Research Paper

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Mortality of Reptiles, Aves and Mammals Due to Vehicular Traffic Around Ahmedabad, Gujarat, India

Zoology

KEYWORDS : Road kill, vertebrate, season, size class, species.

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ABSTRACT

The environmental impact of roads both positive and negative includes the local effects of highways and public roads such as noise, water pollution, habitat destruction and local air quality disturbance. Study was conducted along the main road from Motera-Ahmedabad (23.030 N 72.580 E, 53 m) to Kalol (22.6060 N 73.4630 E, 100m) 24 km express way and other is from Motera-Ahmedabad to Gandhinagar (23.150 N 72.450E, 76 m), 20 km state highway. The vehicles were counted from 7am to 9pm and it was observed that the average numbers recorded was 125 vehicles/hour on expressway and 72 vehicles/hour on state road. The numbers of road kills were recorded from January to December 2013. The killed animals were observed and recorded by travelling on motorbike at very low speed (20 to 30km/h) at regular time intervals. Mainly three classes namely Reptilia, Aves and Mammalia were taken into account as they exhibit considerable volume of road kill. In class Reptilia total 35 animals belong to eight families were killed on road. In the class Aves total 83 bird species belongs to 14 families were killed. Total 90 individuals belongs to 5 families were killed of class mammalia. In the class Aves eight bird species of sizes from 27 to 32cm were killed, two birds were small in size (15 to 22cm), five bird species falls in size class of 44 to 47cm and just one bird species of 75cm size were killed. In monsoon more number of animals killed on road followed by summer and winter.

Introduction

The most evident effect of roads on wildlife is mortality inflicted by vehicles. In coming years probably more and more animals may be killed in road accidents then they are hunted by human cause (Forman and Alexander 1998). The environmental impact of roads both positive and negative includes the local effects of highways and public roads such as noise, water pollution, habitat destruction and local air quality disturbance. Roads can have both negative and positive effects on air quality. Roads can act as barriers to animal movement and lead to habitat fragmentation (Prajapati, 2006). Many species will not cross the open space created by a road due to the threat of predation and roads also cause increased animal mortality from traffic. This barrier effects can prevents species from migrating and decolonising areas where the species has gone locally extinct as well as restricting access to seasonally available or widely scattered resources. Habitat fragmentation may also results in increased risk on population decline and extinction. Another negative effect is the amount of space roads take up (Trombulak and Frisswell 2000, Serrano et.al. 2002, Develey and Stouffer 2001). In 1994, India had 3 million km of road, of which 50% were surfaced (Rajvanshi et al. 2001). Currently Indian road network of 33 lakh km. is second largest in the world and consists of 200km expressway, 92851km of National highways, 131899 km state highway, 467763km major district road and 2650000km rural and other roads (National highway authority of India). The number of vehicles has been growing at an average pace of 10.16% per annum over the last five years (National highway authority of India, 2015). There is general awareness of the prevalence of mortality due to vehicular traffic of free-ranging vertebrates in India, and reports of such mortality are increasing (Dhindsa et al. 1988, Sharma 1988, Kumar et al. 2000 Rajvanshi et al. 2001, Vijaykumar et al. 2001). The animals killed on road due to vehicular traffic received very little attention in Ahmedabad. To fill lacuna in this particular field I selected the problem and postulate hypothesis to check current scenario-

- Badly affected species with proportion.
- Road kill is similar throughout the year?
- Which size class are affected more?
- Is there road type has any crucial role?

