

# The Asian elephant (*Elephas maximus*): its habitat, status and distribution in Arunachal Pradesh, India

Bharath Sundaram, Surendra Varma, Arun Venkataraman and Raman Sukumar

**Abstract** The survey assessed forest contiguity, distribution and status of elephants in some areas of Arunachal Pradesh to identify likely gaps in the protected area network. The survey also examined changes seen in elephant distribution between 1984 and the present. The study was carried out through field and questionnaire surveys in the administrative districts of the state. Elephant habitat maps with vegetation types and elephant distribution information were produced. The encounter rates of elephant signs per kilometre were calculated to ascertain specific zones of high, medium and low elephant abundance. Based on the results, East Kameng,

Tirap and Papam-Pare had high, medium and low abundance areas respectively. Qualitative information on district wise elephant status, distribution and conservation is also presented. The survey found very patchy habitat in many areas and many areas that are important for elephants do not fall under the protected area network. The paper also discusses specific recommendations for conserving the species and its habitat.

**Keywords** Elephant, Assam, Arunachal Pradesh, Human-elephant conflict.

## Introduction

Arunachal Pradesh, the largest state in the north-east India, covers an area of 83,743 km<sup>2</sup> between 26° 28'-29° 30' N and 91° 30'-97° 30' E. Lying in the Eastern Himalayan region of the Himalayan biogeographic zone, Arunachal Pradesh is located at the junction of the Palaeartic and Oriental (Indo-Malayan) realms (Rodgers & Panwar, 1988). Arunachal Pradesh comprises mountains that ring eastern Assam, terrain thrown up by the sharp twisting of the Himalayan ranges as they turn suddenly from a southeastern to a southerly direction. These mountains drop precipitously into the tropical lowland evergreen forests of the region. Because of the wide gradients in elevation (50 m-7,000 m asl) and annual rainfall (1,000 mm-5,750 mm), an array of forest types, ranging from tropical evergreen forests, tropical semi-evergreen forests, riverine semi-evergreen forests, subtropical pine forests, temperate broadleaved forests, temperate coniferous forests, alpine forests, and high montane grasslands are seen. Such a diversity of habitats harbouring rich plant and animal life, packed into a relatively small area, makes Arunachal Pradesh a hotspot of global biodiversity. It is also home to over 5,000 species of plants (including 600 species of orchids), 500 species of birds and 29 species of mammals listed under Schedule I of the Indian Wildlife Protection Act. These include 4 species of large cats, 7 species of primates, and 3 species of goat antelopes.

There are over 100 species of amphibians and reptiles recorded from the region (Anon. 1994).

Arunachal Pradesh shares international borders with Bhutan in the west (border length 160 km), China to the north and northeast (1,080 km), and Myanmar to the east (440 km). Culturally diverse, Arunachal Pradesh, with a population under 10 lakh (of which 70% are tribal people), has 21 major tribal groups with over 100 ethnically distinct subgroups and over 50 distinct languages and dialects. Spread over 14 districts, the people of Arunachal Pradesh practice semi-nomadic swidden agriculture (also called *jboom* cultivation), terraced wet agriculture, high montane pastoralism, and traditional trade and barter. Arunachal Pradesh is a land of mighty rivers such as Siang, Dibang, Lohit, and Kameng, all of which join the Brahmaputra in the Assam valley. Over 70% of Arunachal Pradesh is forested, and 11.8% of the total land area falls under the protected area network (Fig. 1), with one Biosphere Reserve (BR) (Dibang-Dihang Biosphere reserve), one Tiger Reserve (TR) (Namdapha Tiger Reserve), one National Park (NP) (Moulting National Park), 10 Wildlife Sanctuaries (WLS) and one Orchid Sanctuary (Sessa Orchid Sanctuary). Eighty-six Reserved Forests (RF's) account for an additional 12.7% of the total area. The rest of the forested areas come under the purview of the 3,649 villages in Arunachal Pradesh and are classified as Village Forest Reserves (VFR's) or Unclassed State Forests (USF's).

