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Field Report

Estimating breeding pair densities of the Indian fox in Kutch, Gujarat, India

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Abstract

The availability and use of denning sites are important aspects of the ecology of most canids and indicative of breeding units within the habitat. In this paper we discuss the breeding den densities of the Indian fox *Vulpes bengalensis* in a primarily scrub habitat in Kutch, Gujarat, India along with den site observations that were made during the study. Density of breeding units/km² was estimated as 11 ± 1.66 (SE) during the 2005 breeding season. We suggest that, since denning in the Indian fox is restricted to the breeding season, density of breeding units can be used as an effective tool for estimating reproductive success over the years for population monitoring.

Introduction

The availability and use of denning sites are important aspects of the ecology of most canids and are indicative of breeding units within the habitat (Tannerfeldt et al. 2003). Habitats for denning could be a limited resource largely determined by factors such as patchiness (Dell'Arte and Leonardi 2007), food availability (Eberhardt et al. 1983), presence of conspecifics, predators (Tannerfeldt et al. 2002, Arjo et al. 2003, Szor et al. 2008) and human disturbance (Rova 2003). In some fox species, denning is restricted to the breeding season (Eberhardt et al. 1983) and foxes have been known to return to their natal dens to breed (Strand et al. 2000, Frajford 2003). The number of breeding dens is an important indicator of reproductive success and hence can be regarded as a reliable method of determining fox population changes over time (Angerbjörn et al. 1995, White and Garrott 1997). In this paper we discuss the density of breeding units (breeding pairs) established through observations made during the denning period of the Indian fox in a primarily semi-arid scrub habitat in Kutch, Gujarat.

Study area

The study was conducted in scrub habitats of Abdasa Taluka (68°27′ E 22°56′ N to 69°16′ E 23°31′N), Kutch district, Gujarat from November 2004 to May 2005. This area is a part of the semi desert region of India (Biogeographic Zone 3B) (Rodgers et al. 2002), characterized by scant and erratic rainfall (average annual precipitation of 332mm [1980-2002]) as well as temperature extremes, resulting in high evapo-transpiration rates (Tripathy and Pandey 2005). The vegetation is Northern Tropical Thorn Forest (6B), further sub-classified as Desert Thorn Forest (6B/C1) (Champion and Seth 1968). The study area was a human-dominated landscape subjected to varying levels of disturbance.

The Indian fox, like other fox species, has been reported as an omnivorous opportunistic canid (Manakadan and Rahmani 2000, Johnsingh and Jhala 2004, Home and Jhala 2009, Vanak and Gompper 2009). It is mostly crepuscular and nocturnal, foraging usually at night. Much of the information regarding den ecology of the Indian fox is attributed to a single study that was conducted in Rollapadu Wildlife Sanctuary (Manakadan and Rahmani 2000). The breeding season in Rollapadu Wildlife Sanctuary was preceded by re-excavation of old dens as well as digging of new ones, and denning was particularly restricted to the pup rearing period (February to June). In Kutch, the breeding season has been reported from December to January with an average litter size of two (K.S Chauhan, pers. comm.).

Methods

Fox dens were intensely searched within 30km^2 in the scrubland from December 2004 to January 2005 using information obtained from signs as well as secondary information from shepherds. Dens were classified as active if they showed obvious signs such as scats (adult and pup), tracks, occasional sightings and hair or prey remains outside dens etc. Dens were classified as inactive if they had not been prepared for use in the current breeding season and showed no signs of activity. Since we could not mark the individual foxes, active dens once located were monitored intensively. We identified den groups (sets of dens that were used by a single pair during the denning season) based on intensive field observations and monitored them using two-way radios from February 2005 till May 2005. This involved two to three researchers along with field staff. The location (GPS grid reference), evidence of activity, and number of entrances were recorded for each den. Observations were made from hides positioned 300m away from the dens using Olympus 8X40 binoculars. The foxes were observed between 0500h and 1200h, and 1500h and 1930h continuously for seven days per month so that adequate information about pairs using more than one den could be obtained. Since the foxes were not collared, it was not possible to track the animals beyond 1930h. We also involved the shepherds and villagers in the data collection of dens having pups.

