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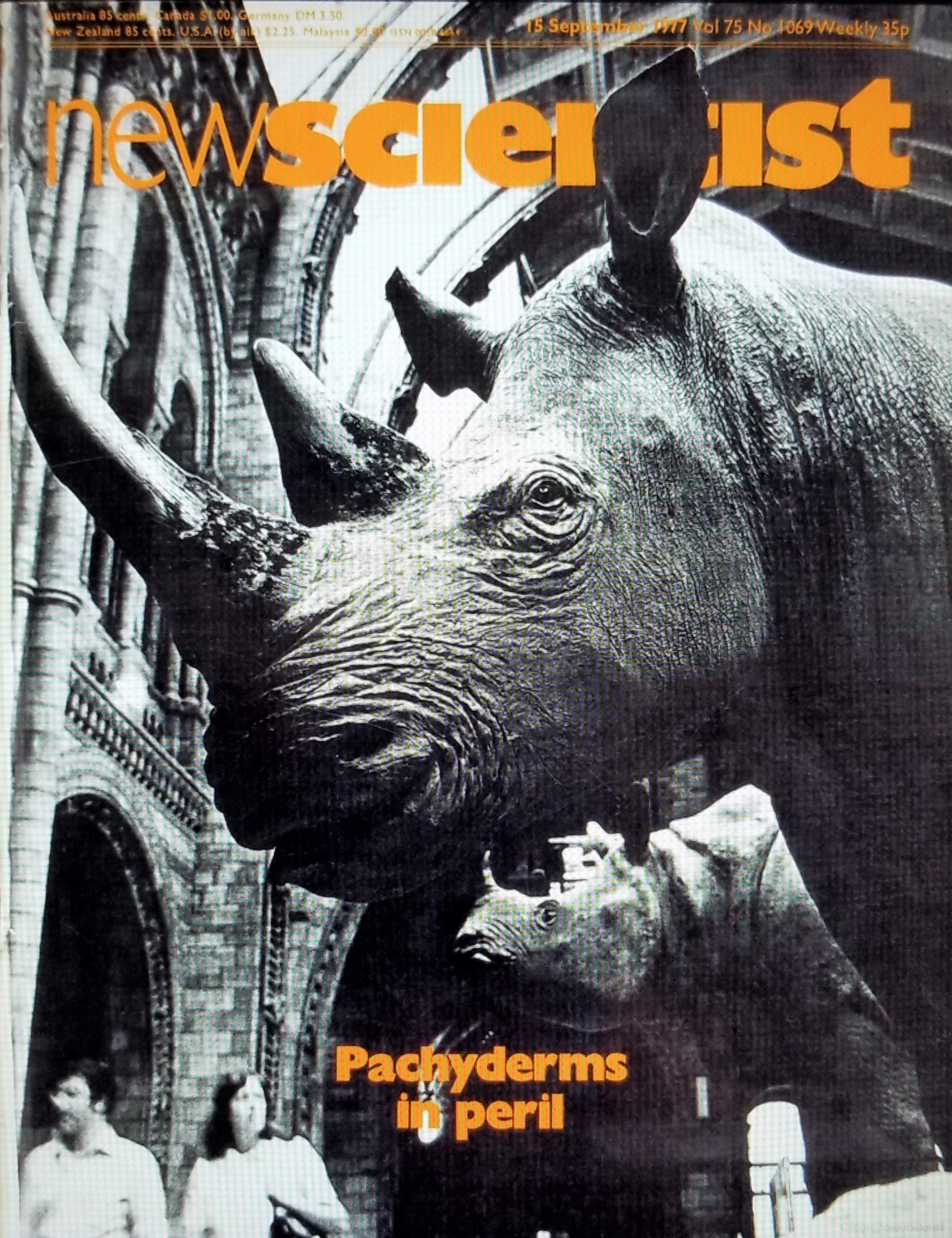

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Elephants, rhinoceroses and hippopotamuses may not be related, but their life-styles are essentially the same. All exploit similar countryside in similar ways, and are now threatened by man's activities (see p 656).

