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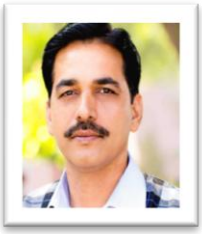
Effects of Road and Traffic on Avifauna in Bhilwara District of Rajasthan India



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Abstract

Avifauna is very sensitive to the changes in surrounding. The era of development leads to construction and maintenance of paved roads and the vehicles which travel on them increase bird mortality on road. During present study it was estimated that there are certain groups of birds which are more risk prone. Out of 236 bird species observed Owls, Shrikes, Babblers, Coucal, Myna parrots and doves are more prone to road mortality due to vehicular collision. Future road construction and safety regulations must be for wildlife consideration. If man made habitats are responsible for killing of the healthier part of natural populations of avifauna, this may lead to common birds up to verge of threat. Other secondary factors like vehicular noise and pollution also accountable for behavioral changes.

Keywords: Avifauna Paved Roads, Mortality, Vehicular Noise, Risk Prone Species.

Introduction

Urban environments may have a rich diversity of bird species (including endangered and threatened species), may be a prime habitat for at least some of these species, Play a role within the overall metapopulation dynamics of bird species at the regional or national scale (which may not be studied for most species) or it appears species-specific (varies across studies of different species), have the potential to connect people to wildlife and nature, as the majority of the global human population now reside within cities. Birds require sufficient and well-connected habitats to establish viable populations. In cities, habitat is fragmented and large suitable patches are lacking. This negatively impacts bird diversity and abundance (Donnelly and Marzluff 2006; Chace and Walsh 2006). The rapid development of road infrastructure and rise in number of vehicles on the roads is going to be an increasing threat to native habitat of many wildlife populations around the world (McGregor *et al*., 2008; Polak *et al*., 2013; Chen and Koprowski, 2016a). One of the important bird sites Gurlan pond situated 15 km from Bhilwra on Bhilwara - gangapur road was badly affected by highway construction. Up to 2015 the Pond was inhabited by more than 80 species including winter visitor like Greater Flamingos, bar headed geese, grey legged geese, great white pelican and painted storks with a population of more than 2000 birds. In 2016 highway construction started on its bank and the bird population abruptly declined. In the case of birds, the literature has shown that occurrence, abundance and species richness of birds is 49 reduced near to roads. This reduction is larger near high-traffic roads than low-traffic roads (Summers *et al.* 2011).

Roads as physical encroachment gives rise to disturbance and barrier effects that contribute to habitat fragmentation, disturb and pollute the physical, chemical and biological environment (Laurance *et al.* 2004; Chen and Koprowski, 2016b). Indirect effects include noise and artificial light influence avian biorhythms regarding to development, singing patterns, breeding, molting and migration (De Molenaar *et al.* 2006; Morelli *et al.* 2014).

Objective of the Study

The objective of this study was to estimate effect of surface road transport on avian fauna of Bhilwara District

Review of Literature

Bishop, C. A., and J. M. Brogan. 2013. Bird mortalities caused by vehicular collisions are recognizedas a conservation concern at both local and national scales,but are more challenging to address than with other vertebrates.

Bruma, T.R. et al. 2018 measure animal road kills on roads in distinct landscapes and recorded 178 roadkills in 4,950 km travelled a rate of 0.035 animal/km-travelled. Number of birds was small, possibly underestimated becausebirds are more easily consumed by scavengers, decreasing the possibility of recording these road kills.

Ciach M. and Yosef R.2011.compared road-killed individuals to those killed by predators in SE Poland in three birdspecies: Yellowhammer *Emberiza citrinella*, Barn Swallow *Hirundo rustica*, and Chaffinch *Fringilla coelebs*. Road-killed individuals are in significantly better condition, so apparently road-kill results in the random eliminationof healthy individuals.

Chhangani A.K. 2004.Described bird taxa killed in road accidents, and the frequency of road-kills at Kumbhalgarh Wildlife Sanctuary. A total of 228 individuals of 32 species of birds were found dead on the roads.