A 100% Minimum Convex Polygon (MCP) (Mohr 1947) was plotted for GPS locations of the dens using Arc View GIS (Version 3.2). We also plotted the grid references for the surrounding villages in the study area. Distances were calculated from the centre of activity of each den group to the nearest neighbours using Proximity Analysis. The average of the distances between den groups was added as buffer around the MCP to include the area of possible use by the animal around the dens. Similarly a distance matrix was generated for the dens and the surrounding villages and smallest distances obtained in the matrix were averaged to obtain the minimum distance of fox dens from human habitation. Since dens having pups have been reported to have a higher number of holes (Frajford 2003) we used a t-test to compare the mean number of holes/den between the active dens and those where the pups were sighted/reported using NCSS 2007 (Version 7.1.13) (Hintze 2008).

Results

We were able to track five breeding pairs in the intensive study area. Of these, four pairs were known to have at least two dens sites. The average distance between two or more dens within a den complex was 0.8km (±0.4 (SD)). The buffer computed by taking the average of the minimum distances between den complexes was 1.54km. The total area (MCP + buffer) was 44.4 ± 6.5 (SE) km^2 (Figure 1).

Thus the density of breeding pairs (no. of breeding units/100km²) in the scrubland was found to be 11 ± 1.66 (SE). Minimum distance between fox dens and human habitation was calculated to be 2.9 ± 0.44 (SE) km. An average of 5.25 ± 0.75 (SE) holes/den was seen for all the dens sampled (n = 12) and 6.5 ± 1.2 (SE) holes/den for dens where pup signs were first seen (n= 6) in the scrubland. However there was no significant difference in the average number of holes between dens having pups and the dens without pups (p >0.05).

