Elephant-human conflict in West Bengal

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THE ASIAN ELEPHANT (*Elephas maximus*) is an endangered species and, generally speaking, a shy animal which loves to lead a private life in the forests avoiding any contact with humans. But its need for a huge quantity of food and a large living space sometimes brings it into conflict with the human beings. The Gazetteer of Darjeeling (O'Malley, 1907) records : "For the last few years, the Terai has had a melancholy record of persons killed, crops destroyed and villages ruined by them (elephants). Indeed, the depredations of these animals in this part of the district have become so serious a menace to life and property that there is a danger of much of the land being thrown out of cultivation and relapsing into jungle." Cases of crop damage and occasional man-killing by wild elephants have been recorded since time immemorial, and the people have been retaliating by killing or injuring elephants. But a rapidly growing human population, accompanied by a large scale shrinkage of forest cover has led to an unprecedented increase in the incidents of elephant-human conflict in recent times.

The Asian elephant occupies a place of priority in the conservation efforts being made by the Government and other agencies in India. Obviously, such efforts cannot succeed without public support. But public cooperation cannot be obtained in all such areas where elephants have become a threat to the life and property of human-beings. Therefore, a resolution of the elephant-human conflict has become a major issue in the management of wildlife in India.

Elephants in West Bengal

West Bengal is one of the major elephant range states in the country, which also suffers from the problem of elephant-human conflict. Infact, the control of elephant depredation has become the most important concern for the Forest Department in West Bengal since the mid-seventies (Bist, 1997).

In West Bengal, the elephants are mainly located in its northern part (*i.e.* the civil districts of Darjeeling and Jalpaiguri) which forms the western limit of the north-east Indian population of the Asian elephant. They occupy a geographical area over 6900 km^2 with a forest cover of about 2200 km^2 (Bist, 1994). A census conducted by the State Forest Department in February-March 1992 recorded their population in this region to be 186 which is less than 1% of the total elephant population in India, However, these elephants have been responsible for killing 476 people during the period 1980-1990, giving an average of over 2.5 casualties per elephant, probably the highest rate anywhere in Asia where elephants exist. The tea gardens in the North Bengal plains are the worst affected areas in terms of loss of human life and house damage by elephants.

Some elephant populations are also found in the southern part of West Bengal, but resident herds were non-existent here in the early 1950s when the forests were taken over by the Forest Department. A few unattached males, moving either singly or in small groups moved around in the forests of Purulia and parts of Midnapore and Bankura districts. One or two herds of elephants from Dalma sanctuary in Bihar also used to visit the adjoining forests in the southern West Bengal during the winters, causing some crop damage and killing one or two persons every year. It was in December 1987 that a migrating herd comprising about 40 elephants crossed the river Kangsabati and moved eastward for the first time in living memory. The herd killed 11 persons. The elephant herds have since been regularly crossing the Kangsabati and spending more and more time within West Bengal. Of late, they have extended their movement to Burdwan and Hoogly districts and their range now extends over an area of 11,000 km^2 holding a forest cover about 1850 km^2 (Pandey *et.al.*, 1994).

Impact of conflict

The impact of conflict is visible on both, the people as well as elephants. People suffer on account of elephant depredation by way of death or injury, damage to crops and houses and the loss of livestock. Such damage by elephants in West Bengal has been considerable in recent years. The State Government spends Rs.40-45 lakh every year on anti-depredation measures. The tea gardens in North Bengal also suffer great economic losses on account of damage to labour houses and reduced production due to labour problems fomented by elephant depredation. (*See box alongside.*)

At the same time, elephants too suffer a lot on account of conflict with people. They are harassed, chased and disturbed constantly whenever they go. A large number of elephants bear marks of injury caused by villagers and tea garden labourers. In some cases, irate villagers have even cleared entire patches of forest in their neighbourhood to deprive elephants of shelter. As a result, the elephants are seen to be changing their movement paths frequently and have been visiting new places where they were not reported in the past (Bist, 1994). Barua (1995) has quoted an increase in the diurnal activities of the elephants, marked aggressiveness in their behaviour and a significant rise in the cases of abandoned elephant calves in North Bengal as an evidence of elephants being under tremendous stress. Incidents of poaching of elephants are also not uncommon. A number of cases of wild elephants dying of cattle-borne diseases (*e.g.* Anthrax) have been recorded from West Bengal in recent years.

Causes of conflict

No single factor but a host of reasons is responsible for the conflict between elephants and human-beings in West Bengal. Some of these causes are :-

1. *Changes in habitat*

In North Bengal, the destruction of habitat by extension of agricultural land and tea gardens has been identified as the prime reason for elephants straying out of forests and causing depredation (Fawcus, 1943; Lahiri Choudhury, 1975 and Dey, 1991). Forests have also been destroyed for making roads, railways, irrigation projects, army cantonments, refugee colonies, mines and factories. As a result, elephant bearing forests have shrunk and become fragmented. As elephant is a long ranging animal and cannot remain confined to a particular forest for long, in small fragmented forests it comes in contact with human beings more frequently than in large compact forests, thereby increasing the chances of conflict.

In South Bengal, ironically, it is the improvement in the forest cover in the 1980s, as a result of better protection with the help of local forest protection committees, which is believed to be attracting elephant herds from relatively degraded forests of Dalma in Bihar. And now, some good forests in South Bengal have been cleared by desperate villagers to deny shelter to the elephants near their villages (Pandey *et.al.*, 1994).

2. *Grazing*

Cattle grazing in forests is a serious problem which not only deprives the elephants and other wild herbivores of their legitimate fodder but also results in the spread of many diseases among them. Fodder scarcity forces the elephants to spend less time in a forest than they would otherwise do and be more inclined towards raiding agricultural lands.

3. *Defective forestry practices*

Some of the practices followed by the forest department in the past, such as clear felling of large forest tracts, conversion of natural forests into plantations of teak, eucalyptus and other non-fodder species, large scale extraction of bamboo and canes and establishment of forest villages have also resulted in degradation of many forest areas.

Gupta (1958), reporting in respect of Kalimpong forest, states: "The Khumani forests, which hold a salt lick in Rongo compartment No.1 on the left bank of the Nuxal khola, has been for generations past a rendezvous for herbivorous animals from adjoining Bhutan, the foothill forests of Kalimpong and the farthest end of the Tondu forests. Upto the outbreak of the World War-II, the sanctity of the salt lick was respected....The war proved to be the undoing of many things and the preservation of wildlife was one among these. Throwing the basic principles of management of forests and of wildlife to the winds, the most accessible parts of forests were heavily exploited and large clearings were made all over for labour-force establishments....The importance of salt lick at Nuxal khola ...was completely overlooked. Extensive clear felling were made in Khumani block along the game paths, a large clear felling was made fairly close to the salt lick and a forest village established therein ....It seems strange that in the working plan for the management of Kalimpong forests .... no provision was even made for the exclusion of forest strips along the permanent game paths leading to the salt lick to serve as corridors ...."

4. *Over-exposure to human beings*

In North Bengal, there are at least 100 forest villages comprising over 6000 families, cultivating over 3000 ha of land inside forests in the elephant zone. Movement by people in the forests for grazing their cattle, collecting fodder and firewood or for other purposes, has increased tremendously. Thus, people are coming in contact with elephants more frequently than in the past. While this makes the elephants desperate, such over-exposure has also resulted in elephants losing their inherent fear of man.

