A PRELIMINARY REPORT OF REPTILIAN MORTALITY ON ROAD DUE TO VEHICULAR MOVEMENTS NEAR KAZIRANGA NATIONAL PARK, ASSAM, INDIA

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Abstract

We report road mortality of reptiles on a highway segment passing along the southern boundary of Kaziranga National Park, Assam, India. A total of 68 instances of road kills of reptiles belonging to 21 species and seven families were recorded. There was a greater mortality among snakes compared to lizards. The arboreal reptiles were the most affected, the highest percent being those that were diurnal followed by the nocturnal, crepuscular and both day and night active species. Possible explanations of such differences in mortality among reptile groups are discussed. It is feared that such kind of persistent loss can be detrimental to the local reptilian population.

Keywords

Assam, India, Kaziranga National Park, reptile, road kill

Of late, roads have been recognized to produce various kinds of ecological consequences including habitat loss and fragmentation (Carr & Fahrig, 2001; Reed *et al*., 1996; Vos & Chardon, 1998). Roads have become one of the growing threat to animal and plant populations (Forman & Alexander, 1998; Trombulak & Frissell, 2000). Through direct mortality on the roads (Ashley & Robinson, 1996), or indirect effects such as the modification of adjacent aquatic and terrestrial communities through vehicle exhaust or runoff (Turtle, 2000), or barriers for movement (Oxley *et al*., 1974), or increased predator activity near roads (Ortega & Capen, 1999) roads contribute to reduced average heterozygosity and genetic polymorphism (Reh & Seitz, 1990).

Roads appear to be barriers to movements for some birds and mammals (Develey & Stouffer, 2001; Goosem, 2001) but not for others (Goosem, 2001; Mc Donald & St. Clair, 2004). Studies dealing with mortality of relatively slow moving animals with limited dispersal ability, such as reptiles (Haxton, 2000; Rosen & Lowe, 1994), and amphibians (Hels & Buchwald, 2001) have been conducted elsewhere. Investigators have suggested that the growing intensity of traffic on roads at the global scale is a contributing factor to declining amphibian populations (Fahrig *et al*., 1995). Herpetofauna with less dispersal ability and greater sensitivity to habitat alteration than birds and mammals may be more sensitive to barrier effect of roads (deMaynadier & Hunter, 2000) 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 herpetofaunal mortality on roads (Vijaykumar *et al*., 2001, Gokula, 1997, Chhangani, 2004), but considering northeastern India, which is a diversity hotspot for herpetofauna (Jayaram, 1974), no study on such ecological loss is hitherto known.

Study Area

The study was carried out during May 2004 to September 2004 on a 60km road segment of National Highway 37, passing adjacent to Kaziranga National Park (26°34'-26°46'N & 93°08'-93°36'E) (KNP), Assam, India. The 7.5m wide paved road separates the southern side of Kaziranga National Park from Karbi Anglong Hills (KAH) and passes through tea gardens, human habitations, paddy fields, teak plantations besides forest habitats of KNP at Panbari, Haldibari, Kanchanjuri and Ghorakati (Fig. 1). All these adjacent forest habitats are animal corridors and are frequently used by megamammals like Elephants, Indian One-horned Rhinoceros, Water Buffalo, Tiger, Leopard and Hog Deer during their to and fro movement between KNP and KAH.

The animal crossing increases manifold particularly during the rainy season (July-September) when the water from river Brahmaputra on the northern side inundates the low-lying areas of KNP.

Methodology

We followed the 'night driving method' to detect reptiles on the road. This method is a type of road transect that yields a reasonable estimate of the species and individuals actively foraging or migrating to and from breeding sites (Shaffer & Juterbock, 1994). This technique outlined by Klauber (1939) has been used extensively to assess the relative abundance and species richness of reptiles (Dodd *et al*., 1989; Fitch, 1949; Rosen & Lowe, 1994) and amphibians (Fahrig *et al*., 1995).

