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Abstract: Today, confined to less than 7% of their original range, tigers are going through one of the worst crises in their evolutionary history. The Indian subcontinent, which contains most of the world's wild tigers, represents only 11% of the world's tiger habitat. We estimate that there may be less than 1,600 tigers in the whole of the Indian subcontinent and the realistic maximum number of tigers that could be supported with its current habitat would be around 3,700. Tiger conservation in the Indian subcontinent faces a range of serious and complex threats, but we believe that most of these issues are still possible to address; India showed that this was possible in the 1970s when the survival of the tiger in the country also looked bleak. Here, we summarize some of the most important issues and suggest some means by which these may be addressed to secure the future of this majestic big cat.

Status and Conservation of Tigers in the Indian Subcontinent

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THE TIGER IN THE INDIAN SUBCONTINENT

The tiger (*Panthera tigris*) originated in the landscape that is now China, and was widely distributed over Southeast Asia even about two million years ago [1]. It began occupying, among others, a variety of biomes in the Indian subcontinent, including the high mountains of the Himalaya where temperatures dip several degrees below freezing. It also occupied the leech-infested wet evergreen forests of the eastern Himalaya and the Western Ghats, the hot and humid mangrove swamps of the Sundarbans, as well as the dry forests of western India where summer temperatures reach a searing 48°C. Based on molecular genetic data on the Indian tiger, the species is believed to have entered India through the Assam gateway approximately 12,000 years ago.

Within the subcontinent, tigers perhaps never colonized Sri Lanka because they moved in to southern India only after rising sea levels had already severed the land bridge between India and Sri Lanka [1]. In Pakistan, the last tiger was shot in 1906 in the Indus river valley. Seals from the Indus Valley civilization (3,000–4,000 BP) had engravings of elephant (*Elephas maximus*), rhinoceros, tiger, and gaur, all animals of forests or tall wet grasslands [2]. Along the Assam gateway, in the course of time, other large mammal fauna from the humid tropics of the Oriental realm, including sambar, buffalo, gaur, and wild pig, all adapted to forests and marshy areas, also moved in to the forested habitats of India. It was much later in geological time that northwest India closed up to the mainland mass [3], thereby allowing the influx of Ethiopian fauna, dominated by bovids, such as gazelle, blackbuck, chowsingha, and nilgai, which colonized the dry deciduous and thorn forests. Together, all these ungulate prey species have enabled the tiger to thrive in the subcontinent.

Although no historical data exist on tiger population sizes, old hunting records provide valuable insights into their abundance in the past. The historian Mahesh Rangarajan, for example, estimated that between 1875 and 1925, nearly 80,000 tigers were killed in Central India alone [4]. Tigers were also so common in Nepal *terai* habitat that a multitude of tigers could be killed in short periods of time: King George V and his party shot 39 tigers in 11 days in 1911–1912, and the Maharaja of Nepal and his guests shot 433 tigers between 1933 and 1940 [5].

PRESENT TIGER RANGE AND POPULATION ESTIMATES IN THE SUBCONTINENT

Today, tigers in the subcontinent are scattered across India, Nepal, Bhutan, and Bangladesh, which represent a varied ecological and demographic milieu (Table 24.1). Where once they ranged widely across the Indian subcontinent, they now occupy only around 400,000 km² [6]. Breeding populations are now believed to be restricted to about 40,000 km², which is less than 1% of their historical range [7]. Over time, the subcontinent has seen a phenomenal increase in the human population and a rapid economic growth, a loss of forest cover, and increasing habitat degradation. As a result, there has been a serious population decline among top carnivores like the tiger. Recognizing this trend, the Indian government started Project Tiger in the early 1970s, an ambitious recovery and conservation plan aimed to secure the status of the country's national animal (see Sahgal and Scarlott,

TABLE 24.1 Synoptic overview of the ecological and demographic context of tiger conservation in countries in the Indian subcontinent

Country	Land area (km ²)	Human population density (km ⁻²)	Percent forest cover	Tiger habitat (km ²)	Percent tiger habitat protected	Estimated tiger number (breeding adults)
Bhutan	47,000	49.5	72.5	14,313	70	67–81 [11, 12]
Bangladesh	133,910	1,123.5	6.7	6,000	100	200 [13]
Nepal	143,181	201.9	25.4	9,000	50	98–123 [38]
India	2,973,190	380.0	22.8	364,200	20	1,600 [9]

Chapter 23). Over time, as tiger conservationist Valmik Thapar lamented, ‘people and their livestock have been spilling into the reserves rather than tigers spilling out as originally envisioned’ [8]. Johnsingh and Goyal recently estimated that there may be fewer than 2,000 tigers in India [9] across a potential habitat of 364,200 km² [10].