David Andrighetto 2018 Find that a some of Fifty-five (59% of total) native avifauna (birds) ouch t of which a minimum 11 confirmed species/species groups were reported in roadkill including listed threatened species, the Masked Owl (*Tyto novaehollandiae*) in Warrell Creek to Nambucca Heads Road Kill Monitoring Report 2018

Guinard E. *et al.*2012. Survey methods developed to estimate abundance of killed animals on motorways may be biased due to the unequal detectability of carcasses, their persistence time on the lanes, and scavenger's activities. Unbiased surveys are needed to evaluate the relationships between bird casualties (mortality), motorways characteristics, and the neighboring avifauna

Joanna Jack*et al.* 2015 concluded that traffic mortality is an important component of the negative road effect, and that mitigation of road effects on birds should include mitigation for traffic mortality.Where there is a higher risk of traffic collision, there is a stronger decrease in the number of forest birds close to roads over the course of the breeding season.

Kociolek A. V. *et al.*2010.Explore the effects of roads on birds with an emphasis on paved roads. One potential contributor to the worldwide decline of bird populations is the increasing prevalence of roads, which have several negative effects on birds and other vertebrates.

Kociole A., *et al.*2015.In the last three to four decades, the massive and expanding surface transportation network has become a new threat to many avian populations globally through habitat loss and direct mortality. Mitigation measures to reduce mortality due to traffic collision were suggested.

Moller A.P., Erritzoe H., and Erritzoe H.2015. Enumeratewhy some species are killed more often than others in road accidents. They hypothesized that risktaking behavior may affect the probability of certain kinds of individuals being killed disproportionately often. Further more, behavior of individuals on roads, abundance, habit at preferences, breeding sociality, and health status may all potentially affect the risk of being killed on roads.

Morelli F. *et al.* 2014.Reviewed a total of 92 peer reviewed publications for the period of 36 years between 1978 and 2014, which reported positive effects of roads and associated anthropogenic structures on birds. Our results show that roads, railways and several associated constructions, commonly implicated in the decline of biodiversity, may also have positive effects on certain bird species or communities.

Garcia *et al.* 2007 Urban development and road networks extend their impacts on the surrounding habitats along a variable distance, affecting birds living in natural environments. Study identifies the threshold distances upon which several cities and roads, located across a largemosaic landscape of ca. 300 km2 in central Spain, alter the abundance patterns of the native avifauna. Total species richness, total bird abundance, and abundance of different guilds of birds which are potentially sensitive to human disturbances were modeled bymeans of tree regression analyzes. The effect of roads is negative and highly generalized, although threshold distances to roads vary among different groups of species. The bird communities of deciduous woodlands show higher resilience to deleterious influences from nearby cities and roads.

Lucian-Ionel Cioca and Larisa Ivascu 2016 Assess the number of traffic and road accidents and find that this is depending on a series of variables like collision mode,road configuration, conditions of occurrence, road category, type of vehicle involved,

Pandey S.K. 2016. Wild species living close to us and nowadays struggling for survival due to mass destruction of species in road side accident, however there is less effort has been done in this area.

Spellerberg I.F. 1998 Emphesize Effects of heavy metal accumulation and the processes and effects resulting from habitat fragmentation. There is a need to assess the effectiveness of underpasses and tunnels and the nature and functioning of buffer zones. A literature database has been assembled and is being updated

Summers P.D. *et al.* 2015. Bird abundance, occurrence and species richness are reduced near roads, with thelargest reductions where traffic levels are high. Negative correlations have been reported betweenbird richness⁄abundance and traffic noise but the possible causes of road effects are inter-correlated.

Concepts and Hypothesis

Road kill can negatively affect natural populations of animals; particularly if it removes animals of reproductive age. This affects birds especially, since they have low population density, live in wide areas, and have low reproductive rates.