Study area

The study was carried out along the main road from Motera-Ahmedabad (23.03^0 N 72.58^0 E, 53 m) to Kalol (22.606^0 N 73.463^0 E, 100m) that is 24 km express way and other is from Motera-Ahmedabad to Gandhinagar (23.15^0 N 72.45^0 E, 76 m), 20 km state highway without fencing. The expressway is very wide properly maintained toll road, with mostly four lanes and somewhere two lanes. This road is very well protected from both the side with tight fencing and small continuous shallow channel which prevent entry of vehicles and large animals. On express road continuous heavy traffic is flowing round the clock except few late night hours. At some places where villages are located there occurs an entry and exit point. On expressway variety of small to large vehicles are plying. Especially during the night hours the vehicular pattern change and the large and loaded trucks takes charge. The speeds of the vehicles are more on the expressway which ranges from average 70 to 120 km per hour. Ahmedabad Gandhinagar state highway is two and four lane free drive road without any kind of fencing. It is although in a good well maintained condition as it is main connecting roads which connect Ahmedabad with Gandhinagar the capital of Gujarat. On this state highway moderate vehicular traffic (Average 72 vehicles/hour) are going on. The intensity of traffic is relatively low on Saturday and Sunday as there is holiday in government offices. Mostly two wheelers and cars, auto rickshaws, tractors and small tempo trucks, buses and jeeps are plying. The speed of the vehicles on state road is ranging from 40 to 80 km per hour. The numbers of vehicles passing are counted from every five kilometre distance in every other month on both expressway and state highway from January to December 2013. The vehicles were counted from 7am to 9pm and it was observed that the average numbers recorded was 125 vehicles/hour on expressway and 72 vehicles/hour on the state highway and there is no significant difference in numbers of vehicles plying were noted on both road throughout the year. Along the sides of the road were cultivated plantations of common road side plant species, behind which there are agricultural crop fields, fruit and vegetable fields, habitation, and open space are common on both road. But the expressway is unique in case of numbers of small and large scale industries which are higher in number whereas on state road there occurs shopping moles, complexes and small shops. Two medium size perennial and three small seasonal water bodies are located along side of the expressway and five small water bodies are located along side of the state road in which four are perennial as sewage water flowing into it and one is seasonal filled only during monsoon.

Three broad seasons are winter, summer and monsoon in which road was observed. The winter starts from November– February, the summer from March – May, and the monsoon from June-October. Climate is arid to semi-arid type. It is strongly periodic and seasonal. It is characterized by low erratic rains received primarily during the monsoon. The annual precipitation

is highly variable. Rain starts with onset of the Southwest monsoon during the second half of June and ends by the last week of September. During study period annual rainfall was 1254 mm. Highest rain fall 470 mm was recorded in the month of July and the lowest rain fall 167 mm was in the month of August. The maximum temperature recorded was 41^{0}C in May and lowest minimum temperature was 70^{0}C in January. Maximum 88% and minimum 32% humidity was recorded (Bureau of economics and statistics, Gandhinagar 2013).

Methods

The numbers of road kills were recorded from January to December 2013. The killed animals were observed and recorded by travelling on motorbike at very low speed (20 to 30km/hour) at regular time intervals (Two visits/week, from 7am to 9am and from 5pm to 7pm). On expressway I used service road as they do not allow slow moving vehicles on expressway. The killed animals were observed and identified from feathers, beak, and claws for birds and from skin, nails and scales for reptiles and skin, hairs, hoof in case of mammals. Some time the condition of animals killed were so bad and only the little flesh remains, in that case I try to identify by its remains like claws, feathers, skin etc. possibilities are there in which road kills were eaten by scavengers and struck by vehicles and crawled away were not possible to consider and not taken into account. Birds are grouped into size class, as per Ali and Ripley 1989. Statistical analysis was limited to ensure if frequency of road kills were different across seasons by percentage count. It is known that speeds of vehicles, intensity of traffic, the kind of vehicles, width of the road, habitat conditions etc. also affect mortality (Dhindsa et al. 1988, Goosem 1997, Finder et al. 1999). Actual road kill counts may be underestimated due to a variety of factors. Several studies report high incidences of carcass removal by scavengers (Kline and Swann 1998; Enge and Wood 2002; Smith and Dodd 2003).

