



Are Indian foxes vulnerable in degraded habitat in North Gujarat?

The Indian fox, *Vulpes bengalensis* (Shaw, 1800), one of the smallest canids, is restricted to the Indian subcontinent except the Western Ghats (Roberts 1997, Johnsingh & Jhala 2004). They prefer dry vegetation cover including scrub, grassland and agricultural habitat where they can easily feed on rodents, crabs and insects (Prater 1980, Desai & Dharaiya 2022). The Indian fox is listed in Schedule I under the Wildlife Amendment Act 2022 and classified as a Least Concern (LC) species by IUCN (Johnsingh & Jhala 2004), which affords it less attention and a lower degree of protection compared to threatened species.

The Indian fox population is declining in arid landscapes of India and in Nepal due to increasing anthropogenic pressure (Prakash 1994, Shrestha 1997). Construction of new roads and uncontrolled vehicle movement has resulted in collisions with wildlife, which is a significant wildlife mortality factor. Moreover, interspecific competition with feral dog (*Canis lupus familiaris*) near human dominated landscapes reported in Central India is thought to be due to dietary overlap between free-ranging dogs and Indian fox (Vanak & Gompper 2009). Feral dogs compete with foxes because they have the same predatory behavior and are also a reservoir or vector of diseases (Daniels & Befoff 1989, Vanak & Gompper 2009). The impact of habitat destruction, vehicles, and competitors like feral dogs on the population of Indian foxes has gained little attention, except for a few records of fox road kills. This article describes a few cases of Indian fox mortality within degraded habitats, which may be useful in formulating conservation strategies for such underappreciated small carnivore species.

This study is a part of ongoing research on the distribution and ecology of Indian fox in degraded habitat of North Gujarat. North Gujarat is composed of semi-arid forest in five districts

(Mehsana, Patan, Sabarkantha, Aravalli and Banaskantha) covering 16% of the total forest of Gujarat state (Gajera & Dharaiya 2011). The area is in biogeographic zone 4, semiarid, and is classified as ravine thorn forest: 6B/C2 (Champion & Seth 1968, Singh 2001, Chaudhary *et al.* 2022). It is highly fragmented with only a few patches of forest having greater diversity of flora and fauna than the surrounding landscapes (Rabari *et al.* 2022a). The region falls into three different seasons with varied climatic condition where temperature ranges from 5 °C in winter to 48 °C in summer. Annual rainfall is 600–750 mm during the monsoon (Rabari *et al.* 2022b). We visited the field regularly and recorded cases of Indian fox kill. In addition, farmers and livestock grazers from the local area were asked to tell us when they encountered any wildlife kill. Upon receipt of such information, we visited the location for confirmation of species and probable cause of death. For every such incident, the date, time, place and GPS co-ordinates were recorded.

We recorded four cases of mortality in Indian fox during the last five years: (1) 16 November 2019, 08:32 h, in Vagdipodo forest patch (23.939539N, 72.525598E) between Mehsana and Banaskantha: information on the kill of an Indian fox by feral dog(s) received from livestock grazers was confirmed by the kill pattern (Fig. 1A); (2) 23 October 2021, 09:42 h, at SH 10 Kheralu-Siddhpur State Highway (23.882089N, 72.525636E): a road killed adult Indian fox (Fig. 1B) was reported. The 112 km long highway links the towns of three districts of north Gujarat (Patan, Mehsana and Sabarkantha). This highway was being widened during the study period with several diversions; (3) 24 April 2021, 16:37 h, in a degraded habitat at Kheralu, Mehsana (23.853985N, 72.611763E): Indian foxes dig their dens in soil for protection and rearing of pups during the breeding season (Manakadan & Rahmani 2000, Desai & Dharaiya 2022). A female fox with three pups was observed near a single den with 12 openings, which was found destroyed with the remains of burned wood in all the openings a week later.

We observed that a canid, probably the adult female in search of her pups, had tried to reopen the den; (4) On the same day, at another den ~500 m away, pelting with stones in the den entrances was reported.



Figure 1. Photographic evidence of the death cases of Indian fox: (A) a kill by feral dogs and (B) a roadkill

The forests of North Gujarat, which cover foothills at the terminus of the Aravalli Mountain Range are fragile and can be further impacted by increasing urbanization (Rabari *et al.* 2023). Domestic dog is the most ubiquitous canid. The increasing population of feral dogs negatively affects wildlife, especially small and mid-sized mammals. In this study, feral dogs emerged as a threat to Indian foxes in the degraded habitat of North Gujarat. Man's best friend has become wildlife's worst enemy. An estimate of the feral dog populations in villages of North Gujarat is needed and reproductive control should be considered in the conservation of small and mid-sized mammals. The present study also suggests that roads pose a threat to the small to medium sized animals including Indian fox in North Gujarat. Roads, especially those under construction, can be a barrier to animal movements. Animal roadkills by vehicles are significant in rural and urban areas of India

(Dhindsa *et al.* 1988, Sharma 1988, Behera & Borah 2010, Gajera *et al.* 2018, Behera *et al.* 2021). Road length, width, type and surface, and amount of vehicle traffic can influence the rate of wildlife road kills (Smith–Patten & Patten 2008). Collection of fuel wood and grazing are the main reasons for human visits to forest areas. Two Indian fox dens were found destroyed by local people for unknown reasons. According to Singh & Kumara (2006), livestock grazers kill wolves or destroy their dens to prevent predation, but, in the case of foxes, the reason for den destruction is unclear and needs study. Although this study was not conducted in protected areas, our findings can contribute to conservation of small mammals in degraded habitats.