5. *Lure of agricultural crops*

An elephant is a huge animal requiring 250-300 kg. of fodder every day. In forests, it may spend 16-20 hours daily to gather its food. In agricultural land, however, it gets substantial quantity of nutritious food over a smaller area with minimal effort. Once an elephant has had a taste of agricultural crops, it will prefer to raid agricultural fields, more so if there is a scarcity of fodder in the forests. The paddy, which is the principal agricultural crop in West Bengal, is quite a favourite with the elephants. With better availability of quality seeds and irrigation facilities in recent years, farmers in West

Persons killed by elephants

Year	*North Bengal*	*South Bengal*	*Total*
1990-91	73	15	88
1991-92	54	13	67
1992-93	74	6	80
1993-94	45	20	65
1994-95	34	10	44
1995-96	44	12	56
1996-97	47	4	51

Annual crop damage

North Bengal: 4000-4500 ha
South Bengal: Approx.1500 ha

Houses damaged annually

North Bengal: 1000-1200
South Bengal: Approx. 50

Loss of livestock

Cases of buffaloes and other livestock killings by elephants recorded in North as well as South Bengal.

Compensations paid for elephant depredation

(Rs. in lakh)

Year	*North Bengal*	*South Bengal*	*Total*
1990-91	18.12	12.17	30.29
1991-92	23.04	21.31	44.35
1992-93	24.70	21.88	46.58
1993-94	18.90	34.40	53.30
1994-95	17.50	37.50	64.00

Sources : Pandey *et.al.*, 1994; Bist, 1994 and Raha, 1996.

Bengal have been growing two or more crops of paddy in a year and the elephants have also been spending more time in the agricultural fields now than in the past.

6. *Other reasons*

6.1 *Abnormal sex ratio* :It has been suggested by some experts (*e.g.* Dey, 1991) that the male-female ratio among adult wild elephants in North Bengal which is 1:0.75 (based on the 1992 census) is somewhat abnormal whereas the ideal sex-ratio should be 1:3 or at least 1:2. In other words, adult bulls outnumber adult cows, which has lead to more competition among the bulls and resulted in a higher number of solitaries and *maljurias* (male groups). Records suggest that most of the cases of human death and injuries are caused by these solitaries and *maljurias*. However, this remains a disputed issue in view of the fact that capturing of a large number of bulls in the past (*e.g.* 114 out of the 210 elephants captured in North Bengal from 1957-58 to 1980-81 were bulls) and killing of about 32 'rogue elephants' (all bulls, mostly solitaries) since 1973 has not helped to ease the conflict situation in any way (Barua, 1995).

6.2. *Illegal arms* : It is not uncommon for the villagers and tea garden labourers (mostly tribals) in North Bengal to injure elephants using arrows, fireballs or countrymade guns. With the proliferation of illegal arms in the countryside during some militant movements in the region in the recent past, the problem has become more acute. Injured elephants are believed to have a tendency to turn into rogues.

6.3. *Country liquor* :It is believed by many that country liquor prepared illicitly in villages and tea gardens adjoining forests in North Bengal attracts wild elephants, although records do not suggest this to be a major reason. Nevertheless, a substantial number of people killed or injured by elephants are those who are intoxicated and cannot take care of themselves when confronted by an elephant.

Management initiatives

As stated, elephant-human conflict has greatly influenced the wildlife management scenario in West Bengal. In fact, many studies, interesting experiments, ideas and management initiatives in West Bengal since the 1970s have been motivated by the ever worsening problem of elephant depredation in the state. Some of these are discussed hereunder.

1. *Studies and enquiries*

Many studies have been conducted on wild elephants and their management in West Bengal. Notable among these are - Dr DK Lahiri Choudhury (1975 and 1980), whose studies on the wild elephants in North Bengal made recommendations for short term and long term solutions to the conflict problem. The Government of West Bengal also set up inquiry committees comprising senior forest officers and experts in 1986 (for North Bengal) and 1994 (for both, North and South Bengal) to suggest measures for controlling depredation by elephants. Parbati Barua (1995) made a detailed study of the problem in the Western Dooars. The Wildlife Institute of India carried out a study (1995-97) on the elephants of this region and made recommendations to deal with the problem. It was during this study that wild elephants were radio collared in West Bengal for the first time.

2. *Experiment with repellents*

2.1. *Use of tear gas, etc.* : Dr DK Lahiri Choudhury carried out experiments on domestic elephants as well as freshly captured elephants, in June-July 1975 in Jalpaiguri, to find out the efficacy of Amyl alcohol, liquid ammonia

and teargas shells in scaring away elephants. The experiments could not be carried out on wild marauding elephants. It was found that the gas was effective only when fired in favourable wind and direction and could not be used in rain (Palit, 1975).

2.2. *Use of tiger urine* : Experiments with tiger urine and tape-recorded tiger calls as a deterrent against wild elephants were carried out in the early 1980s. The reactions of the wild elephant to tiger urine were observed to be quite aggressive on many occasions. But it was reported that the elephants were more alarmed and reacted defensively when confronted with both the tiger scent and call simultaneously and less so when only one of these was used (Chowdhury & Roy, 1982). However, there are practical difficulties in applying these methods in the field.

3. *Elimination of rogue elephants*

Under the provisions of the Wildlife (Protection) Act, 1972, wild elephants indulging in wanton killing of human beings are proclaimed 'rogue' and liquidated as soon as possible. Since 1973, as many as 23 elephants were killed in North Bengal as 'rogues' including some in self-defence. But killings of rogue elephants has not been without controversy. In 1976, the Prime Minister's secretariat expressed concern over the way the elephants were being shot dead in North Bengal, and the Government of West Bengal advised the concerned forest officers to ensure that the declaration of rogues was kept down to minimum (Anon., 1976). Nine more elephants have been killed since - two in Jalpaiguri district in July 1992 and December 1996 using lethal doses of chemical after immobilizing and verifying their identity. Correct identification of rogue elephants and their timely elimination, however, continues to remain a problem (Barua, 1995).

4. *Wildlife squads*

In 1977, two special wildlife squads were set up in North Bengal to help people deal with elephant depredation. Subsequently, more such squads were set up. During peak periods of depredation, forest staff from nearby Divisions are also mobilized and temporary squads set up. The tea garden labourers and the villagers are also encouraged to form voluntary squads. These squads are provided with arms, crackers, searchlights, vehicles and wireless sets. In South Bengal, specially equipped driving parties, locally known as hoola parties, were a local initiative to drive the elephant herds away. Hoola is 3-4 metre long pole of iron or sal wood with which these squads are equipped. On sighting an elephant group, the tip of the hoola is ignited and persons holding these, charge the animals. However, such efforts provide only temporary relief and often, only drive the elephants from one problem area to another (Barua, 1995).

5. *Power fencing*

A battery operated, energised fencing was installed in North Bengal for the first time in 1979 for controlling wild elephants. At present about 400 km. long energised fences exist in West Bengal to control and prevent the wild elephants from straying (Anon., 1997). But these fences have their short-comings and limitations which have been pointed out in the case of North Bengal (Barua, 1995) as well as South Bengal (Pandey *et.al.*, 1994).

6. *Compensation*

The Government of West Bengal started a scheme in 1979 for payment of compensation to the victims of elephant depredation. In the beginning, compensations were paid only in cases of death or injury to human-beings and crop damage. Since 1986, compensations are also being paid for

damage to livestock. In 1996, the scope of such compensations was further extended to cover cases of house damage as well.

7. *Capture operations*

On the explicit plea of containing elephant depredation, capturing wild elephants by *khedda* or *mela shikar* has been a practice in North Bengal almost regularly since independence till the 1980s. During 1971-81, 117 elephants, forming over 40 % of their population, were captured thus in North Bengal. However, there was no positive outcome of this and the problem worsened in the 1980s (Dey, 1991), which meant that it was not the over-population of the elephants but other factors like habitat loss and biotic interference, which were responsible for elephant depredation (Barua, 1995). Regular capturing of elephants have largely stopped as a result of inclusion of the elephant in Schedule-I of the Wildlife (Protection) Act, 1972. But in 1995-96, an 'Operation Elephant Capture' was launched in South Bengal with special permission from the Government of India, and seven wild elephants were captured between August 1995 and November 1996 (Raha, 1996). The effect of this on the visiting elephant population in South Bengal is reported to be quite encouraging (Ghose, 1997).