Results

Both the roads, Motera to Kalol 24 km expressway and Motera to Gandhinagar 20 km state highway, were monitored twice a week for one year from January to December 2013. Mainly three classes namely reptilia, aves and mammalia were taken into account as they exhibit considerable volume of road kill. In class Reptiles total 35 animals were killed on road in which 40% are on expressway and 60% on state way (Table-3). They belongs to eight family includes Testudinidae (Indian star tortoise), Trionychidae (Indian Flapshell Turtle), Gekkonidae (Common House Lizard), Agamidae (Common Garden Lizard), Varanidae (Common Indian Monitor), Elapidae (Indian Krait), Typhlopidae (Brahminy Blind Snake) and Viperidae (Saw-scaled Viper). Maximum 13 (37.14%) animals were killed belongs to family Gekkonidae, followed by Agamidae with 8 (22.86%), Viperidae 6 (17.14%), Elapidae 3 (8.57%), Trionychidae, Varanidae and Typhlopidae with 2 (5.71%) road kill. Very small number of animal just 1 (2.86%) killed belongs to family Testudinidae (Table-1). In the class Aves total 83 birds belongs to 14 families were killed on road during the study period in the study area, in which 40% were killed on expressway and 60% were on state way (Table-3). They includes Phasianidae (Grey Fancolin), Upupidae (Common Hoopoe), Coraciidae (Indian Roller), Centropodidae (Greater Coucal), Psittacidae (Rose-ringed Parakeet), Columbidae (Rock Pigeon and Eurasian Collard Dove), Charadridae (Red-wattled Lapwing), Accipitridae (Shikra), Ardeidae (Cattle Egret), Threskiornithidae (Black-headed Ibis), Corvidae (House Crow and Large-billed Crow), Sturnidae (Commo Myna), Muscicapidae (Large Grey Babbler) and Passerinae (House Sparrow). Out of 83 road kill maximum birds 17 (20.48%) were killed belongs to family Sturnidae. Second largest road killed 12 birds (14.46%) belongs to Muscicapidae. Third largest was Centropodidae and Corvidae 11 (13.25%) birds of each. Family Passerinae remain at fourth position with 8 (9.64%) birds killed. Followed by Threskiornithidae and Columbidae 5 (6.2%) birds belong to each, Coraciidae 4 (4.82%), Psittacidae 3 (3.61%), Phasianidae and Ardeidae have their contribution by 2 (2.41%) bird belongs to each family. Smallest just one bird was killed from Upupidae, Charadridae and Accipitridae each. Total 90 animals were killed from class mammalia. Among them 31% were killed on expressway and 69% were on state way (Table-3). Families include Bovidae (*Boselaphus tragocamelus*), Canidae (*Canis familiaris*, *Canis aureus* and *Vulpes benghalensis*), Felidae (*Felis silvestris*, *Felis chaus* and *Felis catus*), Herpesetidae (*Herpestes javanicus*), Sciuridae (*Funambulus palmarum*), Erinaceidae (*Paraechinus micropus*) and Leporidae (*Lepus nigricollis*). Indian palm squirrel killed in road accidents in maximum numbers 48 (53.33%) among other mammals. Second one was animals of family Canidae 23 (25.55%). Followed by Felidae (8.89%), Erinaceidae 5 (5.56%), Herpesetidae 3 (03.33%), Leporidae 2 (02.22%) and Bovidae 1 (1.11%) (Table- 2). Total 90 animals of class mammalia were killed and among them 7 families are most affected families and in class Aves 83 birds were killed and among them 14 families are most affected families. In class Reptilia 35 animals were killed in which 8 families are most affected families (Table-2). In the class Aves eight bird of 27 to 32 cm size were killed, two birds are small in size 15 to 22cm, five birds falls in size class of 44 to 47cm and one bird of 75cm size were killed. Season wise very small changes in the number of road kill observed. In summer more number of animals killed on road followed by monsoon and winter (Fig.1).

Discussion

Road kill animals were significantly high on state highway in compare to expressway as it is protected from both the sides so large animals cannot enter in easily as well as expressway is well maintained and cleaned every day for any kind of materials and carcass remain on road. The above things were considered and values obtained from expressway before cleaning in some of the cases. Vijaykumar et al. (2001) found no influence of rain on mortality rates of reptiles as it was observed little during this study. Kumar et al. (2000), however, found a significant positive relationship between the rainy season and number of reptiles killed, particularly uropeltid snakes. Common house lizards were killed more because it was observed that mostly during the monsoon it feeds o the insects fall on road below the light polls. And common garden lizards were killed mostly while crossing the road. The rest of the reptilian species killed in less number and the exact reason not known. In the class Aves medium size 25 to 33 cm size of bird's class were affected. It seems that bird's community is less affected by vehicular traffic but for one or other reason birds are killed on roads. Generally the birds who feed on carcasses of dead animals available on road are killed. In some of the cases it was recorded that certain birds just try to cross the road and killed. Large number of fruiting and flowering trees are planted at both sides of the road as part of the social forestry programme attract fruit and nectar eating birds. Indian palm squirrel killed on road in considerable number while crossing the road followed by dog as dogs are frequently wandering and sleeping on road during most of the time. In addition to that it was observed that dogs chasing the vehicles and killed.

Methods to minimize the ecological effects of roads:

Various measures may be applied to prevent, mitigate for impacts of roads on surrounding habitats and wild life. A variety of road-crossing structures have been implemented to mitigate the impacts of road systems on wildlife movement and mortality (Jackson 1999). The general function of a crossing structure is to provide safe passage for an animal across the road and to provide connectivity between habitats adjacent to the road (Forman et al. 2003).