The tiger habitat in Nepal is in three reserve systems: Chitwan National Park (NP) (2,543 km²) which includes the Parsa Wildlife Reserve, Bardia NP (1,840 km²), and the Royal Suklaphanta Reserve (320 km²) and the intervening areas. In Bhutan the major protected areas (PAs) that have tigers are Jigme Dorji NP (4200 km²), Thrumshingla NP (905 km²), Jigme Singye NP (1,400 km²), Bomdeling WLS (1,545 km²), and Royal Manas NP (1,023 km²). All of these are connected by 3,800 km² of biological corridors. Tigers from Bhutan often range into the Manas Tiger Reserve (2,840 km²) of Assam and into the Buxa TR (370 km²) and Jaldapara WLS (220 km²) of West Bengal [11, 12]. In Bangladesh, tigers are confined only to Sundarbans mangrove forests (6,000 km²), extending a further 4,000 km² on the Indian side. Three million people live in the Bangladesh Sundarbans, while the Indian Sundarbans have 3.5 million. In 2007, Khan estimated a density of 3.7 tigers/100 km² and a total population of about 200 in the Bangladesh Sundarbans [13].

EXISTING BASELINE INFORMATION FOR TIGER CONSERVATION

To save the tiger in this remaining habitat, priority landscapes need to be identified where conservation efforts can be focused to secure breeding habitats connected by functional corridors. Poaching, both of prey and tigers, needs to be controlled. Programs to reduce the dependence of people on the surrounding wildlife habitats need to be promoted, and feral dogs that might kill wild ungulates and deter tigers need to be eliminated [14]. In this regard, four useful exercises were conducted. Wikramanayake and others [6] identified 23 priority tiger landscapes on the Indian subcontinent. This was followed by a study on human influence on tiger distribution range [15] and a comprehensive tiger distribution database across the range of the tiger, furnished by tiger experts from governments and non-governmental organizations [16]. Based on the tiger distribution map, and human influence data (which can indicate availability of suitable habitat and prey for tiger) a potential tiger habitat map was

created (see Sanderson et al., Chapter 9) [17]. In another prioritization exercise, Ranganathan and others used tiger density estimates together with vegetation data from major tiger habitats to model tiger populations attainable through effective management of the subcontinent's nature reserves [18]. They concluded that, depending on the quality of the landscape matrix surrounding them, 150 nature reserves in the subcontinent could potentially hold 3,500–6,500 tigers, with just 21 reserves holding most (58–95%) of this tiger capacity. The ranking of reserves in this exercise is questionable, and it is debatable whether tiger density values corresponding to certain vegetation types in select sites can adequately model the population sizes attainable in a wide range of nature reserves under ideal management. The argument here is that the management priority for reserves with the largest population targets should be the reserves themselves. Whereas in the remaining reserves, tiger conservation would succeed only with additional management of the unprotected landscapes in which the reserves were embedded. More recently there has been a nationwide sampling-based assessment of tiger distribution and numbers by Jhala et al. [19].

While there is increasing analytical sophistication and greater reliability in approaches to prioritize landscapes for global tiger conservation, we believe the crucial roadmaps for on-ground conservation practice in each of the priority landscapes are conspicuously absent. To us, the development of a synthetic toolbox of conservation approaches that draw on the social, economic, political, and institutional complexities of on-ground tiger conservation across various regions is an essential baseline for tiger conservation that is currently missing.

LANDSCAPES FOR TIGER CONSERVATION IN THE INDIAN SUBCONTINENT

In this chapter, we identify 19 priority tiger conservation landscapes (TCLs) for the long-term conservation of tigers in the Indian subcontinent (locations are shown in Fig. 24.1). The findings are based on our 30 years of experience with tigers across the subcontinent, the published work of Wikramanayake et al. [20] and Dinerstein et al. [17], and from information provided by colleagues in the field. A brief profile of each landscape, including a listing of threats (Table 24.2), is based on the likely number of adult tigers that they could realistically support. These landscapes, although subjective, draw on current knowledge of tiger biology, as well as available information on the extent and quality of continuous tiger habitat available, fraction under protection, potential of the habitat for supporting tiger prey, the administrative and political environment influencing conservation, reported number of tigers, and our knowledge of the habitat. Based on the realistic maximum number of tigers they could support, we classify them under four broad categories. The numbers in parentheses following specific landscapes described below correspond to the landscapes identified in Figure 24.1.

