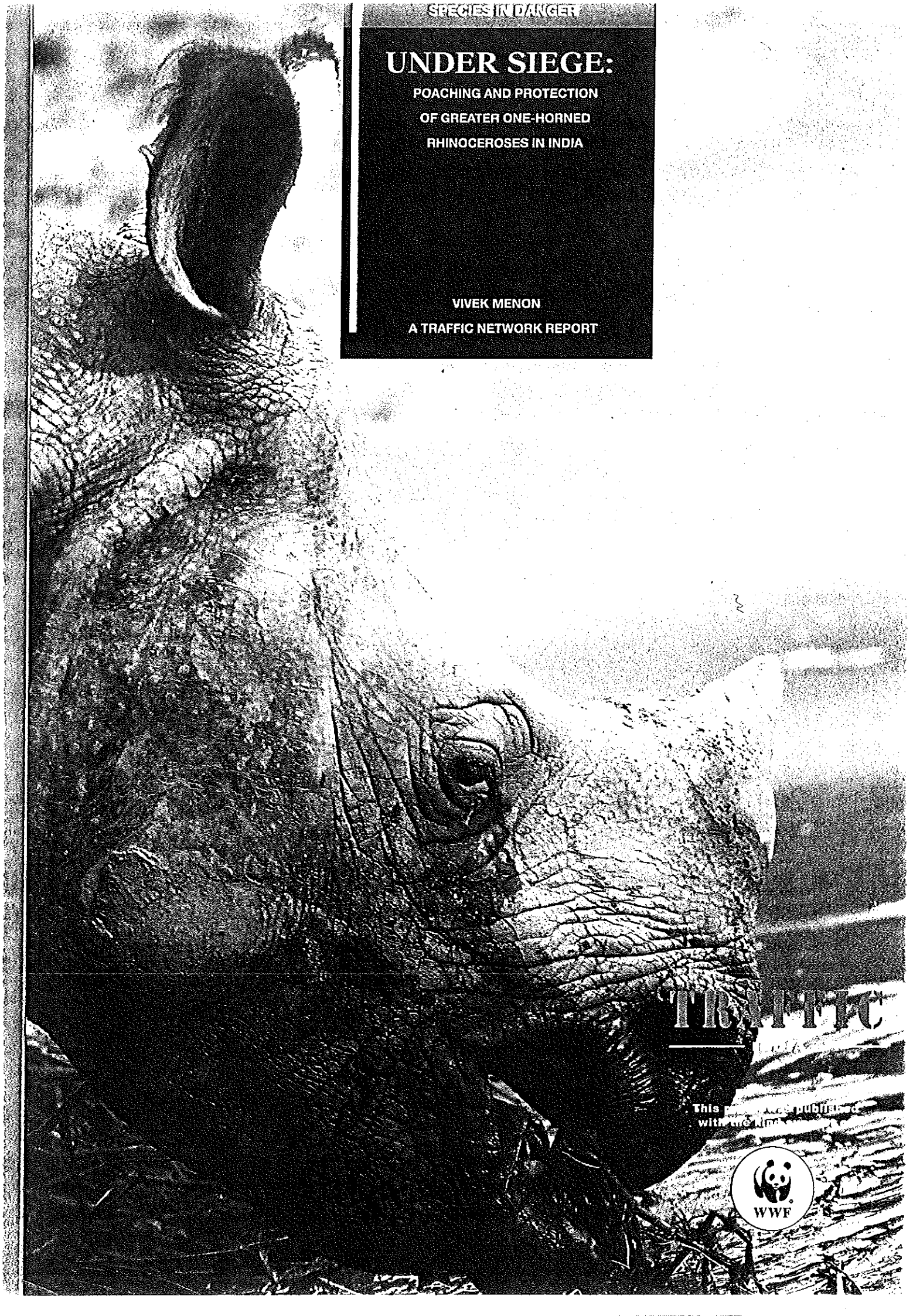
SPECIES IN DANGER

UNDER SIEGE:

POACHING AND PROTECTION OF GREATER ONE-HORNED RHINOCEROSES IN INDIA

VIVEK MENON

A TRAFFIC NETWORK REPORT



TRAFFIC

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WWF

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Rhinoceros skull from an animal killed duing the 1983 massacre at Laokhawa Wildlife Sanctuary range headquarters.

This is a report of TRAFFIC India, which is a division of WWF India and also forms part of the worldwide TRAFFIC Network.

CONTENTS

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INTRODUCTION

The Greater One-horned Rhinoceros *Rhinoceros unicornis* is perhaps the most endangered species of Indian megafauna. The number of animals in the wild is less than half that of Tigers, and one tenth the number of elephants, in India. In 1989, the IUCN/SSC Asian Rhino Specialist Group (AsRSG) proclaimed only three of the seven remaining refuges for Greater One-horned Rhinoceroses in India (Kaziranga and Manas National Parks and Orang Wildlife Sanctuary[1] in Assam) to have a viable population of the species (Khan, 1989). Since then, Manas National Park has lost most of the 100 rhinoceroses it held, victim to a spell of poaching. Today, perhaps only two sites remain with viable populations of Greater One-horned Rhinoceroses in India, with Chitwan National Park in Nepal providing a third such site. All these sites are extremely vulnerable to poaching and a sudden increase in rhinoceros poaching in the early 1990s has been a cause of grave concern. Between 1989 and 1993 official figures record India as having lost 266 rhinoceroses to poaching, which, over the four years, amounted to more than 15% of the country's total population of the species. Unofficially, it is insisted that the toll is higher. Thus, only Kaziranga now seems to have a large enough population (1200 rhinoceroses) to withstand further intensive poaching in the short term. Orang Wildlife Sanctuary with 90 rhinoceroses, Pobitara Wildlife Sanctuary with 68, Jaldapara Wildlife Sanctuary with 35, and Gorumara National Park with 18, could all lose their populations of the species in a matter of months, if determined poaching were to affect these areas.

Several disturbing trends in poaching and trade have emerged. Poachers are displaying more ingenuity, using novel methods, such as electrocution. With the influx of arms into Assam since the early 1980s, because of political unrest in the region, killing a rhinoceros has become easier for poachers. Guards armed with bolt action .315mm bore rifles often come across poachers armed with semi-automatic weapons and other modern arms. The spurt in rhinoceros poaching has a definite connection to the upswing in political unrest, which at one level results in merely oppurtunistic killing of rhinoceroses, when law and order breaks down, but at another in the altogether more purposeful process of procuring rhinoceros horns to finance extremist activities. Rhinoceros horns have begun to fetch as much as Rs300 000 (US$9260) (see Appendix 3), earning a local agent 50 times more than the annual per capita income of India, thus making poaching a very lucrative activity.

The traditional trade routes via Calcutta and Myanmar are being forsaken for new routes through Bhutan, Nepal and more recently through Bangladesh, and the reported involvement of high ranking nationals of some of these countries in the trade makes the issue even more complicated, and more threatening, for the rhinoceros conservationists. There is continued evidence of the horn reaching the Far Eastern markets of Taiwan, South Korea, Japan, etc. These are destined for the traditional Chinese medicine trade in these countries.

The demand for rhinoceros horn in the Asian traditional medicine market is perhaps the single largest factor affecting the decline in the animal's numbers. With a seemingly never-ending demand for the keratinous horn in the Orient, the Greater One-horned Rhinoceros is facing the biggest threat ever to its existence. This is despite notable efforts made by several East Asian countries to curtail the trade by imposing stiff penalties. This is a testament to the fact that rhinoceros horn, more than other animal-derived medicine, such as Tiger *Panthera tigris* bone, is considered a life-saving traditional Chinese medicine (Mills, *in litt.*, 1996).

BACKGROUND

History of rhinoceroses in India

The Greater One-horned Rhinoceros is one of five remaining species of rhinoceros of an approximately 30 genera that once roamed the world (Nowak and Paradiso, 1983). Rhinoceroses first appeared in the late Eocene period. The oldest Indian rhinoceros-like species was *Brontops robustus*, but the genus *Rhinoceros* may be

traced back to the Pliocene period in northern India, and fossilised remains show that these animals were dwellers of riversides and marshes (see Table 1). Although the reluctant breeding habits and fixed behavioural traits of rhinoceroses may today appear to make them weak candidates for survival in the face of extinction, the fact that they have persisted for 60 million years in a remarkably unchanged fashion testifies to their stalwartness. Yet, humankind has now brought rhinoceros species to the point of annihilation.

Table 1

Fossil remains of Greater One-horned Rhinoceroses

Country	Site	Era	Reported by
India	Ganganagar, Rajasthan	3500-400BC	Banerjee and Chakravorty (1973)
India	Langhnaj, Gujarat	Pre-Pottery phase	Zuener (1952), Clutton-Brock (1965)
India	Lake Kaneval, Gujarat	8000-1200BC	Momin *et al.*, (1973)
India	Siwalik Hills	Miocene-Lower Pleistocene	Baker and Durand (1836), Falconer and Cautley (1847), Falconer (1868), Lydekkar (1876)
India	Mirzapur, Uttar Pradesh	Not known	Cockburn (1883)
India	Banda, Uttar Pradesh	Not known	Cockburn (1883)
India	Chirand, Bihar	c.1700BC	Nath (1976)
India	Madras, Tamil Nadu	Not known	Lydekkar (1880)
India	Gokak, Belgaum, Karnataka	Not known	Foote (1874)
Pakistan	Harappa	2500-1500BC	Prashad (1936)
Pakistan	Mohenjo Daro	c.3000BC	Marshall (1931)

In India, the rhinoceros has an old and tradition-linked history. The representation of the rhinoceros iconographically or its mention in written accounts has been reviewed by a number of authors including Yule and Burnell (1903), Ali (1927), Ettinghausen (1950), Rao (1957) and Rookmaaker (1982). Although most of these quote sixteenth and seventeenth century accounts by mediaeval authors and other second-hand information, the accounts by Al Beruni and Ibn Batuta, two historians and scholars of the same period, are among the more authentic and detailed ones.

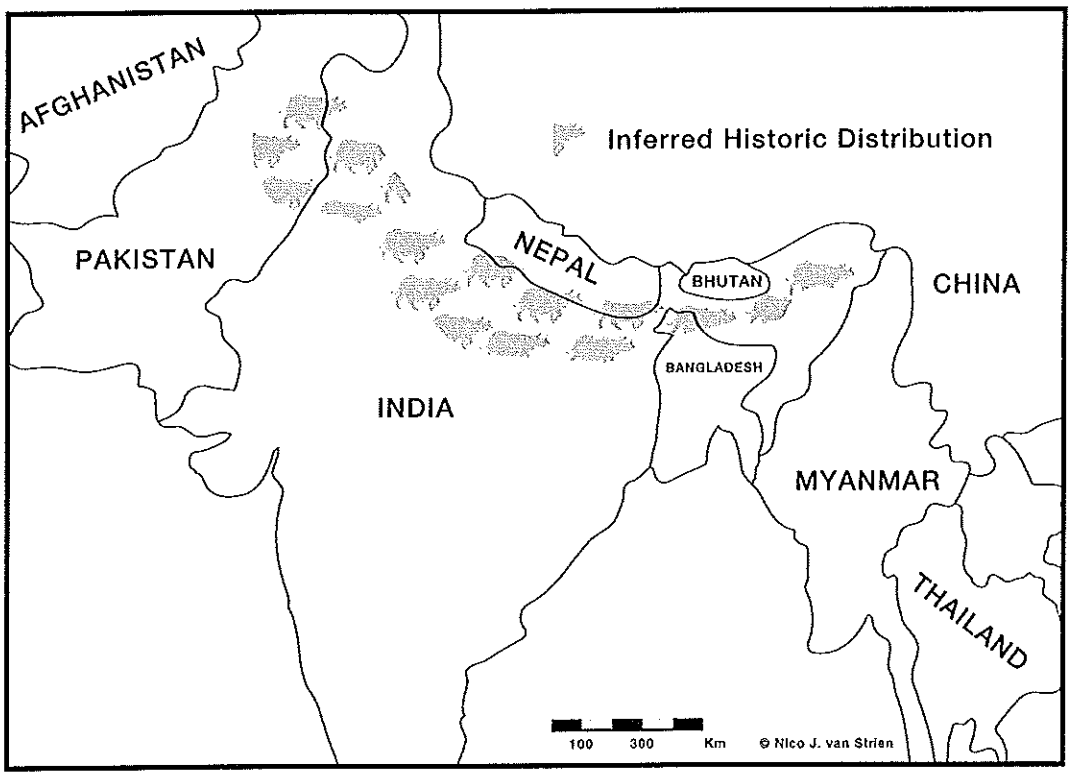
Al Beruni (*circa* 1030 AD) wrote of the animal which existed "in large numbers in India, more particularly about the Ganges". Ibn Batuta, an Arab traveller, saw rhinoceroses near the Indus river in 1340 AD. Babur, the first Mughal emperor of India (1505-1530 AD), hunted rhinoceroses west of the Indus River, which he records as being called *Karg-khana* or "rhinoceros-home", in such great numbers were the animals found there. He also records the existence of rhinoceroses near Peshawar (now in Pakistan) and, in fact, uses the word "masses", to describe the quantity in which they were found. However, a few years later, in March 1529, no rhinoceros was found near Benaras by Babur, when he went there for a hunt. Sidi Ali, a Turkish admiral of Suleiman the Great, saw rhinoceroses in northern Pakistan, in 1556, near the city of Peshawar and records them as having a horn of two hands' length (Yule and Burnell, 1903). Akbar, the third Mughal emperor of India (1542-1605), records the existence of rhinoceroses near Sambhal in Uttar Pradesh (Jarratt, 1949). Another Mughal emperor, Jahangir, records them in his memoirs as inhabiting Aligarh.

A large number of miniature paintings and other representations depicting "naturalistic" rhinoceroses were made in India between 1500 and 1650 and are characterised by the famous miniature painting of *circa* 1600, showing Emperor Jahangir hunting rhinoceroses. Although these animals are easily recognisable as Greater

One-horned Rhinoceroses, all three Asian rhinoceroses once inhabited the Indian subcontinent. The Javan and Sumatran Rhinoceroses *Rhinoceros sondaicus* and *Dicerorhinus sumatrensis* became extinct in India in the early part of this century and the Greater One-horned Rhinoceros is therefore now the only rhinoceros species left in the wild in the country. While the Javan Rhinoceros was the first to be extirpated, perhaps as far back as 1900, the Sumatran Rhinoceros is believed to have survived till 1935 (Baidya, 1982). Both these rhinoceros species had an easterly distribution in India, the Javan Rhinoceros being known from Bangladesh to Assam and Sikkim in the far north-east of India. The Sumatran Rhinoceros is reported to have existed in Assam also, and areas bordering Burma (Rookmaaker, 1982). The Greater One-horned Rhinoceros, in comparison, ranged from as far west as Pakistan, to the very north-eastern tip of India (see Figure Background). Past evidence shows that the species existed from Pakistan to the Indian border with the countries of Myanmar, Nepal and Bhutan, and may have also existed in southern China, Myanmar itself, and even further east (Khan, 1989). The identification of all these western range rhinoceroses as Greater One-horned Rhinoceroses is the result of research by Guérin (1980) and later Rookmaaker (1982), but the species disappeared from most of northern India during the seventeenth and eighteenth centuries, as a result of the combined pressures of habitat loss and hunting: few records of the Greater One-horned Rhinoceros in northern India from the nineteenth century exist.

Figure Background

Map showing former range of the Greater One-horned Rhinoceros in India



Source: Khan *et al.*, in prep.; AsRSG

The Greater One-horned Rhinoceros species

The Greater One-horned Rhinoceros, variously called the Indian Rhinoceros, the Great Indian Rhinoceros, or the Indian/Nepali Rhinoceros is much larger than the other Asian rhinoceros species. It can be clearly distinguished by its large head, highly developed neck skin folds and only two skin folds around its body, distinct from other rhinoceros species in these ways. Both males and females have a single, well-developed nasal horn. In India, the species is a grassland and swamp animal with all historical records pointing to its previous existence in well-watered or swampy areas. This is in contrast with the African species, which are usually residents of open savanna. Today, the Greater One-horned Rhinoceros has shrunk from its Indo-Gangetic (usually referring to the flood plains of the Indus and Ganges Rivers) distribution to be limited to a few select pockets in eastern India and Nepal.

The Greater One-horned Rhinoceros is one of three species of rhinoceroses found in Asia. Fewer than 2000 individuals of this species are distributed in seven protected areas in India and two in Nepal. In India, about 1500 Greater One-horned Rhinoceroses survive in under 1300km^2 of fragmented habitat. There is no viable population of the species outside these protected areas. Although numbering less than half the total of wild White Rhinoceroses *Ceratotherium simum* (n=>7500) in the world and being fewer in number in the wild than even the critically endangered Black Rhinoceros *Diceros bicornis* (n=2400) of Africa, this species is generally considered to be relatively secure. Partly, this is owing to the fact that the other two species of Asian rhinoceroses have a much smaller population in the wild, still, and are therefore more threatened (there are fewer than 100 Javan Rhinoceroses and no more than 300 Sumatran Rhinoceroses in the wild). Similarly, there are 134 Greater One-horned Rhinoceroses in captivity, as compared to 21 Sumatran Rhinoceroses and no Javan Rhinoceroses. (For comparison, there are about 650 White Rhinoceroses in captivity and 210 of the less numerous Black Rhinoceros in captivity, worldwide (T. Foose, pers. comm., 1996.)) Further, the Greater One-horned Rhinoceros is known to have climbed from precipitously low numbers to a position of relative stability, for example, from fewer than a dozen animals in Kaziranga in 1908 (Laurie, 1978), to over one thousand by 1984. Thus, the immense threat that still confronts this rhinoceros species is often underrated.

Ecology and biology of the Greater One-horned Rhinoceros

The Greater One-horned Rhinoceros is a denizen of the open and marshy habitats of the Terai (a belt of marshy jungle between Himalayan foothills and plains) and the Brahmaputra basin (Khan, 1989), and its ecology and biology largely stem from the unique habitat in which it lives. The rhinoceroses are also said to have a special role in the maintenance of the Terai ecosystem, where much of the grassland flora have evolved alongside these animals. Many authors have recorded the chronic herbivory of these "mega herbivores" (mammals greater than 1000kg) and the selective force they exert on certain Asian plants (Dinerstein, 1992). Inversely, the Greater One-horned Rhinoceros benefits in a particular way from the annual flooding of the Brahmaputra River, which is well known for its bank erosion and formation of islands, or *chaporis*, which are rapidly colonised by grass. Later stages of colonization, where grassland is slowly converting to woodland, and includes a mixture of grass species, such as those of the genera *Saccharum, Arundo* and *Phragmites*, provide an optimum habitat for rhinoceros evolution and ecology.

In evolutionary terms, the Greater One-horned Rhinoceros is more closely related to the Javan Rhinoceros, the other one-horned rhinoceros species extant, than to the Sumatran Rhinoceros. The Greater One-horned Rhinoceros, however, is a much larger animal than the Javan Rhinoceros, adult males of the former species measuring about 1.7-1.85m (Owen-Smith, 1988) high at the shoulder and weighing between 1600 to 2100kg (Lang, 1967; T. Foose, pers. comm., 1996) (see Table 2). It is important to bear the biological and ecological differences between rhinoceros species in mind when assessing poaching patterns and counter measures: salient

Table 2

Physical statistics of extant rhinoceros species

Species	Height at the shoulder	Weight	Horn height (average)	Horn weight
Greater One-horned Rhinoceros *Rhinoceros unicornis*	1.7-1.85m (Owen-Smith, 1988)	1600-2100kg (Lang, 1967; T. Foose, pers. comm., 1996)	20cm average (Ghosh, 1993), can reach upto 52 cm (Nowak, 1991)	0.72kg (Martin, 1983)
Black Rhinoceros *Diceros bicornis*	1.40 - 1.65m (Nowak, 1991; Owen-Smith, 1988)	800 - 1400kg (Nowak, 1991)	50cm average (Nowak, 1991), can reach 135cm (Ward, 1935)	2.8kg (Leader-Williams, 1992)
White Rhinoceros *Ceratotherium simum*	1.70 -1.85m (Nowak, 1991; Owen-Smith, 1988)	1600-2300kg (Owen-Smith, 1988)	60cm average, can reach 150cm (Nowak, 1991)	4.0kg (Leader-Williams, 1992)
Javan Rhinoceros *Rhinoceros sondaicus*	1.60-1.75 m (Nowak, 1991)	1300-1500kg (McNeely, 1977; Owen-Smith, 1988)	15cm average, can reach 25cm (Nowak, 1991)	0.68kg (Leader-Williams, 1992)
Sumatran Rhinoceros *Dicerorhinus sumatrensis*	1.1-1.2m (Owen-Smith, 1988)	800-900kg (Owen-Smith, 1975)	One specimen was 38cm (Nowak, 1991), usually smaller	0.27kg (Leader-Williams, 1992)

differences between rhinoceros species and their relation to poaching and anti-poaching strategies are listed in Table 3.

Table 3

Salient biological features of rhinoceros species and their relevance to poaching

Biological\ecological feature	Relevance to poaching\anti-poaching
Open-country inhabitor	Easy visibility of animal
To a large extent a grazer	Dependent on grass, favoured areas known
Comparitively a social species	In cases of breakdown of law and order, mass killings easy
In suitable habitat, can reach high population densities	Same as above
Very small individual home range	Easy to track and find individuals
Floods cause local migrations	Often takes them out of protected areas, thus easier to poach
Prefers to frequent shallow water\wallows	Favoured areas known
Defecates at marked dung heaps	Known spot for pit poaching/electrocution
Moves in fixed paths or *dandis*	Same as above

Source: Author's research and adaptation from Anon. 1994b

Rhinoceros horn

A rhinoceros horn, which in the case of the Greater One-horned Rhinoceros measures an average of 20cm in height, and weighs an average of 720g (in one instance a horn weighed as much as 2500g), is the main part of the rhinoceros's body sought by poachers in India today. Therefore, a more careful look at the biology, morphology and growth patterns of the horn is instructive when attempting to eradicate poaching. In many cases, where a rhinoceros is discovered to have been poached, official records show that the horn was not fully developed. In some cases, the rhinoceroses in question have been adults, which is puzzling. The Greater One-horned Rhinoceros horn, like that of all other rhinoceroses, is a cemented mass of hair growing on top of the snout and separated from the skull. The horn rests on a bony boss and is replaced, if lost. The slightly loose fixing of the horn means that a poacher takes less time to hack the horn off, presumably, than if it were conjoined with the skull. In fact, accounts from poachers reveal that if the flesh is cut, the horn can even be knocked off the skull with a sharp blow of a stone or dagger handle and in many cases, there is no need to hack right through the bone. However, regular practice is seemingly to hack the horn off the bony boss.

Greater One-horned Rhinoceroses use their horns neither as organs of defence, nor offence, nor for digging (Ghosh, 1993). Apart from the fact that the horn of a male is of slightly wider basal circumference, it is virtually indistinguishable from that of a female of the species, in terms of size. Very unlike African rhinoceroses, Greater One-horned Rhinoceroses normally uses their teeth as a major weapon of offence. In addition, they can also charge down and trample a person. However, very rarely, if ever, is a rhinoceros seen using the horn to attack or defend itself. As both sexes carry approximately the same sized horns, the use of the horn in sexual rituals (Ghosh, 1993), is also suspect. There are, however, some instances of horns having been split or broken off during fights between two male rhinoceroses, but it is believed that their breakage in such cases is only incidental (Ghosh, 1993).

It is interesting to note that Ghosh (1993) reports that the horn of a male rhinoceros in Jaldapara Wildlife

Sanctuary was broken in two during a fight, but that it regenerated within six months. It is therefore apparently possible for an adult rhinoceros to regenerate a complete, if slightly smaller, horn in the process of one year. If this is indeed true then the rate of regeneration is much faster than that observed among African rhinoceroses. Milliken *et al.*, (1993) record that Black Rhinoceroses in Namibia annually regrow nine centimetres' length of horn, which is a total for both horns on each animal (Berger, 1993), while White Rhinoceroses in Hwange National Park show growth rates of 6.8-7cm, for anterior horns, and 2.5-3.4cm for posterior horns, annually (Rachlow, 1993). In India, no detailed work has been done on horn regeneration, which could be a very important biological factor in determining the potential of options for dehorning as part of future conservation practices for Greater One-horned Rhinoceroses.

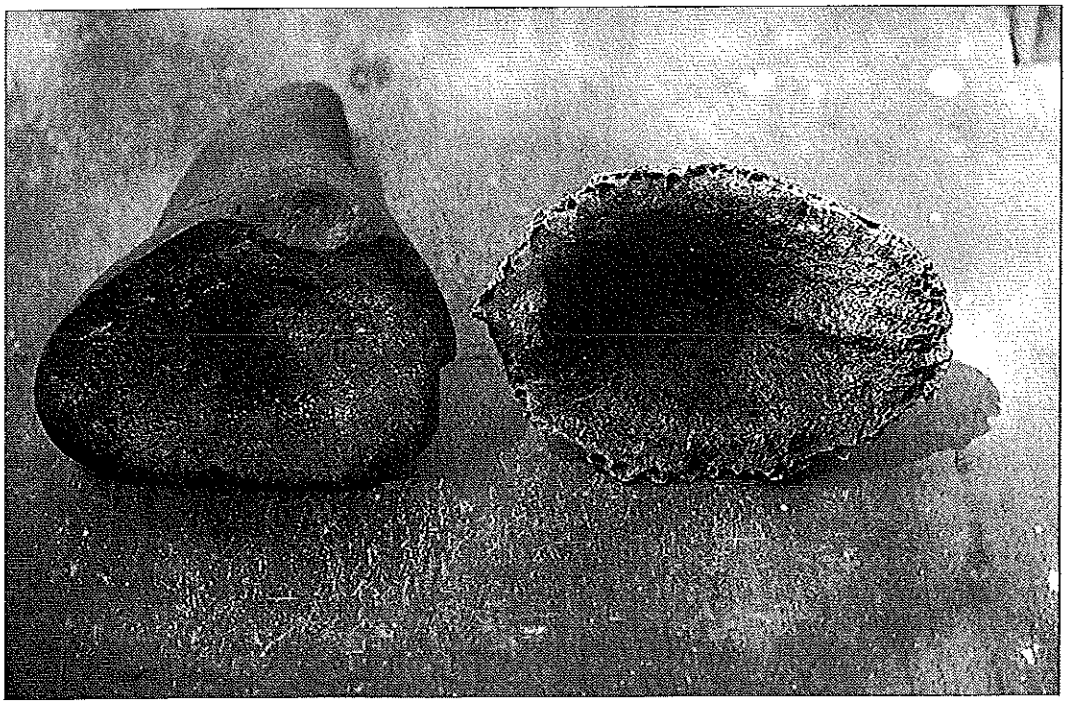
Table 4

Growth patterns of Greater One-horned Rhinoceros horn

Age of rhinoceros	Measurements	Remarks
At birth	–	No appearence of protruberance
6 months	1.1- 1.65cm	Slight protruberance
1 year	3.3 - 5.5cm	Blunt, conical stub
2 years	6.6 - 8.8cm, basal circumfrence 17.6 - 22cm	Still blunt, conical stub
3 years	8.8 - 13.2cm, basal circumfrence 17.6 - 44cm	Pointed horn shape
3-10 years	Growth to 19.8 - 22cm	Fully mature horn
25-30 years	Reduction in height due to wear and tear	Basal curcumfrence increases

Source: Ghosh, 1993

Rhinoceros horn has a porous base riddled with canaliculi-like channels. This spongy, pock-marked surface is most often the part that cannot be recreated by a person making rhinoceros horn fakes. Although not true canaliculi (the rhinoceros horn is not a bone but a mass of hair), the fine perforations that dot the basal surface



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Real (r) and fake (l) rhinoceros horn. The fake horn is made from water buffalo horn.

are best imitated using old bamboo root, specially treated for the purpose. However, with the usual material used for fakes, i.e. cattle horn, the reproduction is very difficult. It has been observed in the field by the author that Asian rhinoceros horn is far more porous and soft than African horn, but this needs to be confirmed in the laboratory. A number of traders in Guwahati and Calcutta contacted during this study, however, claim that it is indeed almost impossible to carve an Indian rhinoceros horn (and it would, in any case, be much more likely to be sold for Oriental medicine), whereas an African one may be carved with comparative ease. Conversely, it is easier to powder Indian horn than African horn.

METHODS

TRAFFIC India initiated a study into the poaching of Greater One-horned Rhinoceroses, and the trade in their horns in 1992, on the results of which this report is based.

Data were collected systematically from 1993, up to August 1995, and some field updates continued to be obtained until April 1996. All the rhinoceros-bearing areas of India were visited by the author during the study, most of them more than three times. All the known trade centres were also visited and some of the trade routes traced. This report contains an analysis of the data collected during the period, although confidential information on the rhinoceros horn trade was passed on to relevant authorities during the course of the study, in the interests of efficient rhinoceros conservation.

The report is divided into sections treating rhinoceros-bearing areas; population trends and an assessment of current populations' viability; poaching techniques and occurrence; trade in and use of rhinoceros horn; prices of horn; anti-poaching strategies; conclusions; and recommendations. The level of detail included in the first chapter on rhinoceros-bearing areas in this report may seem high, but is felt to be justified, since in the case of the Greater One-horned Rhinoceros, numbers are so low that the available habitat remaining and its degree of protection are critical to its survival as a species. That chapter therefore aims to acquaint the reader with the protected areas in which remaining wild Greater One-horned Rhinoceros populations persist in India.

Several limitations to this study must be pointed out at the very outset. Lack of resources and time led to Nepal not being covered in this study and this report is thus limited to an assessment of poaching and horn trade with respect to the Greater One-horned Rhinoceros in India. Even within the country, Manas National Park could not be visited till May 1995, owing to the turbulent political situation there. As the rhinoceros horn trade has been completely banned in India for a number of years, some information is from unofficial sources, but great care has been taken to make sure that all such information has been verified to the extent possible. All information on poaching cases is from Government files, or as mentioned, from reliable covert information. Current, unreferenced information for India within this report may be assumed to be from such sources.

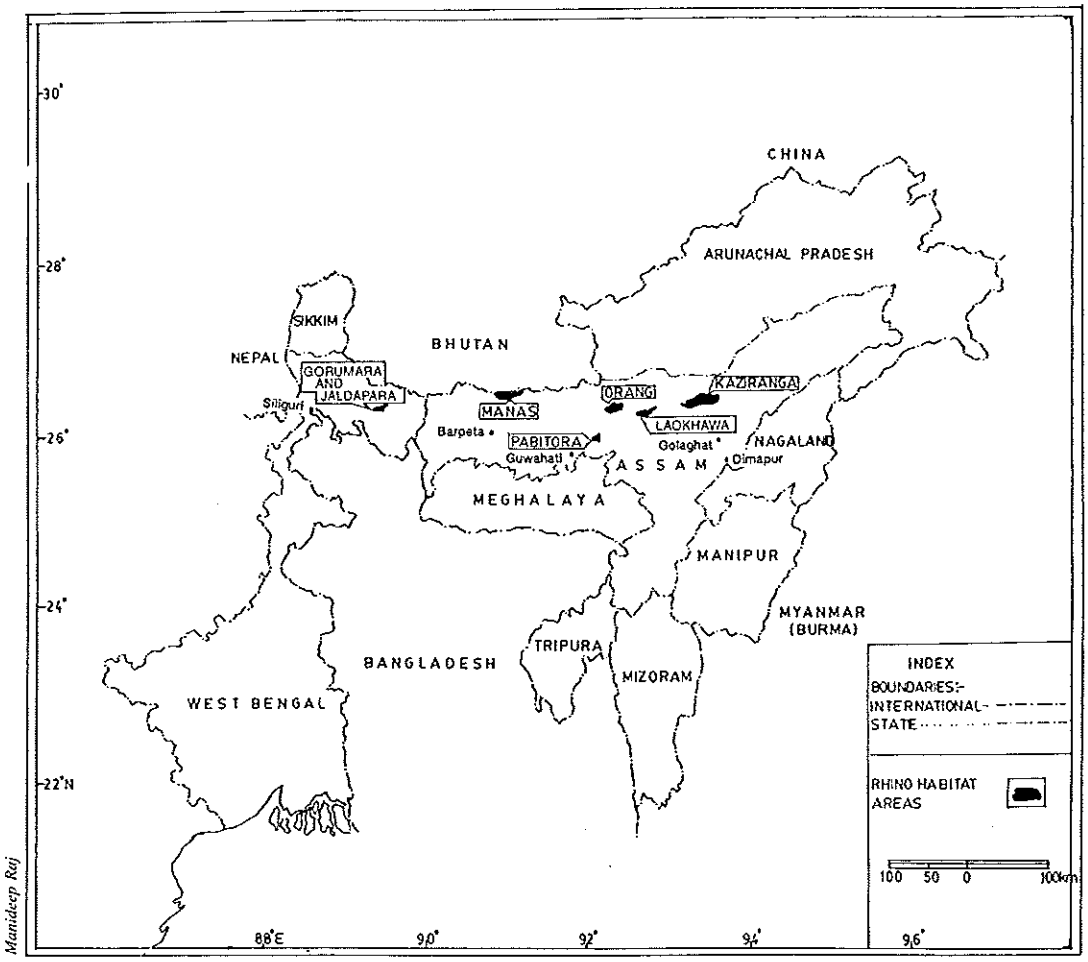
Scientific names, with common synonyms at first mention only if widely known, have been used for plant species mentioned in this report.

AN ACCOUNT OF RHINOCEROS-BEARING AREAS

Greater One-horned Rhinoceroses are today restricted in the wild to nine protected areas in India and Nepal. Although rhinoceros-bearing areas have been connected by forests in the past, allowing rhinoceroses to move between the protected areas, the present situation is one of an almost complete island effect for the rhinoceros populations in each of the separate protected areas. The few rhinoceroses that do wander out are restricted by the availability of suitable habitat and food to the areas immediately outside the sanctuaries, and are in many

Figure 1

Map of rhinoceros-bearing areas in eastern India today, with salient towns also shown



cases driven back to them by humans. Specifically, these isolated safe areas today are at Kaziranga, Manas, Orang, and Pabitora in Assam; Jaldapara and Gorumara in West Bengal; Dudhwa and Katerniaghat in Uttar Pradesh; and Chitwan and Bardia in Nepal. This chapter discusses all these areas from the point of view of location, habitat, infrastructure, rhinoceros populations, mortalities and threats to rhinoceros survival. Figure 1 gives the geo-political distribution of rhinoceros habitats in India.

Box 1
Classes of protected area related to rhinoceros conservation in India

Unclassed Forest – Unprotected forest lands belonging to the State or to the people.

Reserved forest – Protected forest owned by the State. It receives the lowest levels of protection and permits can be given out for tree felling, grazing, fishing, etc. However, once declared a reserved forest, land cannot be diverted for non-forest purposes.

Wildlife sanctuary – The notification of an area as a wildlife sanctuary (earlier called a game sanctuary) gives it a higher level of protection than a reserved forest. There is restriction on entry into a sanctuary and a permit is required for grazing, fishing, etc. These are given only to local villagers, who depended on the land for these activities.

National park – The highest level of protection that a reserve is afforded for its ecological value. No trespass or utilization of resources is permitted within a national park. The strictest penalties are levied if any offence is committed within a national park.

Tiger reserve – This could be a sanctuary or a national park, and in most cases includes areas of each. It is an area demarcated as falling within the administrative purview of Project Tiger, India's Tiger conservation programme, in place since 1973.

Table 5

Extent of rhinoceros-bearing protected areas in square kilometres

	Kaziranga	Manas	Orang	Pabitora	Laokhawa	Jaldapara	Gorumara	Dudhwa
Area	226.17	391	80.54	15.85	70.14	100.98	8.52	63
Year	1908	1928	1915	1971	1972	1975	1976	1958
Area	+ 3.5	500	- 17.29	38.84	70.14	+ 115.53	9.6	+ 212
Year	1911	1990	1931	1987	1979	1976	1993	1968
Area	+ 54		+ 8.73			216.51	+ 69.85	+ 200.2
Year	1913		1969			1976	1995	1972
Area	+ 150.11		75.6				79.45	490
Year	1917		1985				1995	1977
Area	+ 0.6							
Year	1967							
Area	430							
Year	1993							

Source: Compiled by the author

Table 6

Legal status of protected areas

	Year of declaration as sanctuary	Year of declaration as national park
Kaziranga	1950	1974
Manas	1928	1990
Orang	1985	-
Pabitora	1987	-
Laokhawa	1979	-
Jaldapara	1976	-
Gorumara	1976	1995
Dudhwa	1958 (as Sonaripur)	1977

Source: Compiled by the author

Kaziranga National Park

Rhinoceroses in India are associated chiefly with the State of Assam and specifically with Kaziranga National Park. The park, which is spread over 430km² (see Table 5), has an official[2] rhinoceros population of 1200, and is thus the repository for 81% of all Greater One-horned Rhinoceroses in India, and 61% of the world population of the species. A reserved forest was designated at Kaziranga[3] in January 1908 and a game sanctuary in 1916, which was in turn converted into a wildlife sanctuary in 1950 and finally, in 1974, Kaziranga became one of two national parks in the State of Assam (see Table 6). The park lies between 26°30' and 26°45'N and 93°5' and 93°40'E, in Golaghat, Naogaon and Sonitpur districts of Assam. The park headquarters are at Bokakhat. Apart from this the park has four range offices at Agaratoli, Kohora, Baguri and Burrhapahar. While the first three govern the eastern, central and western ranges of the park respectively, the fourth oversees parts of the semi-hilly area adjoining the Karbi Anglong hill districts. Kaziranga National Park is bound on the northern side by the Brahmaputra River and on the southern side by National Highway 37. Apart from this, two tributaries of the Brahmaputra, namely, the Jiya Difloo and the Mora Difloo course through or around the park creating numerous channels and *beels* (shallow lakes) in the park.

These watercourses bring about an annual submergence of parts of the park, which in particularly wet years assumes flood proportions. Apart from flushing out the waterways and maintaining a check on invasive Water Hyacinth *Eichornis crassipes*, the submergence helps to maintain the unique grasslands of the park, which make it such a suitable habitat for large herbivores. In fact, 65% of Kaziranga is covered by wet, alluvial grasslands (especially in the Kohora and Baguri ranges), while 27% of the park is occupied by woodlands (mostly in the Agaratoli range). The wetlands, which as explained above are a vital component for the maintenence of both the other forms of habitat, form more than 8% of the park.

In terms of vegetation, it is the elephant grass and other associated species which stand out as the most important flora of the area. Species such as *Imperata cylindrica, Arundo donax, Saccharum spontaneum, Phragmites karka, Erianthus ravanio, Saccharum naranga* and *Erianthus filfolius* and *Cymbopogon* spp. constitute the main grass types. Aquatic vegetation, such as *Eichornia* spp., *Andropogon* spp., *Ipomoea* spp., *Enydra* spp., *Pistia* spp., *Lomma* spp., *Nymphia* spp. and *Nelumba* spp. occupy the wetland niche, while the most predominant trees in the area are *Bombax ceiba, Lagerstroemia parviflora*, and *Albizia procera*.

According to evaluations made during the Population Habitat Viability Assessment (based on a model created

by the IUCN/SSC Conservation Breeding Specialist Group), of the 138 one-minute grids into which Kaziranga National Park was divided, 37 had high suitability for the Greater One-horned Rhinoceros, 94 had moderate suitability, and seven had low suitability. Purely in terms of habitat suitability for this species, therefore, the park ranks very highly among the protected areas of the Indian subcontinent.

The climate is monsoonal with a mean annual rainfall of 1828mm, 90% of which is received between April and October. The annual floods inundate almost the whole of the alluvial plain habitat from June to October, and even in December much of the lower lying ground is underwater. During the dry season the tall grassland is burned by the park staff to encourage the growth of lush young grass. Both fire and floods have helped to maintain the habitat as it is now for thousands of years (Spillet, 1966; Lahan and Sonowal, 1973).

Kaziranga is overall the best protected rhinoceros-bearing area in India. Of its 542 staff, 204 are forest guards. Kaziranga is also comparitively well equipped, having a stockpile of 255 arms, which include 179 rifles (.315mm bore), 60 shotguns, and six revolvers. It has eight fixed radio transmitter sets among a total stock of 40 (the remainder of which are mobile sets) (see Tables 7 and 8 and 9). Kaziranga is managed through four range headquarters at Agaratoli (eastern range), Kohora (central range), Baguri (western range) and Burhapahar (hill range). The fact that it is bound on one side by National Highway No. 37 and on the other by the Brahmaputra River, enhances its potential for protection.

