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An overview of the conservation status of and threats to rhinoceros species in the wild

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This paper summarizes the recent status of rhinoceros species, as provided by IUCN Species Survival Commission's Rhinoceros Specialist Groups, and describes some of the current conservation measures. At the time of writing there are *c.* 14 950 rhinoceros remaining in Africa and *c.* 2850 in Asia. During the last decade conservation initiatives have achieved notable successes; however, numbers of some species and subspecies have declined over this period and three subspecies are close to extinction. The illegal demand for rhinoceros horn and the subsequent poaching this generates continue to pose a serious threat to rhinoceros populations worldwide. However, experience indicates that where anti-poaching efforts are concentrated above minimum threshold levels population losses as a result of poaching can be reduced to a low and sustainable level. However, not all populations receive sufficient protection and declining budgets of range-state governments for field conservation are a major cause for concern. The role of donor support is, therefore, becoming increasingly important. For some subspecies lack of adequate habitat protection rather than lack of suitable habitat is a major constraint for population expansion and growth. Many rhinoceros populations in Africa are managed as part of bigger metapopulations. However, sub-optimal biological management is also reducing population growth rates in a number of populations.

Key-words: conservation status, endangered species, habitat, illegal trade, protected areas, rhinoceros, threats

Rhinoceros, like other charismatic megaherbivores, require large areas to support viable populations. They act as umbrella species (Foose *et al.,* 1995) for the ecosystems they inhabit because their conservation requirements, by default, encompass those of other smaller species. If rhinoceros can be successfully conserved and protected within an area, then the other species in the area will also benefit. Before considering the status of each rhinoceros species in turn, it is worth first examining the main threats to rhinoceros species worldwide.

THREATS TO RHINOCEROS POPULATIONS

Rhinoceros have been hunted for centuries as agricultural pests, for trophies and meat, their skin has been used for shields and good luck charms, and their horn has been used in traditional medicines and as handles for ceremonial daggers (Emslie & Brooks, 1999). Over the last century a significant area of rhinoceros habitat has been degraded or lost as result of land-management practices and human settlement.

Increasing poverty in many African countries has often been associated with war and civil unrest, and the associated free flow of weapons has also had a negative impact on conservation efforts for rhinoceros. For example, insurgencies and civil wars in Nepal, parts of Assam and

[5] Dr Tom Foose, International Rhino Foundation Program Director, died on 18 May 2006. One of the founders of the IRF and with a passion for rhinoceros conservation, Tom will be remembered for the enormous contribution he made to the shaping of rhinoceros conservation programmes.

the Democratic Republic of the Congo have led to considerable reductions in numbers in specific parks in recent years (Hillman-Smith & Ndey, 2005).

The use of large tracts of land for wildlife conservation is under continued threat in Asia and Africa, as demand for land for subsistence farming, cattle grazing and commercial use, such as plantations and logging, increases. Human population growth and rising unemployment add to the pressure for land. In particular, habitat loss has had a significant impact on the Sumatran rhinoceros *Dicerorhinus sumatrensis*. However, many range states still have sufficient land to maintain rhinoceros populations.

Protection and conservation-management programmes for rhinoceros can be extremely expensive and beyond the reach of some range states. In both Africa and Asia effective anti-poaching efforts and management of rhinoceros can cost up to US$1000 annually for every square kilometre of habitat (N. Leader-Williams, pers. comm.; T. Conway, pers. comm.). Declining government budgets in real terms and, in some cases, declining capacity, pose a threat to the continued successes in a number of range states where population numbers have been increasing under effective protection and management strategies. Therefore, the assistance of donor agencies is becoming increasingly important, as are attempts by a number of range states to increase revenue for conservation through ecotourism. In some southern African countries rhinoceros contribute towards the cost of conservation through sustainable-use ventures, such as ecotourism, live sales and limited sport hunting of old and surplus ♂♂.

The major threat to rhinoceros is the illegal demand for horn and the poaching pressure that this trade stimulates. Over the last few decades poaching has been the main cause of decline in some areas. However such declines have not been universal as populations in many well-protected parks in Africa and Asia have increased over the last 10 years. Evidence suggests that in order to be effective, anti-poaching efforts need to be concentrated above minimum threshold levels. Where this can be achieved, poaching invariably has been reduced to low and sustainable levels. For this reason many rhinoceros are maintained in fenced sanctuaries or in intensive protection zones within larger national parks where manpower and resources can be concentrated at effective levels (Leader-Williams, 1988; Emslie & Brooks, 1999). In contrast, attempting to reintroduce rhinoceros into vast tracts of land without the necessary budgets and manpower to protect them successfully is not recommended.

