

Challenges Presented by Pilgrimage Sites and their Impact on Ecology of Protected areas: A Case Study of Ranthambhore Tiger Reserve, Rajasthan

The traditional pilgrimages to religious sites are evolving into large scale religious tourism in many protected areas across India. A growing influx of visitors leading to infrastructural development of these sites within protected areas has potential to immensely damage the natural ecological balance. There are significant changes in the scale and frequency of visits to religious sites over past few decades creating an undue anthropogenic pressure on the ecology of protected areas. The present study tried to estimate the impact of religious tourism on the local ecology inside Ranthambhore Tiger Reserve (RTR), India. Through direct field mapping and interview based surveys in RTR, 352 religious sites were documented. Out of 215 grids of 2x2 km laid down using GIS mapping, 135 (62.79%) grids had religious sites and the accompanying pilgrims in the critical tiger habitat. Disturbance indices for a subsample of randomly selected 42 religious sites were calculated considering ten potential disturbance factors. There was a positive correlation between number of annual visitors to the selected sites (N=42) and the amount of garbage found at the sites. Authors have suggested some measures to reduce the impact of religious tourism on local ecology.

Key words: Religious tourism, Ecological impact, Disturbance index, Protected areas, Anthropogenic pressure

Introduction

The close relationship between culture and ecology was an integral part of ancient Indian societies (Bhattacharya, 2014). In these early periods, humans were considered as an integral part of the nature and not the owner of it (Ganguly, 2012). Ancient Indian texts elaborate on the concepts of forest ecology and sustainable conservation (Bhattacharya, 2014). Growing populations, declining forest areas, economic growth and the changing lifestyle of people continue to diminish the traditional way of life, which was sustainable with nature (Sharma *et al.*, 2014).

Religion is a cultural system of designated behaviors, practices and ethics that relate humanity to supernatural or spiritual elements (Morreall and Sonn, 2013). Thousands of sites of worship and pilgrimage from different religions are found all over India, including protected forest areas (Syamala and Kakoti, 2016). Some of the famous sites, viz., Gomukh (Gangotri National Park), Jyothirling (Bhimashankar Sanctuary), Sabarimala (Periyar Tiger Reserve), Kedarnath (Kedarnath wildlife sanctuary), Pandupol temple (Sariska tiger reserve), Kankai and Tulsishyam (Gir National Park), Siddha baba temple (Pilibhit Tiger Reserve) are found in highly protected areas, like tiger reserves, national parks and wildlife sanctuaries (Upadhyaya, 2019; Sinha and Sinha, 2008; Mansinghka, 2014; Chakraborty, 2014). Until the 1990s most religious sites were small and visited by few pilgrims with a very small ecological footprint (Sinha and Sinha, 2008).

Management of protected areas needs to take into account ecological impacts of religious tourism within the protected area and suggest ameliorative measures for keeping local ecology in good condition.

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In present, the number of such religious sites has grown manifold due to economic development and access to better transport (Shinde, 2007 and Patange *et al.*, 2013). Nowadays, a large proportion of such journeys to pilgrimage sites are motivated not only by religious beliefs but also for tourism (Gladstone, 2005). In the Indian context, a large portion of the literature on pilgrimage is primarily anthropological and only discusses the religious, cultural, social and economic dimensions of religious tourism while offering very little insight on its impact on the environment (Shinde, 2007 and Patange *et al.*, 2013).

In India, around half of the forest area is fragmented, because humans are dependent on these forests and this dependency leads to extensive degradation (Roy *et al.*, 2013). The destruction of forest cover has created isolated patches of forests, resulting in the alteration of forested land (Heilman *et al.*, 2002). Apart from clearing land for agriculture, fuel wood, timber collection, grazing and poaching (Nageeb *et al.*, 2009; Kala and Dubey, 2012) growing pilgrimage activities also exert pressure, degrade forest ecosystems and negatively affect wildlife (Sinha and Sinha, 2008; Seshadri and Ganesh, 2011).

In India almost every protected forest area has religious sites inside it and these sites are regularly visited by large number of pilgrims (Upadhyaya, 2019; Sinha and Sinha, 2008; Mansinghka, 2014; Chakraborty, 2014). The critical analysis of the existing literature revealed that existing scholarship on the presence of religious sites and their impact on protected areas were very limited. All of the literature focused only on a few large sized religious sites inside protected forests, but there is no literature available on account of all the religious sites inside a particular protected forest. Similarly the managing authorities of protected areas are focusing on management of only large size religious sites. For example in 2014, the Ranthambhore Forest Department and the Ashoka Trust for Research in Ecology and Environment conducted a study on "Sustainable Green Religious Tourism in Ranthambhore Tiger Reserve" in which they focused only on the influx of pilgrims coming to one of the biggest and most frequently visited temple complexes in the area, their impact on the environment and how to mitigate that impact (Devy *et al.*, 2014). Smaller religious sites, which are often neglected, can also exert some pressure and disturbance on forest ecosystems. Thus, there has been lack of a comprehensive study focusing on all the religious sites of varying sizes and popularity, total number of pilgrims going inside a protected area and their impact on the environment and wildlife. Therefore we present a case study of Ranthambhore tiger reserve (Henceforth RTR) where the locations, status of all the religious sites, significant changes in the facilities and their possible ecological impact were documented. The study evaluated present forest

management and its effectiveness. Measures of mitigation to halt the further expansion of sites, pilgrims number and their negative impact have also been suggested.

Ranthambhore in the state of Rajasthan, India is a protected forest area which was declared a tiger reserve in 1973 but there were many villages within its boundaries. One of the first priorities was to make the area free from human disturbance and this fundamental objective warranted relocating 17 villages outside the reserve. Therefore in 1976, a total of 12 villages were relocated from Ranthambhore and the remaining five villages were completely relocated within the years 2009-2014 (Sahu, 1997; Verma *et al.*, 2015 and Dhakad *et al.*, 2017). While the villages themselves were relocated, the religious sites in the villages were left behind inside the forest. This resulted in people coming back inside the protected area to visit these religious sites for worship. In the past, the number of pilgrims was low but with time and increase in transport facilities, the numbers are steadily increasing.