Table 7

Statement of arms held by certain rhinoceros-bearing areas in India

	Arms	Kaziranga	Manas	Orang	Pabitora	Jaldapara	Gorumara	Dudhwa
1	Rifle .315 (total)	179	150	19*	14	14		40
	Servicable	170				10		
2	SBBL shotgun (total)	33	20	2	-	3		
	Servicable	33				-		
3	DBBL shotgun (total)	27	20	6	1	34	4	100
	Servicable	24			1			
4	Revolver (total)	6			-			
	Servicable	5			-			
5	Others (total)	10			-	1		
	Servicable	-			-			

*Most now stolen

Source: Author's research

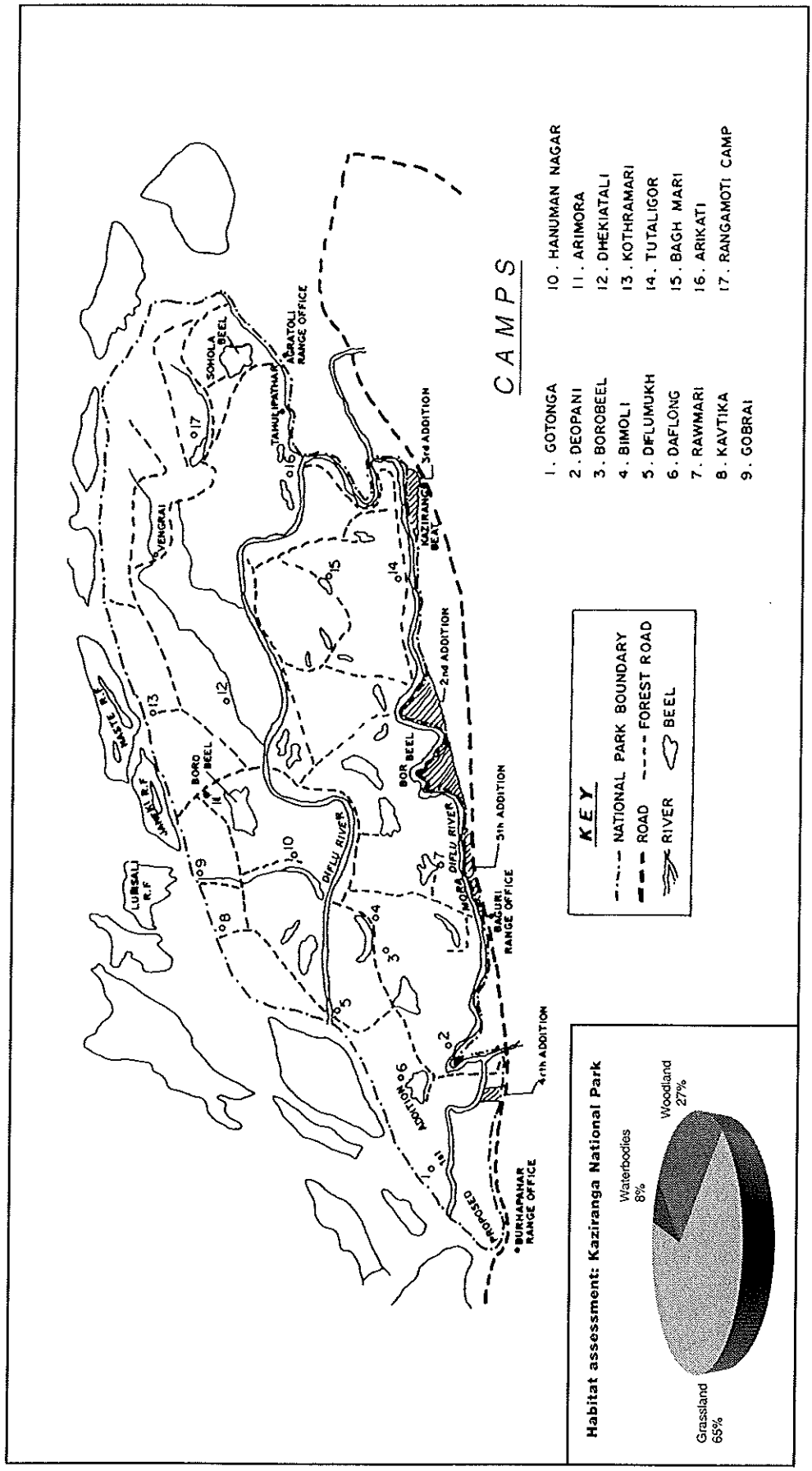


Figure 2

Map of Kaziranga National Park

Table 8

Equipment held by certain rhinoceros-bearing areas in India

Equipment	Kaziranga	Manas	Orang	Pabitora	Jaldapara	Gorumara
Fixed radio transmitter	8	8	1*	2	16	-
Mobile radio transmitter	9	15	9*	7	3	-
Walkie - talkie	23	4		-	12	2
Van			1		1	0
Jeeps			1		3	0
Country boat			15			
Fibre glass boat			1			
Elephants					12	

* Now stolen

Source: Author's research

Table 9

Staffing patterns of certain rhinoceros-bearing areas in India

Designation	Kaziranga	Orang	Pabitora	Jaldapara	Gorumara
1 Range Officer	7	1	1	6	1
2 Deputy Ranger	6	1	1		
3 Game Keeper	2		-		
4 Forester 1	49	9	7	19	
5 Forester 2	19	3	2		1
6 Head Game Watcher	4	-	1		
7 Mahout	26	9	3		
8 Game Watcher	56	9	15		
9 Forest Guard	204	21	33	43	1
10 Boat Man	60	9	12		
11 Home Guard	45	12	4		
12 Casual Labourers	64	16	14	156	16
13 Drivers		2	2		
14 Ghasi		5	2		
15 Messenger or peon		3	1	34	

Source: Author's research

Records of rhinoceros populations within Kaziranga park are illustrative of pressures upon them (see also **Population** chapter). Patar (1980) documents 939 rhinoceroses in the park in 1978, as compared to 658 in 1972, and 366 in 1966. Of the 939 animals in 1978, 331 were adult males, 322 adult females, 35 sub-adult males, 26 sub-adult females, 163 calves, and 62 unsexed individuals (43 adults and 19 young). Significantly, the rate of increase of the rhinoceros population in the park was documented to be decreasing uniformly at about 0.75%. This is seen even more clearly for the following few years. In 1984, the population was 1080, in 1991 it was 1129, and 1164 in 1993 (see Table 10). Although a casual glance at the figures shows an increase

from 366 in 1966 to 1164 in 1993, a more detailed analysis shows that there is a concern related to even this apparently good situation. The census figures from 1966 to 1993 show increases, in chronological order, of 292, 281, 141, 49 and 35 rhinoceroses between each census. There is therefore a significant decrease, over time, in the number of rhinoceroses being added to the population (see Figure 10). However, it is also a well-known fact that as the population increases, the growth rate levels off, given constancy in habitat, size, food availability, and so on. However, the two largest dips in rate of population increase (see Figure 10) (between 1978-84 and 1984-91) coincide with two peak poaching periods, from 1982-86 and 1989-93 (see **Poaching**). A correlation between poaching and decrease in population growth may therefore be assumed.

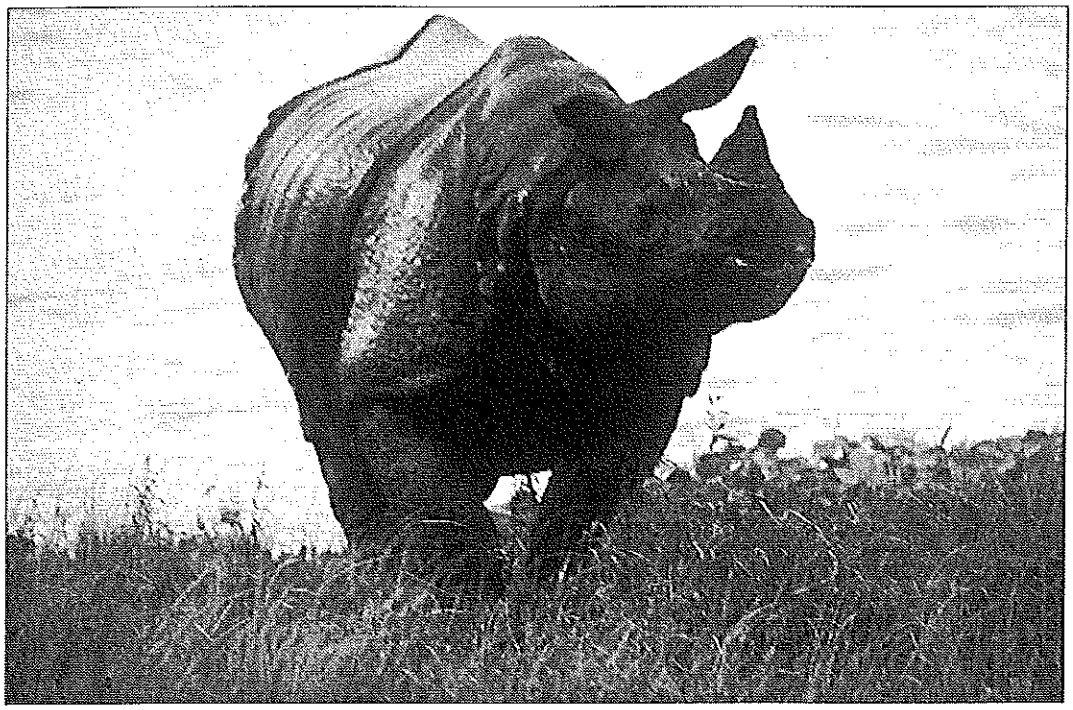
Table 10

Rhinoceros population and mortality in Kaziranga National Park

Year	Population	Poaching	Natural deaths	Total mortality[4]
1980	939	11	58	69
1981		24	39	63
1982		25	48	73
1983		37	46	83
1984	1080	28	50	78
1985		44	37	81
1986		45	38	83
1987		23	41	64
1988		24	105	129
1989		44	54	98
1990		35	57	92
1991	1129	23	79	102
1992		49	66	115
1993	1164	40	58	98
1995	1200			

Source: All population figures are official census figures. Population for 1980 is from 1978 census. Mortality figures compiled by author.

In Kaziranga, although 45 rhinoceroses were poached between the years of 1965 and 1968, greater poaching pressure started in 1980 when 11 rhinoceroses were poached during that one year (see also **Poaching over the years**). Thereafter, until 1993, the minimum number of rhinoceroses poached annually was never lower than 23, and reached a high of 49 animals in 1992. During poaching waves between 1982 and 1986, and 1989 and 1993, Kaziranga lost 179 and 191 rhinoceroses, respectively. It is interesting to note that for all other rhinoceros-bearing areas, with the exception of Manas, the first onslaught of poaching was by far the most destructive, in contrast to the case in Kaziranga. It may be that poachers only succeeded in penetrating the defences of what were then India's largest two populations during the second effort.



Vivek Menon

Greater One-horned Rhinoceros at Kaziranga National Park.

In terms of deaths from all causes, 1988 was the worst year for rhinoceroses in Kaziranga, when a bad flood accounted for nearly half of the 105 natural deaths, almost double the normal number of deaths in a year (see Figure 17). Interestingly, 1987-88 also shows a respite from poaching, relative to the two waves of hunting by poachers, which may be attributed to the floods and consequent inaccessibility of the area. Of rhinoceroses poached in Kaziranga between 1989 and 1993, 59% were shot, 39% trapped in pits and two per cent were electrocuted; there has been no case of poisoning so far (see Figure 12). Analyses of data from 1989-93 show no obvious fixed season for poaching, but between May and September poachers appear to have been relatively inactive during all but one year (1991), during which maximum poaching occurred in July (see Figure 16). The apparently usual months of reduced poaching incorporate the monsoon season at Kaziranga. There is no known reason for poaching to fall off during these months, but general inaccessibility of the park may offer some explanation (Talukdar, 1994). On the other hand, guards would experience increased difficulty in patrolling and guarding rhinoceroses during the monsoon, which would aid poachers.

Manas National Park

Manas National Park (90 50'E, 26 40'N) lies 176 kilometres north-west of Guwahati, close to the Assam - Bhutan border where the Manas River emerges from the Bhutanese hills. The park forms a linear west-east strip and falls within the districts of Barpetta and Kokrajhar in Assam. The eastern and western boundaries of the park are the Alabari River and the Sukanjan River, respectively. The northern demarcation is the international boundary between India and Bhutan, and the southern boundary is formed by a forest road (see Figure 1). The park is divided into three ranges, namely, Bansbari, Bhuyanpara and Panbari (see Figure 3). Possessing 22 species of mammals that are listed in Schedule I of the *Wildlife (Protection) Act*, 1972 of India, and at least 320 species of birds, the national park is one of the high biodiversity areas of the country.

In 1928, 391km^2 of Manas were declared a sanctuary, upgraded to a national park in 1990 (see Table 6), and expanded to 500km^2 (see Table 5). The area is one of the few trans-boundary parks in India: the Bhutanese part

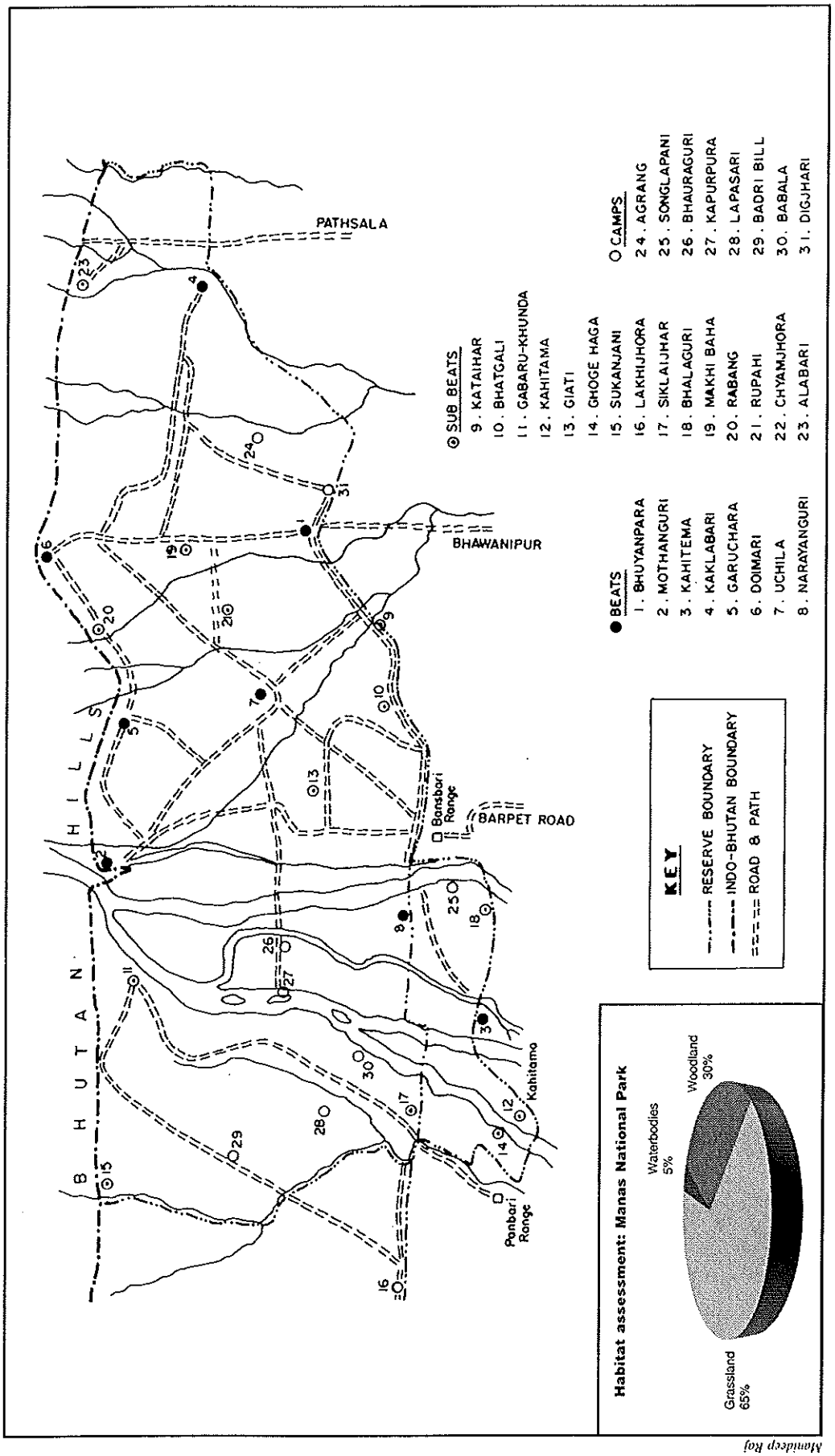


Figure 3
Map of Manas National Park

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of Manas, the Royal Manas National Park, occupies 443km² and has been a protected area since 1964. Although the Manas National Park has an area of 500km², it forms part of the Manas Tiger Reserve (2837km²), which has been protected under the auspices of Project Tiger since 1973 and was declared a United Nations World Heritage Site in 1984. The entire area of the park has also been proposed as a Biosphere Reserve, under the Man and Biosphere Programme of the United Nations. All forestry operations and timber felling were halted in 1964, since which time this park of hills and plains has been fully dedicated to wildlife conservation.

Manas has a moist tropical climate with a mean maximum summer temperature of 37 degrees Celsius and average winter temperature of 11 degrees Celsius. Rainfall is distributed throughout the year, December and January being the driest months, and June and July the wettest ones. Soil formation is varied but fertile in much of the park, supporting grasses of different species intermixed with trees (Deb Roy, pers. comm., 1993). Forest types occurring within the park are sub-Himalayan alluvial semi-evergreen; east-Himalayan, moist, mixed deciduous; and low alluvial savannah woodland of three categories – open grassland (65%), woodland (30%), and riverine areas (5%). The park is traversed by numerous rivers and streams flowing south from hills in Bhutan and in addition there are many smaller *nallahs* (see **Glossary**), which provide water sources. The Manas River is the largest in the park and during rains its many channels flood the land alongside its banks, while water from other streams disappears underground, which influences the distribution and seasonal movement of animals. Floods typical of the Brahmaputra Basin do not occur in Manas, but destructive floods following heavy rainfall do cause erosion and disruption of communications. Fire is used as a management tool with controlled burning being carried out in a systematic manner in the grassland.

In May 1995, Manas National Park was surveyed by the author and a distinguished biologist familiar with the park, noting habitat destruction, signs of poaching, and deployment of park staff. Given the relative inaccessibility of Panbari and Bhuyanpara Ranges and the absence of range officers from them, these parts of the Park could not be surveyed and the survey was restricted to the Bansbari Range (200km²). The general habitat of Bansbari range was seen to be excellent with very little change since 1987-88, but extrapolation from these findings for the other two ranges of the Park is not possible, and indeed there are many reports of large-scale habitat destruction as a result of logging and other disturbances in parts of the other ranges. The habitat in Bansbari Range varied from mixed grasslands including *Imperata cylindrica, Saccharum naranga, Phragmites karka, Arundo donax*, to non-grass species, such as *Alpinnia alughos* and *Lea crispa*, intermixed with moist deciduous woodland. There was no evidence of grazing, large-scale fishing or any other human activity that would necessarily put pressure on the habitat.

Manas National Park has 43 guard camps and equipment includes around 200 arms and 30 wireless sets (see Tables 7 and 8). However, a recent survey by the author found only 19 of the 43 camps in Manas manned, the remainder abandoned because of the threat from Bodo rebels. Of the manned camps, 13 are in Bansbari Range and three each in Bhuiyanpara and Panbari Ranges. Of the 13 in Bansbari, six camps do not undertake patrols, and according to official sources, none occurs in the other two ranges either. Effective camp strength within in Manas is probably therefore in the order of six: several camps visited in Bansbari had no arms and wireless sets, these having being withdrawn to deter militants from raiding camps with the aim of stealing such equipment. While the deterrent factor of such camps is greatly reduced by their lack of such equipment, it is yet worthwhile to keep them manned at least as information-gathering points. While one camp seen by the author, at Uchila, was among the best guarded with 20 Forest Department personnel and 18 battalion personnel posted there, evidence of attack upon others was clear, such as at the burnt camps of Gorusara and Makhibaha (Menon, 1995b).

Table 11

Population and poaching in Manas National Park

Year	Population	Poaching	Remarks
1962		1	
1963		1	
1964		0	
1965		1	
1966	15	0	Population estimate by E. P. Gee (Spillett, 1966)
1967		0	
1968		0	
1969		0	
1970		0	
1971		1	
1972		0	
1973		0	
1974		0	
1975		0	
1976	40	4	Population estimate by Laurie, 1978
1977	75	0	Deb Roy, pers. comm.
1978		1	
1980		0	
1981		2	
1982		1	
1983		3	
1984		4	
1985		1	
1986	75-80	1	Population estimate by Forest Department
1987		7	
1988		1	
1989	85	6	Population estimate by Forest Department
1990	85-100	2	Population estimate by Forest Department
1991		3	
1992	80	11	Population estimate by Forest Department
1993	60/30[5]	22	Population estimate by Forest Department
1995	30/12[5]		

Source: Adapted from Vigne and Martin, 1994; author's research

There has been no direct link in recent times with other rhinoceros populations of the State of Assam, which occupied a discrete and contiguous belt further east. Formerly, the rhinoceroses of Manas extended west to Jaldapara Wildlife Sanctuary (see Figure 1), but even this population became fragmented by human settlement and no links have existed since 1962 (Deb Roy, pers. comm., 1993). In 1966, as few as 15 animals were estimated to reside in the protected area at Manas (Spillett, 1966) but the number was estimated to have grown to 40 10 years later (Laurie, 1976) (see Table 11). (This census was an undercount according to many informed sources (Deb Roy, pers. comm., 1993).) By 1987, authorities estimated that there were approximately 85-90 rhinoceroses in Manas, the second-largest population of Greater One-horned Rhinoceroses at the time in India, and the third-largest in the world, after those of Kaziranga and Chitwan national parks (Lahan, 1993). This figure was also close to the potential carrying capacity for Manas, estimated at 100 animals, according to the AsRSG Action Plan of 1989 (see Table 23) (Khan, 1989). Some six years later, Lahan (1993) estimated the population to be around 60 and, although no previously published censuses or even calculated estimates exist for following years, informed local sources put the current population at no more than 20-25 animals. At the AsRSG meeting of 1993, the rhinoceros population of Manas was recorded to have an annual growth rate of 3.45% (see Figure 10), a mortality rate of 7.47%, and a poaching rate of 3.8%. Today, however, the population seems to have further dwindled. Reports from field visits to Manas between 1995 and early 1996 by the author and by rhinoceros experts of Assam (Deb Roy, pers. comm., 1996; Choudhury, pers. comm., 1996) puts the number at no more than a dozen animals (see Figure 9; **Population** chapter).

The sharp fall in rhinoceros numbers from 1987 may be attributed to the start of civil unrest and the Bodoland agitation (see **Poacher's profile**). Attacks were launched on park range headquarters and other locations (Deb Roy, 1994), which caused severe injury of a park range officer and the loss of 22 rifles, nine rhinoceros horns and cash. Further, the home of the Divisional Forest Officer was bombed in March 1994, while park buildings have been periodically burnt down. All rhinoceroses killed between 1990 and 1994 have been shot, rather than trapped or electrocuted, and it is reported that as many as 18 of the 20 rhinoceroses poached in 1993 were killed during the hospitalisation of the wounded range officer. However, the low morale of park staff as a result of their fear for their safety has resulted in their withdrawal from most camps in the park.

The situation for rhinoceroses in Manas is extremely grave. Although it is impossible to say with certainty, as some reports claim, that rhinoceroses have been extirpated from Manas, there have been high poaching levels during the period 1992-95 (see also **Poaching over the years**). The officially recorded ratio of rhinoceros deaths as a result of poaching to deaths from natural causes in Bansbari Range for the five years 1989-93 is 37:9. It should be borne in mind that Bansbari Range constitutes only 200 of the park's 500km^2, and it is likely that the other two ranges of the park have been worse affected by poaching than Bansbari, given their lack of park rangers. Therefore, one can project that at least 50-60 rhinoceroses may have been killed in Manas during 1989-93, or about two-thirds of the 1989 population. Such figures are supported by information that traders promised over 60 rhinoceros horns, which they said originated from Manas, to an undercover agent in Siliguri. To this amount, may be added the 20 horns, also allegedly from Manas, recovered from a Bhutanese princess in Taiwan recently (Loh, *in litt.*, 1993). Although horns from old stock or other areas may have been incorporated, field research finds that the trade in rhinoceros horn has particular areas of supply and transportation routes. During the author's survey of Bansbari Range, rhinoceroses were not seen, and only one guard reported to have seen one a few weeks earlier. However, it is known that the area is capable of holding up to 20 rhinoceroses with very infrequent sightings.

Although Manas National Park is today under severe threat from poaching and impending habitat destruction, the situation is not irretrieveable. However, an immediate appraisal of Bhuiyanpara and Panbari Ranges must be made, to assess these 300km^2 of the park. The value of Manas as a sanctuary for the Greater One-horned

Rhinoceros should not be discounted: such a view could fuel a sense of defeat, which could in turn prove fatal to this region of high biodiversity.

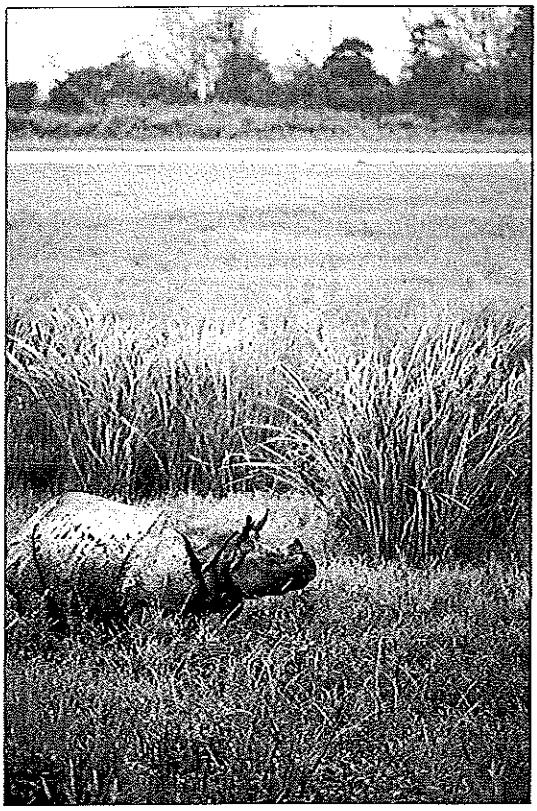
Orang Wildlife Sanctuary

Orang, or the Rajiv Gandhi Wildlife Sanctuary, in central Assam is today the repository of India's second-largest population of rhinoceroses. After Manas lost most of its rhinoceroses to poachers, this small sanctuary on the northern bank of the Brahmaputra River, straddling the two districts of Darrang and Sonitpur, has become a bastion for the species (see Figure 1).

Orang was formerly an abandoned village. The soil has two distinct layers of alluvial deposits and, owing to secondary succession, thatch and other grass species covered the area inviting wildlife. An area of 80.54km^2 was declared as Orang Game Reserve in 1915 and extensive plantations made. In 1931, an area of 17.29km^2 was dereserved on the northern side for settling immigrants from erstwhile East Pakistan, but an area of 8.73km^2 was added in 1969. It was notified as a Wildlife Sanctuary in 1985, with an area of 75.60km^2 (see Tables 5 and 6).

The Dhansiri and Panchnoi Rivers originating from the Bhutan Himalaya flow through the sanctuary, complementing the number of canals and artificial ponds dotting the park (see Figure 4). Although the Brahmaputra River floods annually, the presence of a high terrace of land that remains above the waters accounts for there being no rhinoceros deaths owing to floods. However, the rivers erode the southern and western parts of the park regularly.

The dry grassland areas of the parks are protected from fire by extensive firebreaks, as a result of which much of these areas are now covered with thick *Saccharum* growth. The southern part of the sanctuary consists of a swampy area annually flooded by the Brahmaputra, which harbours the rhinoceros population during the dry season. Habitat assessment of Orang has revealed that the area comprises 70% grassland, 29% woodland and 1% waterbodies. The major precipitation in the park is between May and September and the average rainfall is about 300mm per year, with temperatures ranging from 7 degrees Celsius to 35 degrees Celsius, and a relative humidity of 66-80%.



Vivek Menon

Greater One-horned Rhinoceros in grassland at Orang Wildlife Sanctuary, April 1995.

Seventy permanent staff and an additional 30 temporary staff (see Table 9), distributed through 23 camps in the sanctuary were equipped with two SBBL (Single barrel breach loading), six DBBL (double barrel breach loading) shot guns and 19 rifles (see Table 7). One jeep, one van, 15 country boats (dugouts), and one fibreglass boat and some of the park's 14 elephants provide transport within the sanctuary. Formerly, radio equipment consisted of a fixed station and nine mobile units for use at range camps, but a raid by Bodo militants in April 1994 resulted in most wireless sets, including the fixed set, being stolen (see Table 8), together with the

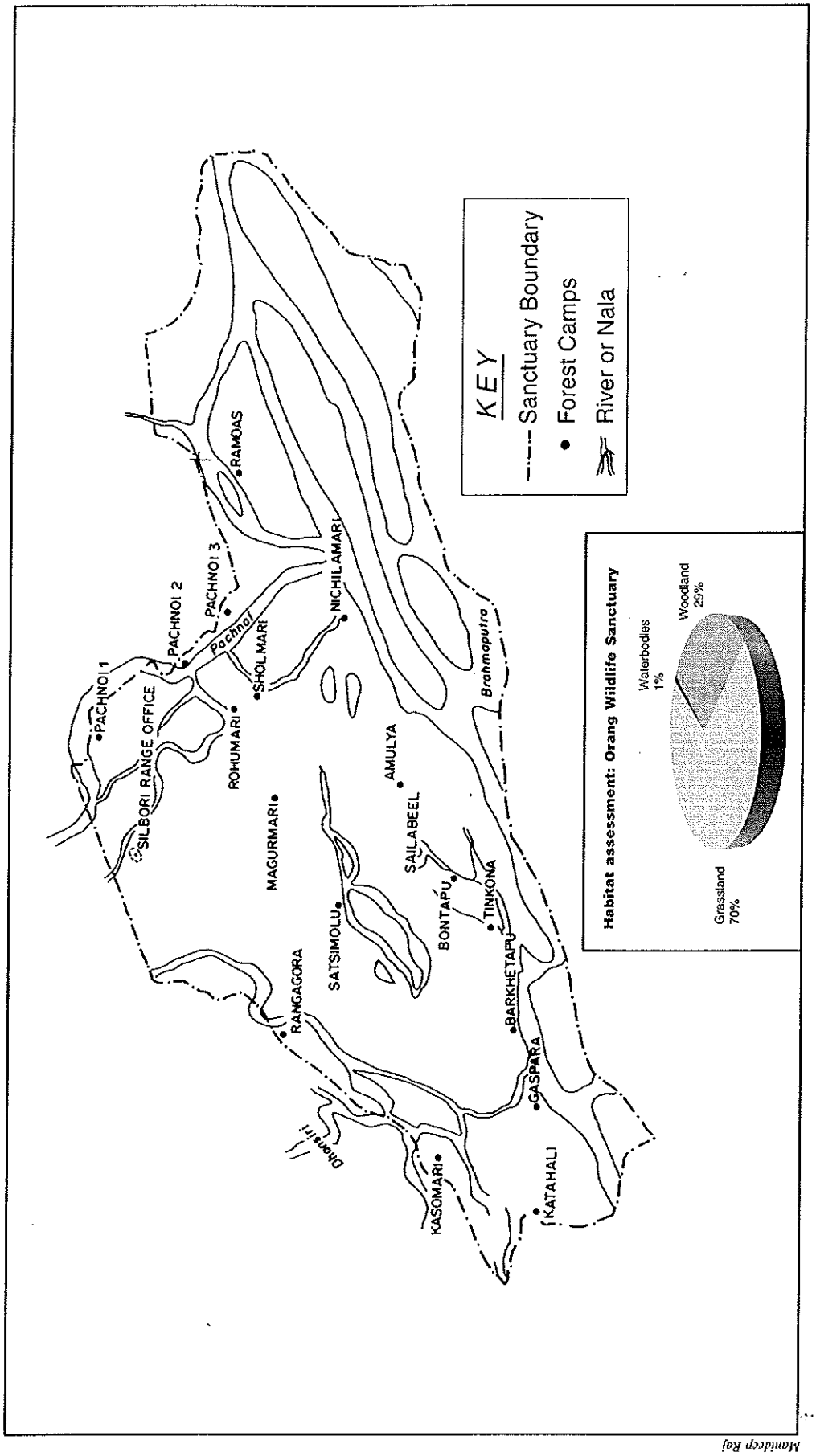


Figure 4

Map of Orang Wildlife Sanctuary

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majority of guns. As a result, the sanctuary is now very short of equipment, which, considering that the area is home to the second-largest rhinoceros population in India, which is one of the two viable populations left in the country, is a situation to be remedied as a priority.

Orang has recently supported a growing number of rhinoceroses (see Table 12). Unfortunately, the latest census of 1995 could not be completed by the Forest Department, but current trends indicate a population of 90-100 rhinoceroses (see also **Population** chapter). The potential carrying capacity of this sanctuary has also been estimated, like that of Manas National Park, to be 100 rhinoceroses by the AsRSG. Orang's rhinoceros population has a male:female ratio of 1:1.4 and a female:calf ratio of 5.1:1. Rhinoceros poaching in Orang touched a high during the 1983 Assam civil unrest, causing the loss of 34 of the total of 48 rhinoceroses killed between 1980-92 (see Table 12; **Poaching over the years**). By contrast, 1990 was a year without poaching in Orang, and only three animals were poached during the three years 1990-92, thanks to the conscientious work of one range officer. This is despite the fact that the terrain of Orang is very suitable for digging pits, and although 45% of the rhinoceroses killed there from 1972 to 1992 were shot, 38% were killed by pit poaching (see Figure 12). No rhinoceroses have been electrocuted, although a few poisoning cases have been detected (two per cent).

Table 12

Population and mortality in Orang Wildlife Sanctuary

Year	Population	Poaching	Natural deaths	Total mortality
1980	25-30	2	0	2
1981		2	0	2
1982		6	4	10
1983		10	6	16
1984		7	4	11
1985	65	8	1	9
1986		3	1	4
1987		1	3	4
1988		4	1	5
1989		3	2	5
1990		0	1	1
1991	97	1	2	3
1992	100	1	2	3
1995	90			

Source: Mortality figures are from TRAFFIC-India's database; population figures from official censuses and Laurie (1978).

Apart from poaching, which represents the greatest threat to the survival of the rhinoceros population in Orang Wildlife Sanctuary, the fact that the entire area is surrounded by villages means that there is a constant pressure on the sanctuary's lands for use for grazing, fishing, collection of thatch and firewood, etc. Added to this, the morale of the park staff is currently at its lowest ebb owing to a variety of administrative problems and this could potentially be very dangerous for India's second-largest population of Greater One-horned Rhinoceroses.

Pabitora Wildlife Sanctuary

Pabitora Wildlife Sanctuary is located 50km east of Guwahati on the southern bank of the Brahmaputra River in District Morigaon of Assam (see Figure 1). It covers an area of approximately 16km² and holds 65 rhinoceroses, making it one of the areas most densely populated with the animals in the Indian sub-continent, and perhaps the world.

Before 1971, Pabitora Wildlife Sanctuary was a grazing reserve for surrounding villages. During that time a few rhinoceroses strayed from Laokhowa and Orang sanctuaries and became resident in Pabitora and in 1971, two grazing reserves comprising 15.85km² were declared a Reserved Forest. Five additional areas were added on and the whole declared Pabitora Wildlife Sanctuary in 1987, comprising 38.84km² (see Tables 5 and 6). Further areas have been proposed to be added to the park and it is hoped this will make Pabitora better protected. At present, there are twenty villages surrounding the wildlife sanctuary.

The sanctuary occupies a basin-like structure surrounded by the Mayong, Kamarpur and Monoha hills. The soil is mostly made up of riverine alluvial deposits, with a high percentage of clay in some places. The Garang and Maduk Lakes and numerous small *nallahs* and *beels* throughout the area provide perennial sources of water to the park (see Figure 5). As the sanctuary is situated in a low-lying area, it becomes entirely flooded with water from the Brahmaputra and Ualong Rivers. Anti-poaching camps get submerged during high flood, and except for the Tuplung-Hoduk road which passes through the east of the sanctuary and two artificially raised areas, all parts become submerged during this period. The climate of the park is subtropical, moist with rainfall distributed almost throughout the year. The heaviest rain is in July and August and the driest month is January.

Although a proper survey of flora has not been conducted, the sanctuary is reported to have 80% grassland, 19% woodland and one per cent wetland (Anon., 1994b). Another survey carried out in 1992 showed the forested land to be only two per cent; thatch with *Albizia* regeneration - 8%; thatch - 40%; thatch with *Phragmites karka* and *Arundo donax* - 20%; perennially water logged area - 5%, and swampy area - 25% (Talukdar, 1994). A major problem for the park is grazing. A large number of cattle depend on the sanctuary and its peripheries for grazing, which is so intensive that grasses inside the sanctuary are stunted. An area of one square kilometre was fenced during 1990 in anticipation of an re-introduction project of Thamin *Cervus eldi*, which resulted in a profuse regeneration of *Albizia procera* and better growth of grasses inside the enclosure.

In 1986, the population of rhinoceroses in the park was estimated to be 40 animals, which increased to 56 in 1993 and 68 in 1995 (see Table 13 and **Population** chapter). This is despite a potential carrying capacity of 45 rhinoceroses, predicted by the AsRSG in 1989. These population figures translate to a theoretical density of 4.06 animals/km² but a probable real density of 1.7 animals/km², the difference owing to the distinction between the 16km²-notified area of the sanctuary and the proposed 38km²-area, which the rhinoceroses actually use. Between 1980-83, there was no poaching from Pabitora, according to official records, but between and one and four rhinoceroses have been lost to poachers every year since then, apart from 1986 (see Table 13 and **Poaching over the years**). Analysis shows that, between 1987 and 1993, most (63%) poached rhinoceroses were shot, while 21% were electrocuted, the highest percentage of electrocutions for any park (see Figure 12). Pabitora is the protected area where electrocution was first used by poachers, a method facilitated by two high tension wires that run through the park and the illegal wires run off these. Otherwise, 11% of poached rhinoceroses were poisoned, while five per cent died in pits during the same period.

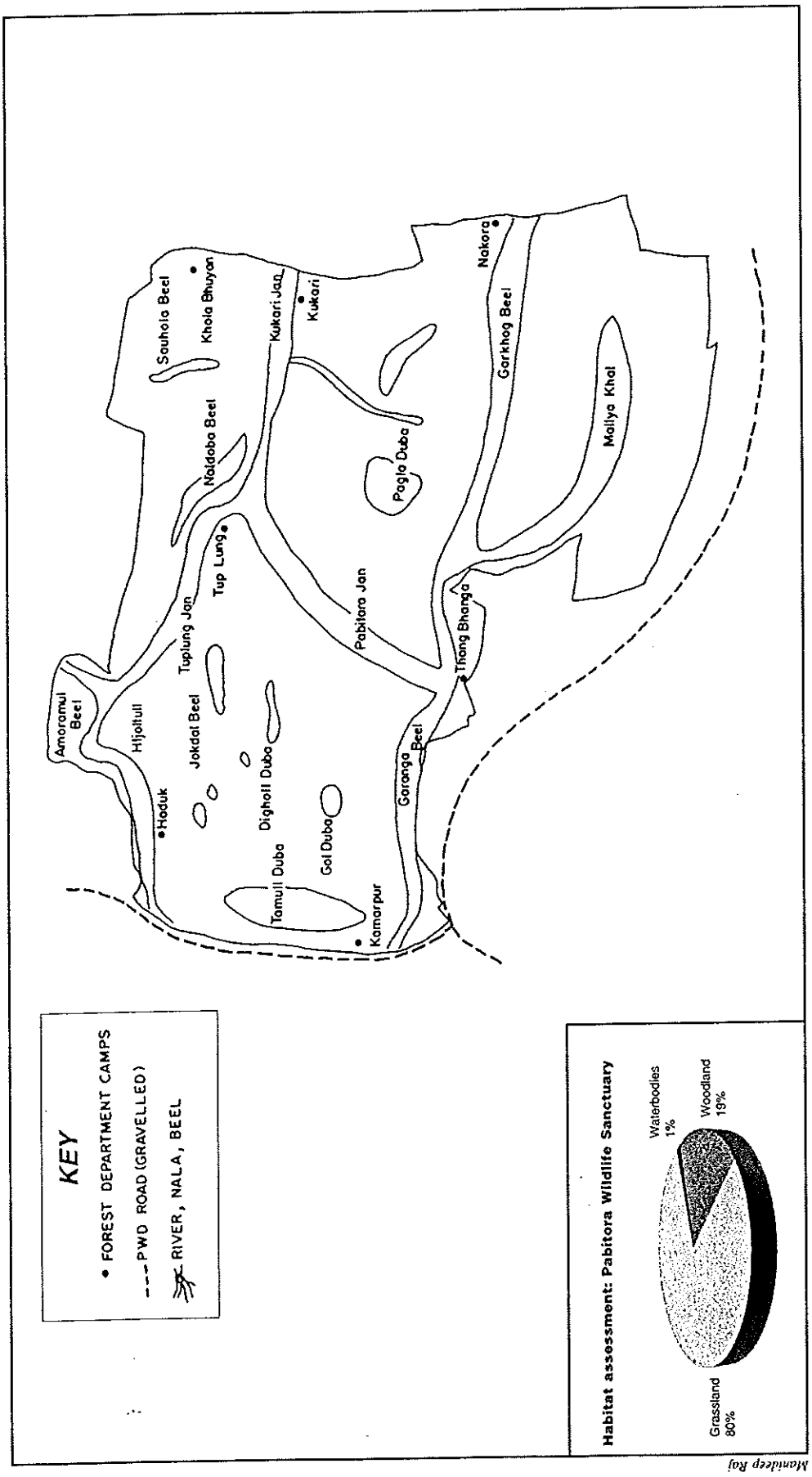


Figure 5

Map of Pabitora Wildlife Sanctuary

Table 13

Population and mortality in Pabitora Wildlife Sanctuary

Year	Population	Poaching	Natural deaths	Total mortality
1984	Not known	4	Not known	4
1985		2	Not known	2
1986		0	Not known	0
1987	54	2	0	2
1988		3	5	8
1989		4	1	5
1990		2	2	4
1991		1	1	2
1992		3	2	5
1993	56	4	1	5
1994		2	1	3
1995	68	2	0	2

Source: All mortality figures are from TRAFFIC-India databases while population figures are from official censuses.

