9

Tigers in Panna: preliminary results from an Indian tropical dry forest

Raghunandan S. Chundawat, Neel Gogate and A. J. T. Johnsingh

Introduction

Quantitative information on movements, activity and food habits of tigers living in the tropical dry forest has lagged behind that now available for tigers living in tropical moist forest and alluvial grassland/subtropical moist deciduous forest types in the Indian subcontinent (Seidensticker & McDougal 1993; Karanth & Nichols 1998). This once extensive tiger habitat type has been increasingly fragmented and degraded. Still today about 45% of the remaining tiger habitat in the Indian subcontinent is in tropical dry forests (E. D. Wikramanayake *et al.* this volume). Tiger density is constrained by the availability of large ungulate prey, cover and water (M. Sunquist *et al.* this volume). In the highly seasonal environment that characterises tropical dry forests, these critical resources are limited in time and space. Surface water is highly restricted, and shade available only around it, from March to June. In the subcontinent, large ungulate densities reach their highest levels in the gallery forests/alluvial plains and their lowest levels in tropical dry forest/savannah (Eisenberg & Seidensticker 1976; Karanth & Nichols 1998). Throughout the dry forest habitats, human disturbance from wood cutters and cattle grazers is high and there is low native ungulate biomass because cattle populations compete with the tiger's natural prey species for food. Cattle are also a source of diseases for the native ungulates. All of these factors place tigers living here at high risk.

This is a preliminary report of an ongoing study of tiger ecology in Panna Tiger Reserve, Madhya Pradesh, from early 1996 to mid-1997. We present data on tiger food habits and on the movements and activities of three tigers established through radio-tracking, and preliminary estimates of prey density. Our research revealed the critical ecological needs of tigers living in Panna specifically and tropical dry forests generally, and we make suggestions on how managers can address these needs so that the tiger can survive in Panna and elsewhere in this forest type.

We thank the Ministry of Environment and Forests, Government of India, and the Madhya Pradesh Forest Department for permission to capture and study tigers. The Ranthambhore Foundation provided transport. Drs P. K. Malik, P. K. Peshin and A. B. Shrivastrava helped us radio-collar tigers. We thank our colleagues at the Wildlife Institute of India for their assistance in our work.

The Panna Tiger Reserve and its environs

The 543 km² Panna Tiger Reserve lies along the Ken River, a tributary of the Yamuna, in Madhya Pradesh, northcentral India (Fig. 9.1). It is composed of three landform units: the upper Talgaon Plateau, the middle Hinauta Plateau, and the Ken River valley. The plateaus are separated from each other and from the river valley by steep, 10- to 80-m high escarpments characterised by rock faces, caves and thick vegetation at their bases. Panna supports a diverse mammalian assemblage including tigers, leopards, hyaenas, sloth bears, dholes and wolves. The Hanuman langur is the most numerous primate. Ungulates include sambar, chital, wild pigs, nilgai and chousingha.

Mean maximum temperature ranges from 6 to 43°C. Annual precipitation depends on the southwest monsoon that lasts from July to September, when an average of 1100 mm of rain