Methodology

Study area

Ranthambhore Tiger Reserve (RTR) (25°30' to 26°21' N and 75°51' to 77°12' E) lies in the Sawai Madhopur, Karauli, Bundi and Tonk districts of Rajasthan, India. RTR consists of three protected areas The Ranthambhore National Park, Kailadevi Wildlife Sanctuary in the north and the Sawai Mansingh Wildlife Sanctuary in the south and the buffer zone also includes the forests of Bundi district. The Total area of RTR is 1700 km² out of which 1113.364 km² is declared Critical Tiger Habitat (CTH), 360.19 km² is a buffer area while the status of remaining 226.446 km² is undecided (Ranthambhore Tiger Conservation Plan, 2015). Physio-graphically, RTR is spread over the northern extension of the great Vindhyan Plateau and older rock units of the Aravalli, separated by a reverse fault trending north-east-south-west (NE-SW) which is known as the "Great Boundary Fault" (Singh and Srivastava, 2007).

There are 291 villages within a 1km radius of the reserve, 66 of which are inside Kailadevi Wildlife Sanctuary. Thus, around 320000 humans and around 200000 heads of livestock are dependent on resources within the reserve (Dhakad *et al.*, 2019). There are several large and small temples inside RTR. Mainly, these include the Ganesh temple in the Ranthambhore fort, Kailadevi Mata temple, Soleshwar Mahadev, Amareshwar Mahadev temple, Khatola Mahadev temple, and Kamaldhar Mahadev temple. The estimated visitation rates of the Ganesh temple are 700000 to 800000 annually, while for the Kailadevi Mata temple it is 150000 to 200000 (Verma *et al.*, 2015).

There are several man-made lakes and pools which are perennial sources of water for wildlife within the reserve. Ranthambhore is a dry and subtropical area which falls under the semi-arid zone and is prone to drought conditions with a definite winter, summer and rainy season. It receives an average annual rainfall of 800mm, and temperatures as low as 2 °C in January and as high as 47 °C in May during peak summer.

The vegetation of RTR is of the northern tropical, dry, deciduous forest and the northern tropical thorn forest (Champion and Seth, 1968), dominated by Dhonk (*Anogeissus pendula*) trees. Apart from *Anogeissus pendula*, the other plant species commonly found are *Acacia catechu*, *Butea monosperma*, *Boswellia serrata*, *Sterculiaurens*, *Acacia leucophloea*, *Diospyros elanoxylon*, *Lannea coromandelica*, *Ficus benghalensis*, *Ficus glomerata*, *Syzygium heyneanum*, *Mitragyna parviflora* etc. (Singh and Srivastava, 2007). The dominant grass species are *Aristida adscensionis*, *Apluda mutica*, *Heteropogon contortus*, *Sporobolus diander*, *Chrysopogon fulvus*, *Cenchrus ciliaris*, *Cymbopogon martini*, *Sehimanervosum*, *Sporobolus evolvus*, *Eremopogon* spp., *Dichanthium annulatum* and *Arthraxon hispidus* (Singh and Srivastava, 2007).

Ranthambhore has seven different wild cat species which makes this area very special. These wild cat species include the *Panthera tigris*, *Panthera pardus*, *Caracal caracal*, *Felis chaus*, *Prionailurus rubiginosus*,

Felis bicolourata and *Prionailurus viverrinus*. Ungulates are represented by the *Rusa unicolor*, *Axis axis*, *Boselaphus tragocamelus*, *Gazella bennettii* and *Sus scrofa*. The Canidae family is represented by the *Vulpes vulpespusilla*, *Vulpes bengalensis*, *Canis aureus* and *Canis lupus pallipes* (Singh and Srivastava, 2007). Together, the Ranthambhore National Park and Sawai Mansingh Sanctuary hold the only healthy population of tigers in Rajasthan.

Ranthambhore is home to several pastoral and agricultural communities which are substantially dependent on its resources for their livelihoods. Gurjers and Meenas are the most dominant communities in the villages around Ranthambhore. The Meena community is largely an agrarian community, while the Gurjers are pastoralists.

For the present study, 5 different ranges in the Critical Tiger Habitat (CTH) in Division-I (615.49 km²) have been selected: ROPT, Kundera, Talda, Khandar and Phalodi (Fig. 1). The distant range of Baler was not included in the study area because it doesn't have any resident tigers.

Design of study

We collected baseline data for all religious sites, the potential impact of religious sites and pilgrims on the flora, fauna and on the critical tiger habitat of the reserve through a survey conducted from June 2018