Eighty of Pabitora's 98 staff are permanent. Park weaponry consists of 14 rifles and DBBL shot gun, while there are nine wireless sets within the sanctuary (see Tables 8 and 9).

Straying of rhinoceroses from the sanctuary to outside grazing lands and the resultant conflicts with the villagers has been a constant problem at Pabitora. Until 1993, this was a regular occurrence leading to nine per cent of rhinoceroses from Pabitora being taken outside the sanctuary (Anon., 1994b). Approximately 20 rhinoceroses used to stray out of the core area to raid crops in surrounding villages, between 30-50km away from the sanctuary limit. Given the very high population density and the relatively sparse grazing fodder within the sanctuary, this habit was not surprising, and was the reason for the stationing of 14 camps outside the park perimeter, in comparison to 13 within (Anon., 1994b). Innovative management measures taken between 1993-95 have reduced straying, the increase in grass availability inside the park having been the chief reason for this.

Laokhawa Wildlife Sanctuary

Laokhawa Wildlife Sanctuary in Naogaon district of central Assam (see Figure 1) is a rhinoceros-bearing area most accurately described in the past tense. Situated on the southern bank of the Brahmaputra River and about 30km from Naogaon town, the sanctuary virtually lost all its rhinoceroses in 1983-84 during the AASU uprising in Assam. The last recorded rhinoceros within Laokhawa died on 5 October 1991, after which no rhinoceros has been seen there (see Table 14). A few itinerant rhinoceroses may still make use of old connections between Kochmara and Orang or even Kaziranga 80km farther east, but this seems unlikely, as most of the corridors have become inhabited by humans. The 70km^2 of Laokhawa's reserve probably held the third-largest population of rhinoceroses in Assam until their assumed complete annihilation. Today, the sanctuary is severely threatened by poaching of the few deer left, and use for crop cultivation and livestock grazing, yet until 1983, when the rhinoceros population was almost completely lost in one year, this sanctuary was thought to be comparatively safe from poachers. Spillet (1966) felt that poaching was not a major problem in Laokhawa but felt rather that rhinoceroses' existence in Laokhawa was threatened by extensive crop cultivation and grazing and flooding.

Table 14

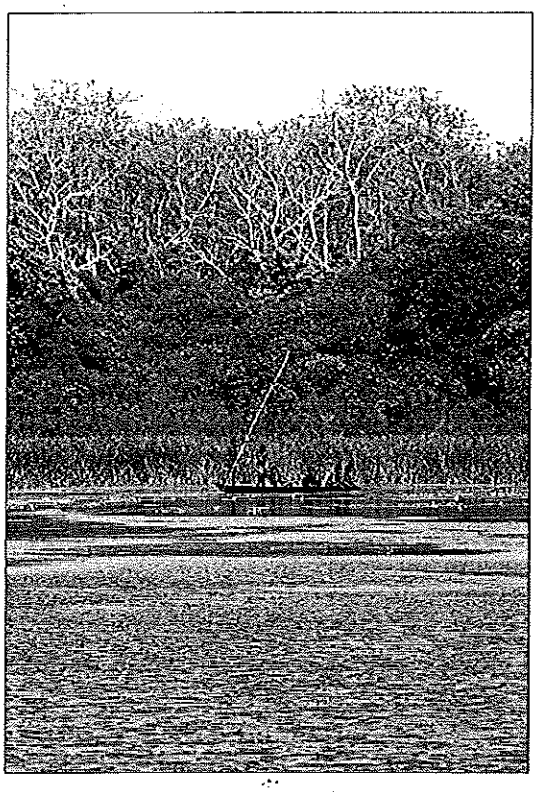
Mortality in Laokhawa Wildlife Sanctuary

Year	Population	Poaching	Natural deaths	Total mortality
1980	*circa* 40	1	2	3
1981		5	4	9
1982		9	12	21
1983		41	6	47
1984		5	0	5
1985		2	0	2
1986	5	1	1	2
1987		0	3	3
1988		0	1	1
1989		0	1	1
1990		3	2	5
1991		1	0	1

Source: The mortality figures are from TRAFFIC-India database; population figures from official censuses.

Although Laokhawa was declared a reserved forest on 28 January 1972 with an area of 70.14km² (see Table 5) and later named as Laokhawa Wildlife Sanctuary on 12 September 1979 (see Table 6), the declaration has never been supported in law, following a court case filed in 1978 by the Rupahi Union Co-operative Fishery and Farming Society in protest at the withdrawal of rights to cultivate parts of Laokhawa land.

The soil of the alluvial plains of Laokhawa is moist with a light texture and sandy loam. Woodland covers almost 40% of the area, grasslands 30% and wetland 30%. Large expanses of short grassland, rough *Zizyphus* and *Tamarix* scrub, *Bombax ceiba* and *Albizia procera* tree plantations, with low sparse undergrowth give way to *Typha* and *Arundo* reeds alongside *beels*. Several of these *beels*, such as Rowmari, Lathimari, Sonaikuchi (see Figure 6), add to the water availability of the region, while the tropical climate brings rain from May to July which can cause the whole sanctuary to be submerged with water for several days at a time.



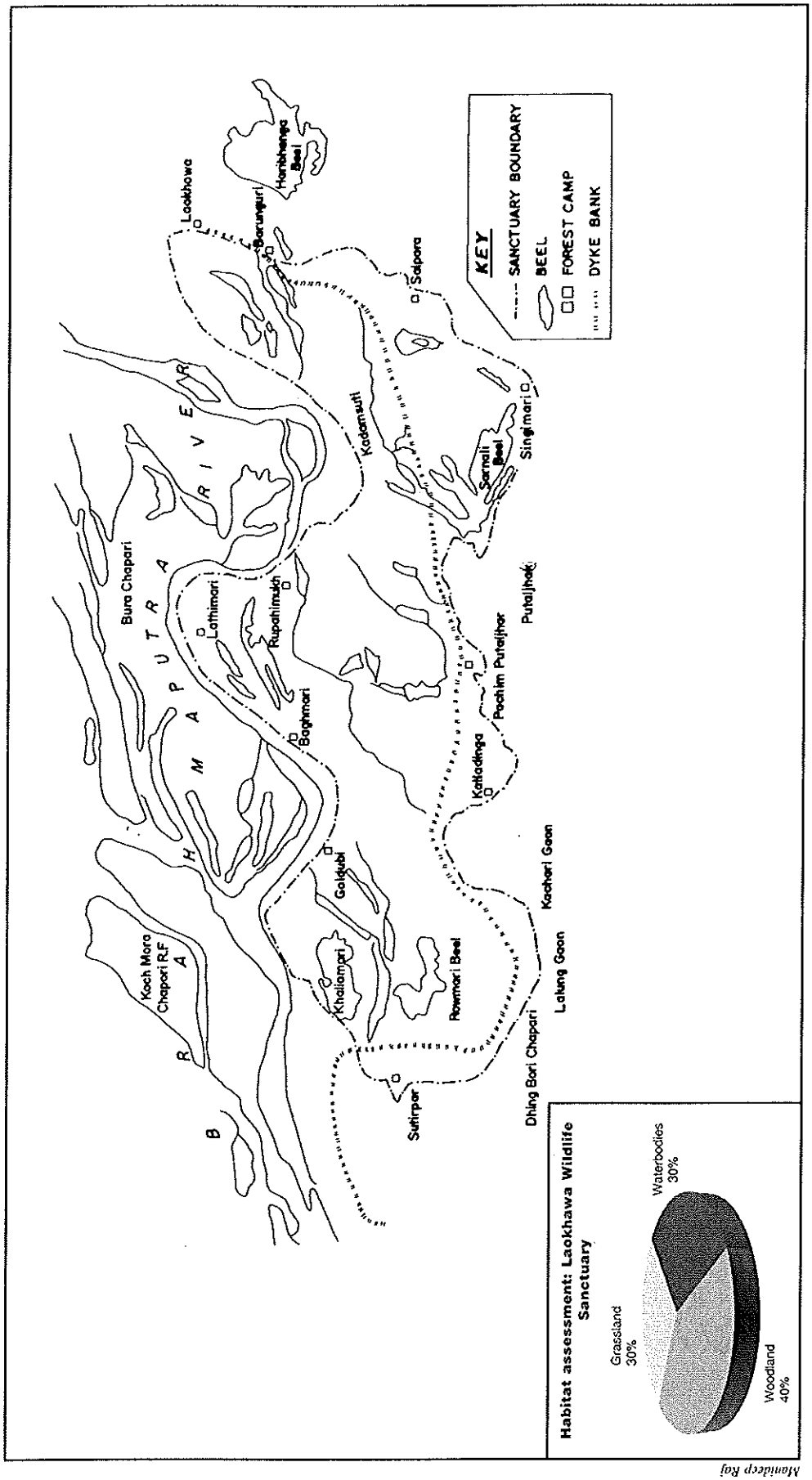
Vivek Menon

Illegal fishing in a *beel* in Laokhawa Wildlife Sanctuary.

The villages around the sanctuary are thickly populated and most of the residents are uneducated. A large majority of people in the area are very poor and solely dependent on the sanctuary for firewood, thatch and fish for their livelihood. They are allowed to live and cultivate land in forest villages within the reserve, in return for a certain amount of free labour for the Forest Department. Nepali herdsmen and Muslim fishermen (both of whom are relatively recent settlers in the area) pay the Forest Department

Figure 6

Map of Laokhawa Wildlife Sanctuary



Manideep Raj

for grazing and fishing rights. These practices may not be deterimental to the sanctuary, if well-managed, but are disastrous if influenced by vested interests, as in the present situation.

Despite the fact that rhinoceroses disappeared from this sanctuary in the 1980s, the sanctuary continues to have a very high potential for rhinoceros conservation, as a possible area to re-introduce rhinoceroses, valuable in itself, but also as a link between Kaziranga National Park, on the one hand, and Orang and Pabitora sanctuaries, on the other (see Figure 1). In recent years, however, a large number of settlers have been allowed to encroach upon the sanctuary, to over-graze, fish, and fell timber inside the park.

In May 1995, the author visited Laokhawa. Driving along the middle embankment that runs through the park, the pressure of human population was immediately visible. During a one-hour ride, over 5000 cattle and 500 humans were counted inside the sanctuary. It is thought that the sanctuary is now home to at least 2000 people and between 8000-10 000 head of livestock (Menon, 1995a). All the large *beels* or lakes within the park, were full of canoes and fishing boats, while the grasslands appeared impoverished. Although technically the villages are outside the periphery of the park, many of them overflow into the sanctuary and all of them exert pressure upon its resources. Row upon row of felled stumps bore testament to the once towering *Bombax ceiba* and *Albizia procera* trees that had entered into illegal trade from the park and guards spoke of lax, even corrupt officers, who had allowed such illegal practices within the sanctuary.

The sanctuary is managed by the Range Officer, under the administrative control of the Divisional Forest Officer, Nagaon Wildlife Division. Laokhawa is a posting that nobody wants - two range officers have been assaulted by local villagers. Unless the Government takes immediate stringent action and increases the motivation of the existing staff, the protection of this sanctuary will seem to have become a very difficult proposition.

Any plans to resurrect Laokhawa should bear in mind the possibility of linkage with the Burrha Sapori (44.06km^2) and Kochmara (21.55km^2) Reserved Forests, situated north and west of Laokhawa Wildlife Sanctuary, with very similar topography and vegetation to the Laokhawa. A thin treeline separates the now exhausted pasturelands of Laokhawa from the Burrha Sapori forest, an area that is being considered for upgrading to a wildlife sanctuary. Although Burrha Sapori still has relatively good habitat, protecting it in isolation holds little value for rhinoceroses when former links to Kaziranga, Laokhawa, Kochmara, Orang and Pabitora are broken and Kochmara Forest is more or less lost to human habitation.

Jaldapara Wildlife Sanctuary

Jaldapara Wildlife Sanctuary (89°30'E, 26°40'N) is located in the flood plains of the Torsa and Malangi Rivers in West Bengal, and, along with Gorumara, its sister reserve, is one of two existing pockets of rhinoceroses in the State (see Figure 1). The AsRSG in 1986 deemed the populations of both these reserves unviable, as together they hold only 48 rhinoceroses, in two small disjunct populations (see Tables 15 and 17). However, Jaldapara is relatively safe from poachers, when compared with most Assamese reserves, and thus gains importance at a time of crisis measures for the Greater One-horned Rhinoceros.

In terms of vegetation, Jaldapara is very similar to Chitwan, in Nepal, where annual floods and fire maintain a high diversity of early successional stages, including grasslands, reedy swamps and riverine forests (Anon., 1994b). It can be broadly classified to include at least half a dozen vegetation types, including northern dry deciduous *Bombax ceiba* – Catechu *Acacia catechu* – Sisso *Dalbergia sissoo* association forest; Sal *Shorea robusta* forest; sub-Himalayan, secondary, wet, mixed forest; eastern, sub-montane, semi-evergreen forest; northern, tropical evergreen forest; and savannah. This high diversity of vegetation, spread over 216km^2 (see

Table 5), makes Jaldapara a highly suitable habitat for a variety of wildlife. As much as 68% of the sanctuary is grassland, 20% woodland and 12% wetland, thus, this is the third-highest percentage of grassland available in any rhinoceros-bearing sanctuary, and is two per cent more than within Kaziranga, proven suitable habitat for the Greater One-horned Rhinoceros. It is worthwhile noting that this is the third-largest area available for the Greater One-horned Rhinoceros, far greater than Orang and Pabitora, which have many more rhinoceroses.

Jaldapara is currently managed by the Divisional Forest Officer, Wildlife Division II and Divisional Forest Officer, Cooch-Behar Division. At present 258 people, of which 43 are forest guards and 156 are casual labourers, are employed to guard the park (see Table 9). A radio transmitter network of 16 fixed stations, three mobile stations and 12 walkie-talkie sets is in place, while three jeeps, a mobile van, 12 elephants (see Table 8), 10 .315mm bore rifles and 40 shotguns (see Table 7) are also at the disposal of the sanctuary's staff.

In the 1920s Jaldapara (including the Patlakhawa reserve, which was later appended to Jaldapara sanctuary) had as many as 200 rhinoceroses. Jaldapara lost most of its rhinoceroses between 1920-30, owing to hunting, habitat loss and flood damage: between 1920 and 1930, at least 100 or more had been hunted or had died naturally, leaving approximately 80 in 1930. The floods of the Torsa River of 1932-33, 1937-38 and 1948-49 also did massive damage to rhinoceros habitats in Jaldapara (see Table 27) and between 1930-32, a large number (possibly as many as 100) of rhinoceroses were poached. Thereafter, until 1968, numbers fluctuated between 80 and 50 (see Tables 15 and 15a and **Population** chapter). Spillett (1966) also noted that there seemed to be a relatively large percentage of young in the population (see Table 16), and therefore felt that the population could well increase. However, a sharp spell of poaching in 1968-72, (by which time the area was a game reserve) brought numbers to 21, since when the rhinoceros population has not recovered (see Table 15), although it has grown.

Table 15

Population and mortality in Jaldapara Wildlife Sanctuary (including Patlakhawa)

Year	Population status	Poaching	Natural deaths	Total mortality
1930 and 1931		50 (approx.)	0	50 (approx.)
1932	40-50	40-50	0	40-50
1935-36	A good number	0	1	1
1936-37	56 (including panbari)	0	1	1
1940-41	Increased in number	0	2	2
1948-49	60+	0	2	2
1949-50		0	4	4
1950-51		0	1	1
1954	30-56	0	3	3
1955-56		2	2	4
1957-58	50 (approx.)	0	2	2
1967-68	76	0	1	1
1968-72		28	12	30
1972-73	21	6	0	6
1973-80	23	5	4	9
1981	22	1	1	2
1982		3	0	3
1933		1	3	4
1984		2	4	6
1985		2	0	2
1986	14	0	1	1
1987		0	1	1
1988	24	0	0	0
1989	27	0	0	0
1990		0	0	0
1991		1	0	1
1992	33	1	1	2
1993	34	1	0	1
1995	35			

Source: Adapted from Bist 1994; official census.

Table 15a

Rhinoceros population in Patlakhawa

Year	Population status
1951-52	A few
1952	25
1952-53	Increasing
1954	Small number
1958-59	10 (approx.)
1967-68	Increasing
1968-69	
1969-70	...

Source: Adapted from Anon. 1994b.

Figure 7

Map of Jaldapara Wildlife Sanctuary

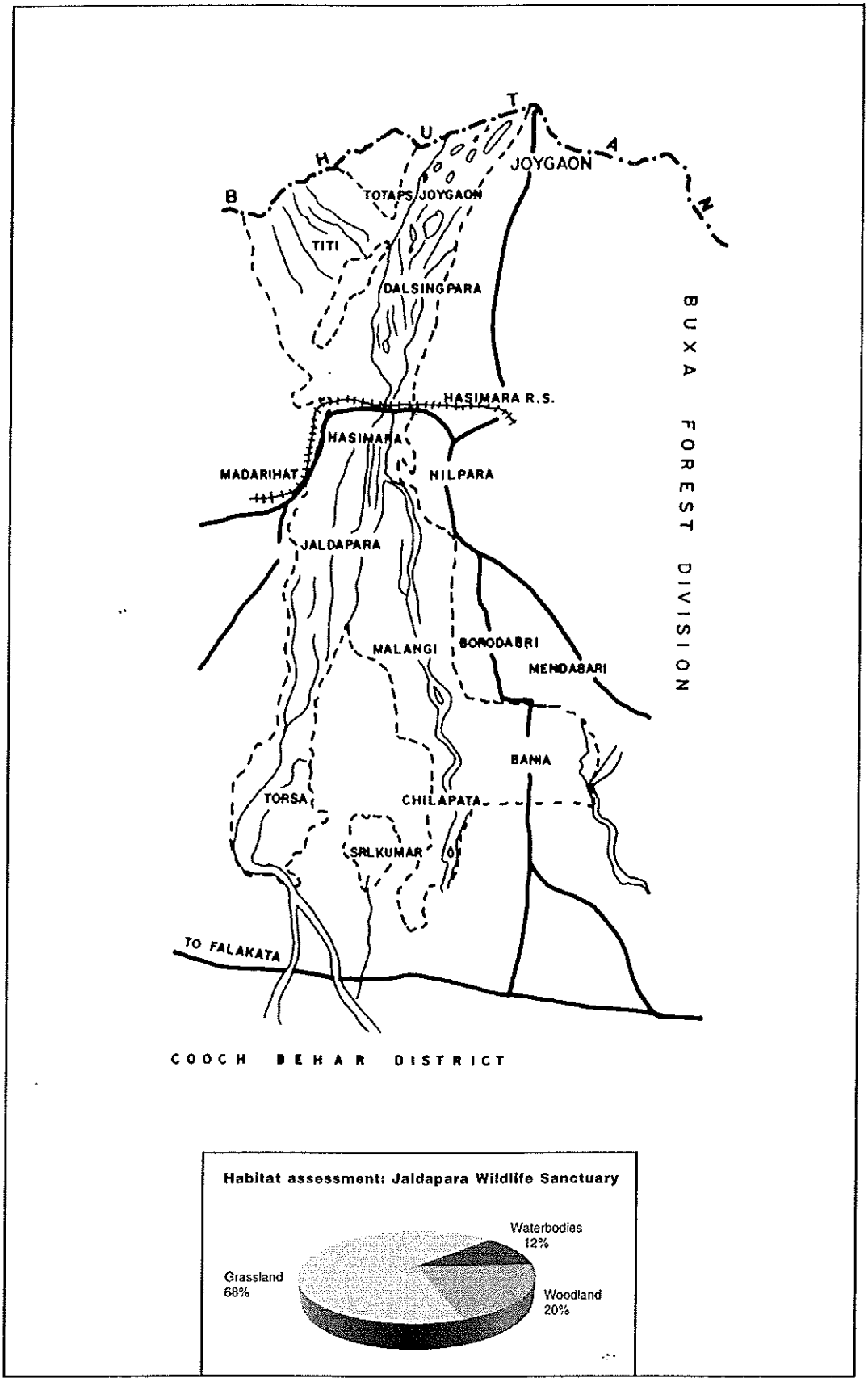


Table 16

Jaldapara Wildlife Sanctuary population structure

Year	Male	Adult Female	Unsexed	Sub-adults/juveniles/calves	Total
1968	-	-	70	5	75
1975	7	7	4	5	23
1978	5	7	4	3	19
1980	5	7	6	4	22
1988 (April)	9	11	-	4	24
1989	9	13	-	5	27
1992 (April)	8	12	-	13	33

Source: Adapted from Anon. 1994b.

Partly owing to the unusual shape of the sanctuary (resembling a pair of trousers), resulting in a very long boundary, protecting the area from encroachment has always been difficult (see Figure 7). Apart from pressure on the land from the 32 villages and eight tea estates that exist along its fringe, the four forest villages included within the sanctuary's boundary and the 1.25 *lakh* (see **Glossary**) livestock population of these villages exert demands on its resources. The approximately two *lakh* villagers depend on the forest for firewood, and the demand for *Dalbergia sisoo*, both immature and mature, and *Acacia catechu* disrupts the mixed forest formations of both, which are the prime habitat of the rhinoceros (Anon., 1994b). Shrinkage of habitat by weed invasion is also a serious problem in Jaldapara, with species such as *Mikania* spp., *Leea* spp., *Eupatorium odoratum, Ageratum conyzoides, Lantana camara, Clerodendron* spp. and *Cyclosarun* spp. dominating.

Gorumara National Park

Gorumara National Park (89°00'E, 26°40'N) of West Bengal lies 80km to the west of Jaldapara, at the junction of the Jaldakha and Murti Rivers. Gorumara National Park was declared a sanctuary in 1976, with an area of 8.52km^2, which was increased to 9.6km^2 in 1993, and to 79.45km^2 in 1995 (see Tables 5 and 6). Rhinoceroses used to travel between Gorumara and Chapramari Reserve to the north, but a new road now restricts them to the southern reserve. Cut off from Jaldapara and Patlakhawa as well, Gorumara exists as an isolated population.

Gorumara is staffed by only 19 personnel under a range officer, 16 of whom are casual labourers, making it the smallest permanent contingent protecting rhinoceroses anywhere in the country (see Table 9). It has the use of four shotguns, two walkie-talkies, and two elephants to help in anti-poaching and management work (see Tables 7 and 8).

First recorded to have fewer than 12 rhinoceroses in the 1920s, Gorumara's population of rhinoceroses has fluctuated between three in number (1952, 1954-55, etc.), five (Spillet, 1966) and 12 (1968-69) (see Table 17). In 1993, seven females, four males and four calves made up the 15 rhinoceroses in the nine square kilometres of the sanctuary (see Table 18), and the population was considered unviable by the AsRSG. The population has currently reached its peak in 1996, with 18 animals, but grave doubts exist of the viability of such a genetically in-bred and marooned population, with very limited habitat (see **Population** chapter). All hopes of a Kaziranga-like resurrection from a population of so few animals remains bleak, although the fears of the West Bengal Forest Department that mixing stocks would dilute unique genetic strains might not really be applicable in this case of a population having been seperated for less than a century.

Table 17

Population and mortality in Gorumara National Park

Year	Population	Poaching	Natural deaths	Total mortality
1950-51	12+	0	3	3
1952	3	0	2	2
1954-55	3	1	0	1
1968-72	12+	4	0	4
1981	8	1	0	1
1982		0	0	0
1983		1	1	2
1984		1	0	1
1985		0	0	0
1986	8	0	0	0
1987		0	0	0
1988		0	0	0
1989	12	0	1	1
1990		1	0	1
1991		0	0	0
1992		1	0	1
1993	15	0	0	0
1995	18			

Source: Adapted from Bist, 1994

Table 18

Gorumara National Park - population structure

Year	Adult Male	Female	Unsexed	Calves	Total
1954-55	1	1	-	1	3
1965-66	-	-	8	2	10
1968-69	-	-	10	2	12
1978	1	3	3	1	8
1989 (Feb.)	4	7	-	1	12
1993 (Nov.)	4	7	-	4	15

Source: Adapted from Anon. 1994b.

Among the records of 139 rhinoceroses killed and 36 injured in the sport hunts between 1877 and 1905 in the State of West Bengal, Gorumara figures only in 1885. Poaching records for this sanctuary show that four rhinoceroses were taken between 1968-72, but in all other years no more than one (see **Poaching over the years**). A spate of rhinoceros aggression between 1985 and 1992, when cases of severe assault by dominant males on other adults were recorded, accounted for the one natural death during that period, that of a calf which bled to death after injury by a male preparing to mate with its mother (see Table 28) (Anon., 1994b).

Dudhwa National Park

Dudhwa National Park, in Uttar Pradesh, is situated near the Indian border with nepal where once Greater One-horned Rhinoceroses occurred naturally (see Figure 1). About one hundred years after the pachyderm became extinct in the area as a result of habitat loss and poaching, it was re-introduced in a sterling effort to return it to its former ranges. The attempt had potential not only in respect of furthering the extant range, but also as a means of furthering the security of the species, considering that the rhinoceros was increasingly restricted to small pockets of northeastern India. The establishment of an alternative site for the species in case of an epidemic or poaching offensive killing animals from the north-east may possibly be of paramount importance to the survival of the Greater One-horned Rhinoceros.

In August 1979, the AsRSG recommended "to identify new areas suitable to harbour additional population units of the rhino and to establish such units by translocating rhinos from over-populated areas". Shortly thereafter, the Indian Board for Wildlife met in New Delhi on 5 November, 1979 and appointed a sub-committee to consider and recommend alternative areas for the translocation of some rhinoceroses from Kaziranga National Park. Later, on the unanimous recommendation of the sub-committee to select Dudhwa National Park as a suitable site, preparation for the translocation of rhinoceroses began and in October 1983 the Chief Minister of Assam agreed to provide six rhinoceroses for the experiment in Dudhwa National Park.

In the event, between 15 and 21 March 1984, two males (one adult, one sub-adult) and three females (two adults and one sub-adult) were captured from Pobitara Sanctuary in Assam. Eight days later, the five rhinoceroses were air-lifted to New Delhi and later transported to Dudhwa National Park. One pregnant female rhinoceros, who resisted captivity, later died following a stressful abortion. Three of the then four remaining rhinoceroses were let out into a specially fenced area on 20 April 1984 (S. Singh, *in litt.*, 18 July 1996).

The plan was to release 20-30 rhinoceroses over a five-year period, to establish a viable breeding population and in April 1985, four more females were captured from around Chitwan National Park in Nepal and the stock at Dudhwa augmented with them (see Table 19). No more translocation could take place, thereafter, however, and so, presently, only 13 animals (one male, four females and eight calves of undetermined sex) inhabit the 20km^2 area encircled by an electric fence (S. Singh, *in litt.*, 18 July 1996) (see Figure 8).

Dudhwa National Park extends over 490km^2, making it potentially the second-largest rhinoceros-bearing area, after Manas (see Table 5). If the rhinoceroses are released into this larger area, basically a mixed *Shorea robusta* forest, a large number of measures need to be taken to ensure their viability. The northern and northwestern boundary of Dudhwa runs along the border with Nepal and therefore the area is potentially particularly vulnerable to poaching threats. As, presumably, the nuclear population to be released would be a small one, it would be even more susceptible to poaching pressures. The national park has been disturbed during the past few years by timber-felling, poaching and militancy and despite having been in place for more than a decade, the translocation project has not yet realized its goal fully.

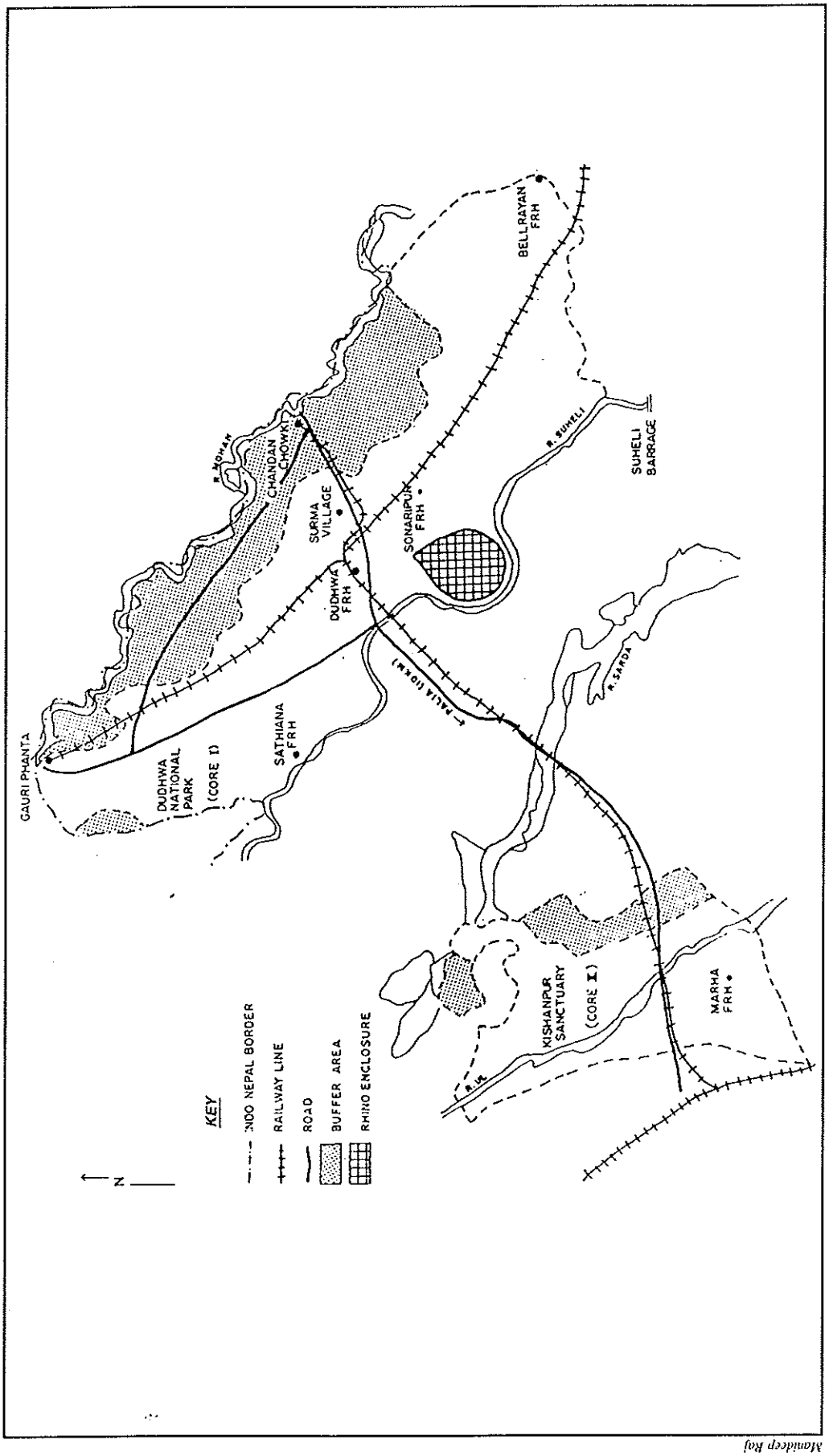


Figure 8
Map of Dudhwa National Park (part of), showing rhinoceros enclosure

Mamdeep Raj

Table 19

Rhinoceros population in Dudhwa National Park (November, 1993)

	Released	Born	Died
Adult males	2		1
Adult females	7		3
Calves		8	2
Total	**9**	**8**	**6**

Source: Adapted from Anon. 1994b

Katerniaghat Wildlife Sanctuary, also in Uttar Pradesh, has a population of four Greater One-horned Rhinoceroses, which migrated from a neighbouring reserve in Nepal.

POPULATIONS OF GREATER ONE-HORNED RHINOCEROSES IN INDIA AND AN ANALYSIS OF THEIR CURRENT VIABILITY

The population of the Greater One-horned Rhinoceros in India has undergone a dramatic change, from the time the animals were widely distributed throughout the Indo-Gangetic plain, to the time of their tenacious survival today. During this century, for example, the population of Kaziranga, as mentioned above, has experienced a near-hundred-fold increase, from 12 to 1200, in 90 years. While an outline of changes in numbers of rhinoceroses has been provided as part of a description of each protected area cited above, this chapter aims to bring together and expand upon that information in a brief chronological account of population fluctuations and resultant analyses of current populations' individual viability. Such information is an essential background to the consideration of the impact of poaching on the populations in question (see later chapter).

Population fluctuations this century

An analysis of the wild population of the Greater One-horned Rhinoceros in India this century shows a steady increase from 580 in 1966 (Spillet, 1966), to 1125 in 1979, 1334 in 1986, to *circa* 1512 in 1995 (see Table 20). Additionally, 35 captive rhinoceroses were present in Indian zoos in 1993, of which 16 were juvenile and 19 adult. Of these 25 males and 10 females, 23 were wild-born and 12 born in captivity (see Table 21). A chronological review of population fluctuations of Greater One-horned Rhinoceroses in India this century is largely restricted, according to available data, to the period post 1960, with the exception of West Bengal. Hence, this chapter demarcates the century pre-1960 as a single time period but others decades are considered individually.

Table 20

Population of rhinoceroses in India

State	Area	Population				
		1966	1979	1986	1993	1995
Assam						
	Kaziranga	400	960	1080	1164	1200-1300
	Manas	15	40	80	25?	12?
	Orang	12	30	65	100	90-100
	Pabitora	6		40	65	68-76
	Laokhawa	40	40	5	0	0
	Other pockets	52	15	25	60?	20
West Bengal						
	Jaldapara	50	40	32	34	35
	Gorumara	5			15	18
	Other pockets	-	-	-	25	?
Uttar Pradesh						
	Katerniaghat					4
	Dudhwa			7	12	13
Total		**580**	**1125**	**1334**	**1504**	**1512**

Source: as for Tables 10-19.

Table 21

Greater One-horned Rhinoceroses in captivity in Indian zoos as of 1993

Location of zoo	Juvenile < 10 yrs		Adult 10-40 yrs		Total captive		Wild born		Captive born	
	M	F	M	F	M	F	M	F	M	F
Guwahati	7	1	3	2	10	3	8	2	2	1
Patna	0	2	2	1	2	3	2	1	0	2
Kanpur	3	0	1	1	4	1	0	1	4	0
Delhi	1	0	1	1	2	1	1	1	1	0
Chhatbir	1	0	1	0	2	0	2	0	0	0
Nandankanan	0	0	0	1	0	1	0	1	0	0
Mysore	0	0	1	0	1	0	1	0	0	0
Bombay	0	0	1	0	1	0	1	0	0	0
Hyderabad	0	0	1	0	1	0	0	0	1	0
Total	**13**	**3**	**12**	**7**	**25**	**10**	**16**	**7**	**9**	**3**

Source: Adapted from Anon. 1994b.

Pre-1960s

Bengal[6]

Some accounts of rhinoceroses in West Bengal are available for the period before the 1960s. In 1920, Jaldapara and Gorumara sanctuaries had about 212 Greater One-horned Rhinoceroses, nearly 200 of them in Jaldapara. The next available information, chronologically speaking, records a sharp drop in numbers to 40-50 animals in Jaldapara and four or five in Gorumara, by 1932 (see Table 15). The reason for this decline is not known: hunting had been outlawed since 1910. By 1959, numbers had climbed to approximately 65 animals in Jaldapara, and eight in Gorumara (Bist, 1994), but these totals reflected only a net addition of about 15 animals to the Jaldapara population, and three or four to the Gorumara population over about 30 years.

Pre-1960, there were also some rhinoceroses present in nearby Buxa Wildlife Sanctuary (then a reserved forest), and Patlakhawa Reserved Forest, (which was not then included in Jaldapara) in northern West Bengal. Buxa Reserved Forest records a couple of rhinoceroses between 1948 and 1950 and approximately 10 animals by 1958-59 (see Table 22). Patlakhawa records as many as 25 animals in 1952, a figure which had decreased to about 10 animals in 1958 (see Table 15a).

Table 22

Rhinoceros population in Buxa

Year	Population status
1948-49	A couple of rhinoceroses
1949-50	A couple of rhinoceroses
1952-53	In fair number
1953-58	Exist
1958-59	10 (approx.)
1966-68	Exist

Source: Adapted from Anon. 1994b.

Assam

As suggested above, the first censuses and estimates of rhinoceroses in Assam started only in the mid-1960s, although there is evidence that numbers increased from the dozen (some reports put this figure as high as 40: T. Foose, pers. comm., 1996) or so animals in Kaziranga in 1908, to well over 200 animals by the beginning of the 1960s (Laurie, 1978).

1960s

Bengal

In Jaldapara, the number of rhinoceroses increased slowly, by about 10 animals during the decade, reaching a high of 76 in 1968, since unsurpassed (see Table 15). Similarly, in Gorumara the number of the species grew during the decade, from eight to twelve (see Table 17).

This decade witnessed the end of a resident presence of the Greater One-horned Rhinoceros in Buxa and Patlakhawa reserves, although each recorded the species as present (in unknown number) up to 1969 (Bist, 1994).

Assam

The 1960s saw the first estimates of rhinoceroses in the reserves at Manas, Kaziranga and Orang. While 366 animals were counted in Kaziranga, there were estimates of 15 animals in Manas, and 12-25 animals in Orang Wildlife Sanctuary (Spillet, 1966). However, no more than this one census in each of these protected areas was made during the decade.

1970s

Bengal

West Bengal was estimated by the AsRSG to have 40 rhinoceroses in 1979. Rhinoceroses in Jaldapara faced the first big drop since the 1930s, from 76 animals in 1968, to around 20 in 1978, while the number in Gorumara slipped back to about eight animals, by 1978. It is presumed that the remaining 12 animals (of the 40 mentioned above) were outside these two protected areas and in the Buxa-Patlakhawa belt.

Assam

Kaziranga National Park was censused twice during the 1970s, in 1972 and 1978, when 658 and 939 animals, respectively, were counted. During the six-year gaps between 1966-72 and 1972-78, the increase in number of animals was approximately the same, namely, 292 and 281, respectively. Forty rhinoceroses were calculated to be in the then Manas Wildlife Sanctuary, and 25-30 in Orang Wildlife Sanctuary (Laurie, 1978). No estimates of populations within Pabitora sanctuary had been made, but in 1979 40 rhinoceroses were estimated to be in Laokhawa Wildlife Sanctuary (Schenkel and Schenkel, 1979). Otherwise in Assam, 15 rhinoceroses were thought to be present in other pockets, presumably including the Mayong Hills, which are today part of Pabitora Wildlife Sanctuary.

1980s

Bengal

The 1980s saw a slight recovery among rhinoceroses in West Bengal: Martin *et al.* (1987) recorded a total of 32 animals in West Bengal, in 1986, while the Jaldapara population reached 27 by 1989, and that of Gorumara 12 by the same year (Tables 15 and 17).

Assam

During this decade, Kaziranga was censused in 1984. One thousand and eighty rhinoceroses were counted, but the increase in number since the 1978 census (141) was smaller than the increases during the two inter-census

periods previous to that. The rhinoceros population of Manas reserve was estimated by the Assam Forest Department twice during the 1980s, as a result of which the previous calculation of 40 rhinoceroses in the area was revised upwards to 75-80, in 1986, and 85 in 1989. These revisions were more a reflection of past underestimates, rather than of a 100% addition to the Manas population within a decade. The first Forest Department censuses of Orang and Pabitora were carried out during the 1980s. Sixty-five rhinoceroses were counted in Orang, in 1985, another case of an apparent doubling of population figures since the previous decade. The census in Pabitora resulted in a tally of 54 animals, far more than expected for this 16km^2 sanctuary. It was after this census that the rhinoceroses were captured to be translocated from Pabitora to Dudhwa National Park, in 1986 (Martin *et al.*, 1987).

1990s

Bengal

So far the 1990s have been promising for the Bengal sanctuaries. Jaldapara recorded 35 rhinoceroses in 1995 and Gorumara 18, a number unprecedented for that reserve, bringing the total wild rhinoceros population of West Bengal to 53 rhinoceroses in 1995.

Assam

Kaziranga National Park has been censused twice so far this decade, resulting in a count of 1129 rhinoceroses in 1991 and 1164 in 1993. The figures show that the population increase of 49 rhinoceroses in the six-year interim between 1984 and 1991 was at a still lower rate than during the inter-census periods of the 1980s. Therefore, while there has been a continuous growth in numbers of rhinoceros at Karziranga since records have been kept, rates of growth have been increasingly low between at least 1978 and 1991 (see Figures 9 and 10). While it is well-known that recruitment rates level off as population sizes increase, this factor alone would not account for such a conspicuous pace of decrease in population growth. Rather, the rate may be explained by the high rate of poaching that has affected the park (see **Poaching over the years**).

Estimates were made of the rhinoceros population within Manas National Park in 1990 (85-100 animals), 1992 (80 animals), and 1993 (60 animals). Since 1993, continued poaching from the national park seems to have caused a further decline in the rhinoceros population, now thought to number only about a dozen animals[5] (Deb Roy, pers. comm., 1996; Choudhury, pers. comm., 1996). This decrease is the most worrying so far this decade, given the alarming effect it has had on the population of rhinoceroses which was India's second-largest during the 1970s and 1980s.

