DISTRIBUTION OF DESERT FOX (*Vulpes vulpes pusilla*) IN THAR DESERT OF RAJASTHAN, INDIA

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Abstract: Understanding the species distribution can have direct inferences for the conservation of its ecological needs. There has been limited scientific information available on the distribution of small canids like Desert Fox (*Vulpes vulpes pusilla*). A long-term survey and study was conducted in Thar Desert of Rajasthan (India) to know its present distribution. Visual encounter, den sightings, road accidents and secondary source of information from literature as well as through personal interactions with locals, forest officials and scientific community, distribution map has been prepared. The results based upon direct sightings, dens, secondary information and road kills revealed that desert fox was present mostly in western Rajasthan, whereas small population also found outside desert region.

IndexTerms **– Desert Fox, distribution, Thar desert, Rajasthan, transects.**

I. INTRODUCTION

The Red foxes (*Vulpes vulpes*) are one of the most widely distributed carnivore in the world that makes their status as Least Concern (IUCN Red Data List) (Sharma and Sharma, 2013). However, Desert fox *Vulpes vulpes pusilla* (Order Carnivora, Family Canidae), also known as White-footed fox, is a sub-species of the red fox whose large population is largely restricted to Thar Desert landscape of India, Pakistan and Iran (Figure 1). In India, this animal is reported from various pockets of Western Rajasthan (Rajasthan) and Little Rann of Kutchchh (Gujarat) (Dookia and Wilson, 2016). The Desert fox is also included in Schedule I of Wildlife (Protection) Act, 1972 in India and Appendix III of CITES for controlling its fur trade. Desert fox shows diurnal activity with peak at early morning and late evening (Dookia and Wilson, 2016). The Thar Desert or Great Indian Desert is the world's tenth largest desert forming a significant portion of north-western India, covering a total area of 2,78,330 km^2, of which 70% is in Rajasthan, 23% in Gujarat and 7% in Punjab and Haryana states (Sharma, 2013). In Rajasthan, it covers 13 districts (partially or fully), *i.e.*, Barmer, Bikaner, Churu, Hanumangarh, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali, Sikar, Sri Ganganagar and partially Sirohi district. The ambient seasonal temperature of this region varies in a wide range between summer and winter whereas daily temperature variation also has a wide range between day and night. During winter season, it goes down upto 0°C in certain pockets whereas in summer season it touches 50°C at various localities. Rainfall is erratic and sporadic ranging from below 10 cm to 50 cm annually for Thar Desert along with low humidity, high precipitation rates and high wind velocity.

Fig 1. Desert fox, identified by characteristic white-tipped tail

With all extreme environmental conditions, this is worlds highly populated desert region in term of human population as well as biodiversity point of view. The Thar Desert has the admixture of Palearctic, Oriental and Saharan elements in the biodiversity with both floral and faunal species constituting an invaluable stock of rare and resistant germplasm (Ahmed, 1969; Gupta, 1975; Prakash, 1988; Prakash, 1994; Sharma, 2013). This is used as dwelling and breeding habitat by various endemic, rare and threatened faunal

species that have adapted to harsh conditions of this arid region (Pocock 1939, 1941; Prakash 1963). The overall region falls in desert (3A & 3B) and semi-arid (4A & 4B) biogeographic province (Rodgers *et al.*, 2000) with broad topographical features being gravel plains, rocky hillocks, sand-soil mix, and sand dunes, the Indian Desert has been divided into four types of landscapes, viz., hills, plains with hills, marshes and plains with sand dunes (Pandey, 1968; Ramesh and Ishwar, 2008; Sharma, 2013). The vegetation is of thorny scrub type, characterized by open woodland dominated by *Prosopis cineraria* (Khejri) and *Acacia* trees, scrubland dominated by *Capparis decidua, Ziziphus nummularia, Ziziphus mauritiana, Salvadora oleoides, Salvadora persica, Calligonum polygonoides, Leptadenia pyrotechnica, Aerva javanica and Crotalaria burhia* and grasslands dominated *Cenchrus ciliaris, Cenchrus biflorus, Cencrus setigerus* and *Lasiurus scindicus*.