Rhinoceros poached in Africa and Asia are targeted primarily for their horn but in some cases the entire carcass is used. However, the preparation and transportation of other body parts is difficult and in practice only the horn is taken from most poached animals (E. B. Martin, pers. comm.). Well-armed poaching gangs that cross international boundaries in search of rhinoceros have also impacted populations. While most of the profit from poaching goes to a few traders and middlemen, even the small amounts earned by poachers are enough incentive to risk fines, imprisonment or death. One problem is a tendency of the press to publicize the high value of rhinoceros horn. These are usually quotes of the final resale prices for rhinoceros horn, which does not bear any relation to the much lower amount poachers may get for whole horns (especially in Africa). This can send the misleading message to potential criminals that there is a lot of money to be made from poaching, when the reality is that in Africa the rhinoceros are worth far more alive than the horns are worth to poachers. There have been a number of cases in Africa in recent years where local dealers have not been able to sell horn and have in the end been caught in undercover sting operations, where it became clear

that the price poachers thought they could command was much higher than the actual black-market price.

TRADE

There are two main uses for Rhinoceros horn. It is carved to make ornate handles for jambiyas (ceremonial daggers worn in Yemen). Rhinoceros horn is also used in traditional Chinese medicine (TCM) (Martin & Martin, 1982; Emslie & Brooks, 1999). Although the media routinely claim that a major use of rhinoceros horn is as an aphrodisiac, this has been found to be largely a myth (Martin & Martin, 1982). Historically, the Gujarati in India did use rhinoceros horn as an aphrodisiac but following the increase in the price of horn this practice effectively ceased (E. B. Martin, pers. comm.).

Since the early 1970s Yemen has imported the largest quantity of African rhinoceros horn, which is preferred to Asian rhinoceros horn owing to its larger size, thus allowing more jambiya dagger handles to be made per horn. Most illegal horn from eastern Africa has been smuggled by traders into Yemen. Africa's Black rhinoceros *Diceros bicornis* population fell from *c.* 65 000 in 1970 to 2450 by the early 1990s. It is only in recent years that Yemen became a party to CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) and has outlawed imports of rhinoceros horn and exports of horn shavings to the East. Internal trade in rhinoceros horn was also prohibited and the making of new rhinoceros-horn jambiya handles was banned. Attempts have been made to lower demand by encouraging high-value substitutes for the horn (e.g. agate: a hard, fine-grained semi-precious stone). For a time the amount of rhinoceros horn entering Yemen declined (Martin *et al.,* 1997; Martin & Vigne, 2005). However, recent information indicates that Yemen remains the main recipient of rhinoceros horn from Africa and the bulk of horn imported into Yemen in 2005 came from the Northern white rhinoceros *Ceratotherium simum cottoni* (Vigne & Martin, 2006). Jambiya with new rhinoceros-horn handles have been found on sale openly suggesting that craftsmen have little reason to hide them because government inspectors are not doing enough to curb the trade (Vigne & Martin, 2006).

Even though the use of rhinoceros horn in TCM is now banned in most countries, rhinoceros horn is still being traded throughout Asia. It has been suggested that in the late 1980s and early 1990s rhinoceros horn may have been stockpiled as a speculative investment (Emslie & Brooks, 1999). With the increased implementation of domestic trade bans the trade has gone underground and it is now more difficult to monitor and assess levels of illegal trading.

While some TCM practitioners have identified a number of acceptable substitutes, others believe that rhinoceros horn is irreplaceable for the treatment of certain, sometimes life-threatening, conditions. In TCM rhinoceros horn is used primarily for the treatment of ailments, such as epilepsy, fevers and strokes. Many pharmacists consider Asian rhinoceros horn to be more effective than African rhinoceros horn. Although African rhinoceros horns are bigger than the horns of the three Asian rhinoceros species, owing to the greater rarity, smaller size and perceived superior medicinal properties, Asian horn sells at a premium (Martin & Martin, 1982). Clinical studies testing the efficacy of rhinoceros horn to reduce fever have concluded that it either had no effect in rabbits (Laburn & Mitchell, 1997) or had only a small effect when given in massive doses to rats (But *et al.,* 1990).