Orang Wildlife Sanctuary increased its numbers of rhinoceroses from 65 (in 1985), to 97 by 1991, and is now thought to have between 90 and 100 rhinoceroses. Thus, Orang is now the claimant of India's second-largest population of rhinoceroses.

Pabitora Wildlife Sanctuary recorded 56 rhinoceroses in 1993 and between 68 and 76 in 1995.

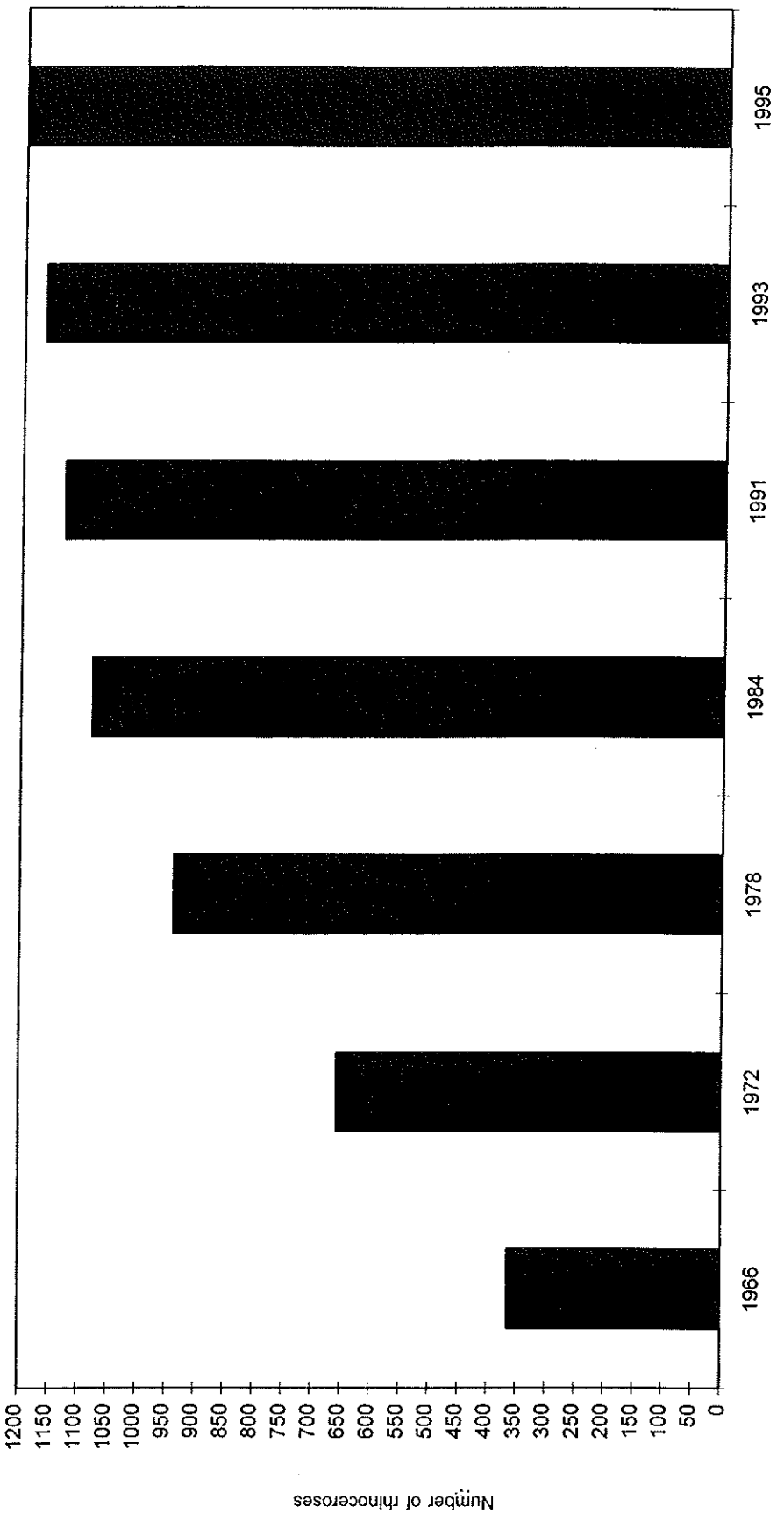
Uttar Pradesh

India has two populations at wildlife sanctuaries in the State of Uttar Pradesh, part of the historic range of Greater One-horned Rhinoceroses. While Dudhwa National Park has 13 animals, Katerniaghat Wildlife Sanctuary has four.

The number of Greater One-horned Rhinoceroses in India stands now, therefore, between 1474-1622, the State of Assam holding the bulk, of about 1400 rhinoceroses. Such a high concentration of such a threatened species in this one State, currently suffering tremendous law and order problems, already places the species's survival in jeopardy, without the added threat of poaching. Although it can be seen that populations of some protected areas have been increasing in numbers recently (Figure 9), it is clear that depiction of the rate of growth of the population in each (Figure 10) reveals a starker prospect for the Greater One-horned Rhinoceros in India.

Figure 9a

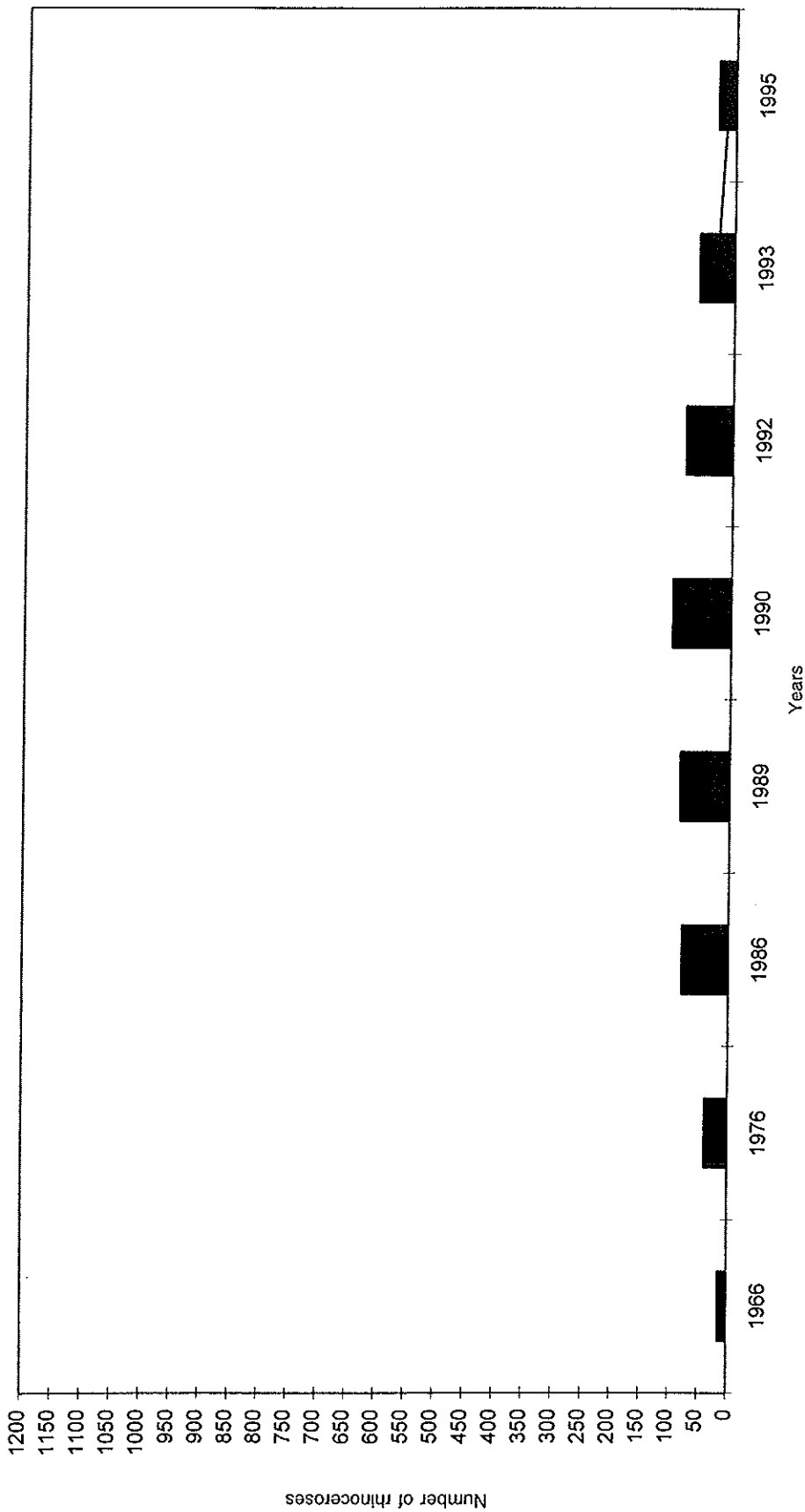
Population of rhinoceroses: Kaziranga National Park



Source: Official censuses.

Figure 9b

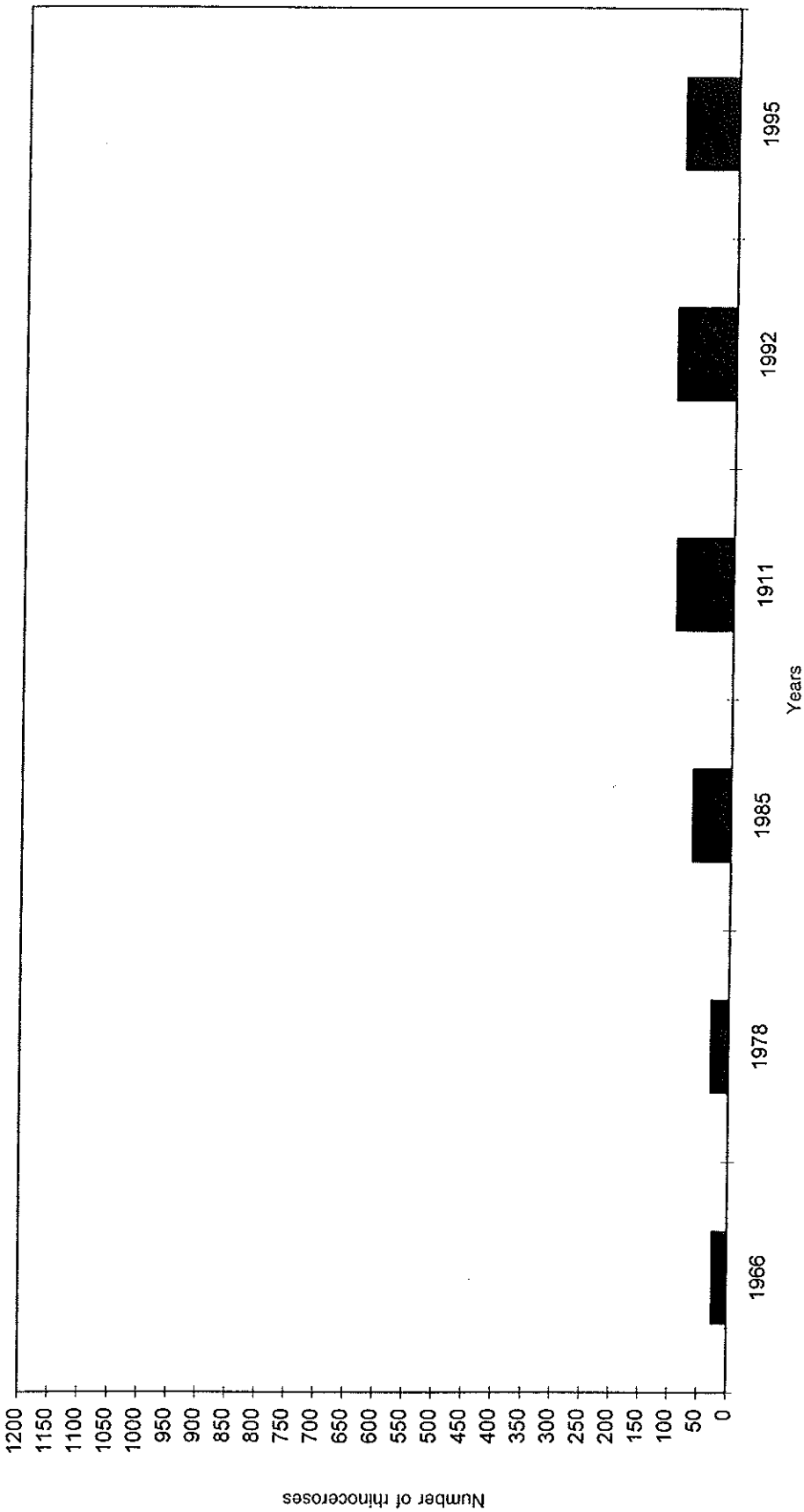
Population of rhinoceroses: Manas National Park



Sources: Official censuses; lower estimates (as indicated by bar) for 1993 and 1995 are author's figures[5].

Figure 9c

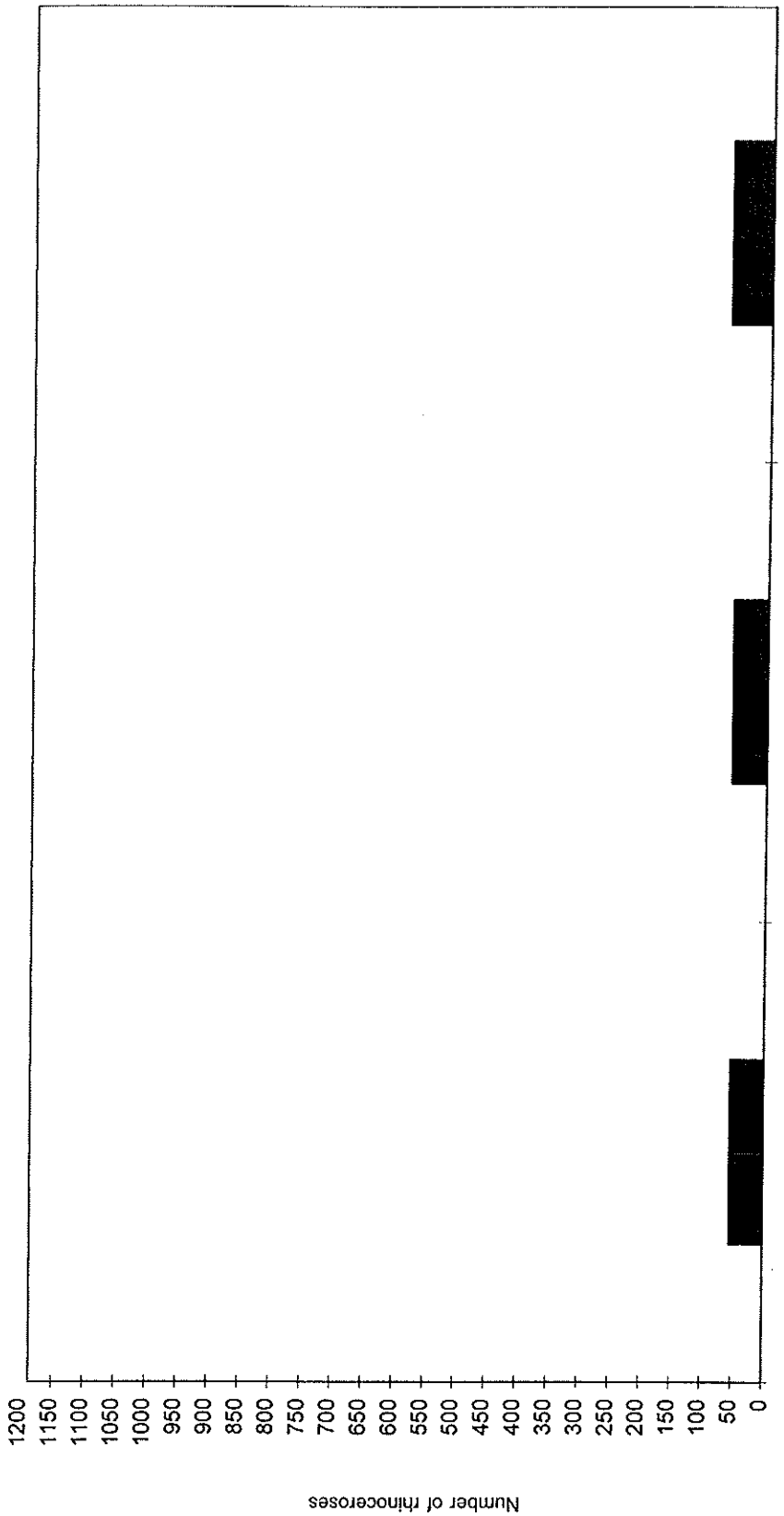
Population of rhinoceroses: Orang Wildlife Sanctuary



Sources: Official censuses; Spillet, 1966; Laurie, 1978.

Figure 9d

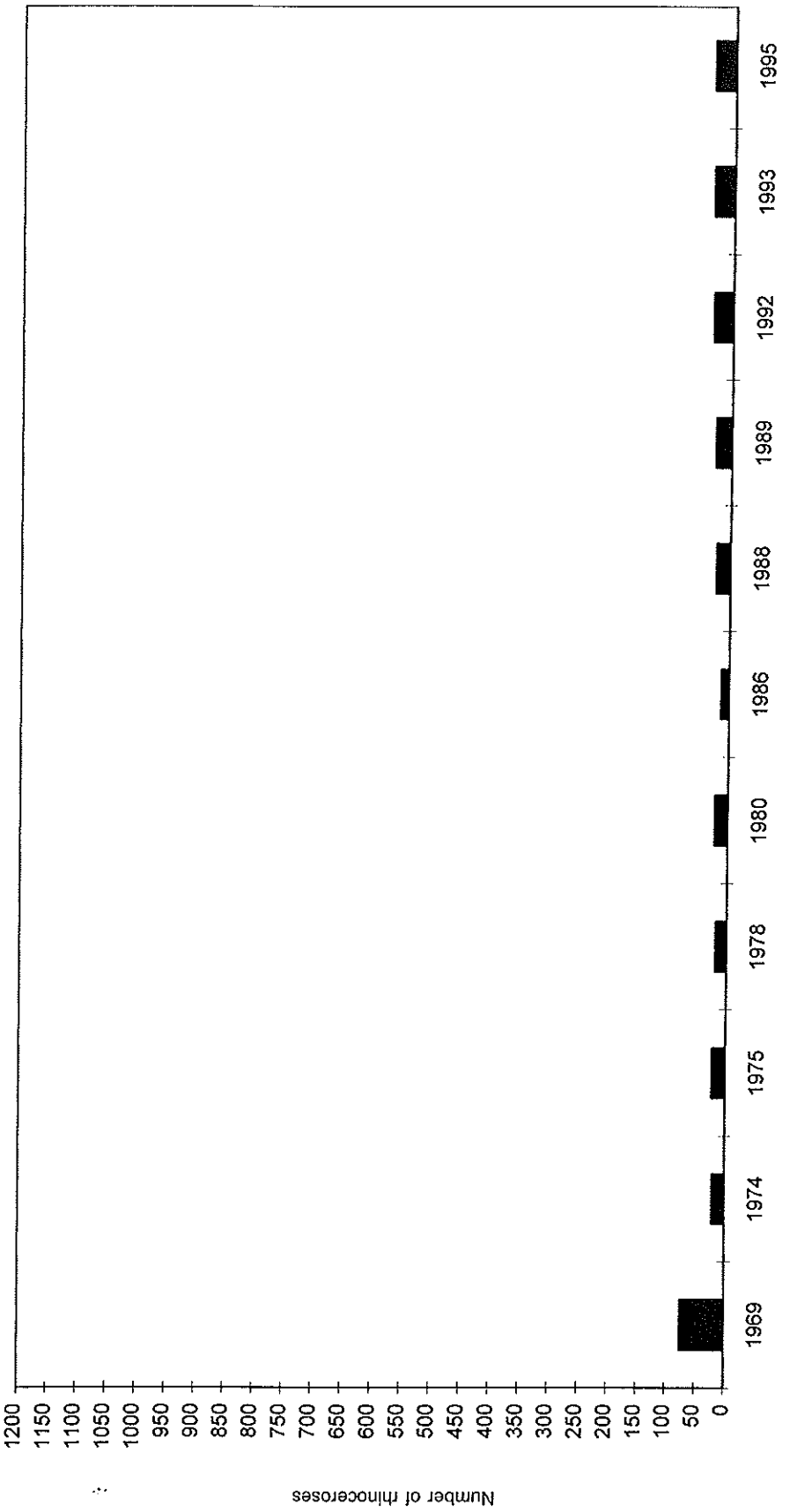
Population of rhinoceroses: Pabitora Wildlife Sanctuary



Source: Official censuses.

Figure 9e

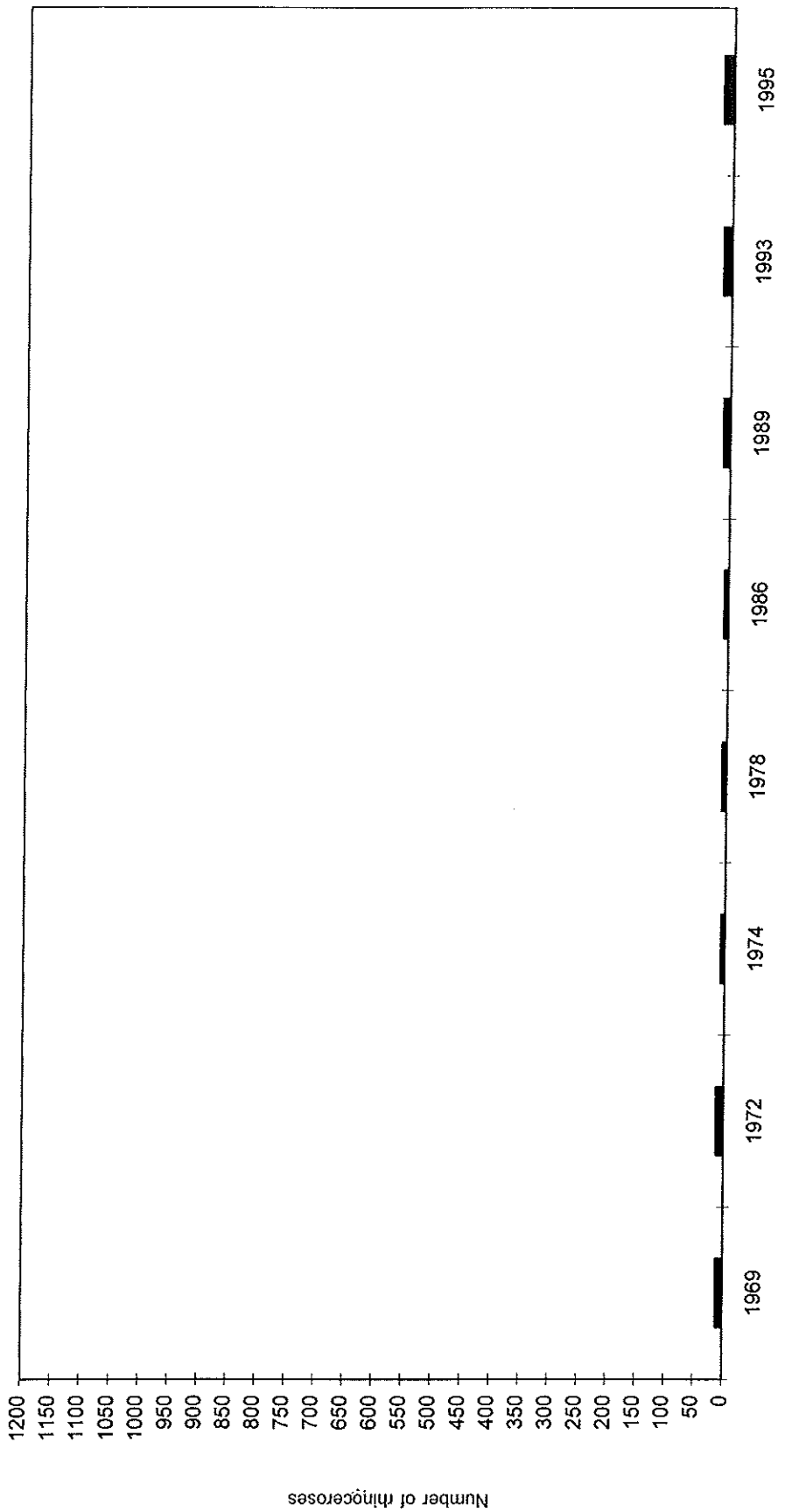
Population of rhinoceroses: Jaldapara Wildlife Sanctuary



Source: Official censuses.

Figure 9f

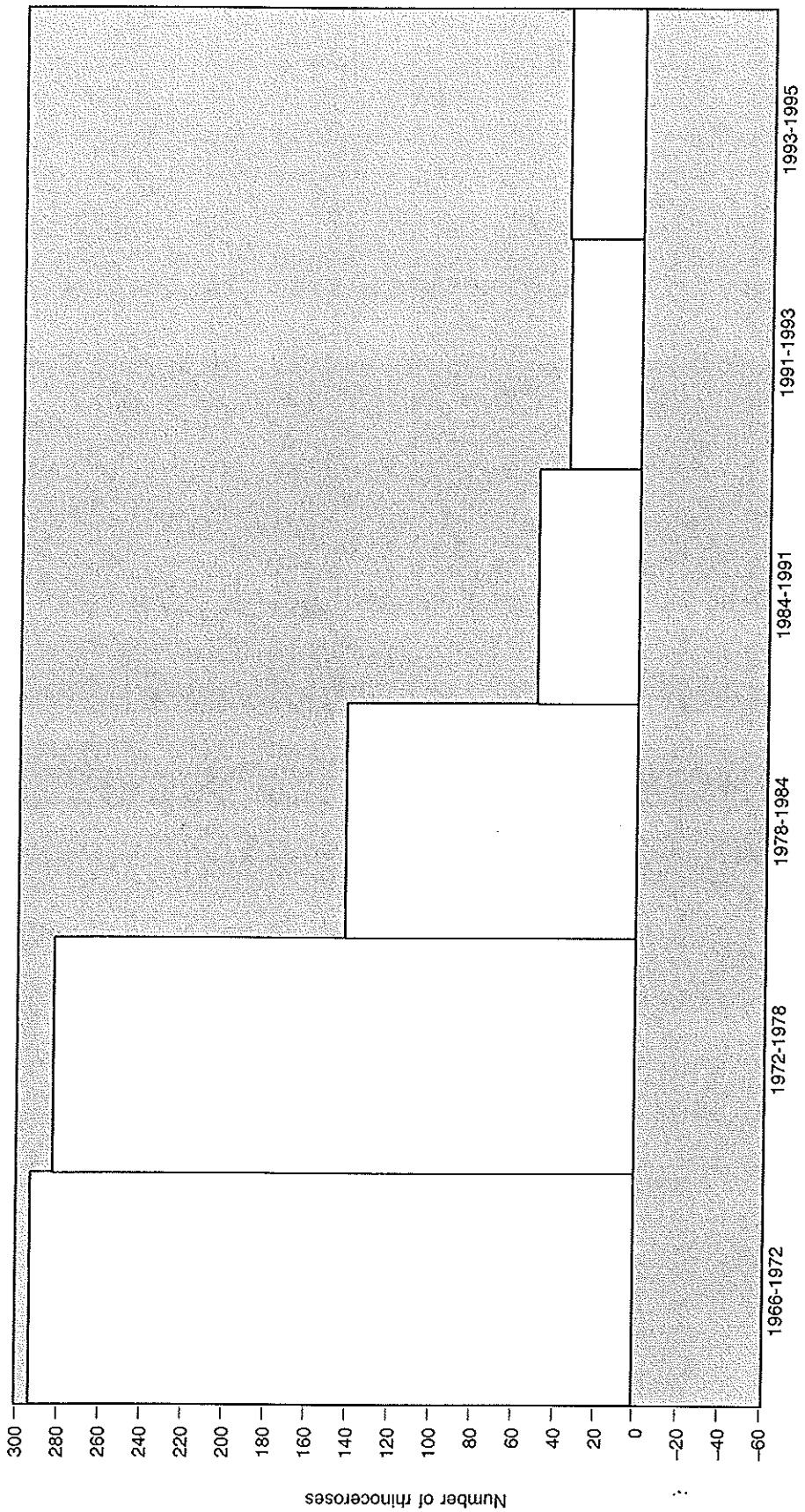
Population of rhinoceroses: Gorumara Wildlife Sanctuary



Source: Adapted from Bist, 1994.

Figure 10a

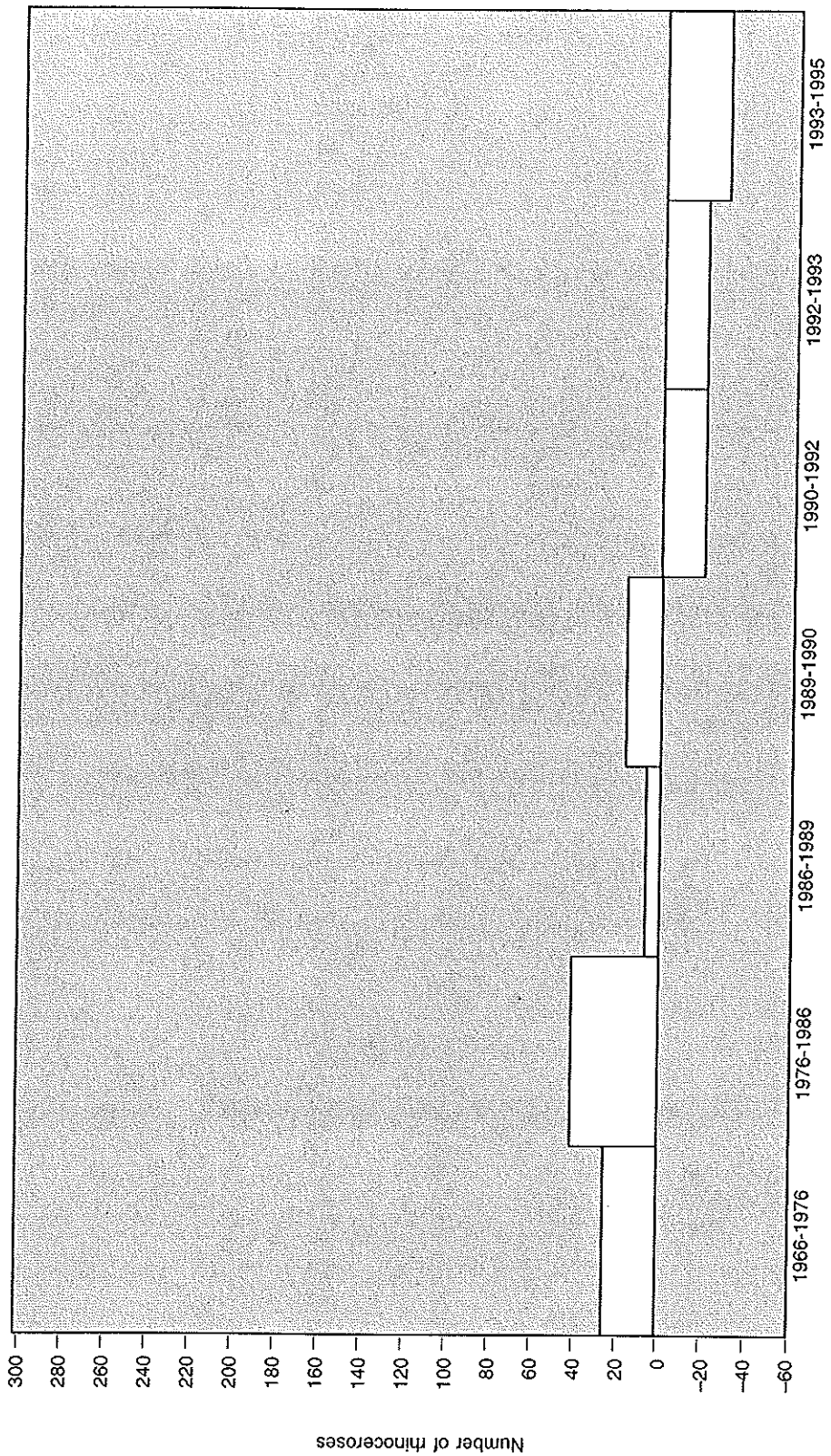
Increase in rhinoceros numbers between successive censuses: Kaziranga National Park



Source: as for Figure 9.

Figure 10b

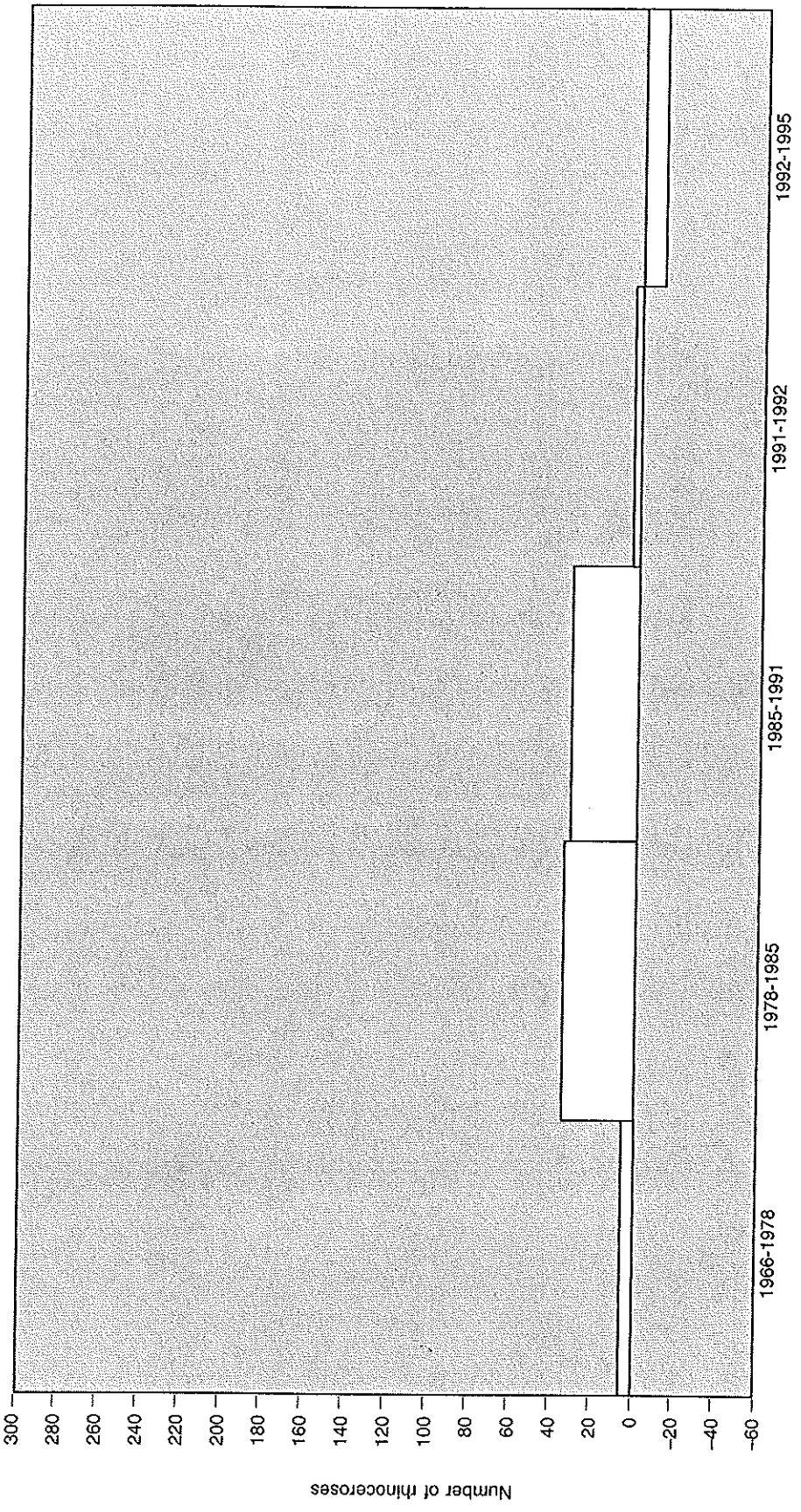
Increase in rhinoceros numbers between successive censuses: Manas National Park



Source: as for Figure 9.

Figure 10c

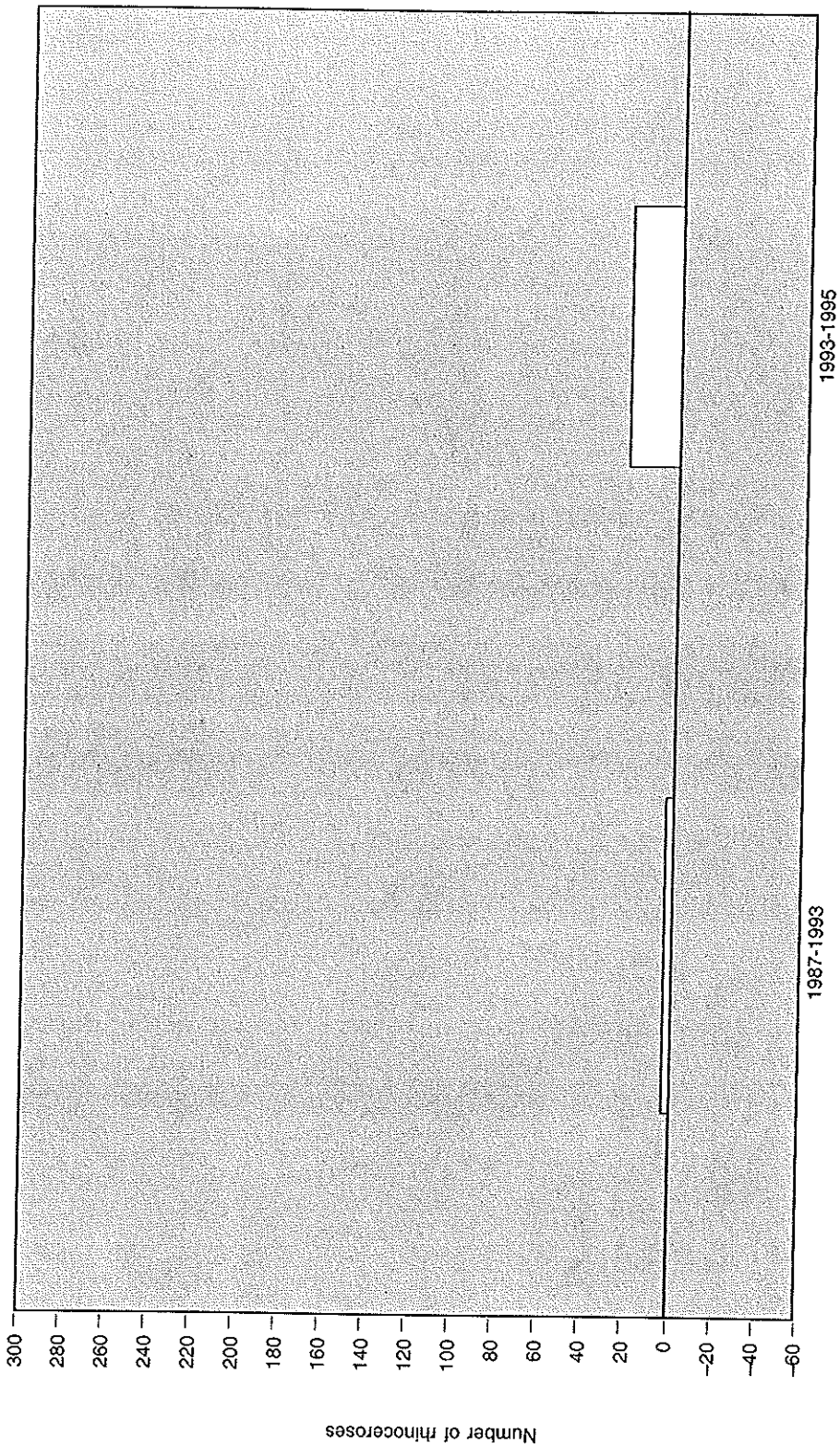
Increase in rhinoceros numbers between successive censuses: Orang Wildlife Sanctuary



Source: as for Figure 9.