We conducted a 60km road transect on NH37 from Burapahar range to Bokakhat town covering the entire southern length of the park. The transect was covered (Bokakhat as starting point and back) thrice every week between 0600-1000hr and 1800-2300hr. The vehicle was driven at 10-20km/hr depending on visibility, and any reptilian road kill seen was either collected as vouchers or removed from the road to avoid multiple counts and the roadside habitat, state of road kills and location of the road kills were recorded. We used taxonomic keys (Smith, 1935, 1943; Zhao & Adler, 1993) for species identification. Scientific and common names of reptiles were after Das (1997, 2002, 2003). A few species could be identified up to generic level only. Wherever possible, reptiles crossing the road were caught, identified and released off the road in the direction they were heading.

Results

Road kills of 68 individuals of reptiles belonging to 21 species and seven families were recorded. Among them 89.7%

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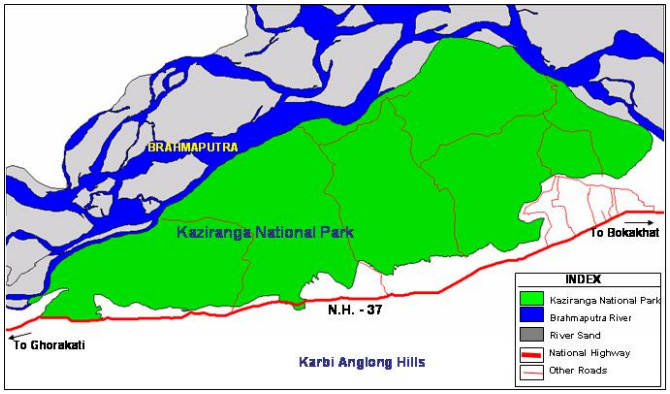

Figure 1. Kaziranga National Park and National Highway 37

(n=61) were snakes followed by lizards 10.2% (n=7). No chelonian mortality was recorded.

Snakes belonging to the families Colubridae (13 species), Elapidae (2 species), Viperidae (1 species) and Boidae (1 species) were recorded, while lizards belonging to the families Scincidae (2 species), Gekkonidae (1 species) and Agamidae (1 species) were recorded (Table 1).

The individuals of the species *Boiga gokool* were more frequently encountered (14 dead; 5 alive) than individuals of any other reptile species.

The percentage of road mortality among arboreal reptiles (*Boiga*, *Chrysopelia*, *Dendralaphis*, *Calotes*, *Trimeresurus*, *Gekko*) was the highest (42.6% (n=29)) followed by terrestrial reptiles (*Amphiesma*, *Mabuya*, *Lygosoma*, *Bungarus*, *Coelognathus* 36.7% (n=25)), arboreo-terrestrial (*Python*, *Lycodon*, *Ptyas*, *Ophiophagus* 13.2% (n=9)) and aquatic species (*Enhydris*, *Xenochrophis* 7.3% (n=5)).

Among the members of the day active species belonging to genera *Calotes*, *Mabuya*, *Lygosoma*, *Amphiesma*, *Chrysopelia*, *Dendralaphis*, *Ptyas*, *Ophiophagus* road mortality amounted to 38.2% (N=26), whereas road mortality among nocturnal (Gekko, *Boiga*, *Lycodon*, *Bungurus*, *Trimeresurus*), crepuscular (*Python and Coelognathus*) and both day-night active species (*Enhydris*, *Xenochrophis*) accounted for 36.7% (N=25), 17.6% (N=12), 7.3% (N=5) respectively.

A number of reptilian species were recorded either crossing the road or close to the road (<5ft on road side habitat) (Table 2).

