

TEXT VERSION OF

FRANCESCO NARDELLI

The rhinoceros: a monograph

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This book is for Torgamba,
the Sumatran rhinoceros bull,
in the sincere hope that he will not prove to be
the last of his kind.

Foreword

I began collecting fine illustrated books on mammals over thirty years ago and soon noticed how few there were, compared with the number of similar books on birds and flowers. Francesco Nardelli's *Rhinoceros* will help to fill the gap. The production of this book is a bold venture inspired by love and admiration, rather than commercial logic or academic zeal. A magnificent tome on the multicoloured guenons might have been a safer bet, but here Nardelli is looking not for safety but personal satisfaction. This noble work on the rhinoceros has been conceived out of his fear for their imminent extermination.

The quality of Matthew Hillier's paintings faithfully portrays the separate physical characteristics and peculiarities of the five surviving types, all of which can still be found in the wild state - but only just. They are literally being eliminated across the board before our eyes, as we read these words. The northern race of the white rhinoceros (*Ceratotherium simum cottoni*) is at its last gasp, reduced to a mere 17 and less than a dozen in captivity. The southern white and the black have been cut down to a few thousand over what little remains of their erstwhile vast range in Africa. The great Indian one-homed rhino is still hovering over four figures, but his last strongholds in Assam and Nepal are shrinking from the pressures of human intrusion. The Sumatran, two-homed, hairy rhinoceros is confined to isolated pockets of flat land and montane forests in Sumatra, Borneo, and mainland Malaysia, his numbers whittled down to less than a thousand, while the Javan rhino, a close cousin of the great Indian, is restricted to the peninsula of Ujung Kulon on the westernmost tip of the island of Java, a habitat that can sustain a population of not more than 60 animals. Whether we like it or not, we are living through the epoch of *Homo vastans*. We watch with horror the fading efforts of our close relatives, the higher mammals, to avoid the doom that we have set in store for them.

The massive bulk of the great white rhinoceros; the brave spirit of his smaller cousin, the black; the armour plating and forward-thrusting tusks of the giant Indian race; the secretive and nocturnal habits of the Javan and Sumatran have not been enough to do more- than postpone the day of reckoning. Some of these qualities, along with many others *painstakingly* described in this book, have enabled these mammals to outlast the millennia and to endure the recent centuries of persecution at our hands. Any concept that the great rhino family was already failing before the cancerous advance of civilization can be confidently discarded. The works of Harris, Lydekker, Selater, and many others bear witness to the astounding number of black and white rhinos in the early part of the last century. Winston Churchill, who shot three black rhino 'monsters' near Makindo in Kenya one morning, described these beautifully adapted browsers as 'odd grim stragglers from the stone age'. He believed them to be 'ponderous brutes, invulnerable to pain and fear'. One bull that he shot reminded him of an 'engine or some great steam barge impervious to bullets'. I wish that Churchill's

colourful language conveyed any truth. On a trip to Lake Rudolf Richard Meinertzhagen bagged three black rhinos before breakfast, and he was a naturalist and the author of *The Birds of Arabia*, a classic of its kind. Neither man, however great and "admirable in other ways, had the slightest compunction in the perpetration of these gruesome crimes. I regret to say that they represented the norm in this respect, not the exceptions of their class and race.

On the whole the rhinoceros has suffered throughout the ages from a catalogue of misinformation based on ignorance and superstition. It is hard to know whether western or eastern civilization has erred most. Generally considered cumbersome, he is in fact agile, being able to halt instantly at full gallop and turn on his own shadow. When a rhino trots he appears to prance on air-compressed springs. His neck muscle and the famous weapon it powers is a wonder of nature and makes an adult rhino immune to the attacks of predators other than man. Before the advent of firearms a veritable war party of braves was required to bring down a rhino and few succumbed to the spears and arrows without exacting a toll.

Those who think him stupid expose their own folly, as the ethologists who have studied him carefully in the wild state, without exception, consider the rhino to be the most intelligent of all the Perissodactyla. Goddard, Schenkel, van Strien, and Laurie have spent an aggregate of over twenty years studying black, Indian, and Sumatran rhinos. They believe these creatures to be extraordinarily well adapted and responsive to their environment. It is only man's explosion in numbers from one to five thousand million in less than a million years, accompanied by the recent excesses of his technosphere, that has all but sealed the rhino's fate. Those who love and admire rhinos must still fight for them and protect them, if possible, in their dwindling wild redoubts, as well as breeding them in captivity if they can. Each task is about as difficult as the other, but both are vital if he is to be ushered into the next century.

If this wonderful but sad book helps save a few rhinos from extinction, or at least delay the date of their execution, then I know that the man behind it will have been repaid in some measure for the risks that he has taken in conceiving a book of such unusual quality for a market so small, and for an animal so little appreciated and so savagely abused.

John Aspinall

Chapter 1/1

All five present-day species of rhinoceros are virtual living fossils. Commenting in 1941 on their survival, the American zoologist Horace Elmer Wood II said:

A specialist on the group naturally regrets their impending doom, but admittedly they are stupid animals and from a human viewpoint, anti-social. Perhaps, instead of deprecating their approaching extinction, we should recognize our good luck that a group, which might well have been exterminated in the prehistoric past, has survived to the present day to help interpret the remains of their fossil relatives and ancestors.

In the same paper Professor Wood also wrote: 'Unless a really determined effort is made, there seems little hope that any except the black rhinoceros can be preserved into another century; and its extermination, although a little further off than the rest, also is probably inevitable.' Since then there have been various determined efforts to conserve the living species, but extinction is still a constant threat to at least three the Black, Sumatran and Javan rhinos. This book describes the current status of all five species, bringing together first-hand field observation and information from widely scattered sources to accompany original paintings and drawings.

Today's rhinos are the last remnants of a family that once included a much larger number of mammals. There is considerable confusion as to how they are taxonomically related to each other now, and to their fossil ancestors, in the past. This confusion derives from the striking parallel development among geographically widely separated species (between the two-horned African rhinoceroses and the extinct Eurasiatic Ice Age woolly rhino and the surviving Sumatran rhino, for example) and the equally striking divergence among neighbouring species, such as the Javan and Sumatran. It seems most likely that the rhinoceroses should be classified on geographical lines, explaining the white rhino, for instance, as a specialized grazing relative of the black African species, rather than a relative of the similarly two-horned but 'woolly' Sumatran species. The genus covering the Sumatran species, *Dicerorhinus*, is generally thought to be the most primitive of the survivors, while the Javan and Indian rhinos are the most advanced among the Asiatic species.

The order Perissodactyla, to which the rhinoceroses are assigned, contains hoofed mammals with an odd number of toes on each foot. Extinct members of this order include the prehistoric titanotheres, chalicotheres, and lophiodonts. The order is divided into two sub-orders, the Hippomorpha, or horses and related animals, and the Ceratomorpha, a group defined by Professor Wood in 1937 to cover tapirs and rhinoceroses. The next rank in the hierarchy is the super-family Rhinocerotoidae, established by Theodore Nicholas Gill in 1872 and including three families of fossil or living rhinos.

The ancestral forms appeared early in the Tertiary period, which lasted from 65 to 2.5 million years ago, and is divided into the Palaeocene (65 to 54 million years ago), Eocene (54 to 38 million years ago), Oligocene (38 to 26 million years ago), Miocene (26 to 7 million years ago), and Pliocene (7 to 2.5 million years ago) epochs. The rhinos emerged somewhere in the Eocene epoch, about 50 million years ago, small and agile creatures, a little like the horses which are among their closest relatives, but with distinctive teeth to fit their browsing habits. Some, like the elasmotherine rhino, outdid the horse in its similar dentition, with high-crowned cheek teeth and crenelated enamel, forming efficient grinding mills. The relationship with horses was observed as early as 1528 by the Mogul emperor Babur, who said of the Indian rhinoceros, 'It bears more resemblance to the horse than any other animal'.

Many of the early rhinos, such as *Trigonias* of the early Oligocene in Europe and *North America*, were hornless, their skulls not showing the roughened patches which would have been needed to provide one or two bases for horns. When the development of horns began there were several variations, from the huge single one of the Eurasian *Elasmotherium* to the side-by-side matched pair of the American *Diceratherium* and the unequal pair, a large with a smaller behind it, borne by the northern Eurasian woolly rhinos of the genus *Coelodonta*. *Elasmotherium*, a rhinoceros about the size of an elephant, inhabited the northern plains of Eurasia during the Pleistocene period (from 2.5 million to 10,000 years ago) and carried the largest horn of all, almost 2 metres (6 feet 6 inches) long. Surviving species today include both single- and double-horned forms.

Rhino horns are made from tubules of horn (keratin) resembling tightly packed hair, quite different from the bone-based horns and antlers of other animals, and relatively easy to detach. Their unique quality is certainly a disadvantage, as rhino horn became the product most eagerly sought by hunters of these animals, accelerating their decline in modern times.

Two of the three rhinoceros families, mostly restricted to North America, were the so-called running, horse-like rhinos of the Hyracodontidae, during the Eocene and Oligocene epochs, and the hippopotamus-like Amynodontidae, which became extinct before the end of the Oligocene epoch, about 26 million years ago. The Hyracodontidae were distinguished by their small size and thin legs and feet, some being almost as slim as gazelles. The Amynodontidae, on the other hand, displayed short, thick legs and broad feet, a barrel-shaped torso and canine tusks like the hippo's, a preference for aquatic, riverine habitats, and a tendency to dwarfism. They were found chiefly in America but also in Mongolia.

The third family, Rhinocerotidae, which may be a development from the earlier running rhinos, includes all the living species as well as a variety of fossil forms, among them the largest land mammal ever known, *Paraceratherium* (formerly *Baluchitherium*). This hornless, long-legged monster lived in Asia and became extinct during the Miocene period, that is, more than 7 million years ago. As it was able to browse among the tops of trees, this animal possibly stood as tall as 5.5 metres (18 feet) at the shoulder and was 9 metres (29 feet) long. It may have weighed as much as 25,400 kilograms (25 tons), or about four times as much as an African bull elephant.

The two-horned Sumatran rhinoceros (*Dicerorhinus sumatrensis*) may be considered as a survivor of the Miocene; the one-horned Javan (*Rhinoceros sondaicus*), one-horned Indian (*R. unicornis*), two-horned African black (*Diceros bicornis*), and two-horned African white (*Ceratotherium simum*) species as dating from the late Pliocene.

Early species of *Dicerorhinus* probably originated in Asia, then migrated to Africa and western Europe. They were apparently quite successful, judging from the fact that many different species evolved, and a few of these entered Africa in the Oligocene. Almost all fossil rhinoceros remains found in Europe and dating from the Pliocene or Pleistocene epochs are referred to this genus, but the present Sumatran rhino is the only one of them left. It pre-dated the woolly rhino, or *Coelodonta antiquitatis*, also formerly known as *Rhinoceros antiquitatis* or *R. tichorhinus*.

The woolly rhino carried two nasal horns, with the larger in front, an arrangement still found in the Sumatran rhino, the most primitive of the surviving species and also the only one to have kept a covering of hair. The woolly rhino's shaggy coat presumably helped it to live through the last Ice Age. This is probably among the most familiar of the fossil species, through the Palaeolithic paintings and engravings of it made in caves in France and Spain during the Stone Age, between 32,000 and 14,000 years ago. The caves of Les Eyzies in the Dordogne contain both an engraved woolly rhino in Les Combarelles and a red-painted one in Font-de-Gaume, first recorded by Henri Breuil and his collaborators in a description published in 1910. The Abbe Breuil later found another woolly rhino drawing across the border in Spain, in the caves of La Pileta, near Malaga, and noticed that this resembled the living two-horned white rhinoceros now found in Africa. More woolly rhino drawings have been found in Galicia, where two carcasses were preserved in the waxy material of an oil seep. There is a rhinoceros painting at Lascaux too, the most famous of the Dordogne caves, but it is believed to be a different species, *Dicerorhinus hemitoechus*, a contemporary of the woolly rhino.

Dicerorhinus, the ancestor of the woolly rhino, shared a common stem with the genus *Rhinoceros*, into which, the Indian and Javan species fall. In phylogenetic terms the latter genus, encompassing only one-horned species, is considered the more advanced, in spite of sharing a predecessor with the more primitive double-horned species.

There are many similarities in the skeletons of the African and Asian species which must be attributed to parallel evolution or adaptation to the same kind of environment. The African species of the genus *Diceros* (the black rhino) first emerged in the Pliocene of North Africa. There is no evidence of any connection with the Asian animals. Although *Diceros* has two horns, just like *Dicerorhinus*, the lineages must have become separated at a very early stage.

The two African rhinos, *Diceros* and *Ceratotherium*, both two-horned, are very similar in many ways, but they probably split from each other in the Pliocene. The white rhino has evolved to be a typical grazer. Both browsing and grazing animals are found among fossil rhinos, but the living white rhino is the only exclusive grazer left, although the Indian rhino sometimes adds grazing to browsing.

Prehistoric rhinoceroses have been found on every land-mass except Australia and South America; but now the survivors are restricted to patches of the Old World in southern Asia and Africa. Fossil forms such as *Aphelops* and *Teleoceras* died out in North America in the Pliocene epoch, between 7 and 2 million years ago, and in Europe other forms died out during the following epoch, the Pleistocene, when changes in climate and the development of man's hunting skills hastened their extinction. The animal seems to have been found in southern China up to 200 AD or perhaps as late as 1200, according to some records. Climatic barriers may account for apparent limits to rhinoceros distribution, preventing any North American forms from accompanying horses, tapirs, and elephants when they passed across the newly formed isthmus of Panama into South America in Pliocene times, or the woolly rhinoceros crossing, the Bering- Strait, from Siberia into Alaska in the Pleistocene epoch. The extinction of so many fossil forms to leave so few living species seems to indicate clearly that rhinos, like tapirs, were less adaptable than their nearest relation, the horse. The tapir too, a living Oligocene fossil, is struggling for survival in its last refuge, the tropical rain forest.

The British Museum (Natural History) has a definitive collection of rhino skeletons and bones. There one can observe how, in many cases, different parts of the body evolved at different rates. While the feet and skeleton remained more or less stable, the teeth, horns, overall body size, and proportions changed dramatically. The palaeontologist Alfred Sherwood Romer (1966) saw the evolution of the rhinoceros as 'a branching bush. There is no main evolutionary stem, but a complex of sprouts, the components of which are difficult to disentangle.' Compared with the detailed elucidation of the development of the horse, which has far more convincingly modern forms, the known history of the rhino is both less complete and more complicated.

Here we are concerned with the rhinos still living rather than the extinct ones. What is certain is that the ones with us today are incredible prehistoric remnants, well worth preserving. As the Sumatran rhino is the most primitive of the survivors, it is the first species described, followed by the Javan, Indian, black, and white rhinos, in the generally accepted order of their evolution.

- Chapter 2/1

Early records

Marco Polo was one of the first travellers to report seeing a Sumatran rhinoceros, in 1292 when he was visiting the north Sumatran 'Kingdom of Basman' on his way back to Europe from China. He seems to have mistaken the two-horned Sumatran rhino for a single-horned 'unicorn'. In Latham's translation (1958), he wrote:

They have wild elephants and plenty of unicorns, which are scarcely smaller than elephants. They have the hair of a buffalo and feet like an elephant's. They have a single large, black horn in the middle of the forehead. They do not attack with their horn, but only with their tongue and their knees; for their tongues are furnished with long, sharp spines, so that when they want to do any harm, to anyone they first crush him by kneeling upon him and then lacerate him with their tongues. They have a head like a wild boar's and always carry it stooped towards the ground. They spend their time by preference wallowing in mud and slime. They are very ugly brutes to look at.

Current opinion holds that what Marco Polo saw was in fact the one-horned Javan *Rhinoceros sondaicus*, but the hairiness described, together with the details of the way the animal attacked its prey, which closely resemble the Sumatran rhino's way of dealing with the saplings that it eats, all point to the Sumatran species. Its inconspicuous second horn is notoriously easy to miss.

Apart from this, the first detailed 'Description of the double horned Rhinoceros of Sumatra' came in a 1793 paper by William Bell, a surgeon in the service of the East India Company at Bencoolen, Sumatra. It was published in the

Philosophical Transactions of the Royal Society of London and summed up several distinct characteristics:

The shape of the animal was much like that of the hog ... The eyes were small, of a brown colour ... The body was bulky and round... and the whole gave rather the appearance of softness... The whole skin of the animal is rough, and covered very thinly with short black hair... The animal had not that appearance of armour which is observed in the single horned rhinoceros.

Bell's sketch of the rhino, which had been shot the day before he saw it, was reproduced in an engraving printed with his description.

The first Sumatran rhino kept in captivity in the West was a female bought by the Zoological Society of London in 1872 for £1,250. J. C. C. Jamrach, a German dealer in wild animals who had settled in London, brought the rhino from India, where she had spent four years in Chittagong before her journey to Europe. In all, her captive life lasted nearly 33 years, still a record. The zoo at Regent's Park later acquired a series of other specimens, though none approached the longevity of the first.

The young rhino born on the steamer *Orchis* in the Victoria Docks, London, in December 1872, was the first Sumatran calf born in captivity, but it survived only two weeks, when both the corpse and its Mother were sent to America. The calf reportedly was about a Metre long and 0.6 metres high at birth, its dark skin covered with coarse black hair. The mother may have been the 'monster two-horned hairy

rhinoceros as large as an elephant' exhibited in Cambridge, Illinois, on 4 September 1874 in the 'Great Forepaugh Show'. In 1886 a ten-Month-old calf arrived in Hamburg.

By the turn of the century Many European and American collections, as well as several in India and Malaysia, included specimens of the Sumatran rhino. The animal was often the plaything and pet of Asian rulers too, as in the case of Datuk Raja Kiah of Jelebu in Malaya (Hubback, 1939a) who, some time in the 1920s, it seems, caught a baby Male after he had shot the mother, and kept it successfully for seven years. The animal became so domesticated that it would voluntarily return to the Raja's house, answering the servants' call of 'Hoh! Hoh! Hoh!' and coming to eat rice after freely foraging in the forest during the day. At night it would sleep below the building, which was raised above the ground on pillars in traditional Malayan fashion. *Distribution*

The description 'Sumatran' is somewhat misleading, for until the early twentieth century the animal could be found in several other parts of South-east Asia besides the Indonesia island of Sumatra. Still, after the very first specimen on record in the West was shot in Sumatra in 173, the label 'Sumatran' was firmly attached to the species.

Records from Burma, for instance, began in 1838 and continued fairly steadily throughout the next hundred years, but by the 1950s the population was estimated to be as low as 36, (E. A. P. Reynolds, 1954) with very few indeed surviving there today. A 1980 report (van Strien, 1986) says that four may survive in the Tumanthi game sanctuary, and six or seven more in the Lassai region.

Western records first reported the Sumatran rhino in India in 1864, living in parts of Assam, Bengal, and Bangladesh (formerly East Pakistan), but by 1960 there seemed only a slight possibility of an isolated few surviving in the Chittagong Hills. The animal was once plentiful in Malaysia and Thailand too, with records occurring from 1872 and 1914 respectively, but in both countries the few now left are largely confined to nature reserves. The conservationist Dr. Boonsong Lekagul apparently confirmed several sightings and killings in Chaiyaphum province, around the Tenasserim range bordering both Thailand and Burma, in the late 1960s (reported by Markus Borner: see van Strien, 1974).

Also in Thailand, tracks were noted in the Phu Khio Forest Reserve during the 1970s (McNeely and Cronin, 1972). Records of Sumatran rhinos since 1890 in Laos, Vietnam, and Cambodia, formerly French Indo-China, are unconfirmed and no recent reports confirm the animal's survival in these countries. The series of wars in the region would in any case have disturbed its habitat seriously enough to prevent its living there any longer.

The largest group left in Malaysia is on the Malayan peninsula in the EndauRompin region, where between 20 and 25 may be living, although the 5000-hectare Sungei Dusun Game reserve on the Selangor side of the Perak state border was also established after 1960 as a refuge for Sumatran rhinos. The status of the EndauRompin area is in transition now, but towards the end of 1987, the two states of Johore and Pahang announced their agreement to designate 92,000 hectares of the area a state park by January 1988. A second group of rhinos, located in the peninsula's national park, Taman Negara, may number about 30. Other recent reports, summarized by Mohamed Khan bin Momin Khan (1986) record no more than two to five rhinos in each of several other peninsular Malaysian locations.

A few rhinos, perhaps 30, appear to be surviving on the large island of Borneo, where the animal has been known since 1889. Most of these are in south-eastern Sabah, Malaysia's easternmost state, in the northern part of the island, where they are threatened by hunting, as are most of the rhinos found outside nature reserves.

A 1986 field report by British biologist, Julian Caldecott, of the Earthlife Foundation, described a population previously known only to the local wildlife department in Malaysia's other Bornean state, Sarawak. Occasional visiting biologists' reports of Sumatran rhinos in the Banamuda catchment area, north of Kutai Nature Reserve in Kalimantan, the Indonesian portion of Borneo, were made in 1977 and 1978 and led to Nico van Strien's visit there in 1980, supported by the World Wildlife Fund. Van Strien, a Dutch zoologist who has spent several years studying the Sumatran rhino, concluded that there were either no rhinos or at least no viable populations in the area, 'acid that the animal was probably virtually extinct

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in Kalimantan. The area with the largest population, from 400 to 750 individuals, is Sumatra itself

(van Strien, 1986). Of these, a concentration of 250-500 animals is estimated in south-western Sumatra's Kerinci-Seblat National Park, with the Gunung Leuser National Park in the north containing the best known group, estimated at about 130-200. Other significant populations may survive in Central Aceh and the Barisan Selatan National Park. While scattered individuals survive in other parts of Sumatra, such as Torgamba, in Riau province, where a captive breeding project is currently based.

Description

The Sumatran rhino was declared one of the world's 12 most endangered animals by the International Union for the Conservation of Nature and Natural Resources (IUCN) in 1984, with an estimated world population between 500 and 750 individuals. It is also the smallest and most primitive of the five living species and so different from the other four that in 1828, when a catalogue of his zoological museum was published, the English anatomist Joshua Brookes placed it in a separate genus, *Didermocerus*. Despite its two horns, a feature shared with the African black and white rhinos, the Sumatran is in fact more closely related to the single-horned Javan and Indian species which are also found only in Asia.

This rhino is primitive in that it is related to the prehistoric woolly rhino, *Coelodonta antiquitatis*, although its ancestry is actually even older than that of the extinct woolly species. Some accounts have called the woolly rhino an 'aberrant offshoot' of the genus *Dicerorhinus*, pointing out that *Dicerorhinus* itself is one of the oldest mammals in existence, going back to the early Middle Oligocene epoch, about 29 to 32 million years ago. The Sumatran rhino's link with the woolly rhino is seen clearly in its distinctive covering of hair, ranging from white to black in colour but usually darkish. During the Eocene epoch, about 50 million years ago, early but similar forms of rhino seem to have been abundant in the forests of western Europe, especially in France and Germany. This fact, together with the lack of Tertiary fossils from India, suggests that the Sumatran rhino is a comparatively recent immigrant into southern Asia. The earliest rhino known in this region was the flat-nosed *Rhinoceros platyrhinus* of roughly the Pleistocene period (2.5 million to 10,000 years ago) in India.

Friedrich Zeuner (1934) concluded that there had been three *Dicerorhinus* branches in prehistory, leading to a glacial-steppe form, the woolly rhinoceros, a grass-steppe form, *D. hemitoechus*, and *D. sumatrensis* itself, a wooded-steppe form. Young Sumatran rhinos today are hairier than adults, with great variations in the density and distribution of this hair on older specimens, although most are hairless on the skin within the body folds and on the face. The hair is especially thick along a strip down the centre of back, on the belly, and on the outer sides of the legs.

An early specific name, *lasiotis* or hairy-eared, referred to the way the animal's ears are commonly lined with particularly dense hairs, often trimmed with a fringe of longer hairs. The tail finishes with a tuft of longer hair as well. Recent observations during the Sumatran captive-breeding project have shown that in the wild the hair is very short, probably kept so through friction against dense forest vegetation. Once in captivity, the rhino soon regrows a long but sparse coat of hair.

Male rhinos are slightly bigger than females, with an average height of about 125-135 centimetres at the shoulder and an average body length of about 250 centimetres, 70 to 80 centimetres of which are taken up by the head. Estimates of the average adult weight range from 800 to 1000 kilograms.

Three sub-species have been distinguished by Colin Groves (1967a) on the basis of skull measurements. The comparative size of the animals' teeth seems to confirm this finding, although too little material is available for comparison to allow this classification to be firmly established. *Dicerorhinus sumatrensis harrissoni*, the smallest, is from Borneo (small

teeth); *D. s. sumatrensis* from Sumatra and Malaya (small to medium teeth); and the largest, *D. s. lasiotis* (teeth very large) from Burma, Assam, and Bangladesh, the rhinos northernmost range.

This rhino's skin seems to fit more closely than that of its larger Asiatic relatives, although there are two prominent folds, one encircling the whole body, just behind the front legs, and the other round the lower part of the body, excluding the back, immediately *in front* of the hind legs. Less distinct folds are found on the neck and legs. The skin, softer and thinner than that of the other Asiatic species, is sometimes marked to look deceptively like small scales. A hard plaque of thick skin covers the nostrils, protecting them, and the lips from dense vegetation. In the wild the true colour of the hide, varying from buff to dark or light grey, as observed in captured or killed specimens, is often disguised by the mud in which the rhino wallows.

It is hardly surprising that Marco Polo and even modern zoologists found it hard to discern the Sumatran rhino's second horn, for the anterior horn is by far the larger of the two, with an average length of 20 centimetres, usually not exceeding 50 centimetres, while the second, posterior, horn is often hardly more than a little bump, the largest on record measuring only 8.8 centimetres. Both horns are formed from dense masses of agglutinated hair. They match the body colour, usually dark grey, though paler at the base, and darker in adults than in juveniles. The twin horns do not grow at the same pace, for some of the largest front horns known have been paired with merely knob-sized back ones. In wild animals the front horn is often worn to a sharp point and curves backwards. Females have smaller horns than males, but in both sexes the horns continue growing throughout their life, enabling it to be replaced if damaged or lost: Although the animal seems to prefer to use its lower-jaw incisors as a weapon, the horn too is sometimes employed for either defensive or aggressive purposes.

As Dr John Anderson of Calcutta put it in 1872, the Sumatran rhino has 'low, stout, somewhat columnar limbs' with broad, flat feet, each bearing three round, blackish nails or hoofs, the middle one being best developed. The pale skin beneath the feet is soft and rather elastic, well suited to the damp forest and marshes the animal prefers to inhabit. According to Bell's 1793 account, 'The soles of the feet were convex . and the cuticle on them not thicker than that on the foot of a man *who* is used to walking.' Measurements of prints vary with the quality of the ground, but the average width of fully grown feet is from 20 to 24 centimetres. Tracks are distinctive enough to distinguish individual animals, if casts and measurements are compared carefully (van Strien, 1986). The casual observer, however, may confuse the rhino's print with that of the three-toed hind foot of a Malayan tapir.

Habitat and Behaviour

Early records suggest that the rhino could once be found at a great variety of altitudes, from sea-level forests to heights of 2500 metres, though it has always preferred dense undergrowth. In more recent times, clearance of low-lying land for agriculture or human settlement, together with hunting, have threatened the animal, which has naturally found it easier to survive on higher, less accessible ground. As a result, the rhino now seems to prefer less easily disturbed hilly or mountainous areas of dense primary rain forest. As early as 1904, G. E. Evans commented: 'The steeper the gradient, the more it would appear to appeal to them. It is surprising how they ever manage to climb over some of the rocky places one encounters, yet they do. They are the most difficult animals I have ever attempted to follow.' It is one of the largest mammals still entirely dependent on the rain forest, and the low density of surviving populations indicates that each animal needs a sizeable home range.,

Many individuals today have become isolated in small patches of forest surrounded by human settlement or other activities and have little hope either of pursuing their normal patterns of behaviour or of meeting a mate. According to van Strien's research (1986) in the Gunung Leuser National Park, males have much larger ranges than females, at least 25 to 30 square kilometres compared with the females' 10 to 15 square kilometres. Each male range has a core area of intensive use, surrounded by less frequently visited peripheral areas. The males travel further afield than the females, who usually restrict their activities to a patch of about ten square kilometres. The female's range appears to differ according to whether she is actually breeding, accompanied by a calf, or not. She will opt for low altitudes in the vicinity of a salt-lick when she has a calf., until the calf is ready to live alone, at which point she will leave it behind in the lower area, where it may stay for two or three years before gradually extending its own explorations until it finds a suitable vacant patch to inhabit.

Except for mating and the eighteen-month period a mother and calf spend together, the Sumatran rhino is a solitary animal. Social contact seems to be focused on regularly visited salt-licks, where useful extra minerals such as sodium and phosphorus can also be picked up, compensating for mineral deficiencies in its herbivorous diet. These licks are sometimes associated with sulphur springs. Each rhino's home range contains at least one salt-lick, for they seem to prefer to keep to the same one. There are, however, no salt-licks in the Endau-Rompin area of southern Malaya, and at

least one group of rhinos there seems to survive quite well without them.

In Sumatra, males visit salt-licks regularly, about every seven or eight weeks, while breeding or nursing females, in more urgent need of mineral supplements, visit them about every three weeks and non-breeding females about every six weeks. Salt-lick meetings are obviously an important element in the mating system. Females generally make short visits to the licks, approaching them by well-defined personal corridors which do not overlap each other, whereas the male, less rigid in his approach, stays at the lick longer, probably in active search for a female. Nonbreeding females seem to organize their territory more exclusively than males, avoiding contact with other non-breeding females, while females with calves appear to structure their range with specific reference to salt-licks, regardless of possible overlapping with other females.

The adult rhino is an inexhaustible walker, wandering over a large area and covering many miles at a stretch, by day but preferably by night. The animal's propensity for sticking to regular trails, particularly around salt-licks and mud wallows, has made it easy prey for poachers, who have only to set traps across the trails and wait. The rhino's vigorous feeding techniques leave clear traces of its passage, with the main network of trails following the clearest natural routes, often along rivers and ridges, to make the going easier. Animals of other species often make use of these trails, which, in the absence of rhinos, tend to become overgrown. For a human being, a well-used rhino trail can mean the difference between walking 15 to 20 kilometres a day or only five if new trails have to be cut through thick forest. Instances of rhinos apparently deviating from the trail several metres before an obstacle such as a fallen tree-trunk suggest that the rhino's eyesight may not be as poor as has been reported in the past (van Strien, 1986). Verdicts on the animal's hearing range from acute to rather poor, while its sense of smell is generally agreed to be good.

Round ball-shaped droppings 6 to 10 centimetres in diameter are found slightly to the side of rhino trails, often close to previously deposited heaps, though the animals may also defecate in water if they cross a stream, apparently merely as an automatic physical response to the cold water. Some observations of behaviour in captivity seem to suggest a deliberate choice to defecate in water (Andersen, 1963: Copenhagen Zoo). Characteristically, the dung contains the whitened, barked fragments of twigs and stalks, each about 2 centimetres long.