Research Design

Avifaunal Surveys and Field Methods

Seasonal field surveys were conducted for a period of Two year from April 2016 to March 2018 for the collection of data. Three seasons namely, winter, monsoon and summers were considered for monitoring and collecting data. Urban habitats were

broadly divided into–urban terrestrial and urban aquatic habitats. Seasonal surveys were conducted in the morning (6.00-12.00) and late afternoon or evening (15.00-18.00) hours. Different sampling methods were employed as per the requirement. Bird species were assessed in representative Plots using the Line Transect Method (LTM) and modified Transect Method (RTM) (Bibby *et al.* 2000, Javed and Kaul 2002, Urfi *et al.* 2005) and Point Count Method (PCM) for farmland, forest hills, gardens, groves, plantations and protected areas and Total Count Method (TCM) for wetland habitats with less than 5 km perimeter (Burnham *et al.* 1980, Hoves and Bakewell 1989). The common and scientific names of the bird species are after Manakadan and Pittie (2001). The resource guides used for the identification and description were Ali and Ripley (1968 – 1999), Grimmett *et al.* (1999) and Grimmett *et al.* (2004), Rasmussen and anderrton (2014). A photographic record was maintained for the every species. Instruments used for this purpose are Vortex diamond back 8 x 42 for observation and canon 70D with sigma 150-500 mm lens for photograph.

Findings

Effect of Road and Transport

(I a) Ecological Effects of Paved Roads on Birds

The rapid development of road infrastructure and rise in number of vehicles on the roads is going to be an increasing threat to native habitat of many wildlife populations around the world (McGregor et al., 2008; Polak *et al.,* 2013; Chen and Koprowski, 2016a). One of the important bird sites Gurlan pond situated 15 km from Bhilwara on Bhilwara - Gangapur road was badly affected by highway construction. Up to 2015 the Pond was inhabited by more than 80 species including winter visitor like Greater Flamingos, bar headed geese, grey legged geese, great white pelican and painted storks with a population of more than 2000 birds. In 2016 highway construction started on its bank and the bird population abruptly declined. In the case of birds, the literature has shown that occurrence, abundance and species richness of birds is 49 reduced near to roads. This reduction is larger near high-traffic roads than low-traffic roads (Summers *et al.* 2011).

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(I b)Mortality

Bird–Vehicle Collisions

I would like to refer increased bird mortality rate after new paved road construction between Bhilwara and Mandalgarh. Several birds died due to vehicular collision in a small distance of 8 km from suwana to Chavandia where the road pass through farmland in first 15 days of the road became operational. Birds like Southern Coucal, Spotted owlet, Babblers and long tailed shrikes and crow and common myna which are well adopted to cross the old road traffic are badly affected, some injured and some died on the road, (Plate1) due to high speed traffic on new paved road. These findings are in in conformity with following studies abroad. The effects of roads are diverse and complex (Forman *et al.* 2003), resulting in a range of impacts on wildlife populations, most of them negative (Rytwinski and Fahrig 2012).

Many studies have shown that birds are less abundant near high traffic roads than low traffic roads.More then sound and pollution by vehicles mortality on road may be one of the important features for avoiding roads.wildlife-vehicle collisions are estimated to kill 653,000 birds annually in the Netherlands (as cited in Erritzoe *et al.* 2003), 10–60 million annually in England (as cited in Bishop and Brogan 2013), 80 million annually in the USA (Erickson *et al.* 2005), and in Canada, 13.8 million birds are killed on paved roads during the breeding season (Bishop and Brogan 2013), and for most birds the peak collision period appears to be during the breeding and fledging period. 157 species and 17 orders of birds and a minimum of 14,287 specimens have been found dead on roads in North America (Bishop and Brogan 2013). There is no estimate available for Bhilwara district regarding traffic mortality. A total of 228 individuals of 32 species of birds were found dead on the roads Kumbhalgarh Wildlife Sanctuary (KWS) in 50

