50

# Envis

Wildlife and Protected Areas

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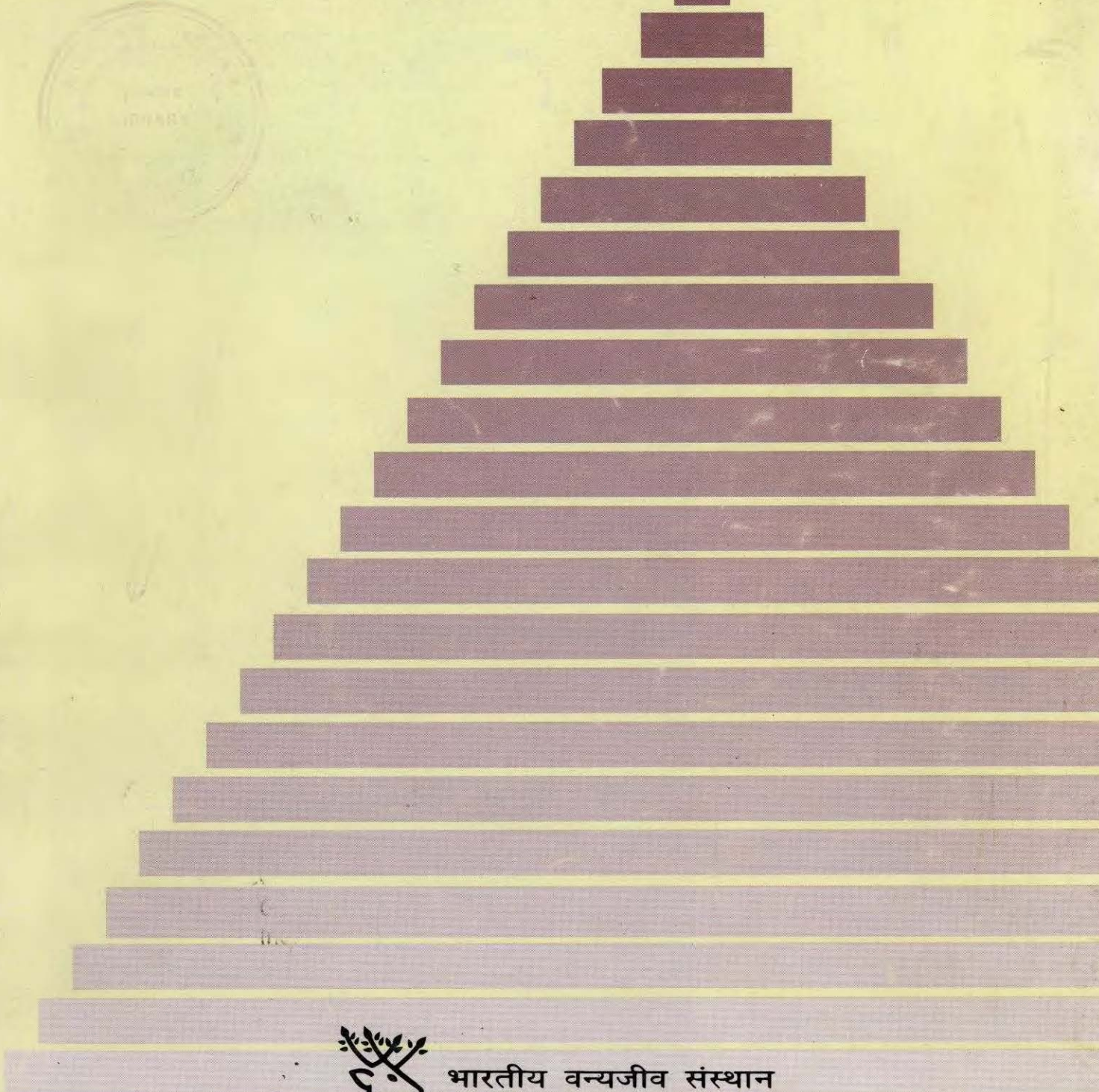

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

The Environment Information System (ENVIS) Centre at Wildlife Institute of India, set up in September 1997, is part of the ENVIS set-up of the Ministry of Environment and Forests, Government of India. It deals with general matters concerning "wildlife" and specifically those related to "protected areas". Its objectives are to :

* Establish a data bank on information related to wildlife and wildlife protected areas, and thereby build up a repository and dissemination centre for information on wildlife science.

* Promote national and international cooperation, and exchange of wildlife related information.

* Provide decision makers at the apex level with information related to conservation and development.


*This issue*

**Envis**

Wildlife and Protected Areas

*Vol 1, No 1; Spring; March 1998*

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*The internet edition of this bulletin will be available from June 1998. Enquire for details.*


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# Contents

Dear Readers,

The Envis Centre, Wildlife Institute of India (WII) presents the first issue of its Envis Bulletin (Wildlife & Protected Areas), a non-priced bi-annual publication issued under the INFOTERA Programme of the UNDP.

This first issue concentrates on the elephant, and why not ! The pachyderm is the living symbol of Lord Ganesh, the elephant-headed god of the Hindu pantheon, with whose name are all auspicious beginnings made.

Culture and history apart, all is not well with this gentle giant; and if the situation does not turn for the better, this largest mammal of our present times might go the way of other lost mammals of the bygone eras. Today, it is an endangered species, facing increasing problems in its survival. This bulletin discusses the issues in the management and conservation of the elephant in India, the problems emanating for the larger society from the distresses the animal is facing - accidents of depredation and loss of human lives and properties. Also provided is information on the presence of wild elephants in the country and a listing of literature available on the species. The information provided, besides the features given under individual authorship, has been gathered from various sources, namely the National Wildlife Database, and the Library and Documentation Centre at the Wildlife Institute of India. Our efforts to disseminate information on Wildlife and Protected Areas globally will reach a new high with the internet edition of this bulletin expected to be available from June 1998.