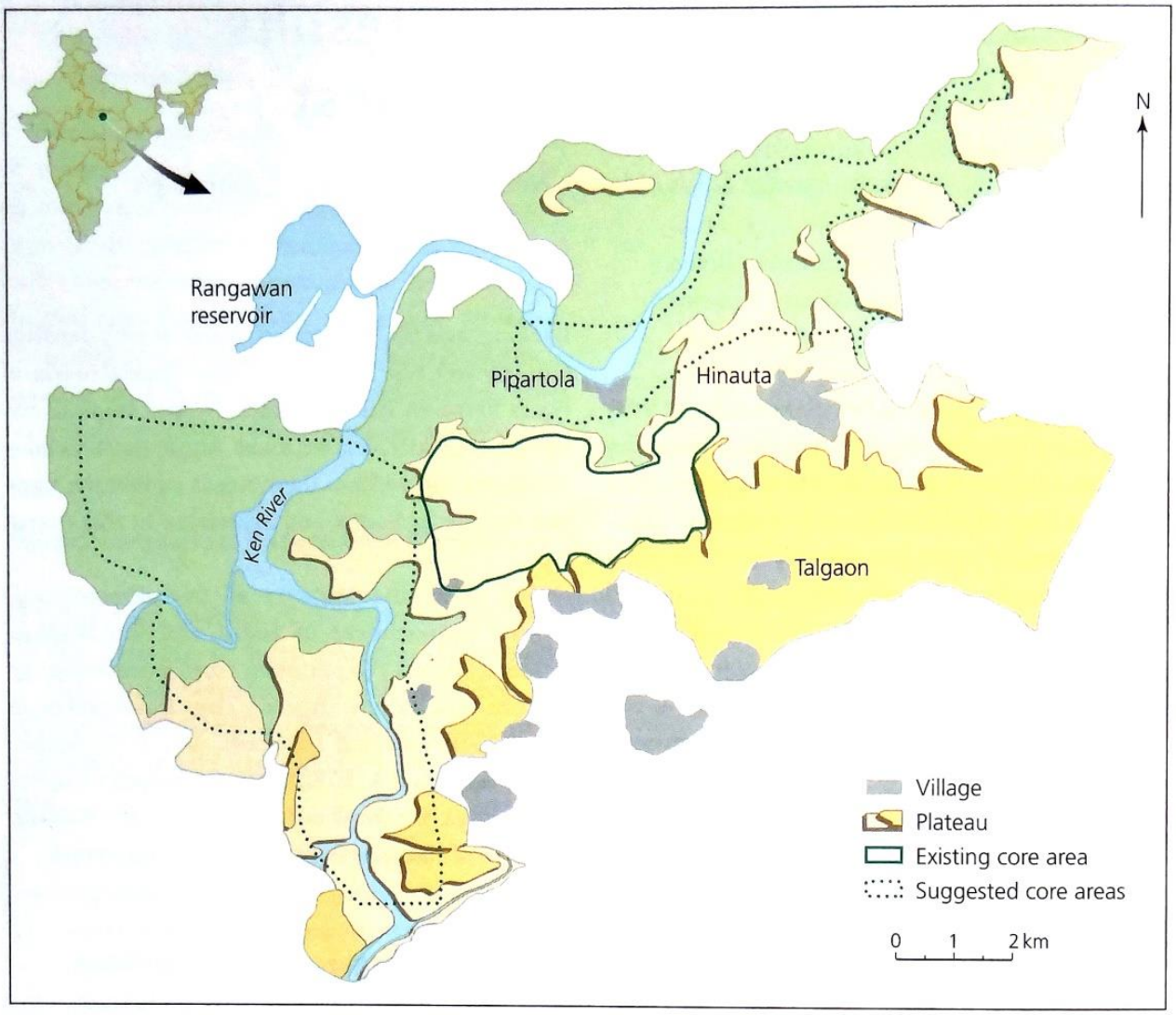

FIGURE 9.1
The Panna Tiger Reserve, India, with existing and suggested core areas.

falls. In the dry season, available water is restricted to the river, seepage at the bases of the escarpments and a few artificial waterholes. Slopes off the plateaus are dominated by *Acacia catechu*. Open woodlands with areas of short grass, the preferred habitat of nilgai and chousingha, are the dominant vegetation on the plateaus, while in the river valleys and along the seasonal drainages are areas of tall grass and closed woodlands that are preferred by chital and sambar.

The central Hinauta Plateau extends over 80 km² and is now relatively undisturbed, following the removal of three villages in the early 1980s. Throughout the remainder of the reserve, however, there is widespread and intense disturbance by people and cattle. Thirteen villages exist within the Panna Tiger Reserve, with human and cattle populations of about 600 and 9500 respectively. There are 79 villages within 10 km of the boundary outside the reserve. Villages place immense pressure on the reserve, primarily through grazing their livestock there.

Methods

Capturing and radio-tracking tigers

We captured and radio-collared an adult male tiger, an adult tigress with cubs less than one year old, and one subadult female we estimated to be about 16–17

Table 9.1. *Size of home ranges for radio-collared tigers in the Panna Tiger Reserve, India as determined by the minimum convex polygon (MCP) methods of establishing home range sizes*

Tigers	Dates tracked	Number of locations	Home range size (km²)			
			Total	Winter	Summer	Monsoon
Subadult female	4/96–9/96	23	31	—	—	—
Adult female	1/97–7/97	115	27	—	16	27
Adult male	4/96–7/97	134	243	110	200	—

months of age at capture (Table 9.1). We located tigers feeding at kills, approached them on elephant back, and darted them from 15–20 m away using a Telinject gun. Medetomidine (0.05 mg/kg tiger body mass) combined with ketamine (3.5 mg/kg) was used to chemically restrain tigers. Radio-collars from Telonics were attached and standard measurements of body size and condition were made. Atipamezole (Antisedan), an antagonist for medetomidine, was given to revive the tiger. We monitored the newly radio-collared tiger from elephant back until it recovered.

