



# Nature-based tourism in Indian protected areas: New challenges for park management

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## Keywords

India; land use; parks; people; tourism; wildlife

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## Abstract

Previous research indicates that numbers of visits to protected areas (PAs) are declining in wealthy countries while foreign visitation is increasing in less-wealthy countries. We focus on India to discern trends and implications of nature-based tourism in an emerging economy. We interviewed 91% of tourist facilities around 10 PAs to assess visitation, employment, and practices. Average growth rate was 14.9% (from -7% in Bandipur to 44% in Periyar from 2002 to 2008) and 80% are domestic tourists. Many facilities (72% post 2000) are recently constructed and 85% occur within 5 km of PAs. Clustering of facilities in some PAs might facilitate easier management of resource use and establishment of best practice guidelines. Contributions of facilities to local employment are marginal. Rules governing entry of people and vehicles vary widely. Domestic nature-based tourism potentially generates public support for conservation but adds to existing challenges of managing PAs already facing pressure from livelihood needs of local populations. Based on these trends, the increasing middle class in India is likely to generate future demand for nature-based tourism counter to trends in industrialized countries. There is urgent need for establishing and enforcing regulations to manage tourists, resource use, and land-use change around PAs.

## Introduction

Nature-based tourism is a rapidly growing sector of the global economy, is an important ecosystem service, and generates support for conservation. Previous literature has identified shifts away from nature-based recreation in wealthy countries (United States, Japan) over the last two decades (Pergams & Zaradic 2008). Balmford *et al.* (2009) find increasing visitors to protected areas (PAs) in 15 of 20 countries, with rapid increases in less-wealthy countries tied to international tourist visitation. While these previous studies focus on tourism generated from industrialized economies, we examine trends and their implications for PAs in India, an emerging economy with increasing mobility and disposable income.

India is one of the world's 17 mega diversity countries, supporting both high biological diversity and densities of people (Mittermeier & Mittermeier 2005). Rapid

economic growth (6–9% annually), globalization, and urbanization have resulted in a growing middle class that doubled from 1990 to 2005 (Beinhocker *et al.* 2007; Gandhi & Orr 2007; Das 2009). Growth in income has increased demand for tourism, including nature-based tourism. The 28 tiger reserves alone receive >1 million visitors a year (Tiger Task Force 2005). Yet, India's 590 PAs cover <5% of total land area, are small (average size <300 km<sup>2</sup>), highly fragmented, and surrounded by high densities of people (Rodgers *et al.* 2003). A key challenge is managing these PAs under pressure from commercial interests (mining, roads) and local human activities (fuel wood and forest product collection, grazing, and hunting). Nature-based tourism adds another dimension to these existing challenges.

There is significant debate about the conservation benefits from nature-based tourism to either PAs or local people (Lindberg *et al.* 1996; Kiss 2004; West &

Carrier 2004; Nash 2009; Sims 2010). Some research suggests that nature-based tourism improves local livelihoods, park management, and promotes conservation by reducing pressures on forest resources (Goodwin 1996; King & Stewart 1996; Wilkie & Carpenter 2002; Lindsey *et al.* 2006). Some communities close to parks have benefited (Bookbinder *et al.* 1998; Nagendra *et al.* 2005; Spiteri & Nepal 2008; Andam *et al.* 2010). Other research finds no benefit to local communities and no community involvement in PA management decisions about tourism (Archebald & Naughton-Treves 2001; Stem *et al.* 2003; Charnley 2005; Bandyopadhyay & Tembo 2010). Critics question sustainability of tourism revenues, and lack of benefit sharing with local communities (Stone & Wall 2004; Arjunan *et al.* 2006; Waylen *et al.* 2009).

Previous literature has identified negative impacts of tourism activities on biological resources in PAs (due to resource extraction, overharvesting, hunting, harassment of animals) and the physical environment (increased fire frequency, soil compaction, water pollution, introduction of invasive species and pathogens, Charnley 2005; Kruger 2005). Others find tourism-generated revenues may be insufficient to sustain PA conservation and management efforts (Naidoo & Adamowicz 2005). There exists significant debate about the benefits and costs of tourism in conservation.

We examine nature-based tourism in 10 PAs in India. We focus on (1) trends and patterns in nature-based tourism and tourist infrastructure in these PAs; (2) attitudes and practices of tourist facilities (resources use, economic opportunities); and (3) tourism management in the PAs. The study aims to quantify these trends and practices to aid in developing solutions for sustainable nature-based tourism in India and other emerging economies.

## Methods

### Study sites

We selected 10 PAs in India to examine nature-based tourism (Figure 1). Since tourism is our main focus, the PAs were selected to cover a range in visitor numbers (5,000–500,000+ people/year) and accessibility to urban centers. Data on visitor numbers for PAs in India are sparse. We collected visitor numbers for 23 Indian PAs where data are available (Figure 2, Tiger Task Force 2005, Balmford, pers. comm. 2010). In 2004–2005, visitor numbers averaged 68,979 (ranging from 1,316 in Bhadra to 371,032 in Periyar). Our 10 PAs fall within the range in visitor numbers and distance to cities of the 23 PAs (Figure 2). The 10 selected PAs also vary in size, local people (diverse socio-economic-cultural back-

grounds), publicity, history of establishment, and cover diverse ecosystems and habitats (Table 1). Data collection depended on ease of access to government records and permission to visit PAs. Therefore, logistical feasibility and forest department cooperation helped focus our selection.

