VEGETATION COVER CHANGE IN MANGLOT WILDLIFE PARK, PAKISTAN: AN INDICATOR OF SUCCESS OR A DILEMMA IN MANAGEMENT

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ABSTRACT

Manglot Wildlife Park was established in early 90's for re-introduction of chinkara, hog deer and urial to the range from where they were extinct. The park's vegetation changed over time with fencing and protection. Vegetation at center improved, while on periphery of the park degraded. This helped escape of some individuals of chinkara gazelle and establishing population in the nearby area with comparatively open vegetation. In this paper we have analyzed the vegetation change in Manglot Wildlife Park over time with Landsat time series. The changes suggest improvement in forest area of 1992 from 553 ha to 669 ha in 2013. This is however concentrated in center of the park, which is probably more protected than its peripheries. The open areas in the park reduced from 317 ha to 231 ha in 2013, however the degradation is more towards the edges, where local communities living around the park is probably cutting the forests. However, this degradation at edges, creating open areas which are preferred habitat of chinkara, has probably played a key role in escape of the chinkara from the park and establishing its population outside of the park, in the nearby open area.

Key words: Manglot, Nizampur, Chinkara, Pakistan, Wildlife, Khyber Paktunkhwa, land use change.

Background and introduction

Protected areas of different types are being established around the world. Different protected areas have different conservation objectives. These vary according to their ecological, ecosystem, and socio-economic needs. It is however often difficult to establish indicators of success to measure achievements of objectives of a protected area. The Khyber Pakhtunkhwa Wildlife Department in Pakistan has established protected areas that cover about 14% of the land cover of the Khyber Pakhtunkhwa province. The various categories of protected areas in the province include 6 National Parks, 3 Wildlife Sanctuaries, 38 Game Reserves, 89 Community or Private Reserves and 3 Wildlife Parks (Khan, 2012).

The Wildlife Parks, 5 in number, were started with establishment of Manglot Wildlife Park in 1990's. The other Wildlife Parks in the province are Tanda, Kotal, Cherat, and Nizampur. The primary purpose of these protected areas was to re-introduce species such as chinkara gazelle (*Gazella gazelle*), hog deer (*Axis porcinus*) and urial (*Ovis orientalis*) to the habitats from where

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those were wiped out. The wildlife parks are fenced and protected for safe breeding of the targeted species. The oldest among these, established in 1990, is the Manglot Wildlife Park, while the newest is the Nizampur that is completed in 2013.

The Manglot Wildlife Park covers an area of around 1756 acres (Anonymous, 2013). The park was fenced at its circumference, which measures about 20 km in length. The fencing purpose was to provide protection to the animals, prevent them from going outside of the park boundaries, exclude livestock and create conditions where habitat can improve through growth of the forests and vegetation cover. The fencing of the Khwara reserve forests was challenged by the local communities and thus a conflict was in place for some time. However, government was successful to establish its writ and stop cutting of the forest. This paper focuses the vegetation cover and its change over time. The research used Landsat time series to assess change in vegetation as indicator of the effectiveness of the protected area, and as a source of achieving its conservation objectives. The analysis indicates that vegetation improved towards the center of the park, but degraded at edges. This probably played a key role in achieving the objectives of the park, as some chinkara population recently reported to have established in the area outside of the park. The paper reviews the analysis and its implications for the park's effectiveness.

The Data, Methods and material

The data used for this paper is a multi-temporal Landsat TM data from Landsat 5 and Landsat 8, which is available in 185 km × 170 km scenes defined in a Worldwide Reference System of path (groundtrack parallel) and row (latitude parallel) coordinates (Arvidson et al., 2001). The multi-temporal data, consistently taken for a given geographic region is useful tool for analyzing and detecting changes through repetitive coverage at short/long intervals and consistent image quality (Singh, 1989). Landsat with launch in 1972, provides the only inventory of the global land surface over time on a seasonal basis (Chander et al., 2009).

To meet objectives of this paper, we used two viable Landsat datasets including Landsat 5 imagery from April 10, 2000 and Landsat 8 imagery from April 14, 2013. This covers one scene with row 151 and path 037. Bands for the purpose used included 5-4-3 of Landsat 5 image and 6-5-4 of Landsat 8 image. The analyses were made through the C++ language sequential program easi.bat, and Focus of PCI Geomatica. April was selected for the images, as this is the active growing season for the acacia and olive forests, the dominant vegetation in the Manglot Wildlife Park. During the month the vegetation has bright green colors, when the images are displayed in Red and NIR bands. The April is the month following spring blooms and sprouting, and therefore the spectral responses could be at maximum.