The male rhino can spray urine in a fine mist-like cloud of droplets for up to 5 metres backwards and 2.5 metres high onto plants along the trails, to mark its territorial boundaries. This spraying is facilitated by the long tapering penis pointing backwards. There is no scrotum and the glans penis is provided with two large, oblong-oval lobes attached to the glans only at the base, as well as a trumpet-shaped extension at its tip. The female also sprays urine backwards though far less spectacularly, reaching a height, of only 60 centimetres or so. Trails may also be marked by twisted saplings and by scratches in the soil made with the rhino's hind feet. These marks are seen as a form of communication with other rhinos. Along the main rhino trails wallowing places are found, as it is essential that rhinos bathe or wallow in water or mud for several hours at a time. Most do this at least once a day, and often much more frequently. This keeps the skin in good condition, free from cracks and inflammation; without regular mud-baths the rhino soon sickens and dies. A coating of mud also protects the rhinos against the bites of fleas, ticks, leeches, and other parasites.

Pools formed by rainfall are favourite sites for wallowing and may be as much as eight metres across. Such wallows can be spotted easily, thanks to the patches of flattened vegetation surrounding them, and banks eroded by rhinos rubbing hide, horns, and feet against them to dislodge more soil, thicken the mud, and enlarge the natural depression. In Malaysia, wallows have been found beneath banks (Hubback, 1939a), sometimes in a series of seven or eight. In Sumatra wallows are sometimes made by rhinos rolling or digging in patches of wet, muddy soil to excavate an oblong pit about two by three metres, or a whole series of them.

Wallowing rhinos have been heard giving contented buzzing sounds, varied with snorts and grunts, though a series of squeaks seems to be the usual sound of an undisturbed rhino. When alarmed, the animal will make a snorting or barking sound. Captive rhinos have been known to emit loud whistles.

An observation made during the current captive-breeding project in Sumatra suggests that skinks (species of the family Scincidae) are allowed to move around the rhino's body, feeding on horseflies and parasites, particularly when the rhino is wallowing. This is similar to the well-documented relationship between cattle egrets (*Ardeola* species) and oxpeckers (*Buphagus* species) and African rhinos.

Sumatran rhinos have been observed to swim well -- van Strien (1986) saw a mother and calf swimming back and forth twice across a deep river in full flood in the Gunung Leuser National Park. But rivers appear to be major territorial boundary markers; having crossed a river, rhinos will usually recross it quite soon to return to their original range.

A certain amount of fighting among Sumatran rhinos is indicated by reports of numerous scars found on the bodies of both males and females killed by hunters, and even on animals held in captivity. Hubback (1939a) found traces of a fight

between two animals while a third was near, a situation interpreted as a struggle between two bulls for the chance of mating with a cow. Two females who lived in the Schonbrunn Zoo in Vienna between 1902 and 1908 were very intolerant of each other and fought furiously whenever they were brought together.

The rhino's relationship with mammals of other species seems more placid. Elephants have been seen sharing the rhinos' wallows, though elephants have also been described by Philip L. Sclater (1872) as afraid of rhinos. Other large mammals that share their forests include sambar deer (*Cervus unicolor*), clouded leopards (*Neofelis nebulosa*), tigers (*Panthera tigris sumatrae*), leopards (*Panthera pardus*), serow or mountain goats (*Capricornis sumatrensis*), Malayan tapirs (*Tapirus indicus*), banteng or wild cattle (*Bos banteng javanicus*), gaur or wild ox (*Bos gaurus*), Malayan sun bears (*Helarctos malayanus*), Asian wild dogs (*Cuon alpinus*), and wild pigs (*Sus scrofa* and *S. barbatus*). The Javan rhinoceros (*R. sondaicus*) was once among the Sumatran species' neighbours in several areas. Q&

There is at least one recorded instance of a young rhino killed by a cobra bite while in captivity, close to Langsar, in Sumatra (Ullrich, 1955), but the animal has no real enemy besides man, the most dangerous animal of all. The rhino avoids human beings as far as possible and retreats rapidly, sometimes showing unexpected agility, when disturbed. Even the most experienced trackers and zoologists find it very difficult to get a clear sighting of the rhino.

Feeding

The Sumatran rhino's chief source of food is shrubs and small trees on which it browses, taking the leaves, twigs, and light branches, with some fruit when it is available, especially mangos (*Mangifera*), mangosteens (*Garcinia*), and citrus fruit generally.

In Gunung Leuser, van Strien noticed that the rhino also ate herbaceous undergrowth, especially species of the family Urticaceae with fleshy stems and leaves, ' notably *Elatostema*, *Pilea*, *Urtica grandidentata*, *Boehmeria*, *Cypholophus*, and *Pouzolzia*. The stems of giant ginger of the family Zingiberaceae are chewed to extract the soft, juicy pith and the hearts of some species of *Colocasia* also seem attractive, as do *Eugenia* species in the family Sapotaceae. A preference for certain plants : of the families Gesneriaceae, Acanthaceae, Piperaceae, Begoniaceae, Balsaminaceae, Rubiaceae, Compositae, Commelinaceae, and Araceae is clear and a rather extraordinary food-plait appears to be a species of *Melanorrhoea* (Strickland, 1967), the latex of which causes a serious rash or ulceration on human skin, but evidently does not affect the rhino.

In cleared, regenerating areas, following landslides. or tree-falls, the rhino may, in addition to the above, feed intensively on the resulting dense vegetation, sampling Melastomaceae, Labiatae, Schisandraceae, Moraceae, Euphorbiaceae, Sabiaceae, Caprifoliaceae, Staphyleaceae, and Verbenaceae. Deliberate clearance of selected forest patches might, therefore, be a sound management technique in some areas where rhinos are known to be present.

The animal's diet reflects the richness of its favourite forest habitat, with over a hundred species from more than 40 plant families identified among its food: a varied mixture of trees and shrubs, many aromatic (not surprising, considering the rhino's well-developed sense of smell) but excluding grasses, except for bamboo.

Trees of the families Guttiferae, Oleaceae, and Styracaceae are favourites with the rhinos in Gunung Leuser. Fruit is only occasionally sampled there, where the fruit most often found on the ground is 'kandis' (a species of *Garcinia*), a favourite of deer and pigs, though van Strien reported that the rhinos never took it, no matter how plentiful it was. In Gunung Leuser the rhino also has no interest in the wild bananas (*Musa* species) so favoured by elephants. In captivity the rhino has been known to eat bananas as well as pineapple, sweet potatoes, plain potatoes, carrots, apples, rolled oats, cooked rice (usually producing severe constipation), and Lucerne hay.

The wild rhino has various methods of dealing with the trees on which it feeds. According to Donald L. Strickland (1967):

These are invariably damaged extensively during feeding. In some cases, the trees are merely bent over or partially broken, but more frequently they are completely snapped off and the young foliage is eaten. Trees up to 6 and 7 cm. in diameter were found broken off at anywhere from a few centimetres to two metres from the ground. The smaller trees were probably bitten off, but the larger ones were broken by first bending them over and then stepping on them ... Many of the young trees that had been eaten had small bits of the bark scraped off about a metre from the ground. In a few cases I found that trees had been scraped in this manner but had not been eaten. I suspect this is one of the ways in which the rhino distinguishes the plant it prefers.

Theodore. Hubback's description (1939a) adds more details to the picture of a feeding rhino:

He will move round and round the end of a (fallen) tree continually altering his position during the process of demolishing the leaves and ends of the branches. A favourite trick of the rhinoceros when feeding is to get a sapling behind his front horn and twist it round and round until it is thoroughly decorticated.

Borner (1979) describes another technique, with the rhino walking downhill over a small sapling, pushing it beneath its body in order to reach the foliage at the top of the trunk. Thin and flexible saplings sometimes recover from this treatment, springing up again once the rhino moves on. Workers on the current captivebreeding project have observed a male, Torgamba, standing on his hind legs to push down a tree of 20 centimetres diameter by gripping the trunk with the nails of his fore feet (Dr Tom Begg, veterinarian to the project and director of Howletts, personal communication).

As the rhino is largely nocturnal and a very light sleeper during the day, the preferred feeding time seems to be night or early morning. There is also a great deal of opportunistic feeding, even while the rhino is on the move along its trails, and some accounts of the animal in captivity have recorded it eating 'all day and all night' (Skafté, 1961).

Reproduction

The Sumatran rhino's pattern of reproduction is still not completely understood, although observations of captive individuals have added some details to information about habits in the wild. It is not known whether there is a clearly defined breeding season, though van Strien (1986) has noted that most births in the Gunung Leuser area occurred during the season of heaviest rainfall, October to May. Births are certainly not frequent, perhaps as seldom as once every three or four years, with a single calf being born after a gestation period of at least 1 months. This long breeding interval may be attributable to the low nutrition level of most rhino fodder, requiring considerable time for the female to build up sufficient reserves of strength between births.

At birth, the calf is about 60 centimetres high and 90 centimetres long, weighing about 25 kilograms, very dark in colour and covered with abundant hair. Its three hoofs or nails are turned under each foot, with pointed ends that gradually wear away to reveal the adult hoof structure. On 23 May 1987 observers were lucky enough to see a Sumatran rhino calf born in captivity at Malaysia's Malacca Zoo, the first born in captivity this century. The mother, already pregnant, was captured in February 1986, and the dates involved indicate a gestation period of at least 15 months. The mother is one of four females gathered at Malacca by 1987 together with one male. I observed the female calf when she was 36 hours old, weighing 24 kilograms. She was covered with curly black hair and her body weight and measurements were as described in earlier accounts, but the formation of the foot and nails, previously stated to be embedded in the skin of the sole, differed at this stage and the nails were no longer turned under into the foot. They were already detached from the sole like the mother's, but their shape seemed to indicate that at birth or during the pregnancy they could have been attached to the sole in the way previously described.

During the first few weeks after birth, the mother in the wild leaves the calf hidden in dense vegetation while she forages for food, returning only to suckle it at her two teats. Each calf seems to spend about 18 months with its mother and no other calf will be born while offspring and mother remain together. This slow rate of propagation is obviously one of several factors contributing to the animal's decline. Traces of calves in the wild are rarely recorded, perhaps because of the difficulty of distinguishing their tracks from those of the mother they accompany so closely. Observations in the field (van Strien, 1986) suggest that the calf usually, but not quite always, precedes its mother, who follows immediately behind. The calf gains weight by about one kilogram a day during nursing. After separation from its mother, the young rhino will wander over about ten square kilometres within the original nursing range, gradually extending further afield before establishing its own territory after several years. Young animals in the wild reach sexual maturity when they are about eight years old.

Hunting and decline

As early as 1939 the hunter Theodore Hubback, based in Malaya, was already lamenting the Sumatran rhino's fate: 'It is now being exterminated throughout most of its range' He added that the only hope of preventing its extinction was 'to constitute inviolable sanctuaries in their own habitat where a suitable environment is known to exist. These sanctuaries must be properly guarded and freed from human interference.' What was true in 1939 is even more urgent now. The reasons for the animal's difficulties are depressingly familiar. They vary from pressure on its preferred habitat by the increasing demands of human neighbours to hunting and poaching, encouraged by the high prices paid for the horn, and indeed most of the other components of the animal, from skin to bones and blood. The rewards offered by the city-based middle-men who process the carcass lure native hunters adept at forest-trekking to trap and kill the rhinos by whatever means is available. In the 1920s and 1930s Thai hunters, having virtually wiped out the species in their own country, repeated the exercise across the border in Burma, where the killing went on as long as any rhinos could be found. Certain

European hunters have been as much to blame as native ones, as the account of an expedition by Arthur S. Vernay in *Natural History*, (1924) magazine demonstrated. Vernay was operating around the Pegu River in central southern Burma and managed to kill a female with 'a lucky shot in the brain'. She had been accompanied by a one-month-old baby which then charged 'viciously but ineffectively' and was easily transported in a bamboo basket to base camp, where it quickly became a pet, bottle-fed on milk. This baby was sent to Rangoon Zoo but did not survive.

The animal is now protected by law wherever it survives, but it is easier to pass such laws than to enforce them. In 1975, van Strien (1976) described traps found in the Gunung Leuser reserve, an area considered safe and the home of one of the largest groups of survivors. Weighted spears were suspended above trails regularly used by rhinos, with threads stretched across the paths to trigger the fall of the spears. Once the weights that hold up the tapering wooden spears were disturbed, the spears buried themselves in the rhino's back, without causing immediate death, although the animal usually died close to the site. A single rhino may set off several traps in a cluster and be speared more than once.

The same report included information from a poacher caught carrying 26 kilograms of rhino bones out of Gunung Leuser, who made it plain that at least three and possibly six rhinos had been trapped there in 1975 alone. Apparently not even the extreme difficulty of finding rhinos in thick forest is enough to protect them. With so few animals left, poaching on this scale is a serious threat. Nor is Sumatra the only area troubled by such illegal activity. A report in the *New Scientist* of 1 August 1985 said: 'Poaching on Sabah (North Borneo) alone is known to have claimed the lives of three rhinos last year, and two so far this year.'

Protection and conservation

With the Sumatran rhino population edging closer to extinction, the World Wildlife Fund (WWF) and the Asian Rhino Specialist Group (ARSG) of the IUCN collected information about survivors and the areas in which they are found. In October 1984 the Ad Hoc Sumatran Rhinoceros Meeting in Singapore, convened by the Species Survival Commission (SSC) of the IUCN, reviewed conservation plans protecting the animals in their native countries and proposals to establish captive breeding colonies at home and abroad. They concluded that at least 700 protected square kilometres would be needed to support a group of 70 animals, adult and young, considered to be the minimal number for a viable population. Rhinos for captive breeding in Indonesia, Malaysia, England and the USA would be taken from unprotected areas, where fragmented natural populations are obviously doomed and the loss of genetic diversity is adding to the problems of survival.

Discussions under way since 1982 came to fruition in May 1985, when an agreement was signed between the government of Indonesia and Howletts and Port Lympne Zoo Parks of Great Britain to proceed with captive breeding of rhinos from Sumatra itself both within Indonesia and at Howletts. The project was spearheaded by Howletts' founder and 'director, British conservationist John Aspinall, who committed well over a million American dollars of his own funds to see the operation through, with enthusiastic co-operation from Prof. Dr. Rubini Atmawidjaja from the Indonesian government', Directorate-General of Forest Protection and Nature Conservation (PHPA). I myself am the director of the operation, and also the IUCN's stud-book keeper for the Sumatran rhinoceros, while the British capture expert Tony Parkinson is directing field operations.

The Indonesian and British governments have issued permits for the export and import of the rhinos caught by this Project and all captured animals and their progeny will be owned jointly by the collaborating partners.

Howletts, which has had considerable success with breeding other mammals, including the black rhino, is now training Indonesian keepers and veterinarians alongside its own staff in England in the care, treatment, and translocation of captive rhinos. The Zoo is also co-operating with Indonesian authorities on plans to improve protection of viable groups still in the wild, especially those in national parks or other sanctuaries. If the captive breeding programme is successful, with numbers increasing quickly, it is hoped that some UK-born individuals can be sent back to reinforce wild populations in protected areas, where, of course, the UK-trained keepers and veterinarians will be available to care for them.

A second agreement, between Sabah's Department of Wildlife and National Parks and five American zoos, through the American Association of Zoological Parks and Aquaria (AAZPA) was planned at the same time as the Howletts/Indonesia venture but collapsed in 1985. The American zoos are now working alongside the Howletts Project in Sumatra with the intention of taking animals caught in Indonesia to Los Angeles, San Diego, New York, Miami, and Cincinnati.

Meanwhile, Malaysia itself, has embarked on captive-breeding programmes, separately run in peninsular Malaysia and on the island of Borneo in the eastern state of Sabah. The operations are quite distinct because of Sabah's political and

financial relations with the federal government based at Kuala Lumpur on the peninsula; wildlife laws and budget allocations which apply on the mainland not always affecting Borneo island.

The combined operations have resulted in eight captive Sumatran rhinos now living in Malaysia: seven females at Malacca Zoo on the peninsula, one male in Sabah. This live figure was reached after four Malaysia Sumatran rhino deaths: the male Napangga brought in on exchange from Indonesia; the female Melintang, who died after being presented as a gift to the Thai royal family; a young male which died soon after capture on the peninsula; and another male captured in Sabah in 1986/7 who died in a pit trap. There were two other captures - one escaped and the other, caught mid-1987, is the individual now doing well at Sabah. Like several rhinos caught in Sumatra, he had been badly wounded before capture by a poacher's snare wound tightly around his leg.

Mohamed Khan bin Momin Khan, Director-General of Malaysia's Department of Wildlife and National Parks and current chairman of the IUCN's Asian Rhino Specialist Group, has been extremely courageous in his pursuit of the captive-breeding programme against a background of controversy on some of the issues in his own country. He has been ably supported by Mohamed Tajuddin Abdullah and Zainal Zahari Zainuddin, the officers from his department in charge of the capture operation and veterinary matters respectively.

Part of a government allocation to Malacca Zoo of 4.82 million Malaysian dollars for 1986-90 has been earmarked for upgrading the rhino enclosures and there is hope of funds for the development of procedures such as embryo transfer and artificial insemination. The state government in Sabah has reportedly allocated 3 million dollars to its own captive-breeding programme. Both operations now eagerly await the capture of a rhino from the other sex - a male for the peninsula, a female for Sabah - in order to start the breeding operation proper.

These Sumatran rhinos are by no means the first captives on record. In a 1961 assessment, R. J. Reynolds counted 55 from the time of the earliest, nineteenth-century captures to the three collected in 1959 by an expedition sponsored by Copenhagen and Bogor Zoos and led by Arne Dyhrberg and Hakon Skaftø. As Kees Rookmaaker's detailed account (1985) makes clear, there has been some confusion about the actual achievements of this expedition, partly because there were in fact two collecting teams active at the same time in the same area around the Siak River in central Sumatra's Riau province. The earlier expedition, led by animal dealer Peter Ryhiner in collaboration with the Singapore dealer Louis de Jong, began late in 1958 when Ryhiner arrived at Buatan on the Siak River to view a male and a female captured by Harry Gillmore, the American manager of Standard Vacuum Oil Company's pipeline terminal at Buatan. He actually saw only the female, as the male was still held in a stockade in the forest. By the time he had organized his export/import permits, in February 1959, Ryhiner returned to find that Gillmore had been obliged to release his rhinos, but almost immediately, the female walked back into a trap. Ryhiner named her Betina. She was shipped to Singapore in May 1959 and flown to Basel Zoo in July, after which Ryhiner returned to the Siak River area in September, in search of a male. Finding the Copenhagen-Bogor team already there, he reluctantly joined forces with Dyhrberg and Skaftø.

An account by the Director of Copenhagen Zoo, Svend Andersen (1963), says that the zoo expedition caught ten Sumatran rhinos; nine females, six of which were released, plus a male that escaped. Accounts by Skaftø, who was a journalist, (1961, 1962, and 1964) recorded three females caught, one of which died soon after capture, one called Subur which went to Copenhagen Zoo and survived till 1972, and a third which went to Bogor Zoo, surviving until 1961, the same year in which Betina died at Basel. Skaftø also left a lively report about the difficulty of capturing the deceptively bulky and heavy Sumatran rhino:

[It is] an ill-tempered animal - and quick as lightning. I have seen it move in and out between trees, roots and other obstacles in the tangled undergrowth, with surprising grace and agility. And I have seen it stop, turn around in a fraction of a second, and charge ahead with the speed of an express train. When it is captured, however, it calms down surprisingly quickly and seems to be comfortable in human company.

While it seems impossible to ascertain the exact number of captures by the zoo expedition (which later also claimed Betina as its own), only the three females mentioned - Betina, Subur, and the Bogor Zoo specimen - were actually sent out of Sumatra in 1958-59. These captures ended a period of almost 40 years during which no Sumatran rhino had been exhibited in the West. The last of the earlier captives, a female, had died in Vienna in 1919, though there had been one at Tennoji Zoo in Osaka, Japan, from 1921 to 1925, the first rhino ever shown in Japan and the only Sumatran, obtained through Singapore. The skeleton of this specimen was still at the University of Tokyo in 1975, though in poor condition, as its horns had been stolen after World War II.

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Unlike the Copenhagen expedition and those which preceded it, the unique nature of the current Sumatran project lies in

its intention to breed in captivity. Births in captivity have been very rare so far. Apart from the 1872 birth at London's Victoria Docks, only two captive-bred calves are on record, both born at Calcutta Zoo, one in 1889 and the other in 1895, before the fourth birth at Malacca Zoo in 198.

The project's progress so far gives cause to believe that many more will follow. The field stage began in August 1985 when a base camp was constructed near Torgamba, in Riau province, where an estimated 10 to 20 surviving rhinos were doomed by the extension of logging into their forest habitat. The patch of forest still left, about 30,000 hectares lying between the villages of Bakambatu and Tanjungmedan, is surrounded by oil-palm plantations, except for a large swamp on its eastern side. Logging roads intersect the forest in all directions, allowing access to illegal settlers and disrupting the rhinos' usual pattern of movement.

The base camp includes two wooden houses and two rhino paddocks, each about 400 square metres and partially covered for shelter. Once these facilities were ready, project personnel surveyed and selected several rhino trails, constructing traps across them in October 1985. Three of the traps were of the stockade type, with an oval palisade of wooden poles broken by a drop door at each end, connected to a trigger mechanism in the centre of the trap. Seasonal rain made it difficult to build pit traps, which are prone to flooding and can result in a rhino drowning if not checked frequently. Checking too often, however, can be self-defeating, as this may scent the trap with human smells which will warn off most rhinos. Eventually a self-draining pit trap was devised and constructed on high ground, wood-lined and with a thick layer of vegetation in the bottom. Staff checked the water level daily. Later in the project, the design was further refined by the addition of a tipping ramp which could slide the rhino comfortably into the pit. With the pit-trap system, it is vital to transfer the animal to a holding pen quickly. Stockade traps on the other hand are checked only every second day, so that human scents have time to disperse. There is also less urgency about moving a captured rhino from this type of trap, as the area within the palisade acts as a sort of holding pen.

On 25 November 1985 a young male rhino was found in the pit trap. This welcome news caused considerable excitement and some confusion as Tony Parkinson and myself had to rush back, to base camp from a meeting in Jakarta. Thanks to the assistance of the American oil corporation, Caltex, which lent one of its helicopters, managed to return within only two hours. The Indonesian workers had already begun to build a stockade pen just in front of the trap. Everyone worked frantically through the night to get the rhino out of the trap and at five the following morning Torgamba, as he was eventually named, walked steadily out of the trap into his new pen. Only an hour later he had recovered enough to start eating some fruit - wild mangos - and a few leaves. He also lost no time in locating a mud wallow provided for him, in which he spent several hours a day.

The next capture was a fully grown female, found on the morning of 23 January 1986 in one of the stockade traps. The project suffered a bitterly disappointing setback when she panicked and injured herself so badly against the fence-posts of her enclosure that she died, probably of a cerebral haemorrhage. The violence of her reaction was not characteristic of the usually gentle Sumatran rhino. An important lesson learned during the project was that pit traps, although more difficult to monitor in monsoon rain conditions, cause less stress in newly captured animals, probably because they are held in relative darkness and their movements are restricted, reducing the danger of their hurting themselves.

Meanwhile Torgamba went through the lengthy process of conditioning and habituation, which project personnel have now perfected, without any further incident. Wild rhinos are surprisingly delicate and cannot be moved abruptly from one new environment to another. After about two weeks the animal can be moved from the stockade pen near the pit trap, still deep in the forest, to one of the paddocks at the base camp. After about a month there, the rhino may be ready to be transported further. It was in April 1986 that Torgamba travelled by truck from the forest to the Indonesian port of Dumai, 200 kilometres away, where he was transferred to a ship bound for Singapore. The voyage took three days. At Changi International Airport cargo terminal, on 4 April, Singapore Airlines loaded him onto a new Combi (passenger and freight) Big Top jumbo jet for the journey to Port Lympne via Manchester.

A second young male, Jalu, about two years old, was caught in another pit trap on 25 March 1986 and is now at Jakarta Zoo. Success followed success during that year, with the capture of a third male, Napangga, on 15 June and a female, Subur, on 22 June, named after the world's last captive animal, which had died in 1972 at Copenhagen Zoo. These last two animals each had a hunter's snare deeply embedded in one of their legs, creating vicious wounds. Had they not been captured and given speedy medical attention by Dr Begg, specially flown from London for this emergency, they would almost certainly have died a lingering death from gangrene.

In the case of Subur, shipping from Dumai to Singapore was rejected in favour of air-freighting. She was loaded into a crate measuring 280 centimetres long by 130 wide and 170 deep and flown by Airfast's DC3 charter plane to Singapore's commercial Seletar airfield, where she was transferred to a lorry, a gruelling threehour operation needing the use of heavy-duty cranes and forklift trucks. The total weight of the crate and its occupant was about 1220 kilograms. She was then driven to Changi Airport for an afternoon's wait before taking SIA's night Combi flight to Manchester. There, like Torgamba before her, she embarked on yet another journey, seven hours south by road to Port Lympne in Kent. The rhinos were accompanied throughout these journeys by Dr Begg, but their resilience to the stress of such extended travel has certainly given their anxious wardens cause for optimism. Sadly, hopes that Torgamba and Subur would form the first breeding pair of Sumatran rhinos in the West were dashed when Subur died of a bacterial infection only a few months after her arrival at Port Lympne Zoo in August 1986. However, by mid

1987 there was a total of Sumatran rhinos in captivity in the world, compared T'

with none between 1972 and' 1984: one male and six females at Malacca Zoo, a male and a female at Jakarta Zoo, one male still held in the Sumatran forest, one male at Port Lympne, and one male in Sabah. The whole 'Operation Sumatran Rhino' is being recorded on film, movie and stills, by wildlife photographer Alain Compost, who works in Indonesia, and this will form an important archive for scientists and wildlife managers. If all goes well this will not be just another documentary on a recently extinct mammal, but a record of a species that is still very much alive and well, held in trust for the future by an international community in a rare example of global co-operation among human beings.

Chapter 311

Early records

The first full zoological description of a Javan rhinoceros came comparatively late, in 1822, when Anselme Gaetan Desmarest included Georges Cuvier's account of the animal in the second volume of his *Mammalogie*. According to Cuvier's brother Frederic, 'Mon frere a donne a cette espece le nom de Javanicus,' but Desmarest seems to have preferred the specific name of *sondaicus*, based on Java's Latin name. The type specimen was one 'of three sent in 1821 to the Museum National d'Histoire Naturelle in Paris by Pierre Diard and Alfred Duvaucel, who had collected the animals in Sumatra. In the supplement to his book Desmarest altered the type locality to Java.

There are, of course, earlier references to the Javan rhino from Asia itself. Chinese records from the Tang dynasty, 618 to 906 AD, mention the export of rhino horn from Java, and twelfth- or thirteenth-century relief in Angkor Wat, Cambodia, clearly depicts a single-horned Javan rhinoceros. If one accepts that the 'unicorn Marco Polo saw in 1292 was a Javan rather than a Sumatran rhino, then his journal is another early source. Jacobus Bontius, a physician who was in Java from 1627 until 1631, certainly wrote about single-horned rhinos near Batavia (Jakarta) which he had observed 'a thousand times, caged or grazing in the woods,' though they were considered then to be Indian.

Taxonomically the early history of the species is shrouded in confusion, because until about 1790 all ^{rhinoceroses} were simply divided into the single-horned varies+ in Asia and the double-horned in Africa. Closer study of the single-horned Javan together with the first scientific description of the two-horned Sumatran rhino ii 1793, at last revealed the true complexity of the rhinoceros family. The Javan rhino now even rarer than the Sumatran, seems always to have been slightly overshadowed by both other Asian species, for it was not distinguished from the Indian *Rhinoceros unicornis* until late in the eighteenth century.

The Dutch anatomist Petrus Camper (1722-89) studied the skulls of Javan rhino in the 1780s and mentioned his work in letters to Sir Joseph Banks and Peter Simon Pallas, but he still distinguished only one African and one Asian specie (Rookmaaker and Visser, 1982). Camper's large collection of specimens and hi work on them later influenced the French anatomist Georges Cuvier (1769-1832) who was given one of the Javan skulls and eventually suggested the existence of two Asian varieties. The differentiation of the two species was finally confirmed when the Museum National d'Histoire Naturelle received the Diard type specimen in 1821

would like to venture the suggestion that the Javan rhino might well belong to an entirely different genus from that of the Indian *Rhinoceros unicornis*. For one thing, the Javan is a browser, the Indian a grazer. The external morphology of the Javan's head, its lips in particular, and its remarkably different behaviour, also set it apart from the Indian. The rest of the anatomy, however, is very similar, any there is no fossil evidence for a very long separation of the two species.

Sir Stamford Raffles and Thomas Horsfield (Horsfield, 1824) saw a captive Javan rhino at the fortress of Surakarta in Java in 1817. It had been tamed and was confined in the entrance courtyard of the royal palace by a broad ditch around

the yard's perimeter. Well treated (although some of its more daring admirers would try riding on its back from time to time) and well fed on its favourite food of figs and plantains, the animal, which was 3 metres long, grew from a height of 1.3 metres to 1.7 metres by 1821. By that time it had no difficulty crossing the ditch and would habitually raid villages for plantation crops, vegetables, and fruit, terrifying the people, though it was quite sweet-tempered and regularly allowed itself to be shooed back to its compound. After a time the putrefying vegetable matter left from the animal's meals and its faeces and urine-soaked wallows in the royal courtyard, became annoying and the rhino was transferred to a small outlying village, where it accidentally drowned in a stream. Horsfield's published account (1824) concluded with more general information on the Javan rhino:

In its manners the Rhinoceros of Java is comparatively mild. It is not infrequently met in the wilds by Europeans and by natives. No instance of its showing a disposition to make an attack has come to my knowledge. Being the largest animal in Java, its passions are not roused, as in many parts of India, by contentions with the Elephant. It is rarely seen in a domestic state, but it is occasionally decoyed into pits, and destroyed. Our animal rambles chiefly at night, and often occasions serious injury to the plantations of coffee and pepper, which are laid out in the Fertile districts selected for its retreat. The horns and skin are employed for medicinal purposes by the natives.

In 1817 Raffles sent the skull of another Javan rhino to the Hunterian Museum of the Royal College of Surgeons in London. His account of an attempted collection from Sumatra (1821) describes the local rhino:

The one-horned rhinoceros of India is not known to the natives of this part of Sumatra; and the single horns which are occasionally produced, appear to be merely the larger horns of the two-horned species separated from the smaller ones. There is, however, another animal in the forests of Sumatra never yet noticed, which in size and character nearly resembles the Rhinoceros, and which is said to have a single horn ... It has been seen at several places, and the descriptions given of it by people quite unconnected with each other, coincide so nearly, that no doubt can be entertained of the existence of such an animal ... A specimen has not yet been procured, but I have several parties on the look-out, and have little doubt of soon being able to forward a more accurate description from actual examination.