### Surveys, interviews, and mapping

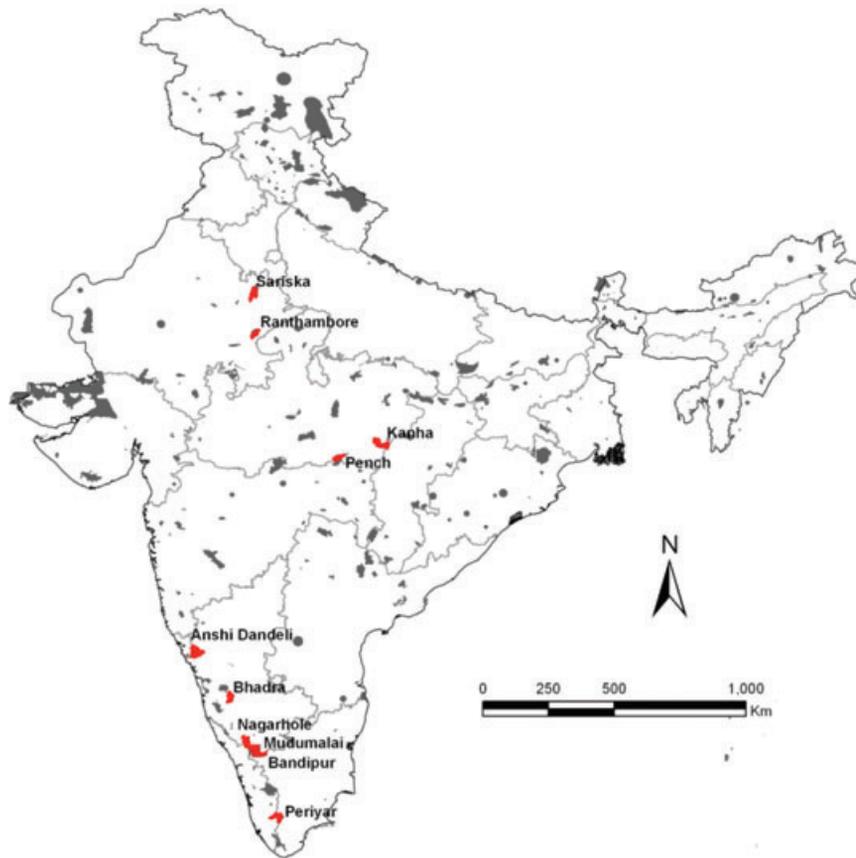
We use multiple data sources to examine trends and perspectives governing nature-based tourism in India. We conducted semistructured interviews with managers or owners of 336 (91%) tourist facilities around 10 Indian PAs from June to September 2009. We visited all facilities within 25 km of the PA (we think this is a reasonable distance that tourists might travel to visit the PAs). Questions to facilities covered history, resource use, finances, relationship with park management, employment, and other opportunities provided to locals. We mapped locations of tourist facilities. We interviewed forest department officials to examine tourism and PA management efforts and collected official records on visitors (numbers, origin, domestic vs. foreign, seasonality), gate fees, and revenues.

## Results

### Trends in nature-based tourism

Nature-based tourism is growing rapidly in India (Figures 3A–J, 4, 5). Although we have data prior to 2002, we compare official numbers from the forest department from 2002 to 2008 for all 10 PAs (Figure 4, Table 1). In 2007–2008, the total number of tourists in these PAs ranged from 5,137 in Bhadra to 566,358 in Periyar (Table 1). Total visitors increased from 2002 except in Sariska (where tigers went locally extinct in 2005, annual growth rate –3%) and Bandipur (annual growth rate –7%, Figure 4). Positive annual growth rate ranged from 7% in Nagarhole to 45% in Periyar.

Tourists are largely domestic except in Ranthambore (Table 1, Figure 6). In 2007–2008, domestic tourists comprised >80% of tourists for all PAs. International tourists have decreased in Sariska (13%) and Dandeli-Anshi (8%), increased in Ranthambore (12%), Kanha (9%), Nagarhole (8%), Pench and Periyar (6%) and not changed in Bhadra, Bandipur, and Mudumalai. Domestic tourists arrive from towns and cities across India (Table S1). Our list covers only overnight visitors, and we might expect day visitors to increase for towns and cities within driving distance of these PAs.



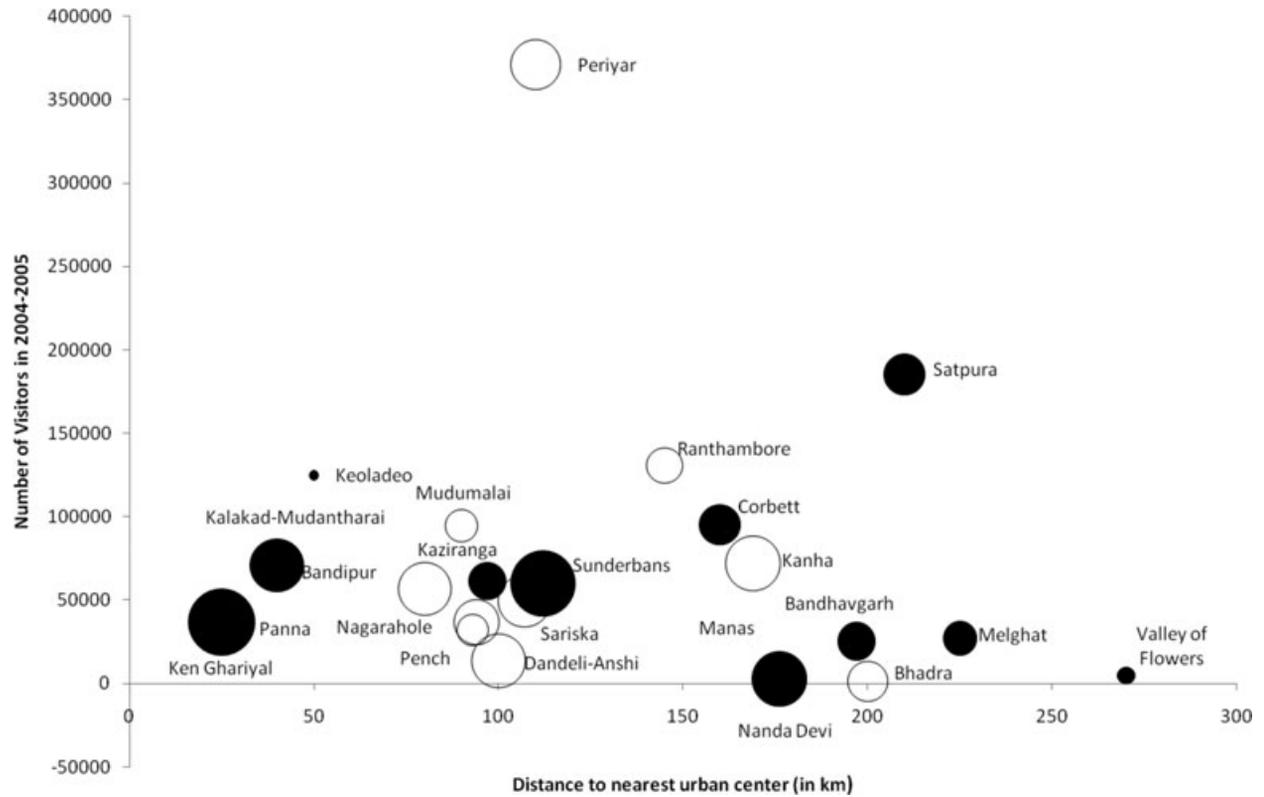
**Figure 1** Ten selected protected areas in India are in red and 300+ other PAs are in grey. The World Database on Protected Areas (version 2010) for 356 protected areas in India indicates that the average size of these PAs is 486 km<sup>2</sup> (minimum of 1.54 km<sup>2</sup> and maximum of 13,647 km<sup>2</sup>). Among 299 PAs, one PA is in IUCN Category I, 50 PAs are in IUCN Category II, and 248 PAs in Category IV. For 319 PAs, the year of establishment ranges from 1928 to 2004.