8. *Chase without capture*

Consequent upon legal restrictions on capturing elephants, the *mela shikar* technique was modified from 'chase and capture' to 'chase without capture' Trained elephants (*kunkis*) were pressed into service in November 1980 and August 1981 to chase away elephant herds in the Kurseong Division (Lahiri Choudhury and Bardhan Roy, 1982). Departmental and hired elephants are since being used in the North as well as South Bengal for this with varying degree of success.

9. *Elephant corridor*

In the late 1980s, the Government of India and the Government of West Bengal in consultation with the Royal Government of Bhutan mooted a proposal to set up a corridor linking Buxa Tiger Reserve with the Mahananda Wildlife Sanctuary so as to provide a free and uninterrupted movement to wild elephants. The proposed corridor, 1 km wide and about 150 km long, covered forests as well as many villages and tea gardens situated close to the Indo-Bhutan border. It was to be developed through afforestation on non-forest land acquired by payment of compensation. But no progress has since been made on implementing the proposal. In fact, in the existing socio-political scenario in West Bengal, acquisition of such a big tract of land by evicting a large population of villagers and labourers does not appear feasible. Attempts are, however, being made to identify, protect and improve the existing corridors.

10. *Translocation*

In July 1988, an experiment was carried out to translocate a problem elephant in North Bengal. The said elephant was tranquilized and captured in the forests of the Bagdogra Range in the Kurseong Division and released in the core area of the Buxa Tiger Reserve, about 250 km away. But the elephant travelled all the way back and was found dead two months later (September 1988) in the Panighata forests close to where it was captured. This put a question mark on the efficacy of any translocation of problem elephants in West Bengal in the future (Barua, 1995).

11. *Habitat improvement*

Various efforts have been made to improve elephant habitat. The Forest Conservation Act, 1980 prohibits any exploitation of natural forests in West Bengal. The State Forest Department has been planting bamboo and other

fodder species favoured by elephants in protected areas and also elsewhere in the elephant zone to improve forest quality and thereby induce elephants to spend more time inside forests. Till 1996-97, about 1372 ha of such plantations had been raised (Anon., 1997). Also, the canopy in the monoculture teak plantations in North Bengal were opened to allow ground vegetation and other miscellaneous species to grow. Water conservation works have been undertaken in and outside the protected areas. These initiatives have shown encouraging results - particularly in Mahananda and Jaldapara wildlife sanctuaries where the elephants now spend much more time than in the past (Bist, 1994). However, the gains and impact of such development works are lost due to biotic interferences in the form of cattle grazing, illegal collection of fodder and firewood and unregulated fire (Barua, 1995).

12. *Ecodevelopment*

Ecodevelopment works are being carried out in villages on the fringes of protected areas with the objective of reducing people's dependency on forests and thereby bringing down the biotic pressure on the forests. The aim is also to improve the forest staff-local people relationship and encourage and ensure people's participation in the protection of forests and wildlife. Under the IDA supported West Bengal Forestry Project (1992-97), ecodevelopment works were extended to forests outside the protected areas as well. By and large, these initiatives have been effective - at least in bringing down pressure on forest officials, if not in eliminating elephant-human conflict.

13. *Joint forestry management (JFM)*

Since the late 1980s, the Government of West Bengal has been formally involving the people of the villages on the fringes of the forests in the protection of forests on a "care and share" basis. The people are encouraged to form Forest Protection Committees (FPCs) and help the forest staff in protecting forests and wildlife. The members of these committees, in turn, get priority employment in all forestry related works, besides deriving certain benefits in cash or kind from the forests protected by them. In June 1996, the JFM concept was extended to the protected areas through the formation of Ecodevelopment Committees (EDCs) by the local people. By 1996-97, 3289 FPCs comprising 3,71,790 members and providing protection to 4,49,300 ha of forests were functioning in West Bengal (Anon., 1997). About 70 EDCs are also operational in North Bengal. As far as elephant conservation is concerned, the JFM concept has been quite successful in South Bengal in rejuvenating degraded forests, as is evidenced by the fact that visiting elephant herds spend a longer time here than they did in the past. Also, at many places, FPCs/EDCs members provide active support to the forest staff in dealing with wild elephants.

STRATEGY FOR CONFLICT RESOLUTION

More improvisation

From the foregoing discussion it is obvious that the measures adopted in West Bengal for dealing with elephant-human conflict are both short-term and long-term : providing immediate relief to the people against depredation by wild elephants as also seeking to remove the factors responsible for the conflict and creating ideal living conditions for elephants within forests. The measures adopted are innovative as well as traditional. However, elephants exhibit remarkable intelligence in detecting the limitations of various techniques devised to contain them and adapt themselves accordingly. What, therefore, is required is continuous improvisation in the various

methods. Short term and long term measures should be adopted side by side to tackle the problem effectively.

Living in harmony with elephants

Another important aspect in the management of elephant-human conflict is to enable the people residing in elephant zones to live in harmony with the elephants. Experience in West Bengal suggests that elephant depredation can be greatly reduced by taking certain precautions and adopting preventive measures (Bist, 1996) as follows :

1. Generally, wild elephants are shy of electric lights, while people can protect themselves better under electric light than otherwise. For the tea gardens in North Bengal which account for 60-70% of total human casualties due to elephants every year, electrification of labour habitations is of utmost importance.

2. It is observed that houses built on pillars are less susceptible to damage by elephants and provide more security than houses built at ground level. Houses, as such, should be accordingly designed, particularly in the tea gardens which suffer enormous damage to houses by elephants.

3. It has been observed that houses with white-washed or brightly painted walls are more prone to damage by elephants than those with green, ochre or earth coloured walls.

4. The houses should also not have tall hedges around them which could prevent sighting an approaching elephant. Also, people should be advised against growing bamboo, banana, jackfruit and similar plants very close to their houses as these may attract elephants.

5. In areas where crop damage by elephants is a regular feature, the farmers may be encouraged to grow alternative crops such as jute, potato, oilseeds, *etc.* which are not favoured by elephants.

6. People must be cautioned against injuring elephants wantonly.

7. People should not move outdoors after dusk in intoxicated condition and should also be warned against preparing and storing country liquor openly in their houses.

Intensive publicity among the people and suitable training must form part 'n' parcel of a conflict management programme. Some of these suggested initiatives have already been taken in West Bengal, but much more needs to be done in the days to come.

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Table 1
Protected areas with elephant populations

Name of PA	Area (km^2)	Estimated elephant population
Andamans	**131**	**70**
1. Interviews Island WS	131	70 (feral)
Andhra Pradesh	**357**	**40**
2. Kaundinya WS	357	40
Arunachal Pradesh	**3,281**	**2,000-4300**
3. D' Ering WS	190	NA
4. Itanagar WS	140	NA
5. Mehao WS	282	NA
6. Namdapha TR	1,807	NA
7. Pakhui WS	862	NA
Assam	**1,987**	**5,524**
8. Barnadi WS	26	NA
9. Garampani WS	6	NA
10. Kaziranga NP	696	800
11. Laokhowa WS	70	NA
12. Manas TR	1,097	1,200
13. Rajiv Gandhi (Orang) WS	92	NA
Bihar	**5,160**	**753**
14. Dalma WS	193	60-70
15. Palamau TR	767	155
16. Singbhum*	4,200	471
Karnataka	**4,218**	**5,980**
17. Bandipur TR	874	256
18. Bannerghatta NP	104	56
19. Bhadra WS	492	161
20. Biligiri Rangan Temple WS	574	914
21. Brahmagiri WS	181	NA
22. Dandeli WS	995	37
23. Nagarhole NP	572	300
24. Nugu WS	30	16
25. Shettihally WS	396	NA
Kerala	**2,158**	**4,286**
26. Chendurny WS	100	NA
27. Chimmony WS	90	NA
28. Chinnar WS	90	NA
29. Eravikulam WS	77	NA
30. Neyyar WS	128	NA
31. Parambikulam WS	285	187
32. Peechi Vazhani WS	125	NA
33. Peppara WS	53	NA
34. Periyar TR	777	935-1,100
35. Silent Valley NP	89	NA
36. Wynad WS	344	163

Table 1 contd.