The relative lack of information about the Javan may be explained in part by the small number ever kept in captivity, for it has been exhibited less than any other rhino. Apart from those kept in private menageries by Javan princes in the seventeenth and eighteenth centuries, Reynolds (1961a) records only 10 others, including a male kept at Adelaide from 1886 to 1907—the longest life-span known—and exhibited as an Indian rhinoceros. Vienna Zoo acquired a calf in 1788, but it died on the journey out and ended as a specimen in the Museum of Natural History instead. Another was shipped from Calcutta to join a menagerie travelling in Scotland, and was exhibited at Liverpool in 1836, ending its days as a specimen in the anatomical museum of Guy's Hospital in London. Regent's Park Zoo bought a Batavian male from Jamrach in 1874 for £800 and kept it alive for 11 years, while the zoo at Alipore, Calcutta, had two females in the 1880s.

A report in a 1933 issue of *Bangkok Sport and Gossip* said: 'About the year 1886, a one-horn was captured and brought alive to Bangkok from a place near Krabin, to the west of the capital. It was kept in captivity here for some time ere it passed out.' What also seems to have been a Javan rhino was trapped in the Dindings region of Perak state, Malaysia, in 1905 and transported to Penang. Granville O'Hara (1907) witnessed the operation and reported: 'It was a magnificent specimen of a three-quarter grown bull rhinoceros, it had a horn about 2 1/2 or 3 inches long and stood from 4 1/2 to 5 feet in height; its skin was of a dark reddish brown in colour.' This animal was sold to a Singapore dealer for 500 American dollars and then to the People's Park in Madras for 1500 rupees. Its arrival in Madras has not been substantiated, nor is it known how long the animal lived. *Distribution* '„

In the first half of the nineteenth century the Javan rhino was found in Malaya, Burma, Thailand, Indo-China, possibly south-western China, and parts of northern India, from eastern Bengal to Assam and Bhutan, as well as Java and Sumatra. It has since been exterminated over most of that range and is now certainly extinct in India and China. Occasional reports of sightings elsewhere, from Burma in 1954, from Malaya in 1957, and several in the 1960s from Thailand, Vietnam, Burma, and Malaya, for example, remain unconfirmed. Insurgency in parts of Thailand and most of Burma, coupled with the Vietnam and Cambodian wars, make it almost impossible to verify reports through field-work, although zoologist John MacKinnon reported a firm finding of rhino in the lower Mekong area of Vietnam in about 1985 and this, most likely, was the Javan species. If there are any Javan rhinos

in Indo-China they are likely to be found in the Cardamom Mountains of Cambodia, J

in north-western Laos, in the Bolovens Plateau region of southern Laos, and in parts of the former South Vietnam near Da Lat.

The Tenasserim Range bordering both Burma to the west and Thailand to the east was rhino country until fairly recent

times. Theodore Hubback shot a Javan rhino there in 1920 and persistent reports from Karen tribesmen of further sightings continue throughout the 1960s. A 1976 report from one of these tribesmen said Javan rhinos were seen at Khao Sam Chan in Thailand, near the border between the provinces of Uthai Thani and Kanchanaburi. On the Burmese side of the mountains the vegetation is tropical rain forest, while most of the Thai slope is dry deciduous forest. As a result, the rhinos appear to spend most of the year on the Burmese side, crossing into the Thai side only during the monsoon (May to October). Karen hunters and insurgents have for long dominated this area, without regard to national boundaries or governments, and they have been killing the rhinos to sell for huge profits.

Javan rhinos have also been reported in recent years close to the Malaysian border, in Thailand's Krabi and Trang provinces and, even in the 1980s, from the Malaysian side of the border, according to local press reports. Among the last recorded in Malaya were the specimen shot by Hubback at Teluk Intan in Perak in 1932 for the British Museum (Natural History) and another shot by Arthur Vernay in Perak's Kroh forest, while Milton (1964) said that the last definite shooting in Malaya was at Ulu Bernam, Selangor, in 1937. The last authenticated specimen from Burma was shot in the Tenasserim region by Hubback in 1920. In the face of only tentative evidence to the contrary, R.N. Burton's statement (1951) that the Javan rhino was virtually extinct in Burma, Malaya, and Thailand by 1947 cannot be denied.

In Indonesia, Sumatra lost its Javan rhinos about 50 years ago although they were once common from Aceh in the north to the Lampung district in the south. The history of the Javan rhino is better documented in Java than elsewhere, from the Dutch colonial days of the seventeenth century onwards. In 1662, for example, Albrecht H. Jerpoort sailed along the River Bekasi in western Java and saw rhinos coming down to the river to drink or forage in the vegetation on its banks (Hoogerwerf, 1970). In eighteenth-century Java the rhinos were so numerous and their activities so damaging to agriculture that from 1746 to 1749 the colonial government offered hunters a reward of 25 guilders a head. This proved so expensive that the reward was suspended after three years, but not before 526 of the animals had been destroyed. A bounty was once again offered by the government in 1820 (Sody, 1959).

The animal was still common in western and central Java in the nineteenth century, especially in high or sparsely populated regions, although it was also found in the plains of the southern part of the island until the 1920s. The last rhino in the southern plains of western Java was probably a bull killed in 1934 just south of Tasikmalaya by P.F. Franck, the taxidermist of the Bogor Zoological Museum. The last specimens from the northern plains were recorded in 1910 and 1912. A tame animal from the island of Nusa Kambangan, just off the south coast of central Java, was reported by a coffee-planter called Gelpke who 'had to shoot it' in 1834. The animal had apparently lived there for years and was so tame that it would spend each night close to villages, eating with relish the waste thrown to it when villagers were pounding rice. The islanders regarded this rhino as sacred and called it 'Kerto Dupo', the name of a man who had been killed while collecting edible swifts' nests. It finally had to be killed because of the damage it was doing to coffee plantations, and its head was presented to a museum in what was then Batavia (Jakarta).

The rhinos generally seemed to prefer the western and central parts of the island, and indeed the last surviving population in the world is now concentrated on Java's westernmost tip, in the Ujung Kulon reserve. The explanation for this lies in the eastern end of the island being covered in deciduous forest, while the rhino's favourite habitat is evergreen rain forest. A similar difference in plant cover may account for the Javan rhino's sparse distribution in the Shan states of Burma, northern Thailand, and southern Laos, before it vanished from these regions.

Over much of their former range Javan and Sumatran rhinos' territory overlapped, as both prefer tropical rain forests, yet there are no reports of direct competition, suggesting that they may have occupied different ecological niches. Groves (1967a) explains this by 'the concept of ecological displacement [which] ... implies that where two closely related species are sympatric, their habitats will be segregated, but where one or the other is found alone, it can occupy both preferred habitats.' In Sumatra, for example, the heavier Javan rhino seems to have been restricted to lower, flat areas of soft or even swampy ground, though on its own island it could be found anywhere from sea level to hilly ranges. The Javan species' greatest concentration was always in the west of Java, where the last survivors still live, though formerly they were found in virgin or secondary forest, as well as in relatively open, marshy regions, providing the vegetation was sufficient to offer some shade. In Burma the two species, using the same pools and wallows, apparently preferred mountainous ranges free of human disturbance.

Apart from hunters' accounts in the 1930s (Hazewinkel, 1933, and Franck, 1934 and 1935), the first long-term studies of the Javan rhino were made by Andries Hoogerwerf (1932 to 1957, the accumulated findings published in 1970), and by Rudolph Schenkel and Lotte Schenkel-Hulliger from 1969 onwards. Groves (1967) had earlier distinguished three subspecies of *Rhinoceros sondaicus* by comparing skull and -tooth measurements: one with small teeth, *R. s. sondaicus* from the animal's central range in Indonesia; another with larger teeth, *R. s. annamiticus* (Heude, 1892) from its eastern

range in Indochina; and a third with the largest teeth of all, *R. s. inermis* from its western range, around the Sundarbans, the swampy islands in the Ganges delta. Specimens from Malaya, Vietnam, and Bhutan do not all fit into this classification but as the sole surviving population is in the Ujung Kulon reserve, it seems unlikely that any more data can be gathered to confirm or contradict this theory.

Description

The Javan rhino resembles its Indian relative in size, but it is more lightly built, with a smaller head. Average height at the shoulder is about 160 centimetres and its body length, including a head approximately 70 centimetres long, about 300 to 350 centimetres. Average weight appears to be about 1500 kilograms.

The thick, dark grey skin is divided by deep folds, with those on the neck meeting on top to form a distinctive 'saddle' on the front of the shoulder. This folded skin is one reason for the armoured appearance of both the Javan and the Indian rhinos. Another is the embossed, nodular quality of the Javan species' skin, which resembles a mosaic in relief, though this characteristic cannot always be clearly discerned beneath the spattered mud acquired during wallowing. There is no hair on the skin, barring a sparse fringe around the ears and the bristles at the end of the tail, a feature which helps to distinguish it from the smaller, hairier, Sumatran rhinoceros.

The single horn of the male Javan rhino reaches an average length of 20 centimetres, with the longest on record measuring only 27 centimetres. Females often have no horn at all, or only a very small one, more of a bump than a proper horn. The horn is roughly the same colour as the skin. Hoogerwerf (1970) reported that it may show signs of wear as it is used to help clear thick vegetation blocking the animal's path in the forest. It can sometimes be knocked off with a hard blow, whereupon the wound will bleed profusely, but a new horn will start growing within a year.

The Javan rhino, like the Sumatran, is armed with formidable incisors, much valued by the Javanese for semi-magical and medical purposes. Early accounts failed to record these, largely because the Javanese had already removed these teeth before the skulls reached European anatomists and collectors abroad.

The broad, flat feet bear three toes each, rather larger than those of the Sumatran rhinoceros. Prater (1939) stated that both the Indian and the Javan rhinos have foot glands embedded in the integument of the feet, 'scent glands which the Sumatran rhino does not appear to possess: The Javan's almost circular feet have short toes, compared with the Sumatran's more elongated, almost claw-like ones. This difference suggests that the Sumatran rhino is better adapted to steep slopes requiring a good grip, a theory reinforced by the Sumatran's generally smaller and lighter build. Average measurements of diameter on record for Javan rhino feet are 28 centimetres for the fore feet and 26 centimetres for the hind ones. When tracking it has proved practical to classify fore-foot prints with a 24-centimetre diameter or less as those of an immature animal, those with a larger diameter as belonging to an adult (Amman, 1985). With the dense vegetation and low visibility in the Ujung Kulon reserve, where the last survivors live, coupled with the animal's own natural shyness, identification from spoor is a vital scientific tool, as it is with the Sumatran

rhino. *or and Behaviour*

Ujung Kulon is now the sole habitat relevant to the study of the Javan rhino. Only part of the park is suitable for rhinos, and now they seem to prefer the lower forest zones along the coast, including swamps, to the rolling hills further inland. Thickets of vegetation - rattan, bamboo, and mangrove, among others - make access difficult for humans, but the rhinos apparently find it relatively easy to manoeuvre their way at surprising speed through even the thickest scrub and the roughest terrain. One of the best times to follow rhinos is in the rainy season, when tracks show up very clearly, but the weather, combined with the rhino's agility' and somewhat inaccurate maps, make tracking a daunting prospect.

When moving through hilly districts the Javan rhino, like the Sumatran, often opts for secondary growth areas on the forest margin, where the open tree canopy admits more sunlight, speeding up the regeneration of the shrubs and saplings whose shoots, leaves, twigs, and fruit make up the animal's diet. Equally, the rhino needs deep forest with tall trees as the density protects it against sunlight and ensures a stable water supply, while the tall trees, through their own reproduction, provide saplings to be eaten. The best possible habitat for a Javan rhino therefore seems to be 'a mosaic of glades interspersed with patches of forest,' as Hartmann Amman put it. Ujung Kulon fills this bill perfectly.

The land including the reserve has been deeply influenced, particularly in terms of its vegetation profile, both by man and by the Krakatau volcanic eruption in 1883. Before 1883 it was relatively heavily cultivated by the residents of several villages, and

ja centre for the export of rubber, among other products. Primary forest in the region today is limited to the upper slopes of Gunung Payung mountain (500 metres above sea level, for it is possible that forest regeneration has been inhibited by

a deep layer of volcanic ash over the original cultivated area. The resulting open patches, with small plants and seedlings, are ideal feeding centres for Javan rhinos.

Like the Sumatran rhino, the Javan is a retiring, solitary wanderer, though it does not range quite so far afield, which creates greater concentrations of the Javan species than is usual for the Sumatran. An animal's home range is not permanent, life-long arrangement and may shift according to changing circumstances. A Javan rhino may travel 15 to 20 kilometres in a single day, but it will also restrict itself to a much smaller patch for as long as three weeks at a time, if feeding conditions are attractive. Males occupy larger territories, up to three times those of females, and it seems that the territory of one male may overlap several females'. This obviously makes it easier for the male to breed as often, and with as many females, as possible. While female territories overlap each other quite a lot, male territories do so only a little, at their periphery, since males seem quite intolerant of each other, though Hoogerwerf

has reported instances of two bulls wallowing together. A typical male's territory may extend from 12.5 to 21 square kilometres, while the females are only 2.6 to 13.4 square kilometres (Amman, 1985).

The rhinos make their way along a not always continuous network of trails, often linking wallows and pools or the courses of rivers, in which the animal has been swimming. The Javan rhino seems more likely to take the easier route than its Sumatran cousin, making detours round dense vegetation or steep slopes, another indication of its greater adaptation to lowlands. The animal's well-trodden tracks through thick scrub may turn into low tunnels which are also used by other animals. Banteng (*Bos javanicus*), Javan deer (*Cervus timorensis russa*), and wild boar (*Sus scrofa vittatus* and *S. verrucosa*) inhabit the same forests, as did once the extinct Javan tiger (*Panthera tigris sondaica*). Thomas Horsfield, in his *Zoological Researches In Java* (1824) noticed these beaten tracks: 'Its retreats are covered by deeply excavated passages which it forms along the declivities of mountains and hills'.

The wallows linked by these trails are often hollows filled by rain, situated on low hills or ridges and usually well concealed by vegetation. Most are 6 to 7 metres long by 3 to 5 metres wide. The rhinos seem to prefer fresh water, for few of the wallows

are brackish, though muddy river banks and the margins of tidal forests also seem to be attractive locations. They will wallow on average about every two days, often urinating in the wallow to impregnate it with their scent. They also urinate in streams, apparently stimulated by contact with the water. Rolling in the deep, soft mud beneath the water on the wallow's surface keeps the rhino's skin supple and free of external parasites, such as ticks (*Amblyomma* species) or biting flies (species of Tabanidae and Diptera, among others), besides cooling the animal down. Simple bathing in rivers and pools probably allows fishes and crustaceans to clean off body parasites. Like the African and Sumatran rhinos, the Javan seems to have other helpers to rid itself of body parasites too. Photographer Alain Compost has reported seeing crows on the rhino's back, picking off insects and ticks.

The rhino is most active at night and in the early morning. When it rests, usually around noon, it does not always like down, but usually stands still, dozing, with its head hanging low. Even then it remains alert, the ears flicking constantly.

Communication among the rhinos is mainly olfactory, particularly through urine traces. The odour of rhino urine squirted high on vegetation is noticeable even to human beings. The male animal urinates backwards and upwards as far as two metres in short squirts, while the female does so in a continuous stream between her hind legs. It seems likely that the higher frequency of urine squirting among the males is connected with the assertion, of dominance and the marking of the territory over which a single male may hold sway. As the rhino brushes against vegetation along its trails, it leaves behind urine-scented mud from its wallows. One male may react to the tracks of another by squirting urine as soon as he encounters them. Tracks more than one day old, however, do not stimulate such interest. Females may convey information about what stage of oestrus they are in through their urine although they urinate much less frequently than the males, only about three times a day. Males respond by squirting urine about twice as often as usual when they encounter a female's tracks. Common piles of pungent-smelling faeces deposited by more than one animal at an apparently designated spot, usually beside trail or even in running water, are another olfactory means of communication or advertisement of the rhino's presence.

Vocal communication is rare, though the rhino has been observed to 'neigh' (a high blowing whistle), often on scenting a female; 'bleat' (mostly communication between cow and calf); snort explosively or even shriek when disturbed. It may also indulge in lip vibration while feeding, this being more like comfort behaviour than true communication. The animal's loud roars, probably uttered when wounded or fighting, as well as during the male's rut, have been compared to the trumpeting of elephants.

Rhinos are at their most vulnerable while wallowing and hunters have reported that they will not attack them, though then

may be aggressive at other times, especially if a mating pair or a mother and her calf have been disturbed. The rhino will usually avoid human beings, leaving an area if it repeatedly encounters fresh human scent, but it has been known to make rushing charges at intruder when confronted in the open. Schenkel and Schenkel-Hulliger (1969a) have relayed reports of a pilgrim's being attacked by a rhino in Ujung Kulon during their stay there in 1967-68. He was apparently bitten, knocked over, and bitten again, but they were unable to interview the reportedly seriously injured man. Hoogerwerf was also attacked several times (Hoogerwerf, 1970).

Feeding. Over 190 plant species from 61 families have been identified among the animal's food, 179 of them dicotyledons and only 11 monocotyledons, from rattan and pandanus palms to young bamboos, mangoes, and figs. Contrary to early supposition, there is no evidence that the rhino eats grasses, apart from bamboos. The four principal species eaten, 44 per cent of the total, are *Spondia pinnata*, a herbaceous *Amomum* species, *Leea sambucina*, and *Dillenia excelsa*. Other important plants are the climbers *Uncaria* species (possibly *U. ferrea*), *Poikilospermum suaveolens*, *Merremia vitifolia*, *Mikania cordata*, and *Lantana camara* with *Syzygium polyanthum* (Amman, 1985). The rhino shows a strong preference for several other plants when they are available: *Kleinhovia hospita*, the fig *Ficus variegata*, *Sumbaviopsis albicans*, *Planchonia valida*, a kind of mango *Dracontomelum mangiferum*, wild bananas of various species of *Musa*, *Hibiscus tiliaceus*, *Chisocheton microcarpus*, and *Gossampinus valetoni*.

The animal seems well able to cope with prickly plants too, although it will avoid dense thickets of mature bamboo and rattan, and, like its Sumatran relation, can even digest some species of *Melanorrhoea* of types that often raise blisters on human skin. It rarely eats bark, however, preferring the softer shoots and foliage on the upper parts of trees or shrubs. One observer, seeing the rhino standing knee-deep in the sea, has speculated that it may include mangrove vegetation in its diet, but this remains speculation for the moment. Amman thinks it possible that the rhino favours coastal vegetation as a source of salt in some cases, while Francs (1935) and Schenkel and Schenkel-Hulliger (1969a) have reported the animal drinking brackish or even salt water.

Although feeding rhinos will tear or even uproot branches or saplings, many of the plants treated so roughly manage to recover. The animal uses its neck and head to force down attractive foliage, and sometimes also its horn to twist branches, seizing foliage with its prehensile upper lip. At other times, especially near wallows, it may simply rub its body against trees. Such treatment leaves ample scars on the vegetation to betray the recent passage of browsing rhino.

The rhino constantly changes its food-plants through a very diverse range of choices, eating mainly the highly nutritious young parts. Amman has suggested that this switching habit may be to avoid taking in too much of any one toxin, since young plants are rich in toxic alkaloids and tannins. This constant change would cope with the alkaloids, but different tannins combine to produce a cumulative effect, and the rhino seems to manage this problem by passing high-tannin plants more rapidly through its system than others.

One reason the animal may prefer open-space and secondary vegetation when feeding is that plants in such locations are usually less well defended by toxic chemicals, high fibre, and low nutrition content. In considering the relative ecological niches of the Javan and Sumatran species it should be noted that the bulkier Javan rhino is able to withstand toxins in larger doses than the Sumatran and this, combined with the observation that its feet seem less well adapted to slopes, suggests that the Javan is generally more comfortable in thick lowland forest (where shade-tolerant plants are well protected by toxins) than the Sumatran, which favours hilly areas. Both species, however, choose clearings, often man-made, and areas beneath gaps in the canopy created by fallen trees, where they are available. Indeed, as Groves has warned, their apparent ecological separation of habitat is only a tendency, never a rule.

There has been some discussion of whether or not the banteng (*Bos javanicus*) in Ujung Kulon has been competing with the Javan rhino for the same food resources (Schenkel, 1982). Grazing grounds were cleared specially for the banteng in 1937, and there seems to have been a population boom among them as their number was estimated at 200 in 1971. Amman feels that this has not been a serious problem for the rhinos, as the banteng eat mostly monocotyledonous plants; particularly palms, bamboos, and other grasses, whereas the rhinos prefer dicotyledons, although he warns that more study of the two animals' possibly overlapping ecological niches may be necessary before firm conclusions can be drawn.

Reproduction

Like many other aspects of the rhino's life cycle, its behaviour when mating is little known. Estimates so far suggest that females are sexually mature when five or six years old, males when they are six. The male seems to trace and follow the scent of a female in heat, but it is still not certain how long a mating pair stays together - perhaps only about four days.

Wildlife photographers Dieter and Mary Plage (1985) have described a male spraying urine in the Ujung Kulon forest, his spoor closely followed by a female. Male rhinos have also been seen fighting, for they are generally aggressive during their rut, which is sporadic and does not seem to follow any set season. They appear to indulge in a fairly prolonged courtship of the female, following her from some time and prefacing mating with a fight, accompanied by loud roaring.

Both the period of gestation of the Javan rhino and the length of, time a calf remains with its mother are uncertain, though estimates suggest about 16 months' gestation and a cow-calf companionship of about two years (Plage, 1985). The calf is said to be slow in maturing, staying with its mother until it is nearly adult. Some reports say that a sub-adult may rejoin its mother after some time if she has no other calf, particularly if a later calf has recently died. Although mothers with calves tend to move more slowly in general, cases have been reported of a cow with a calf as young as three months moving 6 to 8 kilometres during 12 to 24 hours.

Rhinos seem to be quite long-lived, with some individuals perhaps reaching 40 years of age. The oldest known in captivity was bought for £65 in Singapore at the age of 18 months and survived at the Adelaide Zoo for 21 years, from 1886 to 1907. Further information on such questions depends entirely on the survival of the Ujung Kulon population.

Hunting and Decline

As Groves (1967a) said of the Sumatran and Javan rhinos: 'A hundred years ago both species (especially the former) were abundant. It seems amazing that thousands were slaughtered, both for sport and for gain, and a mere handful preserved in museums.' As, usual, the reasons for the Javan's sharp decline include the pressure of a rapidly increasing human population - doubled in Java between 1900 and 1950-combined with the depredations of both hunters and poachers.

Attempts to protect the animals in Java began in 1908, when hunting in the state forests was limited to those who had obtained special permission. Even so, the hunters were not closely supervised and A.R.W. Kerkhoven was able to shoot nine rhinos in Ujung Kulon about that time. In 1909 the Javan rhino was declared a

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protected species and in 1910, several other wild mammals were given the same protection, though this had little effect on trapping or hunting, for which special permits were still issued. Fines for illegal hunting, around 100 guilders, and prison sentences of only about eight days, were very light in comparison to the potential profit to be made from a dead rhino.

Perhaps even less forgivable was the macho attitude of many European big-game hunters, who killed more for what they termed sport than for money. This is epitomized in the story of the Belgian hunter from Africa, Baron Robert de Charcourt, who was killed by a rhino he hit in north Sumatra. At the time he already claimed to have killed 299 rhinos in Africa and elsewhere. As Hoogerwerf (1970) repeats the story, first told by W. McAdam Shirley,

He departed for the happy hunting grounds with the ennobling feeling that he had killed 300 rhino, probably almost exclusively in Africa. The report in question, which bears the title 'Death of an Avenger', contains the following: 'Shortly before he died, de Charcourt opened his eyes once more and said with a loud, clear voice to his head boy, "Mark him down, Latiki. He is number 300 ..."' It is only to be regretted that such heroes lived so long.

Right through the 1920s and 1930s, the extent of lalang grass covering burned-off areas within Ujung Kulon gave evidence of the regular intrusions of professional poachers. Schenkel says that 16 rhinos were poached in 1935 and 1936; other reports suggest that another 20 to 25 were taken during 1937, and in 1939 one European hunter took a cow with her calf. The shock of this last outrage, however, did lead to intensified patrolling of the Ujung Kulon area. Ironically, the Japanese occupation stabilized the situation somewhat, as penalties for carrying firearms or ammunition were severe and opportunities for international trade were restricted. Perhaps as many as 42 animals were killed between 1930 and 1970. In a group as small as that at Ujung Kulon, poachers may easily take more animals than can be replaced by natural population increase.

Protection and Conservation

The extinct Javan tiger is credited with saving the rhino from human beings temporarily, if we believe an old story (Plage, 1985). After World War II a poachers' syndicate plotted the extermination of the Ujung Kulon population, but when they entered the reserve one of them was killed by a tiger. Local villagers refused to help the poachers after this, for

they believed that their ancestors' souls lived in tigers and saw the tiger's slaughter of a poacher as a gesture of support for the rhinos. The poachers gave up their project.

Outside Java the rhino received even less protection, and between 1925 and 1930 a former officer of the Royal Netherlands Indies Army, J.C. Hazewinkel, killed 12, both Sumatran and Javan, near Palembang, southern Sumatra; in 1933 he got permission to kill even more. Another set of regulations for the protection of wild animals was brought into force in 1931, attempting to ban the trade in rhinoceros products. These regulations were kept in force after Indonesia gained independence in 1945, but the poaching still did not stop.

The animal's last refuge since 1935 has been the 30,000 hectares of the Ujung Kulon National Park, once a hunter's paradise but declared a nature reserve in 1921. Javan rhinos were known to be present there as far back as 1861. It is a virtual island on the western tip of Java, a peninsula connected to the main island only by a narrow, 1.5-kilometre, isthmus. The reserve was turned into a game sanctuary in 1937, allowing controlled exploitation, partly to raise funds for better protection; the same year saw the first attempts to post guards on the area. After World War II the young nation of Indonesia had other, largely political, concerns to distract it from wildlife conservation issues, and it was also too poor to implement even the measures clearly desired by the authorities.

By 1967 the world population of Javan rhinos was down to only 25, all at Ujung Kulon. Thanks to the concerted efforts of Professor Rudolf Schenkel, Professor R. Geigy, the World Wildlife Fund, and the Indonesian guards, poaching has been virtually eliminated since 1967, except for one case in 1983. In 1977 a management plan was drawn up by an FAO/PHPA team (Blower and van der Zon, 1977), preparatory to the designation of the area as a full national park in 1980, with its boundaries extended to include the Krakatau archipelago.

The Javan rhino can now make the sad claim of being the rarest large mammal on earth and the nearest to extinction of the live rhino species. The peculiar economic and demographic dilemma in which Indonesia finds itself unfortunately makes the long-term survival of the rhino problematic. Should local population pressures or tourism lead to any human intrusion into rhino habitat, the animals are bound to suffer. To quote a warning from Dr Esmond Bradley Martin, 'Tourism development in the absence of stable government and the manpower, will and ability to enforce the law, has led to the rape of several African national parks' To prevent this is imperative as the Javan rhino's tremendous sensitivity to human invasions of its own habitat, which can disturb vital courtship and mating patterns, has been underlined in recent studies.

Current estimates of the Ujung Kulon population range from 30 to 50, not enough to allow the birth of many young. There is no captive-breeding operation under way for no zoo in the world has a Javan rhino today and a single population concentrated in a single location, is, of course, extremely vulnerable to natural disasters, poaching, epidemic diseases, demographic instability, or inbreeding depression. Further, not all members of the group are capable of breeding, nor are the sexes balanced, so the danger of the animal's imminent extinction is obvious. While the total population in 1980 was estimated at 70 (Amman's 1985 slow estimate, which other observers feel may be too optimistic), including 17 per cent juveniles, the sex balance was poor, with 0.64 males to each female. As he saw only four calves born within one year, Amman thought that there might also be too many old females in the Ujung Kulon population, or that mortality among young females' first-born might be abnormally high, though the death of first calves is not in itself unusual.

Studies so far have increased evidence that there may have been a relatively recent vegetation change in the area, a disadvantage to the rhino in terms of its food-plant preferences. Amman found rhinos travelling considerable distances each night in search of suitable food. Possibly linked with this problem is potential competition for resources with a burgeoning banteng population within the same area, although more study is needed to confirm this suspicion. There is also some tentative evidence that the Ujung Kulon area may in any case have reached its maximum carrying capacity for the Javan rhino, with the population stable since 1975. Nothing highlighted the potential threat to this last surviving group more dramatically than the death in 1982 of at least five rhinos. Investigations revealed only that they died suddenly from a still mysterious epidemic disease apparently resembling anthrax and possibly connected with the intrusion of man's domestic animals into wild rhino habitat, although no disease was discovered among the domestic animals tested at

the time.

The number of rhinos actually doubled over the 17-year period up to 1975, through Professor Schenkel's successful joint effort with the Indonesian authorities to improve management and quash the poaching rampant until the late 1960s.

Schnookel had been particularly anxious to raise the guards' morale and did so by means of better pay and medical attention and more regular liaison in the field with their superiors, among other measures. Since 1967 the WWF and the

IUCN have been helping the Indonesian government with the protection of Ujung Kulon, encouraging the provision and training of more guards and the organization of regular scientific expeditions to monitor the number and state of the animals in the reserve. Some of the assistance given has been very basic but very effective, such as the provision of patrol boats and vehicles. The Schenkels found that even new uniforms, shoes, and hats raised the spirits of the guards, significantly improving their effectiveness.

Without the constant presence of patrolling guards, especially along the coasts and the rivers that allow easy access to poachers travelling by boat, this small population will inevitably reach such a low level that natural breeding patterns will be disrupted and the last survivors will perish. In addition to better conditions for guards, therefore, Professor Schenkel has recommended:

- careful monitoring and counting of the rhinos during both the dry and wet seasons;
- drafting a detailed vegetation map of the area, paying special attention to the rhino's food-plants;
- deliberate vegetation management to encourage the growth of the rhino's favourite food-plants in its preferred environment, that is, open unshaded areas with saplings and bushes, sometimes cutting back certain palms and other plants;
- control of the banteng population, but only if further studies prove that it is in competition with the rhino;
- translocation of about 10 rhinos to a second location, perhaps in southern Sumatra, to start a second viable population, a strategy to be embarked upon only when the Ujung Kulon population has recovered from the effects of the 1982 disease and begun to reproduce again.

There is unanimous agreement with these suggestions among conservationists but an alternative, if controversial, amendment to the last point has recently been raised. This is to introduce captive breeding, which will inevitably entail capture from the wild. I favour this second option, based on encouraging results from the current captive-breeding project for the Sumatran rhino. This proposal would involve capture of individuals, probably from the eastern fringes of the Ujung Kulon National Park where poachers and disease are most prevalent, thus leaving the core area's population as undisturbed as possible.

In addition, there is a proposal to set up a Foundation for the Conservation

of the Sumatran and Javan Rhinoceros, under the auspices of the IUCN/ WWF. Its purpose will be to raise funds, educate through effective public forums, finance and train special guards to protect the last viable populations in the wild, and carry out the translocation and/or captivebreeding projects as agreed.

