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Loss of Biodiversity Due to Road Accidents in District Bahawalpur, Punjab, Pakistan

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ROADS affect the population of wild animals and are source of barrier between animal's, leads to reduction of biodiversity results in population isolation. To observe roadside accidental biodiversity loss and estimate the total number of accidental biodiversity loss in order to provide solutions to reduce the roadside biodiversity loss, the study was designed to measure the roadside accidental biodiversity loss from Bahawalpur to Lal Sohanra road with a length of 30 Kms and Yazman to Bahawalpur with a length of 31km distance) where two way traffic mode which kept under observation for the collection of data. Average mortality ratio was calculated and it was observed that Reptiles, Birds and Mammals have 2.88±1.92, 3.71±2.96 and 7.46±3.88 per month respectively, on both studied transects (Bahawalpur to Lal Sohanra and Yazman to Bahawalpur). Road has a profound effect on the mortality fauna and wildlife loss occur due to neglegance of drivers. Foraging behavior of animals is one of the major causes to these exposures of roads. In conclousion, Propre counseling of driver about the importance of fauna, vistors should avoid putting partially consumed food bags on road, solid waste management should adequqte and fancing of roads by trees to avoid exposure of fauna to roads.

Keywords: Wildlife, Biodiversity, Bahawalpur, Accidents, Mortality

Introduction

Roads provide multiple benefits to human beings in transportation also a way for fast communication. Roads play important role in development of a country and departments such as health and education [1]. Ecological disturbance is also due to roads such as mortality of animals by collision of vehicles, change of natural hydrologic movement of ecosystems, noise and chemical contamination, and increase of soil erosion [2]. One of the major roles of roads to promote the establishment of different human's communities in a vast area and connects among themselves [3]. Scientists studied various ecological impacts of roads on animals in America Europe and Asia [4].

There is a great need to worry about the biodiversity loss created by roads because at different places there is a variation in severity due to variations in in topography, ecosystem, community, population dynamics, and

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characteristics of a species [5]. Causalities of animals are conspicuous ecological effects of roads [4]. Estimation of mortalities on roads range from hundred to million individuals per year in Pakistan, India and other Asian countries. Millions of vertebrates killed by vehicles are reported from different countries such as in Bulgaria every year five million birds were killed and in Australia approximately every year five million frogs and reptiles were killed [6].

In recent years human developmental and encroachments activities are risk for wildlife habitat because these activities fragmenting their habitat and isolating local animals beyond the loss of animals on road vehicles are also damaging plants by polluting them [7]. The major groups of animals killed by vehicles are reptiles, amphibians, mammals and small animals including birds [8], Collision of animals with trains are also common [9].Roads affect the population of wild animals and are source of barrier between animal's leads to reduction of biodiversity results in population isolation [10]. To save wild life it is necessary to made bridges at regular distance for animal's crossings. This reduces road kills and improves connectivity between animals and their habitat[11].

Many scientists trying to estimate the population of wildlife by using roadkill data. Though it is a good way for estimation but it is not well accurate because not all the animals cross roads. So we need to build mitigation measures for animals [12]. Road side collisions of wild animals increases rapidly in Pakistan, but in our area there is less struggle has been made. In our study highway status of wildlife species was observed including Death of Dogs, Monkey, Donkey, Snakes, Cats, Fox, Ox, Cow, Birds etc. and revealed the management, reduction and prevention of wildlife species death in road side accident[13]. By development of tourism and economic industries, the thickness of traffic volume and road networks have been increasing quickly in current years, which has resulted in inevitable influences on wildlife[14].

Material and Methods

Study Area

Bahawalpur (N 29.3956°, E 71.6836 °), lies in the Cholistan desert and it is located on the south side of River Satluj. It is located 90 kilometer from Multan, 240 kilometer from Lahore, and 700 kilometer from national capital Islamabad. The funna is Chinkara deer, Hares, Parcupines, Owls, Hawks, and Mangoose found in larger number. Average rain is 20 to 25 mm annually.

A study was designed to measure the roadside accidental biodiversity loss from Bahawalpur to Lal sohanra with a length of 30 Km and Bahawalpur to Yazman with a length of 31km distance and two way traffic mode which kept under observation for the collection of data during study period of January, 2015 to December, 2015. Roads were selected due to heavy and frequent traffic from dawn to dusk and even after dark road remains busy with heavy traffic. Study area has a contrasting variety of roadside from agricultural area to residential area, urbanized and scattered residences. There were a variable number of deaths in different areas [15].