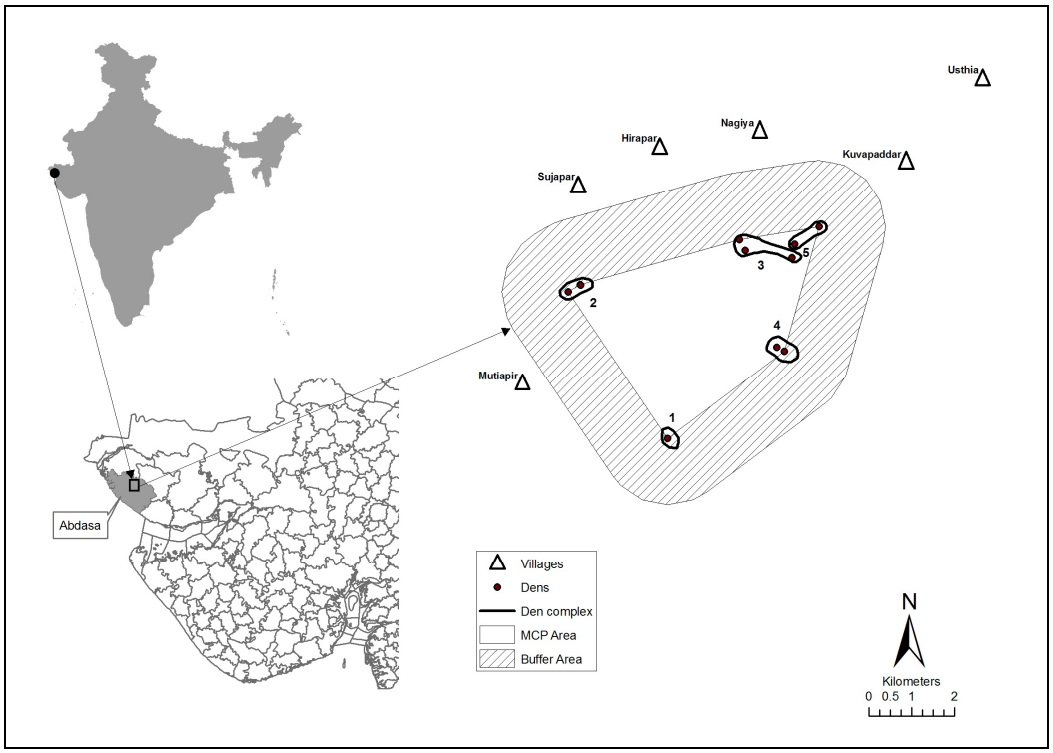

Figure 1. Den groups of the five breeding pairs (shown in black lines) of Indian fox with village locations and sampled area (MCP and buffer) delineated in the scrub habitat of Abdasa, Kutch.

Discussion

Den density (11 ± 1.66 (SE)/100km²) in the present study is indicative of minimum density of breeding units within the scrub habitat since despite intensive search effort, there is a possibility that some breeding dens might not have been located. In the current study we have defined den densities with respect to the presence of den groups only (dens used by the same pair) as compared to studies that have considered only breeding dens in the habitat (Eberhardt et al. 1983, Hewson 1986, Prestrud 1992, Anthony 1996). Breeding group sizes observed for the Indian fox was two for all dens. Although pups were reported from the dens through occasional sightings, much of our den site observations are based on one of the five den units which had a litter size of two.

Our *ad libitum* observations at den sites revealed interesting aspects of den ecology of

the Indian fox. During the denning period the adults remained within 100m of the den that had pups, indicating intense den guarding from predators and conspecifics during pup rearing. Pups were warned by the adult using short barks if they ventured out inquisitively. During denning a considerable amount of diurnal activity was seen. We also observed very strong territorial behaviour during the denning period. On two occasions, adult foxes were seen barking and actively driving away neighbouring conspecifics (as seen in the case of foxes of den groups 3 and 5 (See Figure1)). Multiple uses of dens by foxes during the whelping period have been known to be an effective strategy for predator avoidance as well as sanitation (Sargeant et al. 1975, Zoellick et al. 1989). We observed an incident of den shifting when the pups were approximately one month old. This happened after a jackal was seen in the vicinity of the den the previous evening.

Foxes in general have been known to tolerate moderate levels of human disturbance and often do well in human altered environments (Kamler and Ballard 2003, Frost 2005). The present study shows that Indian fox dens maintain a minimum distance of 3km from surrounding human habitations. The presence of water around human habitations influences den site selection (Zhang et al. 1999) especially during lactation, and fox dens in Kutch have been reported within 2km of water sources (Y. V. Jhala, unpublished data). In the present study, local shepherds also reported foxes frequently visiting the village ponds at night.

In semi-arid environments where food resources for foxes fluctuate due to changes in rainfall patterns, foxes maximize their reproductive abilities during resource-rich years. Earlier in Kutch, densities of breeding pairs in and around scrublands were found to be around 4-6 breeding units/100km^2 which increased to 10-15 breeding units/100 km^2 during periods of rodent abundance (Johnsingh and Jhala, 2004). The minimum density of breeding units estimated in the study (11 ± 1.66/100km^2) seems to indicate a healthy population of breeding pairs in 2005 suggesting a good prey base (since the value corresponds to the range of higher breeding densities mentioned above).

Densities of breeding dens have been effective in monitoring fox populations (Anthony 1996) as well as planning management strategies to control fox populations where they are considered to be pests (Hewson 1986, Gentle 2005). Being an effective indicator of breeding success, if sampled for successive years, they can give important insights of changes in populations. This may be further associated with ecological correlates such as availability of potential prey species as well as the presence of diseases. Since some of the standard techniques used for estimating fox populations, such as capture-mark-recapture (Baker et al. 2001, Harrison et al. 2002) and radio-tracking (Baker et al. 2000) rely largely on money and manpower, estimating the density of breeding units can be a cost-effective tool for the long-term monitoring of Indian fox populations.

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