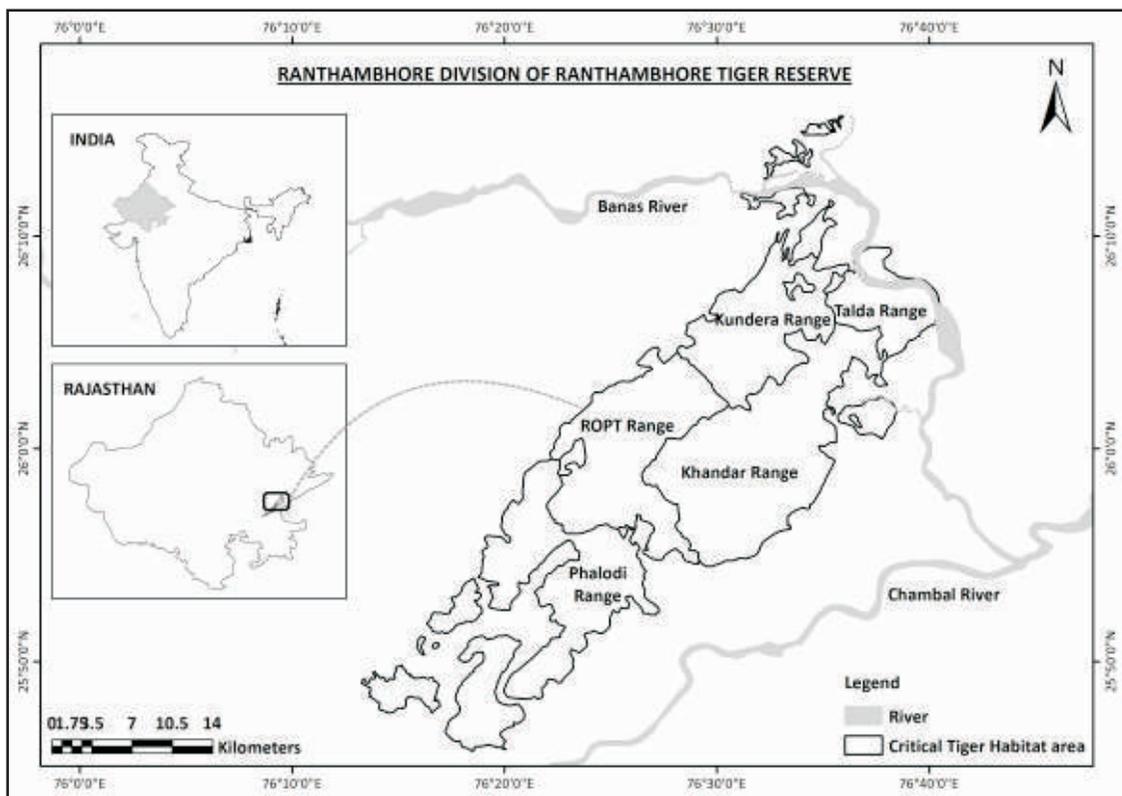


Fig. 1: Study area map

to June 2019. Each and every religious site was visited and surveyed range-wise by the team with the help of local villagers and forest officials. The GPS locations of all religious sites were collected using Garmin GPS etrex 10 and mapping was done using the ArcGIS software. A grid wise spatially explicit map of pilgrim number was prepared by using ArcGIS software. The sanctuary was divided into 2X2 km² grids and all of the grids were given 1 to 7 codes based on number of pilgrims visiting the site per annum (Table 1).

Table 1: Scheme of grid codes given according to pilgrim numbers

Code	Range of Pilgrim Influx per annum
1	0
2	1-1000
3	1001-2000
4	2001-7000
5	7001-30000
6	30001-200000
7	>200000

All religious structures were measured and photographed. The team collected information using open ended questionnaire directed at priests/ managing authority, leaders of the nearest villages and various villagers (>5), (Table 5) which helped in the documentation of the number of pilgrims visiting yearly, the seasonal changes in pilgrim numbers, important festivals and festival times, number of vehicles visiting yearly and on festival days, the history of the site and changes in the structure of the site in the last 15 years, the name of the villages from which most of the pilgrims originate and the different paths being used to reach the site were noted down (Please refer to supplementary material S1 for details of the questionnaire). Documentation of basic facilities such as electricity, drinking water and housing were also documented. The team documented the type of fuel used by pilgrims for cooking, especially if they were using forest wood as fuel. The use of sound producing equipment at the religious sites was also documented.

On the basis of pilgrim influx, all of the sites were divided into 3 categories: Category A included sites with >6000 visitors per year, Category B included temples with 1000-6000 visitors per year and Category C contained temples with < 1000 visitor footfall per year (Table 6). Intensive site development monitoring of category A religious sites was done by noting the changes in the structure of the site in the last 15 years by conducting interviews. Changes in the area occupied by the religious structure, and structural changes were estimated using past and present Google Earth views.

10% of the sites in each category were randomly selected to estimate the generation of waste (N= 42). The data on waste generation was collected by walking on approach road up to 1 km from the

religious structure outwards. Both sides of the road were surveyed and number of plastic, paper and other waste items were collected and counted. The same 42 sites were considered for the calculation of Disturbance index. We have considered 10 factors which potentially lead to disturbance in surrounding forest area of a religious site. These factors include structure type, access to electricity, source of drinking water, whether pilgrims cook food, use of sound producing equipment, presence of construction work and presence of natural waterbody. These seven factors were given 0 or 1 score (yes/ no answers). Remaining three factors viz., distance of site from the periphery of the reserve, seasonality of pilgrim influx and quantity of garbage, were given 1 to 3 score as explained in Table 2.

Table 2: Score criteria for calculating disturbance index

Distance from periphery of reserve	
Distance	Score
<500m	1
500m-1km	2
>1km	3
Seasonality of pilgrim influx	
Only on a particular day	1
whole month	2
Throughout the year	3
Quantity of Garbage	
0-150 pieces	1
150-300 pieces	2
>300 pieces	3

As per the scores a site can have minimum 0 and maximum 16 as disturbance index. Therefore, 0 to 16 is the disturbance index scale of the sample survey sites (N=42).

Results and Disussion

In this study a total of 352 religious sites were identified inside the Ranthambhore division of Ranthambhore Tiger Reserve. The study recorded that 138, 69, 65, 51 and 29 religious sites in Phalodi, Khandar, Kundera, ROPT and Talda ranges respectively (Fig. 2). It was confirmed that all these sites were inside the critical tiger habitat (CTH) as designated by Forest department management plan 2015. The vast majority of the sites are on the periphery (up to 1 km inside protected area) and a few of the sites are deep inside heart of the forest.

