1. INTRODUCTION

Our country is blessed with a wealth of wildlife, varieties of forests and diverse habitats. Presently wildlife of India comprises of about 372 species of mammals, 1228 species of birds in nearly 2100 forms and more than 20,000 species of insects and a large number of other animals (Saharia, 1998). It is a 'Megadiversity' country with atleast to 'Hot-Spots' containing a large number of endemic forms. However, we must also realize that along with this grace we also inherit a huge responsibility to conserve, utilize and pass on this treasure to generations to come. The task is far from simple with a democratic-secular form of Government against the growing demands of about 1.1 billion people and 600 million farm animals. Besides, a large number of people belonging to 'Below Poverty Line' and varies ethnic communities often depend to a large extent on the living natural resources of the country for their subsistence. To meet the demands of growing population; wildlife and forest areas of the country are decreasing every year. Per capita forest area in our country is less than 0.12 hectare while the world average ins 1.0 hectare.

We have an antique tradition to maintain a peaceful, respectable association with the environment. Our 'Vedas', 'Brahmans', 'Aranyakas' and 'Puranas' tought us to live peacefully with nature. Emperor Ashoka (B.C. 269-227) scripted the first laws of the world to protect fish, game and forest in his 'Fifth Pillar Edict'. Lord Buddha, Emperor Ashoka and Mahatma Gandhi of our country preached 'Non-violence'. We have a lot of religious doctrines and taboos to be kind and conserve all living beings including plants. But the present human population pressure in most developing countries particularly in our own has reached such an acute level that any leniency to the cause of wildlife and forests may tantamount to defeat in the struggle for survival in the Darwinean sense, - and there can never be any compromise on the issue of survival. Despite having such divine preachings and ancient tradition of peaceful, attruistic co-existence with nature people in various corners of our country at present do not hesitate to fight

adversaries, - a monkey or a tiger or any other. Thus, ensues the phenomenon of 'Man-Animal Conflict', - a phrase of common usage in many parts of the world.

Linnaeus (1758) named the group of animals to which we ourselves belong as primates. The primates in general inhabit a variety of habitat types from tropical wet evergreen forest to moist dry temperature forest. As such reduction of forest areas due to developmental activities affect their population. Today, there are fewer types of primates than there were in the past. The extant primates are a large and diversified group of mammals encompassing more than 50 genera in which atleast 200 species are well defined. Many modern primate genera are at present restricted in distribution as well as number in comparison to the past. In general, the more arboreal the species the greater is the tendency for it to be restricted in geographical distribution.

Field study in a natural environment provides the full range of behavioural patterns in most species. Field studies are essential to sort out problems of : relationships of behavioural patterns to population pressures, to the ecological or climatic changes, to the presence of predators or to the formation of a social group. It also helps to determine the social structure and group dynamics. C. R. Carpenter actually pioneered primate field studies in middle and South America and in East India during the 1930's and published a series of excellent monographs. After independence the leaders of our country framed policies for all round development within a schedule period particularly in agriculture and industry. Consequently massive dams, numerous irrigation canals, National Highways and giant industrial complexes started coming up one after another. At the same time due to improved medical facilities, health and sanitary conditions human population experienced on unprecedented explosive growth rate. Naturally more and more forest areas were taken up under cultivation to materialize the 'Grow more food' campaign. The results were disastrous in general on the forests, the biological support system and on the wildlife in particular.

The reasons for studying primate ecology and behaviour are varied. Apart from the obvious values of primates in biomedical research, primates studies have yielded new perspectives in problems of group dynamics, beavioural ecology and evolutionary history of man (Altmann, 1962; Bernstein, 1968; Carpenter, 1934; Lindburgh, 1969; Southwick, 1967 and many others). Recently, economic or rather socio-economic impact of primate populations are more and more coming under scientific investigations mainly from two separate and diagonally opposite considerations i.e. economic gain through wildlife tourism involving monkeys and great apes and economic loss due to crop destruction and other forms of damage caused by monkeys and apes. The later forms of loss is on the increase in most developing countries with high human population necessitating conversion of wildlife habitats to agricultural fields, industrial areas, urbanization and various other developmental requirements. This situation engenders the problem of man-animal conflict which assumes critical dimension in many parts of our country.