Landscapes Likely to Support at Least 200 Tigers

We suggest that the Indian subcontinent has five general areas which, together, stretch over nearly 150,000 km², and are each capable of supporting at least 200 tigers. These landscapes are characterized by large, contiguous forest blocks where size, inaccessibility, or a

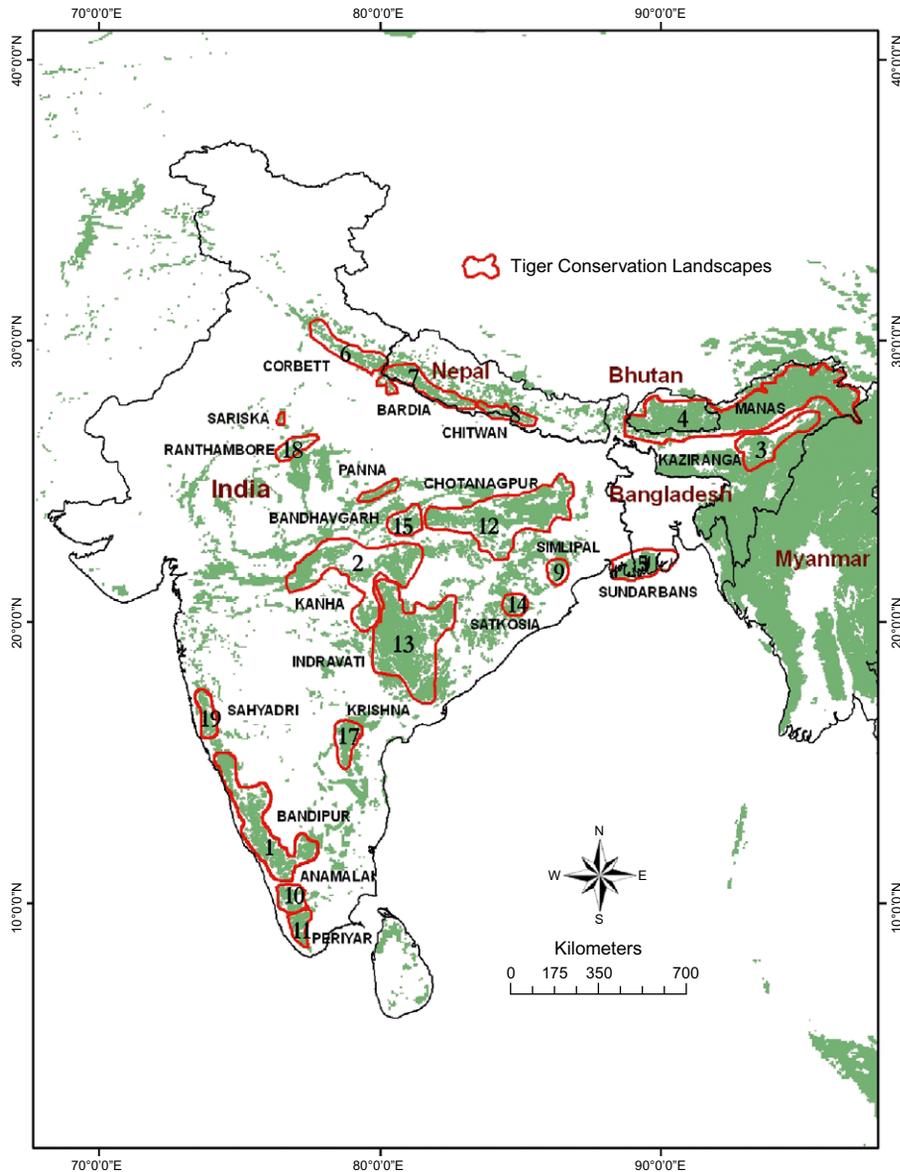


FIGURE 24.1 Tiger conservation landscapes in the Indian sub-continent.

history of better planning and protection enhance their value for tiger conservation. These landscapes also support a wide range of other endemic and endangered species, and provide valuable ecosystem services to humans.

The *Palakad-Bandipur-Dandeli landscape* (1) is an extremely rich tract that may currently support 250 adult tigers. It has the potential to support at least twice as many, as long as prey poaching and anthropogenic pressures are contained and the vast tracts of reserved

TABLE 24.2 The nineteen most important landscapes for tiger conservation in the Indian subcontinent