During the survey it was found that majority of the religious sites were built by the local communities especially by pastoralists who formerly lived inside Ranthambhore and regularly go inside to graze. Most of the sites are little more than small pedestals with painted stone or small idols. The pastoralists or agriculturists often face various challenges related to low rainfall, livestock health issues, snake bites, human health issues and the problems they attribute to 'ghosts' or other negative 'energy'. Therefore all of these communities historically established various religious sites related to the many deities in the vast

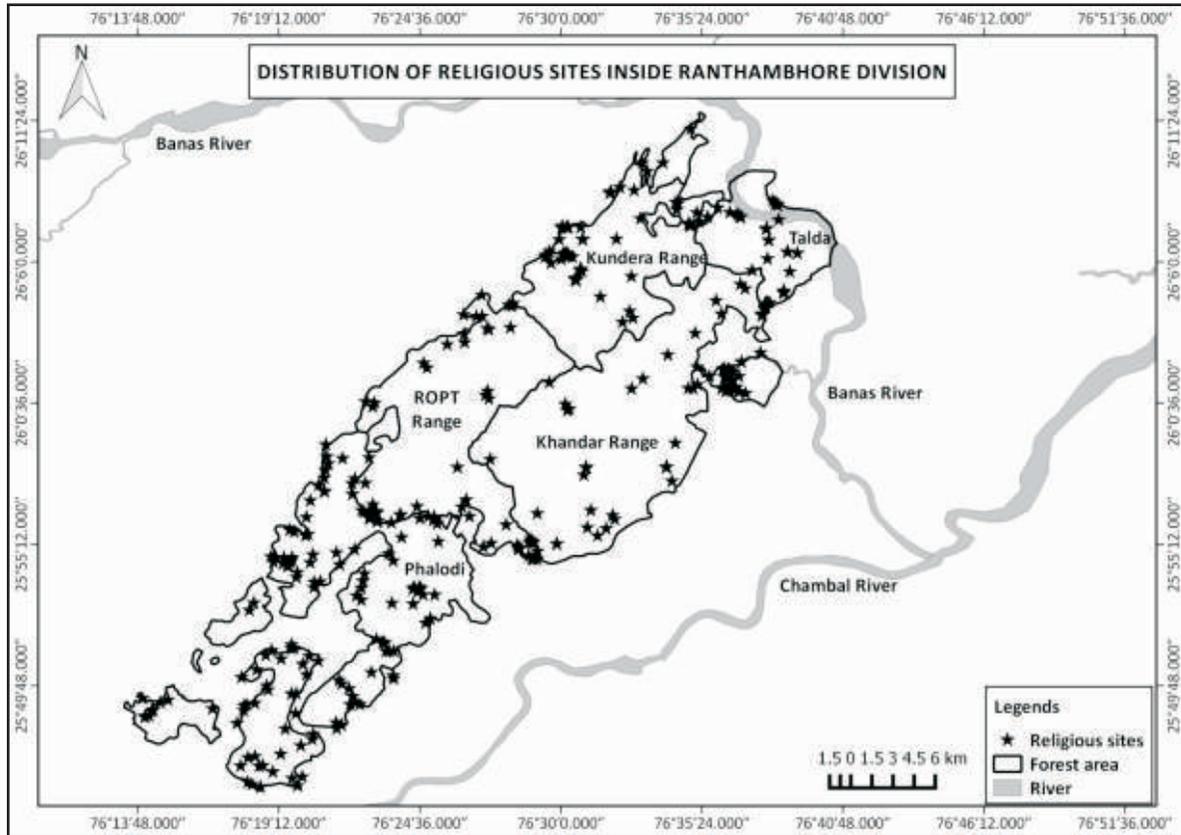


Fig. 2: Distribution of religious sites inside Ranthambhore Division

Hindu pantheon, for example “*Mataji*” (Goddess of Power) temples near villages are intended to prevent disease and infection, “*Heeraman*” for the health of livestock, “*Tejaji*” (Snake folk God) for the prevention and cure of snakebites and other venomous animals and “*Bhairav*,” “*Bhomiya*” and “*Prait Baba*” for addressing what they believe to be ghosts and negative energies. There are also “Shiv” temples near natural water sources where some priests continue to live. There are a few Islamic shrines as well built in the memory of martial Figures. A couple of generations after the relocation of villages outside RTR, the villagers still have unwavering belief in these deities and therefore often come inside the forest to visit these religious sites on pilgrimage.

Influx of Pilgrims and Vehicles

In this study it was discovered that a total of 2.2 million pilgrims were going inside the CTH Ranthambhore division annually, out of which 1.2 million pilgrims were going to a particular temple called the Ganesh temple and its associated sites and the remaining 1 million pilgrims were going to other sites inside the tiger reserve. All of these pilgrims are able to go deep inside the tiger reserve due to increased ease of transportation facilities.

It was estimated that 175854 vehicles (Motorbikes-118860, Light motor vehicles-54031 and Heavy vehicles, *i.e.* mainly tractors-2963) were going inside the Ranthambhore division annually for visiting religious sites. The pilgrims can only visit the Ganesh temple without permission but others religious sites are deep inside the tiger reserve; therefore technically visiting such sites is illegal. However, pilgrims still visit these sites by vehicle or on foot. There were 144 (40.9%) sites where pilgrims go by vehicle and the remaining 208 (59%) sites were inaccessible by vehicles. Therefore, it was established that the majority of the religious sites of the Ranthambhore division were visited by pilgrims who traverse critical tiger habitat area on foot, thereby putting themselves in grave danger.

A total of 215 grids of 2X2 km were laid down and it was found that there are only 80 (37.2%) grids free from the presence of any religious sites but these areas are still traversed by pilgrims on their way to religious sites in nearby grids. The remaining 135 (62.79%) grids are those which have the presence of religious sites and the accompanying pilgrims (Fig. 3, Table 3).