Undoubtedly, all this is not an exhaustive reading on the species, and in fact, there may be many shortcomings; but we have only just made a beginning. The bulletin is bound to grow in size and content in due course. We would welcome your reactions on the issue and also any additional information you may like to provide on the subject which we could carry in the subsequent issues of the bulletin.

With 1998 being the International Year of the Tiger, as it is the Chinese's *year of the tiger*, the next issue of the Envis bulletin will be on "Lesser Cats of India" which is expected to be published in October 1998. Should you wish to send any information (including bibliographic information), article and other write-up on the subject, we will gladly accept these for publication, but latest by end-August 1998.

SK Mukherjee

# Elephant at crossroads

THE ELEPHANT HAS BEEN AN INTEGRAL PART of India's history, tradition, myth and culture. Its huge size, the peculiar formation of its dentition, its marvellous proboscis and a marked intelligence, have endeared it to people through all ages. Prehistoric carvings, paintings and sculptures, and seals and medallions from the Harappan civilization (2500-1500 BC) testify its association with man. The kings of yore used it as royal mount, in peace and in warfare. Chandragupt Maurya (321-296 BC) had as many as 9000 elephants in his army. In Emperor Ashok's times (268-232 BC) the elephant became the symbol of Buddhism. Early Tamil literature of 1st-3rd century AD speaks of the elephant being an intimate part of people's life. The great poet Kalidas (about 400 AD) makes eloquent reference to the animal in his poems and plays. The rock carvings of the Pallava dynasty (600-740 AD) and the temple sculptures from the Hoysala period (1110-1130 AD), among others, depict the elephant in detail, documenting its eminent position in the society. The Mughal king Akbar (1556-1605) had great love for the animal and it is believed that in his times there were about 32,000 elephants in the imperial elephant stables. Their number during his son Jahangir's reign is said to have gone up to as much as 1,30,000.

In due course, with warfare taking a different mode, the use of elephants stopped. But they continued to be owned in private. Today, in south India, many of the major temples have their own elephants which are decorated and displayed on important ceremonial occasions. Elephants continue to remain in good demand from the logging industry, the government forest and tourism departments and the circus owners. Till the early sixties, the Sonepur cattle fair used to attract over a thousand elephants for sale every year. And even today, the landed gentry in some parts of the northern states of Bihar and Uttar Pradesh, covet it as a status symbol. And what is indeed remarkable is that elephant is the only animal employed by man for which no selection breeding has ever been carried out for developing a domesticated strain.

Yet, because only a very few people may have actually seen the elephant in the wild, it is often difficult for people to comprehend that this essentially wild animal, the symbol of wealth, prosperity and abundance is today a highly endangered species whose very survival has become precarious.

The Asian elephant (one of the two species, the other being the African elephant) was once distributed in a vast area stretching from the Tigris and Euphrates valleys in the present-day Syria and Iraq to south-east China up to the Yellow river in the east and Sumatra in Indonesia in the south. But today it has a highly fragmented distribution, having disappeared entirely from Iran, Afghanistan, Pakistan, Java and most of China (Oliver, 1978) and found in small fractions in India, Sri Lanka, Nepal, Bhutan, Bangladesh,

Myanmar (Burma), China, Thailand, Laos, Cambodia, Vietnam, Malaysia and Indonesia. According to the Asian Elephant Specialist Group/IUCN, the current total population of the Asian elephant is estimated to be 34,000-54,000, with approximately half of these in India (17,000-22,000). However, even here, its present distribution has been severely reduced from its past record. In India, during the last 100 years, elephants have become extinct in five states - Punjab, Rajasthan, Madhya Pradesh, Maharashtra and Andhra Pradesh.

The major problem facing the elephant and its ecosystem is uncontrolled increase in human population and the resultant demand for land and natural resources. In India, since the mid-nineteenth century, an enormous area in prime elephant habitat has been lost to coffee, tea, rubber and teak plantations carved out of the existing forests. Large scale deforestation, mining and submergence because of hydroelectric projects have also ravaged elephant habitats. Poaching for its ivory tusks has hastened the decline in its populations. Today, as a result of the numerous hindrances to the free movement of elephants and exploitation of the natural resources in elephants habitats, there are increasing cases of confrontation between man and elephants. The states of north-east India, which used to be the main stronghold of the elephant in India, are the areas where the main elephant-human conflict has developed.

The elephant is a large animal, currently the largest of all terrestrial animals, with a huge appetite which governs its long distance migration and a large home range. As such, it is among the first species to suffer from any fragmentation or destruction of its habitat. In fact, the distribution of the elephant populations through the ages is a good indicator of the progressive deterioration of the environment in the region.

Concerned at the continuous decline in elephant numbers and deterioration in the extent and quality of its habitat, various international and national organizations such as the IUCN, Bombay Natural History Society, Wildlife Institute of India and the Centre of Ecological Sciences, among others, suggested initiating a Project Elephant, similar in principle to the Project Tiger. Accordingly, in 1990, the Government of India set up a task force to identify the problems facing the elephant and frame a long term programme for its conservation in India. Based on the recommendations of this task force, the **Project Elephant** came into being in February 1992, seeking the long term survival of this magnificent species along with all the biodiversity of its habitats.

Elephant today is at crossroads, where one way leads to its doom and the other to survival. It not only depends on us which way the elephant will go but on its survival depends the very survival of the human race.

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# A project to save elephant

*Vinod Rishi*
*Chief Conservator of Forest*
*(West Bengal)*

THE SURVIVAL OF THE ELEPHANT population in India is perceived to be facing the following **threats and shortcomings** :

a) Decimation and fragmentation of elephant habitat and population units into isolated and genetically unviable small units,

b) Increasing human antagonism towards free ranging elephants as a result of growing confrontations between people and elephants at forest interfaces and consequential loss of human life, crop and property therein,

c) Declining sentimental value of elephant in Indian people's psyche,

d) Increasing elephant mortality due to anthropogenic causes,

e) Lack of standard management infrastructure and procedures for conservation of elephant in free living conditions,

f) Financial inadequacy in field management.