Many ways of dealing with this particularly vulnerable animal cause disagreements among naturalists but the danger is that while the talking goes on, the animal will die.

- Chapter 4/1

Early records

For several hundred years after the German artist, Albrecht Durer, made a drawing of it in 1515, the Indian rhino was *the* rhinoceros, immortalized as a virtual icon for the Western world. Neither other artists' more accurate images, nor subsequent detailed and differing zoological descriptions, nor even the display of eight live rhinos in Europe between 1515 and 1800 succeeded in displacing Durer's powerful impression. The chance that allowed an unusual animal to be drawn by an equally remarkable artist was enough to ensure that the word rhinoceros, unmodified by any adjective, is still often interpreted as referring to the Indian.

There are many earlier references to the Indian rhino, from both its own continent and Europe. Representations of these animals were found on 4000-year-old seals during excavations at Mohenjodaro and Harappa in Pakistan. There is a rock painting of one at a Mesolithic site (between 3000 and 8000 years old) at Bhimbetka, near Bhopal in Madhya Pradesh. A horned animal depicted on the Gate of Ishtar at Babylon, the Mesopotamian citadel settled 3000 years before Christ, might well have been a rhinoceros. Ancient Indian texts, including the Chandogya Upanishad of about 900 BC, also mention the animal.

The rhino appeared in classical accounts too. Late in the fifth century BC, for example, Ctesias, a Greek physician who worked in Persia, described an 'Indian Ass'. This animal had a horn from which poison-detecting cups were made, but otherwise it seems to have resembled a horse more than anything else, albeit one with cloven hooves, a dark red head on a white body, and a boar's tail. The Greek geographer Strabo (63 BC-23 AD) gave a more accurate account of a rhino,

possibly based on an Indian one which a local ruler had presented to the Emperor Augustus in 11 BC. Ptolemy VI Philometer (181-145 BC), of the dynasty which ruled in Egypt, paraded a rhino through Alexandria, his capital, and other Egyptian rulers are known to have kept rhinos in their private menageries, though these are perhaps more likely to have been African individuals.

The Romans knew both the African black rhino and the Indian species, on the evidence of their appearance in mosaics, and they were used in circuses and gladiatorial games. Pliny (23-79 AD), in his *encyclopaedic Natural History*, recorded that a single-horned rhino had been exhibited at Pompey's games in 55 BC. Pliny's tale of the traditional enmity between rhinos and elephants was echoed by many later writers, persisting into the twentieth century and may have some grounds, judging from numerous reports of elephants retreating in panic when faced with a rhino. Pure fantasy was attached to the animal, however, when the Greek writer Oppian (circa 200 AD) said that since no females were ever seen the rhino must be born asexually, perhaps by spontaneous generation from the rocks or the soil. Oppian also stated that the rhino's horn was hard enough to pierce both bronze and rock, and that the animal was endowed with golden hair on its forehead. Indian rhinos continued to be exhibited in the West until the collapse of the Roman Empire in 476 damaged European contacts with oriental countries. w1~

In their native land Indian rhinos were sometimes tamed as pets or used in war. Folk history tells of their acting as live tanks in the front line, with iron tridents fixed to their horns. When the Mongolian warrior Tamerlane marched victorious into

Delhi in 1398, he was ^{greeted by} 12 tame rhinos belonging to the local ruler,

Mohammed Nassan Ed bin, their heads lowered in respect for the conqueror. Just over a century ago the big-game hunter Colonel Pollock told of an Indian *dhobi* or washerman in Assam who kept a tame rhino which would follow him about, carrying his washing on its back. The animal's relative docility in captivity has been confirmed more recently, with the female Joymothi at Basel Zoo frequently allowing her keeper to ride on her back for up to ten minutes at a time. Late nineteenth-century accounts from Assam also tell of domesticated rhinos pulling ploughs or grazing side by side with cattle.

Tamerlane hunted rhinos on the Kashmir border, while the Mogul emperor Babur caught some close to the Kyber Pass in the 1520s. Babur's memoirs, translated by Leyden and Erskine (1920 describe the rhino in northern India (Hindustan) as:

A huge animal. Its bulk is equal to that of three buffaloes. The opinion prevalent in our countries, that a rhinoceros can lift an elephant on its horn, is probably a mistake. It has a single horn over its nose, upwards of a span in length, but I never saw one of two spans. Out of one of the largest of these horns I had a drinking-vessel made, and a dice-box, and about three or four fingers' bulk of it might be left. Its hide is very thick. If it be shot at with a powerful bow, drawn up to the armpit with much force, and if the arrow pierces at all, it enters only three or four fingers' breadth. They say, however, that there are parts of its skin that may be pierced, and the arrows enter deep. On the sides of its two shoulder-blades, and of its two thighs, are folds that hang loose, and appear at a distance like cloth housings dangling over it.

In Europe the rhino gave rise to the legend of the unicorn, with its fondness for virgins. Unicorns, it was believed, would precede other animals at water-holes and dip their poison-detecting horns into the water to test it before the others drank. Not until well into the nineteenth century did discussion of the 'real' unicorn fade a little, though it persists as a favourite symbol, and there are several current theories about the zoological background to the legend.

After the fall of the Roman Empire the long pause in Europe's acquaintance with live rhinos came to an end at last in 1515, when King Manuel I of Portugal received in Lisbon a full-grown animal sent to him from Goa by Albuquerque, the governor of Portuguese India, who had himself received it as a gift from Sultan Muzzafar II of Cambaia (Gujerat). Almost miraculously for a herbivore needing fresh grass, the animal survived the 18-month voyage. This exotic present was sent on to Rome in December of the same year as a gift to Pope Leo X. The rhino, adorned with a gilt chain and a green velvet collar ornamented with gilded flowers, was shipped via Marseilles on a vessel commanded by Captain Juan de Pina. When the French king, Francois I, asked for the animal to be put on display for him at Marseilles, de Pina was happy to oblige for a royal reward of 5000 gold crowns, after which diversion he proceeded on his voyage through the Gulf of Genoa. Here the ship sank in stormy weather. The rhino's carcass drifted ashore and finally reached the Pope as a stuffed specimen. Another ill-fated attempt was made to introduce a Pope to the rhino, in a different form. When Pope Gregory XIV lay on his death-bed in 1590, his physicians tried to treat him with the powdered tip of a rhino horn, but without success. The horn used, still in its original decorative leather cover, was auctioned in 1909 and eventually reached the American Museum of Natural History in New York.

It was on Pope Leo's unfortunate rhino that Durer based his pen-and-ink drawing, now in the British Museum as part of

Sir Hans Sloane's founding collections. Among several oddities, this drawing's most peculiar feature remains the extra - and fictional - little horn, looking rather like a twist of barley sugar on the back of the animal's neck. Some later artists' embroidery on this theme added a third horn, positioned in the middle of the rump. Durer may seem less culpable if it is realized that he never saw the animal alive. All he had to work on was rather vague information from a printer, Valentim Fernandes, and a Portuguese artist's sketch of a dead specimen sent from Lisbon to his studio in Nuremberg. T.H. Clarke (1986) has pointed out that Durer's neighbours were armourers and the artist himself had drawn designs for decorated armour. Small wonder then that the apparently armour-plated rhinoceros appealed to him and that he emphasized this aspect of the animal's appearance.

There was another version of the rhino, drawn at Augsburg in the same year by Hans Burgkmair, a friend of Durer's, which may have used the same sources. This drawing was far more accurate, but never matched the popularity of Durer's. It can be seen today at the Albertina in Vienna, preserved in a single woodcut copy.

. The German inscription accompanying the first edition of the woodcut version of Durer's drawing in 1515 was translated in James Parsons' 1743 description of the rhino:

In the Year 1513 upon the 1. Day of May, there was brought to our King at Lisbon such a living Beast from the East-Indies that is called Rhinocerate: Therefore, on account of its Wonderfulness I thought myself obliged to send you the Representation of it. It bath the Colour of a Toad and is close covered with Scales, in Size like an Elephant, but lower, and is the Elephant's deadly Enemy; it hath on the fore part of its Nose a strong sharp Horn; and when this Beast comes near the Elephant to fight with him, 'he always first whets his Horn upon the Stones; and runs at the Elephant with his Head between his fore Legs; then rips up the Elephant where he hath the thinnest Skin, and so gores him: the Elephant is terribly afraid of the Rhinocerate; for he gores him always, wherever he meets an Elephant; for he is well armed, and is very alert and nimble; This Beast is called Rhinocero, in Greek and Latin; but, in Indian, Gomda.

The rhino was indeed known to many about this time as *a ganda*, the Gujerati name for the animal. Over the next hundred years seven more editions of Durer's print were issued. Copies also began to appear in books, including the first part of Conrad Gesner's *Historia Animalium* (1551), an authority which must have helped to establish this particular version as the standard of its kind.

A second rhinoceros was sent from India to Lisbon about 1580. It fell into the hands of Philip II of Spain, who in 1583 took it back to Madrid. It was illustrated in an Antwerp engraving by Philippe Galle, published in 1586, but this image also remained in the shadow of the dominant Durer rhino. It seems that soon after the Antwerp engraving appeared, the poor animal's horn was amputated and its eyes gouged out because it had overturned a chariot full of princes and nobles. The Hapsburg Emperor Rudolf II, who ruled from 1578 to 1612, was another monarch with a taste for rhino exotica. An inventory begun in 1607 of his cabinet of curiosities includes several rhino horns, plain, carved, or mounted in silver.

The next two Indian rhinos in Europe arrived in London, imported by a group of East India Company merchants. One was described by John Evelyn, the other by James Parsons for the benefit of the Royal Society. When the earlier of these two, a female, was put on show in the middle of October 1684, it was the first rhinoceros seen in England. Evelyn's diary entry for 22 October is full of this 'very wonderful

creature':

Sir William Godolphin and I went to see the Rhinoceros (or Unicorne) being the first that I suppose was ever brought into England: It more resembled a huge enormous Swine, than any other Beast amongst us; ... what was the most wonderful, was the extraordinary bulke and Circumference other body, which though very Young, (they told us as I remember not above 4 yeares old) could not be lesse than 20 foote in compasse: she had a set of most dreadful Teeth, which were extraordinarily broad, and deepe in her throate, she was led by a ring in her nose ... but in my opinion nothing was so extravagant as the Skin of the beast, which hung downe on her hanches, both behind and before to her knees, loose like so much Coach leather, & not adhering at all to the body, which had another skin, so as one might take up this, as one would do a Cloake or horseCloth to a greate depth, it adhering onely at the upper parts; & these lappets of stiffskin, began to be studded with impenetrable Scales, like a Target of Coate of maile, loricated like Armor, much after the manner this Animal is usually depicted. When she lay down, she appeared like a greate Coach overthrowne, for she was much of that bulk, yet would rise as nimbly as ever I saw a horse ... to what stature she may arrive if she live long, I cannot tell, but if she grow proportionable to her present age, she will be a Mountains.

Evelyn's account strongly suggests his familiarity with Durer's rhino, or copies of it. The English rhino survived for another two years, until September 1686. She had no successor until over fifty years later, in 1739, when a young male arrived in the country. James Douglas, a London physician, showed some drawings of this specimen to the Royal Society

in June 1739. After his death in 1742 his assistant, Dr James Parsons, continued his studies, reading a 'Letter ... containing the Natural History of the Rhinoceros' at a meeting of the Royal Society in 1743. This paper was published in the Society's *Philosophical Transactions* the same year, illustrated with engravings of Parsons' own drawings. As a first-hand account from life by a competent zoologist, the description deserves some attention. It began with complaints about earlier information on the rhino:

It was not difficult ... to discern an Uncertainty in the Figures that were exhibited of that animal, because they differed so widely from each other; ... Albert Durer's Figure of this Creature has led several of those Natural Historians, that have Wrote since his Times, into Errors; for such have always copied him; and indeed many have exceeded him in adorning their Figures with Scales, Scallops, and other fictitious Forms. Now, from the Badness of his Figure, I am induced to believe that great Man never saw the Animal; for he certainly could not have been so mistaken in the Performance ... In this Account I have had no Regard to those of other Authors, but have barely described him, as I have often seen him.

Next, Parsons described the animal's behaviour and how it was being managed in captivity:

He was fed here with Rice, Sugar and Hay - of the first, he ate seven Pounds mixed with three of Sugar every day, divided into three Meals; and about a truss of Hay in a week, besides greens of different kinds, which were often brought to him and of which he seemed fonder than of his dry Victuals; and drank large quantities of Water at a time, being then, it seems, two years old. He appeared very peaceable in his Temper, suffering himself to be handled in any Part of his Body; but outrageous when struck or hungry, and pacified in either Case only by Victuals. In his Outrage, he jumps about and springs to an incredible height, driving his Head against the Walls of the Place with great Fury and Quickness, notwithstanding his lumpish Aspects ... In height he did not exceed a young heifer, but was very broad and thick ... I have observed a very particular Quality, ... of listening to any Noise or Rumour in the Street; for though he were eating, sleeping or under the greatest Engagements Nature imposes on him, he stops everything suddenly and lifts up his Head, with great Attention, till the Noise is over.

Parsons' account, published in French and German as well as English, was meticulous, working its way from head to tail, noting features such as the 'very inconsiderable tail' and the thick skin, 'covered all over, more or less, with hard Incrustations like so many Scabs'. Dr Parsons was also the first to suggest that there were at least two species of rhinoceros, one with a single horn and another with two. Such scientific accounts, however, failed to suppress the lively tradition of fanciful ideas about the rhino.

The next Indian individual in Europe, a female, lasted longer than its predecessors, travelling around the continent from 1741 to 1758. The fact that this animal was so well-travelled explains why there are so many pictures of it, by artists as eminent as Jan Wandelaar, a leading scientific draughtsman, Jean-Baptiste Oudry, and Pietro Longhi, as well as lesser ones. The Dutch anatomist Petrus Camper also studied and modelled the animal. The most important of these drawings, zoologically speaking, was Oudry's, for it was copied by Jacques de Seve to illustrate the Comte de Buffon's description of the rhino in volume 11 of his *Histoire naturelle*, published in 1764.

Caught in 1739 as a small baby in Assam and 'tame as a lambe ... like a lap-dog', according to English posters in the 1750s, this rhino was taken to Holland by a Dutch sea captain, Douwe Mout van der Meer, reaching Europe at the age of about three. It seems to have been sustained largely on a curious diet: 27 kilograms of hay and 9 kilograms of bread with 14 buckets of water daily, generously supplemented with beer and wine. At eight years old it was said to be 1.7 metres tall and 3.7 metres long. The animal's skin was kept in good condition by a regular rub-down with fish oil.

The rhino proceeded on a triumphal tour of Europe, described in loving detail by T.H. Clarke (1986). It was borne upon a carriage drawn by 20 horses and escorted, in Vienna at least, by a ceremonial guard of honour. Everywhere it attracted the attention of artists and poets. Casanova recorded in his memoirs that in Paris he visited the rhino, accompanied by his current mistress, who had momentarily mistaken the dark-skinned attendant collecting money at the door for the rhino itself. King Louis XV of France attempted to buy the rhino for his menagerie at Versailles, but was daunted by the owner's asking price of 100,000 crowns. The animal finally died in London in 1758. In Paris in particular there was a sudden explosion of 'rhinocerotica', as anything to do with the beast became all the rage. There were even ladies' coiffures inspired by the animal and beribboned furbelows *a la rhinoceros*.

Rhinos had been used as symbols or decorations in an earlier period - appearing in a bronze relief of 1600 on the west door of the cathedral at Pisa and as a personification of Asia on the title-page of John Parkinson's herbal, *Theatrum Botanicum*, in London in 1640 - but the eighteenth century saw the most enthusiastic use of this exotic motif. There were Meissen figures of rhinos, bronze or porcelain rhinos appeared like heraldic beasts supporting ormolu clocks, and the

animal became a decorative theme on large dishes. The first of these was one from the Duke of Northumberland's 1750; Meissen dinner service with animal pictures, depicting a Durer rhino encircled with a wreath of flowers. A Chelsea copy of this decoration followed five years later. Rhinos also appeared on tapestries and embroideries. An extraordinary man-made hybrid, 'The Rhinoceros of the Sea', sporting a fish-like tail and dorsal horn, is on a hanging from the court of Mary Queen of Scots, dating from about 1580. For those who could not see a live rhino all kinds of replicas were made, for processional floats and wedding parties, among other occasions.

In 1770 the French king, Louis XV, having failed twenty years earlier to buy the Dutch rhino, at last acquired one of his own, from the French settlement of Pondicherry in India. It survived a six-month voyage, accompanied by two butchers used to dealing with carnivores, and was transported overland from Lorient to Versailles in about three weeks, along with six jars of fish oil to moisten its hide. At Versailles the animal was given a comfortable enclosure complete with a shelter and a pool, and there it survived the worst excesses of revolutionary terror until its death in 1793.

This rhino is memorable for the number of water-colours it inspired among the *velins*, or natural history drawings on vellum, commissioned by successive French kings and now kept at the Museum National d'Histoire Naturelle in Paris. Most of the series of almost 40 *velins* of the rhino are the work of Pierre-Joseph Redoute, far better known as a painter of flowers. Another rhino that attracted the attention of a great artist was the male displayed in London at Gilbert Pidcock's Exeter Change menagerie from 1790 until its death in 1793. According to a contemporary account by the Reverend William Bingley:

He exhibited no symptoms of a ferocious propensity, and would even allow himself to be patted on the back or sides by strangers. His docility was equal to that of a tolerably tractable pig. He would obey the order of his keeper to walk across the room and exhibit himself to the numerous spectators who came to visit him. He was very fond of sweet wines, of which he would often drink three or four bottles in the course of a few hours. His voice was not much unlike the bleating of a calf. It was most commonly exerted when the animal observed any person with fruit or other favourite food in his hand, and in such cases it seems to have been the mark of his anxiety to have it given to him. During the severe illness which preceded his death, this noise, but in a more melancholy tone, was almost constantly heard, occasioned doubtless by the agonies he underwent. In the month of October 1792, as this Rhinoceros was one day rising up very suddenly, he slipped the joint of one of his forelegs. This accident brought on an inflammation that about nine months afterwards occasioned his death.

In view of the creature's penchant for alcohol, it is hardly surprising that its life in captivity was short. George Stubbs' portrait of this specimen formed part of the museum assembled by the great anatomist and surgeon, John Hunter, which now belongs to the Royal College of Surgeons in Lincoln's Inn Fields. Among the more illustrious visitors who trooped along to gaze at the strange beast were King George III and Queen Charlotte. After its death this rhino was stuffed and continued to be displayed as part of the menagerie. Pidcock later acquired two more Indian rhinos, an unlucky one which died almost as soon as it arrived in 1799, and another in 1810 which was sold to a buyer elsewhere in Europe four years later.

During the nineteenth century and later, Indian rhinos were exhibited in many zoos in Europe, Asia, and North America, many of them surviving in captivity for long periods: one at London Zoo for 40 years, one at Berlin for 36 years, and, according to Edward Blyth, a pair at the Zoological Gardens at Barrackpore in India for 45 years. The first Indian rhino to be shown in North America made its debut at Peale's museum in New York on 16 October 1826, followed by another in Boston the next year. The animal collector Carl Hagenbeck imported one from Nepal in 1929, while Vincennes Zoo acquired a bull in 1933. By 1960 R.J. Reynolds could record 94 captive specimens, one of which had lived in captivity for 47 years. The London Zoo regent's Park and its country twin at Whipsnade have had the greatest number of Indian rhinos, 15 from the first imported in 1834 to the most recent additions which were at Kathmandu, Nepal, in 1982, and the next at Calcutta Zoo in 1925, a premature baby that died within a few hours.

Distribution

Once this rhino was found right across Indian sub-continent, from Pakistan to northern Burma. The preferred habitat was concentrated on marshes, alluvial plains, grasslands, and forest on the flood plains of the three great rivers, the Indus, the

Ganges, and the Brahmaputra. By late in the nineteenth century this widespread distribution had been whittled down by hunting and the destruction of their habitat to only a handful of sites in Nepal, Bhutan, Assam, and West Bengal, with about three-quarters of the survivors in two national parks, Kaziranga in Assam and Chitawan in Nepal

description

It is understandable that the Indian rhino has always been a favourite with zoos, for it is a good deal larger than the other member of its genus, the Javan rhino. An adult presents an imposing spectacle, standing from 1.6 to 1.9 metres tall at the shoulder, measuring from 3 to almost 4 metres long, and weighing just over 2000 kilograms (males about 1600 kilograms). After the elephant and the African white rhino, it is the world's third largest land mammal.

Males and females alike bear a single horn made of tubules of keratin resembling tightly packed hair. This may be up to 60 centimetres long, although about 30 centimetres is more usual. Those of the males are often broader at the base, and they are more frequently lost, worn down, or broken. The Indian rhino's horn seems to be more firmly fixed than that of its African relative. Both sexes also have tusks - long, pointed incisors - directed more to the side than in the Javan and Sumatran species. Adult males boast more massive heads and more prominent flaps of skin hanging from the neck than the females, with a thick patch of skin on the upper part of the chest. The hide is grey-brown, though pinkish in the skin-folds. While Javan rhinos have three skin-folds around their bodies Indian rhinos have only two, more pronounced in the male than the female. The patterns of the folds and of the raised blisters on the hide, together with distinctive marks like scars, are individual enough to have allowed Andrew Laurie to distinguish each one among the animals

studied from 1972 to 1976 in the 907 square kilometres of the Royal Chitawan National Park, in southern Nepal. Laurie's was the first long-term study (published in 1978 and 1982) of Indian rhinos in the wild.

The armour-plated appearance so often exaggerated by artists arises from the characteristic folding and bumpiness of the animal's thick, hairless skin, which is accentuated with age. In modern wars Germans called their armoured cars *Panzernashorn*, 'armoured rhinos'. Many Asian folk-tales insisted that the rhino was indeed bullet-proof, and during the Indian Mutiny (1857-59) an Indian soldier was court-martialled for shooting a captured tame rhino in an attempt to verify this old wives' tale. None the less, rhino hide did make excellent shields for warriors in several regions of northern India.

On the whole, the animal's eyesight is poor, although Laurie found that some of his subjects in Chitawan could detect movement, even against a dark background, from as far as 80 metres away.

The animal's short, thick legs end in three toes on each foot, the whole foot measuring between 26 and centimetres in width. Beneath the skin on the base of each foot are the pedal glands, apparently used for scent-marking territory. *Habitat and Behaviour*

The Indian rhino's social organization is quite different from other species, one facet being that the animal is not truly territorial, relying chiefly on dominance to establish one individual's superiority over another. Laurie suggests that hippos and rhinos once occupied similar ecological niches in India, as their social organization is very similar. Hippos have died out there, but in Africa their survival may explain why African rhinos do not swim, as water has become the preserve of hippos.

Usually solitary, the Indian rhino can occasionally be found in short-lived temporary groups at wallows or seasonal feeding grounds. It seems generally true that Indian rhinos can be maintained at a higher density, in smaller areas, than other Asian species, though groups usually comprise only sub-adults, not adults. Laurie saw young males touching or lying close to their elders while wallowing, and occasionally being allowed to do so for some time before being chased away. It seems that immature males may be more gregarious than adults or immature females, though still a great deal less so than white African rhinos. Young females may sometimes accompany an older cow and her calf, but the longer time spent by male calves with their mothers or in the company of other sub-adult males has much to do with the heightened vulnerability of young males, which are often attacked by adult males.

Like all rhinos, the Indian has no real predator apart from man and will defend itself very effectively even against a tiger, though tiger predation is a significant factor in the high calf mortality rate of 8.5 per cent per annum described by Laurie, especially if the calf is in its first year of life. Like other species of rhino, the Indian has developed a symbiotic relationship with a bird, in this case the jungle mynah (*Acridotheres tristis*), which not only picks parasites off its back but also acts as a sentry, sounding the alarm when danger approaches. In Assam rhinos have also been seen with cattle egrets (*Bubulcus ibis*) performing a similar function. Among the large mammals which share the Royal Chitawan National Park in Nepal with the rhino are chital or spotted deer (*Axis axis*), hog deer (*A. porcinus*), sambar (*Sus scrofa*), gaur or wild cattle (*Bos gaurus*), tigers (*Panthera tigris*), leopards (*P. pardus*), sloth bears (*Melursus ursinus*), and Gangetic

dolphins (*Platanistagangetica*).

The Indian rhino has always enjoyed a wide-ranging habitat across marshes, alluvial plains, grassland, arid forest on the flood plains of the three great rivers, the Indus, the Ganges, and the Brahmaputra, which they share with elephants and buffaloes. They spend a good deal of their time wallowing in pools, particularly during the hot and rainy monsoon season from June to September. Wallowing lowers the animal's body temperature, wards off biting insects, and *offers* opportunities for socializing with other rhinos. The animals submerge themselves for anything from a few minutes to several hours. After wallowing they rub their heads, necks, flanks, or horns against nearby trees, leaving the vegetation around the wallow coated with mud. More active at night, the rhino tends to stick to established trails which link salt-licks and wallows, together with favoured feeding grounds. Individual ranges are smallest where the vegetation is most mixed, attracting larger numbers of rhinos.

The average size of an adult Indian rhino's range, not necessarily exclusive of other rhinos, is just over three square kilometres, slightly more for a youngster. Laurie, however, found ranges from less than half a square kilometre to nearly nine. Dominant adult males, usually breeding individuals, are particularly likely to establish exclusive territories in the richest habitat. They will roam about in overlapping territories of about six square kilometres each, usually among the most concentrated collection of females. Mature females themselves cover much more ground and may compete for the most attractive settings. Sub-adult males, on the other hand, may be confined to areas less likely to be defended by their dominant elders, though successful mating is not necessarily connected with a claim to exclusive territory.

For communication with its own kind the rhino uses chiefly sound and scent. Most communication seems to be aimed at defence of personal space, maintaining or increasing the distance between individual rhinos.

The Indian rhino's sense of hearing is acute, a useful characteristic in the low visibility of its usual environment of thick forest or tall grassland. An account from Whipsnade Zoo in the 1950s tells of a cow who refused to enter her winter accommodation until a water heater had been cured of a dripping leak which made an irritating sound. Laurie and other field-workers have testified to the difficulty of approaching rhinos without being heard. It seems logical that for an animal with relatively poor eyesight, sound should be a more important means of communication than either visual or tactile signals. Laurie's rhinos showed signs of interest when he played them recordings of their own noises, particularly when these were the sounds of fighting, whether between males or between a male and a female. Male rhinos tended to move in the direction of the sound, seeking its source.

Laurie has categorized ten different types of vocal communication used by the rhino and has also identified individual rhino voices. The Indian rhino has a surprisingly large vocabulary, from aggressive honking to submissive bleats, squeaks, roars, grunts, and rumbles, but, no pronounced alarm call as there is a lack of any real

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predator. The animals may snort when sniffing traces left by other rhinos, and females being courted or mated tend to whistle-pant. Another sound heard by Laurie, possibly a signal, was made by slapping the hind feet against the belly.

Scent-marking of territory takes several forms, one of them being defecation on dung left by other rhinos, a kind of 'bulletin board' on individuals' spacing and reproductive status, in Laurie's words. Marking is also effected by urination, apparently by both sexes, especially what Laurie describes as squirt urination: urine which the animal sprays behind itself, a way typical of breeding males or females in oestrus. When squirting urine, often in response to the sight or scent of another rhino, or disturbance by a human being, the male animal may also rub his head and horn against nearby vegetation, and scrape his feet in the soil, leaving parallel furrows behind. These activities leave clear signs of the rhino's passage through the forest in the shape of broken twigs and disturbed earth, probably visual as well as olfactory signals. Pedal scent glands are also used to mark territory.

Dominant males in neighbouring territories rarely attack each other, but neither are they likely to leave complete strangers alone. It is obvious that fights occur, if only from the old wound scars seen on many males. A male may be dominant in a particular area for only two or three years before being attacked and sometimes ousted by an ambitious newcomer. Aggression displays usually include drawing back the lips to show the tusks, at which point the subordinate

animal may turn and run. Other danger signs are prolonged stares and snorts. If the subordinate male does not run away or submit in some way, the two rhinos may charge each other with lowered heads and lock horns.

Feeding

In their mixed setting of grassland, swamp, and riverine forest Indian rhinos feed by both grazing on grasses and browsing on a mixture of plants from other families, though their teeth identify them primarily as grazers. They are quite happy to alter their diet according to the season, especially the monsoon rains, and the habitat in which they find themselves, a flexibility providing them with a highly diverse diet and greater potential for survival.

This diversity is also consistent with most herbivores' need to avoid toxic build-up from plants with chemical defences, and with the rhino's particular need to maximize its intake of amino acids. As large caecal fermenters, unlike the ruminant ungulates, rhinos can tolerate food of quite low quality providing it is abundant, for they can process the food faster and maintain a steady flow of nutrients. Their body mass means that they require less energy and protein per unit of weight than smaller animals. Laurie's study (1982) lists 183 plant species from 57 families in the rhino's diet, but 70 to 89 per cent, depending on the season, came from 50 species of grasses. In the 1930s the Swedish photographer Bengt Berg reported from Bengal that the rhinos would leave the hillside sal (*Shorea robusta*) forest in the cool evenings to graze on grass shoots growing oil newly burned areas, and this is still the case. They have also been seen to eat the ashes left after fires, probably for their sodium content. Burning is both a natural^s and a man-managed occurrence of very long standing in Chitawan and other areas.

Grasses, although high in fibre and silica, are less toxic than many other plants, thus fitting the rhino's special requirements. Favourites with the Indian rhino are tall grasses abundant in the spring, chiefly the *Saccharum* species *S. spontaneum*, and *S. munja*. Grasses of the genus *Narenga*, such as *N. potphyrocoma*, are also enjoyed. During the monsoon shorter grasses including *Cynodon dactylon* may also be eaten. The animal's most obvious choice, however, is the less abundant *Vetiveria zizanooides*. By 'short grass' Laurie means those as tall as 3 metres, compared with the 'long grass' of up to 8 metres.

The remainder of the animal's diet is made up of leaves or br inches from shrubs or trees of genera such as *Treivia*, *Callicarpa*, and *Litsaea*, sedges and ferns such as *Cyperus*, *Scleria*, and *Pteris*, or aquatic plants such as *Hydrilla verticillata*, *Vallisneria spiralis*, *Pistia stratiotes*, *Commelina* species, and *Caretophyllum demersum*, plus occasional meals of highly nutritive crop plants, especially rice and wheat when available. The rhino's mouth is ingeniously adapted to curl round short grasses, while the animal pushes down the stems of the taller varieties to reach the more succulent tips. It harvests aquatic plants by ducking its head as much as a metre under water, for as long as 45 seconds at a time, for these plants are a useful source of sodium. On average a rhino will spend 45 per cent of its time feeding, often at night, 25 per cent wallowing, meeting other rhinos, or moving about and 30 per cent resting.

Salt-licks on soil or rock surfaces provide the animal with sodium and other minerals, and the water from some rhino wallows has been found to be rich in potassium, calcium, and magnesium, much of it apparently recycled by means of the rhino urinating and defecating in its own wallows. Unlike the elephant, for example, the rhino does not insist on facing upstream when drinking and will frequently drink from urine-contaminated wallows and pools.