Recommendations:

Conduct more research on the effects that roads and vehicles have on inhibiting road crossing by animals in terms of indi-

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rect effects. Field studies should be conducted at local areas and multi-site areas over periods spanning a minimum of one-generation of target species to account for migration patterns. Acquire and incorporate information on the location and importance of chronic road kill sites to improve placement of road crossing structures.

Table 1: Frequency of road kills of reptiles, aves and mammals in Ahmedabad (Jan. – Dec. 2013)

Class	Family	Scientific name	Common name	No. of individuals (% of total)
Reptilia	Testudinidae	Geochelone elegans	Indian star tortoise	1 (02.86)
	Trionychidae	Lissemys punctata	Indian flapshell turtle	2 (05.71)
	Gekkonidae	Hemidactylus sp.	House lizard	13(37.14)
	Agamidae	Calotes versicolor	Common garden lizard	8 (22.86)
	Varanidae	Varanus bengalensis	Common Indian monitor	2 (05.71)
	Elapidae	Bungarus caeruleus	Indian Krait	3 (08.57)
	Typhlopidae	Ramphotyphlops braminus	Brahminy blind snake	2 (05.71)
	Viperidae	Echis carinatus	Saw scaled viper	6 (17.14)
Total				35
Aves	Phasianidae	Francolinus pondicerianus	Grey francolin	2 (02.41)
	Upupidae	Upupa epops	Common hoopoe	1 (01.20)
	Coraciidae	Coracias benghalensis	Indian roller	4 (04.82)
	Centropodidae	Centropus sinensis	Greater coucal	11(13.25)
	Psittacidae	Psittacula krameri	Rose ringed parakeet	3 (03.61)
	Columbidae	Columba livia	Rock pigeon	3 (03.61)
	Columbidae	Streptopelia decaocto	Eurasian collard dove	2 (02.41)
	Charadridae	Vanellus indicus	Red-wattled lapwing	1 (01.20)
	Accipitridae	Accipiter badius	shikra	1 (01.20)
	Ardeidae	Bubulcus ibis	Cattle egret	2 (02.41)
	Threskiornithidae	Threskiornis melanocephaluss	Black headed ibis	5 (06.02)
	Corvidae	Corvus splendens	House crow	8 (09.64)
	Corvidae	Corvus macrorhynchos	Large billed crow	3 (03.61)
	Sturnidae	Acridotheres trestis	Common myna	17(20.48)
	Muscicapidae	Turdoides malcolmi	Large grey babbler	12(14.46)
	Passerinae	Passer domesticus	House sparrow	8 (09.64)
Total				83
Mammalia	Bovidae	Boselaphus tragocamelus	Blue bull	1 (01.11)
	Canidae	Canis familiaris	Dog	20(22.22)
	Canidae	Canis aureus	Jackal	1 (01.11)
	Canidae	Vulpes benghalensis	Fox	2 (02.22)
	Felidae	Felis silvestris	Wild cat	4 (04.44)
	Felidae	Felis chaus	Jungle cat	2 (02.22)
	Felidae	Felis catus	Domestic cat	2 (02.22)
	Herpesetidae	Herpestes javanicus	Indian mongoose	3 (03.33)
	Sciuridae	Funambulus palmarum	Indian palm squirrel	48(53.33)
	Erinaceidae	Paraechinus micropus	Indian hedgehog	5 (05.56)
	Leporidae	Lepus nigricollis	Indian hare	2 (02.22)
Total				90
Total kills =		208		

Table 2: Status of road kill.

Sr. no	Class	No of individuals killed (%)	Family (%)
1	Reptilia	35 (17)	08 (28)
2	Aves	83 (40)	14 (48)
3	Mammalia	90 (43)	07 (24)
Total		208	29

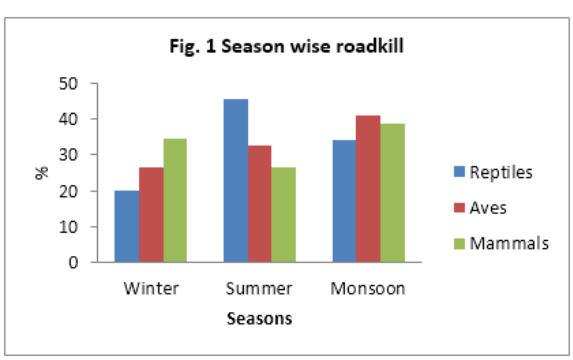

Table 3: Comparison of road kills on expressway and state way.

Class	Road kills		
	Express way (%)	State way (%)	Total
Reptilia	14 (40)	21 (60)	35
Aves	33 (40)	50 (60)	83
Mammalia	28 (31)	62 (69)	90

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