Name of PA	Area (km^2)	Estimated elephant population
Meghalaya	**254**	**2,872**
37. Balphakram NP	200	591
38. Nokrek NP	49	NA
39. Siju WS	5	NA
Nagaland	**56**	**140**
40. Intanki WS	56	140
Orissa	4,579	1,600
41. Chandaka WS	189	60
42. Hadgarh WS	192	10
43. Kapilasa WS	126	40-45
44. Kotagarh WS	400	300
45. Kuldiha WS	273	NA
46. Lakhari Valley WS	118	50-60
47. Satkoshia Gorge WS South	478 }	150+
48. Satkoshia Gorge WS North	318 }	
49. Simlipal TR	2,200	375
50. Ushakothi WS	285	100
Tamil Nadu	**2,489**	**2,307**
51. Anamalai WS (Indira Gandhi)	890	NA
52. Grizzled Giant Squirrel WS	400	NA
53. Kalakkad-Mundanthurai TR	800	39-60
54. Mudumalai WS (Jayalalitha)	321	300-350
55. Mukurthi NP	78	NA
Tripura	**349**	**120-150**
56. Gumti WS	349	10-20
Uttar Pradesh	**2,711**	**877-1,069**
57. Corbett TR }	1,400	159
58. Sonnadi WS }		
59. Dudwa TR	490	25
60. Rajaji NP	821	263
West Bengal	**950**	**155**
61. Buxa TR	750	84
62. Chapramari WS	9	NA
63. Gorumara WS	9	NA
64. Jaldapara WS	216	50
65. Mahananda WS	66	16
TOTAL	**28,780**	**26,724-29,230**

NA - Not available; * - Reserved forest,
(Sources: *Sukumar, 1986; Johnsingh, 1989; A Week with Elephants, 1996; Project Elephant Action Plan, 1996*).

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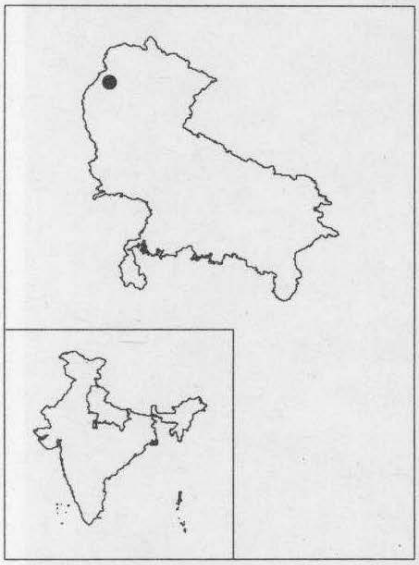
Rajaji National Park

Uttar Pradesh



Date of establishment	:	12 August 1983
Bio unit	:	07A (Upper Gangetic Plain)
Total area	:	821 km²
Location		
Latitude	:	29° 15' to 30° 31' N
Longitude	:	77° 52' to 78° 22' E
Topography		
Altitude	:	302 - 1000m above msl
Climate		
Temperature	:	-1°C (Min); 44°C (Max)
Average rainfall	:	2000 mm

Human habitation

About 512 Gujjar families, with a total population of over 10,000 officially reside within the park. There are 57 villages within the park's "zone of influence", with a total population of about 65,000 inhabitants.

Elephant population

Rajaji National Park, Corbett Tiger Reserve and adjacent forest areas form the north-western range for the Indian elephant. The elephant population in this area is about 700 to 750 (Singh, 1986; Johnsingh *et. al.*, 1990; Chowdhury, 1995). According to a report by Christy Williams, et. al. (1997), the elephant population in Rajaji is 263 as follows:-

	Adult	*Subadult*	*Juvenile*	
Male	50	46	13	
Female	66	33	22	
Calf	-	-	-	28
Total	-	-	-	263*

* Status of 5 elephants not known.

Research and monitoring

a) Pastoral ecology, habitat utilization and wildlife interaction in the former Rajaji Wildlife Sanctuary in January-April 1985 (Clark et al., 1986).
b) Status of Chilla-Motichur corridor assessed (Johnsingh *et. al.*, 1990).
c) Effect of wiidlife on *Sal* forest (Rodgers *et. al.*, 1991).
d) Assessment of elephant damage to woody vegetation in Rajaji National Park, Uttar Pradesh (AJT Johnsingh & SP Goyal, 1994).
e) Economic assessment of human-forest relationship in the forest corridor linking the Rajaji and Corbett National Parks (Ruchi Dhaundiyal, 1997).
f) The relationships among large herbivores, habitat and humans in Rajaji - Corbett National Park, Uttar Pradesh (AJT Johnsingh *et. al.*, continuing).

Conservation problems

1) *Habitat fragmentation* largely as a consequence of developmental projects *viz.* irrigation (Chilla canal), roads/rail, expansion of township (Hardwar, Rishikesh), resettlement programmes (Tehri dam oustees), the army ammunition dump and other factors.

2) *Habitat degradation* due to wood cutting, tree lopping, grass-cutting, cattle grazing by Gujjars living inside the forest, and *bhabar* grass collection by people from adjoining villages outside, resulting in opening up of the forest canopy. (Dhaundiyal, 1997; Johnsingh & Joshua, 1994); Sunlight filtering through the open canopy, resulting in weed proliferation; forage species do not regenerate and waterbodies are polluted; lack of sufficient food for elephants (Chowdhury, 1995; Johnsingh & Joshua, 1994); Elephants frequenting outside the national park because of abundant bamboo there (Joshua & Johnsingh, 1995); Human-animal conflict (Johnsingh & Joshua, 1994).

3) *Shrinkage and habitat fragmentation* of the 35 km long corridor connecting Rajaji and Corbett National Parks, as a result of the excessive human pressure from nearby villages and townships. This corridor is very important for intermixing of the populations of Rajaji and Corbett National Parks (Dhaundiyal, 1997).

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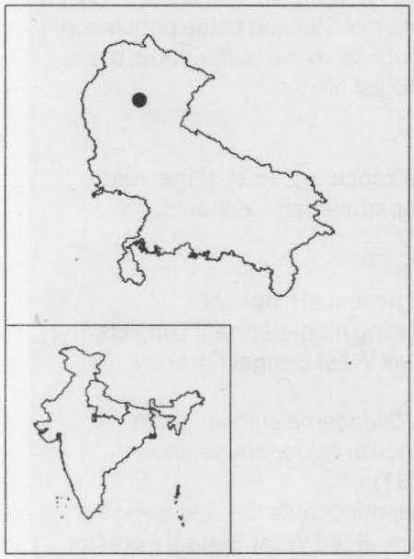
Corbett Tiger Reserve

Uttar Pradesh



Date of establishment	:	11 May 1935
Bio unit	:	07A (Upper Gangetic Plain)
Total area	:	520.82 km²
Location		
Latitude	:	29° 30' to 29° 39' N
Longitude	:	78° 93' to 79° 09' E
Topography		
Altitude	:	250 - 1000m above msl
Climate		
Temperature	:	2° C (Min); 47° C (Max)
Average rainfall	:	1400 mm

Human habitation

Around eight villages on the boundary have grazing rights inside the buffer area. A large settlement has been established at Kalagarh under the Ramgarh Dam project (Singh, 1985).