For analysis of the image to forest and non-forest land covers, the objective of the research paper, was done with decision tree from supervised classification. The supervised classification was used primarily on the basis that adequate priori knowledge about the research area exists and that it is comparatively a small area mapping covered in one scene (Cihlar, 2000). To date, forest change products dominate due to the topicality of forest change regarding carbon accounting, biodiversity monitoring, and other issues concerning forested landscapes. Another reason forests are the most common large area monitoring target using remotely sensed data is that forests are one of the most easily distinguished vegetation cover types when compared to other monitoring targets, such as croplands or urbanized landscapes (Hansen and Loveland, 2012).

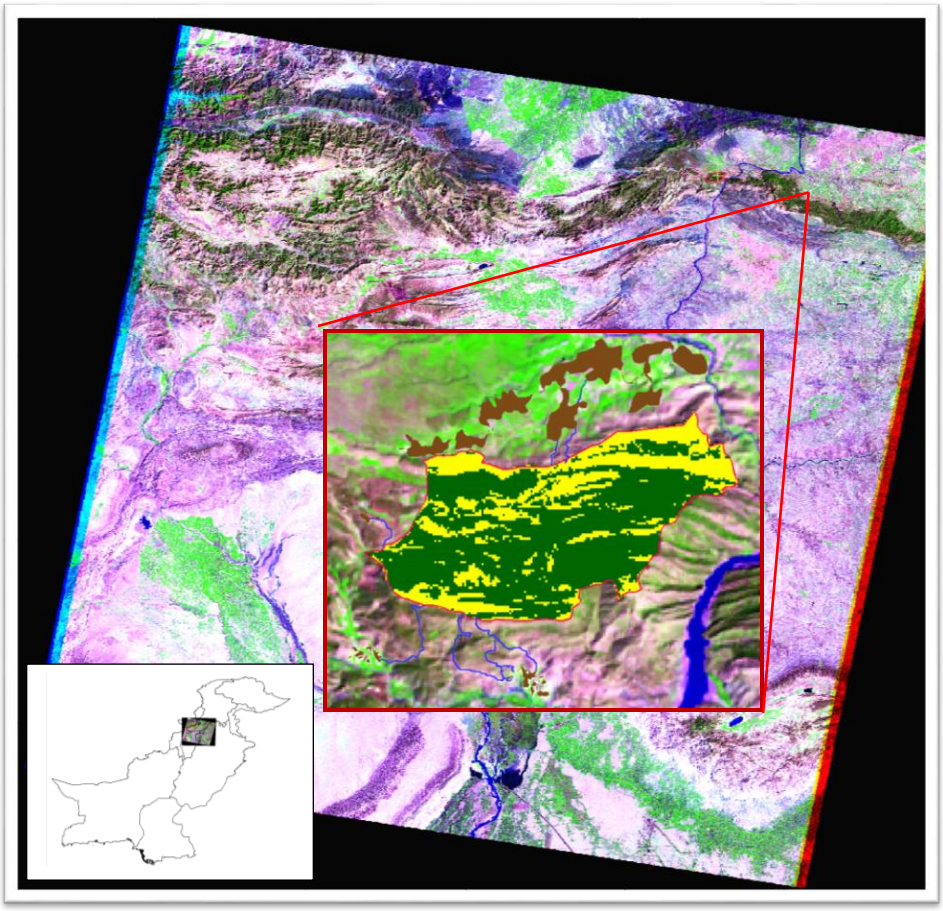
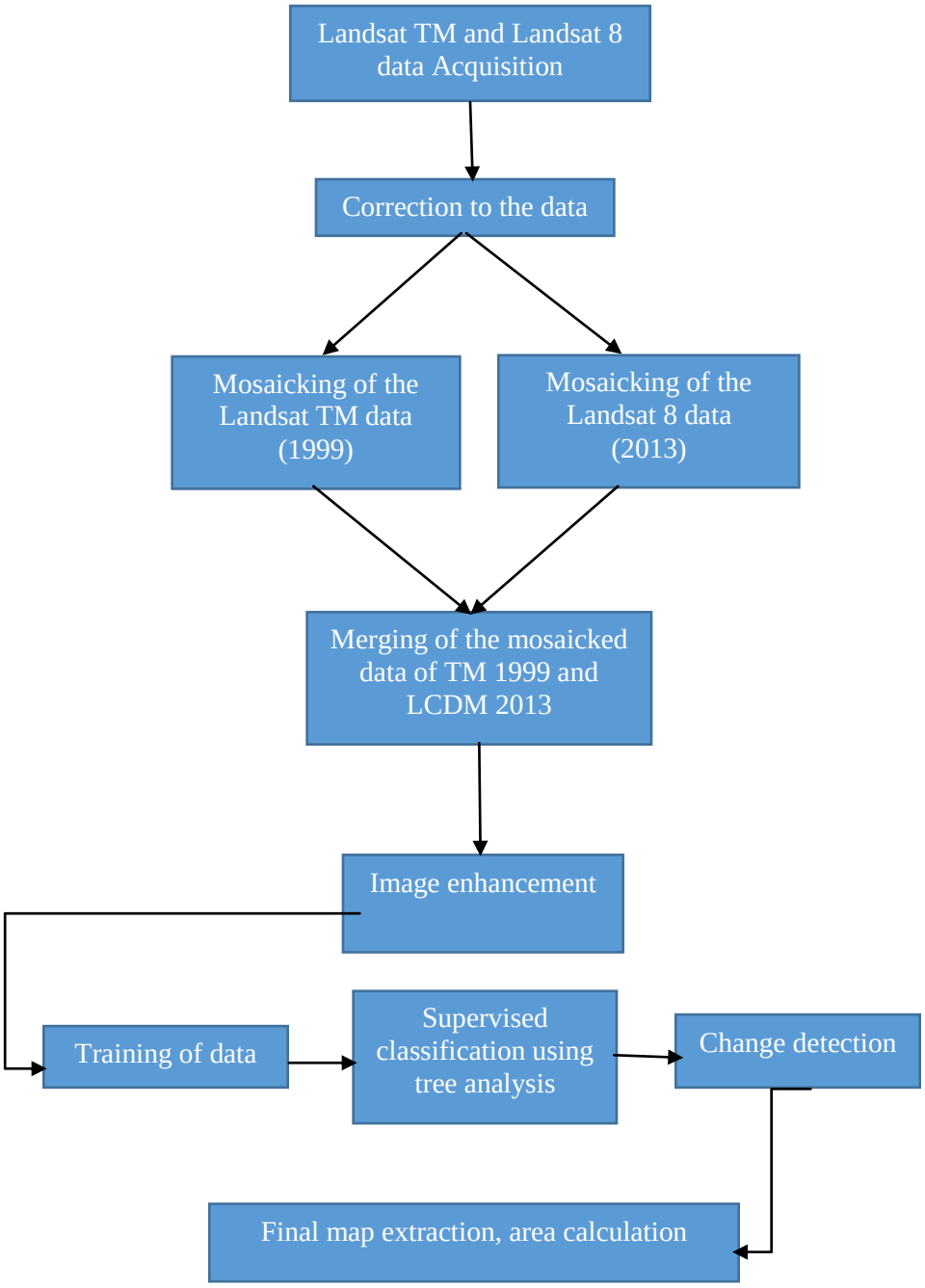