The position of radio-collared tigers was determined by triangulation from known reference points using standard radio-tracking techniques (Sunquist 1981). Tigers were monitored daily for periods of 5–15 days. To calculate home range size, random locations (one every three days for the adult male and one every two days for the adult tigress) were used to ensure independence of sample points. Our index of daily movement was calculated using the distance between the tiger's location on one day and its location on the following day. We used CALHOME to summarise our findings. Home range sizes were estimated using the minimum convex polygon (MCP, Mohr 1947b). Our tiger home range statistics are more complete for the dry season than the wet season because from July to September roads were washed away and we had problem at times in locating tigers.

Estimating tiger diet and prey abundance

Whenever a radio-collared tiger was found in one general location for about eight hours we suspected that a kill had been made and the area was searched intensively after the tiger moved away. This method was successful for the adult tigress, because she lived in areas that were relatively undisturbed by humans and frequently rested near her kills. Finding kills made by the male was more problematic. In the highly disturbed areas he frequented, he fed largely at night and frequently he fed only once from a kill. We also sought information on tiger kills from the reserve staff and villagers. Tiger scats were collected opportunistically. We randomly selected 15 scats for each season and identified remains based on the micro- and macroscopic characteristics of hair (Mukherjee *et al.* 1994). Ungulate prey densities were estimated by counting ungulates along reserve roads and pre-established transect lines; the data were analysed using the programme TRANSECT (R. Chundawat in prep.).

Results

Movement patterns and tiger home range sizes

The adult male tiger moved on average 4.2±3.3 (1.7–10.5, n=38) km between locations on successive days in winter, and 4.1±3.3 (1–13.9; n=28) km in summer. The difference was not significant. This is about three times farther than the female (1.4±1, 0.6–2.9, n=58). The maximum distances moved between successive days were about three times the average for both adults.

The home range of the adult male (243 km²) was about ten times larger than that of the adult tigress with cubs (Table 9.1, Figs. 9.2 & 9.3). In winter his