Cover photograph by Colin Curwood courtesy of the British Museum, Natural History

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Pachyderms in peril

During their long evolutionary career elephants, rhinos, and hippos—the largest of the pachyderms—have exploited environments from dense forest to open country. Because of the rapid expansion into their territory by humans, these pachyderms now face a real threat of extinction

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Linnaeus defined the "pachyderms" as the thick-skinned quadrupeds, and included the elephants, rhinos, hippos, tapirs, pigs, and, in the words of one 19th century writer, "the Mastodon and all those huge wrecks of a former world". Although the term is taxonomically obsolete, we have chosen to resurrect it, as we find it still has some real meaning both when we examine their comparative ecology, and for the practical problems involved in their conservation. For example, apart from sharing the same broad ranges of tropical habitats, they also share certain other characteristics, such as a large body size, more or less hairless skin, and a herbivorous diet, all of which are important in these contexts.

The comparative study of the ecology and behaviour of pachyderms is not only interesting, but also instructive, because it can contribute to a broader understanding of mammalian socio-ecology in the same way that studies of other groups such as primates and antelopes have done. Within these groups we can see basic patterns of adaptive radiation in the ways that body size, diet, habitat and social behaviour, which are all interconnected, differ in different species. The range of adaptations presented by the living members reflects the evolution of their group as a whole, and it is often possible to fit extinct forms into the pattern. We will illustrate this with reference to the pachyderms.

Of the two living species of hippo, the pygmy hippopotamus (*Choeropsis liberiensis*) is a small forest dwelling animal that has never been studied in the wild. From the little that is known it seems likely to have a fairly wide diet of roots, young shoots, and grass. In a forested environment these foods, particularly grasses, are likely to be dispersed or patchily distributed. Pygmy hippos, like other forest ungulates, such as duikers, exploit their dispersed food sources by ranging at low densities, singly, or in pairs. These animals may also be territorial, though we cannot be sure.

The better known *Hippopotamus amphibius*, on the other hand, is a large plains dwelling animal. It feeds entirely on grass which is both evenly dispersed and abundant. *Hippopotamus* form much larger social groups than *Choeropsis* and live at higher densities. These herds or schools may sometimes have several hundred in them, but the size varies considerably according to the local availability of food and suitable daytime resting places in water. They show no true territorial behaviour. One property they retain in common with their smaller forest dwelling relative is a skin which loses water easily and so is particularly unsuitable for life in the open plains. It is for this reason that hippos must repeatedly wallow in mud and water, thus restricting their range to the vicinity of major rivers and lakes.

There are five species of rhinoceros, and the same trends in body size, group size and population density occur here. They too live in areas ranging from forests to plains. The primitive rhinos were forest dwelling browsers very similar to the present day Sumatran rhinoceros (*Dicerorhinus sumatrensis*). This animal has remained in the forests and is unchanged since the Pliocene era (12 million years ago). It is small, solitary in its habits, and ranges widely over steep rainforest hillsides in search of the saplings and shrubs which make up its daily menu. The African Dicerorhines, in the process of adapting to life in the drier plains and bushland, developed a larger body, and while some developed a more prehensile lip for browsing, others developed a square lip and long crowned cheek teeth for grazing on short grasses. These changes eventually led to the present day black rhinoceros (*Diceros bicornis*) which is predominantly a browser in thorn scrub, and the white rhinoceros (*Ceratotherium simun*), which is predominantly a short grass grazer. Both species are more gregarious than the Sumatran rhino.