**The main objective of Project Elephant is to ensure long-term conservation of viable populations of Asian elephant (*Elephas maximus*) and it natural habitats in India.**

Against this overall prime objective, the immediate objectives of the Project Elephant scheme are to:

1) Protect, restore and improve ecologically the existing habitats and linkage corridors used by elephants for their movement between forests;

2) Protect wild elephant populations from poaching and unnatural deaths;

3) Mitigate man-elephant conflict;

4) Help forest departments build capacity in the proper and scientific management of wild elephants;

5) Seek and encourage humane treatment in the management of captive elephants; and

6) Provide technical and administrative assistance to states in fulfilment of the above.

*The author is Former Director, Project Elephant Min. of Environment & Forest, Govt of India.*

*Project commencement*
February 1992

*Estimated elephant range*
12,000 km²
(Administrative Districts)

*Forest area under Project*
Approx. 60,000 km²

*States covered*
Uttar Pradesh, Arunachal Pradesh, Meghalaya, Nagaland, Assam, Bihar, West Bengal, Orissa, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu

*Elephant population (wild)*
25,571 (in 1993)
(Estimated mid-value of the population range)

*Project administration*
Project Director, Govt of India
and
Chief Wildlife Wardens of the elephant range states.

While the Central Ministry of Environment, Forest and Wildlife oversees and guides the Project, it is the concerned state governments which implement the programmes thereunder. -

The **strategy** being adopted for this is twofold :

1) A Steering Committee for Project Elephant has been constituted which includes representatives of the government as well as non-government wildlife experts and scientists. Besides, the Chief Wildlife Wardens of the respective 12 elephant range states, and Heads of four premier institutions, namely the Wildlife Institute of India, Zoological Survey of India, Botanical Survey of India and Indian Veterinary Research Institute are permanent invitees to the meetings of the Steering Committee. The Steering Committee advises the Government of India on Project related issues; and

2) The Government of India, through a centrally sponsored scheme, arranges for and provides financial, technical and scientific assistance to the states having free ranging populations of wild elephants, on approved items of work that directly or indirectly contribute to ensuring the long-term survival of identified viable populations of elephants in their natural habitats.

During the VIII Five-Year Development Plan period (April 1992 - March 1997), including the first year (1991-92), the financial assistance provided under the centrally sponsored scheme to the various states covered under the Project has been as follows :-

| *Year* | *Amount released (in Rs)* |
|---|---|
| 1991-92 | 24,300,000 |
| 1992-93 | 20,200,000 |
| 1993-94 | 55,900,000 |
| 1994-95 | 48,000,000 |
| 1995-96 | 30,200,000 |
| 1996-97 | 45,000,000 |

It may be mentioned that this entire support has been provided by the Government of India and there have not been any inputs from non-government/foreign donors till date.

The broad items covered by the financial assistance given to the states has been as follows :-

**Habitat restoration**

| | | |
|---|---|---|
| 1. | Plantation of indigenous species of plants for providing food and cover for the enrichment of degraded habitats | 2086 ha |
| 2. | Development of pasture lands for wild elephants | 704 ha |
| 3. | Land acquisition for extension of elephant habitat | 151.283 km² |

**Protection and anti-poaching measures**

| | | |
|---|---|---|
| 4. | Restoration of fire-lines and tracks for patrolling | 445 km |
| 5. | Establishment of patrolling camps | 18 nos |

| | | |
|---|---|---|
| 6. | Establishment of watch-towers | 10 nos |
| 7. | Strengthening communication system wireless sets | 204 nos |
| 8. | Vehicular support (25 cycles, 25 motorcycles, 2 jeeps and 2 out board power boats) | 54 nos |
| 9. | Restoration of forest roads | 852 km |
| 10. | Firearms (18 DBBLs and 40 rifles with the required ammunition) | 58 nos |

**Conflict mitigation**

(i) *Anti-depredation measures*

| | | |
|---|---|---|
| 11. | Energised fencing | 569 km |
| 12. | Elephant proof trench | 151 km |
| 13. | Elephant drive | Rs 42.66 lacs |
| 14. | Capture of displaced problem elephants (Sarguja, MP) | 11 nos |
| 15. | Capture of elephants for control of depredations | 26 nos |

(ii) *Other measures and support*

| | | |
|---|---|---|
| 16. | Ex-gratia relief | Rs 181.80 lacs |
| 17. | Eco-development activities | Rs 66.25 lacs |
| 18. | Publicity and awareness campaigns | Rs 65.02 lacs |

In the last half decade since the Project Elephant started, the measures and programmes taken up for the conservation of the elephant have shown some encouraging signs, which indicate the positive **impact** the Project is having on elephant populations and their habitats. Some of these positive effects are :-

1) The Mahananda Wildlife Sanctuary (West Bengal) today retains elephants all the year round as against about one month annually at the beginning of the Project;

2) The elephants displaced from Tamil Nadu in 1985-86 have been accommodated in the forests of Andhra Pradesh. Population increase over the years is incidental indicator.

3) There has been a mitigation of man-elephant conflict in Madhya Pradesh caused by displacement of elephants from Bihar in 1985-86.

4) Elephants straying towards Calcutta in south West Bengal have been controlled.

5) There is downward trend in loss of human life from man-elephant conflict in Andhra Pradesh, Karnataka and West Bengal since 1991-92.

Project Elephant is the only wildlife conservation project in India that covers forest habitats in elephant range states irrespective of their legal status as National Park, Wildlife Sanctuary, Reserve Forest or Protected Forest.

