Asian Journal of Conservation Biology, July 2020. Vol. 9 No. 1, pp. 173-177 AJCB: SC0043
ISSN 2278-7666 ©TCRP Foundation 2020

Impact and assessment of wildlife mortalities on road due to vehicular movements in Desert National Park, Rajasthan, India

Rakesh Kumawat* **and Ashok Purohit**

Department of Zoology, Jai Narain Vyas University, Jodhpur, Rajasthan- 342001, India

(Received: November 22, 2019; Revised: May 29, 2020 ; Accepted: July 05 , 2020)

ABSTRACT

To begin to quantify the effects of roadways on wildlife at Desert National Park, Jaisalmer, regular road kills surveys were conducted with the help of forest officials from January 2016 to December 2016. During these surveys, we have documented overall 289 wildlife road mortalities during an average of one-year period. Nevertheless, the number of individual animals observed is only a small fraction of the number killed on roads in and adjacent to the Park. A total of 289 instances of road kill of faunal diversity belonging to 43 species and 27 families were recorded. Among them one species is endangered and 20 are least concern. There was higher mortality among reptiles. It is feared that such a kind of persistence loss can be detrimental to the local reptilian population of DNP.

Key words: Desert National Park, Road kill, Vertebrate.

INTRODUCTION

Road kill is undoubtedly one of the most significant human-caused factors of direct mortality to vertebrate animals in and around significant biodiversity-rich areas, including many protected areas, yet its overall impact remains poorly documented. In the new parts, there is tremendous development in urbanization with vast networks of national and state highways. This has caused de-fragmentation of many terrestrial habitats. Roads have become one of the severe threats to animal and plant diversity (Forman & Alexander, 1998). Through direct mortality on the roads (Ashley & Robinson, 1996), indirect effects such as the modification of adjacent aquatic and terrestrial communities through vehicle exhaust or runoff (Turtle, 2000), barriers for movement (Oxley *et al*., 1974) or increased predator activities near roads (Ortega & Capen, 1999). Roads contribute to reducing average heterogeneity and genetic polymorphism (Reh & Seitz, 1990).

Roads appear to be barriers in the movement for some Amphibians, Aves and Mammals (Develey & Stouffer, 2001; Goosem, 2001). The current study is dealing with mortality of relatively slow-moving animals with limited dispersal ability, such as reptiles (Rosen & Lowe, 1994). Herpetofauna with less dispersal ability and higher sensitivity to habitat alteration that anurans, birds and mammals may be more sensitivity to the barrier effect of roads and local populations may become isolated and increasingly become susceptible to extinction (Mader, 1984).

In India few studies were carried out to address the issue of wildlife mortality on roads (Vijaykumar *et al.*, 2001; Gokula, 1997; Chhangani, 2004; Baskaran and Boominathan, 2010; Fellows *et al.*, 2015) and several other has studied particularly on herpetofaunal mortality due to vehicular movement on roads (Foster & Humphrey 1995; Groot & Hazebroek, 1996; Trumbulak & Frissell, 2000; Das *et al*., 2007; Row *et al*., 2007; Shwiff *et al*., 2007; Seshadri *et al*., 2009; Dutta *et al*., 2018). However, unfortunately, nearly negligible studies were conducted considering western Rajasthan, which is a diversity hub for peculiar fauna (Sharma, 2013). No study on such ecological loss is hitherto known. The present study is an attempt to report road mortalities of faunal species on a highway segment passing along the middle and southern boundary of Desert National Park, Jaisalmer, and Rajasthan.

MATERIAL AND METHODS

Desert National Park (27°2′22″N 70°53′2″E) is situated in the West Indian state of Rajasthan near the town of Jaisalmer. This is one of the largest national parks, covering an area of 3162 km². The study was carried out from January 2016 to December 2016 on transects of approx 305 km, passing to Desert National Park, Jaisalmer, India. The 35 km long road enters into the Sam village and next to Sudasari, Khuhri and Myajlar in Jaisalmer. This road passes through patchy seasonal fields of Millets, Sorghum, Bajra crops in springs, fragmented grasslands, and scattered rocky terrain, stabilised dunes with scrubland and purely barren dunes. All these adjacent wild, arid habitat are animal corridors and frequently used by small mammals like a wild cat, desert fox, Indian fox, Chinkara, Blue bulls during their to and from movement between above habitats.