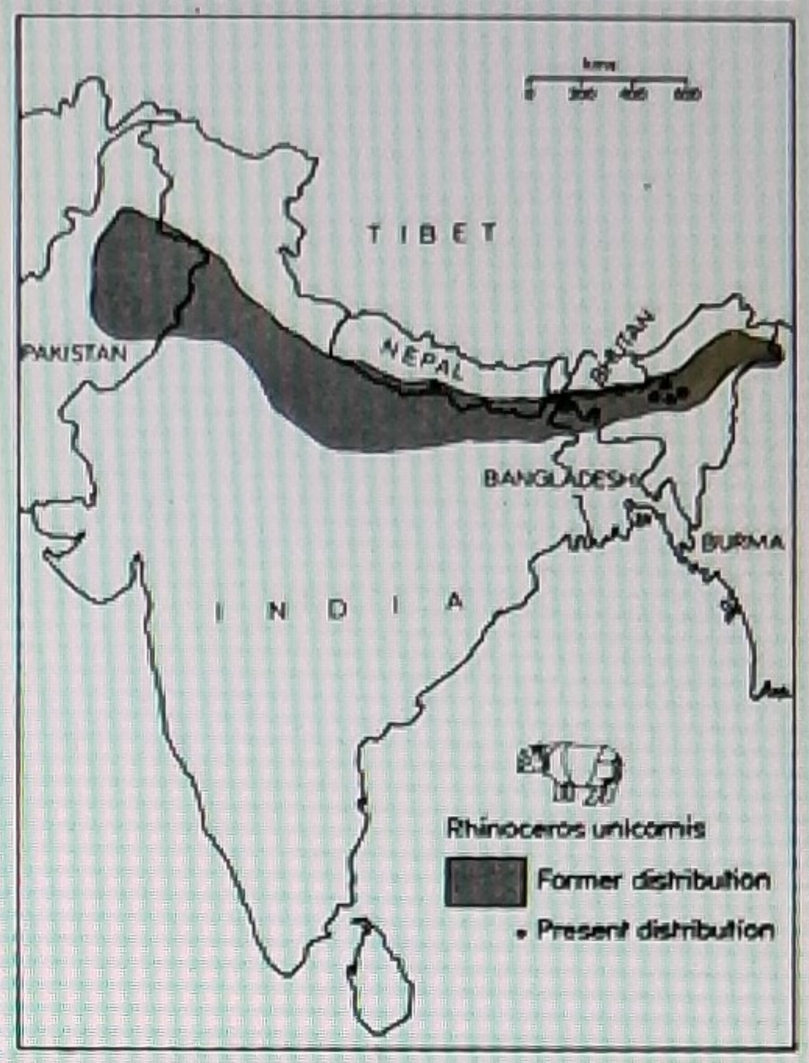
These differences are even more apparent when we look at the two present-day members of the genus *Rhinoceros*. The lesser one-horned rhino (*R. sondaicus*) is restricted to rainforests and is a solitary browser. The greater one-horned rhino (*R. unicornis*) has exploited the riverine grassland habitat of Southern Asia and although it retains its prehensile lip to deal with the tall grass species and browse it can also curl under its top lip and graze on short grass with square lips like the white rhino. *R. unicornis* also occurs at higher densities than *R. sondaicus* and territorial behaviour is aimed, as in the white and black rhinos, at restricting the number of breeding males in an area rather than restricting the density of rhinos. Apart from their very small group sizes, we know very little about the social life of the forest rhinos, but as in the pygmy hippos, it is possible that they have a better developed sense of territory. A number of people have made brave attempts at studying forest rhinos, but it has been extraordinarily difficult to gather information. For instance, Markus Borner spent three years studying Sumatran rhino in Sumatra and only actually saw one once!