Seizure of medicines containing rhinoceros horn indicate that the majority were produced in China, with Hong Kong and, more recently, Singapore acting as major holding centres for rhinoceros horn (Mills, 1997). Research by TRAFFIC has shown that the principal consuming

nations are South Korea, Taiwan and mainland China, with manufactured medicines also being exported to expatriate Chinese communities around the world (Leader-Williams, 1992; Nowell *et al.,* 1992; Mills, 1997).

The issue of trade bans is controversial because such bans have meant that rhinoceros horn has had to be obtained unsustainably by poaching and this may have encouraged black-market activity. Some have argued that if this trade was legalized, the legal stockpiles in some range states could provide a supply of horn without killing rhinoceros; and that horn recovered from rhinoceros that die from natural causes and routine harvesting of horn from live rhinoceros could also provide much needed revenue for conservation as well as creating a further economic incentive for the expansion of rhinoceros range. This, in turn, would convey a strong message that rhinoceros are not becoming extinct, which could lead to a drop in the black-market price of horn and thus reduce illegal demand and, hence, poaching. However, many others are against re-opening a legal trade arguing that the combination of international trade bans under CITES and the more recent imposition of domestic trade bans are starting to be effective in reducing poaching and the trade bans should be given more time. Concerns have also been expressed about whether any proposed trade could be properly controlled and, in particular, whether it would be possible to prevent poached horn from being laundered and smuggled into the market illegally. No range state proposed any downlisting to trade in rhinoceros horn at the last CITES Conference of the Parties (COP 13) and it is highly unlikely that any such proposal would gain the necessary two-thirds of votes needed for a downlisting. Thus, for the immediate future it is unlikely that the trade in rhinoceros horn trade will be legalized.

AFRICAN SPECIES

Of the five extant rhinoceros species, the White rhinoceros *Ceratotherium simum* and the Black rhinoceros *Diceros bicornis* occur in Africa. Historically, the White rhinoceros had a much more restricted distribution than the Black rhinoceros (Emslie & Brooks, 1999). Currently, three of the four Black rhinoceros subspecies and one of the two White rhinoceros subspecies are listed as Critically Endangered on the *2006 IUCN Red List of Threatened Species* (IUCN, 2006).

WHITE RHINOCEROS

There are two distinct subspecies that differ greatly in their current conservation status: the Southern white rhinoceros *Ceratotherium simum simum* and the Northern white rhinoceros *Ceratotherium simum cottoni.* The Northern white rhinoceros is extremely rare and only occurs in one wild population of just a few animals in the Democratic Republic of the Congo (DRC) where recent surveys only confirmed a minimum of three animals surviving following a major upsurge in poaching since mid-2003, while the Southern white rhinoceros is the most numerous rhinoceros taxa, with its main stronghold in South Africa (Fig. 1). Because of the spectacular recovery in numbers of Southern white rhinoceros, the species is no longer listed in one of the IUCN (2006) threatened categories and is rated as Near Threatened. The White rhinoceros is also the only species where numbers now exceed the currently recommended Minimum Viable Population (MVP) size of 5000–7000 individuals (Reed *et al.,* 2003).

Southern white rhinoceros *Ceratotherium simum simum*

Once widespread in the bushveld areas of southern Africa south of the Zambezi River, this subspecies was on the brink of extinction by the end of the 19th century having been reduced to just one small breeding population of *c.* 20–50 animals