The animal crossing increases manifold particularly during the rainy season when the annual water bodies actives. The road transect have taken in to study as 1. Kanoi - Jaisalmer, 2. Barna- Jaisalmer, 3. Sam – Sipla, 4. Kanoi – Barna, 5. Barna – Sundra and 6. Myajlar-Jinjinyawali - Jaisalmer in Desert National Park territory. Overall, nine transects have been implemented in one season. Further three transects plotted each in a season to all six routes in a year of study (Figure 1).

We followed the day and night drive method to detect animals on the road. This method is a type of

**Corresponding Author's E-mail: rakeshophia@gmail.com*

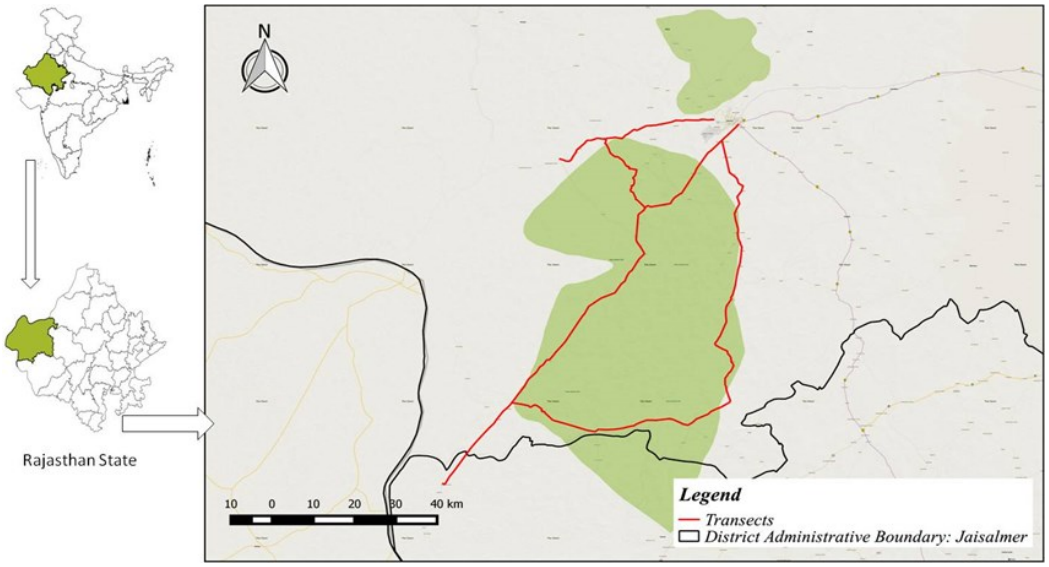

Figure 1. Map of Study Area; India (Left above) and Rajasthan (left below) highlighted in Inset. Red colour lines indicate the roads utilized for the present study survey to estimate road kill mortalities by the vehicles.

road transect that yields a reasonable estimate of the species and individuals actively foraging or migrating sites. This technique outlined by Klauber (1939) has been used extensively to assess the relative abundance and species richness of reptiles at a verity of habitats.

We conducted almost 100 km road transect on Jaisalmer to Myajlar village covering the entire northern range of the park. Transect was covered (Sam as a starting point and back) thrice in every season between 0600hrs to 1200hrs and 1700 hrs and 0000hrs. The vehicle was driven at 20-40km/hr depending on visibility, and any wild animal road kills seen either photographed or removed from the road to avoid multiple counts, and the roadside habitat, state of road kills, and geo-location of the road kill was recorded. We used taxonomic keys for species identification. Scientific and common names of reptiles were Das (1997, 2002 & 2003; Smith, 1943), for mammals (Prakash, 1963).

RESULTS

Road kills of 289 individuals of wild animals belonging to 43 species and 27 families were recorded. Among them lizards kill observed as 61 % (n= 176), followed by mammals 18% (n= 52), then Snakes 10% (n= 30), Birds as 7% (20) and Frogs as 4% (n= 11) (Figure 2).

The most frequently killed native species were the spiny-tailed lizards, the red sand boa and the Desert monitor lizard of Reptiles. These values underestimate because our survey technique could not detect all road-kills. A detailed study of the local population of the fauna is needed to determine whether such a level of road mortality is sustainable. The frequency of road-kill of many ground-dwelling or arboreal mammal species in this study highlights the importance of impact mitigation by road authorities.