Group	Region	TCU	TCL	Key protected areas	Potential habitat (in km ²)	Protected habitat (in km ²)	Threats and management challenges	Estimated current number	Realistic maximum number
>200 tigers	Palakad-Bandipur-Dandeli	55, 56	66, 67	Mudumalai TR, Bandipur-Nagarahole TR, Bhadra TR, Kudremukh NP	20,000	7,500	Livestock grazing, fuelwood and NTFP collection, prey poaching, weed proliferation, unregulated tourism, livestock-large carnivore conflict	250	500
	Melghat-Pachmarhi-Kanha-Tadoba	28, 31, 44, 45	50, 51, 52, 53, 54	Melghat TR, Tadoba-Andhari TR, Kanha TR,	35,000	8,000	Organized poaching of tigers, expansion of interior human settlements, mining and habitat fragmentation due to reservoirs	250	500
	Kaziranga-Intanki	16	38	Kaziranga TR	20,000	1,600	Tiger and prey poaching, shortening shifting cultivation cycles	150	300
	Jigme Dorji – Manas – Namdapha	10	37	Namdapha TR, Pakke TR, Manas TR, Royal Manas NP, Jigme Singye NP, Jigme Dorji NP	60,000	15,000	Tiger and prey poaching, shortening shifting cultivation cycles, forest encroachment	100	500
	Sundarbans	18	39	Sundarbans TR	10,000	5,000	Tiger–human conflict, fuelwood and NTFP collection	200	200
100–200 tigers	Yamuna-Sharada	1	44, 45, 46	Rajaji NP, Corbett TR	8,000	2,000	Heavy resource-demands on tiger habitats from towns, prey poaching, stealing of kills,	120	200
	Suklaphanta-Bardia-Dudhwa-Pilibhit	2, 3, 4	42, 43	Sukhlaphanta Reserve, Bardia NP, Dudhwa TR	4,000	1,500	Prey poaching, habitat fragmentation, livestock grazing	100	150
50–100 tigers	Chitwan-Valmiki	6	40	Chitwan NP, Valmiki TR	3,550	2,000	Prey poaching, tiger–human conflict, habitat encroachments, civil unrest and insurgency	80	100
	Simlipal	39	58	Simlipal TR	7,700	3,000	Traditional mass hunting, tiger and prey poaching, livestock grazing, livestock-large carnivore conflict	50	100

	Anamalais	58	65	Anamalai TR, Parambikulam TR	5,000	1,600	Numerous interior hamlets, prey poaching, stealing of kills	50	100
	Periyar- Kalakkad	59	63, 64	Periyar TR, Kalakkad Mundanthurai TR	5,000	1,800	Prey poaching, threats to habitat connectivity, privately owned forest estates and enclaves	50	100
	Chota Nagpur Plateau	27	59	Sanjay NP, Tamorpingla WLS, Palamau TR, Kaimur WLS	40,000	3,500	Tiger and prey poaching, insurgency, mining and habitat fragmentation	50	100
	Indravati	46	55	Indravati TR, Pamed WLS, Kagar Ghati WLS	30,000	3,500	Insurgency, prey poaching	50	100
<50 tigers	Satkosia	-	57	Satkosia TR	2,500	800	Prey and tiger poaching, mining and other infrastructure projects	20	30
	Bandhavgarh	-	49	Bandavgarh TR	1,200	1,100	Increasing human pressures, livestock grazing, poaching of tigers and prey	20	30
	Panna	-	47, 48	Panna TR	600	500	Fuelwood and NTFP collection, livestock grazing, prey and tiger poaching	20	30
	Krishna River Landscape	52	61, 62	Nagarjuna Sagar Srisailam TR	13,000	3,900	Fuelwood and NTFP collection, livestock grazing, livestock-large carnivore conflict	30	50
	Ranthambhore	-	20	Ranthambhore TR	1,500	1,300	Fuelwood collection and livestock grazing, proliferation of exotic <i>Prosopis</i> , tiger poaching	20	30
	Sahyadris	-	71, 72	Radhanagari WLS, Chandoli NP, Koyna WLS	2,000	1,100	Prey poaching, habitat fragmentation, mining	10	20

forest areas can be effectively managed to link existing protected areas in the region. Organized tiger poaching is presently rare here.

The *Melghat-Pachmarhi-Kanha-Tadoba landscape* (2) may currently have c. 250 tigers, but has the potential to support over twice that number as long as expansion of villages and associated habitat encroachment and human-wildlife conflict, shortage of forest staff, organized poaching of tigers, annual forest fires, heavy livestock grazing, mining, and reservoir projects are curtailed. Forest corridors in the reserved forests connecting existing protected areas must be fully secured, while working with local communities in these forests on issues such as water harvesting, forest protection, and sustainable agriculture.

The *Kaziranga-Intanki landscape* (3) has one of the most productive tiger habitats anywhere and could potentially support c. 300 tigers (as against the current estimate of c. 150) provided insurgency and other anthropogenic impacts on forests and wildlife are curtailed. Outside Kaziranga, hunting is widespread and heavily impacts not just the tiger, but its entire prey base. Given the strong cultural underpinnings of hunting here, effective protection and law enforcement is possible only in tandem with locally sensitive means to dissuade hunting. Another urgent need for this landscape is the assessment of large mammal abundance in the Karbi Hills, from where little information is currently available.