Reproduction

Rhino courtship is aggressive and noisy. The process seems much more violent in the Indian rhino than among the other large species, the black or white African. Some zoos, Whipsnade and Chicago among them, have reported irreconcilable hostility between male and female. Females come on heat about every 27 to 32 days, though this may vary considerably with some zoo records noting intervals of anything from 30 to more than 100 days between periods of oestrus. At this time, both sexes will spray urine more frequently than usual, with the bull constantly sniffing the cow's spray and displaying the behaviour known as *flehmen*: curling the lips back while raising the nose in the air to sniff. It follows the scent of his chosen female for several days and kilometres, making what Laurie calls 'squeak-pant' sounds, while the female emits a 'honk-bleat'. She will make determined efforts to repel him.

It has been postulated by Laurie that by evading copulation for some time, simultaneously advertising her availability, the female is maximizing her chances of mating with a strong male, not necessarily the one already in pursuit of her. Females may also follow courting pairs, on the assumption that a male already with a female is likely to be strong and therefore worth mating with. In the Chitawan population, the sex balance was found by Laurie to be over 32 per cent female to 20 per cent male, with 21 per cent sub-adult and almost 27 per cent calves.

The aggressive phase of the male's chase may last an hour and the pair may fight seriously enough to inflict wounds. This

is followed by a more peaceful time when the couple may stand quietly together, the female sniffing at the male's penis. Eventually, and only after several unsuccessful attempts, the male will mount her with some difficulty, usually after the preliminary of resting his head on her rump. Copulation is prolonged, from 30 to 75 minutes, with repeated ejaculation, a characteristic that may well have encouraged the general belief in the supposed aphrodisiac properties of rhino horn. The couple then separates, although in several cases pairs have been observed to stay together for about two days afterwards, during which time they do not copulate again.

~An interestescription of the courtship process, possibly not a typical one, allowing for the potentially distorting factor of captivity, came from Whipsnade Zoo after a 2¹/₂-year-old female from Assam's Kaziranga Game Reserve, Mohini, was introduced to the zoo's resident 9-year-old bull, Mohan, in 1952. She came into oestrus in 1954, at the age of about 4h, Mohan by then being about 11 years old. The two rhinos' encounter in their shared paddock at this stage was described by Whipsnade's Director, E.H. Tong (1958):

The female continually emitted a shrill whistling sound and passed urine at short and frequent intervals. Both animals stood nose to nose, each waving the head up and down for minutes at a time. The male appeared to be somewhat afraid and broke off and ran away, several times until eventually he went into the pond, standing up to his neck in water, and although Mohini came to the edge of the water, she failed to entice him out.

Several more scenes like this ensued, always ending with Mohini in hot pursuit of the whistling and blowing male (perhaps using Laurie's 'whistle-pant'), who regularly retreated to the pond. No mating had been observed by the following year and the male always seemed to reach his peak of excitement only two days after Mohini's being on heat. Oestrus periods appear to last only about 24 hours each time. Adjustment of the rhos' diet from rich clover hay, high in oestrogenic substances that could harm, m4e fertility, to meadow hay, failed to have the required effect. After judicious admix istration of sex hormones to the male, however, pregnancy resulted, gestation being estimated at about 488 days before the birth in October 1957.

Females bear their calves one at a time, the first at about 7 years old, and approximately every three 'years thereafter, producing perhaps eight or nine offspring in a lifetime. Males may become sexually mature at about the same age as females, but in captivity they will not reach their full size until they are about 8 years old, and perhaps much later in the wild. Cows become nervously aggressive just before giving birth, following an average 16- to 17-month pregnancy. Although the Indian rhino will rarely charge a human intruder - and usually veers aside at the last moment even when it does, preferring rapid flight-the human deaths reported from India and Nepal are often the result of a cow with a young calf carrying through a charge.

The Whipsnade female, Mohini, became very restless, making a dismal bleating sound on and off all day' at the time of the birth. She carted her straw bedding from her stable to the open enclosure yard and made clear her antipathy to all humans. As with most rhinos, birth usually takes place in seclusion. Labour is rapid, about 30 minutes, with the mother delivering either standing up or lying down. The mother turns to make nose-to-nose contact with the calf, tearing the umbilical cord. Unlike some other mammals, the cow does not lick her new-born calf, but she does eat the placenta.

There were births in captivity as early as 1826 in Kathmandu and 1925 in Calcutta, but not until 1956 was an Indian rhino bom in Europe, at Basel Zoo, when the female Joymothi gave birth to a male, Rudra. About 40 have been bred in captivity in Europe since then.

The calf struggles to its feet anything from 7 to 30 minutes after birth. During the first couple of days of life Indian rhino calves are noticeably pink-skinned, weighing about 60 to 67 kilograms and standing 61 to 63 centimetres tall, with no horn. The pink colour recedes to the skin-folds after a few days. At Whipsnade Zoo in the 1956s it was also noted that the vulva of a new-born female calf was very prominent, making it easy to sex the animal on^{-sight}. Calves are suckled for over a year, and from observations in captivity they appear to consume about 25 litres of milk a day during the first few months, and manage leaves and hay by the second month. Their weight increases by about 2 kilograms daily, to reach a level of about 620 kilograms by the end of their first year. Mothers may leave their calves for an hour or two at a time while they themselves feed up to 800 metres away.

As they grow the calves are both very playful and very inquisitive, sometimes wandering away from their mothers and risking attacks from tigers and adult male rhinos. When danger threatens both mother and calf, the youngster will run ahead of its mother. Calves have been seen playing, gambolling, nu77ling, and sparring around wallows, sometimes even picking up a stick and shaking their heads, just as domestic puppies do. The cow will also play with her offspring extremely vigorously, even when the calf is still very small. The mother will try to keep herself and the calf away from

other rhinos as much as possible, except at wallows. The calf will stay with its mother for about three years, leaving before another calf is born. If it does not leave in good time, it may be driven away by the mother with some violence about a week before the birth of her new calf. Once they reach the stage of separation from their mothers, young rhinos may stay more or less within the same range, and indeed may seek the company of calves with or without the same mother, until they are driven away to a less attractive area.

Hunting and Decline

While fighting among males has some attritive effect on rhino populations, nothing compares with the depredations of man. Rhino-hunting has probably been going on from time immemorial but it was not until the nineteenth and twentieth centuries that the numbers caught began to have a disastrous effect on the total population. The institution of royal hunting reserves, such as those operating in Nepal until 1950, ironically often acted to protect the rhinos. The ancient kings' arrows made little impact on the population but the development of firearms and the growing scale of nineteenth-century hunting with elephant-borne army officers and local maharajahs competing for the highest totals, had a far more serious effect. The Maharajah of Cooch Behar, for example, shot 207 rhinos in West Bengal and Assam between 1871 and 1907. Many other hunters also contributed to the sharp decline in the rhino population until, in 1910, hunting was at last forbidden in India.

As late as 1896, however, the Bengal government was still paying a bounty of 20 rupees for every rhino shot, although the animal's range had already been reduced to present-day proportions by 1890. When hunting was banned, the Kaziranga area of Assam, a hundred years before the home of the largest Indian rhino population, was left with only about a dozen animals. Tea-planting had contributed to this decline almost as much as hunting. From about 1850 vast areas of Assam were cleared for tea plantations, along with the inevitable accompanying roads, railways, and housing for plantation workers. By the late 1880s, rhinos were restricted to only the plains. Outside India itself, a few individuals could be found in the Nepalese border areas of Bhutan Duars and the Terai forests. Now there are only about 1700 Indian rhinos left in the wild, restricted to eight small protected areas in southern Nepal, West Bengal, and Assam, with about three-quarters of the survivors confined to two national parts, Kaziranga in Assam and Chitawan in Nepal. The species is on the endangered list compiled by the IUCN.

The energy of committed conservationists like the naturalist and forester E.G. Shebbeare and the pioneer photographer Bengt Berg in the 1930s effectively promoted the cause of the rhino, particularly in the sanctuary of Bengal's Jalapara reserve, where there were still 30 to 40 rhinos. In 1959 E.R. Gee, an English tea-planter who had settled in Assam in the late 1920s, assessed the number of rhinos surviving in India as a total of 47 in Bengal and 350 in Assam. His later survey in 1964 yielded figures of 65 for Bengal and 375 for Assam.

Laurie's 1978 census of the animal showed: in Assam Kaziranga, 600; Laokhowa Reserve, less than 50; Orang, 25 to 30; Manas, 40; Sonai Rupai, 15; and elsewhere in the state about 25; in West Bengal - Jaldapara, 30 to 40; Garumara, 5; in Nepal - Chitawan, 270 to 310. Generally, these figures have increased since 1978, when Laurie noted a population growth rate of 2 to 6 per cent a year. Clearly sanctuaries granted to the rhino lead to a gradual population increase but the suitable habitat available for the animal in all these areas combined now amounts to a mere 500 square kilometres.

Protection and Conservation

Kaziranga, together with Manas, was set aside as a forest reserve in 1908, while Chitawan in Nepal became a national park in 1973, after a decade of closely enforced protection in the area. Kaziranga became a game sanctuary in 1916 and was kept closed until 1938. The rhino population there gradually recovered from its lowest point of 12 in 1908 to Laurie's 600 in 1978 and about 1000 in 1985, in a park that now covers 425 square kilometres along a narrow belt never more than 18 kilometres wide, following the Brahmaputra river. This population increase is a dramatic illustration of the effectiveness of vigilant protection.

Kaziranga is still, however, bedevilled by poaching. Four poachers were killed by guards from 1969 to 1978, with several more-wounded in other incidents. The lucrative market for rhino horn is a constant encouragement to poachers for, although Indian rhino horns are smaller than those of African species, it is believed that for this very reason they are all the more powerful. Poaching is at its height in the drier months, though during the monsoon, in July and August, flooding may drive rhinos from Kaziranga to forage for food outside the park proper, among farmers' crops, which can attract illegal hunters. Higher penalties and longer prison sentences are now being imposed on poachers, but while there is a market the temptation will remain. Between 1965 and 1980 Kaziranga lost 85 rhinos to poachers.

Apart from Kaziranga, the other main group of surviving rhinos is in the Royal Chitawan National Park, Nepal. Established in 1973 on 544 square kilometres, it was expanded to a total of 907 square kilometres in 1977, with the

support of the government of Nepal, the United Nations Food and Agriculture Organization, the World Wildlife Fund, and the Fauna and Flora Preservation Society of the United Kingdom. Chitawan, in the Nepali Terai, was for a while protected against human intrusion by the virulence of the malaria encountered there, and by being a hunting ground reserved exclusively for Nepal's hereditary prime ministers, the Ranas, and their royal guests. Poaching offences then carried the death penalty. During the 1937-38 season a typical bag was 38 rhinos and 120 tigers. In those days the lush Chitawan Valley area covered about 2600 square kilometres and the only resident humans were the Tharu people, who had apparently developed a degree of resistance to malaria. But still the rhinos were pushed back to the area immediately around the Narayani, Rapti, and Rau rivers and by 1942 the Nepal government forester E.A. Smythies could report only about 400 animals left, about the same number as Gee found on a 'visit in 1958 even after a massive migration of farmers into the area following the fall of the Ranas and political upheaval in 1951.

By 1961, however, no more than 160 rhinos were left in the Chitawan Valley and a malaria eradication programme increasing human settlement from 1950 to 1960 cleared 70 per cent of the forest and grassland to make room for about 50,000 more people, the population jumping from 36,000 in 1950 to about 100,000 in 1960. Today humans in the Chitawan Valley number about 200,000. Farmers and rhinos are mutually irritating, in that rhinos raid crops, especially rice, and the farmers' grazing stock, for their part, often invade the rhino habitat within the national park, while simultaneously altering the habitat, gradually converting it to scrub.

Poachers killed as many as 60 rhinos in Chitawan during the 1950s and 17 during the 1970s, but there has been no known poaching in Nepal since 1976, when the Royal Nepalese Army took over the role of guarding the newly founded national park. As a result there are now more than 300 rhinos in the park. The tradition that every new king of Nepal is allowed to kill one rhino, in order to exercise his right to bathe in its blood, has much to do with Nepal's very real concern to preserve the rhino.

Outside Kaziranga and Chitawan, the third largest group of Indian rhinos is in the Jaldapara reserve in West Bengal, set up in 1936, becoming chiefly a rhino sanctuary in 1941. It contained between 30 and 40 rhinos in 1978, a little over half the number recorded in 1964. The West Bengal Forest Department says that 37 rhinos were killed illegally between 1967 and 1972 in Jaldapara and the tiny Garumara reserve. By 1980 there were only 24 survivors in Jaldapara and a mere six in Garumara, due to the predation of a single gang of highly organized poachers.

But poaching is not the sum total of the threat to the Indian rhino. The problems of epidemic disease and overcrowding hang over the populations confined to Kaziranga and Chitawan and anthrax is always a frightening possibility as contact with domestic livestock increases because of human intrusion. In 1974 such fears became reality when 15 of the Kaziranga rhinos died of haemorrhagic septicaemia. Another possible threat was mentioned by Laurie: changes in river courses and large-scale erosion could lead to vegetational changes which might harm the rhino's food-plants. There is also evidence of an invasion of exotic plants which could threaten the rhino. The very fact of the animal's being confined to only a few small areas is of course dangerous and at Kaziranga overcrowding is a problem, with some evidence of increased fighting among the rhinos as a result. At Chitawan Laurie has recommended partial translocation to alternative safe havens to counteract these threats, with proper policing if such an exercise is not to prove futile. Laurie also recommended an extension of 73 square kilometres to the Royal Chitawan National Park.

One translocation experiment has already begun in India. In 1981 a special committee, set up by the Indian Board for Wildlife two years earlier, reported on the conservation status of the rhino in India and recommended a trial translocation to Dudhwa National Park, in the Terai zone of northern Uttar Pradesh. The Botanical Survey of India confirmed in 1982 that the food-plants within the 90 square kilometres of the proposed reintroduction area were suitable for Indian rhinos and said the area would support a maximum of about 90 animals. Capture techniques using immobilizing drugs were learned, staff were trained in rhino management at Kaziranga, and 27 square kilometres of Dudhwa were enclosed by a two-stand electric fence, reinforced by a trench beyond the fence at critical points.

In- 1984 the operation swung into action to take 10 rhinos out of an area just outside Pobitara Sanctuary in Assam, where they were damaging crops and becoming difficult to protect. In the event only five were captured, crated and transported to Dudhwa, where they were gradually released into the reintroduction area from individual holding stockades in the field. Another four were brought into the same area from Chitawan. At the latest count seven animals have survived and settled well in the patch contained by the electric fence - one young female and two males from Assam and four young females from Chitawan. This could prove to be the first viable population of rhinos in central northern India since the last century.

Nepal has also recently reintroduced a group of rhinos from Chitawan into Bardia Wildlife Sanctuary in the west of the country.

As early as 1933 Bengt Berg saw the writing on the wall for the Indian rhino:

Many more people are out to slaughter the gigantic beasts than there are beasts to be slain. Their armour does not protect them. Extinction is approaching rapidly. In another hundred years, their stuffed mummies will stand in the museums of the world, next to the skeletons of tyrannosaurus and the titanotherium, and in their guide books the visitors will read about the armourclad beasts which used to inhabit the fevery jungles of India. Should a copy of my book still survive by then, sportsmen and zoologists will look at the pictures and smile about the poor photographer's primitive equipment. But they will also feel a pang of *envy*. Lucky chap! - they will say- to have lived at a time when there were such animals to be stalked with a camera! This is exactly what I myself have always thought of the hunters who, thousands of years ago, painted pictures of mammoths and ice-age rhinoceroses on the walls of their caves.

It would be pleasant indeed if Berg's prophecy were not to be fulfilled within our times, but unfortunately his words still ring with an uncomfortable relevance today.

Chapter 5/1

Early records

The double-horned black rhinoceros from Africa, *Diceros bicornis*, was one of the species known in the Roman world. It was also displayed in a procession of exotic animals in Alexandria, then ruled by Ptolemy II, probably in the earlier part of his reign (283 to 246 BC). By the late first century AD black rhinos were among the animals seen in gladiatorial contests in Rome, where, according to Martial, they were some of the most aggressive fighters, sometimes even impaling bears. So familiar did the black rhino become in the classical world that models of it were made. A small bronze figure of a male, measuring 11.5 centimetres long and 5.6 centimetres high, was recently found in the wreck of a ship dating from the latter half of the second century AD, located at a depth of seven metres in the Mediterranean Sea, off Port Vendres, in the Pyrenees Orientales. This figure, described by D. Coils and others (1985), is quite well preserved and realistic enough to allow firm identification, as it shows the typical pointed muzzle and unequal pair of horns, the front one larger and curved.

After this early appearance -in Europe there was a long hiatus in accounts of the animal, until eighteenth-century travellers in Africa began to publish descriptions of the rhino on its home ground. One of the earliest was in Peter Kolb's book about South Africa. Published first in German in 1719, it was translated into English by George Medley and dedicated to Sir Hans Sloane in 1731 as *The Present State of the Cape of Good Hope*. Kolb lived at the Cape from 1705 to 1715, using the opportunity to collect information about the local flora and fauna, as well as other subjects. Though he may not have seen a black rhinoceros, his description featured several details presumably supplied by those who had:

If he [that is, the rhinoceros] is not provok'd, the attacks not a Man; unless the Man is in a red Coat, for then he attacks him very furiously . He is pretty swift of Foot, but very slow and awkward in turning ... The Rhinoceros is in perpetual Enmity with the Elephant; and whenever he discovers him, makes at him with all his Rage.

Rookmaaker (1981) has described the confusion caused by the first German edition, which illustrated Kolb's account with a version of Durer's Indian rhinoceros. This mistake was corrected in the Dutch edition of 1727, which replaced it with a plate by Jan Vandelaar, a leading Dutch engraver of the period.

Later in the century an increasing number of accounts, including those of Sparrman and Bruce, helped to establish that African rhinoceroses always had two horns, though uncertainty about the native lands of the double-horned and single-horned species persisted, caused in part by the vague locations attached to some of the horns preserved in European cabinets of curiosities. James Parsons (1743) had already suggested the number of horns as a characteristic dividing the species, but not until the comparative studies of the Dutch anatomist Petrus Camper in the 1770s (published in 1780 and 1782) was this division confirmed by an authoritative voice. By the time James Bruce (1790) described his travels in Abyssinia from 1768 to 1773 he was able to say: 'Naturalists seem now in general to be agreed that there are two species of this quadruped, the first having two horns upon his nose, the second one ... That with one horn is thought to be exclusively an inhabitant of Asia, that with two horns to be only found in Africa.'

Another traveller, further south, was Anders Sparrman, one of Linnaeus' students, who explored the Cape from 1772 to 1776. His journal of December 1775, published in English in a translation by Georg Forster ten years later, with a second edition the following year, recorded his satisfaction at being able to look at a rhinoceros, an animal which 'excepting the horns, has been absolutely unknown ... What a feast the sight and examination of this creature must have been to a naturalist.' This specimen had been killed by Hottentots.

The black rhino has in quite recent times rapidly declined in the wild, but is flourishing and breeding well in captivity. R.

J. Reynolds (1963) has described its history in captivity, listing a total of over 275 examples and 22 captive births between 1941 and 1963. A census of black rhinos in captivity was also made in 1962 by the Zoological Society of London and published in the 1963 *Into-national Zoo Yearbook*.

After its first appearance in Europe, in Rome in the first and second centuries AD, there was a long interval until 1868, when a Young male captured by Arabs in the Sudan was bought first by a collector in Vienna and then for £800 by the Carl Hagenbeck, the animal dealer from Hamburg, who resold it for £1000 to the Zoological Society of London, making a very small profit which did not please him, particularly as he received only 50 per cent of the payment in cash, the remainder being paid in kind, in the form of other animals. The young rhino arrived at Regent's Park Zoo on 11 September 1868, the first captive rhino in modern times, and survived there until 1891.

Hagenbeck wrote of this rhino:

I remember this rhinoceros well, for he came near to doing me a nasty injury. He was quite a young animal and stood only about 32 inches at the shoulder, but nevertheless he blossomed out one day into a veritable athlete, a fact which I remember the more because he challenged me to a match, in which no doubt I should have come off second best had I not thought discretion the better part of valour. On the journey from Trieste to Vienna, I travelled in the same compartment with the young rhinoceros, for thinking him to be very especial treasure, I wished to take charge of him personally. I was dozing comfortably in a corner. when I was suddenly awakened by a pull and saw that the young rhinoceros had the tail of my coat in his mouth and was cheerfully sucking away at it. The animal appeared to find the flavour pleasant but the operation not being precisely beneficial to my garment, I endeavoured, with all due politeness, to free the coat from the young herbivore's jaws. The brute, however, was not disposed to submit to this privation; he flew suddenly into a terrific rage, gave a shrill cry of anger and assaulted me with fury. I fully admit that I was not over-anxious for a duel with the little monster and indeed I found the situation far from pleasant. With quite remarkable agility I leaped over boxes and sacks to escape from the formidable onset' and in so doing I upset a sack weighing about 150 lb. which rolled into the rhinoceros' stall; and the animal, possibly mistaking the harmless sack for his enemy, hurled it into the air as though it had been an indiarubber ball.

Hagenbeck was the leading importer in the early part of this century but his records were destroyed in the Second World War, so precise details cannot easily be reconstructed, though his book *Beasts and Men (1910)* includes some interesting notes on the animal. He reported that the rhinos were easily tamed when young and would follow their keepers 'like dogs'. If the keeper hid from them, the young animal would run around uttering plaintive cries, looking for him. During the 1870s Hagenbeck imported several more black rhinos, some of which went on tour with his so-called 'Nubian Caravans' of exotic animals. A female called Molly, which he had with him in Berlin, in 1870, was bought by the local zoo, where it lived until some time between 1884 and 1887. In 1888 one of Hagenbeck's caravans visited Berlin again, this time with three tame young black rhinos. Hagenbeck was also the first to exhibit black rhinos in Frankfurt. In 1881 another black rhino was displayed at the Hamburg Zoological Garden (now no longer in existence), but apparently it survived for only a year. Among other European zoos to acquire black rhinos early were Breslau in Germany (now Wroclaw in Poland) in 1888 and the Jardine des Plantes in Paris in 1881.

America was not far behind Europe. In 1872 P. T. Barnum advertised a 'Monster Black Rhinoceros' as a feature of his 'Great Travelling Exposition', and this or another black rhino was with the Barnum Circus in 1886. His example was soon followed by other circuses and by New York's Central Park Zoo which acquired a black rhino in 1886. The American showman Montgomery Queen acquired a rhino in 1877, advertising it in a Los Angeles newspaper thus: 'Among the strange animals and most unusual to be exhibited' will be a two-horned rhinoceros, the eighth wonder of the animal world. The only animal of its kind ever exhibited on the Pacific Coast. This horned horse will be the first ever seen in California.' The animal was later auctioned and sold to the Sells Brothers' Circus in 1878.

W. W. Cole's Circus took a black rhino from America to Australia and New Zealand in 1880, the same individual that was finally acquired by the Central Park Zoo in 1886, after the Commissioners of New York City had paid 4200 dollars for it. It lived there till at least 1906. The first black rhino resident in an Australian zoo lived at Melbourne from 1914 to 1916. The Giza Zoo in Cairo was the first to exhibit the black rhino on its native continent, in 1910, while the Ueno Zoo in Tokyo showed the first in Asia in the early 1930s, a specimen probably bought from the Hagenbeck Circus touring Japan in 1933. T&A, first resident rhino in South America was the male that arrived at the Zoological Gardens of Buenos Aires, in January 1938.

Since the Second World War more and more black rhinos have been brought into captivity. Hagenbeck's firm brought in 6 in 1954 alone, and a total of 12 between 1945 and 1959, but none thereafter, while another major importer, also German, L. Ruhe of Hanover, handled no fewer than 35 animals between 1945 and 1963. Although they do not live as

long as Indian rhinos, a record of 34 years in captivity is held by a male kept at Johannesburg's Municipal Zoological Gardens, where it died in 1948. In all, over 300 captives have been recorded, of which perhaps half are still alive.

The first black rhinos born and bred in captivity appeared at Chicago Zoo in 1941 and 1944, followed by over 30 more in various zoos in North and South America, Australia, and Europe.

Reynolds (1963) has also chronicled the adventures of two film-star female black rhinos, one of which, Mary, was bought by Metro-Goldwyn-Mayer from the Hagenbecks. Mary worked during the winter of 1933-34 on a film called *Tarzan and his Mate*. 'She was taught to lie down, roll over and permit Tarzan to ride her during a "charge" sequence where she was "stabbed to death" by the hero. This was a remarkably tractable rhino,' as Reynolds says. Yet poor Mary died in 1933, as the result of wounds inflicted with a pitchfork by a disgruntled employee of the Ringling Brothers Barnum and Bailey Circus, which had bought her the year before. The other film-star rhino, also female, was Molly, owned by a private collector, Tony Diano of Ohio. She starred in *The Snows of Kilimanjaro* in the early 1950s, and died in 1960 while travelling with the Cristiani Brothers' Circus in Illinois.

One rhino, Cacareco, born in Rio de Janeiro in 1954, almost took political office while on loan to the Sao Paulo Zoo for its opening in 1958. During that town's municipal council elections in 1959 Cacareco, by then a very popular attraction, received almost 100,000 write-in votes to lead all the candidates, an achievement attributed to a popular protest against politicians and prevailing local conditions. Cacareco acted once again as an emissary of goodwill when she was sent to Porto Alegre for the official opening of the zoo there in 1962, but within a month she was flown back because of the cold weather, and died at the end of the same year. *Distribution*

The black rhino's varied diet may explain its wide former distribution, as it was once found in large numbers from Ethiopia and Somalia all the way south to the Cape. living in areas of bush or scrub between open grassland and rain forest. In the early part of the nineteenth century there may have been as many as a million individuals, about four times as many as the larger white rhino, though one or the other, and sometimes both, occurred almost everywhere in Africa south of the Sahara, except in the rain forests. In Tanganyika in 1856 Richard Burton (1860) found that 'The black rhinoceros with a double horn is as common as the elephant.' That was not true for long, as explorers and colonists joined the indigenous hunters, using ever more efficient weapons to increase the slaughter.

The black rhino is both smaller and darker in colour than the so-called 'white' species. Its skin varies from yellowish grey to dull brown or black and is almost hairless, except for the edges of the rounded ears and the tip of the tail. It also lacks

the prominent skin-folds of the Asian species. Its average height at the shoulder is 1.65 metres, while its weight is between 1000 and 1500 kilograms. The length of its head and body is between 300 and 375 centimetres, with the tail, flattened at its tip, adding about another 70 centimetres. William Burchell, who saw his first in southern Africa in 1812, described it in his journal of 8 March (published in 1822): 'The first view of this beast, suggested the idea of an enormous hog, to which, besides in its general form, it bears some outward resemblance in the shape of its skull, the smallness of its eyes, and the proportionate size-of its ears; but in its shapeless clumsy legs and feet, it more resembles the hippopotamus and elephant.' C. P. Groves (1967h) has distinguished seven subspecies of *Dicerops bicornis*, using their size and geographical location to separate them. The largest, formerly inhabiting the Cape region, appears to be extinct: smaller, *D. l. somaliensis*, was found in northern Kenya and Somaliland, and a small, high-legged one, *D. b. occidentalis*, in southwestern Africa. These latter two may still be found. There are also a few other distinct groups, such as *D. b. michaeli*, originally from Kenya, now also translocated in South Africa's Addo Elephant National Park, and *D. b. minor* in the Natal region of South Africa. Other genetic oddities have also been noted, such as abnormally long horns and a strain devoid of external ears, both found in the Amboseli black rhinos of East Africa.

The twin horns vary a great deal in size and shape, though the front is usually the larger. Extra horns have also been recorded in this species, and Groves (1971) says they are common. The bases of the horns are broad and the horns themselves are sometimes very thick, though females generally bear longer, more slender horns. The longest anterior horn on record, measuring 136 centimetres, came from a female shot in Kenya, but the average length is only about 50 centimetres. The record for the longest posterior horn is 53.5 centimetres, with the average once again much less. *Habitat and Behaviour*

The Schenkels (1969b) observed no clear territories associated with particular animals, though a system of distinctive, well-defined tracks and trails, mostly stripped of their vegetation, is used by the rhinos. They estimated that, in their study population of about 120 individuals, the population density was about one rhino per 1.7 square kilometres.

Rhino trails are often shared by elephants living in the same area and there is evidence of interdependence between elephants and rhinos, even though they seem to avoid each other where possible. In many cases the elephants are actively

responsible for maintaining the rhinos' trails and for digging water-holes which the rhinos also use, particularly during serious droughts. The elephants also break down taller vegetation, bringing it within feeding reach of the rhinos, although there is an overlap of feeding preferences which is disadvantageous, for some elephant-engineered destruction of plants definitely harms the rhinos' feeding areas. The Schenkels noted that in large parts of Tsavo National Park the rhinos' favourite *Commiphora* and other bush vegetation had been converted into thin grass cover by elephants. This competitive element perhaps throws new light on Pliny's first century AD opinion, that the rhino and the elephant were sworn enemies. The Abbe Ladvocat, an eighteenth-century librarian of the Sorbonne, elaborated on this theme, writing in 1749: 'They find themselves at war because both animals are of gluttonous habits and grudge each other the grazing. The elephant, crafty and subtle as he is, sometimes manages to elude the rhinoceros' onslaught, tires that animal out with his trunk and hacks it to pieces with his teeth.'

Observers closer to our own time think there may be more than a grain of truth in this. Philip Keller, in *Africa's Wild Glory* (1959), describes an incident where elephants seemed to harass rhinos simply for fun. An old rhino enjoying a dust bath was slowly encircled by four young bull elephants, causing the rhino to snort his protest. The elephants then began, apparently quite deliberately, to kick up the dust in unison, squirting some of it over the rhino with their trunks until finally he rose amid a suffocating cloud and ran away. Shortly afterwards the elephants moved off and, says Keller, 'The way the elephants dangled their tails back and forth as they minced away, convinced me that they had enjoyed the prank immensely and were only laughing up their trunks at the truculent old sobersides.'

Bradley Martin has told of a rather more dramatic elephant-rhino encounter, in 1979 at the Ark Lodge in the Aberdare National Park in Kenya. In this case 16 elephants approached a water-hole to drink but, noticing a rhino already there, gave chase first. A mother rhino then arrived with her calf, who proceeded to play with one of the young elephants, thus annoying the mother elephant who picked up the rhino calf, threw it into the forest, and would have impaled it on her tusks had not the mother rhino charged to distract her. The rhino calf escaped, but when the original male rhino first found drinking at the water-hole returned, the elephant calf, by now thoroughly enraged, charged him and "tossed him into the air, finishing him off by kneeling on him and thrusting one of her tusks through his body."