Figure 10d

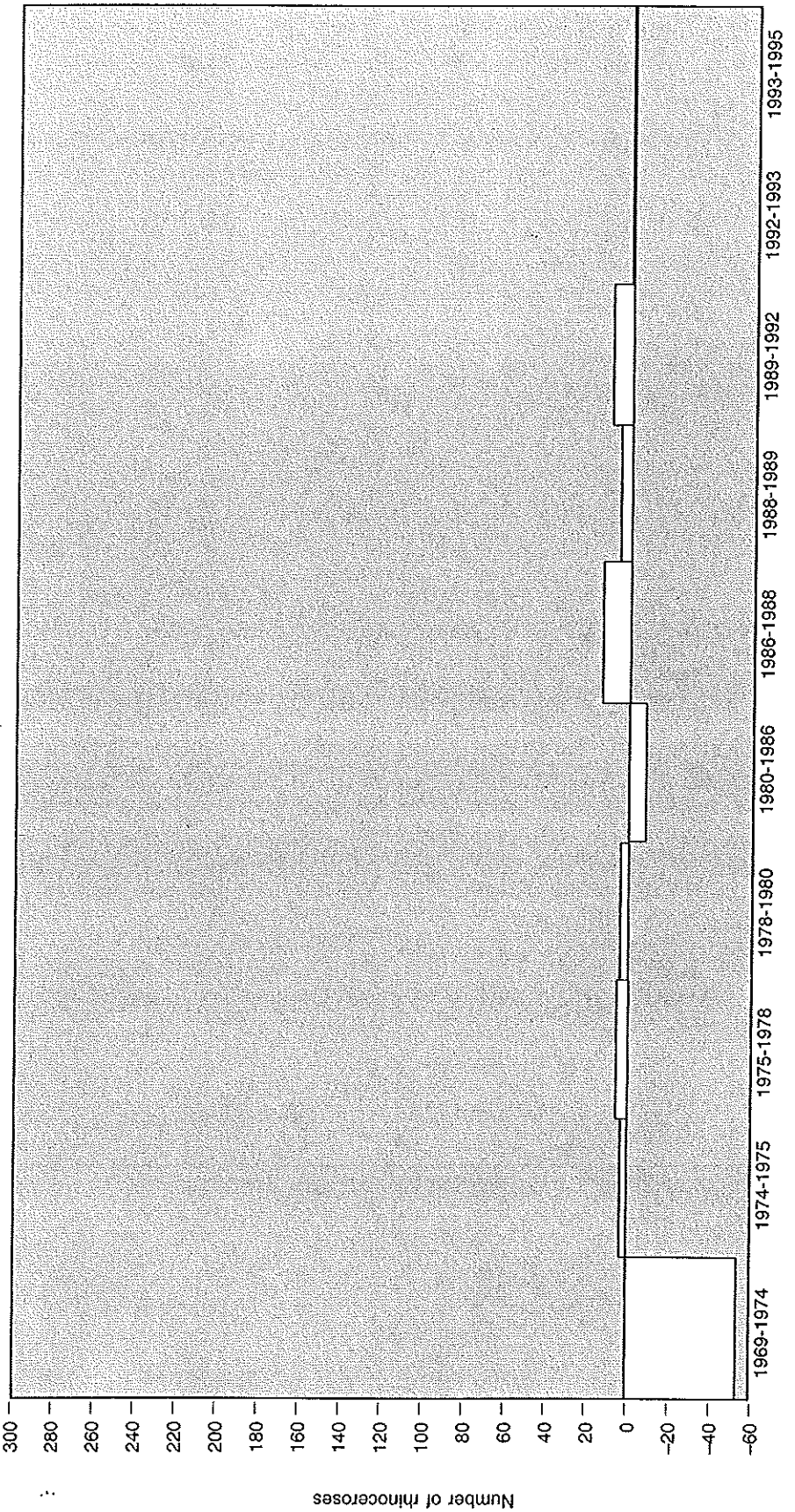
Increase in rhinoceros numbers between successive censuses: Pabitrora Wildlife Sanctuary



Source: as for Figure 9.

Figure 10e

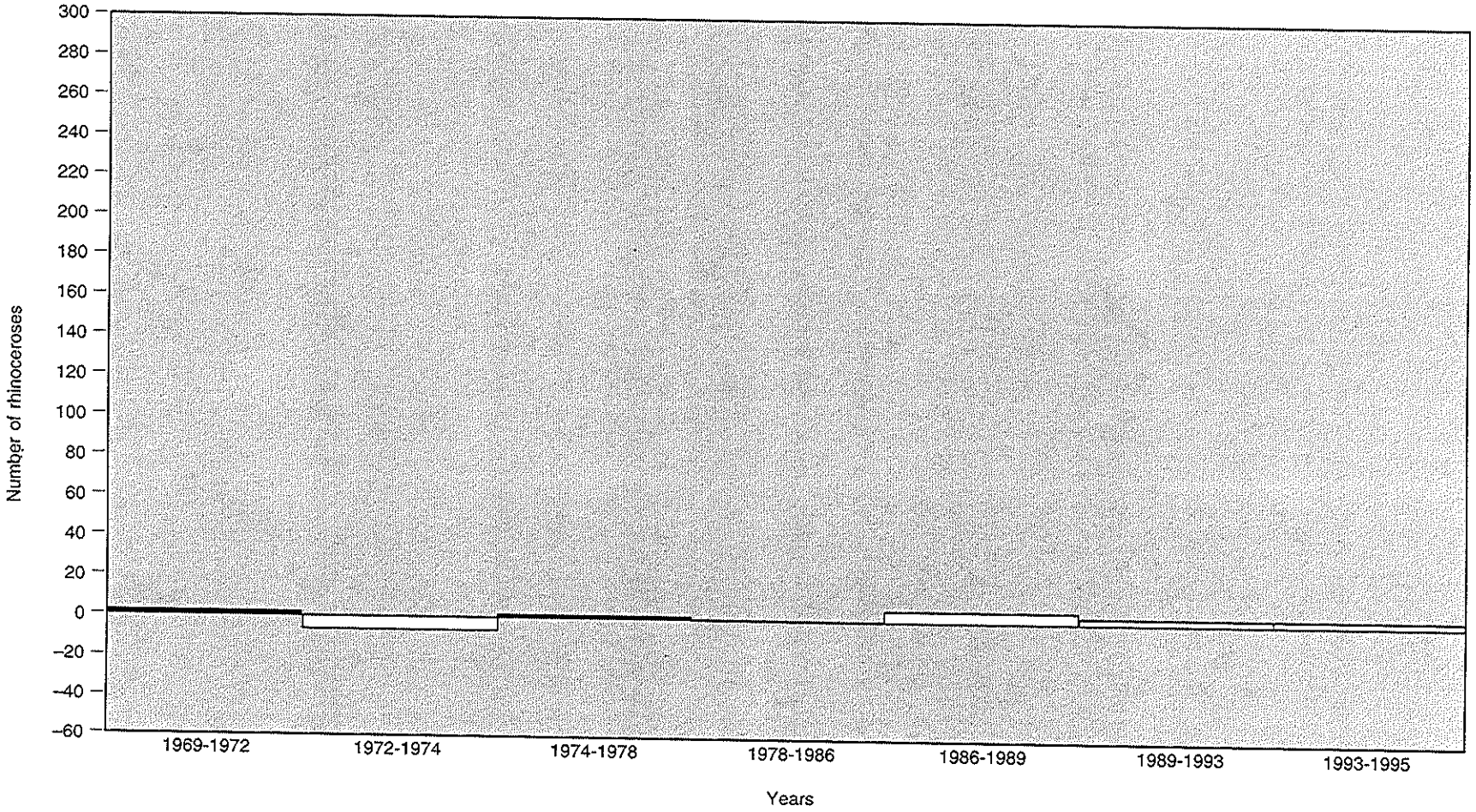
Increase in rhinoceros numbers between successive censuses: Jaldapara Wildlife Sanctuary



Source: as for Figure 9.

Figure 10f

Increase in rhinoceros numbers between successive censuses: Gorumara Wildlife Sanctuary



Source: as for Figure 9.

Viability of wild populations

The viability of populations of rhinoceroses can be assessed according to consideration of various factors as they relate to the populations, such as conservation biology, habitat destruction, and poaching activity. Khan (1989) accordingly distinguishes three categories of viability for Asian rhinoceros populations, which are set out below. The categories are followed by an analysis of each as it relates to the current status of Indian populations of Greater One-horned Rhinoceroses.

"1. Reasonable Viability

A minimum number of 100 rhinoceroses seems to be indicated by the Population Viability Analysis (PVA) for a population to be genetically and demographically viable for periods of time in the order of 150 years. To maintain such populations, areas of 100km² or less will be required in the productive riverine habitats frequented by the great one-horned Rhinoceros. Naturally, area requirements may also vary somewhat depending on the actual carrying capacity of a particular habitat. Longer term viability (>10 generations) will then require that enough of the separate populations of 100 be maintained to achieve a metapopulation, with an N, of perhaps 500 for each species. Because of Ne/N ratio effects, such metapopulations for each species will need to be 2000 to 3000 rhinoceroses."

Analysis

As of 1995, India has only one population which definitely has over 100 animals, which is that of Kaziranga. Orang recorded exactly 100 animals in 1993, but the sanctuary has an area of less than 100km² (76km²) and a potential carrying capacity of little more than 100 animals (see Table 23). Therefore, according to the terms above, only Kaziranga National Park can be said to have a reasonably viable population of Greater One-horned Rhinoceroses, while Orang has a population whose long-term viability would probably be dependent on increased habitat range.

Table 23

Carrying capacities of rhinoceros bearing protected areas in India

Location	Current rhinoceros population	Potential carrying capacity	Habitat availability		Protection status
			Present area	Potential area (in km²)	
Katerniaghat	4	10	20	20	WLS
Manas	12	under 100	500	500	NP
Dudhwa	13	under 100	490	490	NP
Kaziranga	1200-1300	1500	430	900	NP
Laokhawa	0	over 50	70	70	WLS
Orang	90-100	under 150	76	76	WLS
Pabitora	68-76	over 70	18	40	WLS
Pockets in Assam	20	?over 100	508	508	Insecure
Jaldapara	35	over 150	216	225	WLS
Gorumara	18	over 50	79	100	NP
Total	1407-1523				

Source: AsRSG; Indian Government statistics; author's research.

"2. Limited or Uncertain Viability

Populations with fewer than these numbers of rhinoceroses, actually or potentially, may have shorter-term viability and value for the preservation of the species. Periodic artificial migration (i.e. managed movement) of rhinoceroses between smaller populations may effectively render them a single larger population and would thereby enhance the viability of such remnant rhinoceros populations, as discussed further. However, the cost of such operations will be high and their success uncertain.

There may be other factors that render a population smaller than the Minimum Viable Population (MVP) guidelines for long-term viability worthy of attempted preservation.....However, realistic cost-benefit analyses need to be performed on each of the rhinoceros populations of limited viability to determine if intensive and interactive management is feasible in both logistic and economic terms. This cost-benefit analysis should, above all, demonstrate that attempts to preserve these smaller remnants of rhinos do not divert or dissipate resources needed to protect the larger, reasonably viable populations."

Analysis

All rhinoceros-bearing areas in India other than Kaziranga would probably come under this category, with the exception of Gorumara. Manas, which at one time would have been considered to have a viable population is now downgraded to this category, following recent poaching within the reserve. Pobitara and Jaldapara fall in this category, given the number of animals and their habitat size. Dudhwa, although still containing a very small population, is in this category because of its potential.

"3. Inviable or 'Doomed'

A 'doomed' rhinoceros is defined as an animal that is considered to have no possibility of contributing to the survival of the species in its current situation because :

a. it is not part of a population large enough to be viable in genetic and demographic terms, and/or

b. the animal cannot be protected from habitat destruction or poacher activity with acceptable or available levels of resources."

Analysis

Only Gorumara, of the rhinoceros-bearing areas that currently have a rhinoceros population, is unviable in this context. Laokhawa, which lost all its rhinoceroses, of course falls in this category. Unless immediate steps are taken, with re-introduction plans forming part of the conservation package, these two sanctuaries may well be considered unviable, or doomed, in terms of conservation of the Greater One-horned Rhinoceros.

Thus, currently the only two populations of Greater One-horned Rhinoceroses in India which are viable are those of Kaziranga and Orang. In addition, populations at Manas, Pobitara, Jaldapara and Dudhwa are of limited or uncertain viability, while that of Gorumara is considered unviable.

POACHING OF GREATER ONE-HORNED RHINOCEROSES IN INDIA

Hunting, the precursor to poaching

The decline of the Indian population of the Greater One-horned Rhinoceros started essentially with habitat loss and killing by man for sport. Poaching as a commercial activity to supply the lucrative Oriental medicinals trade was a much later occurrence and poaching for the domestic market was also negligible. Any attempt to analyse the poaching trends of today and their effect on numbers of Greater One-horned Rhinoceroses should first take account of the hunting pressures to which the species was subjected in India.

The earliest records of hunting the Greater One-horned Rhinoceros in India date back to *circa* 1030 AD, when Al-Beruni, historian and scholar, wrote, "The *gainda* ("rhinoceros" in Hindi) exists in large numbers in India, more particularly about the Ganges. It is of the build of a buffalo, has a black scaly skin, and dewlaps hanging down under the chin. It has three yellow hoofs on each foot, the biggest one forward, the others on both sides. The tail is not long, the eyes lie low, further down the cheek than is the case with all other animals. On the top of the nose there is a single horn which is bent upwards. The Brahmins have the privilege of eating the flesh of the *gainda*. I have myself witnessed how an elephant coming across a young *gainda* was attacked by it. The *gainda* wounded with its horn a forefoot of the elephant, and threw it down on its face." (Sachau, 1910). Ibn Batuta, an Arab traveller, saw rhinoceroses near the Indus River in 1314 AD and recorded their hunting as follows, "I saw a rhinoceros yet another time when, in the company of the king of India, we had entered a jungle of reeds. The sultan was mounted on elephants along with him. The foot-soldiers and horsemen went in and beat it up, killed it and conveyed its head to the camp." (Gibb, 1971).

Babur, the Mughal emperor in the sixteenth century (see **Background**) hunted rhinoceroses several times. In February 1519 he wrote, "I went to hunt rhinoceros on the Sawati side [Suabi, west of the Indus River] which place people call also Karg-khana [rhinoceros home]. A few were discovered but the jungle was dense and they did not come out of it." In December 1526, Babur had another encounter with a rhinoceros. "There was a rhinoceros in a bit of jungle near Bigram [Peshawar, Pakistan]. ....It took its way across the plain. Humayun [his son] and those come with him from that side who had never seen one before, were much entertained. It was pursued for two miles; many arrows were shot at it; it was brought down without having made a good set at man or horse. Two others were killed." (Beveridge, 1970).

In eastern India, it was the Maharaja of Cooch Behar who had the distinction of almost single-handedly sending the Greater One-horned Rhinoceros to its doom. Legal hunting of the rhinoceros was allowed in the State of Bengal (Cooch Behar being a part of that State), until 1932, when the *Bengal Rhinoceros Preservation Act* was passed. From the detailed records kept in the maharaja's hunting books, it seems the maharaja killed 132, and injured 31, rhinoceroses between 1877 and 1904 in Garodhat and Buxa Reserve Forests (see Table 24) (Bist, 1994). Apart from this, an additional seven rhinoceroses were killed and four injured by him in the present-day Jaldapara-Gorumara region. According to Martin (1979), the maharaja personally shot 207 rhinoceroses between 1871-1907. Martin (1979) also records 47 rhinoceroses killed by Colonel Fitzwilliam Thomas Pollock in Assam and Bengal towards the end of the nineteenth century.

Such hunting pressures caused the rhinoceros to have vanished from the Rajmahal hills in Bihar by 1850, and from Uttar Pradesh by 1878, and thus to have become confined to eastern India by 1890. Until 1896, a sum of Rs20 was paid by the Government of West Bengal for every rhinoceros killed. By the time this practice was officially abolished in 1910, rhinoceros hunting had left perhaps as few as a dozen rhinoceroses in Kaziranga, and the species was poised on the verge of extinction. Luckily, the various protection measures that were effected from around that time (for example, Kaziranga became a reserved forest in 1908), seemed to have been

Table 24

Hunting of rhinoceroses in West Bengal

Year	Jaldapara		Garoghat (Cooch Behar)		Buxa		Patlakhawa		Gorumara		Total	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1877			11	-	4	-					15	-
1879			11	-	-	-					11	-
1880			6	2	-	-					6	2
1881			8	2	-	-					8	2
1882			9	2	-	-					9	2
1883			7	4	-	-					7	4
1884			8	-	5	1	-	-	5	2	18	3
1885			10	2	1	-					11	2
1886			18	-	-	-					18	-
1887			4	1	-	-					4	1
1889			4	2	1	2					5	4
1890			1	-	3	-					4	-
1891			4	2	1	2					5	4
1892			-	-	3	1					3	1
1893	1	1	2	1	5	1					8	3
1895			-	-	2	4					2	4
1896			-	-	4	2					4	2
1897			1	-	-	-					1	-
1904			-	-	-	2					-	2
1905			-	-	-	-	1	1				
Total	**1**	**1**	**104**	**18**	**28**	**13**	**1**	**1**	**5**	**2**	**139**	**36**

Source: After Bist, 1994.

instrumental in aiding the recovery of rhinoceros populations, and in bringing about a conservation success, until such time as the insiduous pressures of poaching began to take their toll.

Poaching over the years

With the official ban on rhinoceros hunting coming into force in 1910 in India, killing of rhinoceroses became an illegal activity. Some records of poaching are available for the 1930s and 1940s, but become noticeably more numerous from 1960 (there are no indications of the number of rhinoceros poaching cases that go undetected). The nature and extent of poaching activity from that time to the present is outlined below.

The 1960s

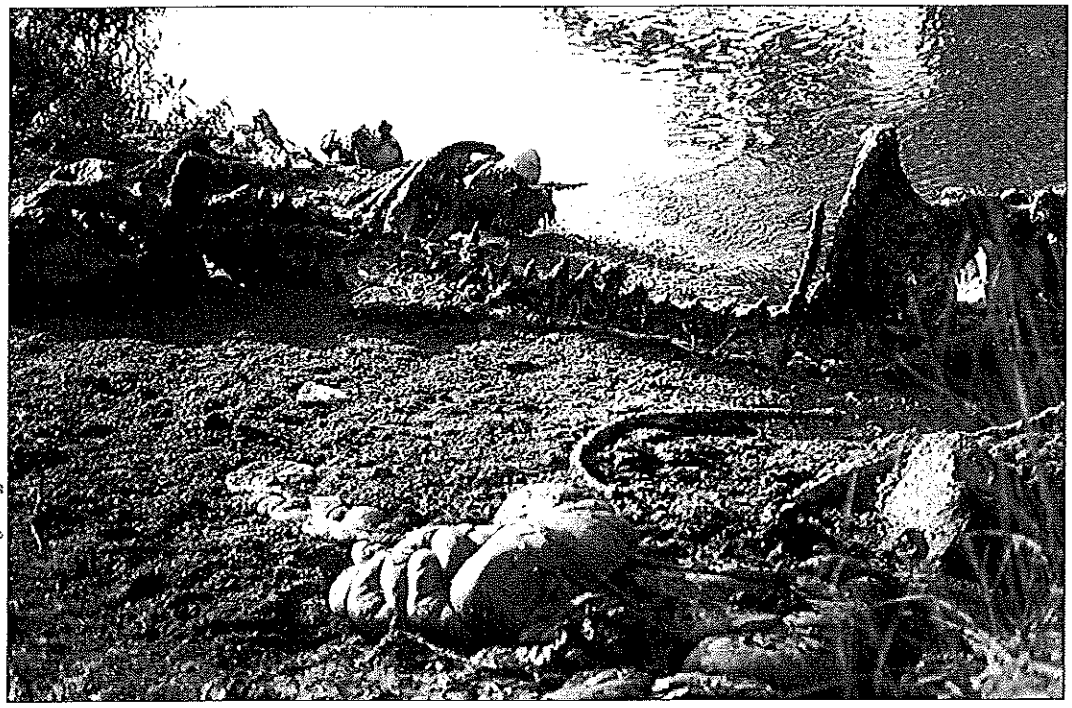
If the 1980s and 1990s can be viewed as the storm years of poaching, the 1960s can be viewed in many ways as the early winds of change. This is partly owing to the number of rhinoceroses present in India during the decade. Although hunting had reduced the Greater One-horned Rhinoceros to a perilous state by the turn of the century, intervening decades of subsequent protection had rehabilitated rhinoceros numbers by the 1960s (see earlier chapter on population trends). A 400-strong population, at least, of rhinoceroses existed in Assam by the mid-1960s and this reversal in the species fortune probably resulted in the first waves of poaching: the relative abundance of rhinoceroses and concomitant relaxation of guard among park staff will have made their location by poachers correspondingly easier. Between 1968-72 (individual figures for the years are not available), Jaldapara and Gorumara lost 32 rhinoceroses to poaching, or a third of the rhinoceroses present in these protected areas; Kaziranga lost 53 rhinoceroses between 1965-69, the first large number lost to poachers, roughly 15% of its population average for the decade. Manas only lost three rhinoceroses to poachers during the decade, but despite scanty and inconsistent records available for the period, it can be seen that the 1960s were the actual start of the poaching trend that was later to endanger the species once again.

The 1970s

This decade has been thought to have been the eye of the poaching storm as absolute figures of poaching were considerably lower than both the decades that preceded and followed it. Owing to their reasonable success in the 1960s, poachers were faced with depleted rhinoceros populations in the 1970s. Once again, data are not consistent enough to present an accurate picture for the whole of India.

Jaldapara and Gorumara lost only 11 rhinoceroses in the 1970s, only a third of the number lost in the 1960s. Nonetheless, this still amounted to roughly one third of the number of rhinoceroses present in the two sanctuaries throughout the decade (26-36), indicating continuing poaching pressure put on the species in the 1970s.

Kaziranga, meanwhile, lost 29 rhinoceroses to poachers in the 1970s, which, owing to an increase in population in the park amounted to only marginally more than three per cent of its average population for the decade. Eleven rhinoceroses were taken from Manas by poachers. No figures are available for other rhinoceros-bearing areas of that period, but if one presumes that a further 10 rhinoceroses were poached outside the protected areas mentioned, it would mean that the State of Assam lost 50 rhinoceroses during the 1970s, or less than six per cent of a population of about 850 animals (an average for the decade). This is a far smaller proportion than that lost from Assam in the 1960s.



WWF India Eastern Region Office

A rhinoceros killed illegally within Kaziranga National Park. Villagers collected the meat from the carcass.

The 1980s

This decade marked a resurgence in poaching. Towards its end, it also saw the start of two new methods of poaching, poisoning and electrocution. While the former was first recorded from 1987, electrocution was first known to be used in 1989. The 1980s was also the first decade for which complete poaching data are available for all rhinoceros populations in India. To understand the pressures in operation, it is useful to consider the 1980s in two parts, that is, 1980-84, and 1985-89. This also facilitates comparison with the similar period of time for which data are available in the 1990s, namely 1990-94.

1980-84

During this period, 251, or 22.3%, of 1125 (Schenkel and Schenkel, 1979) rhinoceroses were poached throughout India. This first half of the 1980s incorporated the start of a wave of poaching to affect India and Nepal, ranging from 1982 to 1986. The sanctuary hardest hit in this period was Laokhawa, which lost 61 rhinoceroses, almost its entire population of the species. Badly affected also, Kaziranga lost 125 rhinoceroses to poachers during the period, experiencing thereby a drop of 13% from its population levels at the end of the 1970s - a massive upsurge in poaching. Poachers claimed 27 rhinoceroses from Orang Wildlife Sanctuary during this period, but the size of the population from which they were taken is not totally clear: the population was estimated by Schenkel and Schenkel in 1969 to number 30, yet in 1986, despite the poaching of 27 animals, the population was counted at 65 (Martin, *et al.*, 1987). It therefore appears that the 1969 tally could have been an underestimate.

Pabitora recorded its first four rhinoceroses poached in 1984.

1985-89

This part of the decade experienced no respite from poaching pressures. A further 232 rhinoceroses fell prey to poachers, resulting in a total of 483 rhinoceroses killed during the 1980s, an alarming number of a species with a world population of under 2000 the wild. The proportion of the total Indian population of rhinoceroses in

1986 (based on Martin, *et al.*, 1987) lost during this part of the decade was 17.4%, only slightly less than the proportion of the total population lost during the previous half of the decade. Kaziranga lost 180 rhinoceroses in the period, 16.6% of its population; Orang continued under pressure, forfeiting 19 rhinoceroses, 29.2% of its population; electrocution and poisoning took a toll of 11 from Pabitora. Manas showed signs of starting to lose animals at a serious pace, 17 rhinoceroses during the period. However, there was little portent of what was to come for this reserve, even by 1989, when the AsRSG referred to it as one of three viable areas for the Greater One-horned Rhinoceros in India (Khan, 1989).

Laokhawa's rhinoceros population was reduced by another three rhinoceroses, all but extinguishing the presence of the species in that sanctuary.

The 1990s

The poaching rates, which redoubled during the 1980s, accelerated during the 1990s. In the four years 1990 to 1993, 209 rhinoceroses were poached in India, equivalent to 13.8% of the remaining population. With the exception of the "black year" of 1983, when the country lost 95 rhinoceroses, never before had more than 60 rhinoceroses been killed in one year, yet in 1992 and 1993, 66 rhinoceroses were poached annually. The most seriously affected reserve of this half-decade was undoubtedly Manas National Park, which officially lost 41 rhinoceroses (68% of its population). Although some accounts claim that rhinoceroses are no longer to be found in Manas, it is believed that 20-odd rhinoceroses might still survive there (see also Table 20). However, as previously indicated, this figure is below the minimum requisite for the population's biological viability. Kaziranga also lost a substantial number of rhinoceroses - 147 - during this period. This equates to 12.6% of the park's population, marginally less than that poached during the preceding half decade. The last four rhinoceroses of Laokhawa were poached during this period; Pabitora lost 10 rhinoceroses; but Orang apparently achieved a remarkable level of protection from poaching, only two rhinoceroses being killed from 1990-92.

West Bengal, which had a reduced population right through the three half-decades (1980-95), has seen a reduction in poaching during the 1990s and lost only five rhinoceroses to poachers.

Projected poaching

Table 25

Projected poaching figures for rhinoceroses in India

Area	Projected annual poaching as of 1993	Comments
Kaziranga	4% (of population)	If existing trends continue
Orang	1-3%	Has since had two bad years of poaching. Projected poaching now over 5%.
Manas	5-6% (1 in 10 chance of 20% of population being poached in any year.)	Probably an underestimate based on population overestimate. Currently at more than 10% annually.
Pabitora	6% for next 10 years	20% chance of increasing to 10% by the end of the decade
Jaldapara	2-3%	If existing trends continue
Gorumara	1-2%	If existing trends contiunue
Dudhwa	1-5%	If population grows and is left without the protecting fence.

Source: Menon *et al.*, 1994

A closer look at present-day poaching

Poaching for rhinoceros horn fast became the single most important reason for the decline of the Greater One-horned Rhinoceros after conservation measures were put in place from the beginning of the twentieth century (and legal hunting ended). Both populations of over 100 rhinoceroses in Kaziranga and Chitwan national parks are descended from fewer than 60 animals each. The fact that the number has reached 1200 in the case of Kaziranga, or 460 in the case of Chitwan (Khan *et al.*, in prep.), reflects the laudable success of the conservation and protection programmes initiated to help retrieve this species from the extinction vortex. In many cases this has led to a certain complacency, and when Khan (1989) writes that "The species has been intensely protected by Indian and Nepalese wildlife authorities and the situation until recently seemed under control.... Recent reports indicate that 238 rhinoceroses were lost in India between 1982-85, though this rate of attrition has been slowed down considerably", he is only indeed quoting what most conservationists thought was the case at that time. However, the poaching wave of 1989-93 turned out to be more catastrophic than that of 1982-85, claiming 266 rhinoceroses. Similarly, Redmond and Martin (1992) reported that Assam lost only 28 rhinoceroses in 1991, the lowest number in years, but although India did indeed only lose 33 animals that year, the two following years claimed 66 each, giving the lie to any notion of attenutating poaching rates.

Ironically, in fact, so successful were the initial protection measures, that Greater One-horned Rhinoceroses survived only in pockets of protected areas, vanishing almost completely from non-protected areas, a situation alien to the conservation of other megafauna in the Indian subcontinent (such as Tigers or Asian Elephants *Elephas maximus*). This fragmentation of Greater One-horned Rhinoceros populations, owing first to habitat loss and hunting, and subsequently to localized protection measures, has increased the exposure of populations to the threat of poaching, held as they are in deposits often far too small and ill-protected. Nothing bears

testimony to this so clearly as the case of Laokhawa, which in 1983 lost 41 rhinoceroses, virtually the entire population of the sanctuary. It was then easier for the poachers to target systematically the few rhinoceroses left and those straying in from outside, such as from Orang Wildlife Sanctuary, and the last rhinoceros in Laokhawa was shot in 1991. Laokhawa, thus, offers an example of how over 50 rhinoceroses in just over 70km^2 can vanish in a short span of time. The vulnerability of populations with fewer rhinoceroses, such as those of Jaldapara, Gorumara, Pabitora, and now definitely Manas, cannot be underestimated. Manas National Park is indeed already another serious casualty, as recent population estimates show as few as perhaps 12 rhinoceroses[5] left in the park of the 80-100 in 1990. The sudden poaching pressures which beset Manas and peaked after 1987 have, in less than a decade, rendered close to unviable that which was India's second-largest population of Greater One-horned Rhinoceroses, and one of only three populations considered viable by the AsRSG (Khan, 1989).

Although poaching pressures on the rhinoceros have always been felt since the inception of their protection (prior to that, in the strictest terms, it was hunting pressures that were operating), two notable poaching waves hit India in the periods 1982-1986, and 1989-1993. These waves were most influenced by local law and order situations: they peaked in 1983 and 1993, respectively, coincident with the Laokhawa and the Manas rhinoceros massacres. Indeed, the phenomenon of poaching of the Greater One-horned Rhinoceros in India can perhaps be best understood in terms of waves, catalysed by local conditions and, conversely, quelled to some extent by retaliatory enforcement. In the eleven years from 1982-93, only three years recorded a poaching figure of less than 40 (1987, 1988 and 1991). Vigne and Martin (1991) recorded the onset of the second wave of poaching in 1989. According to figures gathered during this study, 57 rhinoceroses were killed that year followed in successive years by figures of 44, 33, 66 and 66, totalling 266 rhinoceroses. Although this figure was very alarming, the more so because the two hardest hit populations were India's two largest, those of Kaziranga and Manas, the 1982-86 wave, which claimed 304 rhinoceroses, was definitely the worst one to hit India since the protected areas were set up in the 1950s (see Table 26).

Nepal, which has reported a very low poaching rate of its rhinoceroses, also records the 1982-86 poaching period as having been the worst recently, 11 of the 38 rhinoceroses poached between 1973 and 1990 taken during that time. The country also records a resurgence in poaching in the early 1990s, with 1990 marking a loss of seven rhinoceroses, the highest number lost in a year since 1973. These findings further strengthen the hypothesis of there having been two principal waves of poaching affecting the Greater One-horned Rhinoceros.

The two poaching waves, it should be noted, are clearly distinct from one another, rather than part of a single wave marked by an interim lull: the different geographical epicentres of the two waves illustrate this (see Figure 11). While in the 1982-86 wave, the sanctuaries of Laokhawa, Kaziranga and Orang were the hardest hit, making it almost a central Assam wave, the epicentre of the more recent wave was Manas, in lower Assam. However, it may not be assumed that the two waves were unalike in all respects: given the constancy of demand for rhinoceros horn and the equally constant opportunistic presence of poachers, the waves each represent time periods of relatively poor protection of reserves, breakdown in law and order, and other such local factors that present poachers with their opportunity. In fact, the operations of the United Liberation Front of Assam (ULFA), which began in the mid-1980s, and the Bodoland dispute, which became prominent between 1987 and 1989 (see **Box 2**), coincide neatly with the two main waves of poaching. It has, therefore, been very tempting to attribute a substantial amount of the poaching of rhinoceroses to these two outlawed groups. Even if this were true to some extent, there is enough evidence to show that in all probability it was the opportunistic poacher who profited chiefly from the breakdown in law and order which ensued from the uprisings (see ***Poacher's profile***), more than the actual activists directly, themselves.

Table 26

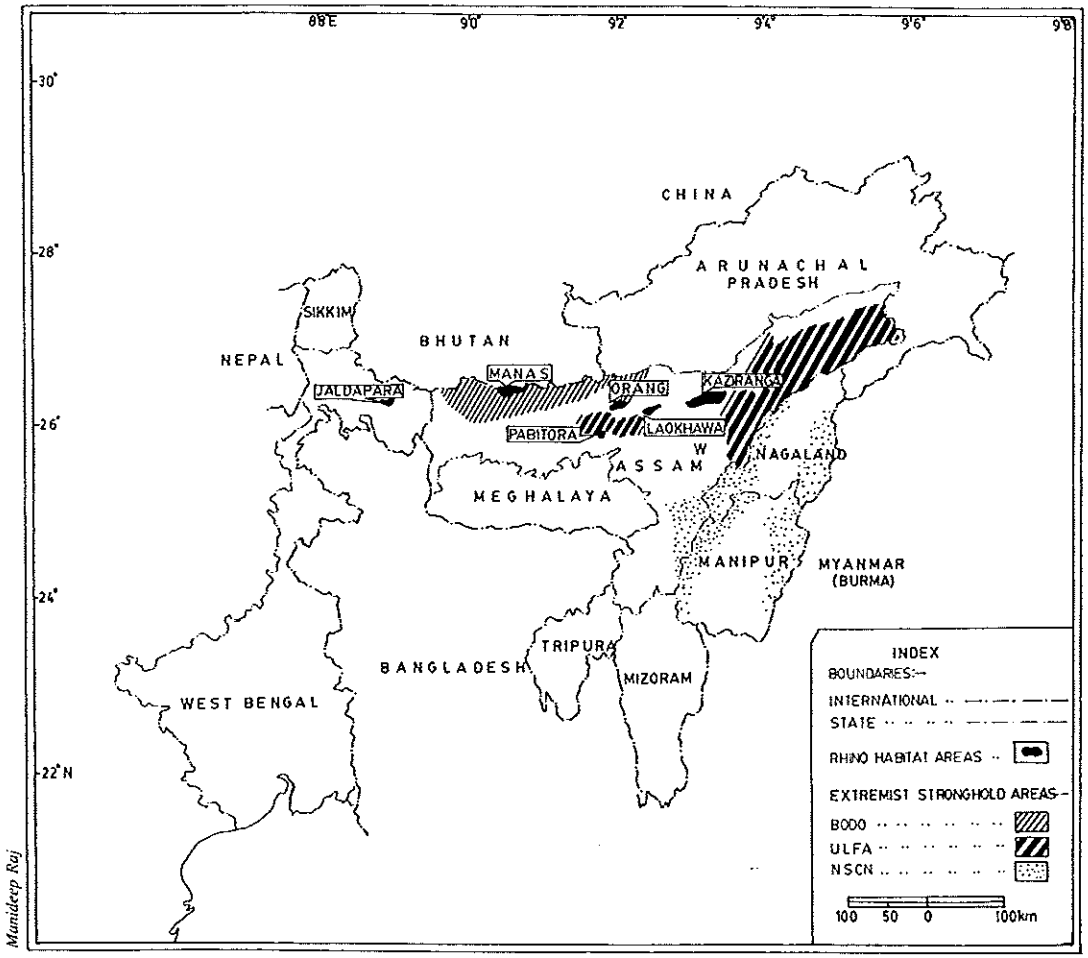
Number of known rhinoceroses poached in India, from 1980 to 1993

Area	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total
Kaziranga National Park	11	24	25	37	28	44	45	23	24	44	35	23	49	40	452
Laokhawa Wildlife Sanctuary	1	5	9	41	5	2	1	0	0	0	3	1	0	0	68
Manas National Park	3	2	1	3	4	1	2	7	1	6	3	6	11	21	71
Orang Wildlife Santuary	2	2	6	10	7	8	3	1	4	3	0	1	1	-	48
Pabitora Wildlife Sanctuary	0	0	0	0	4	2	0	2	3	4	2	1	3	4	25
Other places in Assam	3	2	4	2	0	0	0	0	0	0	0	0	0	0	11
Jaldapara (inc. Patlakhawa) Wildlife Sanctuary	-	1	3	1	2	2	0	0	0	0	0	1	1	1	12
Gorumara National Park	-	1	0	1	1	0	0	0	0	0	1	0	1	0	5
Total Poaching	**20**	**37**	**48**	**95**	**51**	**59**	**51**	**33**	**32**	**57**	**44**	**33**	**66**	**66**	**692**

Source: as for Tables 10 to 15 and 17.

Figure 11

Map to show areas occupied by political rebel groups in India, with reference to rhinoceros-bearing areas in the country



Box 2

Civil uprisings in north-east India

AASU - All Assam Students' Union was a powerful students' association that rocked the State government in 1983 with a series of demands for reform for Assam. During 1983-84 many of their demonstrations took on a violent turn, causing a severe break in law and order in certain parts of Assam. The agitation had as its epicentre central Assam.

ULFA - Today an outlawed group considered extremist by the State government, the United Liberation Front of Assam grew essentially out of the AASU agitation and registered as a party in the late 1980s. For nearly a decade ULFA was a powerful influence on State politics, demanding social reforms and change. The movement turned militant after a more idealogical start and hence was outlawed. Today, surrendered members of ULFA have formed a separate sect called the SWLFA and both groups continue to exert pressure on the State administration.

Box 2 continued

BODO movement - The Bodos are tribals of the lower Assam area centring aound the town of Kokrajhar. The Bodo movement began in the late 1980s and grew in strength until about the end of that decade. From then on it turned militant and pressed for Bodoland, a separate State, where the Bodos believe they would enjoy rights currently denied them. There are several splinter groups in the movement of which the All Assam Bodo Students' Union (ABSU) is the most powerful.

NSCN - The National Students Council of Nagaland is the group fighting for rights in Nagaland, a neighbouring State of Assam. The Naga movement started in the 1960s and has been a festering sore for the Indian administration ever since. The NSCN have been blamed by Indian authorities for most of the arms-running from nearby Myanmar and for subsequent supply through northeastern India.

Poacher's profile

There has been considerable debate in conservation and law enforcement agencies about the identity of rhinoceros poachers and traders in India. The most prevalent information that could be gathered during any field visit is that rhinoceroses are generally killed by Nagas (in central and upper Assam), and by Bodos in lower Assam. Both ethnic groups of people are tribal, the Nagas chiefly from the State of Nagaland, adjoining Assam, and the Bodos being from the plains of lower Assam. The Naga and the Bodo have far greater access to sophisticated arms and are also traditional hunters, which facilitates their entry into rhinoceros poaching. Also, as they are geographically situated near Myanmar and Bhutan, respectively, which are on important trade routes, it is easy for them to act as couriers after the initial poaching, handing over the horns to the agent or financier who controls the trade. An examination of 123 randomly selected official judicial records of poachers and traders dealing in rhinoceros horn in central Assam, however, shows that attributing the majority of blame to these tribal separatists is probably an error. Only five per cent of the 123 apprehended were Nagas, and otherwise the breakdown was as follows: Nepalese and Bhutanese, four per cent; Mising tribals, 11%; Assamese Hindus, 26%; Bangladeshis/Muslims, 35%; others, 19%. (There is no mention of Bodos, since the records are for central, not lower Assam.)

A third group often mentioned in connection with rhinoceros poaching is the outlawed insurgency group, United Liberation Front of Assam (ULFA). The group has been particularly actively involved in poaching from Laokhawa, which lost all its rhinoceroses at the height of the Assam civil unrest in 1983.

Although there is some evidence of extremist groups such as the NSCN, ULFA and the Bodos selling rhinoceros horns to finance their illegal activities (Martin, 1993b), it is seen that a number of poachers are actually financed by opportunistic traders who take advantage of a breakdown in law and order to achieve a rhinoceros killing. While it is true that a large number of Nagas and Bodos are involved as poachers in central and lower Assam, respectively, an equal number of Assamese (i.e. not belonging to those tribes) also indulge in poaching, or are involved at some level. For example, a poacher cannot operate without the active support of some local villagers. As most poachers come from far-off villages, they need a fringe village in which to wait and bide their time, as well as to return to after the poaching. Also, there is a need for a local person who has knowledge of routes, location of anti-poaching camps, patrol times and routes, etc. Further, if arms are to be stored for some time before the actual poaching takes place, once again a local is ideally involved. This local could be a corrupt employee of the Forest Department or a villager: examples of both cases are known and not uncommon. It is stressed, however, that to malign the entire Forest Department or body of villagers local to rhinoceros reserves would be most inappropriate and undesirable. Indeed, it is only with the full co-operation of these groups that poachers' assistants can be identified from among them and extracted.

The rhinoceros poacher in India is typically a completely different sort of individual, compared to the rhinoceros horn trader (see the ***Trader's profile***). It is difficult to categorize a poacher according to his social or economic class, although a general rule of thumb suggests that he would be sufficiently needy to be bought by the sum of money being offered. Although seemingly much more than the sum of money received by an average African poacher, the Indian poacher's reward is nonetheless a small fraction of the value of the rhinoceros horn. According to Martin *et al.*, (1987), poaching is organized by a syndicate of middlemen who recruit two to three men, buy them food and drink and give them a little advance money along with rifles and cartridges. The team, thus prepared, enter a park to poach, usually in the morning or at dusk. Often a poacher is not paid according to horn weight, nor even according to the number of horns obtained, but according to the number of operations conducted. In many cases the poacher is a sharpshooter hired only for the purpose of killing. His team mates have the job of hacking off horn and bringing it to the dealer. In this case the main poacher is paid for just shooting and killing a rhinoceros, and the others get a pittance of the share. Vigne and Martin (1994) recorded that the main shooter in a poaching party receives between Rs10 000-20 000 (US$320-640) and the other members Rs10 000 each (US$320). This may amount to a total payment to the poaching party of about Rs50 000 (US$1600). Martin and Vigne's figures are largely substantiated by investigations for this report, which revealed that one successful operation can obtain between Rs20 000 and Rs50 000 (US$640-1600). This is substantially higher than the US$250-300 normally paid to a poacher in Africa (Martin, 1994).

Methods of poaching

There are six recorded ways of killing a Greater One-horned Rhinoceros: by shooting, trapping in a pit, electrocution, poisoning, spearing, and with a noose. The last-mentioned is known in India only from one isolated case in 1989, in Manas National Park, where a rhinoceros was found caught in the steel wire noose of a trapper, having been killed by strangulation and the cutting of the noose through the skin. This method is more common in Africa, but this stray case recorded in India may not be considered normal practice. Killing a rhinoceros with spears has not been recorded in India, but from neighbouring Nepal, in Chitwan National Park (Martin, *in litt.*, 1996). The other four methods are used in varying degrees in different parts of the subcontinent, depending on the terrain, availability of arms, etc. The ingenious method of electrocution was not used by poachers until as late as 1989 (Vigne and Martin, 1991). Analysis of the data from 1980 to 1993 in three selected sanctuaries show that shooting is by far the preferred method of killing (see Figure 12). The unsuitability of the terrain in Pabitora to pit poaching is evident, since only five per cent of rhinoceroses were killed by pit poaching in that sanctuary, as compared to an unusually high percentage (21%) by electrocution, and 11% by poisoning. The following account describes all the five methods used by poachers in Assam and Bengal.