### Tourist facilities and practices

We interviewed 91% (336/369) resort and home stay owners within 25 km of 10 selected PAs in India. We found representatives to be co-operative (8% of owners or managers could not be located and 1% declined interviews). Most facilities are privately owned, and often run by individuals (ranging from 71% in Sariska and Dandeli-Anshi to 98% in Mudumalai). Most (72%) facilities are established post 2000 and 85% of resorts are located within 5 km of park boundaries. Facilities are located close to PAs with average Euclidean distance to park boundary being 2.1 km (Figures 3–4). Most (97%) facilities are outside the PAs, and those inside are run by the government or older private resorts with long leases (Figure 3A–J, Karanth, pers. obs. 2009). We found new facilities under construction (Table 2, Figure 3A–J). The facilities vary in size (0.01–247 acres) and capacity (2–200 people, Table 2). Homestays have fewer tourists and most are in existing homes or tea–coffee plantations. The num-

ber of facilities has grown in all PAs. We find clustering in Periyar, Ranthambore, Kanha, and Pench (Figure 3), which may allow easier regulation of water and land-use change and establishment of best practices guidelines. However, in other PAs (Bhadra, Dandeli-Anshi, Nagarhole), the geographic spread of facilities makes it harder to monitor practices and manage changes.

The facilities employ between 1 and 150 people, with home stays employing fewer people (Table 2). Percentage local of total employees varied from 43% in Sariska to 93% in Bandipur and Mudumalai (Table 2). However, direct tourism employment in all PAs is a small fraction of the employable population (Table 3). Most facilities were hesitant to discuss wages and salaries offered {salary range was Rs 1,000 (\$20) to Rs 70,000 (\$1,500)/month}. Facilities disclosed that local employees were trained in lower paid positions (gardening, housekeeping etc.) and for higher paid positions (chef, managers) outsiders were recruited. Many job opportunities were seasonal (October to April, peak tourist season in India). Room prices varied



**Figure 2** Distribution of the 10 PAs selected for this study (open circles) according to distance to nearest urban center (defined as population greater than 100,000 with an airport or major railway station) and total number of visitors for 23 PAs for which data were available (PAs not in study are filled circles). The size of the circle represents the size of the PA.

across facilities (Table 2). The average price/person/day ranged from Rs 1,226 (\$30) in Dandeli-Anshi to Rs 4,684 (\$100) in Ranthambore (Table 2). Many facilities purchased vegetables and poultry locally but some expensive resorts shipped food from cities.

The facilities rely on local resources, particularly fuel wood and water. Wood was locally purchased by >93% of facilities (ranging between 93% in Periyar and 100% in most other PAs, Table 2). Water sources were often underground bore wells, ranging from 40% in Bhadra to 100% in many PAs and otherwise municipal water supply (Table 2). We observed swimming pools and water fountains, particularly in Ranthambore, Kanha, and Pench (ASTER 2004–2009; Karanth, pers. obs. 2009). Interestingly, these PAs are located in areas of acute water shortages and high temperatures (40–50°C) in summer months (India Meteorological Department 2009, Table 3). Tourist facilities are often located near villages where local people have limited drinking water and cultivate one rain-fed crop a year. In Ranthambore, severe water shortages required the forest depart-

ment to supplement water bodies used by wildlife inside the PA.

Tourism is changing land use around many of these PAs. Land prices around some PAs have risen sharply, commercial facilities are purchasing land from local people are selling land to outsiders and who moving away from the PAs (Behl, Shreevathsava, Shukla, pers. comm. 2009). Several new tourist facilities are being constructed (Figure 3A–J). Some facilities are located in ecologically sensitive areas and migratory corridors of wildlife (Silori & Mishra 2001; Das *et al.* 2006; Shukla, pers. comm. 2010). Planning and management to mitigate these rapid land use changes in areas surrounding these PAs is needed to maintain ecological connectivity and functionality of these landscapes.