In the first transect of January to April there are 73 mortalities reported at the average of 1.69±5 per species, at second transect of May to August 140 mortalities happen at the average of 3.25±9 per species and third transect of September to December locate 76 mortalities on an average of 1.76±3 per species. The second transect hit the most number of moralities in the study area (Table 1).

The species-wise comparison shows results as Mammals 30% (n= 13), followed by Birds 23% (n= 10) then Lizards 21% (n=9), Snakes 21% (n = 9) and frogs contributes 5 % (n=2) species were recorded as road mortalities. The most affected vertebrate group is Mammals and frogs were the least killed species in road casualties. Global IUCN status shows one species is Endangered (Egyptian vulture), 20 were found Least Concern and 22 were Not assessed.

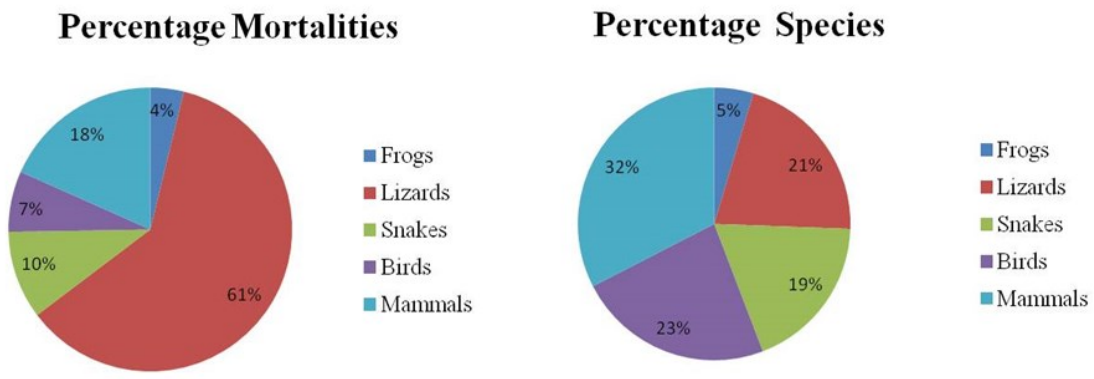

Figure 2. Pie- diagrammatic representation of percentage mortalities (left) derived from the total 289 mortalities of 43 species of five vertebrate groups.

Table1. Frequency table depicted different road killed vertebrate species at Desert national Park at Jaisalmer.