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At least two populations of the Asian elephant (*Elephas maximus*) extend along the Himalayan foothills and plains from northern West Bengal eastwards through Assam, Bhutan and Arunachal Pradesh (Sukumar, 1989). It has also been estimated that 10,000 km<sup>2</sup> of hilly habitat may be available for elephants in Arunachal Pradesh alone. The Arunachal Pradesh Forest Department estimates the population of elephants in the state at 4,000, which is twice that of an earlier estimate (Lahiri-Choudhury, 1980). This discrepancy

could be due to the fact that elephants moving into Arunachal from Assam were also counted (AESG Report, 1981). In collaboration with the Forest Department, the Task Force of the IUCN/Asian Elephant Specialist Group (Lahiri-Choudhury, 1980) mapped the distribution of elephants in northeast India (Lahiri-Choudhury *et al.*, 1984). However, widespread destruction of foothill forests through developmental and other anthropogenic activities have shrunk the range of the elephant, consequently restricting it to smaller landscapes having very little connectivity. An increase of encroachment in forested areas has also led to an increase in elephant-human conflict.

The prime objectives of this survey were to assess the forest contiguity and status of elephants, to identify possible gaps in the protected area network in some areas of Arunachal Pradesh, to examine the changes seen in elephant distribution between the 1984 study and the present one, and to project all the data on maps that could be used by both the Forest Department and researchers for better management and further research.

## Methods

The status and habitat available for elephants were determined through field surveys and questionnaire surveys. Field surveys were undertaken in East Kameng, West Kameng, Papum-Pare, Lower Subansiri, Dibang Valley, Lohit, Tirap and Changlang districts of Arunachal Pradesh. Survey of India toposheets were used to assess forest contiguity in the low- and mid- elevation (100-900m) areas. Information regarding the area was first gathered from the Divisional Forest Office, after which animal trails in the forest were identified. These trails were then traversed on foot, and data on elephant signs, i.e. dung, pad marks, scratch marks, and feeding signs were collected. GPS locations were taken at kilometre intervals, and the habitat at that point was classified by noting geographical features, and the four species of trees characteristic of the vegetation in the nearest vicinity were noted. Direct sightings of elephants were also recorded as

and when they occurred. Proximity to the closest human settlements was also noted. In addition to field data collection, secondary information was gathered through questionnaire surveys in villages and Divisional Forest Offices. This included information on distribution, movement patterns, and numbers of elephants. Since very few elephants in Arunachal Pradesh are resident, data on seasonality of sightings/movement were also collected. Fieldwork was carried out during the dry periods of 2001.

Encounter rates (frequency of sighting elephant signs per kilometre traveled on foot) were calculated (Table 1). From these encounter rates it was possible to determine, within the study area, specific zones of high (encounter rate in the range 4 and above), medium (encounter rate in the range 2.5 to 4), and low (encounter rate in the range 1 to 2.5) elephant abundance.

Maps were created using MapInfo Professional, ArcView GIS, and GMView. Layers of political boundaries, protected area network, forest cover were created using VMap Level 0 data (the data set was derived from 1-km resolution Advanced Very High Resolution Radiometer (AVHRR) data spanning a 12 month period, from April 1992 to March 1993), and Global Land Cover Characterization datasets obtained from the International Steering Committee for Global Mapping, Geographical Survey Institute, Japan. The GPS survey points were overlaid on the forest cover map (Fig. 2), and inferred elephant distribution (from secondary information) was plotted (Fig. 3).