Although traditionally the nights of a full moon are more conducive to poaching activities, in reality, such factors do not appear important: poaching occurs throughout the month, day and night, and throughout the seasons (P. Sarma, pers. comm., 1994). However, the main deciding factor seems to be oppurtunism, which may take account of several conditions, including suitable weather, light and level of surveillance.

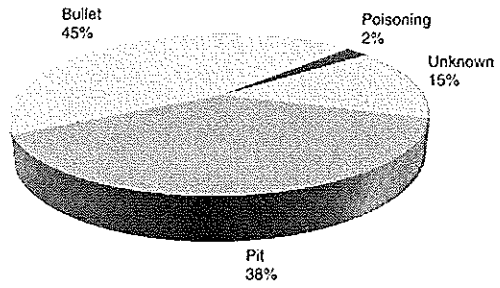
Shooting

All other methods of poaching rhinoceroses in India are newer and less favoured than that of using a rifle or shotgun because of various handicaps with which they present a poacher. Although no figures for the proportion of poaching by shooting are available for Manas, Laokhawa and the Bengal sanctuaries, an analysis of such data for Kaziranga, Orang and Pabitora shows that more than 55% of the rhinoceroses killed in the three

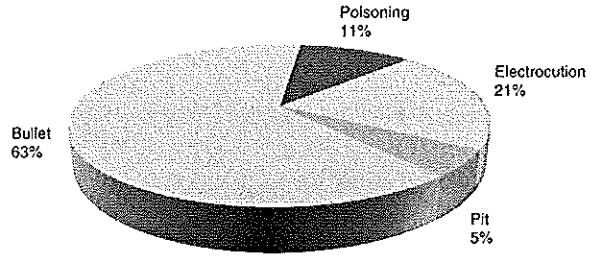
areas were by this one method. According to local sources, almost all the Manas rhinoceroses were also killed by shooting (Brahma, pers. comm., 1995) as were those in Laokhawa (Sharma, pers. comm., 1993).

Figure 12

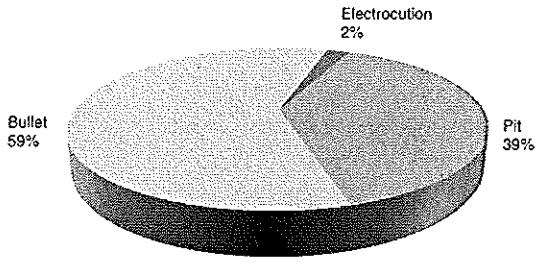
Proportion of different methods of killing rhinoceroses used by poachers in three different reserves in India



Orang Wildlife Sanctuary



Pabitora Wildlife Sanctuary



Kaziranga National Park

Poachers are normally hired gunmen working for financiers or rhinoceros horn agents and traders (Menon, 1996). Very rarely, if ever, does the actual trader do the poaching. A poacher is normally a sharpshooter with some amount of jungle knowledge. This dictum is excepted in cases of large-scale civil unrest (for example, near Laokhawa in 1983), when other opportunists come into the fray. Apart from the financier or the agent and the poacher, two other classes of people normally work in a poaching outfit. One is a local guide who could be a person living in the nearby forest village, or even a corrupt member of the protection force deployed in the protected area. The other is an arms supplier who, although not always a part of the team, seems to be used quite frequently in rhinoceros poaching in the north-east. During the investigations for this report, one arms supplier confessed to receiving between Rs10 000-20 000 (US$320-640) for providing one rifle (type does not

matter, he said) to a poaching party for a week to ten days. Although it is known that the weapon is to be used for an illegal act, it is rarely revealed to the supplier as to whether it is to be used for rhinoceros poaching, specifically. This supplier, like many others of his ilk, is an ex-army man and thus has a basic knowledge of weapons. Martin (1983b) gives a slightly different picutre, of poachers hiring shot guns from farmers demanding between Rs200-500 (US$20-50) for two to three days' use. If this was the practice in the 1970s, then both technology and the high price of rhinoceros horn has caught up with the Indian poacher.

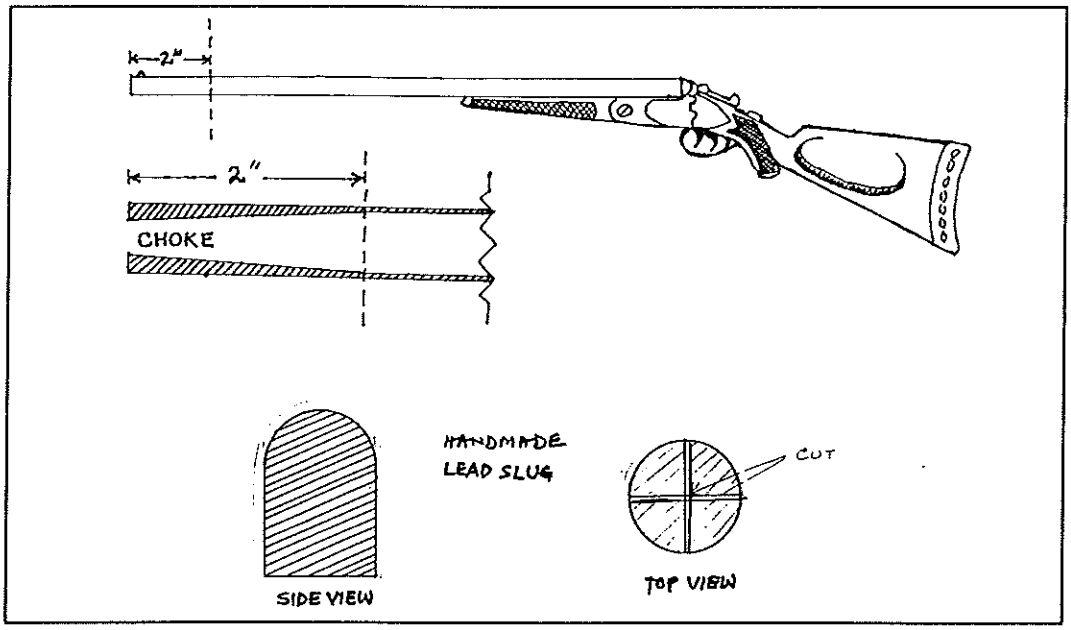
Since 1983, when the AASU agitation hit Assam, and even more since 1987 when the Bodo agitation erupted in lower Assam, the state has had a surplus of illegal arms in circulation. Martin *et al.* (1987) record as far back as 1987 that the syndicates organizing poaching had access to .303mm bore and 7.62-inch bore rifles from Nagaland, the Nagas in turn getting them from neighbouring countries. Despite two army operations in the early 1990s (code-named Rhino and Bajrang) that did cut back on illegal supply of arms, their free availability in the State is a well-known fact. Today, modern weapons, including self-loading rifles, are all freely available in the illegal arms malls of the north-east of India. (In fact, to kill a rhinoceros a far less powerful arm than these is required.) Ironically, covert information gathered during survey work for this report shows that at least a small percentage of rhinoceros horn in trade in India is used by "extremist" organisations to barter for more arms. Some evidence of such exchanges came to light in Manas, as also in the case of horns from Kaziranga bartered for arms in Nagaland and Myanmar.

An analysis of the arms captured by park authorities during their anti-poaching operations show no particular preference in weapons. Arms range from country-made muzzle loaders and shotguns to .315mm bore, .303mm bore rifles, medium-calibre, self-loading rifles and other semi-automatic weapons. In 1995, one park in Assam seized a semi-automatic weapon and a silencer, perhaps the first recorded instance of a silencer being used in India in rhinoceros poaching operations. In the cruder shotgun and muzzle loaders used there is often some distortion of the weapon or its projectile to make it more efficent. In 1987, Martin *et al.* (1987) noted the use of muzzle loaders or shotguns in Manas, by a gang which waited several days near a rhinoceros wallow before shooting. *Machans* (high platforms built on stilts) were used for waiting, a possibility only in places, such as Manas, where the terrain affords only low visibility to anti-poaching staff. The gun used in this instance was a 12 bore shotgun, and it took the poachers one hour to remove the horn with an axe. A shotgun is not used with shot or pellets but instead with a home-made lead slug, or, in some cases, just a piece of iron rod cut to the right size and shaped. The front end of the barrel of the shotgun is then sawn off so that the constriction (or choke) that normally allows for a longer range is removed and a larger projectile can pass through (R. Talwar, pers. comm., 1995) (see Figure 13). A single ball cartridge is usually all that is needed for a rhinoceros, which more often than not is at quite close range and does not require a particular amount of skill or finesse to target. Skilled poachers aim for a shot that kills in one attempt but may shoot a maximum of two to three times. They then usually have about half an hour before the nearest camp staff to have heard the shot reach the place (the chances of a camp, patrol party, or even the range headquarters hearing a shot are high). Thus, shooting is not a good poaching option if a rhinoceros is close to a camp, or if a patrol party is close at hand. It is presumed, therefore, that shooting poachers are usually well-acquainted with camp staff movements, and though the staff cannot be charged with compliance, they are often not sufficiently trained in patrol, ambush, counter-ambush and surveillance techniques.

Although not many accounts exist of poaching in West Bengal, research for the present study indicated that it operates in much the same fashion as in Assam. However, Martin (1983b) says that in Jaldapara, the poacher limits himself to killing the rhinoceros while another person collects the horn. Under present enforcement conditions this would both be risky and unnecessary, and, as mentioned, parties of poachers have been seen.

Figure 13

Illustration to show modification of a shotgun used by rhinoceros poachers in India and side and top view of a handmade lead slug used as a projectile. The top of the slug is cut with intersecting slashes which maximizes damage to the target on impact



R. Talnar

Electrocution

By far the most ingenious of killing techniques, electrocution is more difficult to detect in advance of its use than is pit poaching, and does not alert reserve guards in the way that the sound of shooting can. Wherever high tension powerlines of at least 11 000 volts pass through or near a park, poachers use this mode of poaching. At present, the only two Indian rhinoceros reserves at which this method has been recorded are Pabitora and Kaziranga. The former has two power lines of 33 000 volts and 11 000 volts each running on the northern side of the sanctuary, and one line of 33 000 volts on the southern side. Kaziranga has an 11 000 volt line stretching as far as 25km across the southwestern portion of the park. In Pabitora Wildlife Sanctuary, a network of lines criss-cross the park, from which illegal connections are run to motorized pumps for irrigation of nearby private fields. This makes the job of the poacher that much simpler than it would otherwise be.

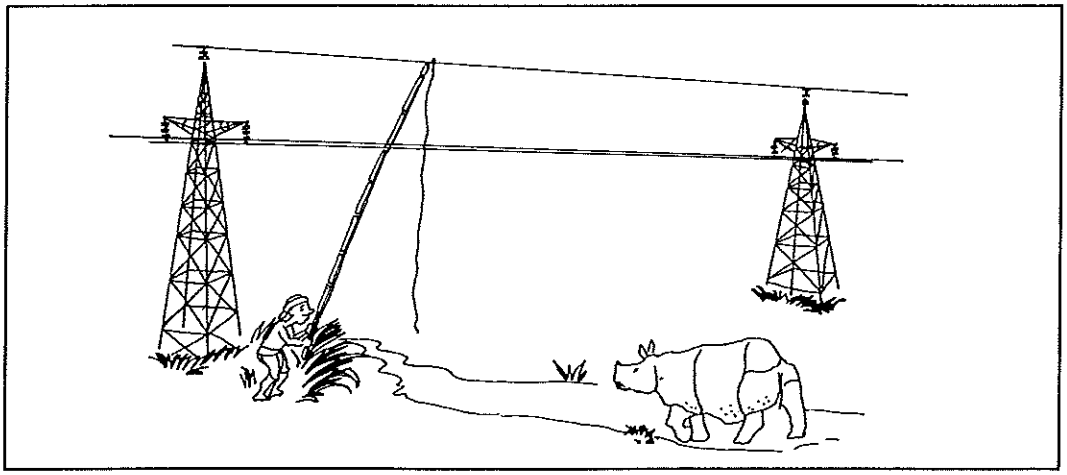
The *modus operandi* for electrocution is to connect a length of wire to a long, insulated rod (bamboo is a perfect material), by means of which it is hooked on to a passing high tension or other power line. In some cases, the actual attachment is effected by using a wire hook, in others, the length of wire itself is twisted to make a hook. The bamboo rod is then withdrawn to leave the length of wire dangling, potentially in the path of a rhinoceros (see Figure 14). Care is taken to put it on a rhinoceros *dandi* (path) so as to maximize the chances of contact with a rhinoceros. The length of dangling wire is such that it would strike a rhinoceros at the level of its chest, thereby allowing smaller creatures to escape its harmful consequences. While this method of poaching is obviously restricted in use to places with suitable powerlines, and thus to certain areas of certain reserves, it is at the same time an indiscriminate method, like poisoning, which endangers many animals, including humans, happening to come into contact with it.

Electrocution is the newest poaching technique in use, and was first used to kill a rhinoceros on 29 September 1989 in Pabitora. November 1989 saw the first electrocution in Kaziranga and during 1989 six rhinoceroses were killed by the method in the two parks of Pabitora and Kaziranga. The park officials at Pabitora found the

rhinoceros electrocuted in September 1989 before the poachers did and recovered a horn weighing 365kg, but in no case over the following five years, during which five more rhinoceroses were electrocuted, were park staff able to find a rhinoceros killed in this way before poachers retrieved the horn.

Figure 14

A length of wire is connected to a power line and suspended above a *dandi* in the hope of electrocuting a rhinoceros



Prasanth

Pit poaching

Pit poaching is by far the second-most popular way of killing Indian rhinoceroses, but is a method only used in certain circumstances. Not only is it highly dependent on the terrain for its success, but it is not likely to be practised by poachers with access to guns: the chances of success are never certain, the digging of pits takes considerable time and more often than not at least two visits to the park are necessary, one to dig the pit and another to check it. This method of poaching is therefore practised only by those who are able to take advantage of sudden opportunities to enter a park and dig pits.

Its advantages as a method are that it is not only difficult to detect before the event (although less so than electrocution traps), but even afterwards: patrol parties have to cover wide expanses of reserve territory, without any audible signal to alert and guide them to the poaching place, as with a shooting. Only rarely are pits discovered before a rhinoceros falls in (although in 1955 as many as six such pits were discovered in Kaziranga National Park).

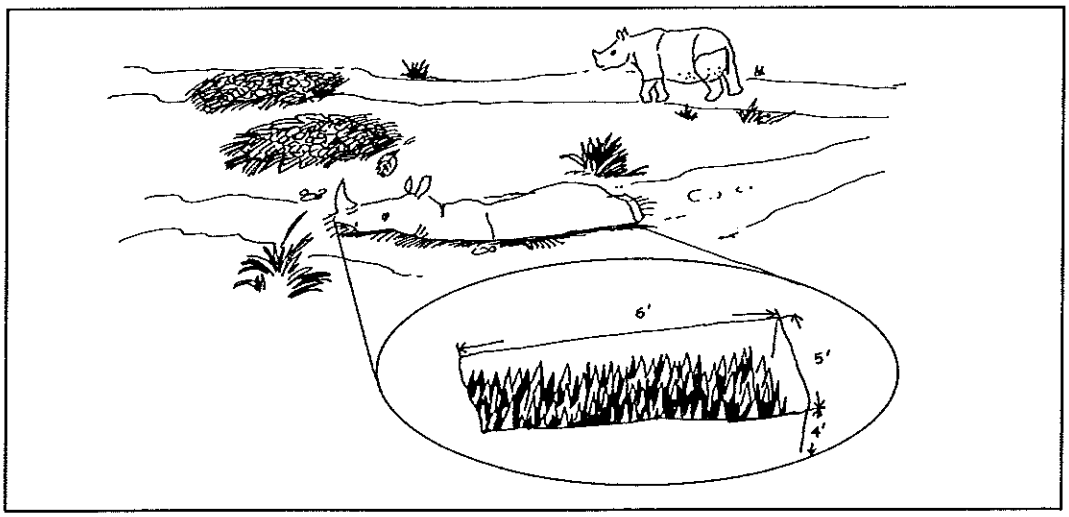
Usually pit-poaching teams comprise three to four men (according to observations of the composition of apprehended teams), and apart from their digging implements, kerosene or paraffin lamps (for light that does not disperse very far from the source), and food, they carry very little else. The pits dug are normally six, by six, by four feet (19.7 x 19.7 x 13.1m) in dimension and in some cases are dug in the shape of a trapezium but mostly are rectangular. Martin *et al.* (1987) recorded that gangs of up to five men digging a hole 6.6 x 3.3ft (21.6 x 10.8m) in Orang Wildlife Sanctuary and covering it with grass. The shape and size of the pit are designed so that a fallen animal has little room to manoeuvre and the head is slightly above the pit. It is then easy for the poachers to take off the horn. A case was recorded in Assam where the rhinoceros had fallen headlong into the pit. Although the animal died, the poachers were not able to retrieve the horn, as they were not able to reach it, nor to move the rhinoceros.

A pit is normally placed on a *dandi* where the rhinoceros is sure to walk, or near areas known to be visited by rhinoceroses, such as defecating heaps, water wallows, etc. In some cases, the pit is lined with sharpened

bamboo stakes (see Figure 15), but in other cases is left unadorned. In all cases, the pit is covered with vegetation.

Figure 15

Illustration to show a pit filled with sharpened bamboo stakes and a rhinoceros trapped in such a pit



It appears that pits were not used in the past as a means of hunting rhinoceroses legally, where instead guns, spears or other hand-held weapons were used. Rather, pit capture was apparently originally a method of taking rhinoceroses live, used by early conservationists: Patar (1980) records rhinoceroses captured in pits surrounded by a wooden stockade, for the purposes of observation. The pits (10 x 6.5 x 4.5 ft (32.8 x 21.3 x 14.7m)) were dug in or around rhinoceros areas (probably referring to *dandis*) and were completely camouflaged with twigs and dry leaves. The aim of retrieving the rhinoceros alive in these cases would explain the relatively large pit size as compared to the ones used by poachers today.

Poisoning

Poisoning as a poaching method is more usually associated with Tigers, than rhinoceroses: (12 of 25 Tigers killed between 1989 and 1990 in Chitwan were suspected to have been poisoned). However, on 7 July 1987, a rhinoceros mother and calf were found dead at Tamuliduba, in Pabitora Wildlife Sanctuary, killed by "chemical poisoning", according to official records. While the horn of the mother was missing, the small 100g horn of the calf was recovered. On 24 March 1988, a female rhinoceros was poisoned in Orang Wildlife Sanctuary and the horn removed. No official record of the type of poison used, nor of any other details, is held. A poisoned rhinoceros salt lick in Manas National Park caused the death of a number of hog deer in the early 1990s, but there was no rhinoceros fatality as a result.

Poisons used in Nepal lend some insight into substances used: two zoo rhinoceroses died in 1990 after eating food laced with zinc-phosphide rat poison (Martin and Vigne, 1992), while two wild ones were poisoned outside Chitwan National Park when they wandered into agricultural fields laced with pesticides, purportedly to kill rhinoceroses.

Seasonality of poaching

One question warranting critical analysis vis-à-vis the effectiveness of any anti-poaching operation is that of seasonality of poaching trends.

Although a larger and more thorough study is required in order to conclude a general analysis, a study of the seasonality of poaching in Kaziranga was conducted for the purpose of this report.

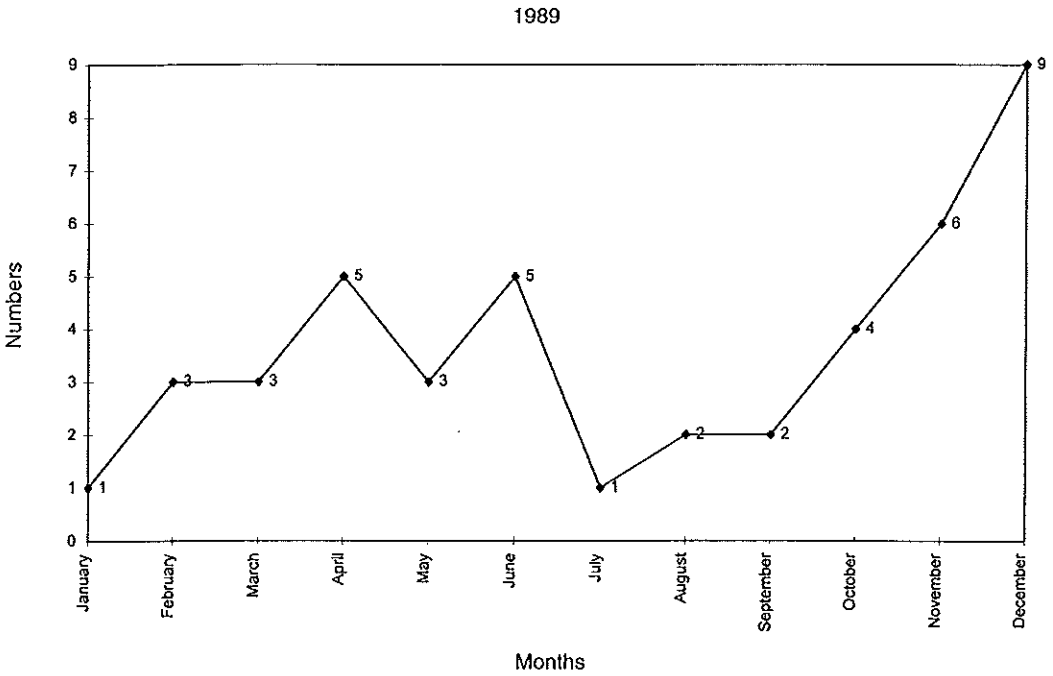
Generally, reports of seasonality appear to be contradictory and confusing. Vigne and Martin (1994) felt that most poaching occurs in the dry months, that is, the first few months of the year when most of the park is accessible. Most informants spoken to during research for this report felt that October to March coincided with peaks of poaching activity, some felt that monsoon months, when anti-poaching efforts were lax, were the time of heightened poaching, and yet others seemed to feel that there was no particularly choice time for poaching. In September 1993, a number of newspaper reports quoted park officials of Kaziranga as saying that floods aid poaching in the park. According to the reports, rhinoceroses would typically be taken by poachers as they crossed National Highway 37 to seek refuge in the Karbi Anglong and Burrhapahar hills, when the rest of the park is under water.

An analysis of five years of poaching in Kaziranga (1989-93), shows that in general, winter months (October to March) seem to be the best time for poaching (see Figure 16). However, the graph for 1991 shows a peak of poaching activity during the monsoon (in July). Other reports cite two distinct periods of November-December, and March, or the month following the burning of grass in the parks, as suggested peaks (Deb Roy, pers.comm., 1993).

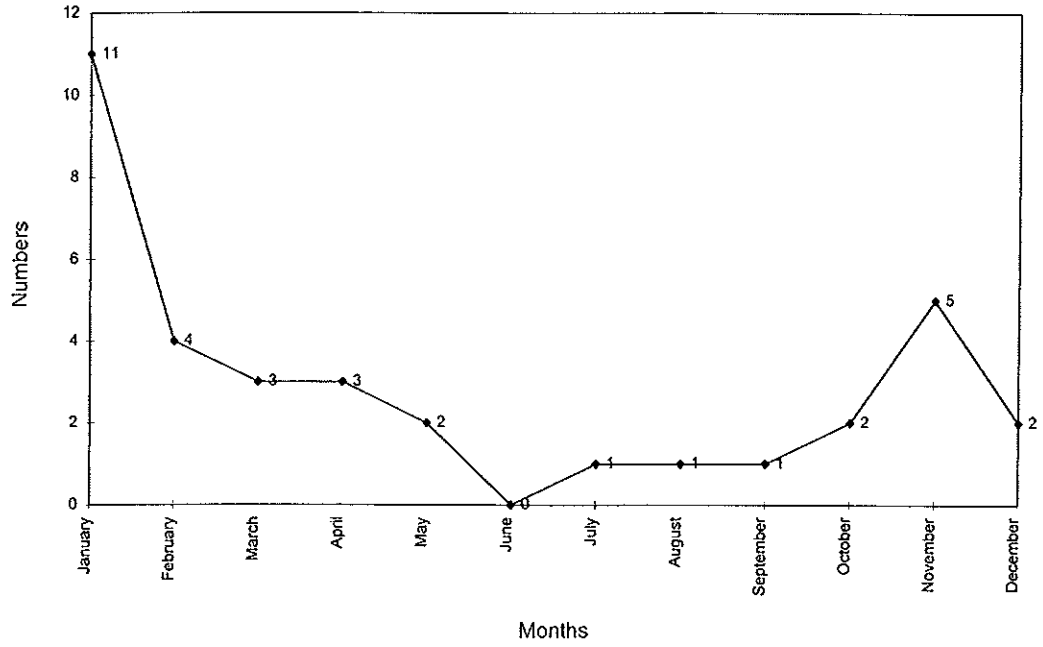
In the Indian context, even when fuelled by highly organized groups, opportunistic poaching sallies would seem then to be based rather around particular periods of breakdown of law and order, at least in Assam, where poaching of Greater One-horned Rhinoceroses in the country is concentrated. As stated above, a more detailed and widespread analysis may be required before seasonal peaks in poaching can be pinpointed, but assessment to date indicates that nothing less than sustained, year-round anti-poaching efforts are necessary to thwart opportunistic poachers.

Figure 16

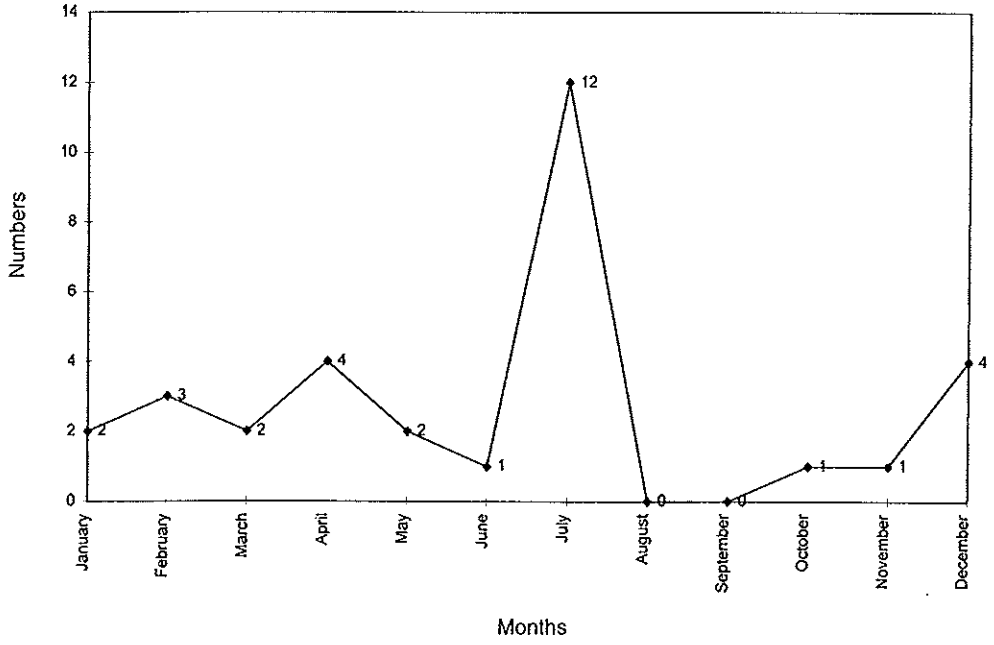
Graphs to show numbers of Greater One-horned Rhinoceroses poached per calendar month, 1989-1993



1990


Numbers
12
10
8
6
4
2
0
11
4
3
3
2
0
1
1
1
2
5
2
January
February
March
April
May
June
July
August
September
October
November
December
Months

1991


Numbers
14
12
10
8
6
4
2
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2
3
2
4
2
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January
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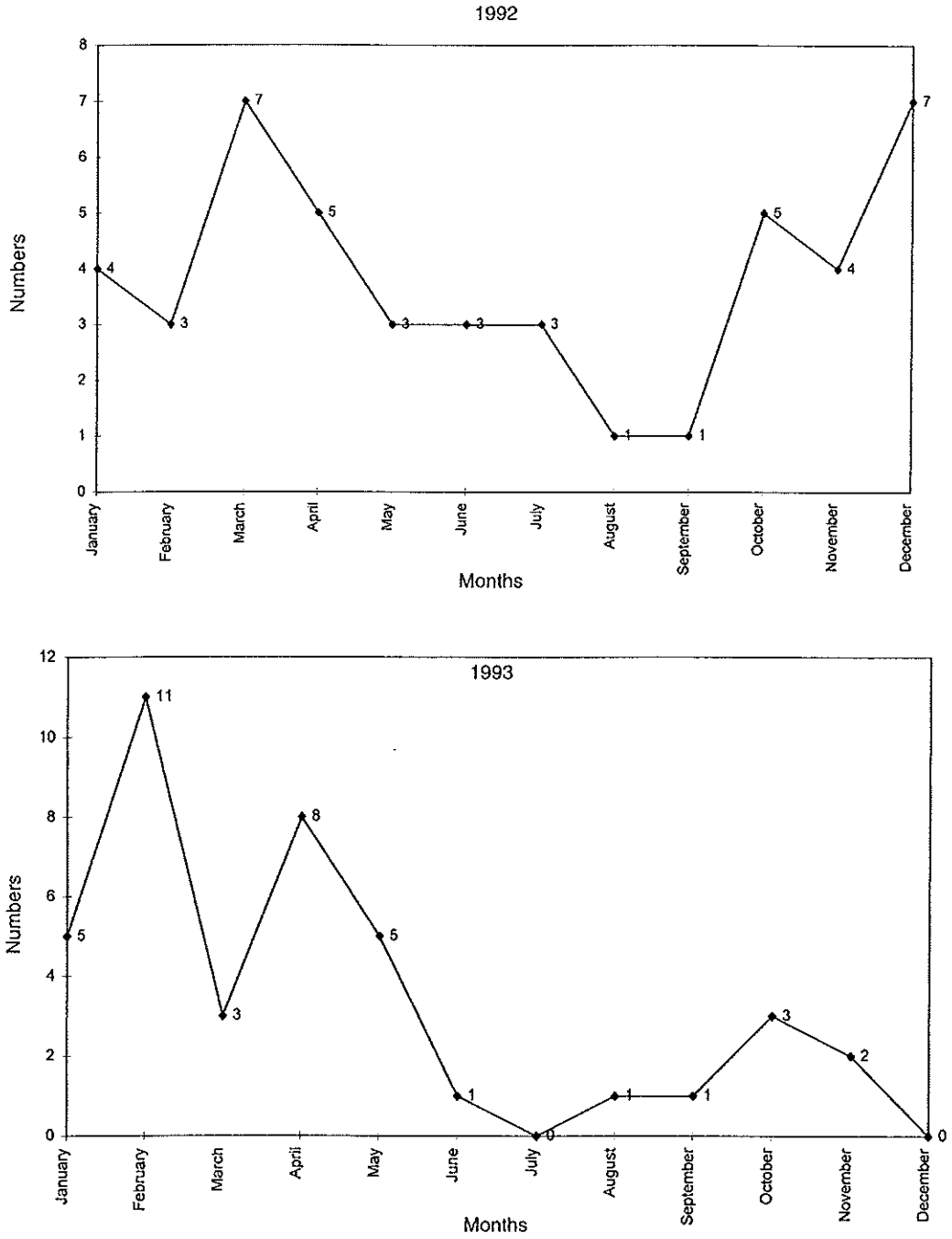
December
Months



Source: Kaziranga National Park official information.

Poaching deaths versus *natural deaths*

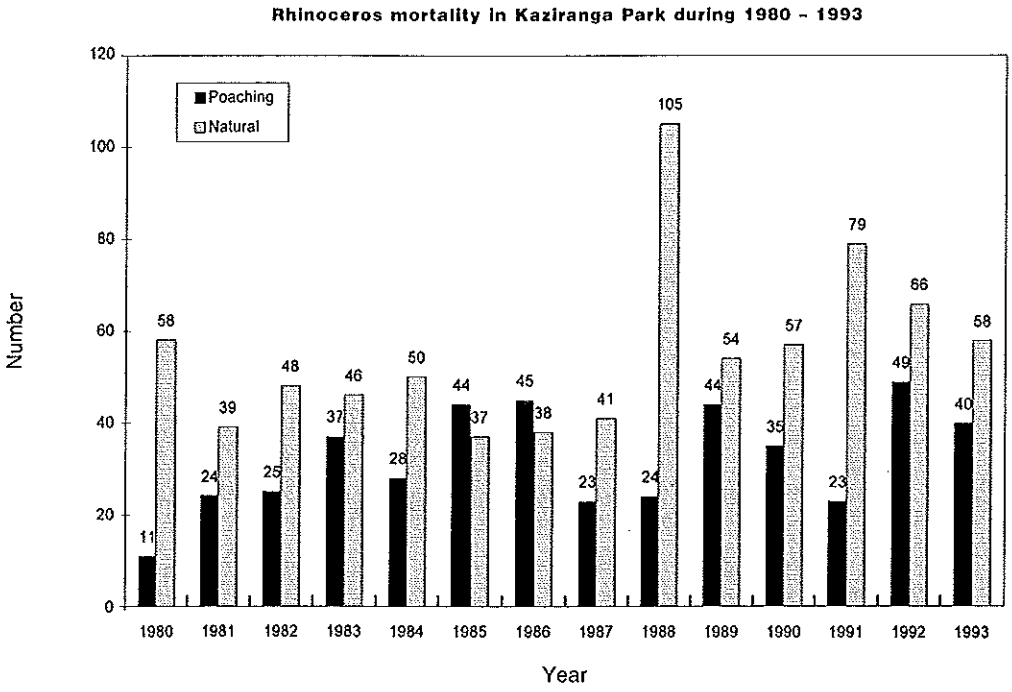
Consideration of the figures for poaching death *versus* natural death is revealing, particularly in cases of certain protected areas. In Kaziranga, for example, natural deaths have been at higher rates than poaching deaths, often by at least a third, and the freak flood of 1988 claimed 105 rhinoceroses as opposed to only 24 poached. However, in 1985 and 1986, the situation was reversed (see Figure 17). Such a pattern is at variance with those for almost all other sanctuaries, where poaching has kept pace with, or outstripped, natural deaths. For example, in Orang, natural deaths are more numerous than poaching deaths in only four years (see Figure 17); in Pabitora, only in 1988 did natural deaths surpass poaching levels. In Laokhawa, however, natural deaths almost equalled, or slightly exceeded, poaching deaths in number, until 1983, the catastrophic year for

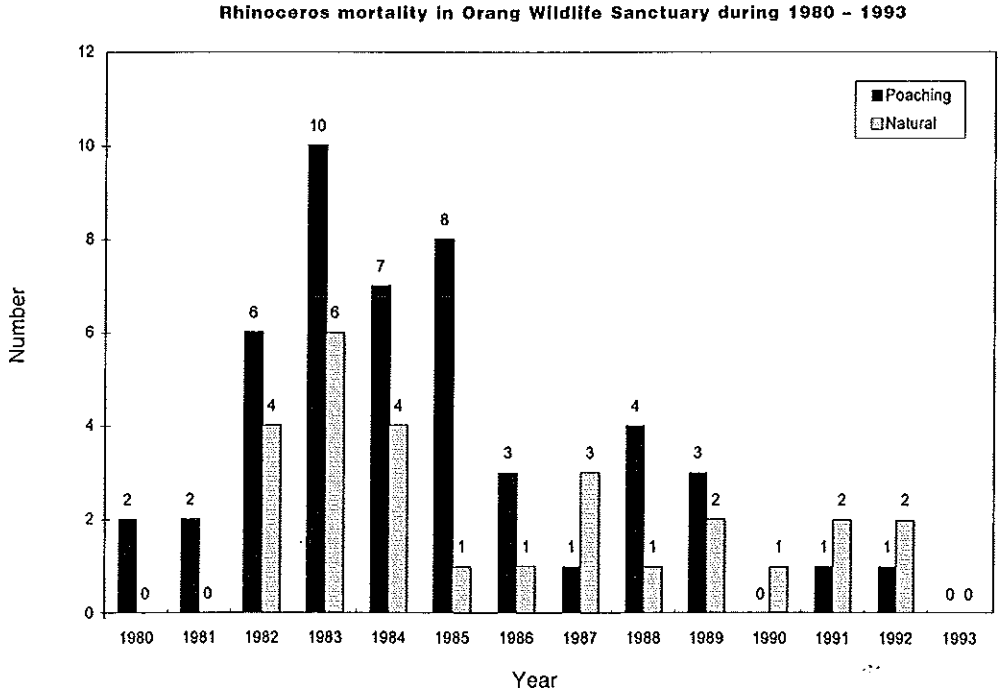
poaching in the reserve, when 41 rhinoceroses were poached in comparison to six natural deaths. During the following two years, all seven rhinoceros deaths were attributed to poachers.

In the north West Bengal sanctuaries such a graphic differentiation is not made because of low mortality where both poaching and natural deaths keep occurring in a seemingly random fashion, owing to low poaching levels.