The *Jigme Dorji-Manas-Namdapha landscape* (4) is an extensive forested landscape that may currently hold about 100 tigers, but with prey restoration could support nearly 500 tigers. In the mountainous tracts tigers occur at a very low density (1/185 km²) owing to the low density of large prey such as takin (*Budorcas taxicolor*), sambar, and wild pig [11, 12]. In the lower altitudes, which are much more productive for tigers, extensive poaching of prey as well as predators by the locals has made the situation extremely precarious for tiger. There is urgent need to strengthen connectivity of Manas TR with Ripu, Chirung, and Manas reserve forests (>1,000 km²), which are still connected through Bhutans Royal Manas NP and Phibsoo WLS. In this ethnically diverse setting, conventional approaches to park protection seem neither effective nor sustainable, and hence, more imaginative and locally appropriate approaches to wildlife conservation are urgently needed [21].

The *Sundarbans landscape* (5) is a unique ecosystem of mangroves, tidal creeks, and backwaters, where tiger densities of 3–4/100 km² are reported from Bangladesh, but only 1/100 km² from India [13, 22]. Given the pressures from an enormous human population residing around this area and limited prey (chital and wild pig) availability, the tiger population in the Indian portion of this landscape is likely to be substantially lower than the official figure of c. 250 [22]. Yet, as most parts of the habitat are difficult to colonize and convert to other land-uses, this population may survive, albeit at low densities, for a very long time under the potential long-term threat of sea level increases due to global warming.

Landscapes Likely to Support 100–200 Tigers

Two important but distinct landscapes, each capable of supporting 100–200 tigers, occur along the *terai-bhabhar* tract of northern India and Nepal. The main tiger breeding habitat of the *Yamuna-Sharada landscape* (6), is Corbett TR, one of the finest reserves in India. This Reserve is broad (c. 40 km) and hilly with numerous deepwater courses, has a high density of sambar, chital, and wild pigs across the Reserve, providing ideal conditions to successfully raise cubs. The eastern part of this landscape (Haldwani and Champawat FDs) has an

intact area of nearly 1,200 km² and has immense potential for large mammal conservation, but a high level of poaching, particularly of wild ungulates by the local people, is a major threat. The continuity of this tract is broken and threatened by the presence of several large towns such as Dehradun, Haridwar, Rishikesh, Kotdwar, Ramnagar, Haldwani, Tanakpur, and Katima, which, together with scores of villages, impose huge demands of fuelwood on tiger habitats. Urgent conservation measures needed here include the control of poaching, voluntary relocation of human habitations from prime and potential tiger habitats, growing fuelwood plantations along the forest boundary, establishment and protection of corridors, and halt of boulder mining in crucial river valleys. Designation of Nandhour-Ladhya Conservation Reserve, in the eastern part of this landscape, is a priority. Only with these measures in place, this landscape is likely to support c. 200 tigers [14, 23].

The *Suklaphanta-Bardia-Dudhwa-Pilibhit landscape* (7) has the largest remnant patch (c. 4,000 km²) of the once extensive *terai* habitat and species such as the swamp deer and Indian rhino. In Nepal, the major forest blocks that contribute to the connectivity of this landscape area are Laljhadi forests (220 km²) between Suklaphanta and Dudhwa, Basanta (650 km²) between Dudhwa and Churia hills, and Banke (550 km²) between Bardia and Sohelwa. In this landscape, besides the usual set of anthropogenic threats, transboundary co-operation is also needed to restore connectivity and control poaching.

Landscapes Likely to Support 50–100 Tigers

Among the productive tiger habitats comprising alluvial grasslands and subtropical moist deciduous forests is the *Chitwan-Valmiki landscape* (8), of which Chitwan NP and the adjacent Parsa WLR form the crucial breeding habitat. The eastern portion of Sohagibarwa WLS and Valmiki TR on the Indian side serve as a buffer to Chitwan NP. Density estimation by Smith and others for Chitwan NP varied from a tiger density of 1/14 km² for tigers living in riverine forest and grassland, to 1/20 km² in a mixture of riverine forest, grassland and low lying sal forest, and 1/37 km² in upland sal forest and Shivalik Hills [24]. Surveys in Valmiki TR (which is subjected to enormous problems of insurgency and poaching) yielded more tiger and prey signs in Ganoli, Ragia, and Govardhana Ranges, all of which had better connectivity with Chitwan NP [14]. One of the serious problems in Chitwan NP-Parsa WLR is the high levels of tiger–human conflict. Efforts are under way to decrease the levels of tiger–human conflict by employing the Tiger Watchers who alert the villagers of tigers in the vicinity, and to increase the value of compensations and make faster decisions regarding their disbursement [25].