## Results

The elephant ranges in Arunachal are mainly distributed along the foothills adjacent to Assam. Elephants are found usually between the altitudinal range from 2,000 to 6,000 m asl but there is some evidence to show that they could migrate to higher levels in search of food and other resources especially during winter months. A total of 1,600 elephants were estimated for the state during 2001 elephant census (Forest

**Table 1** List of areas where ground surveys for dung were carried out, with encounter rates for each area

Area	District	Forest Division	Protection Level	Distance walked (km)	Number of signs	Encounter rate/km
Chessa	Papum-Pare	Bandardewa	RF, USF	12	28	2.33
Chessa	Papum-Pare	Bandardewa	RF, USF	8	15	1.88
Kimin	Papum-Pare	Bandardewa	RF, USF	15	24	1.6
Deomali	Tirap	Deomali	RF, VFR	15	79	5.27
Deomali	Tirap	Deomali	RF, VFR	7	29	4.14
D' Ering	East Siang	Pasighat	WLS	16	88	5.5
Tipi	East Kameng	Khellong	WLS	12	78	6.5
Seijosa	East Kameng	Khellong	WLS	15	89	5.93

Department, unpublished report). Within Arunachal Pradesh, elephants occur in Papum-pare, Lower Subansiri, East Siang, East & West Kameng, Lohit Dibang Valley, Tirap & Changlang districts.

#### *East and West Kameng districts*

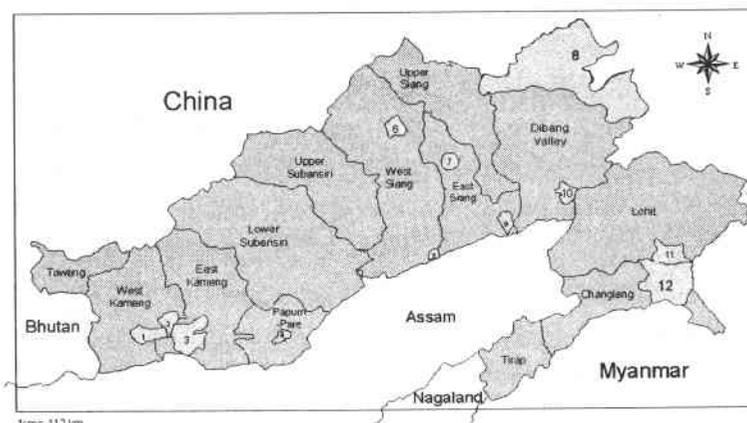
Areas surveyed in these two districts include Pakhui WLS and Khellong Forest Division, both of which support abundant elephants and experience severe human-elephant conflict. The high abundance may be due to these areas bordering Nameri NP and Sonitpur RF in Assam, from where elephants tend to move out. While the forest types in Pakhui WLS range from semi-evergreen to evergreen with patches of secondary *jboom* forests, the forests in the Bhalukpong side (Khellong Forest Division- Amartala, Doimara and Papum RF's) are mostly degraded, with some patches of evergreen forest still existing due to their inaccessibility. Elephants range right from the foothills of the Dhansiri river (at the Bhutan border), to Papum RF east of Pakhui WLS. A specific area of high human-elephant conflict is Tipi (a town close to Bhalukpong). The position of the Tipi Orchid Research Centre (situated in a natural elephant pathway), increased levels of human encroachment, and the construction of a Territorial Range Office on an elephant path have been the reasons for increasing levels of human elephant conflict. Project Elephant has recognised the Kameng -Sonitpur interstate area (ca 4,300 km<sup>2</sup>) as an Elephant reserve (National Elephant Conservation Action plan, 1992), but this area experiences a lot of pressure in

Assam due to the large-scale transformation of land for cultivation.

#### *Papum-Pare and Lower Subansiri Districts*

The areas surveyed in these two districts include the Itanagar WLS and Bandardewa Forest Division, which had medium elephant abundance, with highly migrant animals. These areas are also highly fragmented and degraded due to human encroachment and illegal deforestation. Areas such as Poma, Jote, Kimin, Hoj, Tarajuli, Chessa, Hollongi, Changmara, Kokila, Tengabari, and Balijan have a matrix of habitats composed of semi-evergreen forest, evergreen forest, and cultivation. Unplanned development in the Itanagar area has also destroyed much of the habitat and has been identified as an issue of concern in 1984 (Lahiri-Choudhury, 1985). An elephant reserve has been planned in Papum-Pare district, but the success of this plan depends entirely on how effectively encroachers can be removed. This area shows very little influx of elephants from Assam because the areas on the Assam side are completely under cultivation.

