & J.W. GIBBONS. (2005) How do highways influence snake movement? Behavioral responses to roads and vehicles. *Copeia* (4), 772-782.

BACHAN, A. (2010) *Riparian flora of the Chalakkudy River Basin and its ecological significance.* PhD Thesis, Dept. of Botany, University of Calicut, Kerala, India

BASKARAN, N. & BOOMINATHAN, D. (2010) Roadkill of animals by highway traffic in the tropical forests of Mudumalai Tiger Reserve, southern India. *Journal of Threatened Taxa* 2(3), 753- 759.

BOOMINATHAN, D., ASOKAN, S., DESAI, A.A. & BASKARAN, N. (2008) Impact of highway traffic on vertebrate fauna of Mudumalai Tiger Reserve, southern India.*Convergence* 10(1-4), 52-63

BHUPATHY, S., SRINIVAS. G., SATHISH. N., KARTHIK. T. & MADHIVANAN. A., (2011) Herpetofaunal mortality due to vehicular traffic in the Western Ghats, India: a case study. *Herpetotropicos* 5: 119–126.

CLARKE, G.P., WHITE, P.C.L. & HARRIS, S. (1998) Effects of roads on badger *Meles meles* populations in south-west England. *Biological Conservation* 86(2)*,* 117-124.

DANIEL, J.C. (2002) *The Book of Indian Reptiles and Amphibians*. Oxford University Press, Bombay Natural History Society Bombay, India. p. 238.

DAS, A., AHMED, M.F., LAHKAR B.P. & SHARMA, P. (2007) A preliminary report of reptilian mortality on road due to vehicular movement near Kaziranga National Park, Assam, India. *Zoos Print Journal* 22(7), 2742-2744.

ERRITZOE, J., MAZGAJKI, T. & REJT, L. (2003) Bird casualties on European roads- a review. *Acta Ornithologica* 38, 77-93.

FAHRIG, L., PEDLAR, J.H., POPE, S.E., TAYLOR, P.D. & WEGNER, J.F. (1995) Effect of road traffic on amphibian density. *Biological Conservation* 73, 177-182.

GLISTA, D.J., DEVAULT, T.L. & DEWOODY, J.A. (2009) A review of mitigation measures for reducing wildlife mortality on roadways. *Landscape and urban planning* 91, 1-7.

GOKULA, V. (1997) Impact of vehicular traffic on snakes in Mudumalai Wildlife Sanctuary. *Cobra* 27, 26-30

IUCN. 2022. *The IUCN Red List of Threatened Species. Version 2022-1*. https://www.iucnredlist.org.

KARTHIK, P., KALAIMANI, A. & R. NAGARAJAN. (2018) An inventory onherpetofauna with emphasis onconservation from GingeeHills,Eastern-Ghats, Southern India. *Asian Journal of ConservationBiology* 7(1), 2-16.

MACKENZIE, A., BALL, A.S. & S.R. VIRDEE. (2001) *Ecology*, 2nd edn. BIOS Scientific, Oxford.

MADER, H.J. (1984) Animal habitat isolation by roads and agricultural fields. *Biological Conservation* 29, 81-96.

MITTERMEIER, R.A., PATRICIO, R.G., MICHAEL, H., JOHN, P., THOMAS, B.,CRISTINA, G.,MITTERMEIER, J.L. AND DA FONSECA, G.A.B. (2005) *Hotspots Revisited, Earth's Biologically Richest and*

Most Endangered Terrestrial Ecoregions. Cemex, Conservation International and Agrupación Sierra Madre, Monterrey, Mexico. 391 Pp.

PLANTE, J., JAEGER, J.A. & DESROCHERS, A. (2019) How do landscape context and fences influence roadkill locations of small and medium-sized mammals? *Journal of Environmental Management* 235, 511-520.

PRAKASH, L. & KARTHIK, P. (2021) Effect of Vehicular Traffic on Wild Animals in Anaikatty Hills, Southern Western Ghats, India. *Indian Journal of Ecology* 48(1), 108-111

POOJA, S. SIDHARDH, A.S.K. & BACHAN, A.K.H. (2020) Biodiversity Significance of Low-Elevation Riparian Forests in Vazhachal: Conservation and Restoration Implications. *Journal of Aquatic Biology & Fisheries* 8 S, 77-82

RODGERS, A. &PANWAR, H.S. (1988) *Protected area network of India*. Volume I. Wildlife Institute of India, Dehra Dun. 341 pp.

ROSEN, C. & LOWE. C.H. (1994) Highway mortality of snakes in the Sonoran desert of Southern Arizona. *Biological Conservation* 68, 143-8.

SAMSON, A., RAMAKRISHNAN,B., VEERAMANI, A., SANTHOSHKUMAR, P., KARTHICK, S., SIVASUBRAMANIAN, G., ILAKKIA, M.,CHITHEENA, A., PRINCY,J.L., & RAVI, P. (2016) Effect of vehicular traffic on wild animals in Sigur Plateau, Tamil Nadu, India. *Journal of Threatened Taxa*8, 9182-9189.

KUMAR, S., KANNAN, P., VEERAMANI, A., SAMSON, A., KARTHICK, S., & LEONAPRINCY. J. (2017) A preliminary report on the impact of road kills on the herpetofauna species in Nilgiris, Tamil Nadu, India. *Journal of Threatened Taxa* 9(3): 10004–10010.

SECCO, H., RATTON, P., CASTRO, E., LUCAS,P.S., & BAGER, A. (2014) Intentional snake road-kill: a case study using fake snakes on a Brazilian road. *Tropical Conservation Science* 7(3), 561-571.

SESHADRI, K.S. & GANESH, T. (2011) Faunal mortality on roads due to religious tourism across time and space in protected areas: A case study from south India. *Forest Ecology and Management* 262, 1713-1721.

SHEPARD, D.B., DRESLIK, M.J., JELLEN, B.C. & PHILLIPS, C.A. (2008) Reptile road mortality around an oasis in the Illinois corn desert with emphasis on endangered eastern Massasauga. *Copeia* 2008(2),350-359.

SPELLERBERG, I.F. (2002) *Ecological Effects of Roads*. Science Publishers, Enfield, New Hampshire. 251 pp.

SRINIVASULU, C., SRINIVASULU, B. & MOLUR, S. (2014) The Status and Distribution of Reptiles in the Western Ghats, India. *Conservation Assessment and Management Plan (CAMP)*. Wildlife Information Laision Development Society, Coimbatore, Tamil Nadu.

VIJAYAKUMAR, S.P., VASUDEVAN, K. & ISHWAR, N.M. (2001) Herpetofaunal mortality on roads in the Anamalai Hills, southern Western Ghats. *Hamadryad* 26, 253–260.

DOI
Date submitted 3/9/2021
Date accepted 12/2/2022
Available online 22/7/2022