However, since Project Elephant is a species oriented effort instead of an area specific activity, the tasks therein are more complex. The problems are immense and there are major **areas of concern** yet to be addressed and solutions sought for, such as -

a) Elephants do not remain confined to protected areas. Herds often cross inter-state and, at places, even international boundaries. Inter-state co-ordination is a major challenge for successful implementation of the Project. Sheer numbers are not a reliable indicator of the viability of the species as the elephant is a social animal and breeding units are of greater significance than absolute numbers.

b) As man's interaction with elephant is intense, possibly more than with any other wild animal, elephant conservation involves management of human attitudes in addition to the management of the species and its habitat. However, in the face of generally growing confrontations between man and elephant at forest interfaces which often result in serious loss of life, property or standing crops, the aims of encouraging a better understanding of the elephant conservation problem among the people are not easy to achieve. While the situation of conflict is real, there is often a politicizing of this conflict at local levels which directly or indirectly arise from the diverse and often conflicting views of NGOs regarding the use of forest habitats by the local people.

c) The international trade incentives for poaching of elephants, particularly for their tusks, are very lucrative. The human habitations within elephant habitats are a limiting factor in controlling poaching as detecting and apprehending poachers among the other residents of the area is a difficult task for the enforcement agencies. Moreover, the local people often actively or tacitly support the activity of the poachers either out of fear or because of pecuniary gains otherwise.

d) Other problems include, a less than desired inter-state dialogue and collaboration resolving the problems of elephant management and conservation; unprotected habitats and corridors which lie on public lands, the large size and resource requirements of the elephant; and lack of adequate infrastructure.

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# Elephant Reserves

ELEPHANT, BEING A LARGE ANIMAL, moves over long distances from season to season to meet its large biomass requirement. For this reason, Project Elephant, seeking its conservation, is planned at a landscape level rather than aimed at individual protected areas. The habitat of elephants may often span over two or more states, and so to ensure their long term survival, Elephant Reserves have been proposed to cover as much of the important areas in the path and range of the elephants in the regions as possible which hold their major populations.

Elephant Reserves have been conceived to :-

a) ensure long term survival of identified large populations; the first phase target, to protect habitats and existing ranges;

b) link up fragmented portions of habitat by establishing corridors or protecting existing corridors under threat;

c) improve habitat quality through ecosystem restoration and other measures keeping the main objective of range protection in view; and

d) attend to the socio-economic problems of human populations living on the fringes, including man-elephant conflict.

There are eleven Elephant Reserves designated. These are :-

1

## Southwest Bengal - North Bihar - Orissa

The reserve comprises moist deciduous and semi-evergreen forests. It covers, in southwest Bengal: Mayur Jharna Wildlife Sanctuary; in north Bihar: Dalma Wildlife Sanctuary, Saranda forest divsion, Kolhan forest division, Porhat forest division and Dhalbhum forest divisions; and in Orissa: Bonai forest division (part), Sambalpur forest division (part), Devgarh forest division, Keonjhar, Karanja, Simlipal, Angul forest division, Ushakoti Wildlife Sanctuary, Khalsuni Wildlife Sanctuary and Badampahar. Estimated elephant population 3000.

Major conservation and management problems are :

1. *Dam construction and large scale mining.*
2. *Natural sal forest replaced with teak.*
3. *Agricultural cultivation.*

These have forced elephants to do long distance migration towards Raigarh and Sarguja districts in Madhya Pradesh on the one side, and the Midnapore district in West Bengal on the other which, in turn, has resulted in increasing man-elephant conflicts.

*(Source: Project Elephant; Publication Min.of Environment & Forest, Govt of India; February 1993)*

2

## KAMENG-SONITPUR

Estimated area 7500 km², extending over a long stretch of semi-evergreen forests in Arunachal Pradesh and Assam covering Kheolong forest division, Bandardeva forest division, Darang East and West forest division and North Kamrup forest division (part).

Major problems include :

1. *Forest denudation.*
2. *Human settlements.*
3. *Insurgency.*

3

## DIBRU-DEOMALI

Spread over 5000 km², covering, in Arunachal Pradesh: Kamlong Wildlife Sanctuary, Turung reserve forest, Mamobhum reserve forest, Devmali Kanubari area (Khonsa forest division) and Namsai forest division; and in Assam: Dibru-Saikhowa Wildlife Sanctuary, Digboi forest division, Dumduma forest division and Dibrugarh forest division (part). Estimated elephant population 1800.

Main problems are :

1. *Poaching, including capture of live animals.*
2. *Encroachment and overuse.*

4

## KAZIRANGA-KARBELONG-INTANKI

Covers 4500 km², in Assam: Kaziranga National Park, East and West Karbelong division, North Cacharhills division and Golaghat division; and in Nagaland: Intanki Wildlife Sanctuary. Estimated elephant population 1500 - 2000.

Conservation and management problems are :

1. *Insurgency.*
2. *Encroachment and illegal timber extraction.*
3. *Poaching.*

The heavy use of the region by people, particularly encroachment, has resulted in elephants straying into agricultural fields. The migratory corridors between Kaziranga and Karbelong need to be restored, the Kaziranga National Park enlarged and Mikhir Wildlife Sanctuary created.

5

## BARAIL-SAIFUNG

Covers 1500 km² which includes, in Assam: Cachar and Karimganj (part) forest divisions and North Cachar forest division (part); and in Meghalaya: Saifung reserve forest and Norphu reserve forest including the proposed link between the two. Elephant population under 150.

Major problems are :

1. *Insurgency.*
2. *Shifting cultivation in some areas.*

As the objective of this reserve is to provide protection to the rich diversity in the area, hence the main task is to provide protection to the area.

## 6 Balphakram and Adjoining Areas

Estimated area 1800 km² in Meghalaya, covering Balphakram National Park and its proposed extension, Dambu Sangsak-Darugia Rongangiri reserve forests, Bagmara and Cego wildlife sanctuaries and Rewok reserve forest. Elephant population is about 2500.