Interviews provided open-ended responses for the reasons leading to the increase in tourism. The responses were grouped and presented based on frequency. The reasons include (1) good wildlife sightings particularly in Ranthambore, Kanha, and Nagarahole, (2) increased media-driven publicity for specific PAs and species such

**Table 1** Characteristics of 10 selected protected areas in India

Protected area	PA size in km <sup>2</sup>	Year established	Habitat	Closest city/ies	Tourist numbers 2007–2008 <sup>a</sup>	Annual growth rate for 2002–2008 <sup>b</sup>	Average growth rate for 2002–2008 <sup>c</sup>	Indian tourists 2007–2008
Sariska	866	1955	Tropical dry deciduous, thorn forests	Jaipur (107 km) Delhi (200 km)	38,433 (8)	−3.2%	−3.8%	83%
Ranthambore	392	1955	Tropical dry forest, open scrub	Jaipur (145 km)	159,110 (13)	14.2%	17.0%	42%
Kanha	940	1955	Sal & bamboo forests	Nagpur (260 km) Jabalpur (169 km)	132,601 (13)	14.5%	17.4%	86%
Pench	275	1977	Tropical moist deciduous forest	Nagpur (93 km)	54,027 (13)	15.9%	19.1%	94%
Dandeli-Anshi	876	1956	Tropical evergreen and semi-evergreen forests	Belgaum (100 km) Panaji (130 km)	22,201 (8)	18.8%	22.6%	99%
Bhadra	492	1951	Tropical moist deciduous and evergreen forest, bamboo	Bangalore (300 km)	5,171 (6)	17.3%	20.8%	99%
Nagarahole	644	1955	Tropical moist and dry deciduous forests	Mysore (94 km) Bangalore (180 km)	67,841 (9)	7.4%	8.9%	91%
Bandipur	880	1931	Tropical moist and dry deciduous forests	Mysore (80 km)	45,402 (7)	−7.1%	−8.5%	98%
Mudumalai	321	1940	Tropical moist deciduous, dry deciduous and thorn	Mysore (90 km) Coimbatore (160 km)	154,159 (9)	26.5%	31.8%	99%
Periyar	777	1934	Tropical moist and evergreen forests	Madurai (110 km) Kochi (120 km)	566,358 (12)	44.8%	7.5%	91%

<sup>a</sup>Total number of tourists for the year 2007–2008 (numbers in brackets indicate years of data).

<sup>b</sup>Annual growth rate is calculated as  $\{\ln(2007-2008) - \ln(2002-2003)\} / \text{Number of years} \times 100\}$ .

<sup>c</sup>Average growth rate is averaged for every year from 2002–2008. For some PAs, data are available from 1995–2008. Data for all PAs were available from 2002–2008.

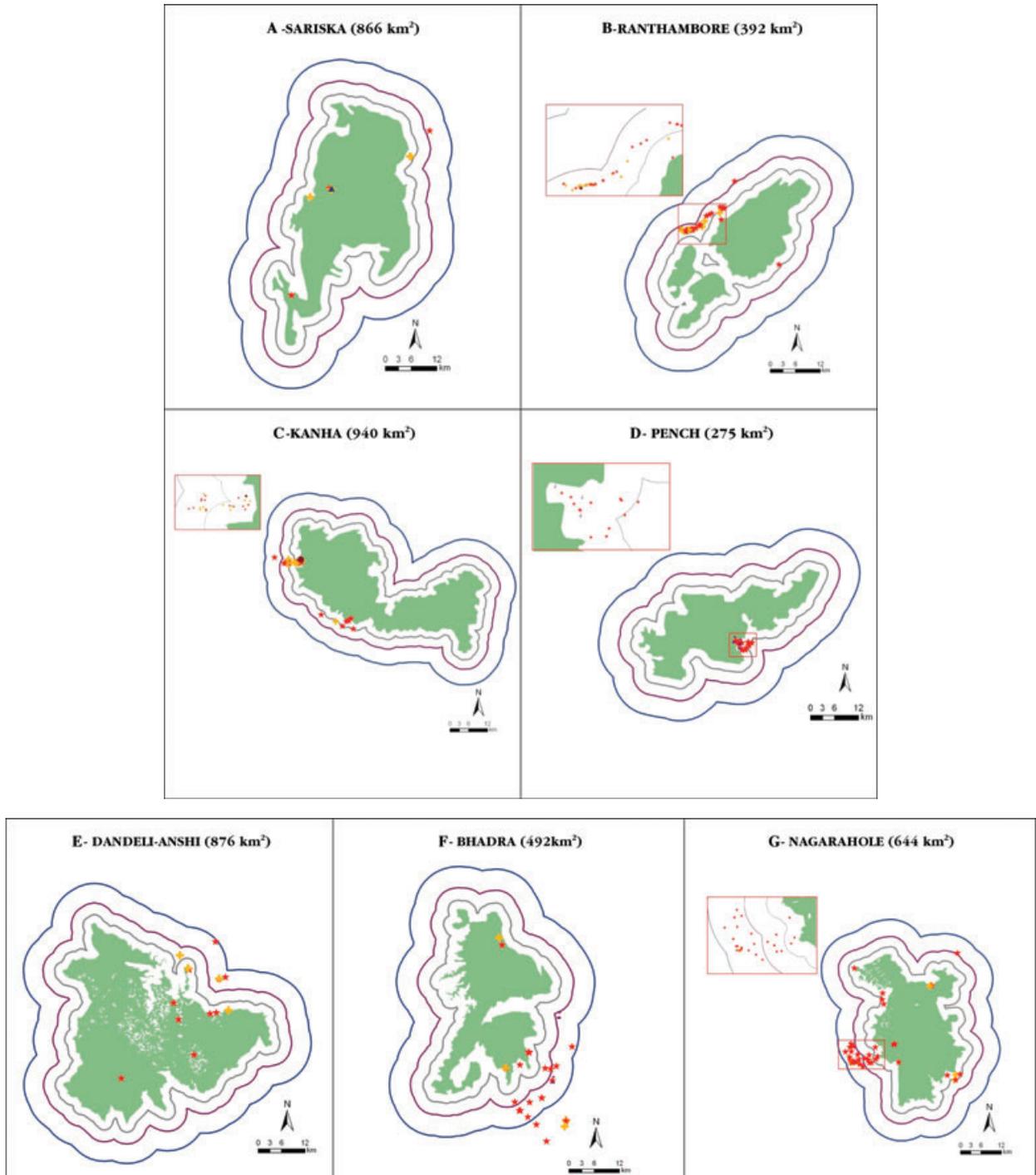
as tigers and elephants, (3) improved accessibility to urban centers, (4) increase in number and improvement in quality of resorts and home stays, (5) good marketing, (6) increase in public interest in nature and being away from urban areas, (7) opportunities for bird watching, elephant rides, boating, hiking, rafting, spice gardens, and tea–coffee plantations etc., and (8) economic growth and increase in middle class spending power. The high numbers of domestic tourists present a tremendous opportunity to educate and involve Indians and sustain conservation efforts in these PAs.