This study reveals emerging and worrying threats to Indian foxes in the degraded habitat of North Gujarat. Foxes foraging in human-dominated areas encounter feral dogs and collisions with vehicles while crossing roads. Anthropogenic pressure in non-protected areas also leads to habitat degradation and populations of small and mid-sized mammals may need the attention of conservationists and government agencies for their survival.

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Literature Cited

- Behera, S. and J. Borah (2010). Mammal mortality due to road vehicles in Nagarjunasagar–Srisailem Tiger Reserve, Andhra Pradesh, India. *Mammalia*, 74(4): 427–430.
- Behera, S., S. Nayak, P.K. Dash, and S.K. Swain (2021). Wildlife roadkill in Odisha, India: the threat to biodiversity needs to be addressed. *Arxius de Miscellània Zoològica*, 19(1): 151–159.
- Champion, H.G. and S.K. Seth (1968). *Revised Forest Types of India*. Government of India Publications, New Delhi: 600pp.
- Chaudhary S.V., P.G. Desai, and N.A. Dharaiya (2022). An annotated checklist of bird diversity of Kheralu, Mehsana, Gujarat. *Species*, 23(71): 74–85.
- Daniels, T.J. and M. Bekoff (1989). Population and social biology of free ranging dogs, *Canis familiaris*. *Journal of Mammalogy*, 70(4): 754–762.

- Desai P. and N. Dharaiya (2022). Diet of the Indian fox (*Vulpes bengalensis*) in dry scrubland of north Gujarat, India. *Taprobanica*, 11(1): 45–46.
- Dhindsa, M.S., J.S. Sandhu, P.S. Sandhu, and H.S. Toor (1988). Roadside birds in Punjab (India): relation to mortality from vehicles. *Environmental Conservation*, 15(4): 303–310.
- Gajera, N. and N. Dharaiya (2011). Status, occurrence, distribution of some mammals of North Gujarat, India. *Proceedings of the Zoological Society*, 64(1): 46–53.
- Gajera, N., P. Joshi, and N. Dharaiya (2018). Highway mortality of vertebrate species in the Aravalli Mountain Range of North Gujarat, India. *Paripex – Indian Journal of Research*, 7(10): 106–108.
- Johnsingh, A.J.T. and Y.V. Jhala (2004). *Vulpes bengalensis*. The IUCN Red List of Threatened Species 2016: e.T23049A81069636.
- Manakadan, R. and A.R. Rahmani (2000). Population and ecology of the Indian fox *Vulpes bengalensis* at Rollapadu Wildlife Sanctuary, Andhra Pradesh, India. *Journal of Bombay Natural History Society*, 97(1): 3–14.
- Prakash, I. (1994). *Mammals of the Thar Desert*. Scientific Publishers, Jodhpur: 114pp.
- Prater, S.H. (1980). *The Book of Indian Animals* (3rd edition). *Bombay Natural History Society*, Mumbai: 326pp.
- Rabari, V.M., A. Malik, and N. Dharaiya (2022a). A preliminary study on relative abundance of wild mammals based on camera trap in Balaram-Ambaji Wildlife Sanctuary, Gujarat State, India. *Journal of Animal Diversity*, 4(3): 53–61.
- Rabari, V.M., A. Malik, and N. Dharaiya (2022b). First camera-trap record of rusty-spotted cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) from Balaram-Ambaji Wildlife Sanctuary, Gujarat, India. *Journal on New Biological Reports*, 11(1): 7–9.
- Rabari, V., S. Chaudhary, P. Desai, and N. Dharaiya (2023). A unique observation of masturbation in a male common langur (*Semnopithecus entellus*) in Jessore sloth bear sanctuary, Gujarat, India. *Munis Entomology & Zoology*, 18(1): 617–619.
- Roberts, T.J. (1997). *The Mammals of Pakistan*. Revised Edition. Oxford University Press, Karachi: 504pp.
- Sharma, S.K. (1988). Bird casualties in road accidents. *Journal of Bombay Natural History Society*, 85(1): 195–197.
- Shrestha, T.K. (1997). *Mammals of Nepal* (with reference to those of India, Bangladesh, Bhutan, and Pakistan) Bimala Shrestha, Kathmandu: 387pp.
- Singh, H.S. (2001). *Natural Heritage of Gujarat*. Gujarat Ecological, Education and Research (GEER) Foundation, Gandhinagar: 262pp.
- Singh, M. and H. Kumara (2006). Distribution, status and conservation of Indian gray wolf (*Canis lupus pallipes*) in Karnataka, India. *Journal of Zoology*, 270(1): 164 – 169.
- Smith–Patten, B.D. and M.A. Patten (2008). Diversity, seasonality, and context of mammalian roadkills in the Southern Great Plains. *Environmental Management*, 41(6): 844–852.
- Vanak, A.T. and M.E. Gompper (2009). Multiscale resource selection and spatial ecology of the Indian fox in a human-dominated dry grass domain ecosystem. *Journal of Zoology*, 281(2): 140–148.

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