The problems besetting the area are :

1. *Insurgency.*
2. *Poaching from across the border.*
3. *Shifting cultivation and cultivation of cash crops*
4. *Man-animal conflict.*

## 7 Nilgiri and Eastern Ghats

The largest reserve, spread over 11,000 km² across a range of forest types from moist deciduous through dry deciduous to dry thorn, besides teak and eucalyptus plantations. It covers, in Tamil Nadu: Mudumalai Wildlife Sanctuary, Gudalur Nilgiris North (part), Satyamangalam, Erode, Dharmapuri and Hosur; in Kerala: Wynad sanctuary, Alattur reserve forest, Tirunelli, Judrakote, Hilldale, Trisshaleri, Harikara Shola; and in Karnataka: Hunsur, Nagarhole National Park, Mysore, Bandipur Tiger Reserve, Chamarajanagar, Kollegal and Bangalore (part). Estimated elephant population 5000.

Conservation and management problems comprise :

1. *Habitat degradation and fragmentation.*
2. *Man-animal conflict.*
3. *Poaching for ivory.*

Crop depredation and human injury/killing are common, but poaching is not so severe now as it was in the past.

## 8 Nilambur-Silent Valley-Coimbatore

Lying south of the Nilgiris and spread over 2500 km² across stretches of evergreen forests, montane shola grasslands, deciduous forests and plantation forests. It covers, in Tamil Nadu: Nilgiri South (part, including Mukurthi sanctuary) and Coimbatore; and in Kerala: Nilambur, Palghat and Kozikode including Silent Valley National Park, Attapadi reserve forest, Muthukulam, Kallady upto Walayar, ex-Manjeri Kovilakam and Nedunjechi. Estimated elephant population 500-600.

Conservation problems are :

1. *Human settlements.*
2. *Encroachment of evergreen forests.*
3. *Forest fires.*

Besides according protection to evergreen forests, the monoculture plantations need to be stopped.

## 9 Anamalai-Parambikulam

Covering about 3000 km² of varied landscape from wet evergreen forests to montane shola grasslands, moist and dry deciduous forests, thorn forests, teak and coffee plantations. It includes, in Tamil Nadu: Anamalai (including Indira Gandhi National Park); and in Kerala: Parambikulam Wildlife Sanctuary, Chimmony Wildlife Sanctuary, Nenmara, Munnar (part), Malayatoor (part) and Chalkudy (part). Elephant population 1000-1200.

Conservation and management problems are :

1. *Habitat fragmentation by a network of reservoirs and canals.*
2. *Forest fires degrading moist forests.*
3. *Poaching for ivory.*

Elephants have been reported falling into the canals; as such, corridors need to be secured.

## 10 Periyar-Madurai

About 3000 km² of evergreen forests, moist deciduous forests and dry deciduous forests, besides plantations. It includes, in Tamil Nadu: Madurai South (including Srivilliputhur); and in Kerala: Periyar Tiger Reserve, Idukki Wildife Sanctuary, Chinnar sanctuary, Ranni (part), Kottayam (part), Konni (part), Achenkoil (part) and adjoining areas. Estimated population 1600-2000 elephants.

Major problems are :

1. *Habitat fragmentation.*
2. *Man-animal conflict.*
3. *Poaching for ivory.*
4. *Illegal cultivations.*

Cultivation is illegal in terms of both the land it is done on - the forest, and also the produce - ganja ! This needs to be put a stop to and the cultivators evicted.

## 11 Rajaji-Corbett

About 8000 km² across the foothills of the Himalaya, through mixed sal forests, rivers and streams, it covers, in Uttar Pradesh: Dehra Dun forest division, Siwalik forest division, Rajaji National Park, Bijnor plantation division, Lansdowne forest division, Kalagarh forest division, Corbett National Park and Haldwani forest division. Elephant population estimated 750-1000.

Main conservation and management problems are :

1. *Diversion of land.*
2. *Overgrazing and tree lopping.*
3. *Monoculture plantations.*
4. *Habitat fragmentation.*
5. *Man-animal and man-protected area conflict.*

Land largely diverted for non-forestry purposes, and the construction of canals and reservoirs have both lead to disruption of migratory corridors and paths, resulting in crop depredation and sometimes injury or death to humans.

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# Elephant conservation : A question of numbers

*JC Daniel*

THE CONSERVATION OF THE ASIAN ELEPHANT has its paradoxical features. A species that has been protected in India from the late 19th century, it is today, unfortunately, one of the highly endangered species of the subcontinent. This is so through circumstances that have down the centuries constricted its habitat. The canopy forests region where it flourished once are now arid deserts. The elephant in the present situation requires intensive management if it is to survive as a wild species.

The problem facing the elephant is seemingly simple - inadequate habitat for an expanding population. The question is how many elephants can survive in any given habitat without eating themselves out a habitat in which they can survive!

To find an answer to this problem one has to determine what is the projected annual increase in the population. The elephant has a gestation period of approximately 22 months and every female is a potential breeder from about 13 years to 55 years of age. Moreover, females are rarely killed and the young are carefully protected by the mother, an additional caretaker or "aunty" and generally by the herd. The only possible predator, the tiger is in its present population status, an unlikely threat. As such, in each wild population of elephants it is possible to more or less accurately predict the probable annual increase. The major causes for decline are conflict with man and habitat degradation.

The question that requires urgent and immediate attention is what is to be done with excess population as admittedly there is no chance of increasing the available habitat. This is a question that needs a long term solution. But before we think of a solution we have to get hard data on the population status of elephants, namely the projected and actual numbers in the wild.