To protect this unique ecosystem and conserve rare as well as endangered animals from the impacts of habitat destruction and modification (Prakash, 1999), the Government of India has declared two important areas in this region as protected area, namely Desert National Park-Sanctuary in Jaisalmer and Barmer districts, with an area of 3,162 km^2 and a small Tal Chhapar Blackbuck Sanctuary in Churu district with an area of 7.89 km^2. The entire landscape has one of the largest and last breeding population of critically endangered Great Indian Bustard *Ardeotis nigriceps* as well as good number of Indian Gazelle or Chinkara *Gazella bennettii* in this region (Dookia, 2002; Dutta et al., 2014). There are many other animals which received little attention, though they are integral part of desert ecosystem. Therefore, in present study, whatever little information sparsely reported in scientific reports and research papers is from the handful of studies that have been conducted almost a decade ago on this animal that has reported its preliminary distribution in few regions of Thar Desert, Rajasthan. In this paper, we report observations on the present distribution of Desert Fox in eleven districts of the state of Rajasthan.

II. MATERIALS AND METHODS

A long-term survey was initiated in 2012 followed by various road transects and interaction with locals about the presence and absence of Desert Fox. The study was conducted from October 2012 to December 2016 in study area (Figure 2) and eleven districts namely Jaisalmer, Jodhpur, Barmer, Bikaner, Churu, Pali, Sirohi, Sikar, Jhunjhunu, Nagaur and Jalore were selected (summary in Table 1). After review of literature and collection of information from secondary sources, areas where maximum times Desert Fox were reported has been selected for validation through systematic and planned survey. Not all but maximum tehsils in every district were covered for survey either by motorcycle, jeep (vehicular) or on foot. Geographic location of direct sighting of either Desert fox or its den was noted down using Garmin GPS during a total of 1946 km survey. During the survey, transects were conducted both during the day as well as in night (spot lighting surveys) that included driving and walking transects in open scrubland, grasslands and agricultural areas in 11 districts. Secondary data was collected in tehsils of all the eleven districts through interactions with people like farmers, shepherds, villagers as well as forest department staff on the possible occurrence (presence/absence) of the species in every district. If more than 50% of the people in a tehsil gave a positive response regarding the occurrence of the Desert fox, we considered the fox as 'present' in the tehsil. Also, to confirm the presence of Desert fox, camera traps were installed at selected locations. Direct sightings included both visual and photographic evidences of hand-held camera as well as camera traps.