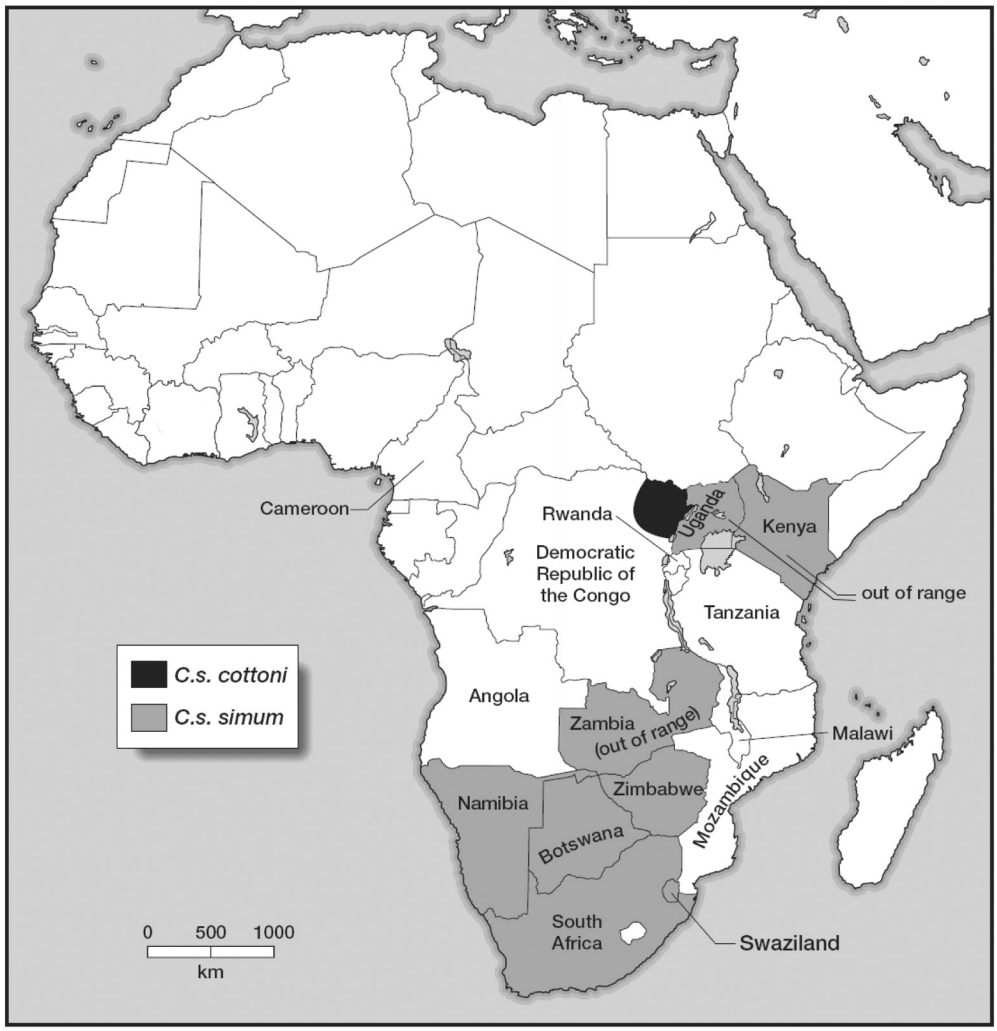

Fig. 1. Distribution of White rhinoceros *Ceratotherium simum* **(as at end of 2003, updated from Emslie & Brooks, 1999).**

in KwaZulu-Natal, South Africa (Emslie & Brooks, 2002).

The development of translocation techniques in the 1960s and subsequent annual removals has resulted in large-scale restocking of many wild populations (predominantly in South Africa but also in a number of range states and some non-range states) with hundreds more being exported to zoos worldwide. Under protection by the end of 2003 Southern white rhinoceros numbers had recovered to over 11 300 animals in 379 wild populations in eight African countries with a further 737 animals held in captivity (Emslie, 2004a). While Hluhluwe-iMfolozi National Park, South Africa, currently conserves 1900, the largest population of 4900 is in Greater Kruger National Park, South Africa, and adjoining private reserves.

South Africa remains the stronghold for this subspecies, with 93% (10 540

animals) of the total population as at the end of 2003. While the majority are still conserved in state Game Reserves (GR) and National Parks (NP), by 2002 a minimum of 2856 Southern white rhinoceros were owned and conserved by the private sector in South Africa (Knight, 2004). Smaller reintroduced Southern white rhinoceros populations occur in Botswana, Mozambique, Namibia, Swaziland and Zimbabwe. Out-of-range populations have also been established in Kenya, Zambia and most recently in 2005 Uganda (a former Northern white rhinoceros range state).

Kenya, Namibia and Zimbabwe are the only countries outside of South Africa to maintain populations of >175 Southern white rhinoceros. Together these 'Big 4' rhinoceros range states conserve 99% of the subspecies in the wild. Interestingly the same four countries also conserve 97% of Africa's Black rhinoceros.