Mortality study was done by using a bike Honda Pridor and a camera (Sony) on daily basis except Sunday. Factors of death were collected/ measured by discussion with local residents and by survey of 1 km squre around the site of accident. Three groups of vertebrates (Reptiles, Birds and Mammals) were selected for the sake of study as the selected area was rich in biodiversity.Study was done along the road from Bahawalpur to Lal Sohanra early in the morning from 8:00 am to 10:00 am and from Yazman to Bahawalpur in the evening from 4:00 pm to 6:00 pm. Dead animals were collected and preserved in 5% formaline.The accident spot was tagged by anchoring a stick on the road side to avoid repetition of record. So that, the same accident would not be recorded twice.

The study area was distributed into four hotspots i.e Agricultural area, Residential area, scattered residences and bus stops as related to the distribution of human population in the study area. All hotspots show unanimous distribution of biodiversity and also pose a different picture of biodiversity loss. Statatistical analyses of collected data was done by using T- test.

Results

Roadside mortality of three classes of vertebrates including reptiles, birds and mammals was observed within twelve months of study period from Bahawalpur to Lal Suhanara and Bahawalpur to Yazman from January to December. Results of average mortality ratio was calculated and it was observed that Reptiles, Birds and Mammals have 2.88±1.92, 3.71±2.96 and 7.46±3.88 mortality per month, respectively on both study transects (Bahawalpur to Lal Sohanra and Yazman to

Bahawalpur) during the study period with a range of 15 (minimum 2 to 17 mammals). The highest mortality rate of the mammals per month was 15 while the lowest was 2 mammals. However, the highest mortality of birds per month was 10 birds; similarly highest mortality of reptiles was 6 reptiles per month (Table 1).

Using Independent Samples T-test was used to find any significant difference among the distribution of mortality of Reptiles on two different roads i.e. Bahawalpur to Lal sohanra, and Yazman to Bahawalpur. A statistically non significant difference in the mortality distribution of the Reptiles was existed in the data collected from two different roads F (22) = .142, P = 0.606. Using Independent Samples t-test was used to find any significant difference among the distribution of mortality of birds on two different roads i.e. Bahawalpur to Lal Sohanra, and Yazman to Bahawalpur. A statistically non significant difference in the mortality distribution of the birds was existed in the data collected from two different roads F (22) = 2.57, P = 0.14 (Table 2).

Using Independent Samples t-test was used to find any significant difference among the distribution of mortality of mammals on two different roads i.e. Bahawalpur to Lal Sohnra, and Yazman to Bahawalpur. A statistically non significant difference in the mortality distribution of the mammals was existed in the data collected from two different roads F (22) = 3.93, P = 0.33(Table 2).When we compare the two study transects separately, it was observed that reptiles have slightly higher mean mortality ratio at Bahawalpur to Lal Sohanra (3.08±1.78) as compared to Yazman to Bahawalpur (2.67±2.10). Similar results were observed for birds as Bahawalpur to Lal Sohanra average mortality of birds was calculated (4.67±3.26) in compared to Yazman to Bahawalpur (2.75±2.38).Mortality of mammals also showed higher ratio on Bahawalpur to Lal Sohanra average mortality of birds was calculated (8.25±4.69) in compared to Yazman to Bahawalpur (6.67±2.84) as shown in Table (2).

Results in Table 3 revealed roadside kills from site 1 i.e. Bahawalpur to Lal Sohanra (31 kilometers). Thirty two (32) mortalities of Reptiles were recorded with an average of 1.03 /Km/Year. While in case of birds 33 mortalities were noticed with an average of 1.06 mortalities/Km/Year. Mortality is largest in case of mammals which are recorded as 84 with an average of 2.71 mortalities/ Km/Year.Table 3 also reveals roadside kills on site 2 i.e Yazman to Bahawalpur (30 kilometers). 37 mortalities of reptiles were recorded with an average of 1.23 mortalities/Year/Km. Birds are second largest in this tregard. Total number of

TABLE 1. Showing an average the mortality of three vertebrate classes during study period (January, 2015 to December, 2015).

	Reptiles	Birds	Mammals
Mean	2.88	3.71	7.46
Std. Deviation	1.92	2.96	3.88
Range	6	10	15
Minimum	0	0	2
Maximum	6	10	17

TABLE 2. Showing an average mortality of Reptiles Birds and Mammals at two study sites.