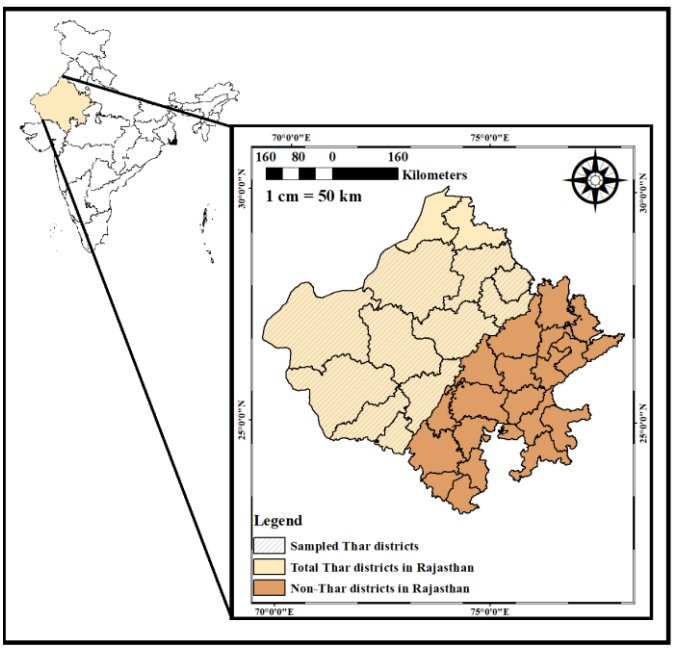

Fig 2. Surveyed regions in Thar Landscape of Rajasthan, India

Table 1. District-wise summary of salient features of study area

District	Area (in Km^2)	Latitude and Longitude	Topography
Barmer	28,387	24°58' to 26°32'N and 70°05' to 72°52' E	Large barren land, loose sand dunes with less vegetation towards west
Bikaner	27,244	27°11' to 29°3' N and 71°54' to 74°22' E	Major western, south western and northern regions are covered with dunes with flat to undulating interdunal plains
Churu	16,830	27°25' to 29°00' N and 73°40' to 75°39' E	Undulating plains covered with and characterized by dunes
Jaisalmer	38,401	26°4' to 28°23' N and 69°20' to 72°42' E	Undulating with sand dunes and barren lands
Jalore	10,640	24°37' to 25°49' N and 71°11' to 73°05' E	Stabilized sand-dunes by natural vegetation towards mid and western regions
Jhunjhunu	5926	27°22' to 28°18' N and 75°1' to 76°03' E	Major portions fall under semi-arid landscapes and Aravalli mountain ranges at South Eastern part.
Jodhpur	22,850	26°00' to 27°37' N and 72°55' to 73°52' E	Mixture of arid land at the western part and semi-arid regions towards the east consisting of rocky hills
Nagaur	17,718	26°25' to 27°40' N and 73°10' to 75°15' E	Major portion of the district is desert with arid regions consisting large sand mounts at North Western part.
Pali	12,387	24°45' to 26°29' N and 72°47' to 74°18' E	Major area is semi-arid and sub-mountainous consisting scattered hills and undulated plains.
Sikar	7742.43	27°12' to 28°7' N and 74°26' to 75°15' E	Area consists of dry regions with brief monsoon season.
Sirohi	5136	24°20' to 25°17' N and 72°16' to 73°10' E	Covered with dry hills and rocky ranges along-with dry deciduous forest.

III. RESULTS AND DISCUSSION

The study resulted in establishing the presence of Desert fox in 11 districts of the Thar Landscape based on various signs as summarized in Table 2. Desert Fox has been confirmed through survey, direct sighting and indirect evidence in 11 surveyed districts of Rajasthan, India (Figure 3 and 4). The results are represented on the bases of direct sightings, dens, secondary information and road kills in selected districts of Thar desert in Rajasthan. Overall, the presence of desert fox was found mostly in western regions Jaisalmer, Churu, Barmer, foothills of Aravalli hills towards western side of Sirohi district, Jhunjhunu and Bikaner districts. However, relatively fragmented and lesser presence was found in eastern regions of Jalore, Jodhpur, Nagaur, Pali and Sikar districts comprising Thar desert.

The presence of Desert fox was found in all 3 surveyed tehsils of Jaisalmer district, mainly in the Jaisalmer tehsil of Jaisalmer district. Even in Jaisalmer tehsil, most of the signs of the presence of Desert fox were located in and around Desert National Park in Jaisalmer district. In Jalore, we surveyed 4 Tehsils (Ahore, Jalore, Sanchore and Raniwara Tehsil) and found that the presence of Desert fox was more in Jalore tehsil. There were road kills found in Sanchore tehsil of Jalore district. 4 tehsils viz. Bhopalgarh, Jodhpur, Phalodi and Shergarh were surveyed in Jodhpur district. The presence of this animal was majority times found in areas located in and around Guda-Bishnoi village as well as dry Luni River basin and in areas towards the dry belt of western regions of Jodhpur district. 4 tehsils (Baytoo, Chohtan, Ramsar, and Sheo) of Barmer district including areas of DNP and 4 tehsils of Bikaner district that included Bikaner, Khajuwala, Kolayat, and Nokha were surveyed and the Desert fox was seen evenly in these tehsils. We surveyed Churu, Ratangarh and Sujangarh tehsils as well as Tal Chhapar Sanctuary in Churu District. It is pertinent to note that Desert Fox was mostly found present in areas outside the Tal Chhapar sanctuary. In Nagaur district, 3 tehsils were surveyed that included Degana, Ladnun and Nagaur wherein most of the Desert Fox sightings were in Nagaur as well as in Ladnun tehsil. However, infrequent presence was also observed in Degana tehsil. In Sirohi and Sheoganj tehsils of Sirohi district that were surveyed, the presence was mostly observed towards the north-western regions of the district, whereas in Jhunjhunu and Chirawa tehsils of Jhunjhunu district, the Desert Fox was found mostly present towards the south-western regions of the district. The presence of Desert Fox was found occasionally but uniform distributed in, Jaitaran, Rohat, Sojat and Sumerpur tehsils of Pali districts as well as in Lachhmangarh and Fatehpur tehsils of in Sikar district that were surveyed.