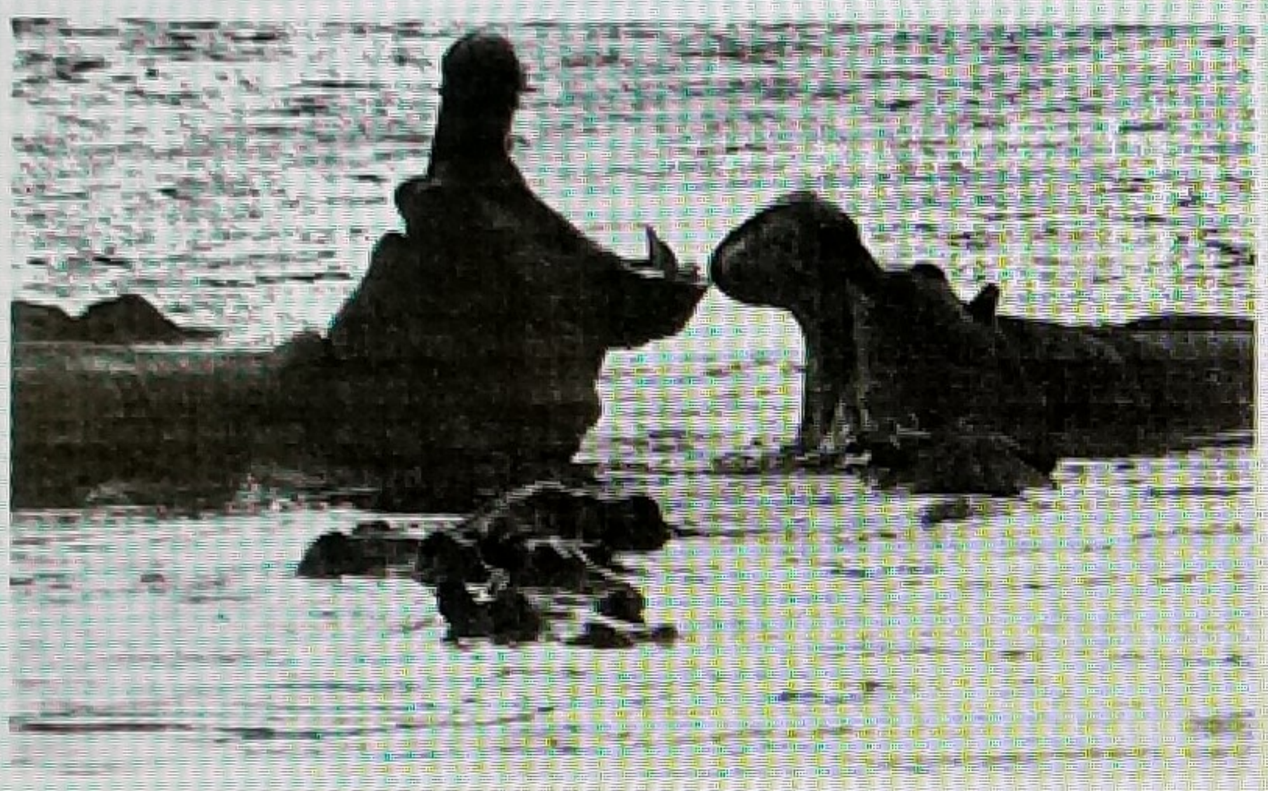
The shift from the forest

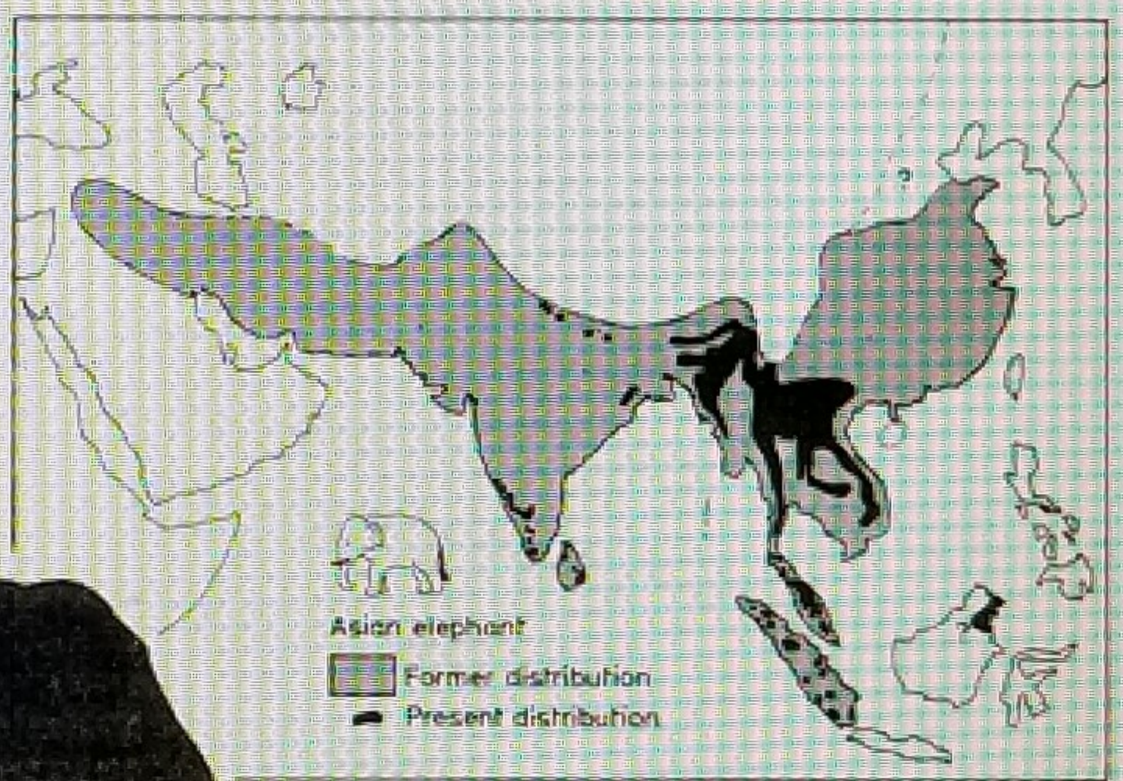
During their evolution over the past 60 million years, ancestral elephants also made the shift from forest to more open land. Although the trends we have described for hippos and rhinos are reflected to some extent by the smaller, forest elephant of Africa (*Loxodonta africana cyclotis*) and the larger bush elephant (*Loxodonta africana africana*), both these sub-species and the Asian elephant (*Elephas maximus*) have features that, according to the general pattern, indicate life in an open habitat. These features are very large body size, heavy dependence on grass, breeding units that seldom contain less than half a dozen individuals, and a more complete lack of any form of territoriality than other pachyderms have.