The Southern white rhinoceros is now the most abundant and its numbers are greater than all the other taxa of rhinoceros combined (Table 1). This recovery in only 110 years from *c.* 20–50 to $>12\,000$ animals (including those in captivity) represents one of the world's greatest conservation success stories.

Threats to Southern white rhinoceros Illegal poaching for the international trade in rhinoceros horn is still the main threat to the subspecies, although it has been infrequent in South Africa. Poaching increased around the time of the independence elections and peaked at 26 animals in 1994 but levels have since declined (Emslie & Brooks, 1999; Knight, 2004). In several range states a number cases of poaching have been successfully investigated, resulting in convictions and jail terms, which should act as deterrents. A major concern is a recent change to legal interpretation in Zimbabwe whereby poaching of rhinoceros no longer results in a mandatory jail sentence with convicted offenders instead now face paltry fines. However, jail terms of 5–20 years have been given in South Africa, Swaziland and Namibia.

Undercover wildlife investigations indicate that the demand for horn is still high, so there is no room for complacency. Should the quality and intensity of field protection efforts decline, poaching levels could increase. Maintaining sufficient budgets and field-conservation capacity will therefore be critical in the years ahead. Declining budgets for range-state conservation agencies and, in some cases, declining capacity for field-conservation action are a major concern (Emslie & Brooks, 1999).

Conservation measures The Southern white rhinoceros was listed on CITES Appendix I. However, since 1994 the South African population of Southern white rhinoceros was downlisted to Appendix II but only for trade in live animals to 'approved and acceptable destinations' and for the (continued) export of hunting trophies. In 2004 the Swaziland population was also similarly downlisted by CITES but with a fixed per cent upper quota for both live removals and the export of hunting trophies. Trade in horn is still banned under CITES and at the last CITES COP no White rhinoceros range states proposed downlisting to reopen a legal trade in horn. To help reduce illegal trade and complement CITES international trade bans, domestic anti-trade measures and legislation were implemented in the 1990s by a number of consumer states. Effective protection of rhinoceros populations has been critical and many are now concentrated in fenced sanctuaries, conservancies, conservation areas and intensive-protection zones (Leader-Williams *et al.,* 1997; Emslie & Brooks, 1999) where law enforcement can be concentrated at effective levels.

Monitoring of rhinoceros numbers and performance has provided the necessary

	WHITE RHINOCEROS *Ceratotherium simum*				BLACK RHINOCEROS *Diceros bicornis*					
	cottoni	*simum*	TOTAL	TREND	*bicornis*	*longipes*	*michaeli*	*minor*	TOTAL	TREND
Botswana		67	67	up+intro				5	5	intro
Cameroon						5*?			5*?	?
DRC	22†		22†	down						
Ethiopia							4‡		4	?
Kenya		218	218	up			439		437	up
Malawi								8	8	up+intro
Mozambique		2	2	?				0?	0	extinct?
Namibia		186	186	up	1238				1238	up
Rwanda							1		1	down
South Africa		10 536	10 536	up§	71		36	1177	1284	up
Swaziland		61	61	up				15	15	up
Tanzania							42	24	66	up
Zambia		3	3	down				5	5	intro
Zimbabwe		250	250	up				536	536	up
TOTAL	22	11 345	11 350	up§	1310	5?	520	1770	3610	up

* Extensive ground surveys are under way at time of writing to confirm how many (if any) Western black rhinoceros still survive. There is a chance this subspecies may now be extinct in the wild.
† The minimum confirmed number in Garamba NP and surrounding hunting areas in the Democratic Republic of the Congo was only three by the end of April 2006.
‡ *Diceros bicornis bruceii?*
§ The figures given are from 2003 (state and defence-force areas) and 2002 (private, municipal, zoo and biosphere reserves).