In the Subansiri range of Panir RF (Bandardewa Forest Division) disturbance affecting elephants has been observed. Dolunmukh is a village bordering Panir RF, which has not reported the presence of elephants for the past 10 years due to such disturbance. Though the disturbance has ceased a few years ago, elephants are yet to return. These areas have large patches of semi-evergreen and evergreen forests. More interestingly, Dolunmukh was reported to have been an area of high human-elephant conflict (Lahiri-Choudhury *et al.*,



1. Eagles Nest WLS
2. Sessa Orchid Sanctuary
3. Pakhui WLS
4. Itanagar WLS
5. Kane WLS
6. Yordi Rabe Sapse WLS
7. Mouling NP
8. Dihang-Dibang BR
9. D' Ering Memorial WLS
10. Mehao WLS
11. Kamlang WLS
12. Namdapha TR

WLS- Wildlife Sanctuary  
 NP- National Park  
 BR- Biosphere Reserve  
 TR- Tiger Reserve

1984). A major hydroelectric project involving the construction of a dam across the Subansiri is also being planned.

#### Lohit District

The floodplain areas of the Lohit River, such as the Paya and Digaru Ranges, were surveyed in the Lohit Forest Division within this district. Of the 7 ranges here 2 showed seasonal presence of elephants. Dung encounter rates indicate that these areas have medium elephant abundance. Affected heavily by flood, the landscape in these areas is highly amorphous. Struck by a major earthquake in 1950, many of the natural forests of this area were destroyed due to inundation and the changing of the course of the Lohit River. The habitat in this area is a combination of secondary riverine forest, *Saccharum* grasslands and plantations. Plantations were established following the earthquake to restore some of the original forest. In providing fresh herbage for elephants after the first rains, this area assumes immediate importance and hence it is necessary to bring these areas under the protected area network. This area is also heavily disturbed due to the presence of 'kbutis' (herds of unproductive cattle). Overgrazing was seen the Digaru area. The Paya and Digaru areas are approximately 300 km<sup>2</sup> in size, and this area supposedly has at least 10-12 *kbutis* (ca. 2500-3000 heads of cattle). Such large number of cattle is bound to put undue pressure on the grassland ecosystem, and should be brought under control. Choudhury (1999) has also cited illegal capture of elephants to be common in this district, but no such instances were observed during this study.

#### Dibang Valley District

The areas in and around Mehao WLS were surveyed. Mehao WLS (281.5 km<sup>2</sup>) lies along an elevational gradient and evergreen forests are found up to 900 m (an area of around 100 km<sup>2</sup>). This area shows medium elephant abundance, and appears to be highly disturbed with a high degree of encroachment (especially in the Koronu and Ippaani areas), where the people are not aware that they are living in the midst of a wildlife sanctuary. Elephants that use the Dibrudeomali elephant corridor sometimes visit this area.