Fig.1. Training data for forests (blue) and non-forest areas (green) was used to train all the pixels in the images



Flow chart of the methods applied in this paper

The classes of interest for classification in this research paper were 1) forests and 2) no forests, 3) change and 4). no change. Various relative calibration methods are first compared and their effects on the results of interpreting the "change image" are then studied. As it is some-times impossible to locate unchanged areas for calibration, the use of both unchanged and changed training areas for calibration purposes is tested here. (Tokola *et al*., 1999).

Land cover maps of forest and non-forest areas and change in forest area between 2000 and 2013 were produced in Focus of PCI Geomatics software. Area of the Manglot Wildlife Park being small and difficult to analyze, was marked through creating a polygon based on boundaries of the Wildlife Park obtained from the concerned management authority (Pers comm. Ayaz Khan. 2014.). The boundary polygon, measuring about 865 ha was overlaid in focus on the images for demarcation of the area and for exclusion of the rest of the image as no-data layer.

RESULTS

1. Visual analysis of the images for 2000 and 2013 indicate to an improved forest cover in the Manglot Wildlife Park. This might have resulted in improved habitat, food security for the animals, and a better opportunity for animals' population growth. The interpretation was done through the following:

    i. The classification results for 2000 and 2013
    ii. The change and its impact on ecology of the area
    iii. The causes for change

2. The total area, as demarcated from the map of the Khyber Pakhtunkhwa Wildlife Department is about 865 ha (2137 acres). This contradicts the area of 1756 acres (710.62 ha) presented for the Manglot Wildlife Park (Khyber Pakhtunkhwa Wildlife Department website) and the Nizampur (2013). This is lower than the area calculated in this paper. The location of the park, as provided in the website of the Khyber Pakhtunkhwa Wildlife Department, doesn't match the Google Earth coordinates. According to the Khyber Pakhtunkhwa Wildlife Department the Manglot Wildlife Park lies between 71^0 56' and 33^0 47' North latitude, and 71^0 58' and 33^0 45' East longitude. According to the measurements from the Google Earth, the Park's coordinates are 71^0 59' 03' E, 33^0 45' 20" N to 72^0 02' 21" E, 33^0 45' 14" N and 72^0 01' 38" E, 33^0 46' 13" N to 72^0 00' 10" E, 33^0 44' 47" N. The coordinates at each corner of the Park are given below:

Long/Latitude	Upper left corner (ULC)	Lower left corner (LLC)	Upper right corner (URC)	Lower right corner (LRC)
East	71^0 59' 38"	71^0 59' 18"	72^0 02' 23"	72^0 02' 05"
North	33^0 45' 58"	33^0 45' 01"	33^0 45' 58"	33^0 45" 00"

3. According to results of the classification, in 2000 about 553 ha in Manglot Wildlife Park were covered by forests, while 312 ha were non forest area including the trails, blank areas and buildings. The non-forest areas were mostly distributed throughout the park, while the forests were mainly concentrated to the left side, which is adjacent to the road. The road access to this part was probably better and therefore the concerned protection officials were able to protect it, before the area was declared as a Wildlife Park.