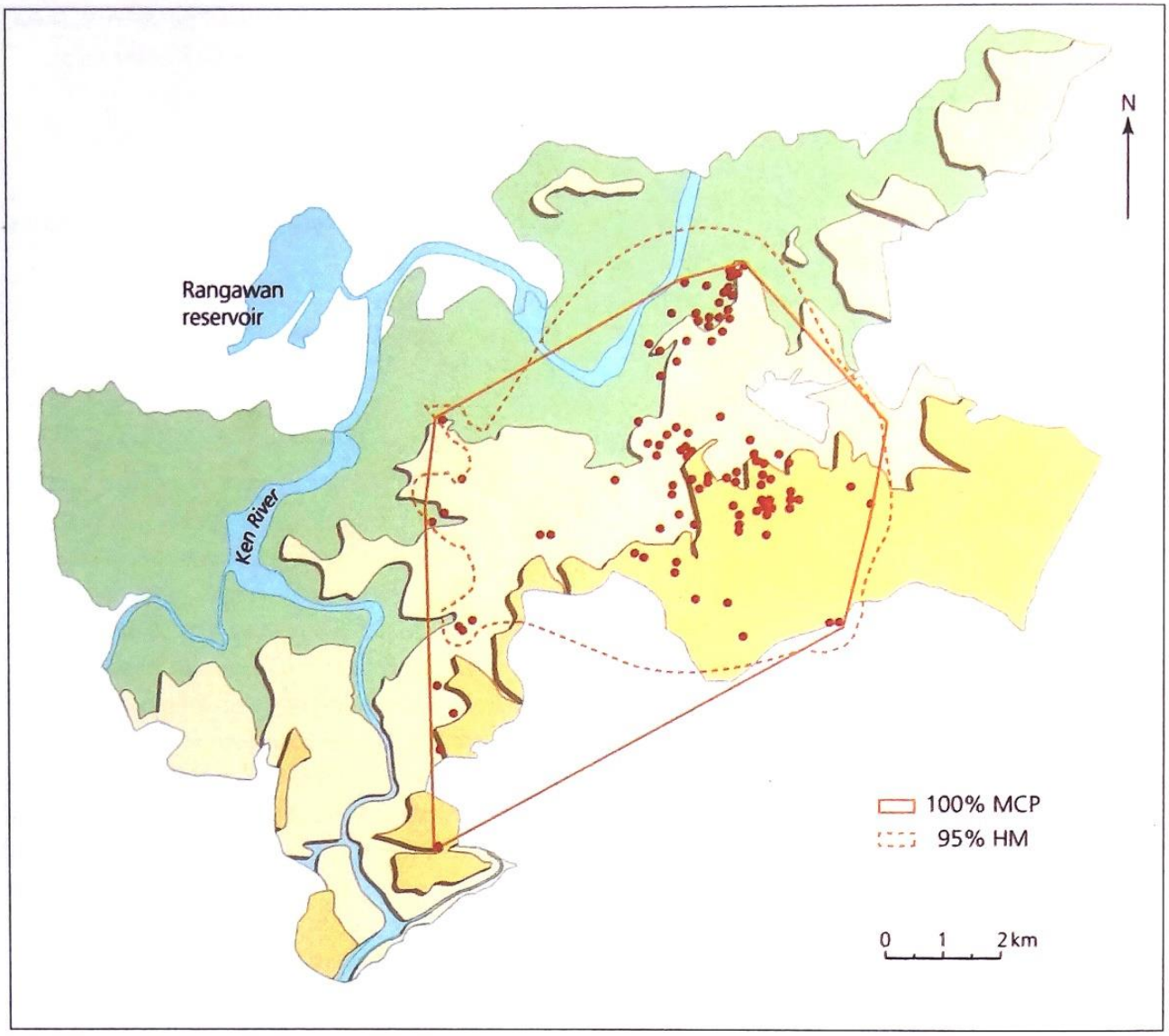

FIGURE 9.2
The home range (territory) of the radio-collared adult male tiger, Panna Tiger Reserve, India. MCP = minimum convex polygon; HM = the harmonic mean method of measuring home range size.

home range was 100 km², nearly half his summer range of 200 km². The adult tigress' home range increased from 16 km² in the pre-monsoon period to 27 km² during the monsoon. The subadult tigress' home range was estimated to be about the size of that of the adult female (Table 9.1, Fig. 9.3). On two occasions she made long movements away when we could not locate her for periods of 7–15 days within an area of about 100 km² around her known home range. She was found dead near a village 10 km away from her home range on September 16, 1996, six months after we started radio-tracking her.

The adult tigress' range covered the central area of the reserve, which was largely undisturbed and supported the highest density of native ungulates in the reserve, and she used this area in a homogeneous manner. No other adult females were living within this area and her home range could be called a territory (Sunquist 1981). The adult male tiger used this same area about 95% of the time and in winter used it in a homogeneous manner. His summer use of the area was more clumped, as he focused his attention on areas along the base of the escarpments where there was dense cover and