Elephant population

The elephant population in 1976 was 128 (Singh, 1986); 161 in 1986 (Singh, 1986) and a few years ago, 160 (Christy Williams *et. al.*, 1995). The age-sex structure of the elephant population here in 1996 was:

Category	Years	Male	Female	Total
Calf	< 1	-	-	6
Juvenile	1-5	15	26	41
Sub-adult	5-12	16	20	36
Adult	a) 12-20	7	3	10
	b) 20-30	11	19	30
	c) 30-40	5	28	33
	d) > 40	1	2	3
Total				159

Research and monitoring

a) Predator-prey relations (Schaller, 1965).
b) Ungulate populations (Tak & Lamba, 1981).
c) Assessment of the impact of the Ramganga dam on the fauna (Lamb, n.d.).
d) Census of large mammals and reptiles (Singh, 1985).
e) Ecology of elephant and deer (Singh, A., 1988).
f) Economic assessment of human-forest relationship in the forest corridor linking the Rajaji and Corbett National Parks (Ruchi Dhaundiyal, 1997).
g) The relationships among large herbivores, habitat and humans in Rajaji - Corbett National Parks, Uttar Pradesh (AJT Johnsingh *et. al.*, continuing).

Conservation problems

1) *Loss of habitat* through development projects such as Ramganga reservoir project.
2) *Man-animal conflict.*

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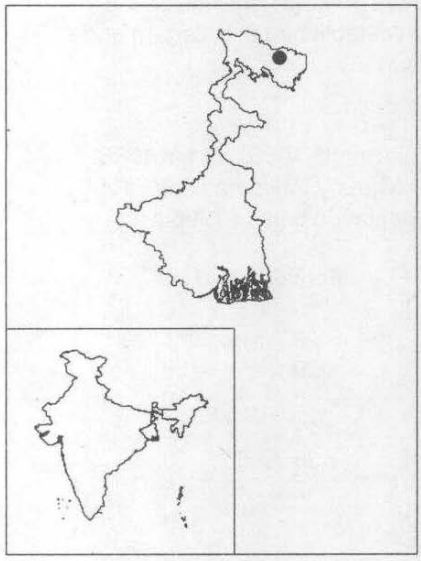
Jaldapara Wildlife Sanctuary

West Bengal



Date of establishment	:	24 June 1976; Revised 31 August 1990
Bio unit	:	07B (Lower Gangetic Plain)
Total area	:	216.51 km^2
Location		
Latitude	:	25°58' to 27°45' N
Longitude	:	89°08' to 89°55' E
Topography		
Altitude	:	60 - 140m above msl
Climate		
Temperature	:	2°C (Min); 41°C (Max)
Average rainfall	:	992 mm

Human habitation

Four villages with a total human population of 959 and cattle population of 1606 located inside the sanctuary. Outside, in the buffer zone, there are 32 villages with 87 234 of human population.

Elephant population

A wild elephants herd of 50 stays in the sanctuary most of the year. Besides, there are 30-35 captive (*i.e.* departmental) elephants.

Research and monitoring

a) Developing approaches to the management of elephant populations in West Bengal for mitigating man-elephant conflicts (Wildlife Institute of India - World Bank West Bengal Forestry Project, 1997).
b) Eco-status of the Indian rhinoceros *Rhinoceros unicornis* with special reference to human interference in Jaldapara sanctuary, West Bengal (Deepak K. Ghosh, 1991).
c) A study on the management of Indian rhinoceros in West Bengal. (Wildlife Institute of India - World Bank aided West Bengal Forestry Project, 1997)

Conservation problems

1) *Habitat degradation* mainly due to illicit felling of timber and fuelwood collection by the local people, grazing of livestock from the fringe villages, and by weeds and climber infestation.
2) *Man-animal conflict*

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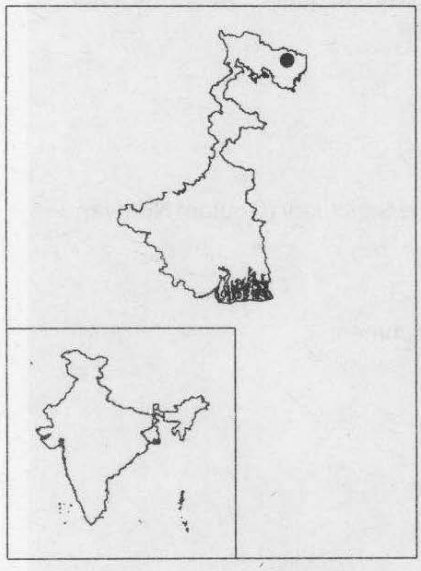
Buxa Tiger Reserve

West Bengal



Date of establishment : 1992
Bio unit : 07B (Lower Gangetic Plain)
Total area : 750 km²

Location
Latitude : 26°63' N
Longitude : 89°55' E

Topography
Altitude : 152 - 1755m above msl

Climate
Average rainfall : 4100 mm

Human habitation
Thirtyseven forest villages with a population of 16,200 (1991 census) inside completely dependent on the forest and the department for their needs as they are excluded from the panchayat system of the State.

Elephant population
71 in 1986, 70 in 1989 and 84 in 1992 (Barua & Bist, 1996).

Research and monitoring
a) Tiger conservation and corporate development - A case study of the fiscal equation in Buxa Tiger Reserve (T Bhattacharya & J Bhattacharya, 1993).
b) Impact of anthropogenic stress and man-animal interaction in Buxa and Sunderbans Tiger Reserves (AB Chaudhuri, 1993).
c) Faunal survey of Buxa Tiger Reserve (S Ghose, ZSI, 1993).
d) Observation on the behaviour and family bondage in wild elephant in northern part of West Bengal (S Ghose, 1990).
e) A sketch of the vegetation of Jalpaiguri Distt. in West Bengal (S Mukherjee, 1965).
f) Mixed interaction of *Leucacytozorn sabrazesi* and microfilaria in the red jungle fowl from the Himalayan foothills of West Bengal (R Roy & B Bandopadhyay, 1988).
g) The Buxa Tiger Reserve - An abode of endangered species (P Sanyal, 1993).

Conservation problems
1) *Habitat fragmentation* due to encroachment.
2) *Man-animal conflict.*
3) *Proposed Sankosh canal* through the reserve.

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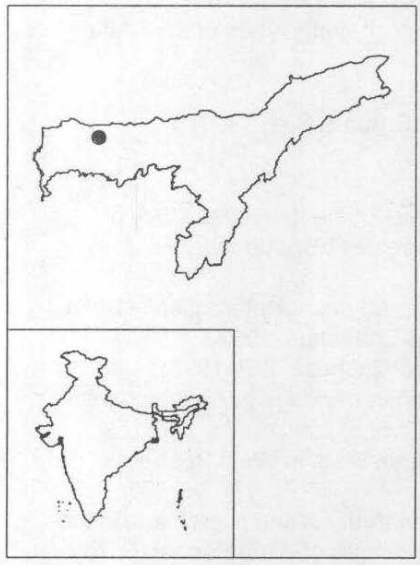
Manas Tiger Reserve

Assam



Date of establishment : 7 September 1990
Bio unit : 09A (Brahmaputra Valley)
Total area : 1097 km²

Location
Latitude : 26° 37' to 26° 50' N
Longitude : 90° 15' to 91° 15' E

Topography
Altitude : 100 - 500m above msl

Climate
Temperature : 11°C (Min); 37° C (Max)
Average rainfall : 4200 mm

Human habitation
About 144 forest villages in the buffer zone. No buffer zone to the south of the reserve, which is thickly populated.

Elephant population
About 1200 (Johnsingh, 1989).

Research and monitoring
a) The Bengal florican at Manas Wildlife Sanctuary (Goutam Narayan and Lima Rosalind, 1990)

Conservation problems
1) *Habitat fragmentation* due to encroachment
2) *Man-animal conflict.*

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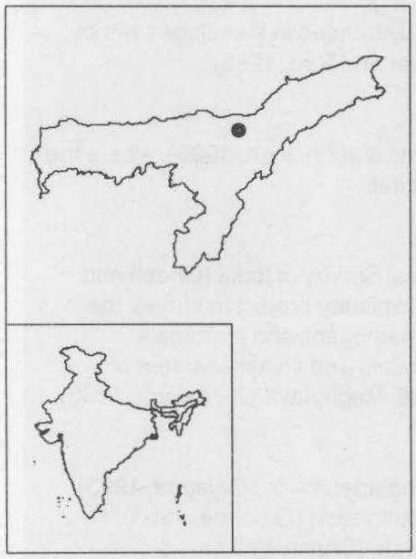
Kaziranga National Park

Assam



Date of establishment : 11 February 1974
Bio unit : 09A (Brahmaputra Valley)
Total area : 696 km²

Location
Latitude : 26° 35' to 26° 45' N
Longitude : 93° 05' to 93° 40' E

Topography
Altitude : 40 - 500m above msl

Climate
Temperature : 11°C (Min); 30°C (Max)
Average rainfall 2500 mm

Human habitation
No human habitations inside or around the national park.