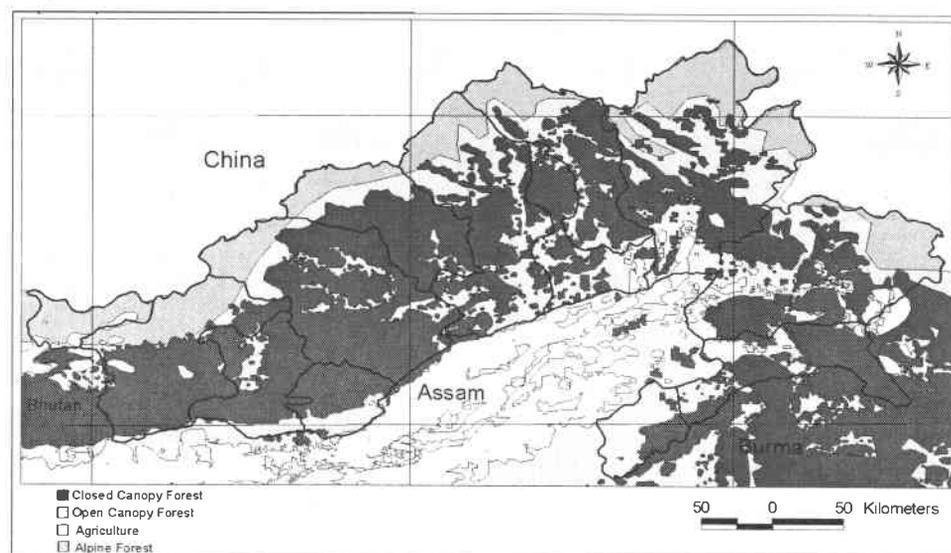
#### Changlang District

Namdapha TR (1985 km<sup>2</sup>) is located on the Myanmar border, and movement of elephants to and from Myanmar cannot be totally ruled out. This area was found to have low elephant abundance. A survey by our team in 1999 also yielded very poor results as far as elephants were concerned. The forest types in Namdapha TR range from semi-evergreen to evergreen on the lower reaches. Evergreen forest habitat has been found to be sub-optima for elephants and this may be the reason for their low abundance.

#### Tirap District

In this district, the Deomali Forest Division (286 km<sup>2</sup>) was surveyed. The Arunachal Pradesh Forest Corporation used this area for timber operations until 1997 and selectively felled patches are recuperating. This is an area of high elephant abundance, with elephant influx from Nagaland in the west, as

Fig. 2 Extent of forest cover in Arunachal Pradesh



well as movement of elephants from neighbouring Joypur RF in Assam. A large number of natural salt licks (*pungs*) were found in the Namsangmukh area. These areas are classified as VFR's and RF's, and must be incorporated into the protected area network, taking into account their value for elephants. Elephants also frequently move from Tinsukhia and Digboi areas (especially around Dibru-Saikhowa NP) to this area and vice-versa

### East Siang District

The D'Ering Memorial WLS was surveyed in this district. The D'Ering WLS (184 km<sup>2</sup>) is composed mainly of *Vetiveria* grasslands and plantations of *Dalbergia* and *Bombax*. It is another area of high elephant abundance and is used seasonally by elephants (before and during the monsoons). The area is also flood prone and is rendered a virtual island during heavy rains and flood. Heavy siltation occurs in the areas affected by flood. Elephants frequently cross over from Jonai and Kobo Chapori in Assam to this area. Cited as an important movement path for elephants (Choudhury, 1999), the Dibru-Deomali elephant corridor includes D'Ering WLS, Jonai and Kobo Chapori areas (Assam), Dibru-Saikhowa NP, Joypur RF and Deomali Forest Division. Consequently, this whole area (ca 4000 km<sup>2</sup>) is under the Dibru-Deomali Elephant Reserve. Presently D'Ering WLS is not protected effectively due to the shortage of manpower and resources. As a result many people from Pasighat and Mebo use it as a hunting ground. Frequent burning of the grassland also occurs.