Table 2. Summary of presence of Desert fox in various districts based on various signs

District	Tehsil	Live sighting	Dens	Road kills	Secondary Information	Effective Hours (District-wise)	Road Surveys (District-wise)
Jaisalmer	Jaisalmer	+	+	+	+	43 hrs	250 km
	Fatehgarh	+	+	+	+		
	Pokran	+	+	+	+		
	DNP	+	+	+	+		
Barmer	Sheo	+			+	39 hrs	201 km
	Baytoo	+	+		+		
	Chohtan	+	+		+		
	DNP	+	+	+	+		
	Ramsar	+		+			
Jodhpur	Phalodi	+			+	35 hrs	260 km
	Shergarh	+	+	+	+		
	Jodhpur	+	+	+	+		
	Bhopalgarh				+		
Jalore	Jalore				+	29 hrs	173 km
	Sanchore			+	+		
	Ahore	+	+		+		
	Raniwara	+	+		+		
Churu	Churu				+	25 hrs	185 km
	Ratangarh	+	+		+		
	Sujangarh	+					
	TCS	+			+		
Bikaner	Khajuwala	+	+	+	+	34 hrs	177 km
	Kolayat	+		+	+		
	Nokha	+	+	+	+		
	Bikaner	+	+		+		
Sikar	Lachhmangarh				+	22hrs	120km
	Fatehpur	+			+		
Pali	Sojat				+	28hrs	156km
	Rohat	+	+	+	+		
	Jaitaran	+			+		
	Sumerpur			+	+		
Nagaur	Ladnun	+	+	+	+	38hrs	240km
	Nagaur	+	+	+	+		
	Degana				+		
Sirohi	Sheoganj	+		+	+	22hrs	100 km
	Sirohi				+		
Jhunjhunu	Jhunjhunu	+		+	+	23hrs	100km
	Chirawa				+		

+: Desert fox presence
***DNP*: Desert National Park**
***TCS*: Tal Chhapar Sanctuary**