Competition with elephants becomes serious only when it is combined with other factors such as fire and general food scarcity. It is not known how well the black rhino could survive in open grassland if it were forced to try, although in Tanzania's Serengeti and Ngorongoro Crater areas it is often seen out in the open, feeding on almost ground-level herbs.

Trails follow the contours of the land very closely, cutting through valleys and gaps and across convenient plateaux or ridges whenever possible. Rhinos will walk steadily along such main trails in search of food or water, singly or in single-file pairs, sometimes with their noses down sniffing scents on the track, at a speed of 3 to 5 kilometres an hour, for about half an hour or so before they slow down to feed casually along the way. Feeding areas are frequently as far as 20 kilometres away from water. According to work done by the Schenkels (1969b) trails can be sub-divided into various categories - main trails, moving-feeding trails, feeding trails, and so on which are used both day and night. While feeding and moving on, rhino's tails almost rotate, flicking each side of the rump in turn. When they rest they do so either lying down or standing up with lowered heads, dozing for up to an hour at a time. They have been observed rubbing their heads or horns up and down tree stumps, occasionally as a scent-making mechanism, but largely as an automatic ritual, possibly preceding feeding.

Many large mammals inhabit rhinos' preferred habitat, together with a number of small birds, like cattle egrets (*Bubulcus ibis*), fork-tailed drongos (*Dicrurus adsimilis*), and red-billed oxpeckers (*Buphagus erythrorhynchus*) who have a particularly close association with rhinos. The difference between rhino-egret and rhino-oxpecker relationships should be emphasized, the one between the rhino and the oxpecker being much the more intimate. Egrets catch insects disturbed when the animal walks, never picking insects directly off the rhino's body. The oxpecker, however, climbs all over the rhino's body, even entering the ears and nostrils. Its insistent alarm chirrup, ascending to a screech, is often useful to the rhino, who is handicapped by poor sight. The fork-tailed drongo's association is more casual - it sits not on the rhino itself, but on nearby twigs, feeding on insects attracted to the rhino, but not leaving its own range to accompany the animal on its journeys. Although often seen in loose association with zebras, onyx, buffaloes, and other ungulates, the relationship is not completely harmonious, with the rhinos making occasional mock attacks.

Rhino trails often link wallowing places, though if muddy wallows have dried up, as happens in an area like Tsavo, dry soil, often the dust from termite hills, is used as a substitute, and sometimes dust and mud baths are combined. Only places with a solid base and a relatively shallow sheet of mud and water are suitable for wallows, which may be shared by as many as four rhinos at the same time, with the settled rhinos rising each time a new arrival enters. Unless they are already together on arrival, rhinos wallow at least two metres apart. They may stay sleeping in their wallow for hours at a

time if the sun is particularly hot. Long baths are probably aimed at cooling the body as rhinos have no sweat glands and the body temperatures must therefore be reduced by evaporation and other exterior coolants - shade, gusts of wind, water, etcetera. Wallowing of course also conditions the animal's hide and protects it against ectoparasites such as biting flies (*Rhinomusca brucci*, *Lyperosia* species, *Tabanus* species, and *Glossina pallipidcs*, identified by Parsons and Sheldrick, 1964).

The Schenkels noted that a sick rhino often has shiny black patches on its body, and concluded that these are characteristic of rhinos which have not been able to wallow for some time. They are caused by the activity of blood-sucking and biting flies which attack the skin once it is unprotected by mud or dust. Several observers have noticed that rhinos, and the black rhino in particular, are often covered in small wounds and sores, which attract insects, including the parasitic bot-fly, whose larvae can penetrate the intestinal tract and attach themselves to the wall of the stomach. Africans long thought that these sores were caused by oxpecker birds, calling them *dundo*, but recent research in South and East Africa has revealed that the sores are infested with minute microfilaria worms, now identified as a new, sixth, species of *Stephanofilaria*, *S. dinniki*. They are probably transmitted to the black rhino by biting flies, but it is not clear whether they are opportunistic invaders of wounds already received - in sexual fighting, for example - or actually the cause of the festering lesions so common on the rhino's hide.

A wallow lasts only a few months before it is abandoned in favour of a new one, probably because of winds blowing away the fine soil, or rains washing it off during the wet season. The animal usually seems to visit the wallow after its morning feeding session, or *en route* to a source of water. Mothers have been seen to suckle their calves in wallows and mating has also been observed there.

Heaps of droppings are often found near tracks or watering places, for these rhinos defecate in particular patches of their home ranges, adding to mounds that may have been established by others. Defecating mothers, by their example, may directly stimulate their young to defecate at the same place and time. Rhino dung is easily identified not only by its smell but also by the short piece of de-barked twigs, about one to three centimetres long, found in it. The Schenkels and others have described the way black rhinos often scrape or scatter their droppings with their hind feet. The true function of this scraping behaviour is not fully understood, but it seems to be a combination of mere display with a certain amount of scent-marking. Another kind of scent-marking is done by the males spraying urine backwards onto bushes and shrubs, especially when others are about. When the urine dries it leaves white spots on the vegetation. Females usually urinate in a continuous pulsating stream but squirt frequently and in small quantities when they are on heat. In so solitary an animal communication is obviously important, and this is done chiefly by scent-marking, through dung or urine. The male's behaviour when urinating can be quite complex and generally ritualized. The Schenkels reported an elaborate bull ceremony comprising a step-by-step ritual of sniffing, snorting, rubbing of the nose and mouth on shrubs, horn beating on vegetation, urinating on plants, and scrape-kicking backwards. This was observed in bulls which were quite alone at the time and only very occasionally as a social display in the presence of cows. So far the classification of this ceremony as simple sexual or dominance display, or perhaps mere scentmarking, can only be speculative.

Generally only females desperate to protect a calf or unusually self-confident bull will attack. It is human scent above all that alarms the rhino. When confronted only with this scent, the rhino will check the air with its nostrils wide open and its upper lip appearing extremely wrinkled, in a way similar to the *flehmen* behaviour noticed in several rhino species. If truly alarmed, as when it smells man 800 metres or kilometre away, the rhino will flee, but only after snorting and making demonstration forward rush for 5 to 10 metres ('blind defensive aggression', as the Schenkels have called it). 'A rhino's world is first and foremost a world of innumerable odours,' says Guggisberg (1966). 'I have seen one of these animals: standing for a quarter of an hour intently sniffing the breeze that blew from where about 300 yards away, 12 lions were devouring a zebra.'

The black rhino is reputed to be the most aggressive of all rhinos. The Schenkels think this characteristic may have been over-emphasized, but the ability of the animals to charge at speeds of up to 50 miles an hour surely explains their reputation even if it has been enhanced by the stories told by hunters. Black rhinos run with their heads and tails raised, adding to the powerful effect. Early explorers' tales are replete with stories of horrifying black rhino charges. One of them was directed at the trekking wagon of the nineteenth-century British explorer and missionary, David Livingstone. Captain C. H. Stigand (1909) was unfortunate enough to get upwind of two rhinos while on safari in Africa:

The next moment a great behorned head burst out of the grass a yard or two from me. I had not time to think, but just shoved my Mannlicher in his face and pulled the trigger. He swerved, but I do not know what became of him after that, as at the same moment, I became aware of the second one bearing down on me from my left. There was not time to reload, so I tried to jump out of his path, with the usual result in thick stuff, that one tripped up. He kicked me in passing,

and then, with a celerity surprising in so ponderous a creature, he whipped round, and the next moment I felt myself soaring up skywards. I must have gone some height, as my men on the elephant track said that they saw me over the grass which was 10 or 12 feet high ... Anyhow, I fell heavily on my shoulder blades ... On looking up, I saw the wrinkled stern of the rhino disappear in the grass, at which I said to myself, 'hurrah!'

James Bruce (1790), said, 'His fierceness may be conquered, and he is brought to be quiet enough,' and records of captivity suggest that young rhinos can easily be tamed and rendered quite gentle. Yet adult black rhinos certainly appear more aggressive than whites. Guggisberg feels that, although the black rhino may seem unpredictable at times, its behaviour is in fact quite logical: most charges provoked by the animal being suddenly startled or taken unawares, or having already experienced harassment by human beings. And, he says, 'A sexually excited bull may possibly take the dark mass of an approaching car for a rival and go for it.' Although the Schenkels would be the first to confirm that the black rhino is rarely dangerous to man if unprovoked, their own account of one attack makes fascinating reading and underlines the significance of human scent to the rhino:

When at a distance of 40 to 50 metres, the bull was alarmed by oxpeckers and could obviously see the-disturber as a moving silhouette against the evening sky. He charged at full speed. The author ran/

towards him shouting, hoping that

the rhino would be frightened. But this did not happen, so he avoided the bull by swerving, passed him, and made for a small tree 20 to 30 metres further away. The rhino turned immediately and despite the fact that human scent had now reached him, chased the author. After a chase which led several times around the small tree ... the author finally tried to climb into the branches. But he was reached and thrown up by the rhino. He fell first on the rhino's shoulders then onto the ground and hid under the broken-down and dead tree-top. But the rhino pushed away this part of the tree ... The author, lacking any protection, remained lying on one side with one leg lifted, intending if necessary to push himself off the rhino's nose. The rhino indeed approached until his nose touched the author's foot, then made another small step forward while the author gave way by flexing his leg. Then suddenly the bull lifted head and tail and trotted off in zigzag flight. Obviously, when optical stimulation by the running human figure ceased, the olfactory stimulation became effective and caused flight in the way traditional to the rhino of this region.

The animal is largely indifferent to vehicles if they do not approach too rapidly or noisily, or alternatively it may be curious enough to chase them. Reaction to lowflying aircraft may vary from indifference through flight to threatening behaviour similar to the aggressive holding of ground seen when encountering elephants.

Feeding

Neither of the African rhinos has incisor or canine teeth, in contrast to the Asian species, and both use their lips to take food. The black has a triangular upper lip with a prehensile tip well suited to collecting shrubby twigs, for the animal is a browser, eating a wide variety of shrubs and herbs. As Bruce reported in 1790: 'The rhinoceros does not eat hay or grass, but lives entirely upon trees; he does not spare the most thorny ones ... For the purpose of gaining the highest branches of these, his upper lip is capable of being lengthened out so as to increase his power of laying hold.'

Shrubs and trees browsed on by the black rhino often show a clipped 'brush pattern' quite unlike anything caused by other animals, according to Schenkel and Schenkel-Hulliger (1969b), who studied the rhinos in Tsavo National Park in Kenya between 1963 and 1966. Twigs or stems are seized with the upper lip, pulled and bent, then neatly cut off by the premolars and chewed, producing a grinding noise audible at a distance of 30 to 40 metres. Lateral branches are sometimes cut more closely than those in the centre of a plant: When new shoots grow from the older branches, they are again cropped back, and the rhino trims the plant more or less evenly to a level between 10 Centimetres and a metre high.

Guggisberg (1966) insists that the black rhino eats exceptionally thorny vegetation and suggests that the rapid spread of the plant pest called whistling thorn over vast areas of Africa in recent years is probably the result of the partial extermination of the black rhino. Although several observers have disagreed with him, Guggisberg maintains that the rhino will eat 'thorns so hard and pointed that they can be used as gramophone needles,' and adds that they 'are also very fond of *Euphorbia* trees, despite the disagreeable milky latex these plants contain'.

The Schenkels' study listed the rhinos' preferred food-plants in the Tsavo area: plants from the family *Amaranthaceae* such as the herb *Aerva persica* and shrubs of *Sericocomopsis* species, shrubs from the family *Boraginaceae* such as *Cordia* species and *Ehretia taitensis*, the bush *Bauhinia taitensis* (*Caesalpiniaceae*), a woody herb *Blepharia* (*Acanthaceae*), the shrubs *Caucanthus albidus* (*Malpighiaceae*) and *Suaeda monoica* (*Chenopodiaceae*). Also attractive

to the rhinos are the woody climber (*Secamone stenophylla* (Asclepiadaceae), the trees *Acacia tortilis* (Mimosaceae) and *Commiphora* species, (Burseraceae), the herbs *Becium* species (Labiatae) and *Crotalaria* species (Papilionaceae), the woody herbs *Cola vera* (Sterculiaceae) and *Indigofera vohemarensis* (Papilionaceae), and the shrubs *Caesalpinia trothac* (Caesalpinaceae), *Grewia lilacine* and *G. villosa* (Tilicaceae), and *Dirichletia glaucescens* (Rubiaceae). With such diverse food preferences, the rhino clearly needs a habitat rich in thick and varied bush vegetation, which can also offer shelter from the blazing sun and a hiding-place from hunters.

The water supply is also crucial. A former Kenya game warden, Blainey Percival, has pointed out that in times of drought, rhinos are quite adept at digging for water, using their fore feet and throwing out the sand between their hind legs, just like a dog. They can excavate holes up to half a metre deep in dry river beds, at the bottom of which water soon begins to collect. Mothers and calves have an average watering cycle of about four days, up to six days as the young mature, nomadically changing their chosen water-hole from time to time. A rhino will approach the water with caution, standing motionless for some seconds before drinking, and will leave in the same manner, probably checking for potential danger. Sometimes the animal stands in the water, rather than merely drinking from the edge. A water-hole may become a place of assembly for many rhinos from a very large surrounding area, and as such, it serves a distinct social function for an otherwise largely solitary species.

Salt is as important to the black rhino as to all other rhino species. At Tsavo the Schenkels found the soil well supplied with salt and there did not seem to be any examples of special salt-licks dug out by generations of rhinos, as has been reported by other researchers (Ritchie, 1963; Spillage, 1960).

Reproduction

Bulls and cows sometimes associate for brief periods regardless of whether they are mating, although an over-confident approach by the bull will result in his being chased off by the cow, puffing rhythmically as she runs after him.

Most social behaviour is observed in connection with mating associations and the time of two to three years that a calf spends with its mother, but the animals are not markedly intolerant of one another. Bulls have even been seen in pairs from time to time, and hostile encounters frequently consist of no more than weak chases culminating in one bull prodding the other's hind quarters with his horn. Usually, however, one of the bulls quickly concedes defeat and the winner will walk away without causing his adversary any further harm. There is also some pre-mating conflict between bull and cow, but is rarely serious.

In Amboseli Game Reserve, also in Kenya, bulls and cows are forced into closer proximity and probably know each other as individuals, possibly sleeping close to each other. There nose-to-nose touching, has been observed, but never at Tsavo, where the Schenkels did their study. Females are usually sexually mature at about five years old, and, according to the Schenkels, more likely to come on heat during March and April. Bulls always approach cows with great caution, and in the early stages of the mating ritual they first follow the cow at a distance of 10 to 30 metres. There is little evidence of the very rough courtship reported for some other rhino species. A pre-mating bond develops between the two, for they stay together every day, feeding and resting together, even sleeping in close proximity, touching one another, the bull sometimes resting his head on the cow's rump. Any hostility between them at first has by now been defused completely, and if the couple are disturbed by men, the bull

will defend the cow.

Eventually the cow will urinate in a ritualized, short-squirt manner and the bull, exhibiting *fflehmen* behaviour, will sniff her urine. The first indication of actual mating intent comes when the bull approaches the cow from behind and rests his head on her rump. In the second stage the bull mounts the cow, without erection having taken place. During mating itself, which lasts 20 to 40 minutes, the male places his fore legs on the shoulders of the cow, stands upright, and lifts his tail to an almost horizontal position for some seconds. Next he lets his fore legs slide down slightly to the side, while he leans over the cow's rump, with his tail now lowered. This twophase rhythm is repeated, probably in sequence with actual ejaculation. During the second half of the copulation the cow walks a few steps forward or may even turn on the spot, and the bull manages to follow these movements without dismounting. After mating bull and cow feed and rest together.

Single calves are born after a gestation period of 530 to 550 days. Guggisberg (1966) records a description of the first few hours of life for the black rhino calf born at Frankfurt Zoo in the late 1950s. The birth happened at night, and the calf attempted to stand after six minutes and succeeded a few minutes later, but fell down again after only two minutes. After another 15 minutes of attempts, the calf at last managed to stay on its feet and search for its mother's teats (unsuccessfully until more than two and a half hours later). Ten minutes after this it could walk about four metres, though still with a rather wobbly gait. Within another 20 minutes it could walk the same distance very steadily, and almost three hours after

birth it uttered 'the first peeping call,' prior to at last engaging with its mother's teats to suckle. For the rest of the night the calf kept moving about, occasionally lying down for 10 to 12 minutes at a time.

The female becomes sexually receptive again about two years after giving birth. In ideal conditions a female may bear a calf every four years, but as populations are reduced and scattered births become much more rare. Sub-adults are living by themselves, separated from the mother, by the time they are two to three years old, and certainly before the mothers deliver of another calf. Sometimes, however, cows in mating associations with hulls, observed by the Schenkels, were still accompanied by a half-grown calf, a situation which did not seem to cause conflict for any of the three animals involved. Black rhino calves follow their mothers, while whites walk in front of their parents, so black calves may be easier game for predators. Mothers with calves do not wallow so effectively as non-breeding females, as they seem somewhat inhibited by the baby lying by their side, although wallows are often preferred places for suckling the calf. While the mother is feeding the baby may play, galloping on ahead only turn back and re-pass its mother, over a looping path of 30 to 40 metres. Sometimes it will playfully butt its mother. A young baby may suck standing up, but when it reaches true calf size it may lie down to stick, usually for about four minutes. The Schenkels have reported seeing a calf as mature as a vicar old still being suckled.

Man, as usual, is the rhino's most dangerous predator, but lions and hyenas may attack the more vulnerable animals, the sick or the Young. In general though, predation is not a problem for the rhino, which shows little fear of other large mammals, even when closely confronted by lions. The rhino does not really recognize man as such, but only in the form of isolated stimuli alarming its senses of sight, hearing, or smell. Its poor eyesight, however, makes it a sitting duck for human hunters. Even when it does perceive their presence it is rarely alarmed, for a rhino may see a moving man within 50 metres and do little more than look. The animal's continuously rotating ears check constantly for sound, but a good hunter can tread

- Most noiselessly yet, close to a rhino, and again the chief reaction is often no more than curiosity, a mock attack, or flight. A mother with a calf will nearly always make a bluff attack and then turn tail to run, with the calf usually running ahead of her. Often the rhino will rely on other animals - zebras, gazelles, or their friends, the oxpeckers - to sound an alarm. Thus, reactions to man can vary from extreme aggression to flight, usually conditioned by the rhino's experiences with humans in the past. *Hunting and decline*

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The black rhino certainly has reason to fear man. As one professional hunter in Tanzania, Robin Hurt, put it: 'A few decades ago, Africa was a sea of wild animals surrounding a few islands of humans. Today the reverse is true.' The dwindling number of black rhinos worried the colonials in Africa as early as 1906, when the Governor of Kenya decreed that sportsmen should shoot only one rhino per licence, instead of the two that had been permitted until then. A. Radclyffe Dugmore wrote in his book, *The Wonderland of Big Game (1925)*:

The most notable decrease among the animals is that of the poor old rhino, notwithstanding what anybody may say to the contrary, and some observers may challenge my statement. During my first visit to Kenya (1906), I saw as many as 1 in sight at one time, and groups of four or five were not uncommon. During my last trip, when I covered a large area of country and visited many places where rhinos used to abound, I saw 1: altogether. The ease with which the stupid creatures may be shot must account for this, coupled of course with the idea, prevalent with many people, that it is a noteworthy feat to kill the wretched brute. Unless very stringent laws are made for their protection, it is safe to predict their early extermination, except possibly in forest country, where they still live more or less unmolested.

A report in *The Times* of 14 April 1986, quoting information from the IUCN Africa: Elephant and Rhino Specialist Group, estimated the total number of black rhino survivors in Africa as 8400 in 1984, although 'numbers are believed to have declined dramatically since the survey'. ; Indeed, they have - today black rhinos number 3500.) Bradley Martin (1982) thought that between 12,000 and 18,000 black rhinos were still alive in 1981, after about 90 per cent of those in East Africa, the region containing the largest populations, had been killed between 1970 and 1980. In Kenya the population dropped from about 20,000 to less than 1500. Early in the 1970s the continent held an estimated 65,000. Successful breeding in the wild is in decline, though it could never have kept up with a death rate of such catastrophic proportions. Only in South Africa, Zimbabwe, and Malawi are surviving colonies at least stable.

In South Africa black rhinos are now restricted to the Zululand reserves run by the Natal Parks Board, and national parks and reserves in Kenya, Zimbabwe, and Tanzania are trying to protect more. In some cases the establishment of reserves may be seen as closing the stable door after the horse has bolted. In Kenya, for example national parks were established soon after the Second World War, but from 1944 to 1946 almost a thousand rhinos were killed in an area south-east of

Nairobi to make more land available for farming. Incredibly, the colonial game department of Kenya actually employed the aptly named J. A. Hunter to eliminate all rhinos in the Makueni district in order to open it up for agricultural development. With this encouragement, Hunter probably shot more rhinos than any other man in a single lifetime: 996 between August 1944 and October 1946. In his autobiography Hunter questions: 'Is it worth killing off these strange and marvellous animals just to clear a few more acres for a people that are ever on the increase? I don't know.' As it turned out, the harsh Makueni environment was more suitable for rhinos than people and the agricultural scheme was finally a failure.

In Kenya's Tsavo National Park, in the early 1970s, another threat to the rhino was drought, which reached disastrous levels, with elephants competing with rhino for the parched bush and rhinos starving by the hundred. Another problem is that concentrating surviving animals in designated areas defines target zones for poacher all too clearly.

Protection and Conservation

Recent strong conservation efforts have been made to halt the extraordinary decline of black rhinos in the wild. The African Elephant and Rhino Specialist Group of the IUCN is leading the battle, with support of other organizations, like Unesco, which has designated some of the rhino's last strongholds as 'world heritage sites'. In Zimbabwe, the Zambezi Valley is one of these. In 1986 the local national parks management started 'Operation Stronghold' to try to stop poaching there. Since December 1984 poachers crossing the Zambezi River at night from Zambia have killed 120 rhinos, while the park rangers and security forces have killed 10 poachers (*The Times*, 14 April 1986). Two more poachers, carrying the horns of another 10 rhinos, were killed in September 1986 (*The Times*, 7 October 1986).

An international appeal to help the Zimbabwe rhinos was launched in 1985, under the auspices of the Rhino Survival Trust. The following year Kenya launched its own Rhino Rescue project, aiming to establish captive breeding colonies in a few protected sanctuaries (*Independent*, 18 October 1986), which quickly raised the initial £.400,000 it needed. These colonies may eventually serve as reservoirs of animals for attempts at reintroducing the black rhino into parts of its former range. The first centre has been built at Lake Nakuru National Park, the idea being based on a paper, *The Black Rhino Management Plan*, submitted by Peter Jenkins, an adviser to Kenya's Wildlife Department. The Jenkins plan envisages sanctuaries enclosed by 12-strand electric fencing 2.6 metres high, charged with 5000 volts, standing on a cleared perimeter line which can act both as a fire-break and as a road for maintenance vehicles; an elaborate internal radio network for security purposes; a specially created water supply; and permanent management staff. The building of the 75-kilometre fence at Nakuru is now complete. Surveys are under way to assess the area's carrying capacity, water supply, food-plant pattern, and other factors and in 1987 fifteen black rhinos were translocated into the reserve.

The Nakuru project is following the example of Courtland Parfet, who established a 72,000-hectare rhino sanctuary on his farm at Soho in northern Kenya in 1971, collecting animals in danger of being shot by neighbouring farmers who found them a nuisance. Here the 15 first arrivals, with a few later additions, have increased to over 100, with the highest density of black rhinos in the world (*The Times*, 26 April 1986; *Independent*, ; March 1987). Now the Solio reserve, patrolled by mounted guards and ringed by a 2.5-metre-high electric fence, also protects white rhinos, buffaloes, lions, and leopards.

In addition to Operation Stronghold and the new reserve at Nakuru, Kenya has also been active in translocation projects. These always tread dangerous, little-known ground, though something is always learned from the mistakes - and in two projects mistakes were made. In one scheme involving threatened rhinos, 5 of the 42 animals captured between March 1979 and August 1980 died shortly afterwards. In another incident two rhinos were captured in the Aberdare mountains and dumped at Amboseli reserve, a completely different environment with vegetation unfamiliar to the Aberdare rhinos. Both animals were dead within a few weeks, and not at the hands of poachers. Careful management of the rhinos in the interim period between captive and actual translocation is crucial and they should not be exposed to excessive human contact if they are to re-enter the wild successfully.

In South Africa, translocation has had a more mixed record. In the Addo Elephant National Park, the population of black rhinos of the Kenyan subspecies *Diceros bicornis michaeli* is descended from four wild-caught animals, translocated in 1961 and 1962. The first mistake made with this group occurred in September 1977 with what Anthony Hall-Martin has called the 'regrettable introduction' of three bulls from Natal of the subspecies *L. b. minor*, one of which had only one external ear. As this was incorrectly believed, to be a genetic fault, the bull was castrated in 1979, but he continued to attempt to mate and to keep other bulls away from cows, so that in the end he had to be shot. The other two *minor* bulls were removed in May 1981, in compliance with a resolution of the African Specialist Group of the IUCN Species Survival Commission in 1980. This meeting also led to the removal of three calves from Addo in 1983, on suspicion that they had been sired by one of the Natal *minor* bulls. These calves were exchanged with the National Zoological Gardens

in Pretoria for an adult cow of the correct subspecies, *D. b. michaeli*, but the transfer of this cow from the zoo to the wild was unsuccessful and she died after three months at Addo. The rest of the Addo population is doing well.

South Africa's National Parks Board is the only organization controlling viable populations of more than one subspecies of black rhino. It has the Addo population of 17 *D. b. michaeli*; 135 *D. b. minor* in the Kruger National Park; and 5 *D. b. bicornis* in the Au-grabie Falls National Park. During 1987 it was planned to introduce a further group of 7 *D. b. bicornis* to Vaalbos National Park. Any other available black rhino habitat in South African national parks will be stocked with either 1) *D. b. bicornis* from Namibia or *D. b. minor* from Natal or Kruger. Hall-Martin added recently, 'The options of establishing a second *D. b. michaeli* population in a suitable protected area, or returning the surplus animals from Addo to Kenya and Tanzania at some future time remain to be explored.'

These activities tempt one to imagine that the battle is already won. but there are still plenty of poachers. and customers for the rhino parts they sell. Education, protection, and conservation all need money from sources other than local governments. but even if this is forthcoming, the black rhino's extinction may only be postponed rather than prevented.

Chapter 6/1

Early records

The second African rhinoceros, *Ceratotherium simum*, is misleadingly called white, thanks to the English adoption of the Afrikaans word *wijd* (meaning wide), taking over the sound regardless of the sense, which actually referred to the animal's mouth. Its other label, square-lipped, is more accurate, as William Burchell (1824) recorded in his description of the first example he saw: 'The new species here alluded to, I have

named *Rhinoceros*^{simus}... from the flattened form of its nose and mouth, by which,

and by its greater size, and the proportions of its head, it is remarkably distinguished from the other African species.' This footnote was added to the printed version of his 1812 journal (1822-29), but before it was published he had contributed a brief account of the new animal to a French journal in 1817:

In my travels in the interior of South Africa, I met with these animals for the first time near the 26 degrees of latitude, where they inhabited the immense plains. They frequent the fountain even, day, not only for drinks, but also for the purpose of rolling in mud, which by adhering to a skin entirely free from hairs, serves to protect them from the scorching heat of the climate. The size is nearly double that of the specimen named *Rhinoceros bicornis*. The two animals are recognized by the negroes and Hottentots as two very distinct species and are distinguished by them by different names. As we killed 10 examples, I have had sufficient opportunities of observing the characters which distinguish them. They consist principally in the form of the snout ... I have named this *Rhinoceros sinus* (the flat-nosed rhinoceros). The negroes and Hottentots inform me that it eats nothing but grass, while the other species feeds on branches of trees and shrubs, a peculiarity which may be inferred from the structure of the mouth. The head, when separated from the first vertebrae, was of such enormous weight, that four men could only raise it from the ground and eight were required to put it into the carriage. The flesh of the two species is equally good to eat; and they resemble each other in having a double horn and wanting conspicuous hairs on the skin.

On the whole, much less has been written about the white rhino than the black or indeed the Asian species, though it has been suggested that the white rhino, the most recently evolved of the five now living, developed from the black. Groves (1975) believes that in southern Africa during the Pliocene and Pleistocene periods (lasting from 7 million to 10,000 years ago), the white rhinoceros outnumbered the black, with the proportion being reversed later, as the grasslands favoured by the white became less extensive. White and black rhinos coexisted in large parts of the continent, as they still do in the Umfolozi reserve in South Africa.

The northern white rhino was introduced to the scientific world in 1908, when the English explorer, Major Alfred St. Hill Gibbons, shot one near Lado on the White Nile in the Sudan, more than 3200 kilometres further north than anyone had previously recorded the animal. He exhibited the skull in Europe, creating a stir among zoologists. The subspecies was first defined and described by Richard Lydekker in 1908, from a skull obtained by Major Powell-Cotton, a big-game hunter and the owner of a private natural history museum, who had staged an expedition to Equatorial Africa to collect a few specimens for scientific examination. As early as 1869, however, Theodore von Heuglin noticed the existence of the white rhino north of the equator: 'In the countries of the White Nile, there may well occur two species of rhinoceroses: one is the common black rhinoceros, the other very probably the lighter coloured *Rhinoceros simus*. We have obtained horns three and half feet long. Which could only have come from that species.'

Until recently, very few white rhinos have been kept in captivity. The first, Zuluana, a southern white, was taken to

Pretoria Zoo on 29 July 1946, six days after her birth, from the Umfolozi reserve. She weighed 47.7 kilograms 15 days after birth. Two more southern whites, a year-old male, Folozi, and a second female, were also taken from Umfolozi to Pretoria in 1949 and 1952 respectively (Bigalke, 1961). Folozi had been found beside his dead mother in the Mpafa Valley, trying to keep the vultures away from her carcass. At the Pretoria Zoo the young rhinos learned to eat hay, bran, bread, carrots, and other vegetables, in addition to grass. Other captives, all of the northern form, were taken to zoos in London, Antwerp, Washington, and St Louis, Missouri, in the 1950s (Reynolds, 1961b). The dealer in wild animals, Carr Hartley, also kept a pair of white rhinos on his ranch in Kenya during the 1950s after he had captured them very young in 1949. More recently, a successful captive breeding colony of northern whites has been established at Dvur Kralove in Czechoslovakia, and zoos at Khartoum and San Diego have acquired a few more of these animals.

Distribution

Once the white rhino ranged from Zululand north to the Zambezi, and from the Indian Ocean west to Angola. Up to 1933 there were unconfirmed reports of a few survivors hanging on in the Zambezi Valley and, more recently, in Angola too. In the northern part of the continent the animal originally spread west from the tipper Nile to Uganda, Zaire, the Central African Republic, and Chad.

There are two subspecies of white rhino, the northern *Cerartotherium simum cottoni* (Lydekker 1908) and the southern *C. s. simum*, the few still surviving restricted to a couple of isolated patches of their former range. Recent research (reported in *New Scientist*, 27 November 1986) on the DNA of the two subspecies has found that they are 'genetically very distinct', indicating a long separation. Among other external differences between the two subspecies is a minor one in the dorsal concavity of the skulls, while the northern is more prone to the loss of body hair in adults, holds its head higher than the southern, and has a shorter body.