Rajastan, India,The most frequently killed species included abundant species in the sanctuary such as Eurasian Collared Dove *Streptopelia decaocto* and Laughing Dove *S. senegalensis.* Road-kills of scavengers such as White-rumped Vulture *Gyps bengalensis*, Indian Vulture *G. indicus*, House Crow *Corvus splendens* and Large-billed Crow *C. macrorhyncus* were often found near mammal carcasses, where presumably they had been feeding by Chhangani, A. 2004. Taken together, these studies suggest that traffic mortality could contribute to or could even be a major driver of observed negative road effects on birds (Plate 5).Birds are attracted to roads as a location of concentrated resources, especially food (Erritzoe *et al.* 2003, Rytwinski and Fahrig 2012). The road and road allowances attract prey populations, in particular small mammals and carrion, but also insects and worms that are washed out of the soil onto roads, and snakes that are attracted to the heat, as are some birds (Erritzoe *et al.* 2003, Kociolek and Clevenger 2011). Other resources found near or on roads include grit and salt (Erritzoe *et al.* 2003), puddles that serve as a water source, and telephone and power lines that serve as perches. Road hedgerows offer breeding sites and shelter. Roads even serve as migration routes. It is no surprise, then, that many birds affected to the sudden impact of automobiles while they focus on these resources along roads.

Affected Species or Groups

Some taxa of birds appear to be more at risk from road mortality than others. Some birds of prey

are especially vulnerable to vehicle collision due to their low flight and hunting behavior and have suffered heavy losses (Ramsden 2003, Reijnen and Foppen 2006, Boves 2007,Romain,*et al.*2012). Accounting for removal and search bias, an Idaho study estimated an overall adjusted mortality rate of 288–599 Barn Owls struck per 100 km/year (Boves 2007). Walking birds, water birds, ground nesters, scavengers, frugivores, winter ground seed eaters and migrants that make land fall after traversing long distances over open water are also considered vulnerable (Jacobson 2005). Omnivores, too, can be more susceptible when compared to other feeding guilds (Gopi Sundar 2004, Boves, 2007) especially if they are localized habitat specialists (Mumme *et al.* 2000). However, a recent Canadian study concluded that ground nesters, aerial insectivores, residents and low flying birds are not particularly at risk (Longmore *et al.).* The study found that scavengers and birds with high wing loading (or low agility) were more vulnerable to being killed.The following groups of bird appear to have a higher relative population density-depressing risk from traffic as estimated by Reijnen and Foppen (2006),

(I c) Avoidance Response to Traffic

The traffic activity associated with roads may affect habitat use by breeding birds and nest predators (Pescador and Peris, 2007; Parris and Schneider, 2008). Collision with road traffic causes death of many birds, mostly native, and growing constantly over the years (Erritzoe *et al.* 2003). Most of the studies (Iglesias-Merchan and Diaz-Balteiro, 2016; Dee Amico *et al.* 2016) argued or assumed that the disturbance by traffic noise is main cause of breeding birds'responses to traffic roads, while Summers *et al.* (2011) highlighted road mortality for decreasing bird species richness/abundance proximity to roads than traffic noise. Deicing agents, petroleum-based organic compounds, sediments and other substances regularly run off on roads during construction.Road salt also attracts birds and its ingestion can lead to death (Findlay and Kelly, 2011). Dust on roads changes vegetation composition (Farmer, 1993; Spellerberg, 1998), which can also affect birds. Pollution appears to have fewer effects than other road related effects (Kociolek *et al.* 2011). Although the ubiquity of road contaminants, toxic effect of roads appears to be rare, even in areas with high traffic volumes (Dee Amico *et al.* 2016). .Lower abundance of forest birds near high traffic roads is usually attributed to traffic noise, but the potential role of traffic mortality has not been adequately tested.

(I d) Traffic noise

Traffic volume and associated noise can affect certain breeding bird densities in woodland and grassland habitats near roads (Kaseloo 2005). list mitigation measures (e.g., physical noise barriers and temporal adjustments to traffic flow) that may help abate noise for the benefit of humans and birds. Experimentation using willow hedges (*Salix sp.)* as sound attenuating measures is encouraging (Labrecque and Teodorescu 2005). However, the true benefits of this type of noise reduction measure are unknown as they may attract birds to highways. Data remains insufficient to guide conservation/mitigation efforts in detail but noise suppressing measures may be able to effectively mitigate the impact of noise on birds (Reijnen and Foppen 2006).