***

*The author is Hony. Secretary, Bombay Natural History Society, Mumbai*

# Elephant-human conflict in West Bengal

*SS Bist*
*Conservator of Forests*
*(West Bengal)*

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 pericds 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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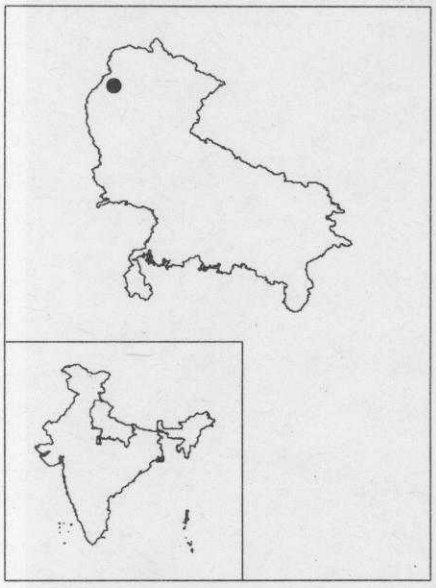
# Rajaji National Park

*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 wildlife 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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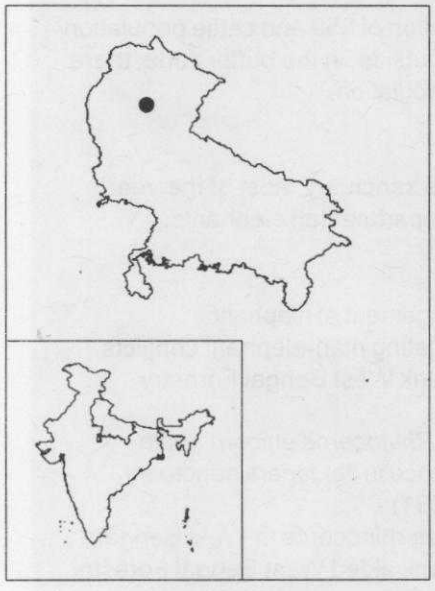
# Corbett Tiger Reserve

*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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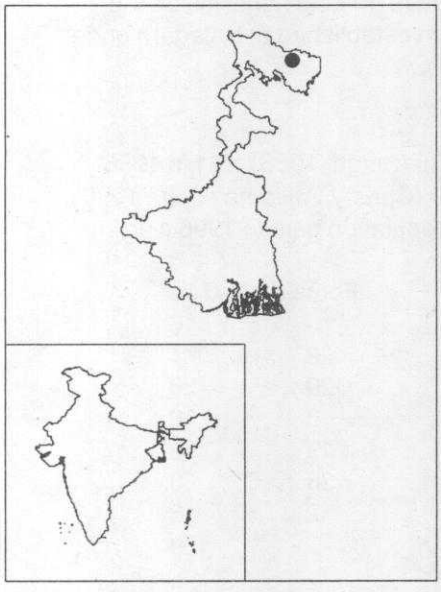
# Jaldapara Wildlife Sanctuary

*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)

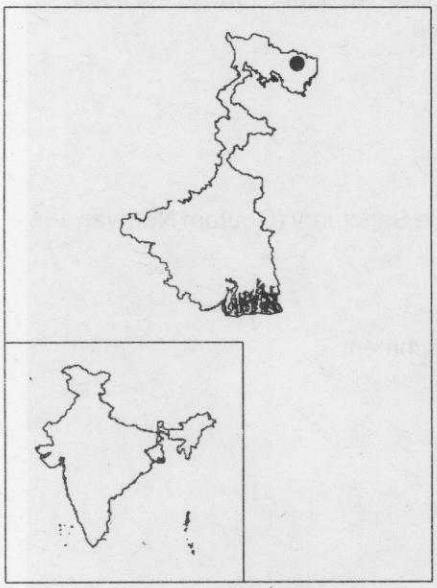
**Conservation problems**

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*

***

# 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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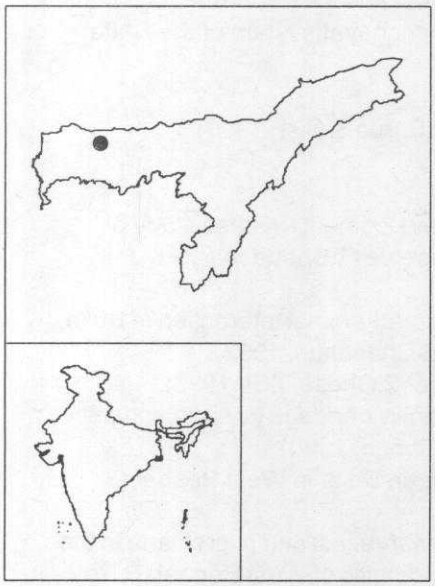
# Manas Tiger Reserve

*Assam*



| | | |
|---|---|---|
| **Date of establishment** | : | 7 September 1990 |
| **Bio unit** | : | 09A (Brahmaputra Valley) |
| **Total area** | : | 1097 km$^2$ |
| **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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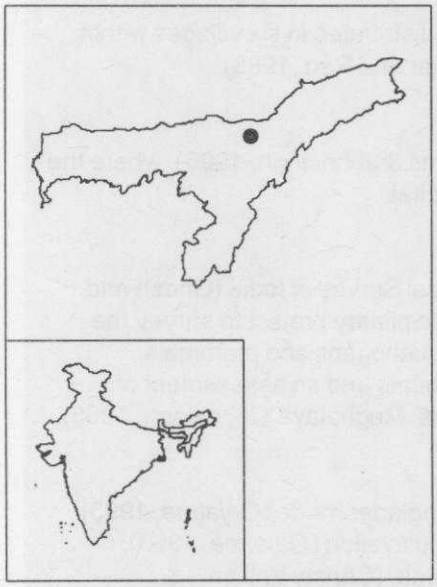
# Kaziranga National Park