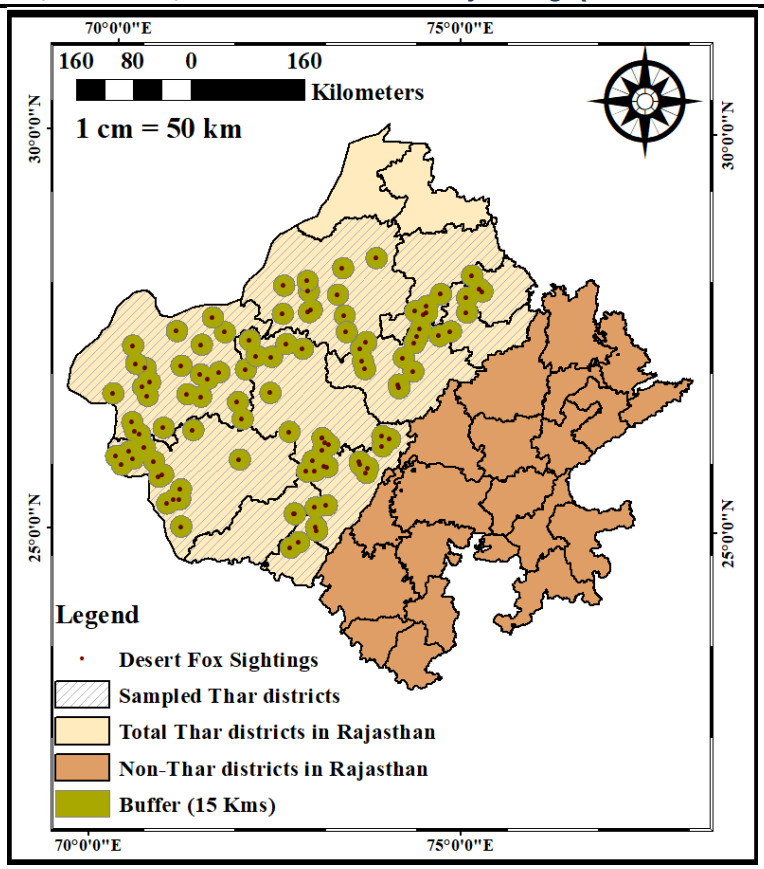

Fig 3. Map showing distribution of Desert Fox in Thar Landscape of Rajasthan, India

So, far no detailed distribution studies have been conducted on Desert fox. Only a little information is available on their distribution and ecology (Rahmani, 1997; Prakash 1997; Sharma, 2013; Dev and Singh, 2016) that seems to be based exclusively on opportunistic observations. Our results indicate that the presence of Desert fox could be seen as more fragmented towards the eastern part of Thar Desert compared to western regions. This may be possible due to that fact the habitat has undergone a fundamental change from open scrub-grassland to more of agriculture land. The most probable reason has been the advent of Indira Gandhi Canal due to which water has become available in this arid landscape (Rahmani, 1997) and agriculture started in an unplanned manner that has disturbed its habitat significantly wherein the pre-existing wildlife including Desert Fox has lost their potential breeding sites and food resources (Sharma, 2005). This has led to the sharing of resources between Desert fox and humans especially in agriculture lands that exposes and makes them vulnerable towards anthropogenic pressure. In addition to this, the findings also suggest that the population is sufficiently present in DNP. However, the same was not true for Tal Chhapar sanctuary in Churu district. This may be attributed to lesser presence of foraging land available to Desert fox in Tal Chhapar compared to vast areas of scrubland present in DNP. Therefore, more detailed information regarding the core habitat and resource utilization of the Desert fox is required to put mitigating measures towards the protection of their habitat.

Fig 4. A - Desert fox pups in Jodhpur district; B - Camera trap image of Desert fox pups in Jaisalmer district

IV. CONCLUSION

The present study was an attempt to document and validate the current distribution pattern of Desert Fox in western Rajasthan, which is its largest stronghold of global population. Though globally its Least Concern, but occasionally hunting and meat consumption of this small carnivore is also observed in western Rajasthan. However, the Desert fox is threatened regionally (Prakash 1997; Sharma, 2013; Dev and Singh, 2016) and its conservation status is poorly known. It was observed that this animal is subjected to various threats arising from human intrusions and disturbance (destruction of microhabitat of dens), habitat Loss or degradation (natural or anthropogenic) and mortality caused by accidents (Figure 5). The main cause of threat to Desert Fox from humans is due to the economic losses it causes to the farmers by preying on lambs and poultry. On the other hand, it may be a keystone predator species in the areas where it is distributed naturally keeping the number of rodents and small mammals in check, thereby benefiting farmers. Therefore, proper measures should be taken for its conservation.

Fig 5. A desert fox victim of road kill in Barmer district

V. ACKNOWLEDGEMENT

We are thankful to the University Grants Commission for funding support to this work, as it is a part of the project under Major Research Project Scheme vide sanction letter no. F. No. 41-29/2012(SR) dated 10.07.2012. We are thankful to UGC for granting this project. We owe a sincere thanks and heartfelt gratitude to the Rajasthan Forest Department for granting us permission vide letter no. 3(02)-11/CWLW/2010/9441 dated 30.1.2013, to work in Desert National Park at Jaisalmer and Tal Chappar Sanctuary at Churu. All the forest officials of the surveyed districts along with ground staff deserved our gratitude for helping us in the survey work. We are also grateful to Dean, University School of Environment Management, GGS Indraprastha University for allowing us to conduct the work and providing lab space.