The religious sites identified in this study are within the tiger reserve and therefore it is not safe to travel inside

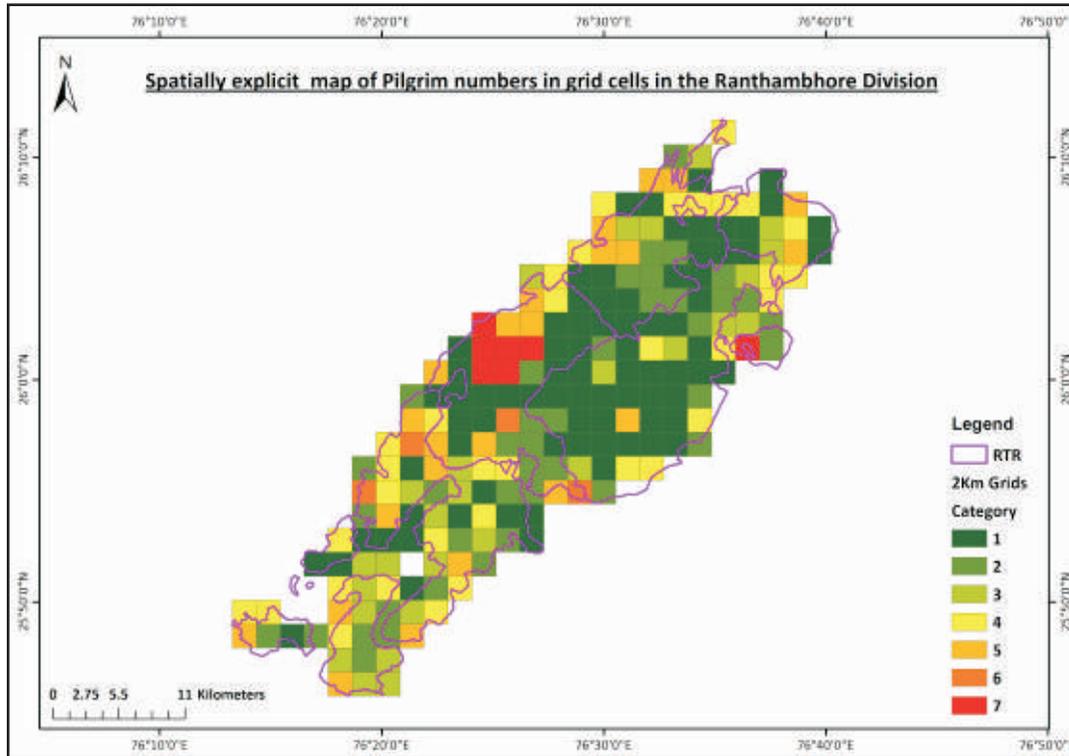


Fig. 3: Spatially explicit map of pilgrim numbers in grid cells in the Ranthambhore division

Table 3: Pilgrim influx in various grids of the study area

Code	Range of pilgrim influx	No. of Grids occupied	Percentage
1	0	80	37.2
2	1-1000	40	18.60
3	1001-2000	27	12.5
4	2001-7000	34	15.81
5	7001-30000	23	10.69
6	30001-200000	4	1.8
7	>200000	7	3.2

without permissions but the pilgrims pay no heed to these instructions. In our study, we found that there were many relatively inaccessible sites where pilgrims can go only on foot. Such situations can lead to carnivore attacks and increase the chances of human-animal conflict. One such incident happened in Ranthambhore tiger reserve when a 12 year old boy visiting the Ganesh temple was attacked by a tiger (Thorat and Gurjer, 2010). Another consequence of disturbance created by humans is that the disturbed animals leave the sites and sometimes move out of the forest areas into human habitation. Similar incidence of human animal conflict was reported from the Kani settlements in the foothills of western-ghats in Kanyakumari district where the residents face high rates of crop raiding by wild animals (The Hindu, 2013). According to Forest department sources, the entry of elephants into human settlements has become a regular phenomenon during December-January as the animals start moving in herds from the

Kerala forests to Tamil Nadu owing to habitat disturbance caused by the heavy influx of pilgrims in the Sabarimala forests (The Hindu, 2013).

Seasonality of Disturbance

In Ranthambhore the number of pilgrims are high several times a year especially during fairs, festival days, religiously significant months and days. Most of the festivals are celebrated in the months of August-October (See supplementary material S2). During the study, there were a total of 28 religious sites where fairs were organized on festivals and around 616950 pilgrims with 7500 vehicles visited these sites. Out of all these sites, 6 sites viz., the Trinetra Ganesh temple, Jhojheshwar, Sitamata, Amreshwar, Soleshwar and Jayanti mata, have the most crowded fairs. The biggest festival is celebrated at the Trinetra Ganesh temple where an enormous number of pilgrims (~5 lakh) congregate from all the villages of Sawai Madhopur as well as the neighboring districts and states.

There are a total of 64 religious sites which pilgrims visit on particular auspicious days in a year. These days are decided on the basis of the lunar calendar, therefore every year the exact date of these visits changes. On these days during the study year, a total of 52950 pilgrims and 10200 vehicles descended on these 64 sites. Ten sites get a large number of pilgrims for a few months only and around 3850 pilgrims and 300 vehicles visited these sites during these months.

Table 4: Categorization of religious sites on the Basis of Influx

S.No.	Pilgrim Numbers per annum	Category	Number of sites
1	6000-12 lakh	A	18
2	1000-6000	B	102
3	<1000	C	232

Based on the footfall (number of pilgrims visiting per annum) the sites were categorized as shown in Table 4.

Structure type of religious sites and facilities

During this study, different kinds of religious sites were found. Temple buildings of historical significance are in the Ganesh temple complex of Ranthambhore fort and the Kamleshwar and Jhojeshwar temples of Sawai Mansingh Sanctuary. A vast majority of the religious sites are just open pedestals, idols and iconic stones. In the survey, it was found that out of 352 religious places, the majority 278 (79%) were of the open structure type like pedestals, statues and idols. Only 74 (21%) places had enclosed structures. There are a total of 78 sites which have additional rooms and tin shades for pilgrims. All of these structures were constructed by village leaders, villagers and pilgrims because they often announce donations to the site in the name of the presiding deity.