The proposed research programme belongs to an investigation of the later category in that it attempts to determine :

1. Different habitats of rhesus including mango orchard, crop field, grassland, roadside and human households.

2. Population studies of rhesus macaques at the study area. This involved population estimate, population dynamics, home range, birth season, sex ratio, population composition, natality, mortality, population increase and population density.

3. Feeding behaviour includes identification of food species, plant parts estimation, food selection ratio, feeding mode of rhesus, food species analysis, diet and seasonal variation, total food intake and drinks.

4. General activity pattern of rhesus includes several diurnal activities, resting sites and utilization of different areas of tree.

5. Social organization consists group types, group size, group composition, sub-grouping activities and interaction with other species.

6. Mango production and employment of people in this trade includes climate and soil factors in mango cultivation of Malda district, cultivated land and nature of production, variety of mangoes, nature and number of mango orchard, involvement of people in mango trade, events promoting mango cultivation and production, mango as medicine, problems and remedies associated with mango cultivation and trade.

7. Interactions between rhesus and humans in Malda district involved incidence of monkey population in different blocks, crop raiding by monkeys, damage induced by monkeys in mango production, subsistence of monkeys in the non-mango season, direct competition and overt attacks on humans by monkeys, assult on humans by the rhesus under various situations, diseases transmitted to human by rhesus, commensal and altruistic association between rhesus and man.

1.1. Importance of rhesus in scientific research

Rhesus monkeys occupy an unique position among non-human primates because of various reasons. They naturally occur in the forests, rural regions and even in urban areas. Macaques are the only group of old world monkeys (Family : Cercopithecidae) that occur in Asia as well as in Africa. Seven species of macaques occur in India of which *Macaca mulatta* or rhesus macaque is the most important species not only because of its wider range of distribution and dominance in number but also because of its importance in biomedical research. This animal is used extensively in the production of vaccines and in other laboratory research. It may be mentioned here that previously large number of juveniles of this species were exported to western countries mainly for use as test animals in Medical Research (Southwick, Beg and Siddiqi, 1970). Its importance in biomedical research is due to the fact that its disease spectrum is very similar to that of human beings. Thus detailed study of this species both in wild state and in

captivity is of more than ordinary interest and it is not surprising that *Macaca mulatta* received more attention than any other non-human primates from scientific community.

It is also one of the most attractive species among the macaques. It lives in wide variety of habitats, including cities, villages, farms, forests and even mountains upto 2600 meters (Southwick, Ghosh and Lauch, 1964; Neville, 1968b). Rhesus macaques can easily be tamed & taught various tricks, especially when young, but is never fully domesticated. In India, a small human community make their living by showing various tricks performed by their pet trained monkeys. This species is also popular as pets in many parts of our country.

1.2. Systematic Position

According to J. Z. Young (1962) the systematic position of rhesus macaques is as follows :

Phylum – Chordata
Sub-phylum – Vertebrata
Super-Class – Gnathostomata
Class – Mammalia
Sub-Class – Theria
Infra-Class – Eutheria (Placentalia)
Order – Primate
Sub-Order – Anthropoidea
Super-Family – Cercopithecoidea
Family – Cercopithecidae
Genus – *Macaca*
Species – *mulatta*

1.3. Close relatives

The genus *Macaca* include several species other than *mulatta* which are shown in Table.1.1. with their present distribution.

The animal has four sub-species recognized by Ellerman and Morisson – Scot (1951), Napier and Napier (1967), all found in South Asia (Table.1.2.). Fodden (1964) stated that *Macaca fascicularis* is a sub-species of *Macaca mulatta.* Hill (1972), however, has shown that *Macaca fascicularis* is an independent species.