Class	Study Site	No. of Months	Mean Mortality of Reptiles	Std. deviation	P-Value
Reptiles	Bahawalpur to Lal Sohanra	12	2.67	±2.10	0.61
	Yazman to Bahawalpur	12	3.08	±1.78	
Birds	Bahawalpur to Lal Sohanra	12	2.75	±2.38	0.14
	Yazman to Bahawalpur	12	4.67	±3.26	
Mammals	Bahawalpur to Lal Sohanra	12	6.67	±2.84	0.33
	Yazman to Bahawalpur	12	8.25	±4.69	

birds found dead on this site were recorded as 56 with an average of 1.866 mortalities/Km/Year. Mortality is highest in case of mammals.total 99 mammals were killed on this site with an average of 3.3 mortalities/Km/Year.Total 149 mortalities of wildlife were recorded at site 1 with an average of 4.81 mortalities/Km/Year.Total 192 mortalities of wildlife were recorded at site 2 with an average of 6.4 mortalities/Km/Year.

Table No.4 depicts the percentage mortality of all the three classes i.e. Reptiles, Birds and Mammals.Of the total mortalities of site No.1, Reptiles are 32 which contribute 21.48 % of the total mortalities of the site. Birds contribute 22.15 % of the total mortalities of the site No.1 while Mammals are in highest percentage i.e 56.38 %. The table also reveals the percentage mortality of different classes i.e. Reptiles, Birds and Mammals of the total mortalities of site No.2, Reptiles are 37 which contribute 19.27 % of the total mortalities of the site.Birds contribute 29.17 % of the total mortalities of the site No.1 while Mammals are in highest percentage i.e 51.56 %.

Table 5 shows class wise total percentage mortality of the total mortalities at site 1 and 2 reptiles are 69 in number out of total mortalities of both sites during study period of one year which contribute 20.23%. Birds are slightly in higher percentage than reptiles which are 89 in number and contribute 26.10% of the total mortalities. Mortality of mammals was recorded as highest percentage of total mortalities. Mammals are 183 in number and contribute 53.66% of the total mortalities.

TABLE 3. Average mortality/km/years.

Site	Class	Total Mortalities	Average Mortality/KM/Year
Site No.1- Bahawalpur to Lal Suhanara	Reptiles	32	1.03
	Birds	33	1.06
	Mammal	84	2.71
	Total	149	4.81
Site No.2- Yazman to Bahawalpur	Reptiles	37	1.23
	Birds	56	1.87
	Mammal total?	99	3.3

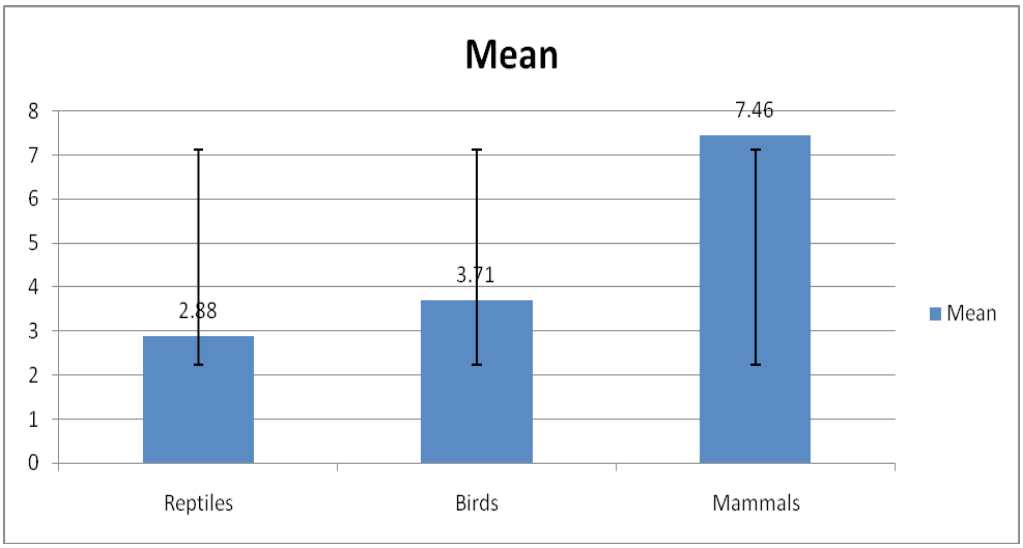

Fig. 1. Showing a comparison of mortality of three vertebrate classes during study period.

TABLE 4. Percentage Mortality at sites 1 and 2.

Site	Class	Total Mortalities	%age Mortality
Site No.1- Bahawalpur to Lal Suhanara	Reptiles	32	21.48
	Birds	33	22.15
	Mammal	84	56.38
	Total	149	
Site No.2- Bahawalpur to Lal Yazman	Reptiles	37	19.27
	Birds	56	29.17
	Mammal	99	51.56
	Total	192	

TABLE 5. Consolidated table of class wise total percentage mortality during the study period.