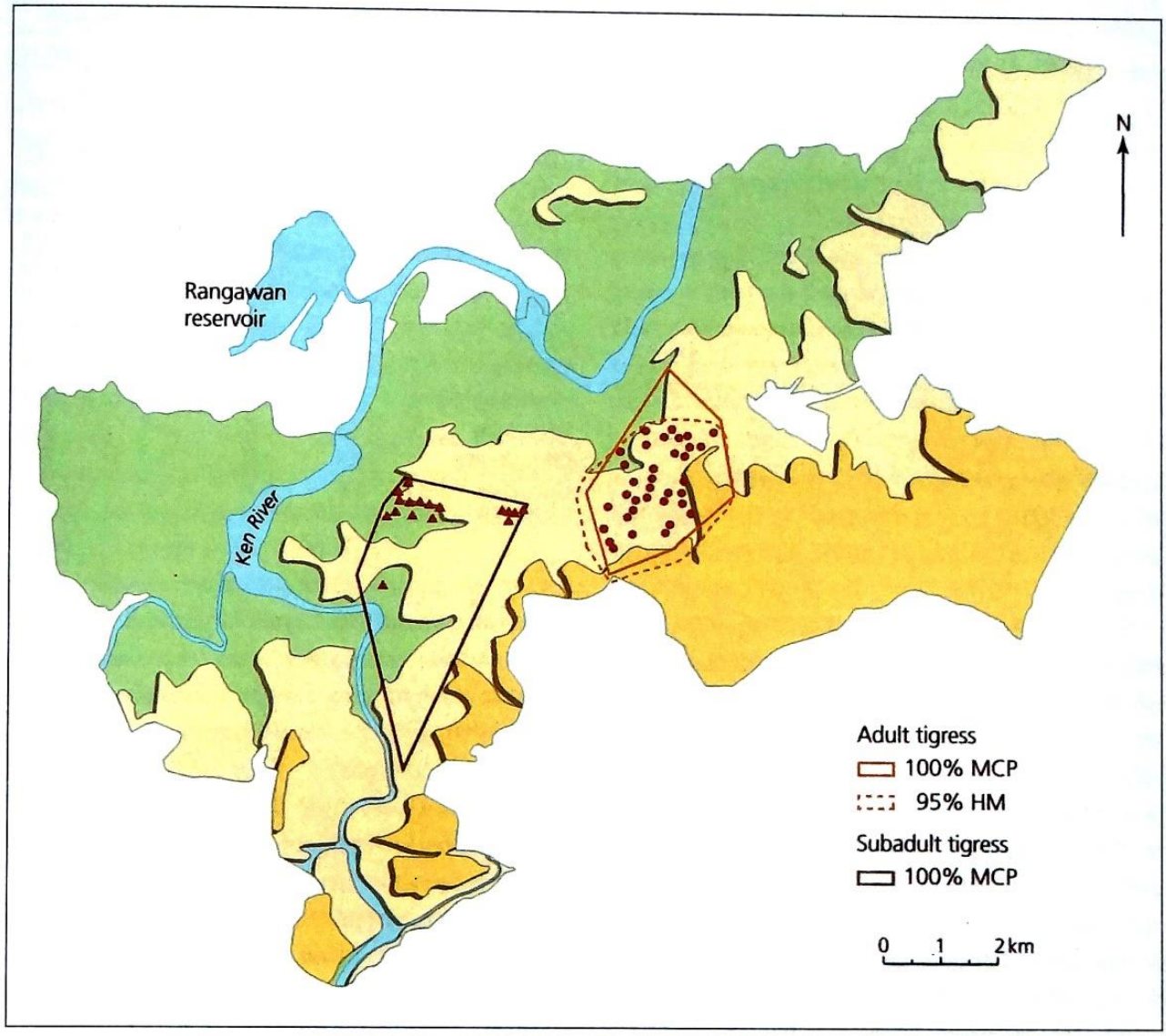

FIGURE 9.3
The home ranges of radio-collared tigresses, Panna Tiger Reserve, India. MCP = minimum convex polygon; HM = the harmonic mean method of measuring home range size.

water. His large home range covered nearly half of the reserve and his movements took him beyond the reserve boundaries. We had no evidence that any other adult male lived within his home range, but we did have evidence that two adult males lived adjacent to his home range.

Prey abundance, food habits and frequency of killing large prey by radio-collared tigers

Our initial estimates of ungulate prey abundance were 1 chital, 1.8 sambar and 2 nilgai/ km² (R. Chundawat unpub. data.) Over a six-month period (January 1997 to July 1997) we located 27 large mammal kills made by the adult tigress and could determine with confidence that she made three additional kills (Table 9.2). On average, she was making a large mammal kill about once every six days while she was accompanied by three cubs less than one year old. We rarely found small-sized kills. Her large prey diet consisted primarily of sambar and nilgai (~80%) in contrast to the diet of the adult male tiger that consisted mostly of cattle (84%). Because of his wide-ranging movements, we were not as successful in finding his sequential kills

Table 9.2. *Tiger kills (% occurrence) found in Panna Tiger Reserve, India*

Prey	Adult male tiger (*n*=19)	Adult tigress (*n*=27)
Sambar	5.3	55.6
Chital	0.0	3.7
Nilgai	10.5	25.9
Hanuman langur	0.0	3.7
Wild pig	0.0	3.7
Cattle	84.2	7.4

Table 9.3. *The diet of tigers (% occurrence) based on scats in the Panna Tiger Reserve, India. Each season 15 of all the scats collected were randomly selected for analysis*

Prey	Winter	Summer	Monsoon	Total
Sambar	13.3	46.7	13.3	24.4
Nilgai	40.0	13.3	20.0	25.4
Chital	13.3	0.0	40.0	17.7
Cattle	13.3	20.0	0.0	11.1
Wild pig	13.3	6.7	6.7	8.9
Hanuman langur	0.0	20.0	6.7	8.9
Porcupine	13.3	0.0	6.7	6.7
Chousingha	13.3	0.0	6.7	6.7
Unknown	0.0	6.7	6.7	4.4

and we could not determine the frequency with which he killed large mammals. On five occasions, we found him feeding at sambar kills made by the tigress.