## Discussion

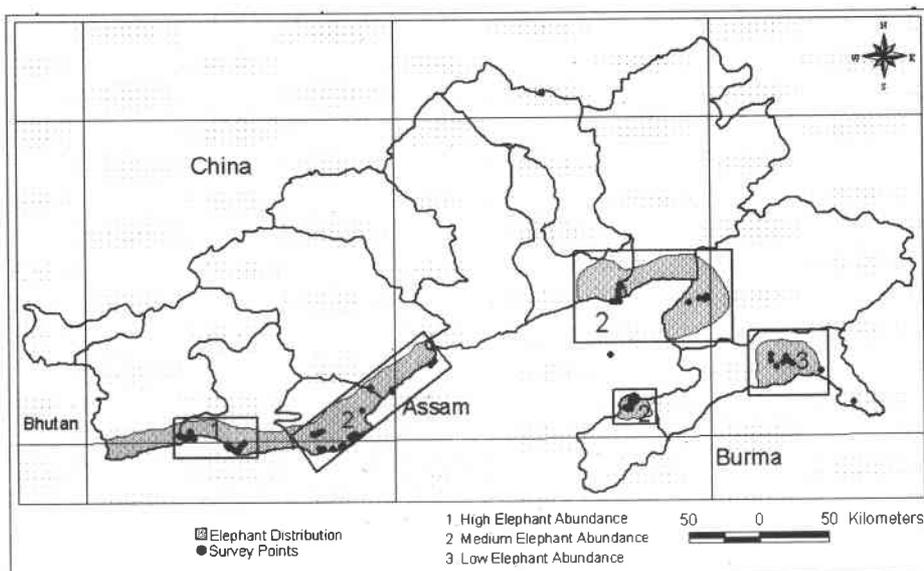
### Habitat patchiness and Elephant-Human Conflict

Most of the areas surveyed, excepting a few, showed very patchy habitat. Mosaics of forest types such as semi-evergreen, degraded *jhoomed* forests, degraded grasslands and degraded riverine forest are interspersed with cultivated lands. During their attempts at maintaining normal ranging pattern, elephants encounter an increased interface between natural vegetation types and cultivation. Elephant-human conflict was a common problem in most of the areas surveyed. The people of Arunachal Pradesh have always been living in close proximity to their forests, but uncontrolled development has already destroyed many prime elephant areas, such as the foothill forests in Papum-Pare district and Lower Subansiri. The problem of elephant-human conflict is compounded by the fact that a large proportion of agriculture in Arunachal Pradesh is subsistence agriculture. Crop depredation affects the subsistence agriculturist very hard, and the existing system is not equipped to deal with this problem. The formulation and implementation of a compensation scheme will greatly help improve relations between the common people and the governmental agencies involved.

### Gaps in the protected area network

Many areas that are important for elephants do not fall under the protected area network. The Deomali area in Tirap district is one such example. An important link in the Dibru-Deomali corridor, this area is presently classified as a VFR. It is not only important to bring some areas under the protected area network, but existing parks and sanctuaries must be well protected as well. The D'Ering Memorial Wildlife Sanctuary is a very important area for elephants as they use the grasslands extensively for feeding. Limitations of manpower and resources make the job of protection difficult, and a solution to the problem lies in finding a cost-effective remedy to ensure

Fig. 3 Distribution of Asian elephants in Arunachal Pradesh based on a questionnaire survey

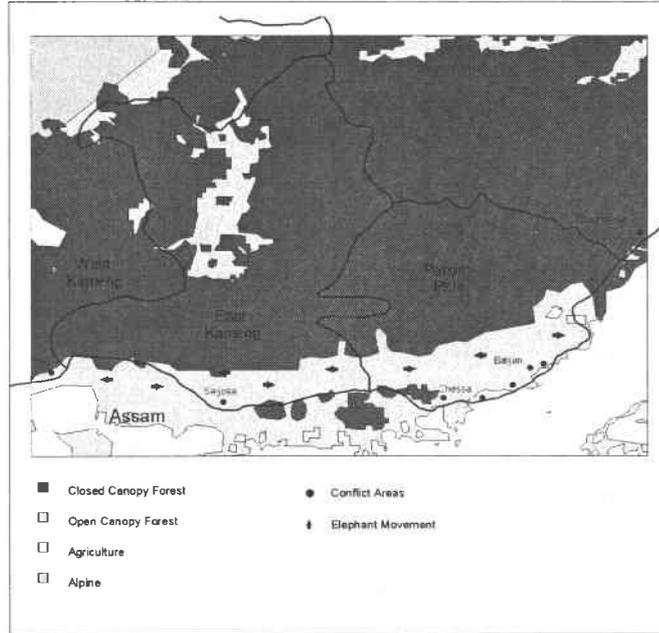


protection by involving the local communities. Since the elephant populations in the northeastern region know no political boundaries, it is necessary to ensure their protection in the neighbouring states of Assam, Meghalaya and Nagaland. Unprecedented levels of deforestation in Assam often cause problems in the areas where cross-border movement of elephants is common, as for example in the Kameng (bordering with the Sonitpur and Balipara forests of Assam) and East Siang-Tirap (bordering with Dibrugarh-Digboi areas) zones. The Forest Department in these states must work out a common strategy for the protection of elephants on a region-wise scale by identifying these key areas.