No white rhinos have ever been reported from the middle ground between the south-eastern limits of the northern subspecies - the River Nile, northern Zaire, and Uganda- and the northern limits of the southern subspecies - the Zambezi River - a distance of some 2000 kilometres. The only exception is a 34,000-year-old cave painting in Tanzania. With no genetic exchange across this middle area, the rhinos in the northern and southern ranges evolved as separate subspecies. The two groups were, probably separated by climatic and vegetational changes during one of the Pleistocene ice ages, about 2 million years ago:

Description

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The white rhinoceros is the largest living land mammal after the elephant - as R. N. Owen-Smith has called it, 'a mega-herbivore'. Its height at the shoulder is from 160 to 200 centimetres and the length of the head and body from 360 to 500 centimetres, excluding a tail 60 to 70 centimetres long. Its weight may range from 2700 to 4500 kilograms. Despite its great bulk, the animal can appear surprisingly agile, walking steadily at about 3 kilometres an hour or trotting at about 30 kilometres an hour when alarmed. Only very rarely will the white rhino actually gallop, at a recorded top speed of 40 kilometres an hour. This species is certainly less of a climber than the black rhino and will not settle in a steeply hilly area, even though it may cross ridges during its daily wanderings.

The skin of the so-called white rhino is actually slate grey, but paler than that of the black rhino, and often covered with the pale, chalky soils of its home ground as a result of wallowing. It is virtually hairless except for the fringes of the ears and the bristles on the tail, though young with rather more hair on their bodies have been seen. As in the black rhino, skin-folds are far less prominent than in the Asian species, occurring only at the shoulder and the flank, just before the hind limbs. Savidge (1961), in his description of the translocation of white rhinos in Uganda, reported that the tender parts of the skin are easily cut.

The massive, elongated head bears two horns, on bases larger than those on the skulls of black rhinos, and the northern form of the white rhino has a flatter skull than the southern one. Examples of the anterior horns are among the biggest on record, with several over 150 centimetres long (Groves, 1971). The average size of the front horn is only 60 centimetres, with the posterior one smaller. The head is characteristically held hanging low when relaxed, pointing to the animal's grazing habits, compared with the black rhino, which holds its head much higher. The collector Herbert Lang explained:

The factors giving the long, weighty head such a remarkable facility of movement are the highly efficient ball and socket joint hinging the head to the neck and the enormous band of sinu nuchal muscles extending from the rear of the skull to the high processes of the vertebral column. A huge mass of muscles on either side of this rubber band are responsible for the distinctive

- hump in front of the shoulder. At every sway of the head they exert enormous pull on the upper corners of the skull, which perhaps has brought about its curious V-shaped dorsal outline in the rear.

The hump he described on the back of the neck is formed by muscular and epidermal tissue unsupported by bone, similar to the hump of Brahman cattle. This fleshy hump, together with a layer of sub-cutaneous fat up to 50 millimetres thick on the abdomen, was what made the white rhino's meat particularly attractive eating, according to nineteenth-century explorers or hunters. This fat helps the animal through the harsh dry season, when its preferred and most nutritious food-grasses are less abundant. Other characteristic differences from the black rhinoceros are the longer, pointed ears and a more sloping forehead, as well as the squared upper lip without any prehensile area.

Habitat and Behaviour

The white rhino is a grazer, in contrast to the black which is a browser, so its distribution in Africa has been closely linked to the availability of grasslands. This difference in diet makes the white rhino's dung distinguishable from the black's, being finer, more completely digested, greenish when fresh but turning black on the exterior when dry and hardening.

Other large mammals, many also herbivorous, share the rhino's range, among them black rhinos (*Diceros bicornis*), cheetahs (*Acinonyx jubatus*), lions (*Panthera leo*), leopards (*P. pardus*), spotted hyaenas (*Crocuta crocuta*), zebras (*Equus burchelli*), buffaloes (*Synceros caffer*), wart-hogs (*Phacochoerus aethiopicus*), and several antelopes: impala (*Aepyceros melampus*), wildebeest (*Connochaetes taurinus*), nyala (*Tragelaphus angasi*), waterbuck (*Kobus ellipsiprymnus*), and kudu (*Tragelaphus*

strepsiceros).

Five birds are also associated with white rhinos. Two, the red-billed oxpecker (*Buphagus erythrorhynchus*) and the pied crow (*Cornis albus*), remove parasites from the rhino's body, while oxpeckers also sound an alarm when danger approaches. The fork-tailed drongo (*Dicrurus adsimilis*) may use the rhino's back as a launching pad for catching insects, while the glossy starling (*Lamprotornis nitens*) and the cattle egret (*Bubulcus ibis*) walk around the animal's feet to pick up insects flushed out when the animal moves. In another form of relationship, rhino dung-heaps are useful to certain beetles as a medium in which to lay their eggs, while the insects attracted to the dung feed a wide variety of birds and mammals such as the banded mongoose, shrews, and moles. Wart-hogs have been seen feeding on rhino dung, and some birds take dust-baths in the dung heaps. As Guggisberg (1966) has noticed, 'All these animals soon reduce the dung to a uniform, chaff-like consistency. When the dung beetles are active, the heap appears to be a heaving mass as hundreds of beetles work and push. The harvester termites will be seen carting away the undigested grass stems to their nest.'

Mud wallows help to protect the white rhino's hairless skin, discourage external parasites, and cool the body. The animal will usually roll several times in the mud and wallow for up to 15 minutes at a time. After this it may spend up to 20 minutes rubbing itself against neighbouring trees or stumps, leaving them polished smooth after a time. This may help to remove ticks such as *Dermacentor rhinocerotinus*, *Amblyomma rhinocerotis*, *A. hebraeum*, *A. variegatum*, *Rhipicephalus maculatus*, and *R. simus* from the hide. Freshwater turtles and two species of fish also help to remove ticks from the rhino while it is wallowing. The animal may also squat to rub the pubic area against low tree stumps. This rub-grooming activity may occur at other times too, independently of wallowing. Rhinos also wallow in pools, lying down quietly in water up to 0.6 metres deep, for as long as several hours.

White rhinos associate in groups, temporarily for hours or days or even semipermanently in stable groups maintained over months. While some observers have reported 'herds' of up to 14 individuals (Ripley, 1958 and Heppes, 1958), thus distinguishing the social structure of the white rhino sharply from that of the black. Owen-Smith does not, however, find the social organization of the two so very different if one discounts purely temporary grazing associations or the occasional and short-term clumping together of groups in the face of danger.

White rhino sub-adults are more usually found in groups than is the case for blacks at this stage, with as many as six accompanying a sort of surrogate mother, an adoptive cow. This, suggests Owen-Smith, might be partly a consequence of the much higher population densities seen among white rhinos, but it also seems to be uniquely characteristic of the species. Most truly stable white rhino groups consist of pairs of animals, whether of two sub-adults which have formed a close friendship, a mother and calf, or a surrogate mother and an adopted sub-adult.

Males follow either dominant (territorial) or weaker (non-territorial) behaviour patterns, with about one-third of the males studied by Owen-Smith at Umfolozi falling into the latter category, a majority of these being either young or old. This differentiation shows up strikingly in the style of urination, for the subordinate males urinate in a steady stream, like

females or immature animals, rather than in the pulsing spray typical of territorial males. Subordinate males are equivalent in social status to the non-territorial males which typically group into the bachelor herds of the more sociable ungulates, such as wildebeest.

The white rhino is unusual in that these bachelor subordinate males move around within the territory of a single dominant male, gradually habituating the resident dominant male to their presence, until an opportunity arises for them to challenge for dominance themselves. As many as three subordinate males at a time may be found in a dominant male's territory. The subordinate status is only a temporary phase of adult life, although the white rhino remains in this phase for much longer than is usual in the social bovids. A dominant male can be deposed, and when this happens he will stay in his former territory, but with the status of a subordinate male, switching overnight even such fundamental behaviour as his style of urination, from spray to stream.

Owen-Smith (1975) has found that adult, dominant males have mutually exclusive and well-defined territories, of an average size of 1.65 square kilometres, with boundaries marked by spray urination sometimes coinciding with topographical features such as ridges or water-courses. But translocated white rhinos in areas of lower population density have been seen to create larger territories for themselves of from 5 to 11 square kilometres. The males patrol their territories diligently. Only at times of acute water shortage will an adult male wander outside his own territory. The females' ranges are much bigger, with an average size of nearly 12 square kilometres, often covering up to seven males' separate territories, but they are much less exclusive than the males' with a good deal of overlapping.

Since visual stimuli are of little use to an animal with such poor sight and almost no binocular overlap, the white rhino interprets its world mainly in terms of sound and smell. Its ears constantly move around to check on sounds, and Owen-Smith has distinguished ten distinct white rhinos noises, ranging from warning snorts and snarls through frightened shrieks and 'gasp-puffs' to whines and squeaks from calves. Most of these noises are related to spacing between individuals, whether indicating a desire for greater distance or closer proximity. Any form of alarm call or sound designed to communicate over distance, common in other species of rhino, is strikingly absent. Visual or tactile gestures may also be used as communication signals - the pinned-back ears and advancing steps accompanying snarls in subordinate or sub-adult males, for instance. Horn-prodding or clashing and charging ritualize attack, while a toss of the head from a sub-adult indicates a desire to play, and mutual side-rubbing signifies a close bond. Owen-Smith has made a detailed list of several other signals, including horn-wiping, horn-wrestling, scraping, curling of the tail, nose-to-nose contact, and so on.

Urination and defecation are prime means of communication, as with other rhinos. Scent-marking of territory is shown by defecation in particular defined patches of ground. Originally this may have been a sensible strategy to avoid contamination of grazing grounds, but by now the dung-pile serves other, more social purposes too. The presence of the dung-heap in itself stimulates the animal to defecate in the same place. Territorial bulls have been seen scattering dung-heaps with their horns, and also vigorously kicking or scraping their hind feet backwards both before and after defecation. African rhinos, unlike Indian rhinos, do not have pedal scent glands so this kicking and scraping ensures wide dispersal and recognition of their own particular dung scent. The dung-pile is also a record of even individual which has passed by, particularly of oestral females. Some rhinos have been observed sniffing carefully at dung-piles for several minutes at a time.

Territorial bulls usually wipe their horns on a low bush before urinating in a powerful, pulsing spray directed backwards, while cows, non-territorial males, and immature animals urinate backwards in a steady stream. Territorial spray urination is especially frequent in the bull when he is blocking a cow from crossing a territory boundary. Under these circumstances Owen-Smith has recorded one instance of 29 such urinations within 122 minutes. When sniffing another animal's urine traces, particularly a female's, male rhinos will often stand with their heads raised and lips parted, the *flehmen* response. Both urine traces and dung may serve to advertise the presence of a resident dominant male.

Encounters between male white rhinos may lead to confrontation, culminating in either submission or mere avoidance. Whatever the response, it is essentially ritualized. Nose-to-nose or horn-to-horn 'staring' seems common, and Owen-Smith (1975) has reported a sort of fencing, with clashing horns. Savidge (1961) was told that in the Umfolozi reserve, when white and black rhinos faced each other, it took two of the much larger whites to discourage a single black. Snorts, snarls, and even roars or shrieks may accompany these episodes. Border disputes cause occasional fights among males, and confrontations may occur between dominant males at the boundaries of their territories or between a resident dominant male and an intruder. The intruder, usually a subordinate male, often makes the most noise, through fear and a desire to tell the resident that he is not challenging but will stand his ground, while the confident resident holds his ground silently and relatively calmly. Confrontation is ended by one of the animals withdrawing, paradoxically most

often the dominant male. Most of these encounters are brief, a matter of minutes, and, in the case of a subordinate male, submission will permit him as the loser to stay on the winner's territory.

Eventually the dominant male will recognize those subordinate males regularly on his patch and ignore them, even allowing them to graze a few metres away from him. When two dominant males confront one another, however, they both stand silently, horn to horn, and the meeting often culminates in a charge. Between dominant males a few fights of an hour or more have been recorded, some of them leaving the loser badly bruised and lacerated; but more usually direct aggression will be avoided and diverted into displays such as horn-clashing and horn-wiping. The horn is apparently such a dangerous weapon that it is better to avoid fighting with it. Dominant males on their way to water will often be allowed to pass through another dominant male's territory. This tolerant form of territoriality is best defined as 'territorial dominance' (Owen-Smith, 1975). In contrast, cows are more or less tolerant to one another and often maintain overlapping territories. Guggisberg (1966) has reported 'terrific battles' between bulls courting the same cow, often ending in death for one of the combatants, and he says that of 32 rhinos found dead in Umfolozi between 1952 and 1957, most had died of wounds received in fighting. *Feeding*

This rhino lacks incisors and uses its broad lips, with a hardened pad on the lower one, to pluck the grass which is its essential diet. Guggisberg has likened the appearance of well-frequented rhino habitat to a place where 'somebody has been busy with a lawn mower, though in a somewhat negligent fashion.' Arid wooded

grassland is probably the best description of the animal's preferred habitat.

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In southern Africa white rhinos are found on open bushveld grasslands, while around the Upper Nile they prefer thick *Combretum* forest but also frequent nearby treeless plains. almost like cotton fields, which are seasonally flooded. In the (Garamba Park, Zaire, they like more open savannah country than in Uganda, provided there are isolated trees offering shade for their daily siesta. The Umfolozi rhinos in Natal live in open woodland, where species of *Acacia* are mixed with the grass. The more nutritious, protein-rich, and low-fibre shorter grasses are preferred. These favoured short grasslands are also to some extent both created and perpetuated by the very fact of the rhino's constantly grazing them to as low as a centimetre above ground. But when the dry season shrivels the short grass the animal is quite happy to eat taller, more fibrous, less nutritious grasses. such as the stands of *Themeda triandra* known as *rooigrass*, commonly found in Umfolozi.

Even with long grasses, grazing pressure from the rhino soon allows more light to reach the soil, which stimulates the growth of shorter grass species. Over time the rhino can convert long grasslands into the shorter ones it prefers. In addition, the rhino-as a non-ruminant has poor digestion and needs rapid throughput of its fodder to extract sufficient value from it, so that it quickly passes out plant material which then regenerates in the soil. The snag with this ability to encourage short grasslands is that the animal still needs a reserve of longer grasses like *Themeda* to tide it over the dig-season, hence conservationists' fears that the vegetation at Umfolozi will not be able to support the rapidly expanding white rhino population.

The animal needs to feed heavily to nourish its great bulk, The main feeding and drinking times, especially in hot weather, are during the early morning and early evening, although there is some night grazing too. The animals prefer to rest for five to eight hours during the hotter summer midday period. Owen-Smith (1973, 1975) began studying white rhinos in 1966 and made the first long-term scientific investigation of them, producing the greater part of our knowledge of the animal. His initial work in Umfolozi lasted about five years. He has recorded 30 different species of grass in the rhino's diet, with 12 species taking up about 95 per cent of the total and 74 per cent made up by the four most important species: *Themeda triandra* (35.5 per cent), *Panicum maximum* (17.1 per cent), *P. coloratum* (12.4 per cent), and *Urochloa mossambicensis* (9 per cent). Other important species include *Panicum deustum*; *Digitaria argyrograpta*, other species of *Digitaria*; *Sporobolus smutsi*, and *Dactyloctenium australe* when it is available. Although there may be competition for food from other herbivores, there is very little evidence of any significant predation of the white rhino by big cats.

although Owen-Smith has noticed white rhino calves nibbling at soil around termite mounds, there are no mineral licks in Umfolozi. The soils are high in calcium and possibly other minerals, however, while springs are reportedly saline, so it is

possible that the animals manage to satisfy their mineral requirements from their food and water alone. If water is readily available, white rhinos may drink once or twice a day, but when the dry season makes longer journeys necessary they look for water less often, at intervals of two to four days.

Reproduction

Females become sexually mature at about 5 years old, but remain in sub-adult groups until the birth of their first young when they are about 6 or 7 years old. The peak oestrus periods observed by Owen-Smith at Umfolozi fall in November and February, leading to calving seasons in March and July. Oestrus seems to be stimulated by the sprouting of fresh green grass after rain, and bulls seem able to predict forthcoming oestrus in a cow as much as 20 days in advance. Any association of a cow and a bull lasting more than a day or two probably indicates that the cow is on heat. The male is still very much a follower at this stage, with the cow dictating the pace of things, displaying strong displeasure if the male comes too close. The preoestrus courtship lasts from one to two weeks, with the male following the female at a distance of about 10 to 15 metres, except when the cow comes too close to his territory boundary. then, he will rush ahead of the cow, squealing and blocking her path. preventing her from entering-,another male's territory, and at the same time scraping or wiping his horn and spray-urinating repeatedly.

Even if this noise or the scent of the oestral cow attracts attention, a nearby dominant male will never cross his territorial boundary to take advantage of the situation. Neither will a resident subordinate male within the same territory attempt to fight for the cow courted by the resident dominant male. Access to oestral females, which is totally denied to subordinate males, seems to be one of the most important functions of territoriality. Since the average territorial male probably has only one or two opportunities for copulation each year, it is not surprising that these few chances are guarded very jealously. Owen-Smith found that the sex balance at Umfolozi was about 80 females to 100 males.

The onset of actual oestrus provokes courtship advances from the male, who approaches the cow from behind, making what Owen-Smith has called 'a wheezy hiccuping sound'. It takes a *full* 24-hour day to progress from this stage to actual copulation. At first the cow rejects the male, but after several hours of persistent attempts to approach her, she will allow him to place his chin briefly on her rump. The initial fey mounting attempts by the male are usually abortive, but during, the later stages the cow emits small squirts of urine each time the bull approaches, and finally copulation is achieved. It lasts from 15 to 28 minutes, with ejaculations every two or three minutes, the bull making repeated soft rumbling sounds while mounted and suppressed squeaks while ejaculating, most likely to ;6 abdominalpressure, according to Owen-Smith. The two rhinos stay together for another few days after this single act of copulation. If conception does not result, oestrus may recur at intervals of about 30 days. Only about 40 per cent of the females in a white rhino. population may actually be mated in a year, although some may have copulated several times.

A single calf is born after about 500 days gestation; the mother usually choosing a thicket of vegetation or a hill slope for the birth. Owen-Smith reports an average interval between calvings of 2.5 years, but E.L. Edroma (1982) suggests that the rate in the wild is a calf every four years. He also records very high infant mortality in the wild, though the Umfolozi experience seems to be the opposite. The calf starts to nibble grass after about two months and grazes well by four months, though the cow continues to nurse it for about a year.

While they are with their mothers white, like Indian, calves always walk in front of them, which may make them less-vulnerable than black calves, which follow theirs. Cows have often been seen guiding calves with their front horns, prodding them in the desired direction. On their part, calves have a very strong attachment to their mothers and will scarcely leave them even in death. Clearly the behaviour of both animals is protective, ensuring that the calf will not fall prey to predators. Calves are driven away by their mothers at about two or three years of age when the next calf is born, but sub-adult males may find surrogate mothers or move around with other sub-adults for several years after that, before becoming more solitary at the age of about eight. after which they try to establish themselves. Young males seem less likely to be attacked by territorial bulls if they associate in pairs or groups, but they are *fully* solitary and mature at 10 to 122 years of age.

When disturbed by humans, white rhinos in a group have been observed to rush together, making panting sounds. They then stand with their rear ends together, facing outwards in different directions, or stampede, still panting. Guggisberg has described a group of six in Umfolozi as performing 'a rhinocerontine ballet which I am sure would have delighted Walt Disney. They were turning around each other, trotting away, circling back, advancing towards me, retreating to the shade - a real circus performance, all the more comical because of the slightly offended expression those enormously long-headed and broad-mouthed animals always seem to wear.'

Lacking a warning call of its own, a rhino detecting a man will approach its companions and stop abruptly beside them,

its head up in an alert posture, sometimes emphasizing its presence by panting, causing the others to look round nervously. Young calves run off ahead of their mothers, while cows with very small calves stay close to their infants. While the animal cannot easily distinguish a stationary person at more than 30 metres, anything moving, even at about 80 metres, is easier for it to pick out. Because of this and also because the animal is apparently less aggressive than the black, hunters have found it relatively easy to approach and attack. These limitations have also proved a boon to researchers, who have been able to track the white rhino closely and quite comfortably on foot. If, however, the rhino detects human scent it will immediately run away downwind. Generally speaking, this species seems a far milder-tempered, more retiring animal than its black relative, but this trait has done little to protect it against hunters and poachers. *Hunting and decline*

Nineteenth-century hunting, helped by ever more efficient weapons, almost wiped out the white rhino, with only a small population remaining by the turn of the century at Umfolozi in Natal, a very early national park. The Umfolozi rhinos are still the main breeding stock on the continent today, from which groups for translocation elsewhere in Africa and for zoos overseas have been taken. Traditional hunters, with or without rifles, have been only too willing to feed the world market for horn, via ports like Mombasa and Malindi in Kenya. The customary Kamba method of killing rhinos in Kenya's Tsavo region is with poisoned arrows, but Esmond Bradley Martin, has reported that they often dip their arrow-heads into nitric acid, apparently in the belief that it will accentuate the effects of their poison, when in fact it tends to neutralize it. As a result, many rhinos wounded by these arrows die a slow and agonizing death from septicaemia.

From 1927 to 1931 there was another spell of enthusiastic killing around Lake Chad in French Africa. Cuthbert Christy (1923), travelling just before and during the First World War, saw a pile of about 100 horns in the shop of a Greek trader at Aba, in today's Zaire, close to the borders of Uganda and the Sudan. A few years later Guy Babault was shown more than 150 horns in Khartoum, from animals killed within Chad during just one year. These hauls were apparently only the tip of the iceberg. For Marcus Daly, the author of *Big Game Hunting and Adventure 1891-1936*, wrote of French hunters who were arming local gangs of up to 50 men with guns, including modern rifles, and setting out on lengthy expeditions to kill as many rhinos as possible. They would return with as much as three tons of horn at a time. One ton of white rhino horn represents about 300 dead animals, so Daly's estimate of about 10,000 white rhinos shot at that time may not have been an exaggeration.

Unrest in the Sudan in the 1980s, and the availability of arms there and in other troubled areas such as Uganda, have been a particular stimulus for poaching, as much of the horn is still traded through the Sudan. Uganda is a particularly awful case. Initially successful World Wildlife Fund projects to monitor and preserve the white rhino ended when Idi Amin's government collapsed after the Tanzanian invasion in 1979. As his troops retreated northwards to the Sudan, through prime wildlife areas including the Kobalega National Park, they looted and killed anything in their path including rhinos, even some tame white rhinos that had earlier been introduced from the West Nile province. Also attacked by the Tanzanian invaders it is estimated that more than 75 per cent of all the game in Kobalega was killed during that one year 1979, and in the midst of the human suffering caused by such wars, who dares voice concern for the animals? Savidge (1961) described the translocation of white rhinos in Uganda, where 10 were taken to the Murchison Falls National Park (late the Kobalega National Park) from West Madi province, the whole operation being filmed by Anglia Television. Of the 10 moved, two adult cows soon died, and the perils of the following 20 years must have wiped out the rest. Indeed, in 1984 the Director of National Parks asked for money and expertise to translocate the only known rhino left in this area, a female, to another breeding group. As late as the 1930s the white rhino was still quite common in and around Uganda; by 1951 only 300 could be found and today there are none at all. Obviously the northern subspecies is in great danger of extinction now, with its last refuge in the southern Sudan, north-east Zaire, and the West Nile province of Uganda violently disturbed by recent civil wars.

After a total population of about 1000 northern white rhinos in Africa had been estimated in 1979-80. Hillman and Smith found fewer than 50 in the wild in 1981 and 13 in captivity. There are thought to be none left in Chad, and only two, unverified sightings have been reported in recent years from the Central African Republic. The need for conservation programmes is most urgent in the Sudan and Zaire. In the Shambe region of the Sudan the population estimate in 1979-80 was about 300, but by the end of 1981 an aerial survey following extensive drought and intensified poaching revealed no live rhinos but hundreds of skeletons. Sudan's decision to expand a small game reserve in the Nile Valley into the Shambe White Rhino National Park (800 square kilometres) is a hopeful sign, but the white rhino has vanished completely from Nimule National Park, once famous for them, and in the Southern National Park, where an aerial survey late in 1980 estimated a population of at least 100, it is thought that poachers almost eliminated the white rhinos between 1981 and 1983. As a result the 1983 survey suggested a total of only

10 to 30 northern white rhinos for the Shambe and Southern National Park regions put together.

In 1986 Zaire's Garamba National Park, established partly for the rhino in 1938, was the last remaining refuge for the only potentially viable group of northern white rhinos, numbering from 15 to 20 individuals, and the area has been designated by Unesco as one of 14 world heritage sites. The rhino population has see-sawed from about 100 in the 1930s to a healthy 1000 or so in the early 1960s, down to below 100 once more when civil and military unrest struck the then Congo in the late 1960s, up to well over 400 by the mid-1970s. At the end of 1981, however, following heavy poaching in 1979 and 1980, only 3S could be counted during a field survey of Garamba conducted on foot.

Protection and Conservation

Since 1981 joint efforts by the IUCN African Elephant and Rhino Group, the Frankfurt Zoological Society, the World Wildlife Fund, and the UNEP (United Nations Environment Programme) Global Environment Monitoring System, together with similar efforts by the Fauna and Flora Preservation Society and the Kenya Rhino Action Group, have been focused on rehabilitating Garamba and its rhinos. Proposals to translocate some of the Garamba rhinos out of the county' were not acceptable to Zaire. Hillman-Smith (1986) and others feel that the Garamba population could easily double within the next decade, if given proper protection. In their 1986 report they assess the northern white rhino's chances as slim. 'but possible with enough long-term input'. The -..also point out that research so far suggests that there is less cause for worry, about genetic viability within very small populations, like that at Garamba, than was previously imagined. One advantage the northern white rhino has is that it seems to start breeding at a younger age than its southern relative. Hillman-Smith and others agree that some form of captivity within Garamba National Park itself, such as a fenced, patrolled area for the rhinos, might be a possible option, and they stress that a strong captive breeding population, such as the one that already exists at Dvur Kralove in Czechoslovakia, is an important reinforcement for the wild population. They also suggested: - examination of the existing captive-breeding group to develop improved

husbandry and assess what further help is needed;

- formalization of the informal agreement already concluded among zoos in 1982, to exchange animals and/or genetic materials;

- loan of Khartoum Zoo's male and possibly also San Diego's male for breeding groups;

- development of techniques such as artificial insemination and embryo transplant as southern white females seem particularly suitable for the latter; establishment of another captive-breeding group, possibly using the Khartoum male. the female available in Uganda, and loans from Dour Kralove and from the Sudan.

Hunting almost drove the southern subspecies to extinction too, between 1840 and 1897. The spread of firearms among native peoples, and their wanton use by the white hunters who brought them. were major factors in this slaughter. By 1920 there were probably only about 150 southern whites left in the Umfolozi Game Reserve, but today southern white rhinos number over 3000 and are so widely distributed that the subspecies was removed from the IUCN's *Red Data Book*, of endangered species at the start of the 1980s. All the southern white rhinos surviving today are descended from a population of about 100 driven into the area between the Black and White Umfolozi Rivers in Zululand in the late 1890s, where, until the 1950s, the virulence of the tsetse fly probably helped to protect them. An area of 250 square kilometres became the Umfolozi Game Reserve in 1897, though it was not properly protected until 1920, and it was subsequently extended to 480 square kilometres. From this seminal colony the population has increased, allowing more than a third of them to be used since 1960 to restock suitable parts of their former range outside Umfolozi. Gradual degradation of the grassland habitat meant that some form of culling of all ungulates in the area. including translocation, became essential as early as the 1960s, even though the tsetse-host eradication programmes of the 1940s and 1950s had eliminated most large mammals apart from the rhinos themselves, which were spared.

In 1981 Owen-Smith discussed the problems of rhino over-population at Umfolozi, where he estimated over 1500 white rhinos in the Reserve itself, and more than 2000 in the wider 950 square kilometres of the Umfolozi Corridor Hluhluwe Game Reserve complex, with densities ranging from 3.2 to 6 per square kilometre according to the exact location. This was in spite of the fact that, prior to 1971. 1000 rhinos had already been translocated. thanks to the foresight of the then Director of the National Parks Board, Colonel Jack Vincent. The rhinos were in danger of degrading Umfolozi's grasslands and consequently its soil cover, below the point where it would be able to sustain a rhino population expanding at a rate of about 9.5 per cent a year (1959-72), said Owen-Smith. Logically, the prospect was further population expansion, extensive habitat destruction, followed by mass mortality and a population crash, with stabilization of the population at much lower levels in a severely damaged habitat. Translocation of the Umfolozi rhinos also helped to correct a sex imbalance, the group having a preponderance of males. Several hundred went to Rhodesia, now Zimbabwe (Tomlinson, 1977) and others to Kenya, including a group sent to the Solio ranch in 1978, adding white rhinos to the

black ones already flourishing there. In under ten years the Solio group of white rhinos has increased from 16 to 35, confirming the good breeding record of translocated whites. Once they have had time to settle down and re-establish social patterns. Elsewhere in Kenya, in Meru National Park, there are other white rhinos brought from South Africa but Somali poachers are doing their best to exterminate both white and black rhinos, although the animals are guarded as well as possible.

The main breeding stock of southern white rhinos is in the Umfolozi reserve, which worries some conservationists who are concerned about the effect that South Africa's current political upheaval could have on conservation. The Umfolozi rhinos were still expanding at a rate of about 6.5 per cent a year at the beginning of the 1980s. As a member of the Rhino Specialist Group said in 1986, 'Unless the scene there is very carefully controlled, there is a chance that a breakdown in law and order could destroy the last breeding nucleus for white rhino in Africa' (*Times*, 14 April 1986).

Conservation-1

Take in Intro Folio 127

Only five species of rhinoceros are left today from more than thirty in the fossil record. Between 1970 and 1986, 84 per cent of all rhinos were exterminated, reducing the total population from 70,000 to a mere 11,500. The survival of even this handful is threatened more and more by hunting, largely for the sake of the fabled virtues of practically every part of the animals, especially their horns. Market prices are posted for horn, skin, bones, teeth, blood, urine, and dung. Thanks to the ingenuity of man, the rhino has been hunted by almost every method imaginable.