1.4. Phylogenetic Consideration

It is difficult to pinpoint the time of origin of primates, however, most authorities believe that the group originated in the early Cenozoic although most of their evolutionary development was confined to Oligocene and subsequent ages (Simpson, 1945). It seems highly probable that tree-shrews of early Cenozoic time were at once the descendants of true insectivores and the ancestors of higher primates. The Eocene prosimian forms resembled monkeys in dentition and skull structure. At any rate it is clear that Cenozoic prosimians were the ancestors of higher primates. The earliest members of the family cercopithecidae arose and evolved from Eocene prosimians during Oligocene epoch (60 million years). The earliest members of old world monkeys and apes may have originated from the ancestral stock, 'Parapithecus', found in Egypt during Oligocene period (Gregory, 1916 and Colbert, 1969). The evolutionary history of macaque was recorded in the middle Pleistocene epoch (about 1 million to 2,50,000 years ago), but outside the Asian mainland. The distribution pattern of macaque confirms with a pattern of evolution away from the Asian mainland (Centered on Burma & Thailand), rather than one having several foci on the 'Sundashelf' (Medway, 1970). *Macaca fascicularis,* a kin of the species *mulatta*, however, has represented the earliest stage of macaque evolution from the middle Pleistocene.

1.5. Present distribution

The family cercopithecidae comprises of the old world monkeys in Africa and Asia and is divided into thirteen genera, of which *Macaca* alone is common to both regions. Of the remaining twelve six are African (*Cercocebus, Cercopithecus, Colobus, Erythrocebus, Papio* [including *Mandrillus*] and *Theropithecus*) and six are Asian (*Cynopithecus, Nasalis, Presbytis, Pygathrix, Rhinopithecus* and *Simias*). Only three genera are in South Asia : *Macaca, Presbytis* and *Rhinopithecus*. Of some 200 known species of recent primates 25 are in South Africa.

The genus *Macaca* is found in North Africa and South and South-east Asia from eastern Afghanistan through Tibet to China, Japan and Formosa; South to India and Ceylon, Philippines and several neighbouring islands. It is found at altitudes upto 3,140 metre in the Himalayas. The distribution pattern of *Macaca mulatta* is extensive : from south-east Afghanistan to the South Godavari river in India to Burma (Fry, 1928) and in small pockets of Laos, Cambodia, Vietnam, Tibet and China.

Present distribution of rhesus monkey in India and neighbouring countries is shown in Figure.1.1. In several areas of Northern India its distribution is curiously discontinuous (Krishnan, 1972). Annekov, Mirvis and Kotrikadze (1972) suggested that there are two groups of populations, a Chinese-Vietnamese and an Indian. Figure.1.2 also shows sites of recent investigations on rhesus in India. At present several wild groups (Pal, Bhattacharjee and Guin, 1982; Kali, 2002) are known to exist in protected forest reserves of North Bengal (Table.1.3.).

1.6. Objectives of the present study

The general objectives of this research work was to study the ecology and behaviour of rhesus monkeys in different blocks of Malda district in the mango and non-mango season. Special emphasis was given to how the ecologic and behavioural aspects of rhesus monkeys affect mango production and subsequently

influence economic well being of local populace. The specific objectives of the study were to determine :

A. MONKEY : Populations and group size, behaviour profile, food habits and interaction with man in the mango and non-mango season.

B. MANGO : Area under mango cultivation, amount of production in weight and price, production per year in monkey infested and non-monkey infested areas, nature and quantum of damage at different phases of mango season.

C. MAN : Number of people involved in the transaction of mango-producing land, gardens, mango cultivation, security of mango orchards, transportation of mango, basket making, mango processing, research on horticultural aspects and various other involvements in mango production. Damage caused by monkeys to properties, crops, fruits and vegetables other than mango and direct physical attacks on man inflicting serious injuries were also studied.