Sl. No.	Common Name	Scientific Name	Road kill frequency			IUCN Global Status
			Jan-Apr.	May-Aug.	Sep.-Dec.	
		Frogs				
1	Marbled Asian Toad	*Duttaphrynus stomaticus*	1	6	2	LC
2	Indian Skittering Frog	*Euphlyctis cyanophlyctis*	0	2	0	LC
		Lizards				
3	Oriental Garden Lizard	*Calotes versicolor*	5	8	5	NA
4	Brilliant Rock Agama	*Trapelus agilis*	1	7	2	NA
5	Yellow Bellied House Gecko	*Hemidactylus flaviviridis*	0	0	1	NA
6	Bark Gecko	*Hemidactylus leschenaultii*	0	1	0	NA
7	Sindh Sand Gecko	*Crossobamon orientalis*	3	2	2	NA
8	Punjab- Snake Eye Lacerta	*Ophisops jerdonii*	0	1	0	LC
9	Indian Spiny Tailed Lizard	*Saara hardwickii*	35	65	25	NA
10	Bengal Monitor Lizard	*Varanus bengalensis*	3	6	2	LC
11	Desert Monitor Lizard	*Varanus griseus*	1	1	0	NA
		Snakes				
12	Red Sand Boa	*Eryx johnii*	2	3	5	NA
13	Common Wolf Snake	*Lycodon aulicus*	0	1	0	NA
14	Glossy Bellied Racer	*Platyceps ventromaculatus*	1	4	0	NA
15	Afro Asian Sand Snake	*Psammophis schokari*	0	2	0	NA
16	Red-Spotted Royal Snake	*Spalerosophis arenarius*	1	1	0	NA
17	Spectacled Cobra	*Naja naja*	0	0	1	NA
18	Saw Scaled Viper	*Echis carinatus carinatus*	1	2	3	NA
19	Sochurek's Saw Scaled Viper	*Echis carinatus sochureki*	0	1	0	NA
20	Sindh Krait	*Bungarus sindhanus*	0	1	0	NA
		Birds				
21	Egyptian Vulture	*Neophron percnopterus*	0	0	1	EN
22	Savanna Nightjar	*Caprimulgus affinis*	1	0	0	LC
23	Laughing Dove	*Spilopelia senegalensis*	0	0	1	LC
24	Indian Roller	*Coracias benghalensis*	1	0	1	LC
25	House Crow	*Corvus splendens*	0	0	1	LC
26	Green Bee Eater	*Merops orientalis*	0	0	1	LC
27	Black Crowned Sparrow Lark	*Eremopterix nigriceps*	0	1	1	LC
28	House Sparrow	*Passer domesticus*	0	0	1	NA
29	White Eared Bulbul	*Pycnonotus leucotis*	2	2	2	NA
30	Common Babbler	*Argya caudata*	1	0	3	LC
		Mammals				
31	Chinkara	*Gazella bennettii*	0	0	1	LC
32	Dog	*Canis familiaris*	2	3	4	NA
33	Desert Fox	*Vulpes vulpes pusilla*	4	1	2	NA
34	Jungle Cat	*Felis chaus*	0	0	2	LC
35	Indian Pale Hedgehog	*Paraechinus micropus*	1	0	0	LC
36	Indian Grey Mongoose	*Herpestes edwardsii*	0	0	1	LC
37	Indian Hare	*Lepus nigricollis*	0	0	1	LC
38	Indian Desert Gerbil	*Meriones hurrianae*	0	1	1	LC
39	House Rat	*Rattus rattus*	0	1	0	LC
40	Indian Gerbil	*Tatera indica*	2	7	2	LC
41	Five-striped Palm Squirrel	*Funambulus pennantii*	5	4	2	LC
42	Domestic Sheep	*Ovis aries*	0	5	0	NA
43	Camel	*Camelus dromedaries*	0	1	0	NA

DISCUSSION

Along the overall road, the annual kill was estimated at 1.05 Kill/km. About 61% casualties were lizards, 18% were mammals while 10% snakes, 7 % birds and 4 % were frogs. Gokula (1997) studied on mortalities in Madumalai revealed seven snakes road kill, over six months, where common wine snake find most affected. In contrast, our study recorded nine species of snakes (Total 30) with the red sand boa (n=11) in the 12 months. The difference could be attributed to the variation in the sampling period, level of effort and survey area. Slow mobility, lethargic to vehicular movement and ignorance of vehicle driver towards animal crossing was the most noticed into the road mortalities. Thermoregulation by snakes by using the road as a substrate and slow

Figure 3. Few depiction of road mortalities in the different transect at Desert national park during the study. Sheep (*Ovis aries*), Spiny tailed lizard (*Saara hardwickii*), Red Sand Boa (*Eryx johnii*), Egyptian vulture (*Neophron percnopterus*), Desert fox *(Vulpes vulpes pusilla*) and Jungle cat (*Felis chaus*) .

movement also has an essential reason for their killing by the vehicles in the Kaziranga National Park, Assam (Das *et al*., 2007). Whereas during the spring season snakes usual find for warmth their body by resting or also coiling similar contributing factor to road mortality estimated (Rosen and Lowe, 1994).

Most of the bird's collision with the vehicles had happened due to their fast ability of flying. We reported a steppe predating on the road killed monitor lizard near to Dav village at Desert National Park (Figure 3) is the same incident where birds have no movement against the vehicles. Vijaykumar *et al*., (2001) research on Anamalai hills, reported 98% of the frequency of *Duttaphynus malenostictus* by the road and vehicular movements, this may occur due to vehicle headlight to feed on the insect in the rainy season (Daniels, 2005). Habitat utilization and human commensal life also a higher exposure to become road kills of frogs (Daniel, 2002).