Elephant population
1150 elephants as per 1980 census (Sinha, 1981). But Johnsingh (1989) reports 800 elephants. According to the State Forest Department (1993), the elephant population structure in the Kaziranga-Karbelong-Intanki elephant reserve is 1823.

Research and monitoring
a) Asiatic wild buffalo in Assam State: Population and ecology for its management (PK Mathur, Pradeep K Malik and Parag D Muley, 1994-95).
b) Food preference of the one-horned Indian rhinoceros, *Rhinoceros unicornis* in Kaziranga National Park, India (Kamal Chandra Patar, 1977).
c) Application of remote sensing techniques in forest cover monitoring and habitat evaluation - A case study at Kaziranga National Park, Assam (SPS Kushwaha and NV Madhavan Unni, 1986).

Conservation problems
1) *Man-elephant* conflict in the migration corridor outside the park. (Sinha, 1981). Because of the Brahmaputra river inundating the area, elephants leave the park in June and return in October.
2) *Poaching*.

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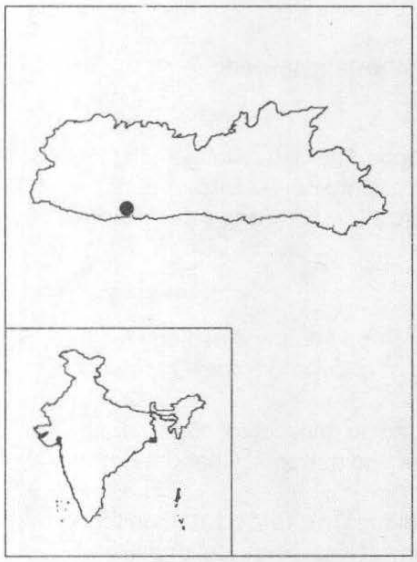
Balpakhram National Park

Meghalaya



Date of establishment	:	2 November 1985
Bio unit	:	09B (North-East Hills)
Total area	:	200 km²
Location		
Latitude	:	25° 19' N
Longitude	:	90° 58' E
Topography		
Altitude	:	192 - 1023m above msl
Climate		
Temperature	:	7°C (Min); 37°C (Max)
Average rainfall	:	6136 mm

Human habitation

About 500 inhabitants (mostly Garos) distributed in six villages within the park (Ghosh & Biswas, 1977; Kumar and Rao, 1985)

Elephant population

591 in South Garo hills (Christy Williams & Johnsingh, 1996), where the national park is the major elephant habitat.

Research and monitoring

a) An elephant census by the Zoological Survey of India (Ghosh and Biswas, 1977) as part of a multi-disciplinary project to survey the vegetation, flora, fungal and insect pathogens and mammals.
b) Status survey of elephant, their habitats and an assessment of elephant-human conflict in Garo hills, Meghalaya (Johnsingh, 1995).

Conservation problems

1) *Insurgency* and *poaching* from Bangladesh side (*Gajatme*, 1993).
2) *Shifting cultivation* and cash crop cultivation (*Gajatme*, 1993).
3) *Manpower shortage* to patrol the area. (Christy Williams & Johnsingh, 1996).

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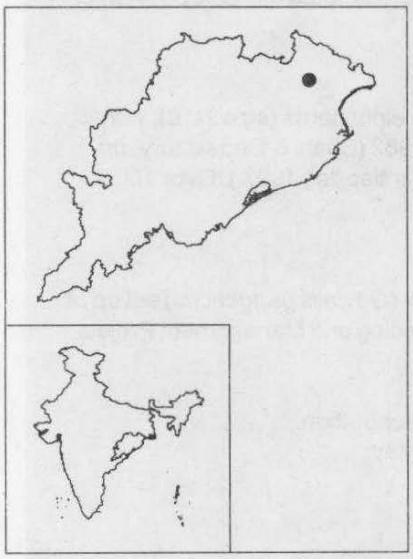
Simlipal Tiger Reserve

Orissa



Date of establishment : 6 August 1980
Bio unit : 06B (Chhota Nagpur)
Total area : 2200 km²

Location
Latitude : ° to 22° 34' N
Longitude : 86° 00' E

Topography
Altitude : 500 - 1000m above msl

Climate
Temperature : -5° C (Min); 45° C (Max)
Average rainfall : 2000 mm

Human habitation
Four villages in the core area. Various tribal habitations along the boundary and beyond.

Elephant population
About 400 (Johnsingh, 1989); about 507 (Singh, 1996); and about 375 (Santiapillai, 1997).

Research and monitoring
a) Regular status survey of tiger, leopard and elephant conducted by the State Forest Department.

Conservation problems
1) *Human interference* from the surrounding villages.
2) *Forest fire.*

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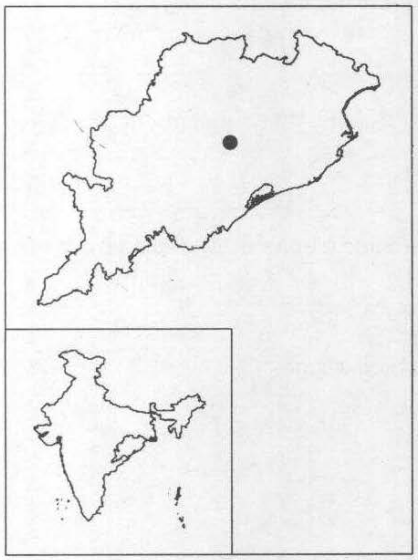
Satkoshia (South) Wildlife Sanctuary

Orissa



Date of establishment : 19 May 1975
Bio unit : 06C (Eastern Highlands)
Total area : 478.52 km²

Location
Latitude : 20° 13' N
Longitude : 84° 36' E

Topography
Altitude : 63 - 927m above msl

Climate
Average rainfall : 1500 mm

Human habitation
Fiftytwo villages inside the sanctuary plus 197 villages in the vicinity, with total human population 73,653 and estimated cattle population of over 2,00,000.

Elephant population
123 (Census report, May 1979). 100 in eight herds (size 2-19), with male:female ratio 1:3, as per Census 1982 (Shahi & Chowdhury, undated). About 300 (Johnsingh, 1989; Santiapillai, 1997). Over 150 (Singh, 1996).

Research and monitoring
a) A captive breeding centre for gharial (*Gavialis gangeticus*) set up at Tikarapara under the Crocodile Breeding and Management Project.

Conservation problems
1) *Cattle grazing*, leading to habitat deterioration.
2) *Annual forest fire* during April and May.

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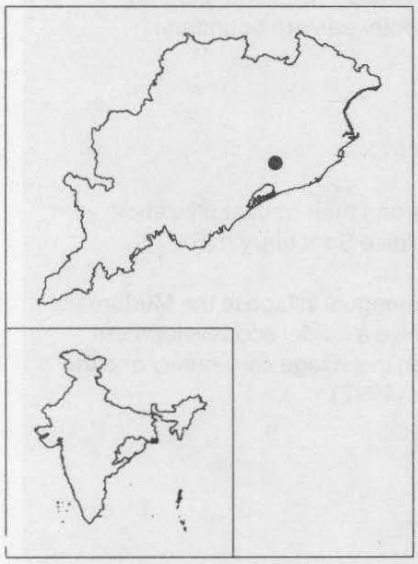
Chandaka Wildlife Sanctuary

Orissa



Date of establishment : 21 December 1982; Revised on 10 June 1986
Bio unit : 06B (Chhota Nagpur)
Total area : 189 km²

Location
Latitude : 20° 16'05" to 20° 26'03" N
Longitude : 85° 34'42" to 85° 44'30" E

Topography
Altitude : 40 - 202m above msl

Climate
Average rainfall : 1500 mm

Human habitation
About 400 families live in five hamlets inside.