Table.1.1. Present distribution of species under the genus *Macaca.*

	Name of the Species	Local Names	*F/D	Distribution	Authority
1.	*M. arctoides* I. Geoffroy, 1831.	Stumptail Macaque	F/D	China, India, Burma, Laos, Thailand, Cambodia, Vietnam, Malay; Sea-level upto 2400 m* altitude.	Medway (1969, 1970), Southwick and Siddiqi (1970).
2.	*M. assamensis* McClelland, 1840.	Assamese Macaque	F	India, Nepal, Bhutan, Burma, Thailand, Laos, Cambodia, Vietnam, Yunnam, 610-1330m. altitude.	Roonwal (1950); Napier & Napier (1967); Hill & Bernstein (1969); Khajuria & Ghose (1970); Fodden (1971).
3.	*M. fascicularis* Raffles, 1821.	Long-tail Macaque	F/D	India, Burma, Malay, Thailand, Vietnam, Indonesia and Phillipines, upto 2000m altitude.	Furuya (1962, 1965); Medway (1969, 1970); Fodden (1971); Southwick and Cadigan (1972).
4.	*M. nemestrina* Linnaeus, 1766.	Pig-tail Macaque	F/D	India, Malay, Indonesia, upto 900m. altitude.	Fodden (1969); Medway (1970).
5.	*M. radiata* E. Geoffroy, 1812.	Bonnet Macaque	F/D	India, upto 2100m. altitude.	McCann (1933); Simonds (1965); Krishnan (1972).
6.	*M. Silenus* Linnaeus, 1758.	Lion-tail Macaque	F	Peninsular, India, upto 610 to 1300m. altitude.	Sugiyama (1968); Southwick and Siddiqi (1970); Krishnan (1972).
7.	*M. sinica* Linnaeus, 1717.	Toque Macaque	F	Ceylon.	Phillips (1935); Pocock (1939); Napier & Napier (1967).

* F = Forest, D = Domestic, m = Metre.

Table.1.2. Present distribution of four sub-species of *M. mulatta.*

Serial No.	Name of the Species	Distribution	Authority
1.	*M. m. memohani*	North-Eastern Afghanistan and Pakistan, about 1,100m.* of altitude.	Pocock, 1932.
2.	*M. m. mulatta*	Nepal, Bhutan, India, Thailand, Laos, Cambodia, Vietnam and Southern China.	Zimmermann, 1780.
3.	*M. m. vestita*	Tibet.	Milne-Edwards, 1876.
4.	*M. m. villosa*	Northern India (Southern Kashmir, Upper Punjab and Kumayun Hills).	True, 1894.

* m = Metre.

Table.1.3. Forest reserves in North Bengal with sizable rhesus monkey populations at present.

Province		Forest Reserve	Altitude (m*)	Authority
West Bengal	1.	Senchal Wildlife Sanctuary, 1915.	1500-2600	Southwick, Ghosh and Louch (1964), Louch (1964), Kali (2001).
	2.	Jorepokhri Wildlife Sanctuary, 1985.	-	Southwick, Ghosh and Louch (1964), Kali (2001).
	3.	Mahananda Wildlife Sanctuary, 1949.	150-1200	Southwick, Ghosh and Louch (1964), Neville (1968), Kali (2001).
	4.	Gorumara national Park, 1995.	Above 120	Neville (1968), Pal and Guin (1981), Kali (2001).
	5.	Chapramari Wildlife Sanctuary, 1940.	Above 100	Neville (1968), Pal and Guin (1981), Kali (2001).
	6.	Jaldapara Wildlife Sancturary, 1941.	Above 150	Neville (1968), Pal and Bhattacharjee (1980), Kali (2001).
	7.	Buxa Reserve (Tiger), 1982-1983.	150-1500	Neville (1968), Kali (2001).

* m = Metre.