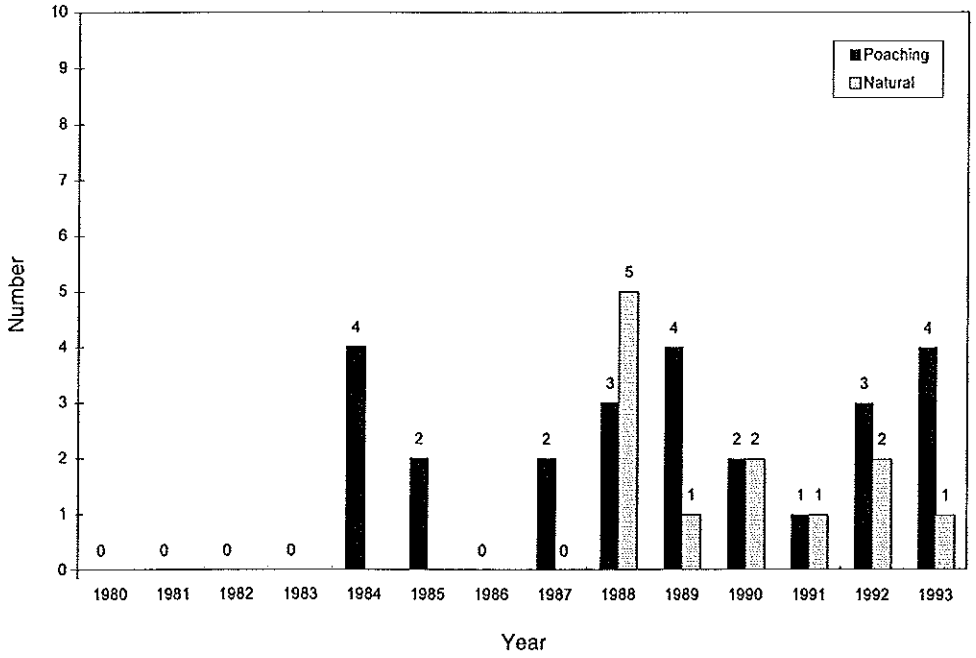
Figure 17

Graphs to compare natural mortality with poaching deaths among rhinoceroses in six rhinoceros-bearing areas in India

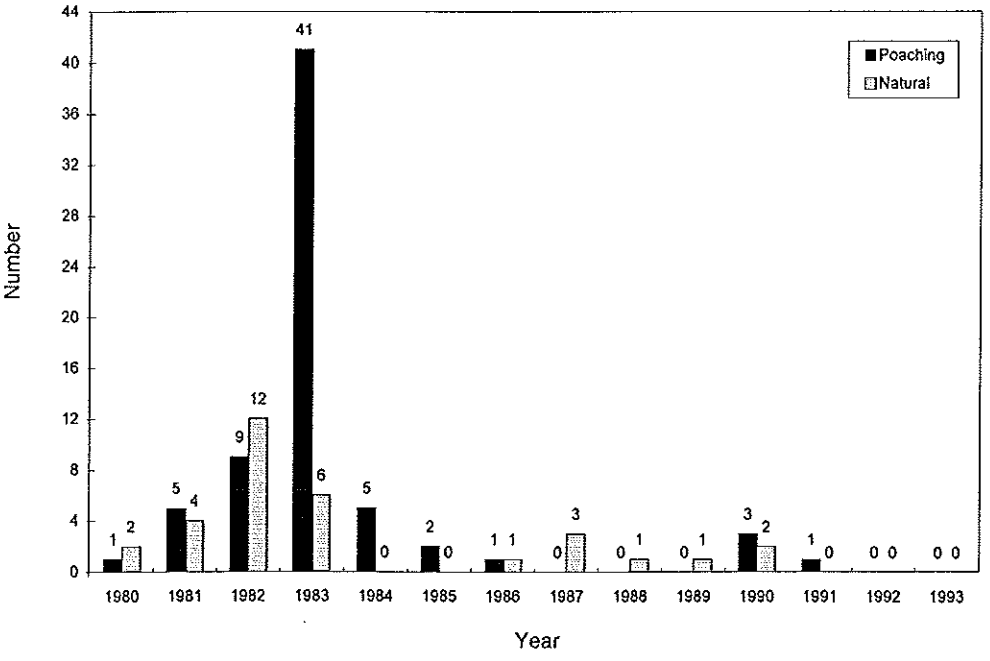




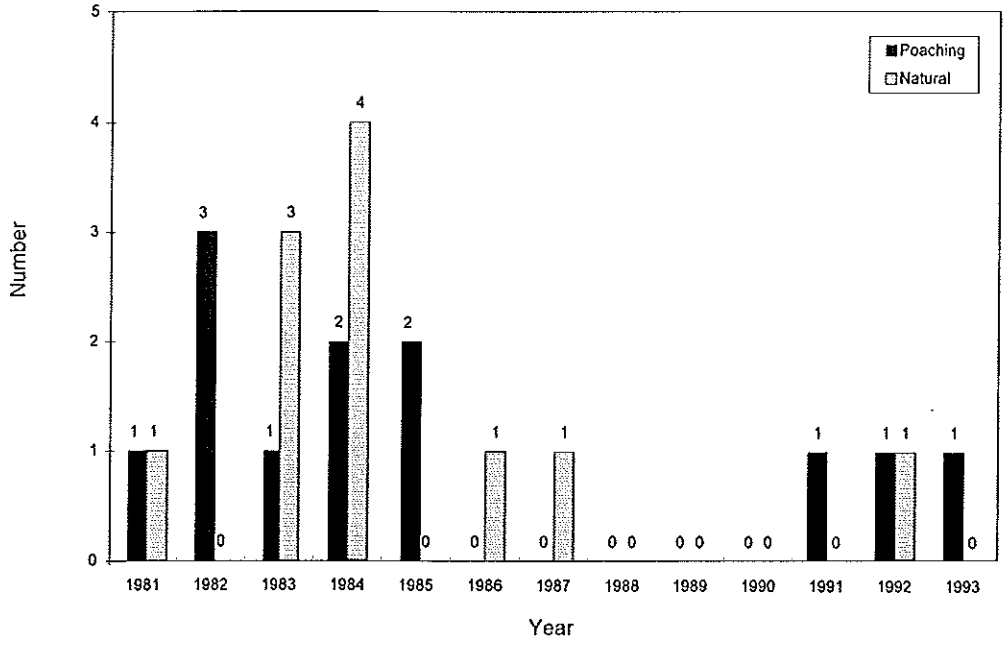
Rhinoceros mortality in Pabitora Wildlife Sanctuary during 1980 - 1993



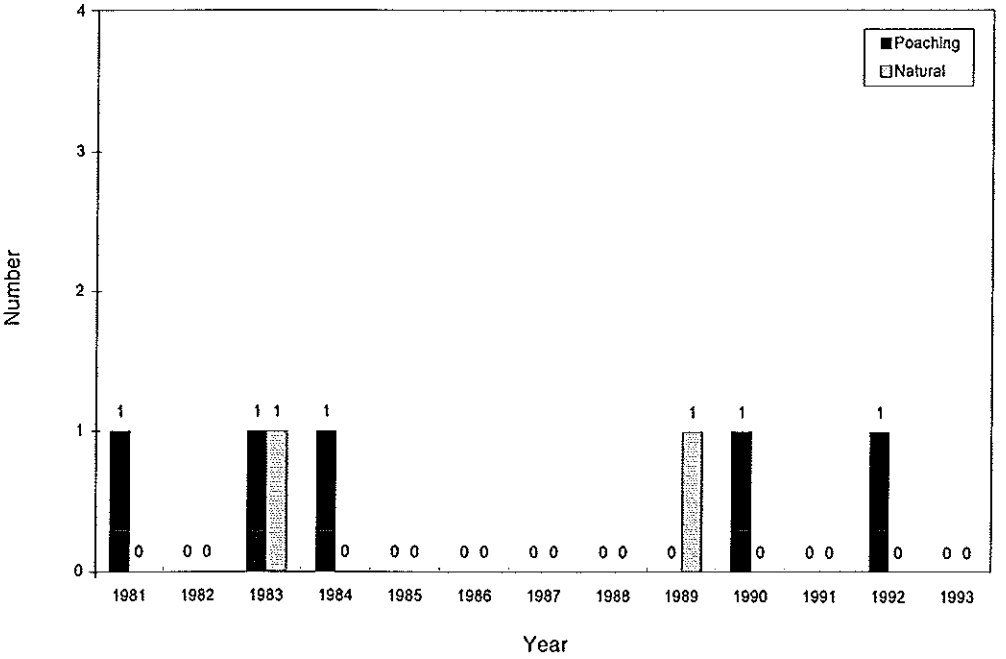
Rhinoceros mortality in Laokhawa Wildlife Sanctuary during 1980 - 1993



Rhinoceros mortality in Jaldapara Wildlife Sanctuary during 1980 - 1993



Rhinoceros mortality in Gorumara Wildlife Sanctuary during 1980 - 1993



Sources: as for Tables 10, 12-15, and 17.

The major causes of natural death, other than disease, are the unprecedented floods of the Brahmaputra River in Assam, or the Torsa and Sankosh Rivers in West Bengal (see Table 27). Apart from disease and flooding, the killing of rhinoceros calves by Tigers (their only natural predators), death resulting from intra-specific fights, and from accidental falls into swamps are cited as natural causes of rhinoceros mortality (see Table 28).

Table 27

Major floods affecting rhinoceroses in northern West Bengal

River	Year	Affected rhinoceros population	Effect
Sankosh	1924-25	Sankosh-Rydak (Buxa)	Large areas of forests in North and South Bholka reduced to savannah.
Sankosh	1934-35		Eroded part of Bholka forests.
Rydak	1930		Shifted course, creating new grasslands.
Rydak	1934	Sankosh-Rydak (Buxa)	Eroded part of Central-Rydak.
	1954		Washed out hundred acres of forests near Dhumparaghat.
Torsa	1932-33	Jaldapara	Eroded Hashimara, Joygaon and Dalsingpara blocks.
	1937-38		Changed course resulting in increase in area in Jaldapara.
	1948-49		Changed course and flooded Sissamara, Bengdaki and Dhaidhaighat, causing heavy damage to the vegetation.
	1952		Damaged crop.
	1954		3 rhinoceroses died. Shelter for rhinoceroses become somewhat thin in parts. Savannah patches became less dense. Sal Forestsof Bania damaged.
	1964		Damaged crop.
	1968		Changed course, composition of Jaldapara and Torsa blocks changed. Damaged forests of Chilapata.
	1984		Damaged crop.
Holling, Siltorsa, Malangi, Titi, Howri	1993		Eroded forests in Jaldapara Barodabri, Titi and Hasimara blocks.
Jaldhaka	1954	Gorumara	Vegetation was damaged, adversly affected the feeding grounds and the cover of rhinoceroses.
Diana	1964		Damaged forests of Diana Range.

Source: After Bist, 1994

Table 28

A case study of accidental and natural deaths in northern West Bengal

Killing of rhinoceroses by Tigers

Year	Jaldapara	Gorumara	Outside sanctuaries
1952	-	2 (mother with calf)	-
1968-69	-	-	1 (calf)
1981	1 (calf)	-	-

Cases of intra-specific fights among rhinoceroses

Year	Jaldapara	Gorumara	Outside Sanctuaries
1948-49	1	-	-
1950-51	1	-	-
1968-69	-	-	1
1983	1 dead, 1 injured	1 (sub-adult)	-
1986	2 (injured)	-	-
1992	1 (injured)	-	-

Recorded instances of accidental deaths of rhinoceroses

Year	Jaldapara	Gorumara	Cause
1948-49	1	-	trapped in swamp
1984	1	-	trapped in swamp
1986	1	-	trapped in swamp
1989	-	1	strayed into Bangladesh and was stoned to death

Source: Adapted from Bist, 1994

Age and sex of rhinoceroses poached

Although this study cannot answer the question of whether there is any preferred age or sex of rhinoceros among poachers, first-hand field information shows that there is marginal, if any, preference for one sex of rhinoceroses or another among poachers. It is to be remembered that both sexes of Greater One-horned Rhinoceroses carry approximately the same size of horn, although males may have a heavier horn. However, this is not easily perceptible in the field and poachers tend to go for any animal with a big horn, if the method of killing allows it. A look at rhinoceros mortality rates (from all causes) in West Bengal reveals that, from 1981 to 1983, 10 males and 10 females died, the even number of each reinforcing the theory of non-selective targeting of rhinoceroses on a basis of sex by poachers.

A rhinoceros horn is evident on an animal aged about one year and any animal of or above this age may therefore be targeted. However, a calf may only be taken when accompanying a mother as the small horn by itself may not lure poachers. Reviewing the same set of data as mentioned above (i.e. those for rhinoceros mortality rates in West Bengal, 1981-1983) *vis-à-vis* age, it is seen that 26 adults in comparison to four calves

died during this period. Natural mortality is at a higher rate in the case of calves than adults, so these data undoubtedly lend credence to the theory that poachers prefer adult rhinoceroses. This set of data should not be taken in any way as conclusive proof of poachers' preferences, however, as no data were available to correlate poaching alone as a cause of death to age and sex, and furthermore, the geographic coverage of such data could not be extended to Assam. A basic problem in collecting such data is that age is more often than not omitted from poaching records, and in many cases where the carcass is discovered in a high state of putrefaction, the sex is also not recorded.

Where pits or electrocution are used, there is obviously no level of selection whatsoever.

Vivek Menon

Rhinoceros horn, Pabitora Wildlife Sanctuary.

INDIAN TRADE IN RHINOCEROSES AND THEIR PRODUCTS

Asian rhinoceroses and their derivatives, including horn, have been traded for over 2000 years (Martin, 1991). Historically, the first record of a rhinoceros being exported from India goes back to Mughal times, when a Portuguese envoy to Muzafar II, King of Cambaia, was presented with a live rhinoceros in May 1514. Its place of capture is not recorded. It was transported to Lisbon, via Goa, by the Portuguese. It lived in Libson from 20 May 1515 until December 1515, when it was sent to Pope Leo X in Rome. It drowned on its way, at the Italian coast near Porto Venere in February 1516 (Da Costa 1937; Rookmaaker 1973).

The history of the use of rhinoceros horn in Oriental medicine is an age-old one, and the horn is used basically as an anti-pyretic or an agent for the reduction of fever. The Chinese recorded one of the earliest uses of the rhinoceros horn, during 200 BC to 200 AD (Martin and Martin, 1982). The utilization and trade of rhinoceros parts in traditional oriental medicine systems is well documented by a number of researchers (e.g. Martin 1989a and c; Mills, 1993). Although long considered to be used as an aphrodisiac by the Western media, the effect of rhinoceros horn on feverish rats has been proven by Dr. Paul But Pui-hay of the Chinese Medical Material Research Centre at the Chinese University of Hong Kong. Despite the fact that a large number of Western pharmaceutical companies had rejected Chinese claims that rhinoceros horn was an anti-pyretic substance, But

et al (1990) proved that it did reduce fever in rats. Although at a dosage of 0.5g/ml of blood there was no effect, the remedy took effect with a dose of 1-2.5g/ml and was maximal at 5g/ml. These experiments further found that Saiga Antelope *Saiga tartarica* horn was as effective as rhinoceros horn at reducing fever and could be used as an alternative. They also showed that buffalo species' horn can be a substitute but only in a higher dosage (Milliken *et al.*, 1991). Rhinoceros horn is generally sold either as raw horn or as manufactured medicine in consumer countries, such as Taiwan, where 'fire' horn (Asian) has been shown to be far more expensive and considered more effective than the 'water' horn (African) (Leader-Williams, 1992a).

The demand for rhinoceros horn in the Middle Eastern markets of Yemen (Martin 1992a; Leader-Williams, 1992a) and Oman (A. Kumar and H. Asadi, pers. comms., 1995) has also been comparatively well researched. Otherwise, current usage of rhinoceros horn includes that by Tibetan medicine, not so far a well-documented form of consumption. This report also documents other domestic uses of rhinoceros horn within India, hitherto unreported.

Domestic trade

There is a small trade in rhinoceros horn and other rhinoceros derivatives within India, which has been documented by Martin (1983b), but which has remained otherwise largely unstudied in the present context. Domestic utilization contributes to a comparatively low volume trade, which at one time involved imports of African rhinoceros horn to India. This was because Indian rhinoceros horn, 'fire' horn, was worth five to 10 times more than African horn in Far Eastern markets, making its trade within India comparatively low-profit. Broadly, the domestic use of rhinoceros horn in India can be classified into the following categories: (a) traditional use, (b) Tibetan medicinal use, (c) other uses.

Traditional uses

The earliest record of use of rhinoceros derivatives in India is that of rhinoceros horns being made into knife handles in the twelfth century (Ahmed, 1960). Apart from this, horns were used to make cups for royalty and aristocracy which were used not only as a decorative objects but also to act as poison detectors - a belief that was widespread in those days. The horn was also ground up into a powder and mixed with drinking potions for use as an aphrodisiac. Rhinoceros skin shields were also common in history, the warrior clans of Rajasthan (of Udaipur, Mewar, Jodhpur, Jaipur, Bikaner, etc.) curing rhinoceros skins to a transparent amber colour, and decorating them skilfully as shields (Watt, 1904). Martin (1983b) documents that the shields were painted with black lacquer and decorated elaborately with gold and gilt. He also documents the European-style emblems on many of them and this, in fact, was very common among the aristocracy of that period. He suggests that the origin of the hide for these shields would more likely have been Africa than Assam, basing his hypothesis on the fact that it was far easier for trading vessels to travel the oft-used trade routes between India and Africa rather than going on perilous jungle expeditions. In view of later imports of African rhinoceros horn into India, such a hypothesis does indeed have a valid base.

Rhinoceros urine has long been considered in India to have medicinal properties (Nadkarni, 1979), and as late as 1984 when the rhinoceros translocation programme in Dudhwa was being carried out, it was recorded that villagers in Dudhwa started asking for rhinoceros urine - a commodity that they would not have had access to for more than 100 years, owing to there having been no rhinoceroses there for nearly a century (Aziz, pers. comm., 1993). From 1977-78, the Guwahati Zoo in Assam collected 240 bottles of rhinoceros urine, each bottle containing 750ml, and sold for six rupees (US$0.75), thereby earning a revenue of Rs1440 (US$177) (Patar, 1980). Martin (1983b) also documents the Calcutta zoo selling rhinoceros urine for about six rupees a litre and making a revenue of Rs9000 (US$1100) in 1979 (see Table 29).

Table 29

Various zoo prices for rhinoceros urine in India

Location of zoo	Legality	Year	Price per litre bottle (Rs)
Calcutta	Legal	1975	1.80
	Legal	1976	3.20
	Legal	1980	3.50
Delhi	Illegal	1980	24.50
Guwahati	Legal	1980	6.50
Bombay	Legal	1976	67
	Legal	1980	Free on demand

Source: After Martin, 1983

Although African rhinoceros horn is documented to have been used as an aphrodisiac in Gujarat (Martin, 1979), Indian rhinoceros horn quickly fell out of use owing to the fact that it quickly became too expensive for Indians to afford, and also again because the prices being offered in the Orient were far greater than could be had in India. Also, the illegality of the trade and the strong penalties instituted against it were successful in discouraging most Indians from using it within the country. Martin (1983b) documented that about 50kg was annually consumed within India for domestic use at that time, but the findings for this report seemed to show that today even this figure is too high. The very negligible quantities used today within India, added together, would not amount to more than a few horns.

The use of rhinoceros horn as an aphrodisiac has very many forms, all of them documented by Martin (1983b). It can either be mixed with herbs (in one case reported to be in a 1:6 ratio) and then dispensed, to be had with honey, cream, ghee or butter. Alternatively, the horn is burnt and the ash mixed with saffron, cardamom and honey and then retailed as a twice-daily dose. The present study found no evidence of the widespread use of rhinoceros horn in Gujarat as an aphrodisiac, as reported by Martin (1979).

Martin also documents the use of rhinoceros horn to cure lumbago, polio and arthritis, as well as haemorrhoids, in which case the smoke from a burning horn is directed towards the patient's underparts. He also describes rhinoceros blood being used as a tonic, rhinoceros meat as a cardiac stimulant and to alleviate nosebleeds. Finally, he documents the use of rhinoceros fat and stomach for treatment of skin diseases and, again, polio. Martin (1983b) documented very little rhinoceros horn for sale in traditional medicine shops in India, however.

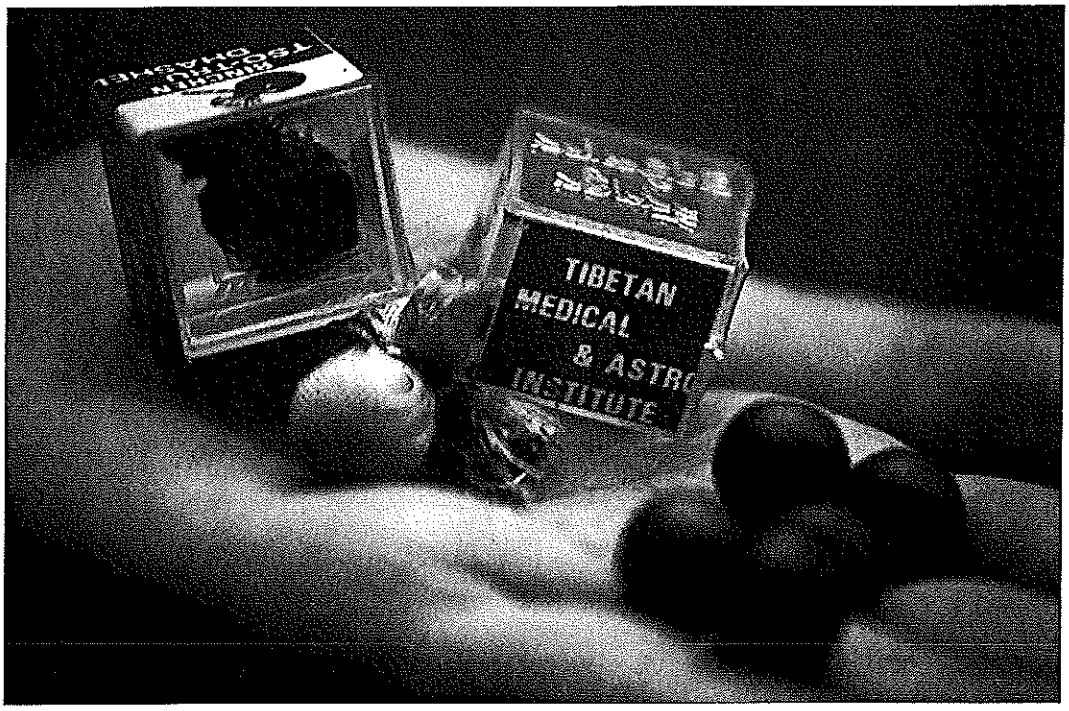
Tibetan medicine

The Tibetan medicine school dates back as early as the second century AD. Although, initially an amalgamation of Indian and Chinese schools of medicine, the seventh and eight centuries AD saw physicians from Persia, Greece and Nepal contributing to the assemblage of Tibetan medicine cultures. Today, the practice is an integrated part of the tantric teachings of the Mahayana school of Buddhism, which aims to lead one to a direct union with reality and liberation from the cyclic world of suffering. After China colonized Tibet in the early 1950s, His Holiness the Dalai Lama, who is the spiritual head of the Tibetan people, fled Tibet in 1959. Under Dr. Tenzin Choedak, the 14th Dalai Lama's physician, the school flourished within India, the country of exile.

Besides using purified mercury as a base for its concoctions, the school uses a large variety of flora and fauna in the medicines, rhinoceros horn being one of them, despite the Dalai Lama's express condemnation of illegal

killing of animals (*in litt.* to B. Thapar, 1994). Rhinoceros horn is used in six principal Tibetan medicines made and marketed in India (Tsarong, 1986). The medicines range from curing renal disorders to haematemesis, hepatic malfunctions, pulmonary disorders and for proper circulation. The complete list of medicines with their ingredients and uses is given in Appendix 1. The medicines are part of 200 different formulations made at the Tibetan Medical and Astrological Institute at Dharamsala, Himachal Pradesh. Founded in 1961, the institute formulates the medicines under the supervision of the chief pharmacist.

The methods of making the pills vary, but normally the concoctions contain between 10-30 ingredients which are weighed, pulverised and sifted. The sifted powder is kneaded with boiled water and with plant extracts and then rolled into pills. These are dried and polished and may be dispensed directly or wrapped in different coloured silk sachets. The six formulations containing rhinoceros horn have between 13-25 different components in them. Faunal components other than rhinoceros horn used in these formulations include deer antlers, mountain goat's horn, "elephant gallstones", musk, bear bile and crab shell. It is believed that the "elephant gallstone" component could be that of an ox, given the absence of a gall bladder in elephants (L. Choudhury *in litt.*, 1993). All the given components are from animals protected under the *Wildlife (Protection) Act 1972*, and therefore their use constitutes a legal offence in India. Among plants used in combination with rhinoceros horn, cardamom *Elettaria cardamomum*, sandalwood *Santalum alba*, gooseberry *Emblica officinalis*, nutmeg *Myrstica fragrans* and saffla *Carthamus tinctorius* were used in more than half the preparations. Costus *Sassaurea lappa*, the only protected medicinal plant in India, figured in two medicines.



Vivek Menon

Tibetan medicine containing rhinoceros horn, from the Tibetan Medicinal and Astrological Institute, Dharamsala, India.

Other uses

Rhinoceros horn has several other minor uses in India that have been documented during investigations for this study. The most common one in eastern India is the use of small flakes of rhinoceros horn in rings worn both by men and women. These flakes vary in colour from a dark yellow to deep amber and after use may turn brownish. They are normally worn by the Assamese although their use in Bengal has also been historically recorded. These rings are worn with many superstitious beliefs, mainly to ward away spirits. They are also

supposed to provide the wearer with good health and protect him or her from diseases. Although, there is no scientific validation for such a hypothesis the wearers allow the rhinoceros horn to touch their skin through a hole in the bottom of the ring. The rings also raise the social prestige of their wearers. It is essential to mention here that a large number of stones and pieces of cattle horn are used to make so-called rhinoceros horn rings.

Vivek Menon

A pair of rhinoceros feet presented as a retirement gift to a former official in India.

Another use of rhinoceros horn is its purported use by militants in preparing fake currency notes. This fact was repeatedly heard during this study from a large number of people in Assam but could not be verified in the field, obviously so because of the nature of use. According to some accounts, rhinoceros horn is one of a dozen or more components that are put together to make the basic printing dye to print fake currency. This is done in underground presses by militant outfits such as the ULFA, NSCN and the Bodos. Reportedly, the rhinoceros horn components give a dark coloration and may also be used as a fixative in the dye production.

Patar (1980) documented the demand for rhinoceroses in Indian zoos and reported that two to three rhinoceroses were captured and sold each year from Kaziranga National Park during the 1970s. He quoted the price for an Indian rhinoceros as about Rs100 000 (US$12 345) each, for an Indian zoo.

International trade

Internationally, the rhinoceros horn trade is centred primarily around the illegal markets in Yemen and Oman for rhinoceros horn-handled daggers, and the Oriental medicine markets of East Asian people (Leader-Williams, 1992a; Mills, 1994). Patar's record (1980) of the demand for rhinoceroses among zoos quotes the price for an Indian rhinoceros as about Rs200 000 (US$24 690) for a foreign zoo. However, the last rhinoceros from Kaziranga to the Americas was sent in 1975, to Bronx Zoo, New York (T. Foose, pers. comm., 1996).

Since the only domestic consumption recorded in India was for Tibetan medicine and other, lesser, miscellaneous uses, and given the high prices in the Far East, as compared to the Middle East, it has been deduced that the vast majority of Indian rhinoceros horn finds its way to Oriental medicine markets (Leader-Williams, 1992a). Asian rhinoceros horn commands several times the price of African rhinoceros horn, and is

especially prized in Oriental medicine markets. As mentioned above, historically, India has imported African rhinoceros horn for use within India, while most of the Indian horn found its way, as far back as the early 1970s, to Taiwan, Thailand and South Korea (Martin, 1979). Moreover, in Singapore in 1985, a survey found that all respondents named India as the origin of rhinoceros horn in the medicinal trade, while only four out of seven even spoke of Africa (Anon., 1985). Later studies (Nowell *et al.*, 1992; Mills, 1993) showed that demand for Asian horn in Taiwan and South Korea continued, 31% of shops selling rhinoceros horn in Taipei and Kaohsiung cites identifying their horn as Asian.

Data for historical trade in rhinoceros horn is very scarce, but some exist for trade from India to Japan and South Korea (see Table 30). Between 1949 and 1971, India officially imported some 13kg of African rhinoceros horn from Kenya, Uganda and Tanzania, according to those countries' official statistics: trade in rhinoceros horn was legal between India and those countries at that time, but became illegal after the enactment of the *Wildlife (Protection) Act 1972* (in 1972). India acted as an entrepôt for African horn to some extent (Martin, 1983b), as well as consuming it domestically (see ***Traditional use*** above).

Table 30

Official imports of Indian rhinoceros horn shown by consumer countries

Country	Year	Weight in kg	Value in US$	Reference
South Korea	1973	30	1055	Martin (1983)
South Korea	1977	19	1661	Martin (1983)
South Korea	1979	20	6775	Martin and Barzdo (1983)
Japan	1965	62	2194	Martin (1983)
Japan	1967	86	3853	Martin (1983)
Japan	1971	31	1539	Martin (1983)
Japan	1975	-	807	Martin (1983)

Export trade in rhinoceros horn was illegal in India from 1972, but between 1965 and 1980 the State of Assam put up rhinoceros horns (from animals killed by poachers or by natural causes) for legal tender on the domestic market, and these auctions are said to have been the largest source of smuggled horn from India after 1972. Auctions stopped after 1979-80 as a result of pressure from conservationists (Martin and Ryan, 1990). (No horn from West Bengal has ever been auctioned.) Auctioned horns were graded into three qualities : sound, defective and third quality. Sound horns were full horns with no cracks in them while defective horns had varying numbers of cracks in them. The third quality grade was usually for broken horns. Martin (1983b) documents that while most bidders at such auctions were traders from Calcutta, from 1965 to 1976 a Kathmandu-based Nepalese bought all the horn, whereas from 1978 to 1980 a merchant from Manipur outbid all others. While recording this, he does not document whether these Calcutta-based and Manipur-based traders are Marwaris (see **Trader's profile**), but field investigations for this report indicate that this could have been the case.

The fact that horn continued to be exported from India after its banning such trade is illustrated by the importation, from 1973-79, by South Korea, of 69kg, according to that country's import statistics. Needless to say, India itself does not have any export statistics for this period, given the illegality of the trade. Between 1970-79, the wholesale price of Asian rhinoceros horn in consumer countries had risen nearly six-fold (Martin and Barzdo, 1984), providing a clear incentive for trade in exported horn from India. From the data shown in Table 31 it can be seen that the price of horn auctioned legally in India was rising steadily during the same

period, until it increased dramatically in 1979. The price per kilogramme rose from Rs7333 (US$1535) in 1965-66, to Rs16 001 (US$1975) in 1978-79. In 1979-80, however, coincident with the cessation of legal sales of horn in Assam, the price went up about four-fold to Rs62 500 (US$7621) per kilogramme. This higher level of demand has been attributed to greater purshasing power among consumers, and possibly the effect of the illegality of the trade in a growing number of countries: all species of rhinoceroses were listed in the CITES (Convention on Trade in Endangered Species of Fauna and Flora) Appendices by 1977 (Leader-Williams, 1992a).

Table 31

Legal sale of rhinoceros horn by Assam Government (1965 to 1980)

Year	Kilogrammes sold		No. of pieces	Price per kilogramme (in Rs)
1965-66	Sound :	29.34	42	7333
	Defective :	?	4	?
1966-67	Sound :	15.34	19	9151
	Defective :	06.70	14	4715
1967-68	Sound :	11.97	17	8701
	Defective :	02.42	04	5101
1969-69	Nil			
1969-70	Sound :	08.10	8	10 001
	Defective :	02.73	4	5801
	3rd Quality :	01.89	6	5201
1970-71	Sound :	07.16	5	10 501
	Defective :	02.48	5	6501
	3rd Quality :	00.80	1	4001
1971-72	Sound :	14.84	16	10 001
	Defective :	07.06	13	6001
1972-73	Sound :	05.51	9	14 201
	Defective :	01.59	4	9001
1973-74	Sound :	15.26	15	13 001
	Defective :	01.77	4	9002
1974-75	Sound :	08.89	12	14 010
	Defective :	16.78	20	9005
	3rd Quality :	05.93	8	6001
	Total	31.60	40	
1975-76	Sound :	13.19	12	14 100
	Defective :	02.83	5	9010
	3rd Quality :	00.11	1	5001
1976-77	Sound :	18.06	27	11 651
1977-78	Sound :	30.04	42	16 001
1978-79	Sound :	45.33	63	16 001
1979-80	Sound :	39.49	61	62 501
	Total	**318.57kg**	**Total pieces 441**	
	Average weight per piece: 722g			
	(The largest single horn sold weighed 2.215kg)			

Source: After Martin, 1983

The high prices commanded in East Asian (see Table 32) markets have continued to fuel poaching of rhinoceroses and illegal export of their horn by allowing augmented prices to be paid to poachers and middlemen (Martin, 1991). Martin *et al.* (1987) and Vigne and Martin, (1991) estimated that such a lucrative export trade accounted for the poaching of at least 489 Indian rhinoceroses during the 1980s, a number easily borne out research conducted for this report.

Surveys in consumer countries have shown that the price of Asian rhinoceros horn has fallen since 1992: the results of the survey in 1993 in Taiwan by Loh and Loh (1994) show that the price of Asian rhinoceros horn had fallen by 37% from 1991 i.e. from NT$6320 per chien to NT$4000 (US$41.03/g). It is believed that this price fall may be explained by the fact that Taiwanese had been stockpiling Asian rhinoceros horn until 1991, so that by that year the amount of rhinoceros horn possessed by retail pharmacists in Taiwan was estimated at around 4667kg, much more than the annual demand of 200 - 400kg (Milliken *et.al* 1993). As the rate of growth of the Taiwanese economy levelled between 1991 and 1993 the potential value of investing in rhinoceros horn decreased and thus the wholesale price fell. Nonetheless, the prices fetched in foreign medicinal markets are presumably still well able to attract traders in Asian rhinoceros horn, given the poaching levels witnessed among India's rhinoceroses beyond 1991.

Trader's profile

Indian rhinoceros horn traders are not normally of the same communities as the horn poachers. Although several wealthy Nagas are thought to be financiers in the operations, the main traders are Marwari businessmen. This study found that the Marwari community more or less controls the trade in rhinoceros horn in northeastern India. Otherwise, traders comprise wealthy Assamese and Bengalis, but the proportion of such persons is very negligible in comparison to Marwaris. The Marwaris, who originally hail from the Marwar district of Rajasthan, are primarily a trading people who are considered throughout India to constitute one of the shrewdest business communities. Marwaris have been in Assam for many years and control much of the large business concerns of both Assam and northern Bengal, as well as of the adjoining northeastern States. Large-scale demonstrations and formations of trade unions by the local populace, somewhat resentful of the Mawari grip on the local economy, have thus far not been able to curtail the Marwari business expansion.

The rhinoceros horn agent or trader does not deal exclusively in the commodity and often deals in a number of other contraband goods. In many cases he or she is also a known narcotics smuggler or illegal arms operative, according to information gathered by the author. The interests run in a parallel and inter-connected fashion that is well known to law enforcement agencies that operate in the field, such as the Directorate of Revenue Intelligence and Central Bureau of Investigation of India. In some instances, there are two levels of dealer, with a primary agent offering horn to the main dealer. As there are a number of dealers, often one takes on the mantle of leader for an area, for example central Assam, or lower Assam and northern Bengal combined, until he is displaced, for example by assassination, as in the case of the most prominent dealer of rhinoceros horn in central Assam in the mid-1980s, who was shot dead by ULFA. Most of the traders operate out of several towns with headquarters in one, but often shifting residences.

Martin (1991) records the existence of several traders, including an Assamese businessman from Dhing (east of Pabitora Wildlife Sanctuary), one from Behali on the northern bank of the Brahmaputra, and another from Naojan on the Assam-Nagaland border.

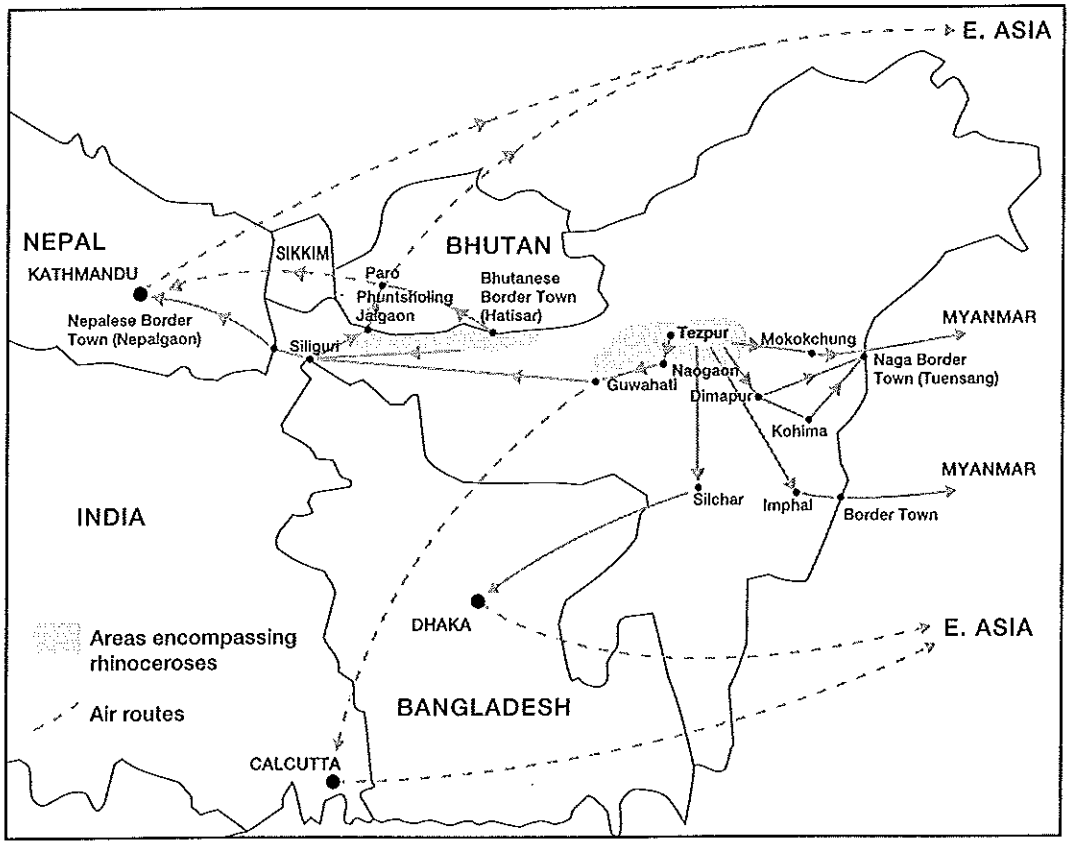
During the present study as many as 125 poachers and traders were identified. The names have been provided to enforcement agencies during the course of the study for appropriate action to be taken.

Trade routes and modus operandi

One of the major objectives of this study was to establish the whereabouts of routes and centres for the rhinoceros horn trade. To a large extent this has been accomplished, although by the inherent nature of this trade it is to be expected that these routes constantly change. Vigne and Martin (1994) record Calcutta, Siliguri, Nagaland, Myanmar and Bhutan as trade centres and outlets (see Figure 18). However, these are links on very generalized routes, with specifics not known. Martin *et al.* (1987) also refer to Simla Bazaar, near Manas, as a trade centre. In the same paper they trace some of the trade routes known at that time for Manas horn, from Bongaigaon, Khusratari and Mazrabari, going on to Siliguri, Jalpaiguri or Kalimpong, and then on to Calcutta. From Kaziranga, rhinoceros horn was sent to Guwahati or Nagaland and then on to Calcutta. Dhing, Behali, Naojan and Bokakhat were recorded as places around Kaziranga from where small traders operated (Martin, 1991). Martin *et al.* (1987) also record a horn seized from a person on the way from Tezpur (near Orang sanctuary) to Siliguri, proceeding to Calcutta and estimated that as much as 90% of all horns passed *via* Calcutta, after which Singapore and Hong Kong were mentioned as two possible trade destinations. They found conclusively that although Nepalese were used as middlemen, the rhinoceros horn they carried was not destined for Nepal.

Figure 18

Map to show main trade routes currently in use for rhinoceros horn out of India



There have been some significant changes between the time of reporting by Martin *et al.* (above) and now. A tightening up of security and a greater understanding of urgency among law enforcement officers has resulted in the dealer becoming very wary. Also, Calcutta, having become a known trade centre, has begun to be circumvented and alternative trade routes have been explored by the traders. Even by 1991, Martin was documenting slight shifts in the trade route *via* Calcutta. Although he still maintained that from Assam some of the horns went out to Calcutta, the Singapore connection was being slowly replaced by a Taiwanese one. In the early 1980s, Martin estimated, some Indian horn went to Singapore - the country was not a member of CITES until 1987. However, as Taiwan started spending more on rhinoceros horn, the Singapore route shifted to a Hong Kong-Taipei link, or a direct route to Taipei. On a survey in December 1990, Martin could identify only one medicine shop selling Indian rhinoceros horn in Singapore, while at least five were selling it in Taipei (Martin, 1991). Extending the opportunistic poacher hypothesis to an opportunistic trader hypothesis, it is easy to see why many trade routes are in use.

Research for this report found that the rhinoceros horn trade has largely shifted out of Calcutta today, although prominent dealers still maintain links in the city. Taking rhinoceros horn overland to Calcutta and then smuggling it outside the country is becoming an increasingly risky option. The main trade routes today all seem to operate overland out of India and then by air to Southeast Asia. As explained earlier, this is not immutable, as traders often change their *modus operandi* to avoid detection. The other main finding of this study relating to trade routes is that there are at least two distinct trader and poacher blocs, one operating in lower Assam and northern West Bengal and the other operating in central Assam. While the first operates south of Guwahati, the other controls the trade up to the border with Myanmar to the east. Field investigations showed that there is very little interaction between these two groups, and normally horns poached from a region are disposed off through the trade centre of that region. The main trade routes operating are as follows:

1. Poaching centre in lower Assam/West Bengal – Simla Bazaar – Siliguri – Jaigaon – Phuntsholing (Bhutan) – Paro – East and Southeast Asia.
2. Poaching centre in lower Assam/West Bengal – Siliguri – Nepalgaon – Kathmandu (Nepal) – East and Southeast Asia.
3. Poaching centre in lower Assam – Bongaigaon – Hatisar – Galegphug (Bhutan) – East and Southeast Asia.
4. Poaching centre in central Assam – Karbi Anglong Hills – Dimapur – Tuensang (Naga border town) – Myanmar.
5. Poaching centre in central Assam – Naogaon/Tezpur – Guwahati(storage) – Siliguri or Calcutta – East and Southeast Asia.
6. Poaching centre in central Assam – Guwahati – Silchar – Bangladesh – East and Southeast Asia.
7. Poaching centre in Assam/West Bengal – trade centres (Guwahati, Siliguri, Dimapur) – direct purchase by East/Southeast Asian national.
8. Poaching centre in central Assam – Karbi Anglong Hills – Imphal – Manipuri border town – Myanmar.

Clearly, three subsidary towns have emerged as trade centres adding to the historically important Calcutta. Siliguri, the new sprawl in northern Bengal is fast becoming the most important centre. As it is the gateway to the north-east all transport from there to Bengal, or vice-versa, and transport to Nepal or Bhutan normally pass through this city. Thus, it is a convenient trade centre. Also, the city is more or less controlled by Marwaris who are the main tradesmen. Dimapur on the Nagaland-Assam border is particularly important for Kaziranga

horn, as it is easily accessible through the district of Karbi Anglong, where law enforcement is at a much lower level compared to other areas, and through which Nagaland is easily accessible. Dimapur is again a Marwari base in Nagaland. The horn from here is probably taken to a border town, such as Tuensang and then bartered or sold to the Myanmarese. Guwahati, the State capital of Assam, has many a time sprung surprises in the form of arrests of poachers and seizures of horn, pointing to the increasing use of the city as a storage point until an alternate route can be taken. The use of Guwahati as a storage point was confirmed when the arrest of an officer of the Directorate of Economics and Statistics in the city on 22 December 1993 revealed that the five rhinoceros horns that were with him were brought in from Manas National Park. Formerly, the horns of lower Assam would usually have gone to Siliguri and Calcutta or direct across the Bhutanese or Nepalese border, but Guwahati has evidently been used as a storage point until surveillance along known trading routes is diverted, or lapses.