The *Simlipal landscape* (9) is another extremely productive landscape for tiger prey, but poaching as well as *akhanda shikar*, a traditional mass hunting practice by the local tribals, poses a problem to wildlife. Organized poaching of tigers, the recent rise of insurgency, and resource-use pressures from the 65 villages within and 1,135 villages around the tiger reserve also remain serious threats to the tiger. Given serious problems of local alienation and poverty here, an inclusive model of conservation in tiger reserves, on the lines of that implemented in Periyar [26], may help strengthen conservation in this beautiful and biodiversity-rich landscape.

The *Anamalais landscape* (10) is the broadest mountain tract in the Western Ghats with the entire complement of Western Ghats' endangered large mammal fauna, among which sambar,

gaur, wild pig, Nilgiri tahr, and Nilgiri langur are the principal tiger prey. Besides large numbers of settlers in tea and coffee plantations, there are six tribal groups in numerous settlements across the Anamalais whose population is between 40,000 and 50,000. Given the extent of fragmentation and insidious problems such as killing, stealing, and poaching, it is critical that local landowners and tribal groups are also involved in the conservation of this landscape. Its connectivity with the Periyar-Kalakad landscape, the southern-most tiger landscape in the Indian sub-continent, is effectively severed for species like tiger and gaur, over a distance of 50–60 km in Kerala side, owing to encroachments and the establishment of cardamom plantations.

The *Periyar-Kalakad landscape* (11) has a habitat break in the Ariankavu Pass that separates Periyar TR from the Kalakad Mundanthurai TR. The creation of an effective corridor for the movement of species like sambar and tiger across the Ariankavu Pass is both an urgent need and a big challenge here, as is the control of widespread local poaching of wild prey species. Active and abandoned estates of cardamom, tea, and coffee across this landscape further reduce the quality of breeding habitats, and may be addressed through the acquisition of some of these estates. With the establishment of connectivity with the Anamalais the biodiversity-rich 10,000 km² southern Western Ghats habitat can possibly support a population of 200 tigers.

Among the largest blocks of tiger habitat in the Indian subcontinent is the *Chota Nagpur Plateau landscape* (12), which has a relatively low density of tigers owing to chronic problems such as insurgency, habitat fragmentation, and anthropogenic resource use. In particular, open-pit coal mines and mining for limestone, quartzite, and pyrite have caused enormous habitat disturbance and pollution in the region. With these threats being addressed, the area could perhaps support 200–300 tigers. The *Indravati landscape* (13) faces a similar suite of threats as the Chota Nagpur Plateau. Once the stronghold for the peninsular ecotype of the wild buffalo, this bovid and other tiger prey in the region are under serious threat due to hunting and human occupation of preferred valley and riparian habitats. Although this region could easily support 200–300 tigers like the Chota Nagpur Plateau (12), it is unlikely that either area currently holds more than 50 tigers.

Landscapes Likely to Support <50 Tigers

Many tiger habitats of the country are vital conservation targets despite their relatively small size, isolation, fragmentation, and the strong imprint of human pressures on them. Only with a comprehensive reduction of these pressures would these landscapes be able to sustain tiger populations into the future.

Among these landscapes are: the *Satkosia landscape* (14), a poorly surveyed and little understood landscape where grazing, retaliatory killing of tigers, and poaching of prey are believed to be serious concerns; the *Bandhavgarh landscape* (15), which has about 60 villages around it from where enormous livestock grazing pressures originate; and the *Panna landscape* (16). The *Panna landscape* mainly comprises the Panna Tiger Reserve, with 61 revenue villages and nearly 40,000 people and 40,000 cattle both within and on the reserve boundary. This imposes serious pressures of fuelwood cutting and livestock grazing on the habitat, which aggravate problems of tiger poaching that has brought the species to the brink here.

The *Krishna River landscape* (17), which has the largest Tiger Reserve (Nagarjunasagar-Srisaillam) in India, is beset by a huge suite of threats, including hydroelectric projects,

intense disturbance from pilgrims to Srisaïlam, besides the resource demands of about 200 villages in and around the Reserve, supporting 200,000 people, 60,000 permanent and 300,000 migrant livestock. This region is also affected by insurgency, which has deterred staff from working effectively in the Reserve.

The *Ranthambhore landscape* (18) is an area rich in prey (density: 97 ungulates/km²) and has high tiger densities (11.5/100km²) in areas free from anthropogenic pressures, with tigers even being absent from some parts affected by acute livestock grazing and fuel-wood collection pressures from the 300 villages within and around the reserve [27–29]. Besides being highly vulnerable to poaching, the Reserve also suffers from invasions of the exotic thorny *Prosopis juliflora*. Over the last two decades, Bandhavgarh and Ranthambhore, in particular, have served as ‘ambassador’ reserves for tiger conservation, with the tigers here being highly habituated to tourists and hence are easily seen, enthraling thousands of visitors and facilitating several works on the natural history of tigers [30].