The major components of the tiger's diet in Panna, as revealed by our analysis of scats, were sambar, chital, nilgai and cattle (Table 9.3). While we were unable to find small-sized kills through our radio-tracking, the scats revealed that, based on percentage occurrence, mammals weighing less than 40 kg comprised about one-third of the tiger's diet in Panna (Table 9.3). Our examination of the scats also revealed that >40% of the diet by season was comprised of one large ungulate species: nilgai during winter, sambar during summer and chital during the monsoon. Cattle and Hanamun langur were killed more frequently in summer. Cattle remains were absent from the scats during the monsoon, when there was abundant food for the cattle to graze near villages and they did not have to enter the surrounding forest areas.

Discussion

In this preliminary report, we want to emphasise the important findings that characterise tigers living in Indian tropical dry forests and the risks they face. These habitats support a relatively low large-ungulate biomass and have high human disturbance. Water and cover, key resources for the tiger, are sparse, seasonal, and clumped in their distribution. In Panna, the adult male tiger's home range was about four times larger and the adult female's home range was about twice as large as comparable tiger home ranges, established through radio-tracking, in the Royal Chitwan National Park, Nepal (Sunquist 1981).

We found just how low the supply of wild ungulate prey is for tigers in Panna. We estimated that there are about five large wild ungulates (chital, nilgai and sambar) per square kilometre, about one-third of the estimated crude density of cattle (17.5/km^2) in the reserve. This compares to ~60 potential wild ungulate prey per square kilometre in the tropical moist forest and alluvial grassland/gallery forest tiger reserves in India and Nepal (Eisenberg & Seidensticker 1976; Seidensticker & McDougal 1993; Karanth & Nichols 1998). In Panna, tigers include a substantial number of small-sized mammals in their diet. They also take about 70 cattle each year. Considering that about 75% of the ungulates in the reserve are cattle, it is surprising that cattle make up only 11% of the tigers' diet (Table 9.3). Tigers in fact take less than 1% of the available cattle each year, but taking cattle on any scale places tigers at risk of poisoning and creates bad feeling towards them.

The extent of disturbance-free habitat with adequate prey in Panna is limited and this limits the area available for females to rear their cubs. The majority of the reserve is heavily disturbed by

humans, and the behaviour of ungulates in relation to such areas is a key ecological factor affecting tigers living in tropical dry forests. The key wild ungulate here is sambar. Sambar drink at night, and during the summer they do so every night. We found that the adult tigress focused her hunting to take advantage of this, and killed sambar coming to restricted watering sites. Sambar are less restricted in their wet season habitat use and the tigress nearly doubled the size of her home range during this period. In other areas of India, chital are also an important prey species for tigers, but chital density in Panna is very low. While nilgai are the most numerous wild ungulate in Panna, their availability as prey for tigers is restricted in some seasons by their use of more open habitats.

The single most important finding to emerge from our work to date has been the importance of the watercourses and watering sites in this forest type as critical habitat for tigers. If small reserves such as Panna are to sustain their tiger populations then they must include as much of the watercourse as possible in a disturbance-free zone, so that tigers can hunt wild ungulates and rear their cubs undisturbed. What is urgently needed in Panna is the creation of at least two more disturbance-free 'mini-core' areas in Balaiya Seha and the Ken River Valley (Fig. 9.1). This requires removing about 4000 people from the reserve; without this, the future of the tiger population in Panna is very bleak. The second lesson from our study of tigers in Panna is just how few tigers there are living here. With these low numbers we cannot see how this can be a sustainable tiger population unless habitat connectivity is maintained with other areas where tigers still live, allowing tigers dispersing between areas to survive. Our data show that currently, dispersing tigers leave Panna and die in the hostile environment that surrounds it. We believe that these conditions are the major threat to tigers throughout India's dry forests and place all the tigers living here at very high risk.