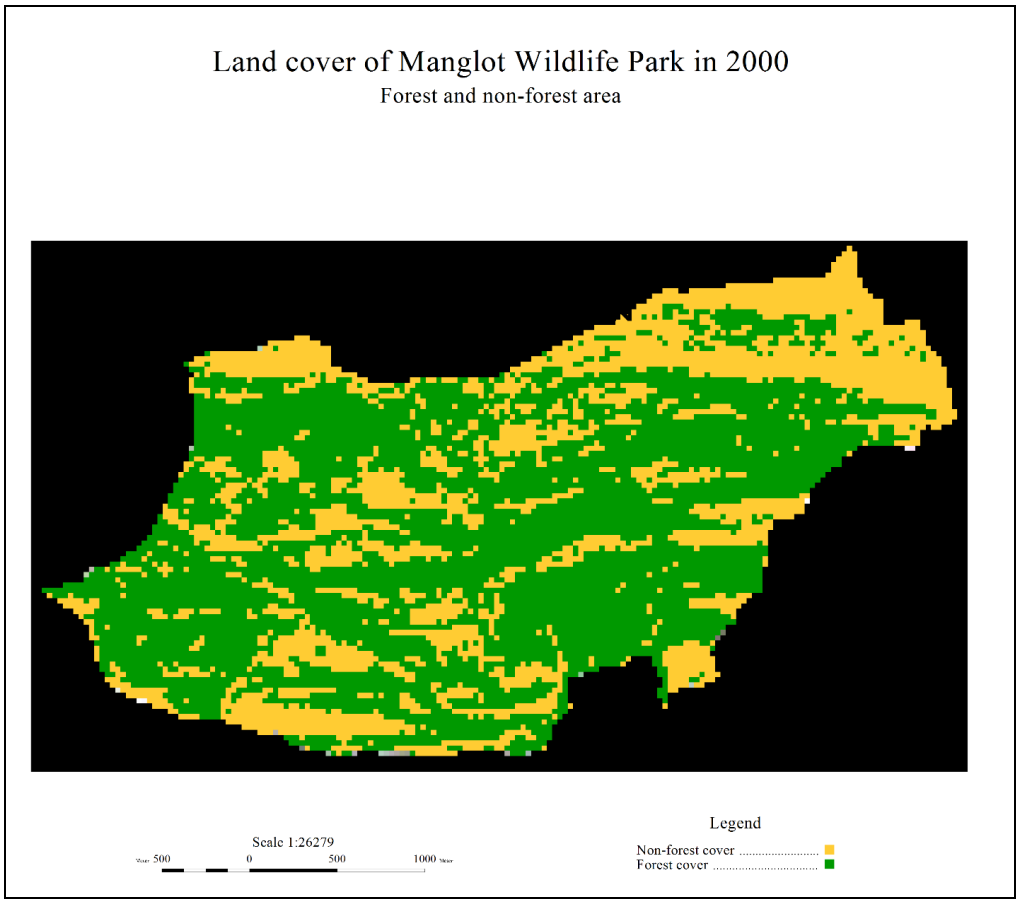


Fig. 2. Forests and non-forest area of Manglot Wildlife Park, 2000

4. The classification results of Manglot into forest and non forest area

suggest that forest area in Manglot Wildlife Park has grown from 583 ha of 2000 to 669 ha in 2013. The non-forest area shrunk from 317 ha to 231 ha, which is a significant achievement. The forest area improved in the center, while the non-forest area converged to the Park's boundaries. This is probably due to fencing of the park with a wire mesh of 8 feet height all along the boundary of the Park. Also that the Park Office is located in the western side along the road, where the protection staff is located. Also, a network of roads in the park was constructed after fencing, which probably resulted in improving access to the park and improved protection.

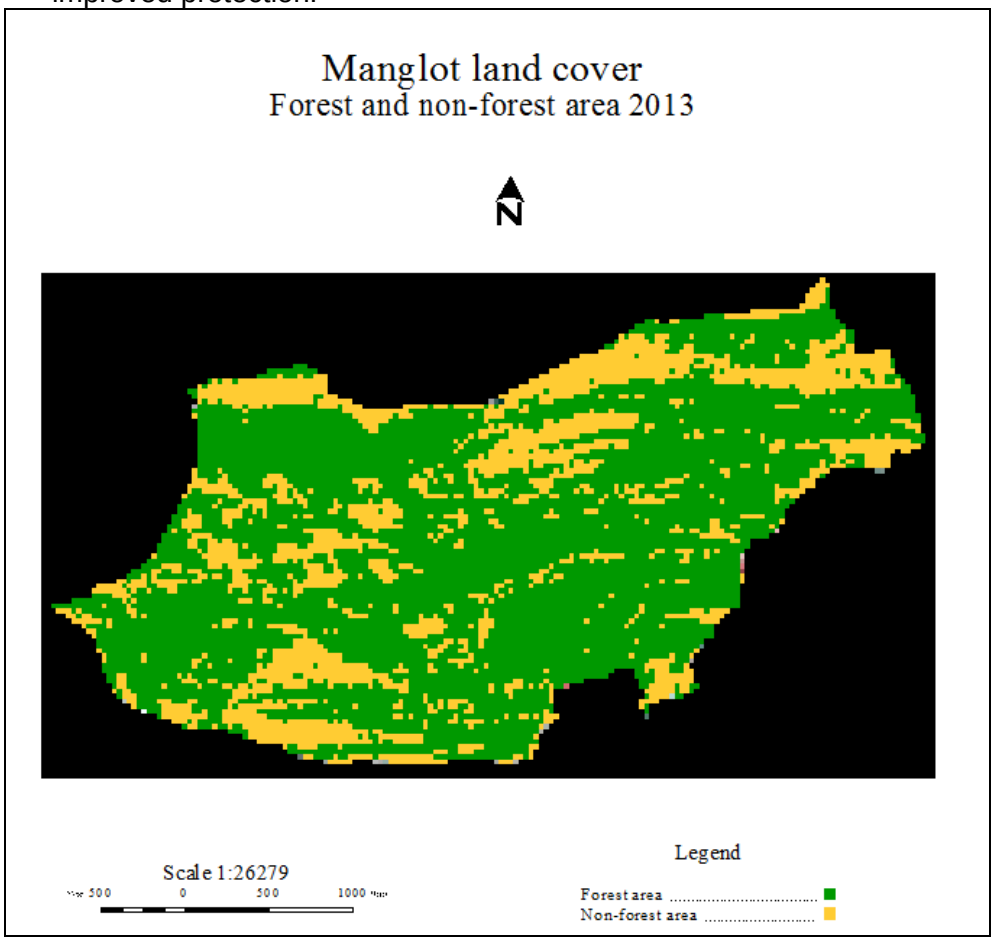


Figure 3: Forest and non-forest area of Manglot Wildlife Park, 2013

The deforestation on Park's North Eastern and Western boundaries is probably due to the location of villages at each of these sides, and that tracks exist that provides access for the villagers to the park. The change detection map

with location of villages and tracks between villages and the Park suggests that deforestation is associated with access from the villages to the Park through the tracks. Where the tracks join the park, the deforestation is higher (see figure 4)