The *Sahyadris landscape* (19) is the northernmost tiger population in the Western Ghats, with the nearest tiger breeding habitat lying south of this landscape in Anshi-Dandeli TR. The abundance of wild prey in the Sahyadris is extremely low, owing largely to extensive poaching. Besides control of poaching, the region also needs measures to maintain and even restore habitat connectivity.

DISCUSSION AND RECOMMENDATIONS

Today, confined to less than 7% of their original range, tigers are going through one of the worst crises in their evolutionary history. The Indian subcontinent, which contains most of the world’s wild tigers, represents only 11% of the world’s tiger habitat. We estimate that there may be less than 1,600 tigers in the whole of the Indian subcontinent and the realistic maximum number of tigers that could be supported with its current habitat would be around 3,700. Tiger conservation in the Indian subcontinent faces a range of serious and complex threats, but we believe that most of these issues are still possible to address; India showed that this was possible in the 1970s when the survival of the tiger in the country also looked bleak. Here, we summarize some of the most important issues and suggest some means by which these may be addressed to secure the future of this majestic big cat.

The direct poaching of tigers to supply high-value markets trading in tiger body-parts remains one of the most serious threats to the species in the subcontinent. Among the prominent reasons for the intensification of this threat is the poor protection and law enforcement in many wildlife reserves. In addition, this threat remains because of the inability to curtail the well-organized regional networks of illegal wildlife trade catering to an unrelenting demand from Tibet, China, and parts of Southeast Asia for tiger parts. The growing indifference and animosity towards tiger conservation among local communities has often taken the form of support for activities such as tiger poaching, further aggravating this serious threat.

The emphasis on economic growth at all levels across the subcontinent has eclipsed ecological concerns in the planning and implementation of commercial and development projects even in and around wildlife reserves. In India, environment impact assessments instituted to foster ecologically responsible development have often failed to protect tiger habitats against seriously damaging development projects [31]. The unregulated local expansion

of agriculture and chaotic delivery of development within and around tiger habitats continues to fragment existing habitats and populations. Very little has been done, either in terms of law or policy, to address threats to tigers arising from poor and unplanned land-use.

Among the biggest threats facing the tiger, its prey, and its habitats across the densely populated subcontinent, is the dizzying suite of chronic and widespread extractive uses of natural resources. These range from the local hunting of tiger prey to meet tradition-driven demands for wild meat [32], and the grazing by millions of livestock that transmit diseases and outcompete the herbivore prey of tigers even in important habitats [33], to the stealing of tiger kills, the harvest of vast quantities of fuelwood [34] and a wide range of non-timber forest products [35] from tiger habitats. Although the natural resources extracted under these regimes often directly meet the subsistence needs of economically marginal communities, faraway markets are increasingly forging close and complex linkages with traditional resource-use systems [36].

The lack of local support for conservation is compounded by persistent local support to threats such as poaching and creates one of the most serious problems to the long-term future of tigers, and indeed, all wildlife in the subcontinent. Although, to a certain extent, the lack of local support may be a response to resource-use restrictions imposed by conservation managers, there are deeper ethical issues here that have received scant attention. The traditional top-down preservationist thrust of India's conservation efforts has recognized the threats that humans pose to wildlife, entrusted management to authoritarian forest departments, and sanctioned coercive means to restrict and exclude human resource use in wildlife reserves. While the preservationist approach is essentially correct in its recognition of conflict between prevailing forms of human resource-use and the needs of wildlife conservation, we disagree with its approach to resolving this conflict. It has rigidly relied on coercive means to restrict human resource-use regardless of context, with no serious effort to create enabling circumstances for local communities to participate—or, at a minimum, even to co-operate—in the state's conservation efforts. Further, there has been little effort to recognize or offset the human/livelihood costs of conservation, including a loss of subsistence options, threat of displacement, as well as material, monetary, and human losses in human-wildlife conflicts, all of which are borne disproportionately by local communities.

In particular, the recognition of the costs of the human-wildlife conflict has been extremely poor among both conservationists and managers. Moreover, compensation schemes to offset losses in human-wildlife conflicts do so at archaic rates, involve tedious and complex paperwork, and are dogged by systemic problems such as corruption and inefficiency. Given the continued losses faced by people in conflict with wildlife, and the absence of readily available measures to offset these losses, there is considerable local animosity toward wildlife conservation and support for activities that undermine conservation. At the same time, the monetary/livelihood benefits of conservation and revenues from non-consumptive use in wildlife reserves, such as skyrocketing tourism revenues, have rarely accrued to local people in any significant way. Understandably, this has fomented local anger against conservation, which manifests in deliberate forest fires, retaliatory killing and poisoning of wildlife, and colluding with poachers and smugglers, all of which have significantly undermined tiger conservation.