Authors monitored Category A religious sites intensely for this study. In the survey, they found that in the last 15 years, these sites had increased in size. Out of 18 Category A sites, 61% (11 sites) showed growth in the

structure and expansion of the site premises. It was found that all of these 11 sites occupied total area of 57280 sq. ft. in 2006 and in 2019 they are covering 83541 sq. ft. which means that these sites have expanded by 45.8% in last 15 years. The presence of ongoing construction work on any pilgrimage site means that the site is growing in size and increase in size will, in turn, attract more pilgrims. A total of 16 religious sites were recorded in the study where illegal construction work was on. Moreover, lodging facilities at some of the religious sites can be used by poachers in non-festival season to collect information on tiger movement in the surrounding areas and conduct illegal activities. The encroachment of natural forests with diverse human interests has been identified as the major reason for the depletion of natural habitat and wildlife.

The study found that 18 sites had electricity connections and ten sites had solar lighting. It was also found that there were various man made facilities providing drinking water near the surveyed religious sites such as Bore wells (8 sites) and hand pumps (50 sites).

Disturbance Index

The study found that none of the site have disturbance index 16 (maximum possible score on the scale of 0 to 16). Religious sites in Khandar range have maximum average disturbance index (8.2), which was followed

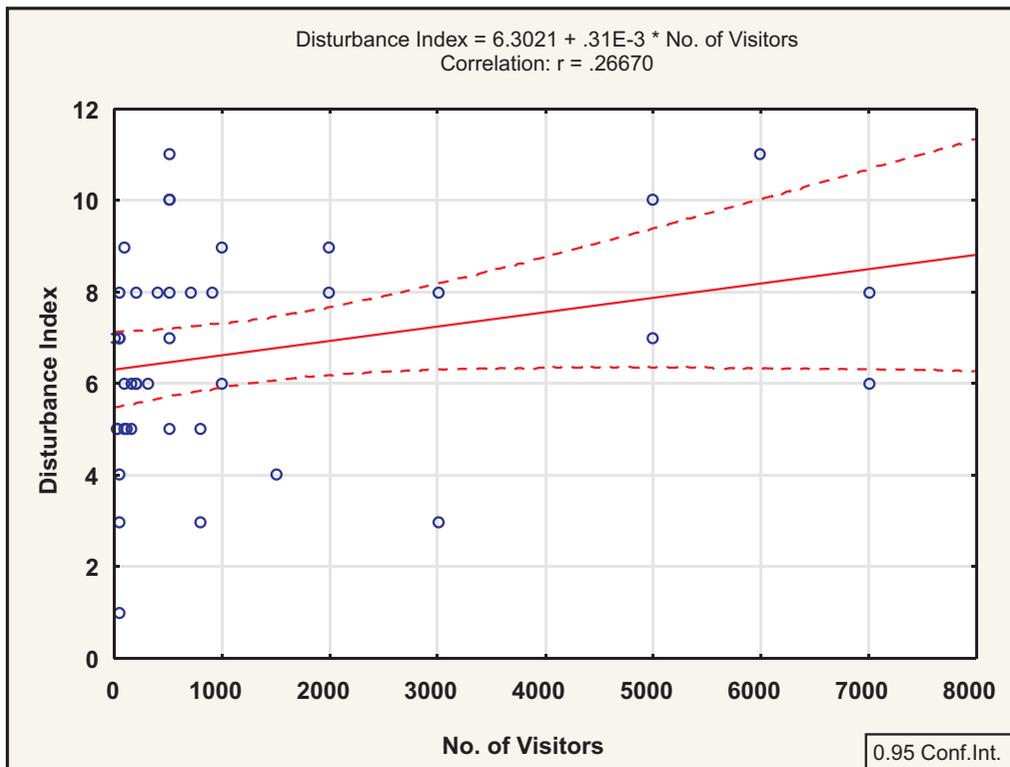


Fig. 4: No significant correlation found between disturbance index and number of visitors

by ROPT (6.7), Phalodi (6.6), Kundera (6.5) and Talda (6). Statistical analysis revealed that the disturbance index of religious sites was not correlated with the total number of pilgrims visiting annually (Pearson product moment Correlation $r = 0.2667$, $p = 0.088$, $N = 42$, Fig. 4). Although the overall disturbance indices at 42 locations showed no significant correlation with number of visitors, the disturbances can have negative impacts on the forest ecology in multiple ways as described below.

Quantification of garbage

A total of 42 (~10%) sites were surveyed for the estimation of waste generated at these religious sites. Survey results show that 40 (95%) sites have plastic/paper/clothes/glass bottles in the surrounding area and only 2 (5%) sites do not have any waste nearby because these sites are very deep inside the forest and are visited by very few pilgrims. It was found that ten (23.8%) sites have the highest level (>300 pieces) of waste around and 33.3% (14) sites have a moderate level (150-300 pieces) of waste in their surrounding areas. A low level (1-150 pieces) of waste was found around 38% (16) sites.

Statistical analysis revealed that that the amount of waste present in the surroundings of the religious sites is significantly correlated with the number of pilgrims (Pearson product moment Correlation $r = 0.33$, $p = 0.034$, $N = 42$, Fig. 5).

The presence of non-biodegradable waste was found near the religious sites. There are chances of wild animals getting entangled and/ or plastic material being ingested by wild animals which can cause indigestion to the animals and even death. This threat/ disturbance can be possibly avoided/ reduced through coordinated efforts involving the pilgrims, forest department officials and local people. Last three years the Ranthambhore Forest Department, Tiger Watch and some school students have joined forces to help clean the mess after festival/ fair near some temples. The effect of these clean-up drives and creating awareness among the visitors needs to be assessed at all the highly disturbed sites.