Drew (1995), reported in his study at Mikumi National park, Tanzania revealed an increased mortalities of the primates and other mammals due to approaching close to the highway to beg eating material from the tourist in the park. Similarly, at Sam dunes tourist point we reported 3 Chinkara, 4 Desert foxes and one camel were found died due to collision with the vehicles. The sudden movement of desert fox, gerbils, spiny-tailed lizards and other creatures also victimize of casualty at roads. Most of mammal, reptile and bird species are nocturnal so that they get blinded by the sharp headlights and killed by the vehicle. In contrast to this, a herd of five sheep's were crushed by a milk van in front of authors in a ruthless manner at a turn near Khurdi village in the desert national park at day time. These studies indicative of increasing road kill mortality problem in a recent year across the globe.

In the Indian scenario, there are certain protected areas where larges cats have also victimized as a road kill. One tigress and two leopards were killed at Sariska Tiger Reserve in Rajasthan (Gruisen, 1998a) and many of leopards in Corbett National Park in Uttar Pradesh (Gruisen, 1998b). In abroad, Maehr *et al*., (1991) reported severe mortalities of endangered Florida Panther Puma (*Concolar coryi*) in Florida. African elephant, (*Loxodonta Africana*, *Panthera leo krugeri* and wild dog (*Lycaon pictus)* were killed by vehicle collisions (Drew, 1995).

The present study is a pilot investigation and short term study. The actual rate of mortality per day and seasonal variability of road kills could not work out. Research depicts the results of the road kill surveys during the study period and discusses the implications towards wildlife management at protected areas and increasing pressure of external development

Conservation Action

The present study has put an issue on the impact of road mortalities on the vertebrate fauna of Desert National Park at Jaisalmer Arid region. When the roads fragment habitats, the animals will be killed or injured by vehicular traffic during movements across roads in search of resources or foraging. The present study shows that the habitat of vertebrate fauna around the roads is the part of their ecology. For the conservation maintenance of biodiversity of vertebrate fauna and increase their genetic diversity, the conservation action plans need to monitor the vehicular traffic of roads crossing the Desert national.

It is recommended that road development plan linking the urban areas in species-rich sites should be made in a manner that animals need not cross the road in their regular movements. To mitigate the problem of road killing, passages and tunnels to be made under the roads, particularly in the biodiversity-rich road accident-prone areas. Fliers and display boards should be placed with instructions such as "Drive slow animals may cross the roads" to reduce the incidences of road kills.

ACKNOWLEDGEMENT

The authors are thankful to the Council of Scientific & Industrial Research - New Delhi (SRF 09/098(0132)/17/ EMR-I) .We also gratified to the forest department of Rajasthan government for the permission for this study (F3 (02)/P/II/CWLW/2016/1754) and Desert national park forest staff at Sam, Sudasari and Khurdi.

REFERENCES

Ashley, E.P. and Robinson, J.T. 1996. Road mortality of amphibians, reptiles and other wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field-Naturalist. 110:403-412.

Baskaran, N. and Boominathan, D. 2010. Road kill of animal by highway traffic in the tropical forests of