As events around the extinction of tigers in India's Sariska Tiger Reserve have shown, there are also serious systemic problems with the implementation of tiger conservation in

the subcontinent. Although the focus of forest departments managing tiger conservation have changed over the decades and now include wildlife conservation, these departments often continue to function in an exclusionary authoritative manner, rather intolerant of questioning and scrutiny, particularly from the public and civil society. Such conduct becomes a serious conservation threat, particularly when management activities carried out by forest departments are based on a shallow understanding of ecological science or are sometimes carried out with dishonest and corrupt motives not only of the bureaucracy itself but also of its political masters. The sinking of dozens of waterholes, the creation of extensive road networks in protected areas, the construction of scores of check-dams and watchtowers, programs of habitat manipulation through fire, grazing, felling and other extraction, all ostensibly as wildlife management tools, are simply not borne out by any conservation need, or worse, they actively undermine conservation.

Management plans do not exist for most wildlife reserves, and where they do, they are either not scientifically reviewed for their conservation implications or are implemented very differently from the approved plan. Yet, even as the system flounders, there are always some remarkable examples of mature handling of conservation problems by individual forest officials who are committed to conservation, capable of grasping its complexities, and willing to innovate (and even subvert the existing system) in order to score victories for conservation.

Although the subcontinent (India in particular) boasts some of the strongest wildlife legislation anywhere, the local contexts also illustrate how extremely difficult it is to implement them everywhere or all the time. For example, although all livestock grazing is prohibited within India's national parks, in reality the need for grazing land is so great, often among the poorest sections of society, that this law has been unenforceable and, therefore, utterly useless in curtailing pressures of livestock grazing on wildlife habitats. There is therefore serious need to revise laws such that they are reasonable, just and fair, and hence truly implementable. Further, the current rigid frameworks of law have hindered adaptive solutions to conservation problems. Worse still, their rigidity coupled with poor and whimsical implementation have provoked a serious legislative backlash such as the recent Indian Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, which places many important wildlife habitats in serious jeopardy.

GLIMPSES OF HOPE

In spite of these burgeoning problems, some notable progress has been accomplished. The Sariska crisis stirred the Government of India out of its slumber, and on the basis of recommendations made by a tiger task force [37], a new National Tiger Conservation Authority and Wildlife Crime Control Bureau was established. At the time of writing, the authority has approved eight new Tiger Reserves, taking the total to 36 (total area covered 42,267 km², c. 1.28% of the total geographic area of India). Nevertheless, the Tiger Reserves will be effective only if funding for appropriate conservation programs is received by the reserves on time and only if the reserves are piloted by capable officials without any political interference and with single-minded dedication to conservation. Efforts in the Indian Sundarbans are a case in point. They involved measures such as the erection of a 3-m high nylon net in areas to prevent tigers entering villages, and encouraging villagers to pursue apiaries to

gather honey instead of going into the forest. These have reduced the level of tiger–human conflicts—and are likely to yield dividends in the form of undisturbed tiger habitats and higher densities of prey and tiger—without compromising human goals.

Among the most progressive measures are the efforts of Nepal to restore 50% of the habitat in the Barandabhar, Khata, and Basanta corridors, reduce retaliatory killing of tigers by 50%, streamline a compensation mechanism for conflicts and measures to reduce the number of poaching and smuggling incidents [38]. One stretch of habitat where Nepal's conservation attention is needed is the Churia and foothill forests between the eastern part of Sukhlaphanta Reserve (the northern part of which is connected to the foothill forests) and the Sharada river, so as to create the Brahmadev corridor across the river to connect with the 1200 km² intact forests on the Indian side. This may one day enable tigers to range from the forests on the west bank of Yamuna to Sohelwa. Bhutan has brought 70% of its tiger habitat under protection in the form of protected areas and biological corridors; and in the absence of significant levels of poaching, tigers are likely to persist in this mountainous tract albeit at a low density [39]. One region where Bhutan, India, and possibly Tibet need to cooperate is in creating a tri-junction Peace Park encompassing Pangolakha WLS (128 km², Sikkim), Neora Valley NP (88 km², West Bengal), Torsa Strict NR (651 km², Bhutan), and parts of Chumbi Valley (Tibet) to bring back species such as tiger, gaur, and red deer (*Cervus elaphus wallichii*).

The challenges to conserving the tiger in the Indian subcontinent are many, but so are the opportunities. More challenges lie ahead for the tiger, but we remain hopeful that tiger range countries in the Indian subcontinent have the resolve to rise to these challenges and secure the future of this big cat.

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