*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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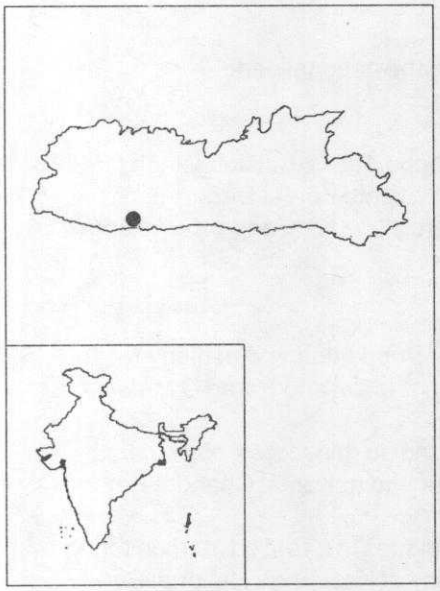
# Balpakhram National Park

*Meghalaya*



| | | |
|---|---|---|
| **Date of establishment** | : | 2 November 1985 |
| **Bio unit** | : | 09B (North-East Hills) |
| **Total area** | : | 200 km$^2$ |
| **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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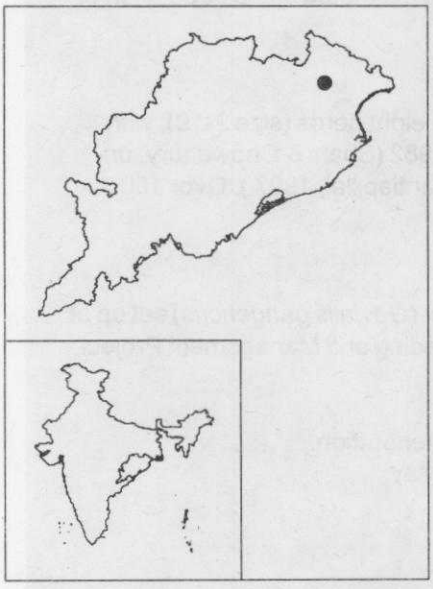
# Simlipal Tiger Reserve

*Orissa*



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

**Location**
Latitude : [illegible]° to 22° 34' N
Longitude : [illegible]° 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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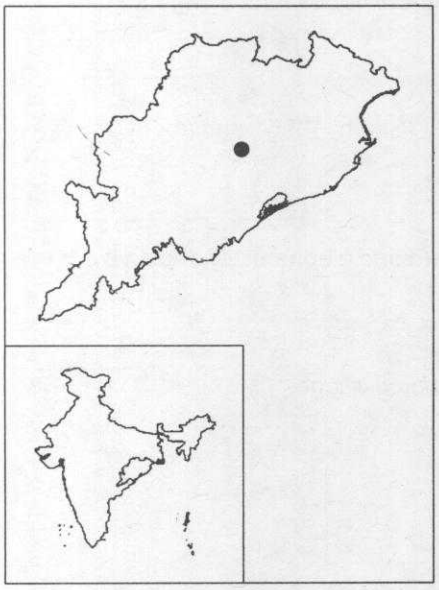
# Satkoshia (South) Wildlife Sanctuary

*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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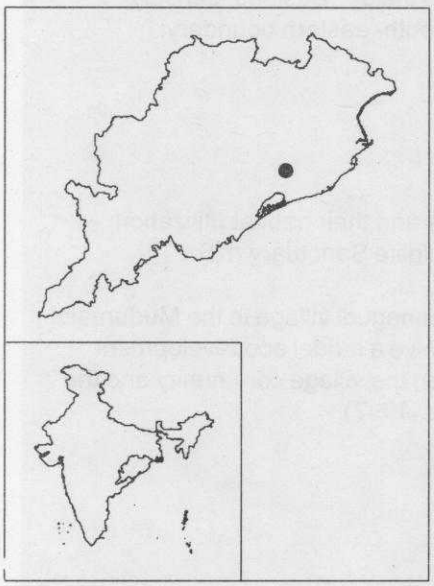
# Chandaka Wildlife Sanctuary

*Orissa*



| | | |
|---|---|---|
| **Date of establishment** | : | 21 December 1982; Revised on 10 June 1986 |
| **Bio unit** | : | 06B (Chhota Nagpur) |
| **Total area** | : | 189 km$^2$ |
| **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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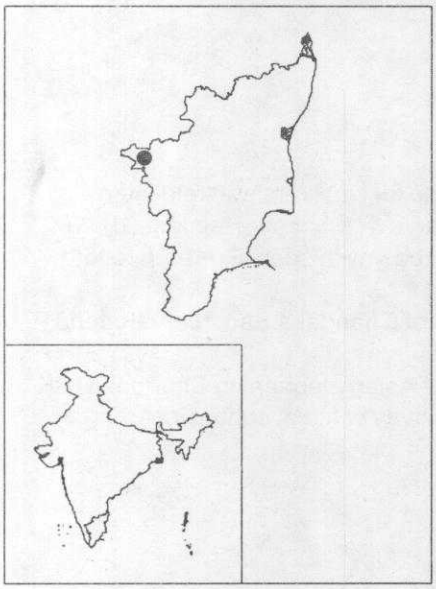
# Jayalalitha (Mudumalai) Wildlife Sanctuary

*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.