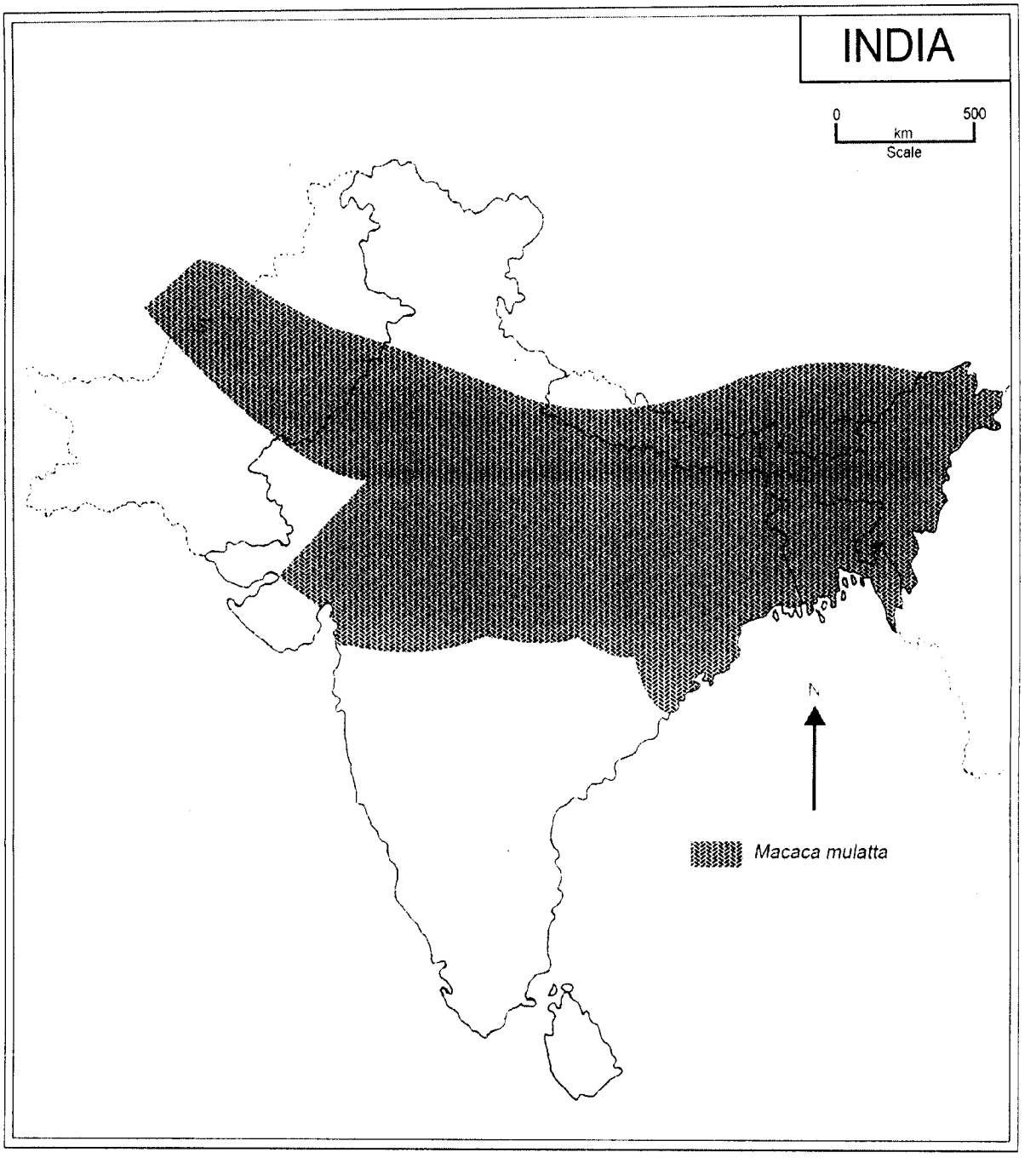

Figure. 1.1. Approximate geographical distribution of *Macaca mulatta.*