However, largely because of their amazingly versatile trunk, which probably evolved in relation to grass feeding, modern elephants have been able to radiate secondarily throughout all types of habitat, from dense rainforests to grasslands and semi-deserts. During this radiation the elephants developed specific adaptations to the different environments that follow the same general pattern that one sees in the other pachyderms. Unfortunately, just as with the other pachyderms, we know practically nothing about the forest species. Amazingly enough, the African forest elephant has never been properly studied, but a little is now known of how the Asian elephant adapts to its range of habitats.

In extreme forest habitats the more important and preferred foods, such as grass, are less abundant and more dispersed, and one finds very small herds that range over







Pictures. A greater one-horned rhino and calf. The calf will stay with its mother for 2-3 years. The two hippopotamuses are sparring, assessing dominance. Asian elephants have been used by man for over 4000 years

The two maps show the former and present distributions of the greater one-horned rhinoceros and Asian elephant. The maps draw on historical sources for the former distributions, including archaeological records, maps, pictures and books

very large areas, just as we suspect of the forest rhinos. Conversely, when the important foods are very abundant, normally a seasonal phenomenon, the elephants join up in larger herds and they don't have to travel so far to get their fill. Similar phenomena have been observed for the African bush elephant, and one could, perhaps predict small herd size and large ranges for the African forest elephant.

It is because they share certain common characteristics that all the pachyderms are now in great peril of extinction. We mentioned some of these characteristics above. Another is the unfortunate coincidence that humans have hunted them since prehistoric times. As potential mountains of meat all have been hunted for food in the past, and their tough hides may have also been put to good use. More significantly, rhinos have been hunted mercilessly for their supposed magical and medicinal qualities. Elephants, and even hippos, have been killed for their increasingly valuable ivory.

Another shared characteristic responsible for their plight is their longevity. They grow, reach maturity, and breed very slowly. Populations are thus unable to react to changes rapidly, and are therefore extremely sensitive to those changes. Nothing about the pachyderms is small, and they all require large amounts of space to live in. So, of course, do people, and with the present lack of forethought and planning these two needs tend to be incompatible. Habitat destruction is the biggest threat of all. With dispersed populations living at low densities, and with almost all the south east Asian rainforests already under timber concessions and millions of hectares of the world's forests being felled annually, it is perhaps not surprising that all the forest pachyderms are on IUCN endangered species lists. Severe hunting pressure and deforestation have brought the two south east Asian rhino species to a dangerously low population level. Both species, until 50 years ago, ranged from Assam to Vietnam and were widespread in Sumatra and peninsular Malaysia. The Sumatran species was numerous in Borneo and the lesser one horned or Javan species was common in Western Java. Now the Javan rhino is restricted to the Ujung Kulon Reserve in Western Java where there are 45 to 55 individuals. There are only a few unconfirmed reports in recent years of Javan rhinos still surviving on the South East Asian mainland. There are about 80 Sumatran rhinos remaining in Sumatra, perhaps 30 in West Malaysia and a few others scattered in small populations in Borneo, Burma, Thailand and IndoChina. The world population is probably less than 300 and, like the Javan rhino, there are none in captivity.