Table 1. List of reptilian fauna found dead on road run over by vehicles

Scientific name	Common English name	Frequency (N)
Family: Agamidae		
1. *Calotes versicolor*	Indian Garden Lizard	3
Family: Scincidae		
2. *Mabuya multifasciata*	Many-lined Grass Skink	2
3. *Lygosoma sp.*		1
Family: Geckkonidae		
4. *Gekko gecko*	Tokay gecko	1
Family: Boidae		
5. *Python molurus*	Indian Rock Python	3
Family: Colubridae		
6. *Amphiesma stolatum*	Buff-striped Keelback	9
7. *Boiga gokool*	Eastern Cat Snake	14
8. *Boiga quinquncinta*	Assamese Cat Snake	1
9. *Coelognathus helena*	Indian Trinket Snake	8
10. *Coelognathus radiatus*	Copper-headed Trinket Snake	1
11. Chrysopelea *ornata*	Ornate Flying snake	2
12. *Dendrelaphis pictus*	Common Bronzeback Tree Snake	3
13. *Dendralaphis sp.*		1
14. *Enhydris enhydris*	Common Smooth Water Snake	2
15. *Lycodon jara*	Yellow-speckled Wolf Snake	1
16. *Ptyas mucosa*	Indian Rat Snake	2
17. *Ptyas korros*	Indo-Chinese Rat Snake	1
18. *Xenochrophis piscator*	Checkered Keelback Water Snake	3
Family: Elapidae		
19. *Bungarus fasciatus*	Banded Krait	4
20. *Ophiophagus hannah*	King Cobra	2
Family: Viperidae		
21. *Trimeresurus albolabris*	White-lipped Pit Viper	4
		N = 68

Table 2. List of reptiles found crossing or by the roadside

Scientific name	Common English name	Frequency (N)
Calotes versicolor	Indian Garden Lizard	3
Mabuya multifasciata	Many-lined Grass Skink	2
Lygosoma sp.		1
Cyrtodactylus khasiensis	Khasi Hills Bent Toed Gecko	2
Cosymbotus platyurus	Flat Tailed Gecko	3
Python molurus	Indian Rock Python	1
Amphiesma stolatum	Buff-striped Keelback	3
Boiga gokool	Eastern Cat Snake	5
Enhydris enhydris	Smooth Water Snake	1
Ptyas mucosa	Indian Rat Snake	4
Xenochrophis piscator	Checkered Keel Back Water Snake	3
Bungarus fasciatus	Banded Krait	2
Ophiophagus Hannah	King Cobra	1
Trimeresurus albolabris	White Lipped Pit Viper	4
		N = 35

Discussion

Large representation of snakes as road-kill may be because (i) snakes use roads as substrate for thermoregulation; (ii) unlike lizards, their movements on a paved road is relatively slow; (iii) NH 37 represents only high land where snakes can take shelter during high flood; (iv) movement related to reproductive behaviour, as during our study period, we recorded road mortality of gravid individuals of *Boiga gookol* (n=4), *Amphiesma stolata* (n=2) and *Chrysopelia ornata* (n=1).

Such kind of persistent loss at population level may be detrimental for the species as road mortality of snakes has been identified as constituting a 'sink' for local populations (Rosen & Lowe, 1994).

Large representation of nocturnal taxa (*Boiga gokool*, *Bungarus fasciatus*, *Trimeresurus albolabris*) and crepuscular taxa (*Coelognathus helena helena*) either dead or live on road presumably reflects their relative abundance across different habitat types of the study area (pers. obs.). However, day and night variation in traffic intensity particularly an increase in density of heavy vehicles during night hours coupled with visual constraints among drivers may also contribute towards high mortality among nocturnal taxa.

Again, water snakes, although abundant in the study area, are poorly represented on road. They might be avoiding roads and using water channels through road culverts, as more than

roadkills they are found entangled in fish gill nets placed against water current under culverts. The barrier effect of the road is probably reflected by the family Gekkonidae, as their species are abundant in the forest, plantation as well as habitation areas near NH 37 (pers. obs.), but represented by a single individual (*Gekko gecko*) as roadkill.

This preliminary study provides baseline data on magnitude of reptile mortality near a protected area. The impacts of such loss on population remain unknown. It can be assumed that impacts are presumably species specific and detrimental for species with small and declining populations (Spellerberg, 1998).

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