Elephant population
About 60 elephants (Singh, 1996).

Research and monitoring
a) Village level conservation programme for biodiversity in relocated villages of Chandaka Elephant Reserve (P Mohanty-Hejmadi, 1994).
b) A study of fauna of Chandaka Sanctuary with special reference to birds (DP Rath, 1997)
c) A socio-economic study of the flora of Chandaka Sanctuary (K Jena, 1997).
d) A study of ecology and behavious of Asian elephant in Chandaka (SK Tiwari and JRB Alfred, Zoological Survey of India, continuing).

Conservation problems
1) *Forest clearing* for cultivation.
2) *Cattle grazing*.

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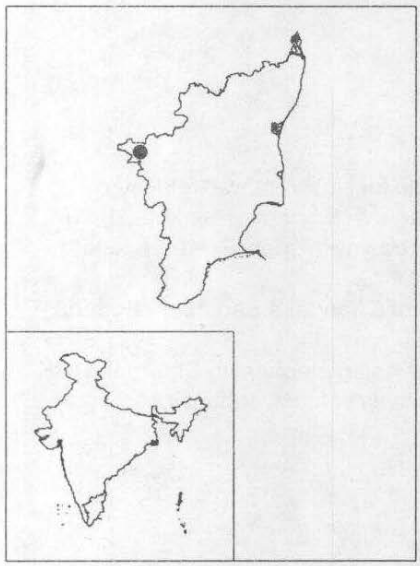
Jayalalitha (Mudumalai) Wildlife Sanctuary

Tamil Nadu



Date of establishment	:	2 January 1990
Bio unit	:	05B (Western Ghats)
Total area	:	321 km²
Location		
Latitude	:	11°32' to 11°43' N
Longitude	:	76°22' to 76°45' E
Topography		
Altitude	:	690 - 1400m above msl
Climate		
Temperature	:	14°C (Min); 33°C (Max)
Average rainfall	:	350 mm

Human habitation

Over 7000 inhabitants in seven villages inside. Besides, densely populated human settlements on the south- eastern boundary.

Elephant population

About 300 - 350 elephants.

Research and monitoring

a) Study on census of large mammals and their habitat utilization during dry season in Mudumalai Wildlife Sanctuary (KS Varman,1988).

b) Study of the rural ecosystem of Masinagudi village in the Mudumalai Wildlife Sanctuary with a view to evolve a model ecodevelopment plan to ensure compatibility between the village community and the sanctuary (CS Silori and BK Mishra, 1997).

Conservation problems

1) *Forest fire.*
2) *Cattle grazing.*
3) *Proliferation of weeds.*

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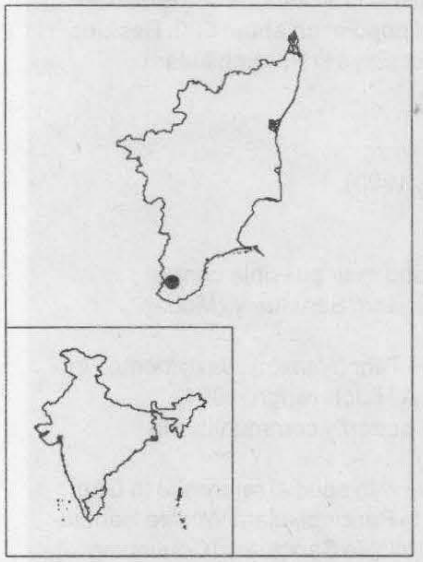
Mundunthurai Wildlife Sanctuary

Tamil Nadu



Date of establishment	:	21 March 1977
Bio unit	:	05B (Western Ghat Mountains)
Total area	:	567.38 km^2
Location		
Latitude	:	18°30' N
Longitude	:	77°30' E
Topography		
Altitude	:	30 -1867m above msl
Climate		
Average rainfall	:	300 mm

Human habitation

Four settlements inside the sanctuary and 165 villages around the sanctuary within 10 km radius.

Elephant population

About 39 - 60 elephants in the twin Mundanthurai and Kalakkad Wildlife Sanctuaries (Krishnamurthy, 1980; Ali *et al.*, 1983).

Research and monitoring

a) An ecological study of Kalakkad-Mundanthurai Tiger Reserve - An ecodevelopment approach - FREEP (World Bank - Wildlife Institute of India, continuing)

Conservation problems

1) *Poaching*.
2) *Forest fire*.
3) *Habitat degradation and fragmentation* from proposed hydroelectric and irrigation dam and inter-state highway projects.

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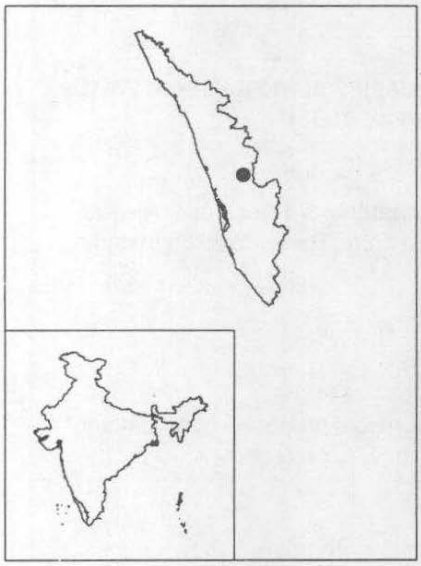
Parambikulam Wildlife Sanctuary

Kerala



Date of establishment	:	12 February 1973
Bio unit	:	05B (Western Ghat Mountains)
Total area	:	285km²
Location		
Latitude	:	10°20' to 10°26' N
Longitude	:	76°35' to 76°50' E
Topography		
Altitude	:	500 - 1444m above msl
Climate		
Temperature	:	20°C (Min); 33°C (Max)
Average rainfall	:	1723 mm

Human habitation

Three tribal communities (Kadar, Malasar and Muduva) live inside the sanctuary in five settlements, with total population about 500. Besides, the staff of Parambikulam Aliyar Project stays in Parambikulam, Thunacadav and Peruvarippalam areas.

Elephant population

Estimated 187 in 1989 (Uniyal & Easa, 1990).

Research and monitoring

a) Study of biotic stresses on wildlife and their possible control measure : A case study in Parambikulam Sanctuary (Mohan Alempath, 1982).
b) Status and conservation of the Nilgiri Tahr (*Hemitragus hyloerius*) in Anamalai Hills (Charudútt Mishra & AJT Johnsingh, 1994).
c) Impact of teak plantations on forest butterfly communities in Parambikulam (Manoj V Nair, 1997).
d) Habitat utilization of larger mammals with special reference to Gaur; Ecology of sloth bear; Insect fauna in Parambikulam Wildlife Sanctuary; and Reptiles in Parambikulam Wildlife Sanctuary (Continuing studies by the Kerala Forest Research Institute).

Conservation problems

1) *Area small* for elephant movement.
2) Threat of *habitat fragmentation* from three reservoirs of Parambikulam Aliyar projects within the sanctuary besides proposed development schemes.
3) Occasional incident of *man-elephant conflict*.
4) *Agricultural practices* of Muduva tribals increase soil erosion.