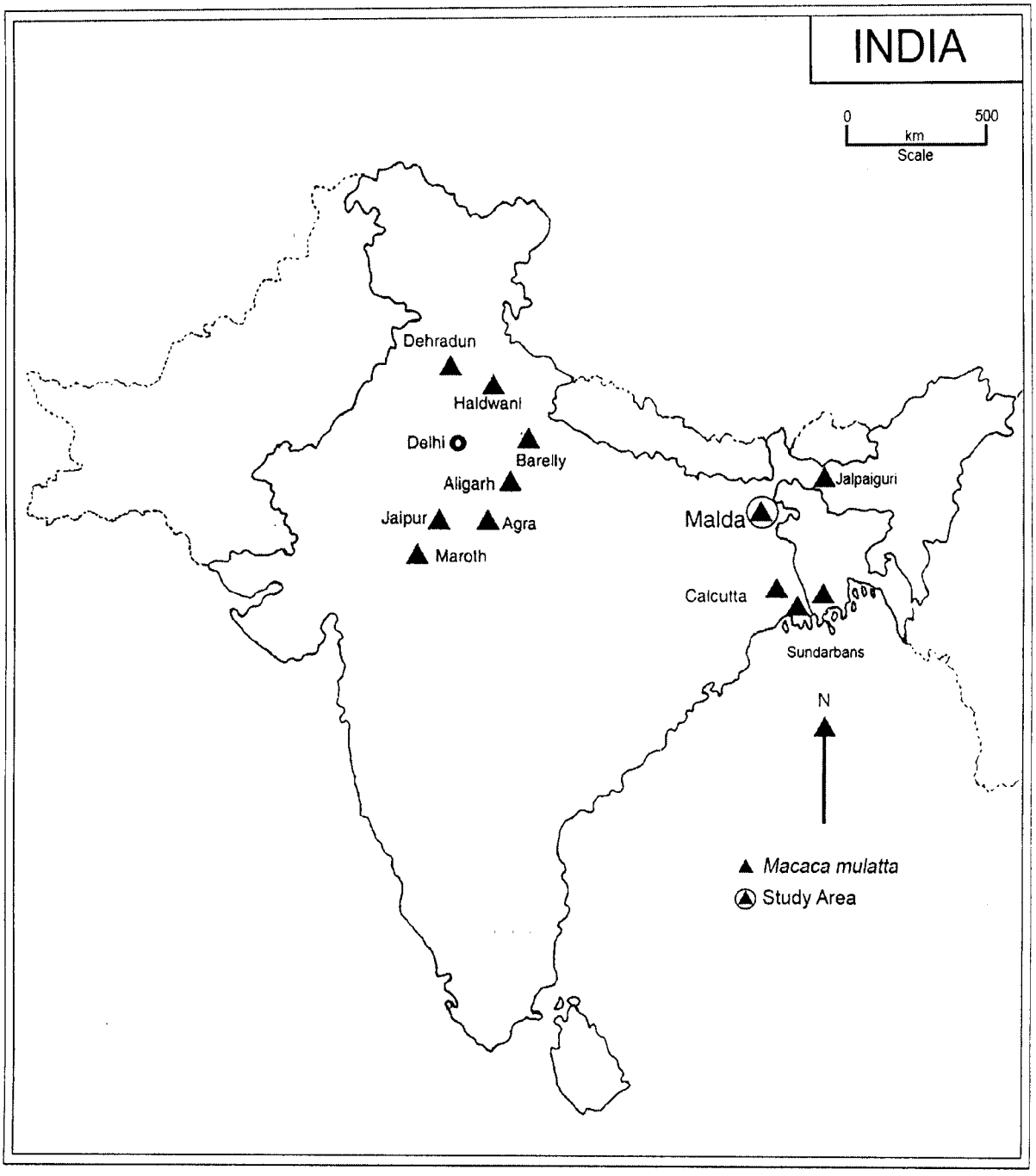

Figure.1.2. Sites of recent feild observations on rhesus monkey in India.