Use of sound producing equipment

During our study we found that at 83 sites pilgrims used loud speakers on festival days. These sites do not have their own sound systems but the pilgrims bring their own personal sound systems or rent them when they visit the site. During the survey it was found that they use big speakers for playing music or in some places they play the *Dholak* (drum) and other instruments too. During the festival season the noise pollution gets enhanced which not only disturbs the local people but also causes hazards to overall environment, health and behaviour of the wild animals (<http://www.naturesounds.org/conservENW.html>).

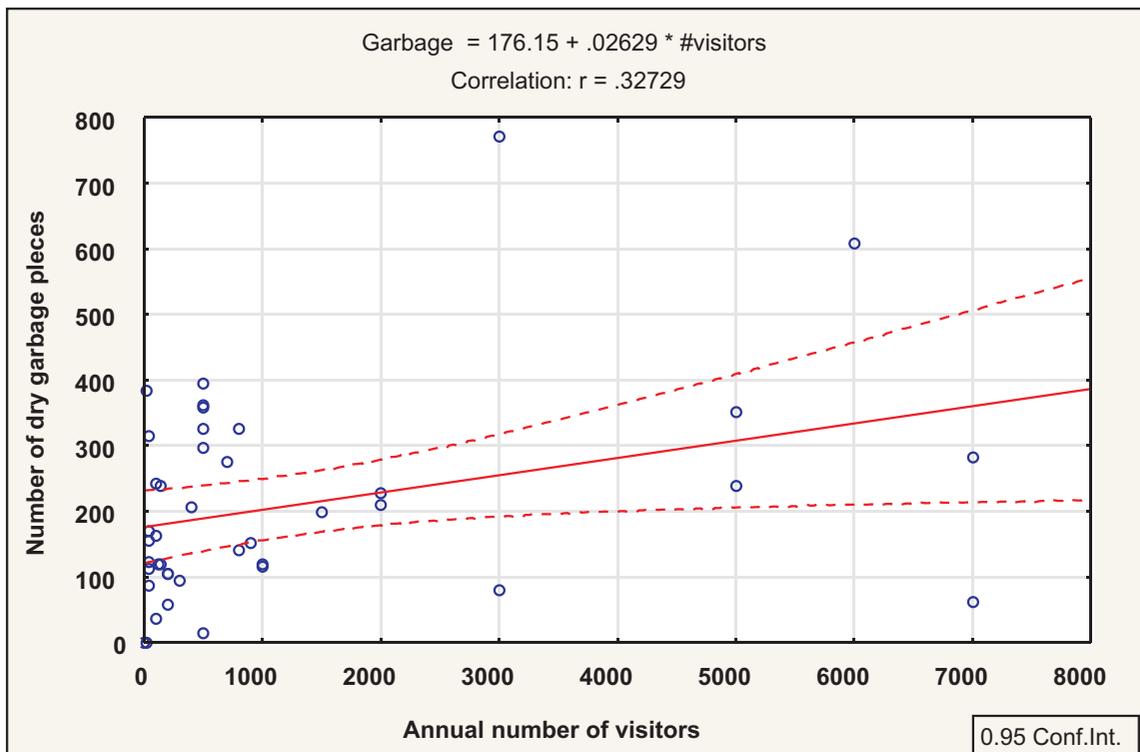


Fig. 5: Positive correlation between annual number of pilgrims and garbage pieces found at the religious sites

Table 5: Format of questionnaire

S.No.	Questionnaire
1	Pilgrim Site Name
2	GPS Location
3	Deity Name
4	Priest name
5	Village of Priest
6	History
7	Since how many years he is working in the respective site
8	Ways to reach site and Distance from wall
9	Structure type- Open/Close
10	Material used- Cemented/ Other
11	Pilgrim Site Map with Structure Measurement (in Feet-LBH)
12	Number of rooms
13	How many House and peoples Near Pilgrim site (If Any)
14	Presence of any Flag - Yes/No
15	Type of trees in vicinity
16	Electricity - Yes/No
17	Source of drinking water
18	Number of pilgrim visiting yearly
19	Number of Fair celebrated on site Yearly
20	On which occasion maximum pilgrim visit (Festival name/Day name)
21	Pilgrim Number on Fair day
22	From which villages pilgrim come for visit
23	Vehicle Number (Yearly): (A)Car (B) Bike (C) Jeep (D) Public transport (E) Heavy Vehicle
24	Vehicle number on festival day: (A) Car (B) Bike (C) Jeep (D) Public transport (E) Heavy Vehicle (A) Car (B) Bike (C) Jeep (D) Public transport (E) Heavy Vehicle
25	Type of fuel used for cooking by pilgrim
26	Music allowed - Yes/No
27	Playing Music - Daily / Occasionally
28	Does pilgrim feed animals/ Birds near around (If Yes)
29	Area Survey- (A) Non-Biodegradable waste (Polythene/Bottles etc.) (B) Tree cutting - Yes/No (C) Grazing - Yes/No (D) Construction Process - Yes/No
30	Status Nearest waterbody - Clean/Polluted

Resource exploitation and pollution

Pilgrims usually depend on the forests for their various needs, which in turn adversely affect the forest and its wildlife in different ways. Water pollution and soil pollution are the biggest forms of pollution created by pilgrims. The study found 36 religious sites which have natural water bodies such as waterfalls, waterholes, ponds and a river. These waterbodies fulfill the drinking water requirements of wild animals but pilgrims also use these waterbodies in various ways such as bathing and immersing items of worship like

flowers. These activities pollute waterbodies by adding plastic and other waste, human excreta along with laundry detergent or soap used to maintain self-hygiene which may lead to an increase in the biological oxygen demand (BOD). This leads to algal bloom and makes the water unsuitable for wild animals (Marale *et al.*, 2011; Bhagat, 2015 and Bhatnagar *et al.*, 2016). Direct or indirect human contact (contact with fecal matter, water and soil contamination) can increase the chances of infections being transmitted to wild life as well as from wild life to humans (zoonotic infections).