Mudumalai Tiger Reserve, Southern India. Journal of Threatened Taxa. Vol 2(3): 753-759.
Chhangani, A.K. 2004. Mortality of wild animals in road accidents in Kumbhalgarh Wildlife Sanctuary, Rajasthan, India. Journal of the Bombay Natural History Society. 101(1): 151-154.
Daniel, J.C. 2002. The book of Indian Reptiles and Amphibians. Bombay Natural History Society/Oxford University Press, Mumbai, Delhi, Calcutta and Chennai. Viii + 238 pp.
Das, A., Ahmed, M.F., Lahkar, B.P. and 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.
Das, I. 1997. Checklist of the reptiles of India with English common names. Hamadryad, Mamallapuram, 22 (1): 32–45.
Das, I. 2002. A photographic guide to snakes and other reptiles of India. London New Holl. Publ. [UK] Ltd. 144.
Das, I. 2003. Growth of knowledge on the reptiles of India, with an introduction to systematics, taxonomy and nomenclature. J. Bombay, Nat. Hist. Soc. 100: 446-501.
Datta, A.K., Hasan, M.K. and Feeroz, M.M. 2018. Threats to Snakes: Mortality of snakes due to vehicular traffic and anthropogenic impacts in Jahangirnagar University campus, Bangladesh. Reptile Rap#179. In: Zoo's Print 33(1): 10-14.
Develey, P.E. and Stouffer, P.C. 2001. Effects of roads on movements by understory birds in mixed-species flocks in Central Amazonian Brazil. Conservation Biology. 15: 1416- 1422.
Drews, C. 1995. Roadkill of animals by public traffic in Mikumi National Park, Tanzania with notes on baboon mortality. African Journal of Ecology 33: 89-100.
Fellows, S., Sharma, G.D., Fellows, A. and Khan, I. 2015. Impact of Existing National and State Highways on Wild Animals of Pench and Satpura Tiger Reserve. Entomol Ornithol Herpetol 4: 167.
Forman, R.T.T. and Alexander, L.E. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics. 29: 207-231.
Foster, M.L. and Humphrey, S.R. 1995. Use of highway underpasses by Florida Panthers and other Wildlife. Wildlife Society Bulletin 23(1): 95-100.
Gokula, V. 1997. Impact of vehicular traffic on snakes in Mudumalai Wildlife Sanctuary. Cobra. 17:26.
Goosem, M. 2001. Effects of tropical rainforest roads on small mammals; inhibition of crossing movements. Wildlife Research. 28: 351-364.
Groot, B.G.W.T.A. and Hazebrock, E. 1996. Ungulate traffic collisions in Europe. Conservation Biology. 10: 1059-1067.
Gruisen, J.V. 1998a. Rajasthan. Tiger Link 4(1): 10-11
Gruisen, J.V. 1998b. Uttar Pradesh. Tiger Link 4(1): 14
Klauber, L.M. 1939. Studies of reptile life in the arid southwest-part 1: Night collecting on the desert with ecological statistics. Bulletin of the Zoological Society of San Diego. 4: 7-64.
Mader, H.J. 1984. Animal habitat isolation by roads and agricultural fields. Biological Conservation. 29: 81-96.
Maehr, D.S., Land, E.D. and Roelke, M.E. 1991. Mortality patterns of panthers in southwest Florida, pp. 201-207. In: Proceeding of Annual Conference of Southeast Association of Fish and Wildlife Agencies 45.
Ortega, Y.K. and Capen, D.E. 1999. Effects of forest roads on habitat quality for ovenbirds in a forested landscape. Auk. 116: 937-946.
Oxley, D.J., Fenton, M.B. and Carmody, G.R. 1974. The effects of roads on population of small mammals. Journal of Applied Ecology. 11: 51-59.
Prakash, I. 1963. Taxonomical and Ecological account of the Mammals of Rajasthan Desert. Annals of Arid Zone 1: 142-162; 2: 151-161.
Reh, W. and Seitz, A. 1990. The influence of land use on the genetic structure of population of the common frog Rana temporaria. Biological conservation. 54: 239-249.
Rosen, P.C. and Lowe, C.H. 1994. Highway mortality of snakes in the Sonoran desert of southern Arizona. Biological Conservation. 68: 143-148.
Row, J.R., G. Blouin-Demers & P.J. Wheatherhead (2007). Demographic effect of road mortality in black rat snakes (Elaphe obsolete). Biological Conservation 137: 117-124.
Seshadri, K.S., Yadev, A. and Gururaja, K.V. 2009. Road kills of amphibians in deferent land use areas from Sharavathi river basin, central Western Ghats India. Journal of Threatened Taxa, 1(11): 549-552.
Sharma, G. 2013. A review on the Studies on Faunal diversity, status, Threats and Conservation of Thar Desert or Great Indian Desert Ecosystem. Biological Forum – An International Journal **5**(2): 81-90.
Shwiff, S.A., Smith, H.T., Engeman, R.M., Barry, R.M., Rossmanith, R.J. and Nelson, M. 2007. Bioeconomic analysis of herpetofauna road-kills in a Florida State Park. Ecological Economics 64: 181-85.
Smith, M. A. 1943. The fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese sub-region. Reptilia and Amphibia. Vol. III – Serpentes. Taylor and Francis, London. 12: 583 + 1 map.
Trumbulak, S.C. and Frissell, C.A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14, 18-30.
Turtle, S.L. 2000. Embryonic survivorship of the spotted salamander (Ambystoma maculatum) in roadside and woodland vernal pools in south-eastern New Hampshire. Journal of Herpetology. 34: 60-67.
Vijaykumar, S.P., Vasudevan, K. and Ishwar, N.M. 2001. Herpetological mortality on roads in the Anamalai Hills, southern Western Ghats. Hamadryad. 26 (2): 253-260.