(I e) Roadway lighting

Artificial lighting can affect avian biorhythms with regard to development, singing patterns, breeding, molting, migration (De Molenaar *et al.* 2006) and possibly other activities. There is some evidence that roadway lighting may exert a negative effect on habitat quality and the timing of breeding for the Black-tailed Godwit, an indicator species for open grassland birds in Afro-Eurasia (De Molenaar *et al.* 2006).

Conclusion

The paved roads and surface transport negatively affect the bird population in several ways. The main factor is bird vehicle collision which is responsible for death of birds on road as shown in Table 1 and Plate 1..Secondarily the effect of noise and light by vehicle may disturb diurnal cycles which may lead to stress.which in turn affect various physiological activities and alteration of behavior like nest building, Song, feeding, courtship and flight initiation response which need detailed further study.

Suggestion

Contributing factors of Bird - Vehicle Collisions and Possible Mitigations

Species abundance along roads may be positively correlated with road casualties .It seems logical that those species involved in vehicle collisions are those that actually use the road environment, although the likelihood of species susceptibility depends on taxonomic and landscape characteristics (Clevenger *et al.* 2003, Ascensao 2005, Ramp *et al.* 2006).

Basic question is whether a basic set of best management practices exists for mitigating bird road mortality. Before particular road kill mitigations can be employed, relatively precise locations of road kill aggregations must first be identified along with specific details on road design and adjacent habitat (Clevenger *et al.* 2003, Ramp *et al.* 2006). It has been suggested that road kill risk can be determined by a combined analysis of bird behavior and habitat types (Varga *et al.*2006). Species' wing loading information may also help better predict areas of high-risk for bird–vehicle collisions.

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Table 1 Percentage of Road Kill

S.No.	Species	Total No of Bird Sighted	No. of Road Kill	% of Road Kill
1	*Athene brama* Spotted Owlet	10	02	20
2	*Lanius schach* Long-tailed Shrike	25	01	4
3	*Turdoides malcolmi* Large Grey Babbler	125	03	2.4
4	*Acridotheres tristis* Common Myna	256	12	4.68
5	*Centropus sinensis* Greater Coucal	22	01	4.54
6	*Psittacula krameri* Rose ringed parakeet	500	02	0.4
7	*Streptopelia senegalensis* Laughing Dove	122	06	4.91

Fig.1: Road Killing of Avian Fauna

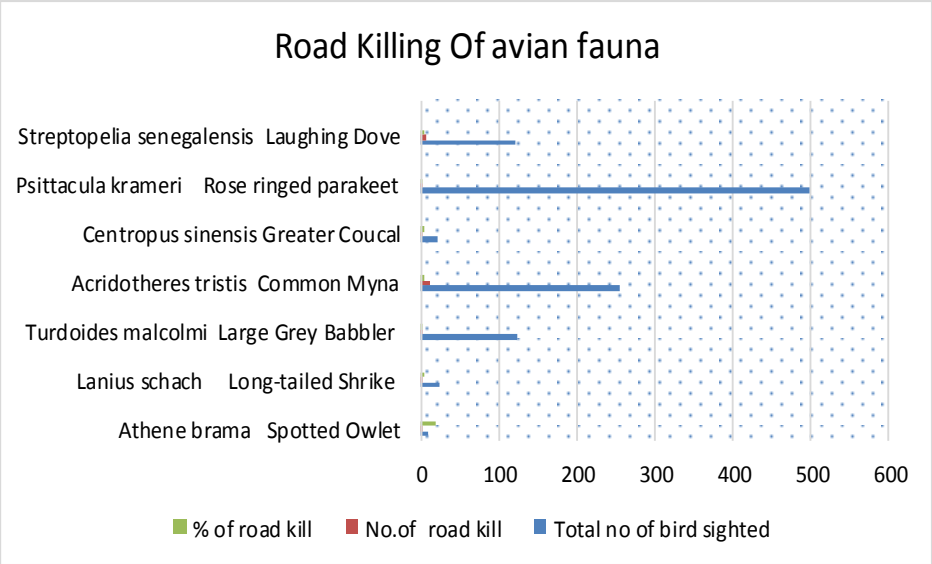

Plate 1: Road Killing of Avian Fauna