Pilgrims also extract water from forest areas by using bore wells and hand pumps. These hand pumps and bore wells were financed by the village head and other residents of villages nearby. Due to the availability of drinking water, these sites have a greater chance of developing new infrastructure in the future and that increases the chances of further increase in pilgrim numbers.

It was recorded that at 186 sites pilgrims cook food for ritualistic offerings. They bring cow dung cakes from their homes as fuel but soon begin to collect fuelwood from the forest surroundings of the religious site, which leads to the destruction of nearby vegetation. Some pilgrims also fed birds with grain as well as processed food items. Providing food to birds and animals around can lead to changes in their natural diet and time budget (Paranjpe and Dange, in review). Other effects of food provisioning on wild life need to be assessed by further studies.

One should keep in mind that the pilgrim influx in study area is in addition to the large tourist influx in RTR as tourists travel to this area from all around the world to watch tigers in their wild habitat along with other jungle fauna. The tourist movement through protected area is controlled to a large extent by regulating the amount of tourist vehicles going inside per day. No such restrictions have been imposed on the pilgrims in any protected area. Our study demonstrates that the uncontrolled activities of pilgrims can have negative impact on the forest and local ecology. Pilgrims come for religious activities and most of them respect nature and animals. We found that the no one kills or hunts animals near religious sites. The pilgrims and other villagers do not cut trees present in the immediate vicinity of the religious sites. However, in most such places the forest management becomes not only an ecological but also sociological, environmental and religious issue. One needs to maintain the fine balance between respecting religious sentiments of local communities and protecting the forest and its wildlife. The way forward may involve mass awareness and educative programs and clean up drives involving local community to reduce all negative impacts caused by pigimage activities.

Conclusions

In the present case study of Ranthambhore tiger reserve it was found that Ranthambhore holds a good source tiger population of Rajasthan. But there are large numbers of religious sites in reserve area which, continuously attract a huge number of pilgrims throughout the year. The increasing number of pilgrims are disturbing the elusive balance of the environment and creating a major management problem for the reserve. The activities of these pilgrims put tremendous pressure on forest resources and create much disturbance for wildlife. Therefore there is an urgent need for regulation of these sites and other pilgrim activities.

This study gives an idea about number of religious sites that can be present inside any protected area and their cumulative impact on forest ecology. Therefore there is a strong need to do similar study in other protected areas of India. The documentation of numbers, location, their impacts and mitigation plan should be made by managers of all protected areas. The managers of all protected areas are advised to incorporate measures in their management plans to reduce the ecological impact caused by pilgrimage. The process of development of religious sites is a hazard to the surrounding forest. Therefore ban on further development in terms of construction, development of pilgrimage facilities, restrictions on use of nearby natural water bodies for taking bath and washing clothes is recommended. At present the non-biodegradable litter from the temple is either being burnt on site or dumped into pit, there is no litter disposal mechanism. Efforts should be made to facilitate waste management and minimizing of the negative impact on nearby areas.

However, religious tourism inside protected areas cannot be stopped altogether as religion is a sensitive issue not only in India but all over the world. But efforts to reduce the pressure can be made by raising awareness about conservation amongst pilgrims. Mass awareness programs for pilgrims, training for temple management personnel, forest officials and local community would be useful in reducing the disturbance in protected area.

तीर्थयात्रा स्थलों द्वारा प्रस्तुत चुनौतियां तथा संरक्षित क्षेत्रों की पारिस्थितिकी पर इनका प्रभाव : रणथम्भौर बाघ रिजर्व,

राजस्थान का एक केश अध्ययन

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सारांश

धार्मिक स्थलों में पारम्परिक तीर्थयात्राएं भारत भर में अनेकों संरक्षित क्षेत्रों में बड़े पैमाने पर धार्मिक पर्यटन में विकसित हो रही हैं। पर्यटकों के वर्धमान प्रवाह के कारण संरक्षित क्षेत्रों के भीतर इन स्थलों का अवसंरचनात्मक विकास हो रहा है, जिसमें प्राकृतिक पारिस्थितिकीय

सन्तुलन को क्षति पहुंचाने की अत्यधिक क्षमता है। पिछले कुछ दशकों में धार्मिक स्थलों में भ्रमण की मात्रा और बारम्बारता में महत्वपूर्ण परिवर्तन हुए हैं, जिससे संरक्षित क्षेत्रों की पारिस्थितिकी पर अनुचित मानवोद्भव दबाव का सृजन हुआ है। इस अध्ययन में रणथम्भौर बाघ रिजर्व, भारत के भीतर स्थानीय पारिस्थितिकी पर धार्मिक पर्यटन के प्रभाव का आकलन करने का प्रयास किया गया है। रणथम्भौर बाघ रिजर्व में प्रत्यक्ष क्षेत्र मानचित्रण और साक्षात्कार आधारित सर्वेक्षण के जरिए 352 धार्मिक स्थलों को प्रलेखित किया गया। जी आई एस मानचित्रण का उपयोग करके तैयार किए गए 2x2 कि.मी. के 215 ग्रिडों में से 135 ग्रिडों में धार्मिक स्थल (62.79%) थे और क्रान्तिक बाघ आवास में तीर्थयात्री संलग्न थे। दस सक्षम विश्लेषण कारकों पर विचार करते हुए बेतरतीब रूप से चयनित 42 धार्मिक स्थलों के उपनमूना के लिए विश्लेषण सूचकांक परिकल्पित किया गया। स्थलों में पाए गए कूड़े की मात्रा और चयनित स्थलों (N=42) में सालाना पर्यटकों की संख्या के मध्य सकारात्मक सहसंबंध था। हमने स्थानीय पारिस्थितिकी पर धार्मिक पर्यटन के प्रभाव को कम करने के लिए कुछ उपायों का सुझाव दिया है।

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