Table 1. Numbers of White and Black rhinoceros in Africa as at 31 December 2003, presented by country and by subspecies (Emslie, 2004a). These numbers are routinely updated by the AfRSG every 2 years and updated estimates for 31 December 2005 will be released after the AfRSG meeting in late June/early July 2006. The table excludes speculative guesstimates. Subspecies totals >500 rounded to nearest ten rhinoceros. Numbers for *D. b. minor* in Tanzania, *D. b. bicornis* in Namibia, *D. b. michaeli* in Kenya, *D. b. longipes* in Cameroon and *C. s. cottoni* in DRC may be higher but this requires confirmation. Numbers of *D. b. minor* in Swaziland approximate to the true number. Other numbers compiled by IUCN SSC African Rhino Specialist Group at meeting in Kenya 6–11 June 2004; intro. introductions.

information to allow wildlife managers to focus on rapid population growth, which has resulted in a surplus of animals for translocation and to establish new populations both within and outside the former range of the species. Increasingly attempts are also being made to integrate local communities into conservation efforts.

While the majority of Southern white rhinoceros live in South Africa, the fact that this subspecies is now managed by a range of different stakeholders (private sector and state) in several countries with significant numbers also in captivity worldwide, increases long-term security.

In Southern Africa the non-consumptive (ecotourism viewing and live sales) and consumptive sustainable use (sport hunting of limited numbers of surplus ♂♂ since 1968) of Southern white rhinoceros has helped catalyse private-sector demand for rhinoceros. By the end of 2003 it was estimated that *c.* 29% (3252) of Southern white rhinoceros in Africa were privately owned. The commercialization of the Southern white rhinoceros has allowed formal state conservation agencies to remove surplus rhinoceros, preventing overstocking in the populations and thus solving a biological-management problem. At the same time this has generated substantial additional revenue to cover some of the funding shortfall caused by declining state budgets for conservation in real terms. On average the underlying growth rates of Southern white rhinoceros populations on private land have been high, contributing to the overall growth in numbers. The movement of Southern white rhinoceros onto private land has also significantly increased the range area for the subspecies. The economic value of rhinoceros has also been used in some court cases to convince magistrates that crimes against rhinoceros are serious offences deserving of heavy deterrent sentences. Their value has also helped conservation-resource economists in southern Africa to suggest to politicians that conservation is a valid economic form of land use and not 'a waste of land'.

Northern white rhinoceros
Ceratotherium simum cottoni

The situation facing the future of the Critically Endangered Northern white rhinoceros is bleak (IUCN, 2004). This subspecies once ranged in large numbers throughout north-central Africa south of the Sahara. In 1960 there were *c.* 2250 animals remaining but in the 1970s (Emslie & Brooks, 1999) and early 1980s, poachers reduced the number of Northern white rhinoceros from 500 to 15 surviving in Garamba NP, DRC. However by 1995, under protection, the population had recovered to 31. Civil wars in neighbouring Sudan and in the DRC led to an influx of automatic weapons into the neighbouring region and an upsurge in poaching. Nevertheless, for many years births in Garamba NP balanced poaching losses and overall numbers remained stable.

However, in mid-2003 there was a major upsurge in commercial poaching by ex- or current Sudan People's Liberation Army (SPLA) members and other southern Sudanese, often in collaboration with Congolese. The start of incursions by well-armed groups of Arabic horsemen from northern Sudan soon after this further compounded the problem (Hillman-Smith, 2004). By September 2004 numbers had been reduced to *c.* 15 individuals but a subsequent count revealed even fewer rhinoceros and additional poached carcases (Hillman-Smith & Ndey, 2005; K. Hillman-Smith pers. comm.). Recent intensive surveys in March 2006 confirmed the presence of only one adult ♂ and one adult ♀, although since the surveys an additional adult ♂ has been seen, bringing the current known minimum number as at May 2006 to three. It is hoped one or more additional animals may still survive and further survey work is required to clarify numbers.

In May 2004 ten Northern white rhinoceros were maintained in two zoological institutions; Dvur Kralove, Czech Republic (seven animals), and San Diego Wild Animal Park, USA (three animals). However, most of these animals are old and breeding has been poor (Hermes *et al.,* 2006).

Threats to Northern white rhinoceros The main threat to this subspecies has been poaching as a result of political instability, civil unrest and war. The small population size, with only one confirmed breeding ♀ and two ♂♂ remaining, will limit population growth and increase the chance of the subspecies going extinct in the wild as a result of chance demographic effects and/or genetic problems in the future (inbreeding depression). Despite improved security since Africa Parks Foundation became involved with Park management, with so few animals remaining and the instability and general availability of weapons in the area, poaching threatens this subspecies to extinction in the wild.