Very little traditional indigenous hunting is done with firearms, though high-tech methods are on the increase, particularly in Africa. In Asia pit traps of various designs, about two metres deep, are widely used, many with sharpened pole-spears on the bottom, covered with twigs and soil for camouflage. In cases where only the horns and hooves are desired, the rhino is usually left in the trap to starve and rot. Another method used in both Burma and Sumatra is the suspended spear. The rhino sets off a rattan trigger wire on its path, releasing the spear hanging vertically about 15 metres above, straight into its own back. Some tribes use poison darts or spears, frequently catching the animal unawares at rest in its mud wallow, while others, as in Riau, Sumatra, have devised a steel-sling wire which can slice off the rhino's snout just above the horn. In Indonesia too, knives are sometimes set along the rhino's favourite trails, to rip its belly apart. There are stories of rhinos being driven towards the sea in Vietnam or flushed out by deliberately set forest fires in Sumatra. The native hunters of Borneo, chiefly in the Malaysian state of Sabah, are particularly well known for their ability to stalk an animal for weeks or months until they finally close with their prey. Hundreds of animals in Sumatra and Borneo alone were slaughtered during the decade 1918 to 1927, when a total of 344 kilograms of rhino horn was exported from these regions a figure which excludes local and unregistered consumption.

Conservation is not helped by loopholes in wildlife protection acts which allow killing to protect one's own life or property, such as livestock, and even more dubious qualifying clauses, like that in the Burma Wildlife Protection Act of 1936: [The Sumatran rhino is fully protected] ... 'provided that it shall not be an offence for any physician or druggist to possess or sell, or for any person to possess for private medical purposes, rhino blood or any preparation thereof.' It is hardly surprising, then, that a Sumatran rhino was legally shot within the Burmese Shwe U-Dong wildlife sanctuary in 1952 for 'medical purposes' (U Tun Yin, 1954). In other countries, such as Malaysia, where intentions are undoubtedly good, penalties written into the law may be derisory, a fine of about 500 American dollars and/or six months in jail. A country like Indonesia can have commendably modern and enlightened wildlife protection laws and yet seemingly be almost powerless to enforce them, through a lack of financial and manpower resources and the mounting pressure of poverty and human overpopulation. The fact that the population of sub-Saharan Africa alone is expected to have tripled between the mid-1980s and the year 2025, to reach 1.64 billion, indicates the scale of the problem.

Poachers in Africa are extremely well organized and well equipped. Wildlife authorities of many African nations find themselves engaged in full-scale warfare against them, mirroring in many ways the current battle between governments and cocaine dealers in South America. Glen Tatham, one of the provincial wardens in Zimbabwe's Kariba National Park, where 500 or so black rhinos roam a strip of land along the Zambezi River on the Zambian border, has described his situation as 'a logistical nightmare by any military standards'. About 70 armed men are patrolling about 240 kilometres of river, outnumbered by and less well equipped than the poachers they hunt, who move around in gangs of about 20 men at a time, carrying automatic weapons. Two-man ranger teams may be away from base camp for up to a month at a time, covering an average of 38 kilometres a day on foot. About five vehicles patrol almost 10,000 square kilometres in the

park. A haul of 30 or so horns from this area may typically fetch 1.6 million American dollars. It takes little imagination to understand how difficult it must be to protect the rhinos in these circumstances.

Van Strien had this to say of the Sumatran rhino in 1974. It is still relevant today for all rhinos:

D. sumatrensis are protected by law throughout their present distribution area, but this does not mean that the last remaining individuals are safe. The enormous sums of money paid for a dead rhinoceros are a great temptation to native hunters. Only a very severe punishment, at least imprisonment, will be able to stop the purposeful hunting of these animals. This punishment has to be applied not only to the hunters, but also to anyone dealing in rhino products. At the moment, the maximum penalties are too low, and the chances of being caught and condemned too small to stop the slaughter. There is inefficacy of the authorities to maintain the law, due to a shortage of funds, staff and equipment, corruption, envy between governmental departments, loopholes in the law, uncertainty about the boundaries of reserves and many other factors. *D. sumatrensis*, especially the animals outside the reserves, are endangered also by rapidly increasing cultivation and timber exploitation . . . The cutting of the trees, mostly rather extensively, will not necessarily make an area uninhabitable for ground living animals, provided that there is a suitable refuge for the time of the operation, but the indigenous people who settle in an area opened up by timber extraction, form a great obstruction, through their cultivation and

hunting practices, for the repopulation of the area.

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Horn

The main uses for rhino body parts are medicinal in Asia, ornamental in the Middle East, and, in the final analysis, commercial everywhere. The wholesale value of African horn rose from 30 American dollars a kilogram in 1970 to 700 dollars in 1986, and for Asian horn the respective values were 2000 and 9000 dollars. An African black rhino carries horn weighing about three kilograms. The popular myth in the West is that rhino horn is prized by orientals as an aphrodisiac, but, as Dr Esmond Bradley Martin, the unchallenged expert on the trade in rhino horn, has found, this use is restricted only to parts of northern India, specially Gujarat and West Bengal, where some men apply a paste of powdered horn and water to their penis and testicles, hoping to enhance their potency and virility. The widespread, erroneous western conviction is hard to change, however, for it is too often repeated even outside the field of wildlife conservation. In Tom Stoppard's 1969 play *Albert's Bridge*, Albert announces 'Civilization is in decline and the white rhino is being wiped out for the racket in bogus aphrodisiacs.' A report in *The Times* of 20 May 1986 about Bradley Martin's work for the World Wildlife Fund Save-the-Rhino campaign stated that 'the horn is used widely in traditional Chinese medicines, as an aphrodisiac and for the treatment of fevers.'

In reality, only the second use is common. Bradley Martin himself, in *Oryx* in 1981, described the fever-reducing drug made from rhino horn being 'sold over the counter along with the aspirin and antibiotic' in Chinese pharmacies throughout South-east Asia. He pictured the scene when a Chinese patient with a rhino-horn prescription from his doctor takes it to his pharmacist, who prepares the medicine in full view, explaining the properties of the ingredients as he goes along. Customers never accept a ready-made powder, as pale grey, ground rhino horn can easily be faked by pale grey ground water-buffalo or antelope horn. The customer therefore inspects the horn itself and, if satisfied, will tell the pharmacist to go ahead. With a sharp knife, one to three grams are then removed. When the patient gets home, he empties the shavings from their ribbon-tied paper packet into a glass of boiling water which, when cooled, will be sipped. If his fever has not been reduced within three to four hours, he will take a second dose.

Even without the aphrodisiac qualities sometimes ascribed to it, rhino horn appears to be a panacea for virtually all ills, according to folklore from both East and West. Powdered rhino horn was a standard ingredient in the European pharmacopoeia into the eighteenth century, and in Asia the traditional symbol of an apothecary is a rhino horn. It is said to cure anything from hallucinations, possession by spirits, dysentery, tuberculosis, and leprosy to cancer, arthritis, and smallpox. It can also be used against snake-bites and stomach-aches, to extract thorns, or as a purgative. A tonic made in Malaysia, *Three Legs Brand Rhinoceros Horn Anti-Fever Water* manufactured by the Wen Ken Drug Company in Johor state, claims: 'This medicine is carefully prepared from the best selected Rhinoceros Horn and AntiFever drugs, and under the direct supervision of Experts. This wonderful medicine acts like a charm in giving immediate relief to those suffering from Malaria, High Temperature, Fever affecting the Heart and Four Limbs, Against Climate Giddiness,

Insanity, Toothache etc.'

According to Bradley Martin, 60 per cent of the horn now sold ends up in medicines, particularly Chinese traditional ones, many still based on the sixteenth-century prescriptions of Li Shih Chan, who compiled a 50-volume encyclopaedia of pharmacology. Zulus in South Africa also still use horn and other rhino products medicinally, and they are able to buy them in Johannesburg and Pretoria. They boil pieces of horn in water and sip the strained liquid for coughs, chest pains, and snake bites, sometimes mixing a crushed form of it with milk as an asthma cure. Bradley Martin knew a Zulu who used to burn the horn and sniff the ash to stop nose-bleeds. Many keep a piece of horn as a good-luck talisman, while others think a little rhino-horn ash rubbed into their eyebrows will help attract beautiful girls. For the Kachin people of Burma, only the posterior horn is effective, while in Malaysia the best horn is that of a freshly killed male and preferably a Javan rhino rather than a Sumatran. The Yemenis prefer the horn, weighing about 1.5 kilograms, from a middle-aged animal in good condition. In Indonesia three grades of horn are distinguished - the most valuable red, the next in value white, and the least valuable and most common, black;

Horn artefacts and trade

In popular imagination, rhinos have gained - or lost - by association with the unicorn, the real animal assuming some of the fabulous powers of the unreal one. The horns of both were said to be capable of detecting poison in liquid poured into them, hence the rhino-horn cups used by mediaeval popes and kings. According to their belief, either the poisoned beverage will bubble, discolour, or be rendered harmless in the cup, or the cup itself will disintegrate. There may be some grounds for this, as ancient poisons were strong alkaloids and might have reacted with rhino horn, which is composed of keratin and gelatin. Ctesias, the Greek physician of King Artaxerxes I of Persia, writing in the fifth century BC, was the first to mention these cups, and the belief had a long life. As late as the 1770s, when C.P. Thunberg, a pupil of Linnaeus, was travelling in southern Africa, he reported that the horns of rhinoceroses were kept 'not only as rarities but also as useful in diseases and for the purpose of detecting poison. The fine shavings of the horns, taken internally, were supposed to cure convulsions and spasms in children, and it was firmly believed that goblets made of these horns in a turner's lathe would discover a poisonous draught by making the liquor ferment.' The use of these cups across Asia, from Persia to India and China, as well as in Europe, indicates the early and long-lasting trade in rhinoceros products, probably pioneered by Arab traders sailing dhows on the routes between East Africa and Asia. China was probably the first major importer of rhino products, from the eighth century AD (about the time the animal became extinct there) though a live rhino was sent to the emperor from a country 'eight months distant by sea' as early as the second century. At roughly the same time African rhino horn was making its way to Arab and Indian ports, and later from there to Canton. Traders had to pay a 30 per cent tax on rhino horn to Chinese officials; the Arabs bartered it for goods which they sold back in Baghdad and other Middle Eastern centres. Until the fifteenth century Arabs continued to be the main suppliers for the growing Chinese demand, when Portuguese conquests disturbed the trade. But it was revived with a vengeance when Seyyid Said, Sultan of Muscat, moved his capital to Zanzibar on the east coast of Africa, today in Tanzania, in 1840. Seyyid Said and his successors presided over massive slaughters of the rhinos; it has been estimated that the two coastal towns of Mafia and Bagamoyo were receiving as many as 8000 kilograms of rhino horn a year from the interior of East Africa in the 1840s.

Skin, blood, and other parts

After the horn, the tough skin of the rhino is most in demand. In the eighteenth-century both Rajasthan and African warriors made shields from the hides of their rhinos. The need for armour may have passed, but the hide is still used to make whips or *sjamboks* in southern Africa. William Burchell's journal of 9 April 1811 described them:

The *shambok* ... is a strip, three feet or more in length, of the hide either of a hippotamus or of a rhinoceros, rounded to the thickness of a man's finger, and tapering to the top. This is universally used in the [Cape] colony for a horsewhip, and is much more durable than the whips of European manufacture ... This manufacture is not peculiar to the Cape; it is well known in northern Africa, and forms an article of trade under the name of *Corbage*.

Dried skin is exported from South Africa to Hong Kong, where Chinese traders process it for medicinal use in the treatment of skin diseases or rheumatic problems. Asian rhino skin is also used for this purpose and has been found by Bradley Martin in shops in Singapore, Taiwan, and Macao, as he reported in 1981. In Thailand the hooves and dried blood of Sumatran rhinos are also used by pharmacists. Rhino dung, taken from the lower intestine of a freshly killed beast, was once considered a laxative, and, in the northern part of the country, a whole rhino penis, dried and soaked in brandy, reputedly produced an aphrodisiac liquid, though the rarity of Sumatran rhinos in Thailand now must severely limit the availability of both of these remedies.

The blood is particularly prized and, in Nepal, believed to ease the process of dying, releasing the soul peacefully to the other side. Rhino blood had mystical significance in both Asia, particularly India and Nepal, and Africa. According to Dillon Ripley, the former Secretary of the Smithsonian Institution, 'There is even said to be an obscure Indian religious rite, a sort of purge, performed by squatting inside the body cavity of a freshly killed rhino after it has been eviscerated. Certain prayers are recited and the severed rhino horn is used as a cup to hold the rhino blood offered to the gods.' The requirement that kings of Nepal bathe in rhino blood is well documented, while in Africa Captain C.R.S. Pitman, describing a trip in the 1920s along the Kerio River in East Africa, wrote:

A particularly unsavoury custom to which I was introduced by some of my voluntary assistants in the course of this trip was that of bathing in rhinoceros blood! It is even more disgusting than it sounds... Two natives indulged in this luxury, so I was told, to acquire unlimited courage and strength. As soon as the rhinoceros had breathed its last, the throat was cut and the jugular severed, the skin below the gash being pulled outwards to leave a capacious hollow, which was sly filled with blood - foul-smelling, evil-looking, and black, more

viscid than fluid. Having stripped themselves of their scanty body adornments, these two savages, with evident delight, smeared themselves from head to toe with the filthy slime till they reeked with offensiveness and literally shone in the brilliant sunshine. ___<

Hunters will rush to plug bullet or spear wounds on a dead animal in order to save the precious blood, and they usually remove the guts carefully on the spot, storing the blood and body fluids in bamboo tubes or in sausages made from the animal's intestines, then smoke-drying the carcass ready for transport out of the forest. Rhino teeth and the penis are used as amulets in Borneo, while the mere possession of a rhino's tail is believed to dull the pain of childbirth. A boiled dung drink is said to cure fever and the urine is supposed to be efficacious against either spirits or rheumatism. Burmese tradition holds that the urine is a cure for asthma, sore throats, and coughs, while Indians mix rhino urine with honey and water as a night-time or breakfast drink. At the zoos in Rangoon and Calcutta, rhino urine has been systematically collected and marketed for such purposes earning Calcutta zoo about US\$750 a year.

Nineteenth-century explorers in Africa wrote that the meat of hunted rhinos was eaten. William Burchell, travelling in the interior of southern Africa in 1812, said that the meat was particularly popular there, either fresh or dried into strips carried during overland travel. He described a feast for 24 Bushmen camped around a rhino he had shot:

They were actively employed the whole night long, in broiling, eating and talking. I watched them with astonishment: it seemed that their appetite was insatiable; for no sooner had they broiled and eaten one slice of meat, than they turned to the carcass to cut another. I scarcely think they allowed themselves any time for sleep... The meat of the rhinoceros was excellent, and had much the taste of beef, and although the flesh of this, which was an old animal, was somewhat tough, perhaps on account of just being killed; yet that of the female, being fatter, proved exceedingly well-tasted and wholesome. The tongue would have been pronounced a dainty treat, even by an epicure.

American cartoonist John McCutcheon, author of *In Africa: Hunting Adventures in Big Game Country* (1910), said, 'The rhino's tongue is even more delicious to eat than ox tongue, and rhino tail soup is a great luxury on any white man's table... The conscience of one who slays a rhino is somewhat appeased by the fact that 100 native porters will have a good square meal of wholesome meat to help build up their systems.'

Only very few groups kill rhinos for food today, most of them small communities in Borneo and Sumatra, although the Chinese are said to be fond of the cooked green contents of the herbivorous rhino's stomach.

Dagger handles

Although its supposed medical properties principally account for its trade, rhino horn is also in demand as a status symbol. For many years, certainly since the 1930s, the Yemen Arab Republic (North Yemen) has imported great quantities, chiefly from Africa, to use as handles for the daggers traditionally carried by most adult men to indicate status and sexual maturity, the size of the handle indicating their rank in society. Until recently, however, rhino handles were the privilege of the elite, at one time restricted to the family and associates of the ruling Imam alone, commoners carrying handles made from cow horn. After a destructive civil war, the 1970s saw a large number of Yemeni men working abroad, and the resulting influx of foreign remittances to the tune of a billion American dollars a year enabled even ordinary Yemenis to buy such desirable things as rhino-horn dagger handles. Bradley Martin justly called it, 'the conspicuous consumption of rhinos'.

This development was probably responsible for escalating the market price for rhino horn from about 30 dollars a kilogram in 1969 to as much as 500 dollars in 1979. Between the early 1970s and 1984 the country imported half the

rhino horn available on the world market, with a wholesale value in Yemen of 10 million dollars. The quantity imported in 1970 was three tonnes. In 1982 Yemen passed a law prohibiting the import of rhino horn, but this was not properly enforced. Between August 1982 and the end of 1986, five tonnes of horn were smuggled in illegally.

This quantity represents the death of 1735 rhinos, 40 per cent of the black rhinos left in Africa. A combination of factors brought the imports down from three tonnes in the 1970s to about 1.5 tonnes a year between 1980 and 1984. Some craftsmen in Yemen say that they were making about 6000 dagger handles a year in the mid-1970s, but less than 2400 a year now. Increasingly, they are switching to substitutes like water-buffalo horn or even plastic. Today a dagger with a rhino-horn handle will sell for between 170 and 845 dollars compared with a plain one for only about 13 dollars.

This decline in the dagger-handle business is not surprising, considering that the black rhino population was reduced from 65,000 to about 15,000 over about the same period. (There are an estimated 4500 in the wild today.) But any other factors combined to produce this situation including reduced demand, partly owing to the increasing westernization of the elite; escalating prices; and belated government realization that the plight of the rhino is grave, leading to better enforcement of wildlife protection measures. This trend was accentuated after 1984 by a sharp economic decline, particularly in the export trade, which left Yemen very short of hard currency and with the value of the Yemeni rial tumbling. Few would-be carvers of dagger handles or customers could now afford rhino horn.

Rhino horn found in Yemen originates in Somalia, Kenya, Tanzania, Zimbabwe, Zambia, Mozambique, Angola, and South Africa, and most of it comes in by air, with some carried by dhows from East Africa, packed in sacks purporting to contain flour, sugar, or rice. Some comes in overland. Bradley Martin (*Pachyderm*, April 1987) detailed one tortuous route. From most African states the horn is exported illegally to the central African republic of Burundi, where the trade is still legal (Djibouti also *plays* a similar role), then freighted by air to Addis Ababa in Ethiopia and on to Dubai in the United Arab Emirates, from where it is trucked across the Saudi Arabian Empty Quarter and over the largely unpatrolled eastern borders of Yemen. A more sinister trade in rhino horn, says Bradley Martin, is well known to be conducted via diplomatic channels and the diplomatic bag belonging to the embassies of certain nations hungry for convertible currencies.

Since Hong Kong began to conform to the principles of CITES in 1979, the shavings of rhino horn left over after Yemeni craftsmen have worked their dagger handles have been channelled chiefly to South Korea and China, selling at US\$220 to US\$ 250 a kilogram.

The Yemenis are the people who most admire the aesthetic qualities of rhino horn today but a long tradition precedes them. Chinese craftsmen made sword hilts, belt buckles, buttons, and ceremonial cups or bowls, and sometimes ornamented a whole horn with carvings. By the sixteenth and seventeenth centuries, carved horns or horn artefacts were prized *objets d'art* in European cabinets of curiosities, mostly made from African rhinoceros horn, which is almost translucent and may resemble amber when polished. Large collections of these carvings may be seen at the Shosin in Japan (including some plaques from the eighth century), the National Palace Museum in Taipei, Taiwan, the Chester Beatty Collection in Dublin, the Fogg Museum in Boston, and the royal Swedish collection, while the Museum voor Land en Volkenkunde in Rotterdam has nearly 80 cups. The carved horn once owned by Linnaeus, is with the rest of his collections in the keeping of the Linnean Society, London.

Several governments have allowed official stock-piles and auctions of rhino horn although as long ago as 1981 Bradley Martin pointed out that these virtually encourage poaching. Ostensibly, stocks of horns maintained by conservation authorities are collected from animals which die naturally. Botswana has now destroyed all its stocks, but legal auctions continue elsewhere. In 1982 Bradley Martin reported one of horns collected at Kaziranga and Manas sanctuaries in Assam. The horn was auctioned at Gauhati, a town 220 kilometres away, the centre for all rhino horn collected in Assam, under the direction of the Conservator of Forests, for the Forest Department. The auction is annual, and although it is supposed to operate on a tender basis - that is, the highest bid does not necessarily get the goods - in fact, horn usually goes to the highest bidder. Between 1972 and 1980, 283 horns weighing a total of 205 kilograms were auctioned at Gauhati. During most of the 1970s a Nepali from Kathmandu outbid the traditional Calcutta buyers for the whole consignment, but toward the end of the decade a merchant from

Manipur state, south-east of Assam, took over.

Inter national Pressure

Until very recently, much of the rhino-horn trade was in, and via, Singapore, which, with the United Arab Emirates, were the major entrepots. Most horn now traded in Asia originates in Africa, but Bradley Martin has said that Singapore is more significant for handling almost all the Asian horn on the world market, particularly from Indian poachers moving their loot via Calcutta. In October 1986 Singapore announced a ban on the import and export of rhino horn, although it allowed existing stocks to remain in place and shopkeepers to continue selling their old stocks. Later in the same year and under escalating pressure from the USA, which took the form of banning all her wildlife exports including the lucrative trade in aquarium fish, Singapore signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the last of the five founding nations of ASEAN (the Association of South-east Asian Nations) - Thailand, Malaysia, Singapore, Indonesia, and the Philippines - to do so.

The sixth and newest ASEAN member, Brunei, had not signed when this book was written and Bradley Martin has reported that this oil-rich sultanate on the island of Borneo is allowing imports of rhino products for its 55,000 Chinese residents. Prince Philip as the President of WWF International, wrote to the Sultan of Brunei in March 1986 about this trade, but there is a fear that, with outlets in Singapore now restricted, Brunei could become a major loophole in the region. Thailand, another CITES member of ASEAN, has done very little to curb the trade in rhino products: in 1985, 34 per cent of the Chinese_ medicine shops in Bangkok were still selling rhino horn.

Nepal, with 350 rhinos of its owns; has been successful in controlling the rhino trade, even though it is one of the world's poorest countries. The main reason is the King of Nepal's personal interest in the problem. Ironically, Nepal was once a primary offender against the rhino. Bradley Martin has told how the wildlife filmmaker, Armand Denis, visited the Maharajah of Nepal at his Kathmandu palace in 1939 and was shown around his trophy room. On each side of the hall were 20 marble pillars, each bearing the stuffed head of a rhino - 40 rhinos in all. Deeply disturbed, Denis said, 'You are aware of course, Your Highness, that there are very, very few of these animals left,' to which the Maharajah's reply was, 'I think you will find that there will be just enough to last me my lifetime.'

Hong Kong was the main importer of horns from 1945 until 1979, when it started to operate CITES, even though it could not join the agreement because of its colonial status. The colony nonetheless cleared all old stocks by late 1985 and now bans all sales abroad. As a result of these developments in Hong Kong, neighbouring Macao, administered by the Portuguese but actually under China's sovereignty, became one of the world's biggest importers of rhino horn in 1984, acting as an entrepot despite both Portugal and China being CITES members. All horn imports were banned after December 1985, however, Macau conformed with CITES from early 1986.

Taiwan legally imported 416 kilograms of rhino horn between 1980 and 1984. Fortunately, Chang Feng-shu, one of the Ministers of State, who also heads Taiwan's Society for Wildlife and Nature, was extremely concerned and lobbied for an end to the trade. In 1985, prompted further by a letter from Prince Philip on behalf of WWF, he was able to persuade the Taiwan government to stop the trade immediately.

South Korea used most of its imported rhino horn to make Chung Sim Hwan medicinal balls for the treatment of high blood pressure, nose bleeds, paralysis, and aches and pains. But late in 1983 the Korean Ministry of Health and Social Affairs ordered that rhino horn be eliminated from these preparations, and this was backed by legislation in 1985 banning both imports and exports of rhino products. Waterbuffalo horn is now accepted as a substitute.

Although traditional medicines are still important to the Japanese, the government of Japan banned imports of rhino horns in 1980 and promoted the use of saiga antelope horn as a substitute, sending letters to every single medicine shop in the country. Very little rhino horn has been smuggled in since this prohibition. China is also a CITES member but, although little horn is found on sale in its medicine shops, it is a major producer of remedies containing rhino horn.

The United Arab Emirates are signatories of CITES too but after banning exports and imports of horn in 1982, they totally ignored the prohibition. However, this is likely to change. At a United States Congressional hearing on the rhino in September 1986, expert witnesses strongly urged that the American government consider blocking its 35-million-dollar annual foreign aid budget to Yemen if the country did not act more decisively to curb its imports of rhino horns. Even more striking was the level of co-operation promised by the Yemeni Deputy Prime Minister and Minister of Foreign Affairs, Dr Abdul al-Iryani (a Yale University Ph.D. in zoology) when he met Bradley Martin, the American and British ambassadors to Yemen, and the African Wildlife Foundation representative late in 1986. He agreed to encourage even further the use of substitute materials for dagger handles, to prohibit the export of rhino-horn shavings, to press the leading Yemeni importer to cease his imports of horn, to talk to the President of the United Arab Emirates

about stopping exports of horn to the Yemen, and to withhold craftsmen's licences for carving dagger handles unless they signed an affidavit undertaking not to use rhino horn. Perhaps most powerful of all is another measure agreed upon at this meeting: that the Grand Mufti of the Islamic faith in Yemen should issue a *fatwa* or religious edict, backed by appropriate passages from the Koran, declaring that it is contrary to the will of God to eliminate an animal species. Several of these measures, though not all of them, had already been implemented by mid-1987.

The Future

With centuries of exploitation behind it, we now find the rhino more admired and appreciated in the west and in its indigenous lands than ever before. A great many factors have contributed to this improved position:

- greater awareness that reserves must be adequately guarded, even to such extremes as Operation Stronghold in Zimbabwe, begun in 1985, which allows rangers to shoot poachers on sight. Twenty-seven have been despatched but not before they and their accomplices killed 200 rhinos;
- captive breeding in many zoos and reserves within the animal's native territory, for all but the Javan rhino of which not a single animal exists in captivity and only 50 to 80 in the wild;
- translocation of individuals within their own country so that the dangers faced by isolated communities, easily harmed by natural disasters and genetic inbreeding, are reduced. Indian rhinos relocated in Uttar Pradesh's Dudhwa National Park are proving a successful new population;
- plans for intelligently controlled tourism in areas such as Malaysia and Indonesia where none exist at present;
- the development of private sanctuaries such as the 72,000-hectare Soho Ranch in Kenya;
- far greater co-operation among naturalists and governments than ever before.

Much of this has been assisted by private finance, such as the captive-breeding project in Sumatra for example, but governments are becoming much more financially liberal than in the past. The millions of Malaysian dollars now being put towards protecting the Sumatran rhino is a wholly new development. It has also come to be internationally accepted that nations fortunate enough to have these animals as native fauna cannot be expected to pay all the enormous costs to maintain them - any more than Egypt was expected to pay all the costs of saving its treasures from increased water levels, so badly needed by its population, when building the Aswan Dam. The WWF and governments throughout the world have helped and there have been imaginative private fund-raising schemes. Volunteers in the American Foundation to Save African Endangered Wildlife (SAFE) donated 100,000 dollars and equipment ranging from dirt bikes to aircraft to Zimbabwean conservation. In London, under the patronage of Prince Bernhard of the Netherlands, a Rhino Rescue Trust was set up in 1986 with such uncommon fundraising measures as an auction at Sotheby's which included a poem about the rhino by Ted Hughes, and a ball for 600 people, which together raised £400,000 during the Trust's first year.

Private individuals have also been moved to help the rhino. Michael Werikhe walked over 1250 miles in East Africa in 1986, distributing a record called 'Save the Rhino' and collecting over £34,000 which will benefit the black rhino. While trekking through Kenya, Uganda and Tanzania, he found that, 'everyone now, people of every type, love animals and want to save them. Even the ordinary man in the street and village gave what he could, even it was food or accommodation or just moral support.' He found the same feelings among Europeans during a 1987 walk

Most of the money raised by private individuals and groups is channelled through the WWF and is helping to fund a new rhino sanctuary at Nakuru National Park in Kenya, among other projects.

All of this is, of course, very encouraging and led Bradley Martin to comment, 'Certainly I am more optimistic than I have been since I first started studying the problems of rhino conservation - almost ten years ago - about future prospects for the rhino in Africa.' There is a long way to go, however, and public relations are absolutely vital to remove the idea of magic associated with the rhino's body part and thus reduce their sale, which will stop poaching; and to raise more funds to back more sanctuaries, protect existing ones, institute captive breeding and translocation programmes, and most of all, respect the animal in its own territory. As the wildlife

is

painter David Shepherd has said (*Landscape*, October 1987), 'We've got to convince every single African, very quickly now, that the wildlife is more valuable to them *all* as an asset, than dead at the hand of the poacher. It's a quick return, if you poach wildlife, for a few unscrupulous people - a few big time racketeers. Left as an asset, renewable resource, it can provide foreign exchange for years, centuries to come. say to the kids in Zambia: "Copper doesn't go on renewing itself,

but animals do.

Both countries which are hosts to wild rhinos and those which can merely admire them from a distance need skilled public relations to break down disagreements between conservationists, not all of whom approve of captive breeding, translocation, and change public lack of interest or exploitation into intelligent concern. All the usual weapons available to replace ignorance with knowledge need to be used - press, radio, television, cinema, slide and video presentations, book posters, leaflets, and lectures. Certainly there is a limit to what mere talk, no matter how ingeniously presented, can accomplish. If it goes on for too long, the rhino will be lost. But there has been such an increase in action during the past few years that there are also definite reasons to hope that poaching will be reduced and existing animals will replace themselves.

1986 WWF International celebrated its twenty-fifth anniversary of helping to save wild species and their habitat in the Italian town of Assisi, the home of St Francis, who preached that all living creatures are our brothers and sisters. This enormous and impressive ceremony, bringing together all the WWF's 23 national organizations, included a pilgrimage walk, a meditation retreat, and a conference, and was attended by many religious leaders. ..

Long before St Francis, holy writings defended wildlife. The Koran states in surah 6, 'There is not an animal that lives on earth, not a being that flies on wings, which does not live in communities like you.' Islamic teaching outlaws waste and forbids hunting for pleasure. Buddhism reveres the bodhi tree as a symbol of enlightenment and the Bible of Judaism and Christianity says, in Deuteronomy 20:19, 'When you destroy a city ... you shall not destroy its trees ... for you may eat of them but not cut them down. Are the trees in the fields men, that they shall be besieged by you?' Hinduism incorporates enormous respect for all living things as differing aspects of oneness and as possible reincarnations of people or gods. The Indian leader Mahatma Gandhi said, 'In its finer or spiritual sense, the term "cow-protection" means the protection of every living creature.' Chinese philosophy promotes the concept of the balance of nature, of cool, dark, passive, and female Yin in harmony with hot, bright, aggressive, and male Yang. Other ancient beliefs, including the dreamtime legend of Australian aborigines and Red Indian spirit cults, all promote the same idea: the oneness of man with the planet Earth and all that is in it and upon it. In this context, wildlife conservation can truly be seen as the last great crusade, a crusade for life.

FOR LAST PAGE OF BOOK:

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In the words of conservationist John Aspinall:

'Who can hope to describe in mere words the character and identity of this noble mammal? Athletic where the ignorant think him' clumsy, intelligent where fools think him stupid, only his legendary courage is agreed upon by all.

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"The arrival of firearms and the plague explosion of human primates have jointly sealed his fate."

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Francesco Nardelli