### Tourism and park management

We examined the attitudes of tourist facilities towards the forest department in all 10 PAs to understand their interrelationship. We find minimal conflict in Sariska,

Bandipur, Bhadra, and Nagarahole to more conflict in Mudumalai and Pench (Table 3, Table S2). Forest department rules were considered fair (ranging between 52% in Bhadra and 100% of responses in Dandeli-Anshi, Table 2). Wildlife offences such as poaching, fishing, setting of fires, grazing, fuelwood, and nontimber forest product collection, and electrocution of wildlife were observed in all PAs (Table 2). Forest departments did take action about reported offences but this support varied across PAs and type of offence (Table 2). Some facilities supported forest department during emergencies such as fire outbreaks, but this support varied across PAs (Table 2). Observations and suggestions of tourist facilities are summarized in Table S2.

The rules governing entry of people and vehicles vary across the PAs. For example, in Pench and Kanha, private vehicles are allowed to enter the park based on a



**Figure 3** (A–J) Locations and growth of tourist resorts and home stays in 10 selected protected areas in India. Legend is at the end.

quota system. In 2007–2008, vehicles entering Kanha were 27,941 and Pench was 9,953 (Madhya Pradesh Forest Department 2008). In Ranthambore, vehicles are privately owned and daily numbers regulated by the for-

est department. In Nagarahole and Mudumalai, tourists viewed wildlife from buses operated by the forest department. In Periyar, tourists viewed wildlife from boats (15 boats, capacity 441 people), however a recent boat

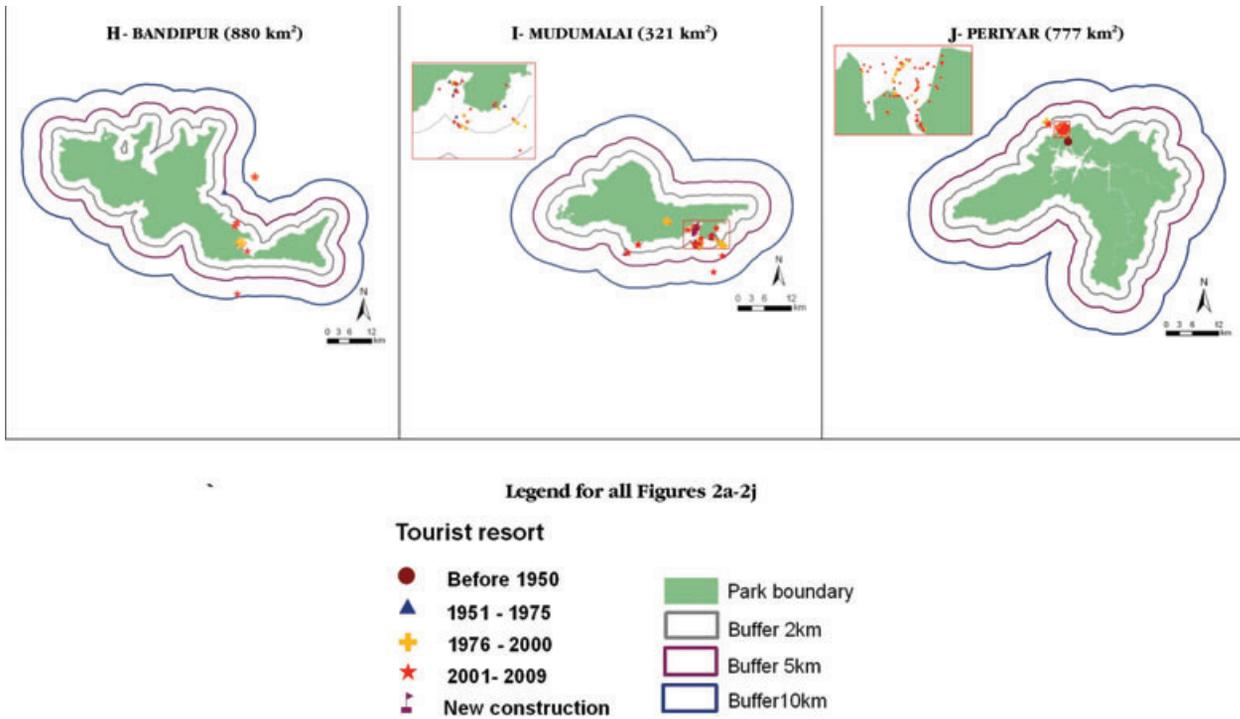


Figure 3 Continued.

capsizing and death of >40 people has brought this practice under scrutiny (Periyar Forest Department 2008). The tourist road network and zone system to control vehicular traffic was most established and longest in

Ranthambore and Kanha. In many PAs, the sole purpose was to view tigers with tiger sightings accompanied by convergence of many vehicles and tourists participating in “tiger shows” (Karanth, pers. obs. 2009). In many PAs