A classic example of complete ignorance of a trade route by enforcement officials can be illustrated in the case of Bhutan. Bhutan was traditionally viewed as a Buddhist protectorate where the very laws of *ahimsa* decreed that animals should not be killed. Martin *et al.* (1987) documented what they said was a new threat from Bhutan, reporting the incident of December 1979 when the King of Bhutan shot a rhinoceros in the Bhutanese part of Manas. This shooting, which was later emulated by his son, is also recorded by Deb Roy (pers.comm., 1993). It is recorded that although the horn and tail were removed, the rest of the carcass was buried. Many believed this to be a royal ceremony where once in the life-time of the monarch, one rhinoceros was to be hunted. However, the portents of a trade through Bhutan did not strike many. On 17 September 1993, Ms. Deiky Wangchuk, the aunt of the present king of Bhutan, Jigme Wangchuk, was held on entry to Taiwan with a consignment of nine bear gall bladders and 22 rhinoceros horns worth NT$20 million (US$769 000), which upon interrogation were indicated to be of Manas origin (Loh, pers.comm., 1993). All the horns had been collected at a bottling plant owned by the royal family in Bhutan and from there conveyed on to Ms. Wangchuk. The King of Bhutan dissassociated himself with such illegal activities and Ms Wangchuk was held in a Taiwanese prison until she was bailed out and returned to Bhutan. What was brought home to conservationists, however, was the use of Bhutan as a conduit in the trade of rhinoceros horn, a fact not formerly suspected. The major Indian trade centre of Siliguri is very close (35km) from the border town of Jaigaon, from where the Bhutanese town of Paro is less than 100km. Paro has an airport that operates flights to Bangkok, and was part of an easy route for horn to pass undetected past a relatively lax and uninformed law enforcement agency.

The recent apprehension of a Taiwanese national buying rhinoceros horns in India lends credence to the theory (B. Wright, pers. comm., 1996) that some East Asian nationals have taken to coming to India themselves for the purchase of rhinoceros horn.

It is to be believed that the trade will continue to shift its operations as routes become known and therefore a constant vigil must be kept to determine fresh trade routes and new *modus operandi*.

Prices and fluctuations

The phenomenal price of Asian rhinoceros horn (although as a final end product in shops it is often difficult to determine the exact species that the horn comes from), as compared to African rhinoceros horn, drives rhinoceros poaching in India. Owing to strict conservation laws in India the trade is completely underground and no current official prices exist.

Several publications list the price of Asian rhinoceros horn in user countries. Table 32 tries to bring together in one place most cited references for Indian or Asian rhinoceros horn both within India (poacher and trader level) and outside India.

Table 32

Prices of Asian/Indian rhinoceros horn over the years

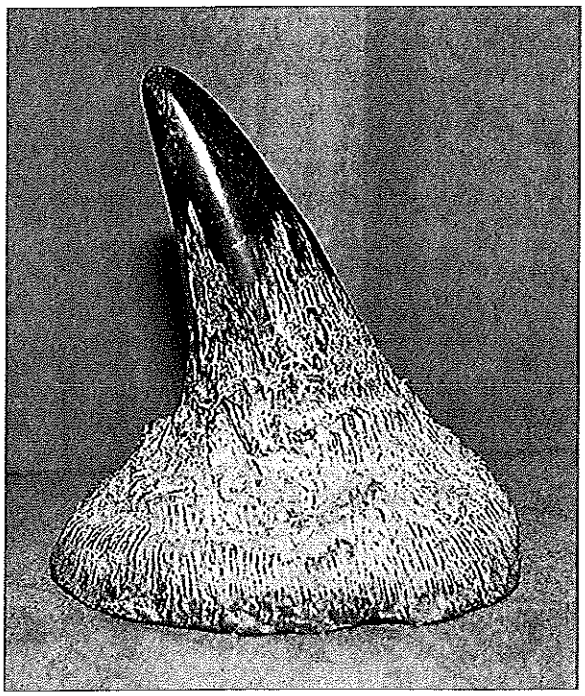
Price (Rs)/kg Poacher's Price	Price category	Year	Reference
14 798	Poacher's price in Manas	1985-86	Martin, Martin and Vigne (1987)
36 996	Poacher's price in Orang	1985-86	R.Bhattacharjee in Martin, Martin and Vigne (1987)
20 000-25 000	Poachers price in Kaziranga	1987	Martin, Martin and Vigne (1987)
32 752	Poacher's price in Assam	1986	Martin (1991)
101 331	Poacher's price in Assam	1989	Martin (1991)
69 375	Poacher's price in Assam	1993	Vigne and Martin (1994)
100 000	Poacher's price in Assam	1994	Present study
Trader's Price in India			
16 000	Govt.of Assam auction price	1977-78	Patar (1980)
70 000		1982	Baidya (1982)
103 536	Trader's price in Assam	1987	Martin, Martin and Vigne (1987)
200 000	Trader's price in Nagaland	1991	Martin (1991)
206 646	Trader's price in Bhutan	1993	Vigne and Martin (1991)
187 750 - 400 000	Trader's price in Assam	1994	Vigne & Martin (1994)
300 000-500 000	Trader's price in Assam	1994	Present study
Trader's Price Abroad			
139 266	Trader's price in Taipei	1979	Milliken, Martin and Nowell, (1991)
263 472	Trader's price in Kaohsiung, Taiwan	1985	Milliken, Martin and Nowell, (1991)
295 092	Trader's price in Taipei	1985	Milliken, Martin and Nowell, (1991)
595 989	Trader's price in Kaohsiung, Taiwan	1988	Milliken, Martin and Nowell, (1991)
563 716	Trader's price in Taipei	1988	Milliken, Martin and Nowell, (1991)
945 268	Trader's price in Taipei	1990	Milliken, Martin and Nowell, (1991)
706 747	Trader's price in Kaohsiung, Taiwan	1990	Milliken, Martin and Nowell, (1991)
349 840	Import price into Taiwan	1990	Martin (1991)
373 524	Retail in Bangkok	1990	Martin (1991)
961 563	Retail in Taipei (powder)	1993	Loh and Loh (1993)
1 282 188	Retail in Taipei (powder)	1993	Loh and Loh (1993)
1 602 500	Retail in Taipei (powder)	1993	Loh and Loh (1993)

Today, research for this report revealed that poachers get approximately a *lakh* of rupees (over US$3000) on site (usually per horn), which then has to be shared between the team of three to five persons. When noting that foreign retailers receive many times this amount for Asian rhinoceros horn, it should be kept in mind that at this stage, the horn is never sold as such and the price is really a calculation based on the price for the minute quantities of rhinoceros horn powder and the medical knowledge dispensed by retail pharmacists.

It is revealing to compare the prices received for Indian horn with those in an African operative. For example, in South Africa traders received between US$535-890 per kilogramme if selling horn to a Chinese or Taiwanese at the beginning of the 1990s, and at least in one case the mark-up was so great that a Taiwanese trader received US$2000 per kilogramme of horn, in 1991, back in Taiwan (Martin, 1994). By comparison, the Indian middleman gets as much as Rs300 000 to Rs500 000, or roughly US$10 000-US$15 000, per kilogramme of horn at the trade level in India. However, considering that the Asian horn is five times or more as expensive, the price earned by the equivalent level trader in India would be expected to be equivalent to about US$2500, rather than several times that amount. Such relatively high prices are an indication of how greatly the rhinoceros is under threat in India, a country where the average annual per capita income is about Rs6000 (US$185).

Trade in fake rhinoceros horn

Rhinoceros horn is a commodity that seems to invite the manufacture of fakes, judging by the number of fake horns in the market. Although adulteration and addition is common at retail points, especially by use of Saiga Antelope horn and Water Buffalo *Bubalus bubalis* horn (Milliken *et al.*, 1991), it is substitution of complete horns that is practised at earlier trade levels. Until the horn reaches the retailer it is normally in one whole piece or in recognizable parts (this is the case when the horn travels from the country of origin and not from a secondary source, such as Yemen). Although such substitution with fake articles is seen in other trades, it is rarely with such diversity and ingenuity as in the rhinoceros horn trade.



B. Wright

Fake rhinoceros horn (water buffalo horn and wax), photographed at Kaziranga National Park, December 1995.

During this study, several fakes were seen and photographed, mainly materials seized by law enforcement agencies. Baidya (1982) documents the manufacture of a rhinoceros horn from a cattle horn (either from domestic cow or Water Buffalo). He reports that a domestic cattle horn is mounted on a cement base and suitably coated to pass off as a genuine rhinoceros horn. However, in the case he examined, the exterior coating had peeled off revealing its spurious character and the fake was obviously not as expertly made as some which are in the market today. Such fakes are also common in Africa: for example, in 1983 six fakes were seen in Zambia. In this case, the horns bearing a close resemblance to real horns were made from a mixture of resin, cow hair and cowdung. The price asked was US$64 per horn.

Among the fakes seen during the author's investigations, the most simple ones ranged from carvings in stone and moulded plastic horns. The commoner ones are made from wild buffalo horns and cattle bones. The horn is shaped and then the basal surface of a rhinoceros horn imitated by using wax or other resinous substances.

In many cases it is very difficult to distinguish real horn from manufactured imitations, but examination of the base very carefully is often the best way of doing so. Real rhinoceros horn has many minute canaliculi-like channels that dot the base creating a pitted surface. It is very difficult to reproduce these on fake horns. The most interesting fakes and usually the ones resembling real horn most closely are those using bamboo root. The roots of certain kinds of bamboos are dug out and carved in the form of a rhinoceros horn. They are then dipped in oil and hung in the sun for many days until the correct colour is attained. The advantage that a bamboo root has over other substances is that naturally, bamboo has a porous base which lends itself to a the creation of a simulated rhinoceros horn base. In most cases, the fakes succeed in being passed off as real ones, and therefore fetch prices commensurate with rhinoceros horn prices.

CURRENT PROTECTION LEVELS

While all the preceding chapters have outlined the current status of the Greater One-horned Rhinoceros in India and the threats that it is facing from poaching for the trade in rhinoceros horn, this chapter deals with current protection measures and analyses their effectiveness.

To put into perspective the strategies undertaken thus far, it is useful to have as a guideline the opinion the AsRSG (Khan, 1989) regarding the protection of rhinoceroses.

"Protectability of rhinoceroses

Factors that need to be considered in evaluating the protectability of rhinoceroses and their habitat include :

- ecological situation, including the location of the area in relation to other places occupied by the rhinoceros;
- legal status, i.e. whether or not the area has been gazetted as a protected area;
- land use plans and the stage of their development;
- pressure to use the area;
- alternatives available for use of land and their costs;
- level of poaching;
- type of poaching;
- accessibility of the area;
- present and future manpower to protect the rhinoceroses;
- cost of protection in relation to other demand on resources."

Despite the undesirable conditions under which staff in India employed to protect rhinoceroses operate, relative to the points enumerated above, (e.g. a review of the resources available to staff (see **An account of rhinoceros-bearing areas**) shows that in many sanctuaries the available equipment and arms are insufficient to combat poachers), they have nonetheless tackled a number of rhinoceros poachers. Martin (1983b) records that

a major anti-poaching offensive was launched in 1968 after a poacher killed a park guard. From 1969 to 1978, according to official statistics, four poachers were killed by forest guards and several others were wounded. In the early 1980s the prison sentence for killing a rhinoceros was increased from three to six months and today it is a Schedule I offence of the *Wildlife (Protection) Act 1972* that invites a maximum sentence of three to six years along with a penalty of Rs25 000 (about US$770). Following are accounts of encounters that took place from January 1991 to March 1993, presented as a case study to facilitate understanding of anti-poaching strategies (Table 33).

Table 33

Anti-poaching operations at Kaziranga National Park (1991-1993)

	Date	Incidents
1.	02.02.91	A rhinoceros was shot by poachers at Daflong area. In the encounter by the patrolling staff the horn was retrieved.
2.	17.02.91	A rhinoceros was shot at by poachers at Bherbheri area. In the encounter the horn was recovered and the poachers fled.
3.	05.03.91	At Borakata an encounter took place with poachers who had shot a rhinoceros. Consequently the horn was recovered.
4.	10.04.91	Near Bandarkhal an encounter took place with the poachers, who had fled leaving behind a rhinoceros horn. Subsequently, a raid was conducted and four persons were arrested.
5.	22.04.91	Near Sahaduba a rhinoceros was killed. An encounter took place with the patrolling staff and the poachers were cordoned inside the park.
6.	23.04.91	An encounter with the same poachers (22.4.91) by the staff took place. Consequently two of the Naga poachers got killed : their bodies were recovered on 24th and 25th April.
7.	24.04.91	Two poachers were apprehended in the raids conducted at Daogaon.
8.	03.05.91	An encounter took place with the poachers by the staff of Daldhibari. Consequently one poacher was killed while one DBBL shotgun and ammunition was recovered. No rhinoceros was killed.
9.	17.08.91	Two rounds of gunshot were heard at Maloni area. The staff on patrolling were immediately alerted. No rhinoceros was killed, while the poachers fled.
10.	28.08.91	An encounter of patrolling staff with armed poachers occurred about 8.30 p.m. at Kanchanjuri. Consequently, one poacher succumbed to his injury and another fled with heavy injury. One DBBL .470 rifle and one DBBL shotgun with ammunition were recovered. No casualty to staff and rhinoceros occurred.
11.	28.10.91	An encounter with miscreants near Naste camp resulted in three persons being apprehended while others fled. The apprehended persons were handed over to the police. Subsequently, a rhinoceros carcass was detected with horn missing under Kartika camp.

Table 33 continued

12. 14.04.92	An encounter with the staff took place at Sesonimukh area under western range and two poachers were killed.
13. May/92	A raid was conducted at Daogaon under Kaziranga Range and three persons, including one telecoms engineer, were arrested and one silencer with .303 rifle recovered as well as 17 live rounds.
14. 20.06.92	An encounter with the staff took place at Bagmari area under Kaziranga Range and one poacher was killed and one Italian-made rifle recovered.
15. 20.08.92	An encounter with the staff took place at Rowmari *nallah* under western range and one poacher was killed.
16. 19.10.92	A raid was conducted at Dolamara area and arms were recovered from the poachers. During the raid an encounter took place. Consequently, one person (Naga) was killed, one injured, and two persons were arrested.
17. 18.11.92	A encounter took place with the staff at Arimora area under Kaziranga Range and one poacher was killed while one rifle of .303 bore was recovered.
18. 12.12.92	A raid was conducted at Jyosipur village near Bokakhat and two .303 rifles were recovered and five persons were arrested.
19. 21.12.92	An encounter took place at Naste under Kaziranga Range and one poacher was killed.
20. 18.01.93	An encounter with the patrolling staff took place at Sesoni under Murkhowa camp (western range) and one poacher was killed.
21. 05.02.93	An encounter with the patrolling staff took place in between Sitalmari and Kartika camp under Kaziranga Range and one poacher was killed.
22. 23.02.93	A raid was conducted at Borbetagaon near Bokakhat and two persons were arrested including one Naga. One .303 rifle and 14 live bullets were recovered.
23. 26.03.93	An encounter with the patrolling staff took place at Tinibeel Tinali under eastern range and one known notorious poacher was killed.

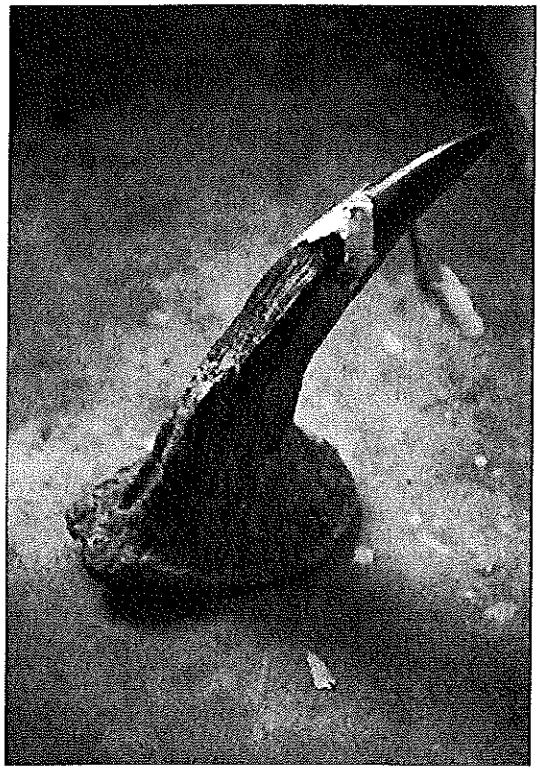
Source: Kaziranga National Park official information

The number of persons arrested in rhinoceros poaching cases by staff of Kaziranga National Park and the arms recovered from them illustrate the scale and tenacity of the poaching problem. According to official sources, nine poachers were killed during 1992 and three during 1993, while 79 were arrested during this period, making it one of the highest anti-poaching efforts by the staff. Moreover, 10 of the 66 rhinoceroses poached during this time were detected in time to salvage the horn, or the horn was recovered soon afterwards.

Although it is clear that strong attempts have been made at anti-poaching activities, the number of horns missing is far greater than the horns recovered. It is obvious that the current anti-poaching strategy is not able to lessen poaching sufficiently in Kaziranga National Park, which yet has one of the most comprehensive anti-poaching strategies for the conservation of the Greater One-horned Rhinoceros. Of the many constraints on its effectiveness mentioned by the Forest Department, the most prominent ones are:

- the lack of an intelligence system;
- lack of infrastructure;
- lack of incentives (including rewards);

- lack of trained staff in combat fighting;
- general law and order problems;
- non co-operation on the part of villagers;
- and delay of finalization of proposed additions to areas of parks.



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Rhinoceros horn seized by authorities at Kaziranga National Park.

It is to be clarified that the current official system in place has programmes for eco-development, but it is seen in practice that in most cases they do not allow for participation by the local villager in decision-making at most levels, leading to their alienation.

In the AsRSG meeting of 1993, the Trade, Human Impact and Public Awareness Working Group referred to the existence in India of 10 or 12 departments concerned with enforcement of measures against rhinoceros poaching and the resultant trade. Co-ordination between these departments was seen as the most important factor for effective anti-poaching activitites. It was also recognized that while in Africa comparitively large sums of money are available for intelligence gathering, this is a low priority in India and Nepal. The report categorically stated that "intelligence is the aspect of enforcement that would bring the greatest success for the least investment. The present strategy on poaching needs to be closely examined. While more money is required for patrolling, firearms, etc., a higher priority is required for intelligence networks. One study in Zambia showed that investment in information-gathering from informers is 30 times more effective than other strategies. Other agencies than wildlife need to be involved after the rhinoceros is poached. The gold and narcotics section of the police agencies in Namibia is the enforcer. Other agencies (i.e. police, revenue intelligence) with existing enforcement capability, should develop information units specific to rhinoceros horn. In Assam, it would be most desirable to have an elite group of forest people trained in combating poaching. Intelligence support from outside would be most welcome." (Menon *et al.*, 1994).

Thus, not only a strengthening or resources, but also a building of intelligence and communication links are seen as essential to more effective rhinoceros protection in India (see **Recommendations**).

CONCLUSION

The Greater One-horned Rhinoceros is possibly more endangered today than ever before. Despite being considerably better off than the other Asian rhinoceros species and also showing an increase in numbers according to official statistcs, the species is facing a very real threat throughout its range. With the exception of Kaziranga in India and Chitwan in Nepal, all other reserves are particularly vulnerable to poaching or have already been affected severely by poaching. Kaziranga today acts as a single reserve for more than half the world population of the species and therefore will need to be paid particular attention with reference to anti-poaching strategies. Lessons from Laokhawa in 1983 and Manas 1987-1995 have shown that a single population can be particularly vulnerable to poaching at times of civil unrest and that numbers can quickly fall to levels where a population's long-term viability is doubtful. The comparative success of Kaziranga must therefore not be seen with a view of complacency by Government and non-government authorities.

Measures aimed at curbing poaching, including intelligence-gathering and enforcement must be considered high priority. The State and central Government departments have aimed at increasing the number of guards and guard posts, but equally importantly the equipment given for anti-poaching operations, as well as equipment that would improve communications, must be provided. Orang can be taken as a case in point, as this was the only sanctuary in recent times to show a zero poaching year, which most people know is largely owing to the exceptional and laudable achievements of one range officer posted at the park. This further underlines the strong role that the range officer has to play in any anti-poaching strategy developed for protected areas for rhinoceroses in India, as also the importance of boosting the morale of the forest guards and other staff working with him.

This study concludes that the poached rhinoceros horn is used to a small extent in the domestic market in India, for Tibetan medicinal and other uses, but that the main demand is medicinal use in the markets of East Asia and Southeast Asia, which are reached using new routes wherever established ones have been put under enforcement vigil. Further, despite measures to prevent sale of rhinoceros horn medicine in many East Asian countries, demand appears to remain sufficient to endow the horn of Greater One-horned Rhinoceroses with a value which is high enough to continue to induce poachers to take calculated risks to obtain it, even where areas are well protected.

Vivek Menon

Rhinoceros swimming in a *beel* at Kaziranga National Park, April 1994.

RECOMMENDATIONS

The following recommendations are limited to addressing the threats faced by the Greater One-horned Rhinoceros owing to poaching and trade in rhinoceros horn in India (as opposed to loss of habitat, disease, etc.). Many of them are for management strategies, while others relate to direct anti-poaching measures. These recommendations do not amount to a complete anti-poaching strategy, which if adopted would save the rhinoceros from extinction in the country, but only a framework which it would be desirable to develop as a follow-up to this report. To facilitate reference, the section starts with general recommendations and then with recommendations for particular rhinoceros-bearing areas.

General recommendations

1. **To review and strengthen security measures at all rhinoceros-bearing areas to minimize access to poachers. Accordingly, detailed recommendations are the following.**

1.1 To arrange for review of all rhinoceros habitat areas for their existing manpower, arms and equipment, and their anti-poaching strategy by an expert team consisting of at least a wildlife biologist, an arms and equipment expert, a combat expert (army, paramilitary or police) and a Forest Department representative.

1.2 To strengthen the radio communication network through establishment of adequate fixed and mobile units as well as to put in place adequate repair systems and monitoring of such equipment.

1.3 To lift the standard of the existing forest guards and foresters with respect to arms training, ambush and counter-ambush training, familiarity with various combat procedures, etc. Where needed, this should be provided by the army, paramilitary or the police at a convenient place, and then refresher courses held to ascertain if the needed standard is being kept up. No forest guard or forester should be posted to a rhinoceros-bearing area without undergoing such a training.

1.4 To provide adequate transport for anti-poaching work so that mobile squads are operable on both land and waterways. It must be seen that upon being alerted, the nearest mobile squad must be able to reach the area of incidence in less than 30 minutes which is often about the time required for the poacher to make a getaway. Such mobile squads must also be able to move outside the borders of protected areas, if in pursuit, and must be given such powers by concerned district administrations. It is also to be seen that there should be adequate fuel available for the vehicles, and the park directors or Divisional Forest Officers responsible be authorized for ensuring the same and also for keeping the vehicles in a fit condition.

1.5 To provide an adequate number of surveillance towers to be manned by properly equipped and armed personnel at vantage points for prevention of entry of poachers into the park. This is to be used particularly in conjunction with night-viewing devices (most certainly infra-red binoculars) as much of rhinoceros habitat can be surveyed using such methods.

1.6 To provide the protection force with such arms as required by them to combat poachers effectively, and if need be, to review the prohibited bore status on certain weapons, such as the .303 and the 7.62 rifles, for use in anti-poaching work. Special Police Officer status could be granted to certain forest personnel under the Police Act, which would give them powers to carry such weapons. Also, arms provided should come with adequate ammunition, not only for the exigency of stopping a poaching event, but also for regular practice, so as to maintain a preparedness necessary for combat.

1.7 To review the division of parks into beats and the placement of camps, to ensure proper coverage and most effective positioning as regards anti-poaching activities.

2. To put into place an intelligence network to enable the physical security measures to function effectively. It is therefore advisable:

2.1 To set up an intelligence network at State and then field level that can ensure collection, sifting, analysis and evaluation of field data on poaching and trade.

2.2 To set up at the State level a cell that can interact with all concerned departments, especially with the police and Customs officials, and which has access to the Central Crime Data Bank of the police and such similar data banks of other enforcement agencies.

2.3 To ensure that a fund be provided at both the State and field level, which is used for payment of informers, that shall be kept confidential and used at the discretion of an officer-in-charge.

2.4 To set up both pre-induction and in-service training modules on intelligence-gathering for all levels of anti-poaching teams.

2.5 To establish a reward system that can be used as an incentive to staff responsible for seizures, arrests, prosecutions and the like. This reward should not be linked with the final judgement of the courts, as the judicial procedure in India normally takes a long time to conclude.

3. To maintain and increase the motivation of park staff, it is advisable:

3.1 To review existing pay and bonus structures for field personnel and to ensure that they are on a par with those of other enforcement agencies.

3.2 To build up infrastructure and social security benefits for park staff, relating to accommodation, education, recreation and family welfare.

3.3 To provide adequate financial compensation to staff in the form of ration allocation, field allowance, proper uniform and other essential items required for life in a camp.

3.4 To ensure a high degree of motivation among field personnel by combining a system of rewards with strict discipline, to keep them in battle-readiness.

3.5 To ensure that field staff are adequately protected against disease, especially those which are common in rhinoceros-bearing areas, such as malaria and cholera.

3.6 To ensure that wildlife postings are not considered "punishment postings" and that interested and physically fit personnel are recruited for anti-poaching activities.

4. To review existing management practices and introduce new ones to help in anti-poaching, and specifically:

4.1 To review food availability within rhinoceros-bearing areas and the linked tendency for rhinoceroses to stray out of the park. To reduce such straying by increasing fodder within parks, by having camps at strategic areas, etc.

4.2 To build escape routes for rhinoceroses to meet the contingencies of high flood by raising and widening the existing roads and by raising more artificial high-grounds for providing shelter to flood-affected rhinoceroses. This is to be done in conjunction with camp placements (temporary) during the floods.

4.3 To extend roads to the extent possible in the park so that patrolling during all seasons becomes easier.

4.4 To ensure that rhinoceros *dandis* are cleared of overhanging vegetation so as to aid anti-poaching and patrolling parties.

4.5 To manage buffer zones in a way that the local villagers tend to look at the park in a non-hostile way and help in anti-poaching efforts.

4.6 To set up, if necessary, village-level committees or protection forces of volunteers who can aid in patrolling and making sure that the village premises are not used by anti-social elements.

4.7 To use elephants already in the possession of the Forest Department in patrolling rhinoceros-bearing areas.

5. To survey previous rhinoceros-bearing areas for possible translocation sites and to form a translocation team that can effectively translocate doomed rhinoceroses. Specifically, this would require activities as follow.

5.1 To investigate and identify areas for establishing new rhinoceros population units as possible re-introduction sites. In doing this all previous rhinoceros-bearing areas, especially those that provide links with existing ones, such as Kochmara, Laokhawa, Patlakhawa, Buxa, etc., should be surveyed.

5.2 To set up a capturing and translocation unit consisting of a rhinoceros ecologist, a veterinarian trained in rhinoceros darting, assistant veterinarians and other technical assistants, with appropriate equipment and drugs.

6. To set up special courts to try wildlife cases and to impress upon the present judiciary the urgency of the need to protect rhinoceroses. Specifically it is recommended:

6.1 To enlighten the judiciary, especially at the district and magisterial levels, regarding the importance of curbing wildlife crimes.

6.2 To set up a system of special courts to try rhinoceros poaching offences, so that speedy redress of such matters may take place.

7. To strengthen enforcement measures against illegal traders and dealers in an attempt to prevent illegal smuggling of rhinoceros horn. In particular, it is advised:

7.1 To affect an immediate offensive on all known dealers, traders and agents in rhinoceros horn in India and their contacts in neighbouring countries (using enforcement agencies of neighbouring countries if necessary) and to break up known smuggling rings.

7.2 To identify all possible trade routes and centres and to maintain vigilence points at suitable locations for gathering intelligence.

7.3 To identify areas of quick getaway from rhinoceros-bearing areas, those linking up to the nearest trade centres and routes, and to establish a conjunction of checkpoint gates, patrol lines and emergency response teams (or flying squads) in such areas.

7.4 To maintain the strictest vigil (by all enforcement agencies concerned) at all possible exit points from India (land, water and air) for rhinoceros horns and to utilize the intelligence network to do so.

7.5 To establish a co-ordination cell if required between the Forest Department, police and Customs, to facilitate an inter-departmental team to react quickly to poachings or information of possible trade or smuggling.

7.6 To maintain a centralized database of wildlife traders and dossiers on them which is available to all enforcement agencies for ready reference. The Subramaniyan Committee constituted by the Government of India to look into wildlife crime recommended the setting up of a national wildlife crime database to be monitored jointly by the Ministry of Environment and Forests and the Indian Police.

7.7 To extend the training courses on wildlife trade and enforcement to all non-wildlife agencies involved in monitoring the trade and to instil in them the importance in doing so.

Additional recommendations for specific rhinoceros-bearing areas

Many of these, more detailed, recommendations relate to conditions not referred to, or not referred to at length, earlier in the report. However, they are included in this section, as they extend from the the **General recommendations** above. It is hoped that they are of interest in providing sharper focus to, and particular examples of, certain general recommendations made.

For *Jaldapara Wildlife Sanctuary and Gorumara National Park*, it is recommended:

1. To place the entire area of Jaldapara Wildlife Sanctuary under the unified control of a Divisional Forest Officer and to transfer the management of Gorumara National Park to a wildlife manager.

2. To strengthen the radio network by bringing in all stations located in both sanctuaries on the same frequency.

3. To re-organize ranges and beats as necessary and to establish additional beats and camps at vulnerable points to prevent entry of poachers and organised smugglers.

4. To reinforce conservation efforts in Jaldapara by developing a rapport with local people, by, for example, considering earmarking an area of Hashimara Block for rotational grazing.

5. To construct a boundary wall with a suitable live hedge of thorny shrubs and a multi-strand electric fence along vulnerable boundaries, to prevent cattle trespassing into Jaldapara Wildlife Sanctuary. Although primarily an anti-cattle trespass mechanism this would also help to curb poaching.

6. To monitor the nearby trade centre of Siliguri and the nearby borders of Bhutan and Nepal by establishing "listening" posts in such centres.

For *Dudhwa National Park*, recommendations are:

1. To institute a joint patrolling and monitoring mechanism of the Forest Department and the Nepalese authorities along the international border running close to the national park.

2. To develop intelligence on possible traders and poachers of rhinoceroses who exist in the area prior to any transfer of the fenced rhinoceroses to the whole park.

3. To attempt to involve local people in the re-introduction programme as far as possible.

For *Kaziranga National Park*, recommendations are:

1. To increase the mobility of staff by providing adequate transportation on both land and water and to ensure adequate fuel for its running, with a view to establishing mobile patrols for the park.

2. To install checkpoints at Methoni, Baguri, Kohora and Bokakhat to reduce the chance of transporting rhinoceros horn by road.

3. To finalize the proposed additions of forests and hilly areas to the park, as well as those of the *chaporis*.
4. To establish new camps wherever necessary, especially on strategic *chaporis*.
5. To remove all the high tension electric lines and posts at least up to three kilometres away from the boundary of Kaziranga. If this is not possible, owing to financial considerations, then these areas must be protected or patrolled as a priority.
6. To establish links with enforcement agencies in Karbi Anglong (see Figure 18) and to ensure close co-operation with them.
7. To review the radio-communication network and supply of arms, to monitoring and protection of the park.
8. To establish an intelligence network in the region and also in the neighbouring state of Nagaland.

For ***Orang Wildlife Sanctuary***, recommendations are:

1. To restore urgently the radio sets stolen from the park in 1994.
2. To ensure adequate monetary resource allocation to the park and the strengthening of number of personnel posted in the field.
3. To review suitability of camp positions and to institute mobile squads in the park.
4. To provide additional transportation and review the arms situation in the park.
5. To develop an intelligence network on the north bank of the Brahmaputra River.

For ***Pabitora Wildlife Sanctuary***, recommendations are:

1. To continue the management measures minimizing the straying of rhinoceroses from Pabitora.
2. To finalize urgently the addition of nearby areas proposed to be made part of the sanctuary and therefore to increase the size of the sanctuary.
3. To remove the high tension electric line from the sanctuary and relocate it at least three kilometres away. If this is not possible, owing to financial considerations, then these areas must be protected or patrolled as a priority.
4. To review the arms and equipment situation in the park as well as institute mobile squads that can operate in the park.
5. To start an intelligence network in the area.

For ***Manas National Park***, recommendations are:

Among all rhinoceros-bearing areas, anti-poaching activities are most essential currently for Manas National Park. Given the current law and order situation that is fast threatening the very existence of rhinoceroses in the area, a definitive strategy must be drawn up to defend the sanctuary against poachers and opportunistic elements. It is therefore recommended:

1. To give the highest priority to the combing of the park by paramilitary or army units to flush out militant rebels inside the park and to restore all parts of the park to Forest Department control.
2. To re-build infrastructure burnt or broken down by extremists and to review the arms and equipment status in the park.

3. To raise the morale of the park staff by appointing range officers to stay in the park and by training them in combat and anti-poaching activities.

4. To establish checkpoints at the Bhutanese border within Manas and at Barpetta Road.

5. To put into place a strong intelligence network for the region and for neighbouring Bhutan.

6. To assess the possibility of translocating rhinoceroses into Manas to augment the depleted stock, after ensuring protection to the area.

For ***Laokhawa Sanctuary***, recommendations are:

1. To assess the status of the sanctuary and the possibility of re-introducing rhinoceroses to it.

2. To consider the Laokhawa - Burrha Sapori complex as contiguous and to draw a management plan and anti-poaching strategy in conjunction with one another.

GLOSSARY

lakh - 100 000

crore - 10 000 000

dandi - path

beel - shallow lake

nallah (or nala) - stream/ditch

chapori - island

machan - high platform built on stilts

gainda - rhinoceros

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NOTES

[1] Orang Wildlife Sanctuary is now re-named as Rajiv Gandhi Wildlife Sanctuary, but the traditional name has been used in this report for the sake of familiarity.

[2] Lower estimate of the 1995 population figure used, in order that calculations of rhinoceros numbers be based on the most conservative information available.

[3] The names of reserves are often not in full in the report, partly to avoid confusion through reflection of their changing rank as protected areas, for example, from Manas Wildlife Sanctuary to Manas National Park.

[4] All mortality data relating to Indian rhinoceros-bearing areas in the report are compiled by the author from a number of sources, both official and unofficial.

[5] The most recent population figures for Manas National Park are not based on official estimates, but on estimates by the author, corroborated by those from Deb Roy, former director of Manas and Anwaruddin Choudhury, Chief Executive Officer, Rhino Foundation, India.

[6] Bengal and West Bengal may often be used interchangably since East Bengal became East Pakistan after 1947 (and is now Bangladesh).

Appendix 1

Rhinoceros horn in traditional Tibetan drugs

Name	Composition	Use and action	Dosage
A-RU 25-MYROBALAN	*Terminalia chibula*, *Terminalia arjuna*, *Emblica officinalis*, *Terminalia belerica*, *Myristica fragans*, *Amomum subulatum*, *Elettaria cardamomum*, *Eugenia caryophyllata*, *Bambusa textilis*, *Carthamus tinctorius*, *Santalum album*, rhinoceros horn, gallstone of ox or elephant, *Piper longum*, *Saussurea lappa*, *Foeniculum vulgare*, *Nigella sativa*, *Cinnamom zeylanicum*, *Clycyrrhiza glabra*, *Fragaria nilgeernsis*, *Verbascum thapsus*, crab shell, mineral pitch, *Mucuna prurtia*.	- disorder affecting the renal nerves - blood disorder affecting the kidneys.	2-3g daily with warm water.
GI-WANG 13 GALLSTONE 13	Bear's bile, *Emblica officinalis*, *Carthamus tinctorius*, *Veronica ciliata*, *Glycyrrhiza glabra*, *Punica granatum*, rhinoceros horn, *Picrorhiza kurroa*, mineral pitch, *Rubia cordifolia*, elephant's gallstone, *Rhodiola sacra*, rGya-skyegs.	- blood in faeces. - hematemesis (vomiting of blood). - menorrhagia. - blood oozing from the nine cavities.	2-3 g daily with hot water.

Appendix 1 continued

Rhinoceros horn in traditional Tibetan drugs

Name	Composition	Use and action	Dosage
GUR-GUM13- SAFFLOWER 13	*Carthamus tinctorius, Eugenia caryophyllata*, elephant's gallstone, rhinoceros horn, vermilion, *Santalum album, Caesalpinia bonducella,* musk, *Aconitum heterophyllum, Saussurea lappa, Terminalia chibula, Terminalia belerica, Emblica officinalis.*	- hepatic tonic. - malfunction of the liver form improper food beverage, or poisoning. - trauma of the kidneys. - difficulty in micturition and at times without any control over urination. - pain on one side of the head from infections.	2-3 g once daily either in the morning or at noon with hot water.
rGYA-RU 14 (Ghya-rhoo)-GOAT 14	Horn of mountain goat, horn of rhinoceros, antlers of deer, *Carthamus tinctorius*, vermilion, *Pterocarpus santalinus, Myristica fragrans, Elettaria cardamomum,* rGya-tsod, *Punica granatum*, bear's bile, *Rubia cardifolia, Mirabilis himalaica, Sabina recurva.*	- promotes proper flow of blood. - regulates nromal flow of menses. - pain in the kidneys, hips, and the lower intestines.	2-3 thrice daily with hot water.
bSE-RU 25 (Say-rhoo) RHINO 25	Rhinoceros's horn, deer's antlers, *Myristica fragrans, Eugenia caryophyllata, Elettaria cardamomum, Bambusa textilis, momum subulatum, Crocos sativus,*	- general pulmonary disorders - specifically for removal of pus, blood or serum in the lungs.	2-3 g daily either in the morning or at noon with hot water or milk.

Appendix 1 continued

Rhinoceros horn in traditional Tibetan drugs

Name	Composition	Use and action	Dosage
bSE-RU 25 (Say-rhoo) RHINO 25 continued	*Saussurea lappa, Santalum album, Pterocarpus santalinus, Mesua ferrea,* mountain goat's horn, *Cassia tora, Cannabis sativum, foecniculum vulgare, Meconopsis grandis, veronica ciliata,* elephant's gallstone, *Geranium* sp., *Terminalia chibula, Emblica officinalis, Hippohae rhamnoides, Onosma hookeri*		
ZANGS-THAL 25 (Sang-thell)- COPPER CALCINE 25	Copper calcine, rhinoceros horn, elephant's gallstone, vermilion, deer's antlers, mountain goat's horn, *Carthamus tinctorius, Myristica fragrans, Elettaria cadamomum, Amomu subulatum, Eugenia caryophyllata, Bambusa textilis, Swertia chirata, Picrorhiza kurroa, Vernica ciliaata, Santalum album, Meconopsis grandis, Mesua ferrea,*	- all types of lung inflammations - specifically for difficulty in breathing and coughing.	2-3 g daily with hot water.

Source: Tsarong, 1986

Appendix 2

Funding/equipment required for the next five years for management of rhinoceroses in India (as presented to AsRSG (1993) in millons of US$ (1994-1998)

Items	W.Bengal	Assam	U.Pradesh	Total
1. Re-enforcement of the existing protective infrastructural facilities & anti-poaching measures				
a) communication network	0.17	16.70	0.015	16.885
b) wireless network	0.14	0.20	0.005	0.345
c) Arms & ammunition	0.03	0.035	0.005	0.070
d) Watch tower, night vision devices/binoculars etc.	0.07	0.325	0.015	0.410
e) Intelligence network	0.035	0.17	0.015	0.220
f) Mobile Squad (land & water ways)	0.05	0.085	0.005	0.14
g) Construction of boundary wall, energized fences, etc.	0.65	0.00	0.035	0.685
2. Habitat management				
a) Removal of water hyacinth & desiltation/diversion water channels	0.17	0.17	0.00	0.34
b) Habitat manipulation	0.105	0.10	0.35	0.555
c) Relocation of enclave villages	1.000	0.35	0.00	1.350
3. Veterinary care & rescue of marooned animals				
a) Establishment of veterinary units	0.065	0.165	0.015	0.245
b) Cattle immunisation programme	0.05	0.055	0.015	0.12
c) Rescue operation centres	0.005	0.025	0.065	0.095
d) Captive breeding centres	0.00	0.035	0.00	0.035
4. Support for security to staff	0.05	0.165	0.015	0.245
5. Eco-development	1.000	7.000	0.35	8.35
6. Compensation payment	0.00	0.400	0.00	0.400

Appendix 2 continued

Funding/equipment required for the next five years for management of rhinoceroses in India (as presented to AsRSG (1993) in millons of US$ (1994-1998)

Items	W.Bengal	Assam	U.Pradesh	Total
7. Tranlocation of rhinos for re-introduction in viable populations	0.335	0.335	0.330	1.000
8. Wildlife tourism and nature awareness programme	0.150	0.680	0.085	0.915
9. Training of staff	0.025	0.035	0.015	0.075
10. Research, monitoring & evaluation	0.07	0.165	0.075	0.31
11. Contingencies	0.330	2.855	0.15	3.335
Total	**4.5**	**30.00**	**1.560**	**36.060**

Note : Total cost is 36.06 million US$ = Rs111.8 Crores @ Rs31/US$

Appendix 3

List of conversions and abbreviations used in the report

1. Rates of conversion from Indian rupees to the US dollar

Year	:	Rs/US$
1965	:	4.775
1970	:	7.558
1974	:	8.025
1975	:	8.382
1977	:	8.764
1978	:	8.190
1979	:	8.149
1981	:	8.681
1982	:	9.485
1983	:	10.104
1984	:	11.348
1985	:	12.332
1986	:	12.597
1987	:	12.943
1988	:	13.899
1989	:	16.213
1990	:	17.492
1991	:	22.712
1993	:	31.250
1994	:	31.160
1995	:	32.400

Sources: Statistical abstract US Bureau of Census, Washington DC; Midland Bank, UK.

2. Land measurements

2.5 acres = 1 hectare

100 hectares = 1 square kilometre

3. Indian terms for currency

1 lakh = 100 000 rupees

1 crore = 10 000 000 rupees