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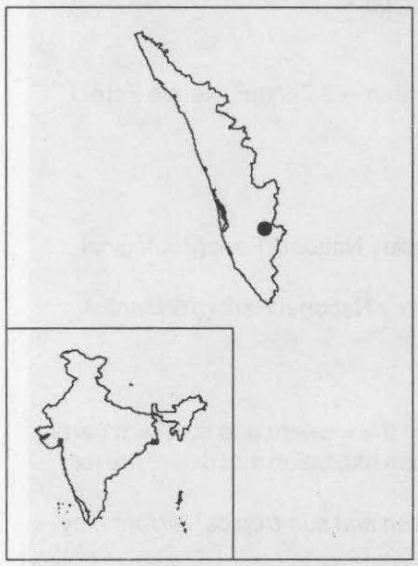
Periyar Tiger Reserve

Kerala



Date of establishment : 27 October 1982
Bio unit : 05B (Western Ghat Mountain)
Total area : 777 km²

Location
Latitude : 9° 15' to 9° 40' N
Longitude : 76° 55' to 77° 25' E

Topography
Altitude : 900 - 2019m above msl

Climate
Temperature : 15°C (Min); 31°C (Max)
Average rainfall : 2000 mm

Human habitation
Four cardamom estates in the core area. About 20 tea and cardamom estates on the crestline and along the north-eastern boundary.

Elephant population
Between 1977 - 1982, a total of 1277 elephants were sighted in 119 herds (herd size 2 - 60) with males 1%, females 60.20 % and young 20% (Nair *et al.*, 1986). In 1983, the population was 932 (Karunakaran, 1990). Mohan Chandran (1990) reported 935-1100 elephants, comprising 193 herds (herd size 2-26) with males 0.49% against females 60.20% and young 17.52%.

Research and monitoring
a) Ten reports in the period 1977-1985 by Wildlife Biology Division, Kerala Forest Research Institute (Vijayan *et. al.*, 1979; Nair *et. al.*, 1985).

Conservation problems
1) *Low percentage of males*, resulting in the population showing signs of degradation (Mohan Chandran, 1990).

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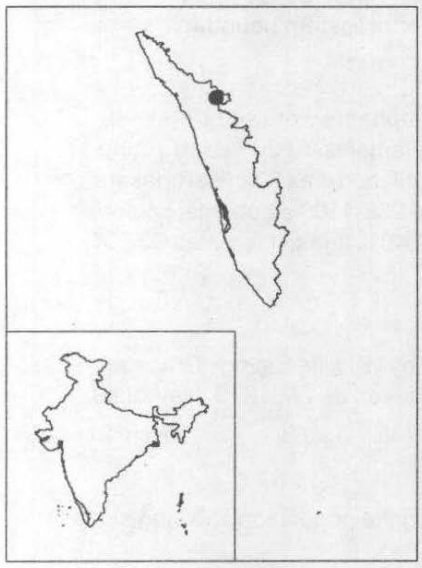
Silent Valley National Park

Kerala



Date of establishment	:	23 November 1984
Bio unit	:	05B (Western Ghat Mountains)
Total area	:	89.52 km²
Location		
Latitude	:	11°40' N
Longitude	:	76°23' E
Topography		
Altitude	:	1000 - 3015m above msl
Climate		
Temperature	:	8°C (Min); 40°C (Max)
Average rainfall	:	3500 mm

Human habitation

No human settlement inside the national park.

Elephant population

Elephant density in Silent Valley - Nilambur is 2.25/km² (Kerala Forest Research Institute, 1993)

Research and monitoring

a) Annual census.
b) A study on the fauna of the Silent Valley National Park (Zoological Survey of India, 1986).
c) A study on the flora of the Silent Valley National Park (KS Manilal, 1988).

Conservation problems

1) *Shrinking habitat and degradation* in the western and southern parts of the park due to clearance for human habitation and use of fire for shifting cultivation.
2) *Replacement of the primary evergreen and sub-tropical hill forest* by secondary grasslands.
3) *Obstruction to elephant movement* toward west because of the rubber plantation in Nilambur valley (Unnikrishnan, 1990).

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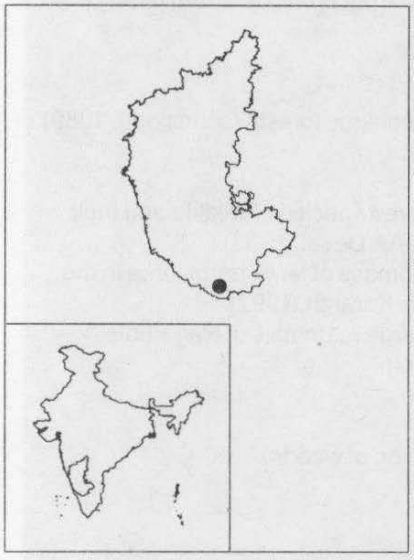
Bandipur Tiger Reserve

Karnataka



Date of establishment : 5 June 1974
Bio unit : 06E (Deccan South)
Total area : 874.2 km²

Location
Latitude : 12°03' to 12°54' N
Longitude : 76°07' to 76°52' E

Topography
Altitude : 690 - 1450m above msl

Climate
Temperature : 18°C (Min); 30°C (Max)
Average rainfall : 1000 mm

Human habitation
No village inside.

Elephant population
The elephant population in 1989 was 934 (Appayya, 1990). The age and sex composition of elephants - Male 14.7%, Female 68.5%, and Young 16.8% (Mohan Chandran, 1990). According to Appayya (1996), the elephant population structure is as follows :

	Adult	*Subadult*		
Male	358	80		
Female	973	101		
Juvenile	-	-	168	
Calf	-	-	259	
Total	-	-	-	*256*

Research and monitoring
a) Ecology and behaviour of the Dhole or Indian wild dog with special reference to predator-prey relationship in Bandipur (AJT Johnsingh).
b) Study of the ecology of certain endangered species of wildlife and their habitats (Salim Ali, N Sivaganesan, AA Desai, 1985).
c) Analysis of predator-prey balance in Bandipur tiger reserve with reference to census report (K Ullas Karanth).

Conservation problems
1) *Man-elephant conflict* resulting in man injury/death (20%), crop raiding (60%) and damages to other properties (5%).
2) *Cattle grazing, removal of fuelwood, timber and MFPS.*
3) *Poaching* for ivory. Fifteen reported cases in 1992-95.
4) *Forest fires.*
5) *Encroachment of forest lands.*

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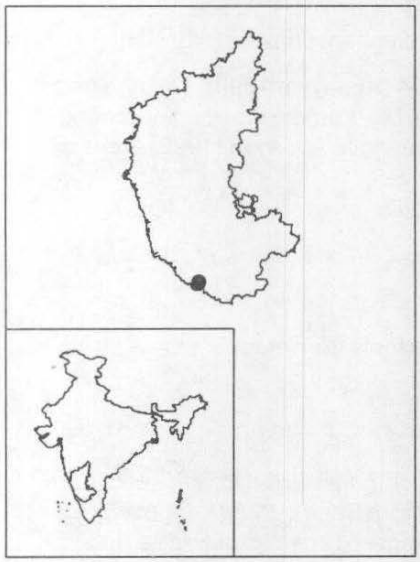
Nagarhole National Park

Karnataka



Date of establishment : 8 December 1988
Bio unit : 05B (Western Ghat Mountain)
Total area : 572 km²

Location
Latitude : 11°45' to 12°15' N
Longitude : 76°05' to 76°25' E

Topography
Altitude : 701 - 959m above msl

Climate
Temperature : 14°C (Min); 33°C (Max)
Average rainfall : 1778 mm

Human habitation
Eight settlements with about 1000 people but prohibited from practicing agriculture or raising livestock.

Elephant population
Around 300 elephants in Nagarhole-Kakankote forests (Johnsingh, 1989)

Research and monitoring
a) Study of ecology of certain endangered species of wildlife and their habitats (Salim Ali, N Sivaganesan, AA Desai, 1985).
b) Population structure, density and biomass of large herbivores in the tropical forests of Nagarhole (K Ullas Karanth, 1992).
c) Predator-prey relations among the large mammals of Nagarhole National Park (K Ullas Karanth, 1993).

Conservation problem
1) *Habitat degradation* due to proliferation of weeds.
2) *Man-animal conflict*.

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