Present day pressures

The greater one-horned rhinoceros once ranged from Pakistan, where it was hunted by the Moghuls in the 16th century, to Northern Burma. Extensive human encroachment of its riverine haunts as well as hunting have caused its decline. The greater one-horned rhino is now restricted to a few small reserves in Nepal, West Bengal and Assam and there are only just over 1000 individuals. Dangers include habitat alteration as a result of river erosion, which increases every year as deforestation in the hills causes increased run off and silting up of the lower river valleys.

"Foreign" plants are also causing problems for the one-horned rhino in India. For instance the water hyacinth, *Eichhornia crassipes*, sinks with floodwaters on to the open areas around the lakes after the monsoon and prevents regrowth of the short grasses which rhinos and other ungulates favour. *Mikania scandens* is an introduced climber which is threatening the grasslands and riverine forest which comprise the rhino habitat in West Bengal and North western Assam; it smothers trees and grasses and transforms large areas into a flat carpet of *Mikania*. Rhinos only eat the young shoots of *Mikania*, so the loss of food resources is serious. Perhaps a method of biological control can be devised for this problem. Poaching and human encroachment are controlled by guard forces in all reserves but because of their small areas—Kaziranga National Park where more than half the surviving rhinos live is only 375 sq. km—they are particularly vulnerable to any change in policies or breakdown of law and order. At present the possibility of rhino overcrowding in Kaziranga and the accompanying dangers of disease and increased fighting are a real possibility. There are plans afoot to spread the population by reintroducing rhinos to other reserves in India and Pakistan.

The Asian elephant, which lives in the remaining remote and mountainous forests of Asia, is listed in the new *IUCN Red Data Book* as "vulnerable". This word conceals the true severity of the situation facing the animal. The elephant of Asia, which has served man in domesticity for centuries, formerly lived in the area from the Tigris and Euphrates basin across the continent south of the Himalaya, and north into China at least as far as the Yangtze Kiang. It used to be so numerous that every ruler in this great swathe was able to maintain enormous stables of elephants for various purposes. These have now all gone and the wild elephants have been driven from their favoured haunts in the lowlands and persecuted for their trespassing in men's crops. Persecution continues to this day, and the areas remaining to the elephants are being split up; there are now probably less than 36 000. Not one single national park or reserve protects more than part of a population for part of the year. The drastic reduction in their range is shown in the maps.

Although there are more animals and more reserves, and the future of the African pachyderms appears more secure, this is no cause for complacency. In South Africa the white rhino was on the verge of extinction but has now recovered in protected reserves to such a level that the authorities have considered selling hunting licences again. There are about 5000 of the Southern race of the white rhino and perhaps 500 of the Northern race which occurs in the region of the Upper Nile in Zaire, Uganda and Sudan. The Northern race is still threatened by encroachment and poaching. The black rhino ranges from South West Africa to Sudan and Northern Nigeria but unlike its previous continuous distribution its present distribution is patchy and there are probably only between 11 000 and 13 000 left. The wild pygmy hippo remains in a limited and vulnerable distribution in the forests of West Africa, mostly in Liberia, but we do not know how many are left.

A dramatic leap in the price of ivory has caused an equally dramatic leap in poorly controlled poaching. Between 1973 and 1975 the elephant population in Uganda's National Parks crashed from about 17 500 to about 3500, due entirely to ivory poaching. This story could easily repeat elsewhere, and is cause for grave concern.

We believe that these animals, which are impressive and fascinating in their own right, and which have served man in some way over the centuries, deserve to be saved. The obvious need is space. Unfortunately, this simple requirement is politically sensitive. Luckily, in the case of elephants in Asia for example, certain compromises in land usage are possible. In Sri Lanka, Thailand, and India people are hoping to create a new type of large wildlife reserve, which they call an "Elephant Range". In these parks the affairs of men, elephants, rhinos and other wildlife will be actively managed to each other's mutual benefit. The case for conserving pachyderms is strengthened by the other values that would be gained through conservation and wise use of their forests; erosion and changes in local climate will be prevented and the other animal species with smaller space requirements than pachyderms would be protected under the same umbrella. But we must work fast if we are to achieve any results. □

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