Conservation measures The subspecies is included on CITES Appendix I. In 1984 the Garamba NP Project began with rhinoceros conservation as its central focus. The increased protection afforded by anti-poaching efforts in Garamba NP allowed the population to double from 15 in 1984 to 30 by 1991. Since then there has been a long-running civil war in neighbouring Sudan and two civil wars in the DRC. In response to the recent poaching, an emergency strategy to move five rhinoceros to a safe sanctuary in Kenya as a temporary measure was developed by the protected-area authority in DRC and a coalition of international organizations in late 2004. The objective was to remove a small breeding group of rhinoceros and conserve them on a custodianship basis with the long-term intention to re-establish the Northern white rhinoceros population in Garamba NP once the Park was secured. The emergency plan included increasing anti-poaching support to Garamba NP to counter the current high levels of poaching. Unfortunately before a protocol could be formalized and signed by the DRC Government, the translocation fell victim to political manoeuvring and national divisions. Conservation activities in Garamba NP were obstructed and finally suspended, leaving the remaining rhinoceros defenceless for a period against poaching (Fauna & Flora International and International Rhino Foundation, Press Release, 7 April 2005). Since then, Africa Parks Foundation has taken over management of the Park in collaboration with the national conservation agency ICCN (Institut Congolese pour la Conservation de la Nature), and overall poaching in the Park appears to have reduced significantly.

BLACK RHINOCEROS

Black rhinoceros exist wherever herb and woody browse occurs in sufficient amounts to support a population. This spans a wide range of habitats covering deserts, semi-deserts, wooded savannahs, woodlands, forests and even sub-alpine heathlands. However, the densities at which Black rhinoceros can exist in these habitats vary 100-fold, from one rhinoceros per 100 km^2 in the desert plains of Western Kunene, Namibia, to more than one rhinoceros per 1 km^2 in thicket vegetation. There are four recognized subspecies of Black rhinoceros occupying different areas of Africa (Fig. 2).

Western black rhinoceros

Diceros bicornis longipes

This Critically Endangered subspecies once ranged throughout the savannah zones of central West Africa but was reduced to only a few scattered animals remaining in northern Cameroon with some animals believed to be seasonal visitors to Chad. There are no animals in captivity and in recent years the status of this subspecies has not been adequately