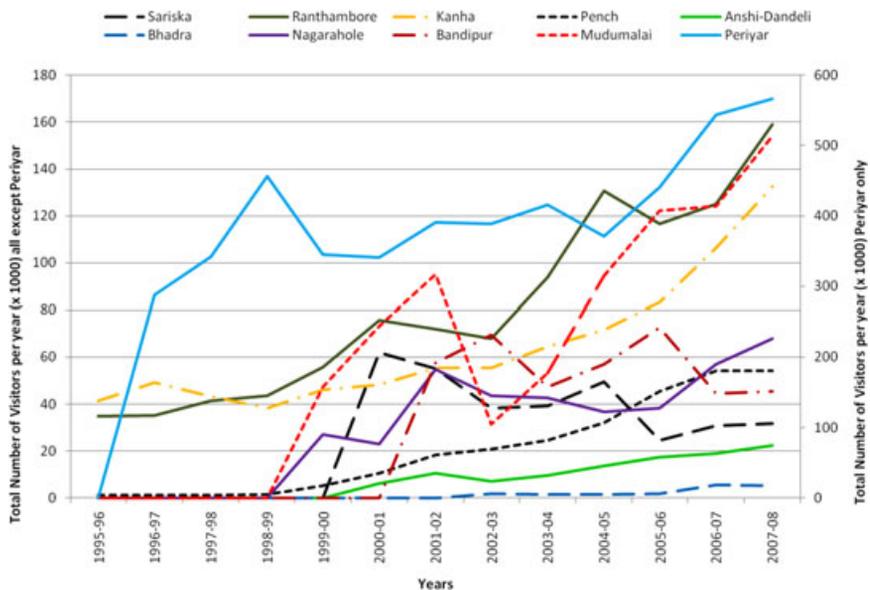


Figure 4 Tourist visitor numbers for 10 Indian protected areas in India. We present numbers from different years for these PAs. Initial visitors numbers are very small for all and followed by rapid increase in some PAs.

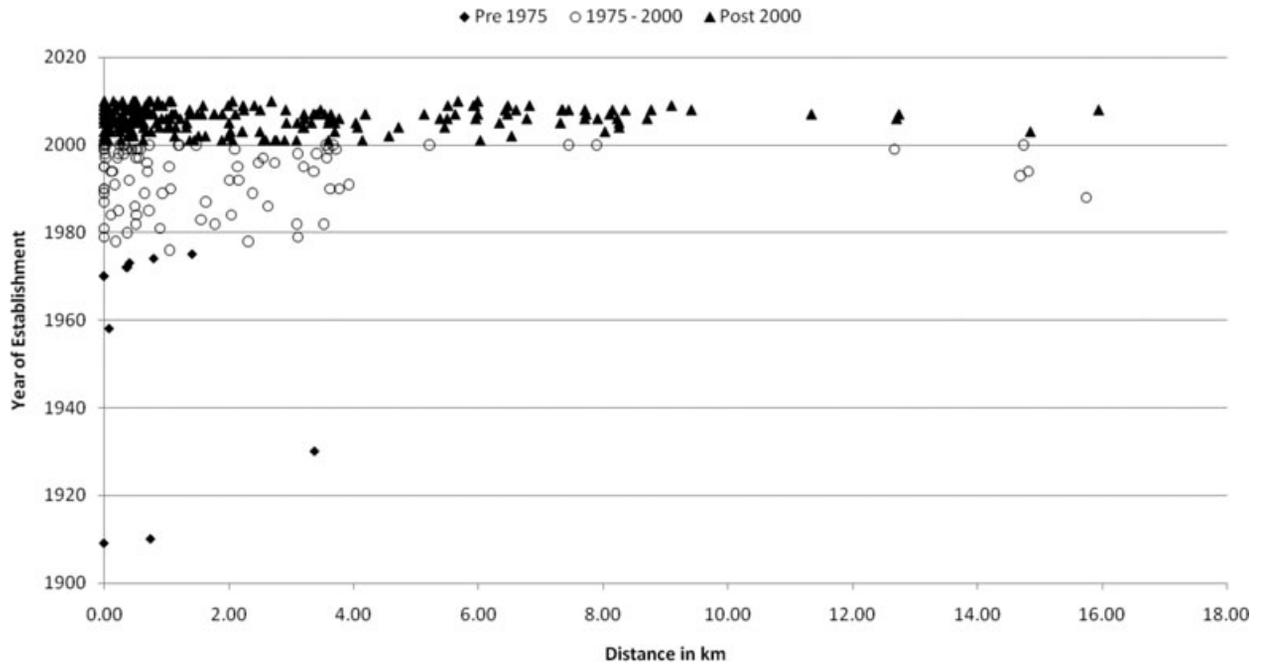


Figure 5 Resorts classified by year of establishment and distance to protected area edge.

(Sariska, Ranthambore, Bhadra, Bandipur, Mudumalai, Periyar), tourists visited the religious temples and shrines located inside. On religious days roads inside PAs are clogged with vehicles, people walking on foot and large amounts of garbage (Karanth, pers. obs. 2009). For ex-

ample, in Sariska ~700 vehicles/day enter twice a week to visit the Pandupole shrine. Forest departments have established guidelines for tourist behavior inside the PAs but we are unsure if they are communicated effectively to tourists.