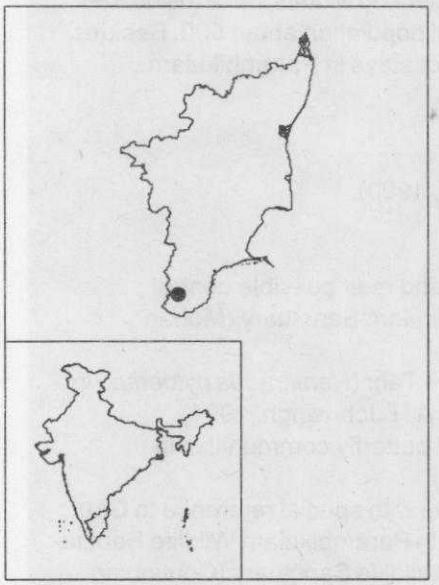
**Research and monitoring**
a) Study on census of large mammals and their habitat utilization during dry season in Mudumalai Wildlife Sanctuary (KS Varman,1988).
b) Study of the rural ecosystem of Masinagudi village in the Mudumalai Wildlife Sanctuary with a view to evolve a model ecodevelopment plan 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.*

***

# Mundunthurai Wildlife Sanctuary

*Tamil Nadu*



**Date of establishment** : 21 March 1977
**Bio unit** : 05B (Western Ghat Mountains)
**Total area** : 567.38 km²

**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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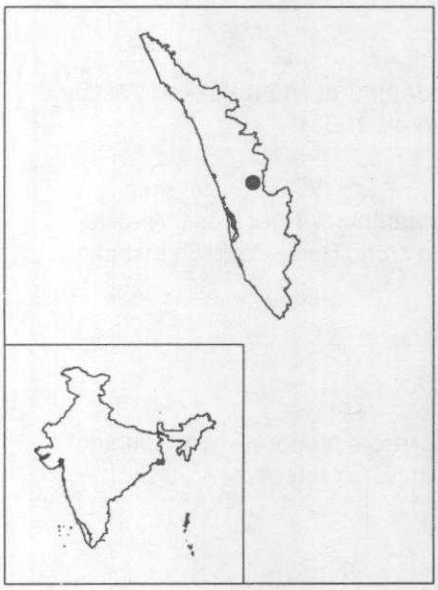
# Parambikulam Wildlife Sanctuary

*Kerala*



| | | |
|---|---|---|
| **Date of establishment** | : | 12 February 1973 |
| **Bio unit** | : | 05B (Western Ghat Mountains) |
| **Total area** | : | 285 km² |
| **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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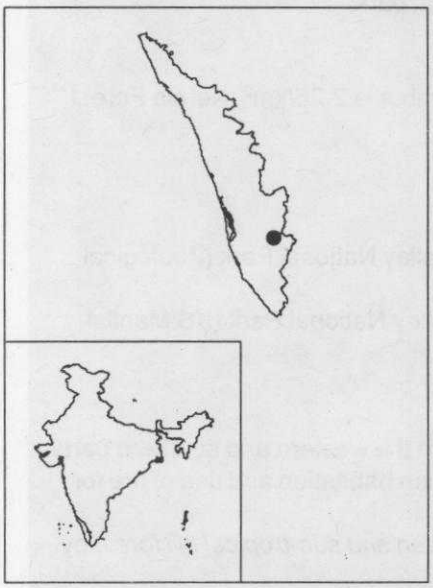
# Periyar Tiger Reserve

*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 Wildilife 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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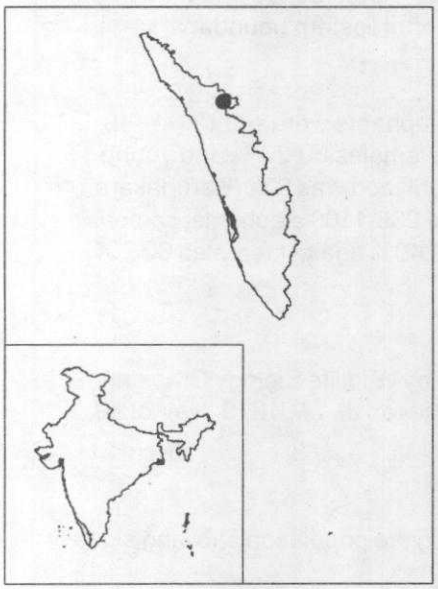
# Silent Valley National Park

*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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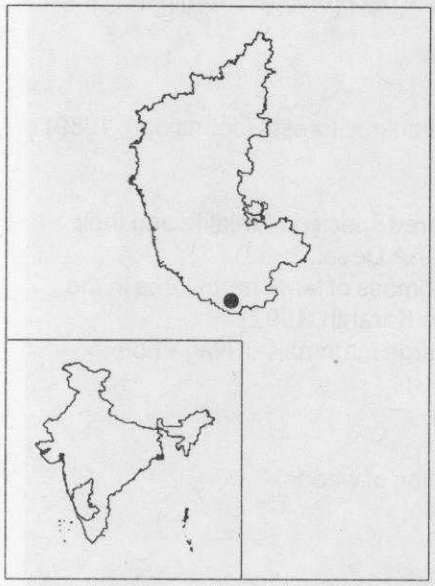
# Bandipur Tiger Reserve

*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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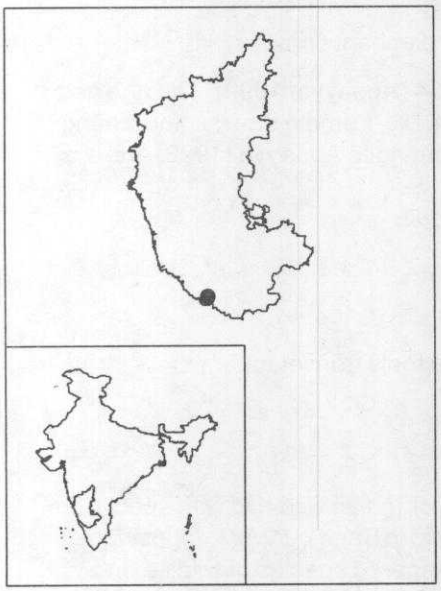
# Nagarhole National Park

*Karnataka*



| | | |
|---|---|---|
| **Date of establishment** | : | 8 December 1988 |
| **Bio unit** | : | 05B (Western Ghat Mountain) |
| **Total area** | : | 572 km$^2$ |
| **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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