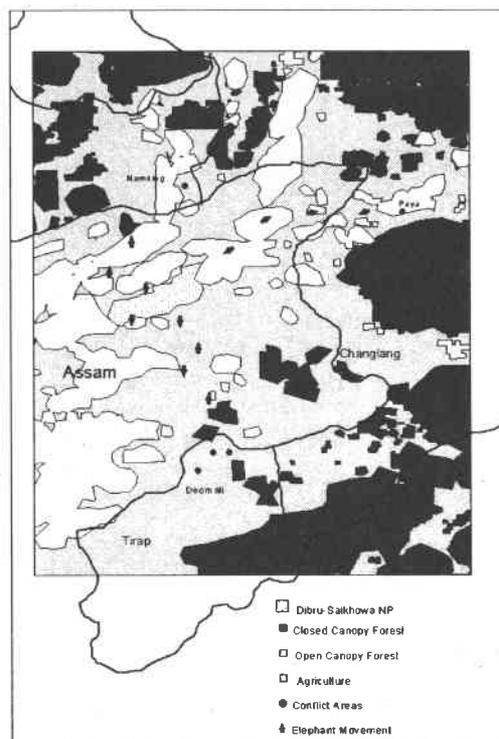
*Preservation of key habitats*

Habitats such as the riverine semi-evergreen forests and grasslands are extremely important for elephants, as they are a ready source of forage, especially following the first rains. These habitats are constantly under threat due to possible conversion to cultivated land. A viable alternative to livestock grazing is stall-feeding and this must be promoted in a large scale in order to reduce the pressure on forest resources. It is very clear that there can be no long-term solution without the combined effort of the Forest Department and the indigenous people of the area.

**Fig. 4** The location of Kameng Sonitpur area in the Arunachal Pradesh and Assam



**Fig. 5** Map of the Dibru-Deomali area of Arunachal Pradesh and Assam



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## References

- Asian Elephant Specialist Group. 1981. *Proceedings of the First meeting of North-East Task Force, Asian Elephant Specialist Group*, IUCN/SSC. 64 pp.
- Anonymous. 1994. *The Wildlife (Protection) Act 1972*. (2<sup>nd</sup> Edition). Natraj Publishers, Dehra Dun, India.
- Choudhury, A. 1999. Status and conservation of the Asian Elephant *Elephas maximus* in north- eastern India. *Mammal Review* 29: 141-173.
- Lahiri-Choudhury, D. K. 1980. *An interim report on the status and distribution of elephants in northeast India*. IUCN-SSC Report. 16 pp.
- Lahiri-Choudhury, D. K., Dey, B., Sar, C., & Mukherjee, A. 1984. *Summarised report on Elephant Habitat Survey in Arunachal Pradesh*. IUCN/WWF Report. 21 pp.
- Lahiri-Choudhury, D. K. 1985. *Distribution, population estimate, and status of elephant in North-East India*. IUCN-SSC Report. 10 pp.
- Ministry of Environment and Forests, Government of India. 1992. *National Elephant Conservation Action Plan- Executive Summary*. 22 pp.
- Rodgers, W.A. & Panwar, H.S. 1988. *Planning a wildlife protected area network in India*. 2 vols. Project FO: IND/82/003. FAO, Dehra Dun.
- Sukumar, R. 1989. *The Asian Elephant: Ecology and Management*. Cambridge University Press, Cambridge.



A bull in musth. (photo: courtesy Dr. H.I.E. Katugaha)