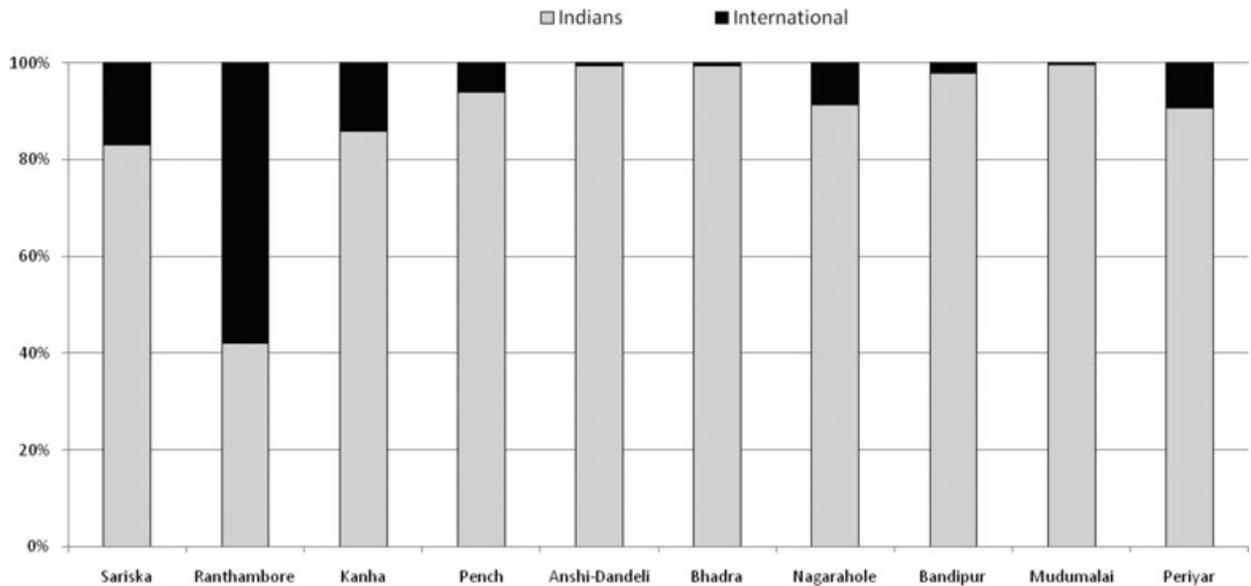


Figure 6 Domestic and international tourists for 10 protected areas in India in 2007–2008.

**Table 2** Characteristics of tourist resorts and home stays in 10 selected Indian protected areas

Protected Area	Dandeli-									
	Sarisika	Ranthambore	Kanha	Pench	Anshi	Bhadra	Nagarahole	Bandipur	Mudumalai	Periyar
Total tourist facilities	8	35	42	16	16	32	48	16	54	102
Interviewed (% age)	7 (87%)	33 (94%)	36 (86%)	14 (88%)	14 (88%)	30 (94%)	45 (94%)	15 (94%)	52 (96%)	90 (88%)
Private ownership	71%	94%	97%	93%	71%	86%	95%	87%	98%	96%
Average Euclidean distance to PA (range, km)	1.0 (0.0–5.5)	3.3 (0.0–5.5)	1.9 (0.0–6.8)	1.0 (0.1–2.0)	2.5 (0.0–9.4)	6.0 (0.0–15.4)	3.9 (0.0–8.3)	3.5 (0.2–12.7)	1.0 (0.0–7.3)	0.2 (0.0–2.5)
Year established	1970–2004	1930–2009	1910–2009	2002–2009	1989–2008	1988–2009	1970–2009	1972–2009	1972–2009	1909–2009
Resorts built post 2000	43%	55%	66%	100%	71%	87%	87%	67%	50%	63%
Resorts outside PAs	100%	100%	94%	100%	79%	97%	98%	94%	98%	99%
Size in acres	0.25–247	0.01–20	1–100	1–19	1–10	0.5–200	0.01–80	1–40	0.25–185	0.2–7
Employees	6–150	6–100	4–68	4–47	2–58	1–60	1–137	2–75	1–40	1–85
Local employees (range)	43%	83%	76%	61%	87%	82%	90%	93%	93%	53%
Salary range (Rs/month)	(20–86%)	(32–100%)	(0–100%)	(38–100%)	(0–100%)	(25–100%)	(14–100%)	(68–100%)	(40–100%)	(8–100%)
Average capacity (range)	3,000–70,000	1,000–30,000	1,250–15,000	1,800–15,000	1,000–8,000	1,000–10,000	2,000–12,000	1,000–10,000	1,000–15,000	1,500–40,000
Average price in Rs (range)	55 (12–200)	41 (2–150)	46 (14–200)	37 (16–125)	30 (8–60)	29 (8–100)	23 (2–72)	29 (10–66)	27 (6–80)	40 (2–152)
Average vehicles owned	3,686 (400–18,500)	4,684 (400–42,000)	3,951 (400–35,000)	5,228 (1,600–18,000)	1,226 (75–4,000)	2,273 (100–40,000)	2,324 (100–20,000)	2,442 (100–10,000)	1,398 (250–6,000)	1,633 (200–34,000)
Bore well use	4	5	2	4	2	2	3	3	2	1
Local fuel wood purchase	100%	100%	100%	100%	43%	40%	100%	94%	81%	96%
Waste disposal	Bury, recycle	Recycle, burn	Burn, bury	Burn, bury	Bury, burn	Burn, bury	Burn, bury	Recycle, burn, bury	Recycle, BURN, BURY	Recycle, bury, compost
Conflicts with FD (yes)	0%	10%	11%	23%	10%	5%	6%	0%	14%	6%
FD rules fair (yes)	86%	97%	72%	79%	100%	52%	69%	60%	78%	83%
Seen wildlife offences (yes)	43%	34%	40%	23%	54%	38%	35%	25%	40%	13%
FD takes action (yes)	67%	30%	75%	71%	100%	26%	61%	100%	32%	18%
Support FD for emergency patroling (yes)	57%	17%	52%	10%	88%	13%	16%	63%	7%	9%

FD = forest department.

**Table 3** Demographic and socio-economics of people living around 10 protected areas in India

Protected area	Districts	District area (km <sup>2</sup> )	Average human population density within 10 km of PA <sup>a</sup>	Total tourism employees	Proportion of people directly employed by tourism <sup>b</sup>	Average district level annual rainfall (mm) (range) <sup>c</sup>
Sariska	Alwar	8,380	290/km <sup>2</sup>	253	0.0002	43.7 (0.00–156.2)
Ranthambore	Sawai Madhopur	4,500	128/km <sup>2</sup>	760	0.001	38.5 (0.00–155.0)
Kanha	Balaghat	9,245	91/km <sup>2</sup>	676	0.0007	91.9 (0.00–568.4)
	Mandla	8,771				76.4 (0.00–393.3)
Pench	Seoni	3,206	98/km <sup>2</sup>	276	0.0006	80.8 (0.00–513.0)
	Chhindwara	11,815				116.3 (0.00–725.2)
Dandeli-Anshi	Uttara Kannada	10,250	119/km <sup>2</sup>	173	0.0004	282.3 (0.00–1,412.6)
Bhadra	Chikmagalur	7,201	231/km <sup>2</sup>	434	0.0004	191.6 (0.00–992.1)
	Shimoga	8,465				219.9 (0.00–1,323.5)
Nagarahole	Mysore	6,268	681/km <sup>2</sup>	587	0.0008	66.2 (0.00–171.2)
	Kodagu	4,102				228.3 (0.00–1,318.1)
Bandipur	Chamrajnagar	5,101	237/km <sup>2</sup>	270	0.0002	48.7 (0.00–109.1)
Mudumalai	Nilgiris	2,452	201/km <sup>2</sup>	375	0.0004	159.3 (0.00–635.6)
Periyar	Idukki	5,105	346/km <sup>2</sup>	938	0.0007	270.8 (0.00–983.4)
	Pathanamthitta	2,462				182.5 (0.00–454.4)

<sup>a</sup>Human population density is calculated using taluk level data from India's 2001 census ([www.censusindia.net](http://www.censusindia.net)) and accounting for park area.