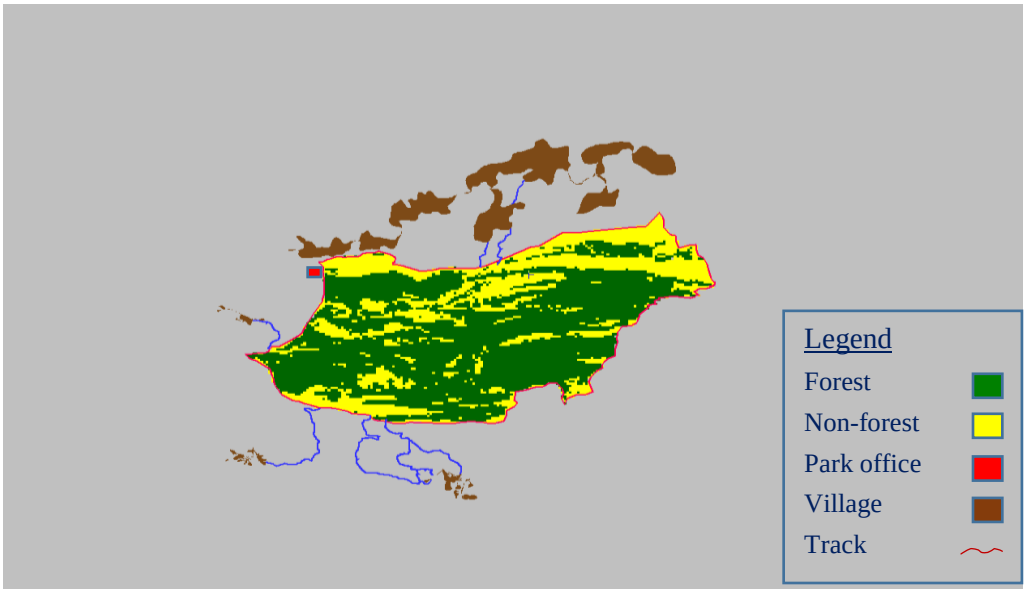


Fig. 4. Shifts in forests and non-forest areas in Manglot Wildlife Park and relative location of villages and tracks

5. There are reports that a small chinkara population has escaped from the Manglot Wildlife Park and established its population in the wild to the south of the Park. The escape is attributed to a broken fence that might have happened during villagers encroaching on the park's territory for cutting wood. However, the map shown in figure 2 clearly illustrates that forest towards the center has improved, and the chinkara gazelle, though adaptable, prefers broken and arid habitat (Roberts, 1997). The opening up of the park at its edges might have attracted chinkara population and they might have found a broken fence, or a gap in the fence to escape and establish in the wild. The edge effect on common leopard (*Panthra pardus*) population in Phinda-Mkhuze complex in South Africa determines a negative impact on the population (Balme et al., 2010). Although assumptive in nature, there is need for further research on it.

CONCLUSION AND DISCUSSION

The forest cover improved in Wildlife Park in general, but with a clear tendency towards the center of the park, which is more protected and guarded. The forest cover to the western side along the road is also intact, as the Park's

office is located there. The forest cover at edges along the northern, eastern and southern boundaries degraded. The loss is mostly in those areas. The evident cause is the location of villages (see figure 4) along these boundaries, and lack of sufficient resources with the field staff to reach and guard it against the people cutting wood there.

The loss of forest cover creates an edge effect, which is of particular interest to a species such as chinkara. The animals' behavior includes preference for open land than forests. It is an inhabitant of desert areas, where vegetation is sparse. The opening up of the edges of the park probably attracted chinkara more than its central parts.

Although needs validation through ground based surveys and analysis, the chinkara attracted to the opened up edges at the park's boundaries provided it with the opportunity to escape through some holes and gaps in the fence. This might have been by small young chinkara individuals. These escaped from the fenced park to the more open habitat in the adjoining areas. The escaped population, finding it more attractive, established in the open forest land near the villages. This population is now establishing itself, and is getting protection from the local inhabitants (Ayaz, M., personal comm. 2014). This indicates to the forest management practices that needs attention and modification according to the behavior of the species for whom the park is maintained.

The findings of this research certainly has management implications for the wildlife parks such as Cherat that are and will be established. The forest management practices have to be applied according to the needs of a target animal species and will have to be modified according to the use.

The local communities, being dependent for fuel wood on the forest, could have been granted access to the park's center and other areas for wood cutting to avoid concentration of cutting at edges. This could be applied in other parks, where aim is improvement in habitat for a species such as chinkara.

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