Site	Class	Total Mortalities	%age Mortality
Site No.1 Bahawalpur to Lal Suhanara and Site No.2- Bahawalpur to Yazman	Reptiles	69	20.23
	Birds	89	26.10
	Mammal	183	53.67
	Total	341	

Fig. 2. Showing Mortality of Mammal

Fig. 3. Showing Mortality of Mammal

Fig. 4. Showing Mortality of Bird

Fig. 5. Showing Mortality of Bird

Fig. 6. Showing Mortality of Reptile

Discussion

Our results in Table1 are parallel to the study of Hobday, A.J. and Minstrell M.L. [16]who revealed in his study most of roadside kills were that of Mmammals.higher number of road kills recorded in countryside shows larger population in those areas. Similarly less mortalities of Birds recorded during our study period may reflect the less number of birds in this area probably because land has been cleared for the purpose of colonization and cultivation which has reduced the bird visits [17].

Moreover Birds are taken as pest in developing and underdeveloped contries like Pakistan and are at higher risk of killing by farmers by mechanical and chemical controls which ultimately reduces the number of birds in the study area.Reptiles are not killed evenly throughout the year because of their ectothermic nature. So less number of Reptiles attempt to cross the road which reduces the rate of Reptile mortality unless these are disturbed by habitat destruction by ploughing the fields [18].

It is apprehended to narrate here that there is no mortality of domestic animal which shows a great concern of people towards conservation of their domestic animals in the study area [19]. It shows that most of the mortalities are a direct result of lack of intrest of commen people in conserving wild life. Most of the birds are killed due to foraging behavior of people. People usualy throw partially empty food wrapers. Dogs come to roads to eat these food remains and are hit by fast coming vehicles [20].

Our study results of average mortality per Km per year revealed by Table No.3 is different from the study of Angel *et al.* [21] that vertebrate road kill rate in his study was 87.8 individuals per Km per Yearand the snake road kills was 78.8 individuals per Km per Year. While in our study 11.2 individuals per Km per Year is very low. This difference may be due to different type of area selected which would be hot spot for mortalities and heavy traffic road as compared to our area of study which is a broader area that is 61 Km while his study area comprises only 6.4 km (prone accidental area selected on personal observation[22]. Moreover our study site is urbanized which ultimately lowers the probability of occurance of wildlife due to habitat destruction for the purpose of colonization and cultivation purpose. Furthermore day length may be another factor directly or indirectly affectin the rate of mortality[23].we have recorded few number of reptile mortalities in winter except the occasional increase in mortalities during harvesting and ploughing season. There is although a higher mortality rate in summer because of their ectothermic nature[24].

Our results in Table 4 are parallel to the study Frietas et al. [25] who revealed his results of mortalities in which most of them Mammals (60%) followed by Birds (31%) and Reptiles (9%).Our results of both transacts reveal the same picture that the mortality of Mammals at site 1 is highest (56%) followed by Birds (22%) and Reptiles(21%).In case of study site 2 the highest mortality was recorded in case of Mammals (51%) followed by Birds (29%) and Reptiles (19%) [26].

These anamoly of result may be due to natural distribution of fauna in both study zones. It also reflects the countinuous arrival of Mammals on road throughout the calander year[27]. Birds come on roads occasionally while acting as scavangers [28]. Similarly Reptiles being ectothermic usually hibernate in fields in winter and come to road in harvesting season when fields are ploughed. Hence mortality of Reptiles and Birds is low while highest in case of Mammals[29].

Our results in table no.5 shows a total number of 341 mortalities of which 183 (53.66%) are mammals, 89(26.09%) are birds and 69(20.23%) are reptiles, areananomous to the Selvan et al. [30] who recorded percentage of mortality in mammals 57(13.48%), Birds 159(37.59%) and Reptiles 125(29.55%) in a study of 423 mortalities.This difference is due to difference of road selected. The road selected by Selvan was a High Way. This may be one of the reasons of difference in mortality results.

Conclusions

It is concluded that raoad has a profound effect on the mortality fauna and Wildlife loss occur due to neglegance of Drivers. Foraging behavior of Animals one of the major cause to there exposure of roads. Inadequate Solid waste management

Suggetions:

- Propre counseling of driver in relation to importance of fauna.
- Vistors should avoid putting partially consumed food bags on road.
- Solid waste management should adequqte, especially butcher shops should keenly manage.
- Fancing of roads by trees to avoid exposure of fauna to roads

Further study suggested to determine the effect of loss on human society and also to determine the socio economic effect of the above said problem.

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Conflict of interest

None.

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