<sup>b</sup>Employment is calculated relative to the total employable population in a taluk.

<sup>c</sup>Rainfall data at district level are for November 2008–October 2009 from the India Meteorological Department ([www.imd.gov.in](http://www.imd.gov.in)) and monthly minimum and maximum data are in brackets.

Tourism related revenue ranges from \$6,848 in Bhadra to \$3,163,753 in Ranthambore (entry fees). In some PAs (Ranthambore, Kanha, Periyar), the tourism revenue can potentially support PA management efforts. However, for PAs with few visitors (Bhadra and Dandeli-Anshi) relying on tourism revenue may be unwise. Entry fees vary in all PAs, being, for example, Rs 15 (30 cents) for Indian nationals and Rs 200 (\$4) for international visitors in Nagarahole. In the interviews, officials suggested that the gate fees be increased for international visitors, while tourist facilities suggested that high entry and vehicle fees were driving domestic tourists away. The tourism revenue is managed by the forest department except in Periyar where 56% of revenues were given to the Periyar Foundation. This foundation was established to support ecodevelopment and people's participation in Periyar (Periyar Foundation 2007), but success of this effort is debated (Gubbi *et al.* 2008).

## Discussion

Recent research on nature-based tourism has found that visitors to PAs in wealthy countries are declining (Pergams & Zaradic 2008) while less-wealthy countries are experiencing growth in international tourism (Balmford *et al.* 2009). We focus on trends and their implications for Indian PAs. With a growing economy (~6–9% annually) India has an emerging middle class generat-

ing increased demand for nature-based tourism (Tiger Task Force 2005). The predominance of domestic tourism (more than 80% of tourists are domestic in all PAs) represents a vital opportunity to educate and mobilize public support for conservation in India.

Our analysis of yearly tourist data in 10 PAs suggests wide variability in annual visitor numbers (5,137–566,358) and tourism growth rates. Some PAs Periyar, Ranthambore, Kanha, and Pench have continued growth, which may be due to the widespread publicity for these PAs and forest officers that support tourism growth (Balasubramaniam, pers. comm. 2009; Pabla, pers. comm. 2009). Others such as Mudumalai, Sariska, Nagarahole, and Bandipur fluctuate in visitors and we might attribute this to changing forest department policies based on the officer in charge (Karanth, pers. obs. 2009). Bhadra and Anshi have fewer visitors, which might be due to them being less known to the public, poor wildlife sightings, and accessibility. Carrying capacities for each of these PAs are yet to be determined scientifically and growth seems to be governed partly by the local forest officers' interest in managing the entry of people and vehicles and availability of tourist facilities.

Tourism revenue ranges from \$6,848 in Bhadra to \$3,163,753 in Ranthambore. Efforts to direct this revenue to support conservation and park management efforts in these PAs must be implemented with caution. Tourist facilities are largely private, recently established

and 85% of them are within 5 km of the PA boundaries (Figure 3A–J, 4, Table 2). Geographical clustering of facilities in some PAs (Periyar, Ranthambore, Kanha, Pench) might enable easier management of land use changes and resource use than other PAs (Bhadra, Dandeli-Anshi, Nagarahole) where facilities are spread out.

We find tourism related employment providing direct income benefits to a few, employing <0.001% of population living within 10 km of these PAs (Table 3). The Indian National Wildlife Action Plan states that ecotourism benefits must be shared with local communities (Tiger Task Force 2005). Similar to other PAs worldwide, tourism revenue in India has rarely been directed towards improving conservation efforts or supporting local people (Wells 1993; Sandbrook 2010). Sustaining tourism in these PAs will require sharing of benefits with local people and building support among private enterprises for conservation initiatives.

Conflict levels and interactions between tourist facilities and forest department varied across PAs, with rules perceived to be fair by many facilities (Table 3, Table S2). There is variability in tourism rules, management efforts and practices followed by the forest departments. Each PA has unique characteristics that mandate site-based guidelines. However, there is a general need for enforcement of existing rules and regulation of tourism management practices regionally and nationally (Sekhar 2003; Hanam 2005; Tiger Task Force 2005).

The trends in nature-based tourism in India is on an upward trajectory and differs from industrialized countries. The growth in domestic tourism generates an opportunity for public support in the urban population for conservation. On the other hand, tourism adds another dimension to the long-existing conservation challenges from local populations who rely on PAs for fuelwood, fodder, and other ecosystem services (Sekhar 2003; Gubbi *et al.* 2008; DeFries *et al.* 2010; Karanth *et al.* in review).

The protected areas in this study, illustrate the range of opportunities and challenges that exist in managing nature-based tourism in India's PAs. In a few PAs, the significant tourism-related revenues may supplement management efforts but generally revenues are not a large source for conservation funds. The direct economic opportunities available to local people from tourism are marginal in all the PAs relative to the large number of people living around them. Enforcement and establishment of clear guidelines to govern tourists, vehicles and use of water, wood, and other resources by tourist facilities is urgently needed in all PAs (Sekhar 2003; Tiger Task Force 2005). Balancing PA management, tourism growth, local community needs and rapid ongoing land use changes around these PAs requires attention and co-

operation between government agencies, private enterprises, and local communities.

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## Supporting information

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Origin of visitors to protected areas in India.

**Table S2.** Observations and suggestions by resorts and home stays.

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