REFERENCES

[1] Ahmed, E. (1969). Origin and geomorphology of the Thar desert. Ann. Arid Zone 8(2), 172–180.
[2] Dev, K. and Singh, P. (2016). Mammalian diversity of Shekhawati region in arid zone of Thar Desert, India. International Journal of Fauna and Biological Studies, 3(5), 16-22.
[3] Dookia, S. (2002). Habitat preference, abundance and group size of Indian gazelle (*Gazella bennetti* Sykes, 1831) in semi-arid region of Rajasthan. Ph.D. Thesis, J.N.V. University, Jodhpur, Rajasthan. 179 p.
[4] Dookia, S. and Wilson, V. (2016). Ecological studies on Desert Fox (*Vulpes vulpes pusilla*) in Desert National Park-Sanctuary, Rajasthan. Final Report submitted to UGC under Major Research Project scheme. 32 + iii p.
[5] Dutta, S., Bhardwaj, G. S., Bhardwaj, D. K., and Jhala, Y. V. (2014). Status of Great Indian Bustard and Associated Wildlife in Thar. Wildlife Institute of India, Dehradun and Rajasthan forest department.
[6] Gupta, R.K. (1975). Origin and geomorphic evolution of the Thar Desert. In: R.K. Gupta and I. Prakash (eds) Environmental analysis of Thar Desert. English Book Depot, Dehra Dun. Pp. 22–37.
[7] Pandey, S. (1968). Some aspects of geomorphology of Indian arid zone. In: Proc. Symp. Arid Zone, XXI Int. Geography Congr. Mimeo.
[8] Pocock, R. I. (1939 & 1941). The fauna of British India. Mammalia. Volume I and II. Francis and Taylor, London.
[9] Prakash, I. (1997). Ecology of desert mammals. Current Science, 72(1), 13-17.
[10] Prakash, I. (ed.) (1988). Desert ecology. Scientific, Jodhpur.
[11] Prakash, I. (1963). Zoogeography and evolution of the mammalian fauna of Rajasthan desert, India. Mammalia 27(3), 342–351.
[12] Prakash, I. (1994). Biodiversity conservation in Thar Desert. Indian Forester 120(10), 873–879.
[13] Prakash, I. (1999). Biodiversity decline in the Thar Desert during twentieth century. In: A.S. Faroda, M.L. Joshi, S. Kathju and A. Kar (eds) Management of arid ecosystem. Arid Zone Research Association of India and Scientific Publishers, Jodhpur. Pp. 46–48.
[14] Rahmani, A.R. (1997). The effect on Indira Gandhi Nahar Project on the avifauna of the Thar Desert. J. Bombay Nat. Hist. Soc. 94(2), 233–266.
[15] Ramesh, M., and Ishwar, N. M. (2008). Status and Distribution of the Indian Spiny-tailed Lizard *Uromastyx hardwickii* in the Thar Desert, Western Rajasthan, Technical Report No T02, Group for Nature Preservation and Education, India. 1-48.

[16] Rodgers, W. A., Panwar, H. S., and Mathur, V. B. (2000). Wildlife Protected Area Network in India: A Review (Executive Summary). Wildlife Institute of India, Dehradun.
[17] Sharma, G. (2013). A review on the Studies on Faunal diversity, status, Threats and Conservation of Thar Desert or Great Indi an Desert Ecosystem. Biological Forum – An International Journal 5(2), 81-90.
[18] Sharma, R. (2005). Impact of canal irrigation on the ecology of arid zone of Rajasthan. M.Sc. Thesis, Sikkim Manipal University. 93 p.
[19] Sharma, S., and Sharma, B. (2013). Major Canids of Rajsthan in: Faunal Heritage of Rajasthan, India. General background and ecology of vertberates Vol 1. In: Sharma, B.K., Kulshreshtha, S. and Rahmani, A.R. (Eds.). Springer. 491–498.