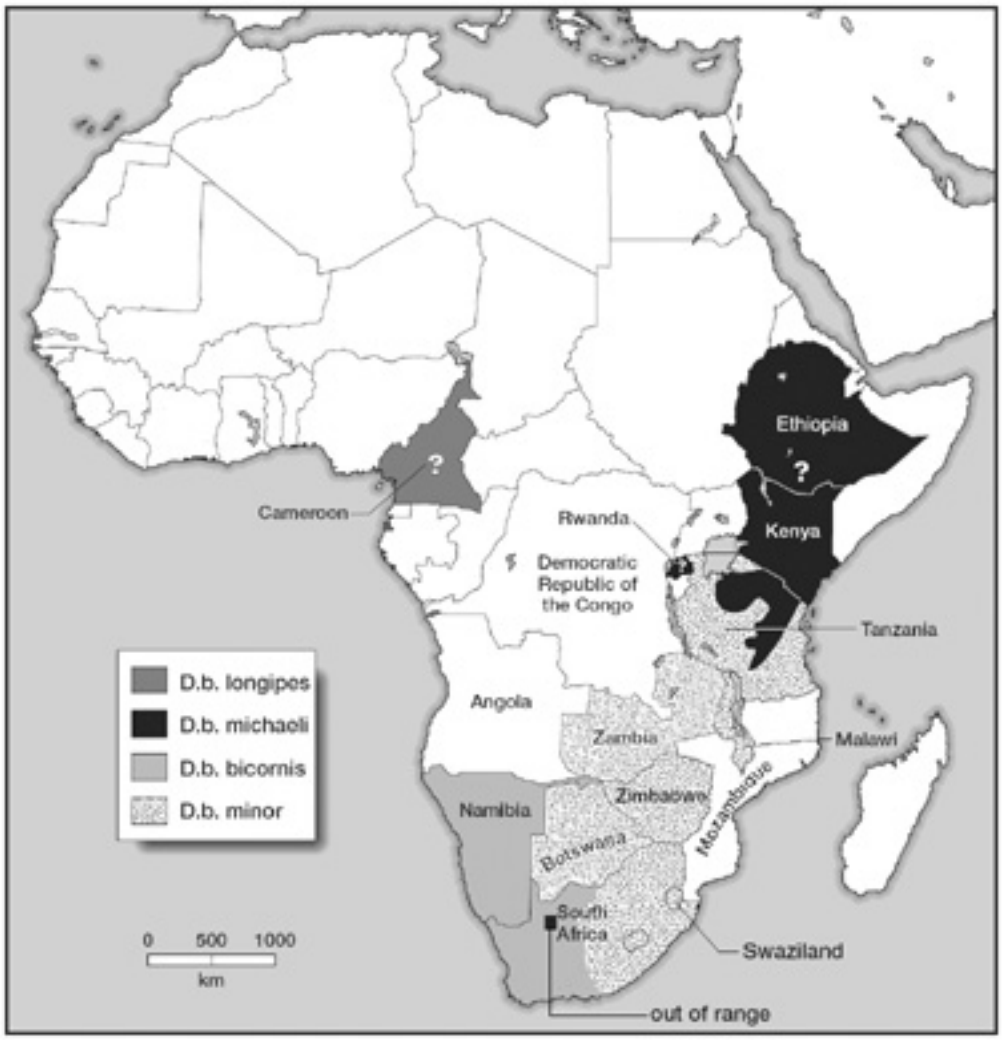

Fig. 2. Distribution of Black rhinoceros *Diceros bicornis* **(as at end of 2003, updated from Emslie & Brooks, 1999).**

known. At time of writing, extensive ground surveys are under way to determine the status of this subspecies and, indeed, whether or not any animals still survive.

Threats to Western black rhinoceros Poaching, lack of finance, limited anti-poaching efforts, limited local capacity for conservation management, failure of courts to give sentences that can act as a deterrent to potential poachers, and genetic and demographic factors all pose serious threats to this subspecies. Over the last decade remaining animals have been scattered in highly vulnerable small groups that may not be in breeding contact (H. Planton, pers. comm.).

Conservation measures The Western black rhinoceros is included on CITES

Appendix I. An action plan for Cameroon was developed in 1993, following an international mission and workshop held at Garoua in northern Cameroon, but this was never implemented. A high-level stakeholders workshop was held in Cameroon in 2000 to discuss potential strategies to prevent the extinction of the subspecies. Before fund-raising could begin it was agreed that there should be evidence that at least five Western black rhinoceros remained. New surveys in 2001 failed to confirm and photograph at least five rhinoceros. Surveys are nearing completion to determine the status of this subspecies and whether or not it has gone extinct.

Eastern black rhinoceros
Diceros bicornis michaeli

Historically this Critically Endangered subspecies ranged from southern Sudan, Ethiopia and Somalia through Uganda, Rwanda, Kenya and into north–central Tanzania (Emslie & Brooks, 1999). Its current stronghold is Kenya with 458 rhinoceros as at the end of 2003, mostly within protected areas, sanctuaries in both protected areas and on private land, and in a free-ranging population on county-council land. Tanzania has *c.* 42 Eastern black rhinoceros, mostly in free-ranging populations in unfenced protected areas and a few in one sanctuary. Rwanda and Ethiopia hold relict populations of one and two to four animals, in a protected area and on community land, respectively. At the end of 2003 South Africa had *c.* 36 Eastern black rhinoceros of predominantly Kenyan origin maintained on private land. As at December 2004 there were 171 Eastern black rhinoceros in captivity worldwide (Foose & Wiese, this volume).

Threats to Eastern black rhinoceros Poaching is the main threat to this subspecies. The majority of poached rhinoceros horn ends up in Yemen to be made into dagger handles (Martin *et al.,* 1997; Martin & Vigne, 2005).

Some populations of the Eastern black rhinoceros in enclosed areas appear to be overstocked and are showing clear signs of density-dependent reductions in reproductive performance (Ouma, 2004). In some cases competition from other browsers, such as African elephants *Loxodonta africana* and Giraffes *Giraffa camelopardalis,* appears to also be negatively affecting rhinoceros carrying capacity (Birkett, 2002; Brett & Adcock, 2002). Limited budgets for conservation are also a problem.

Conservation measures The Eastern black rhinoceros is included on CITES Appendix I. Effective field protection of rhinoceros populations has been critical. Increasing efforts are being made to integrate local communities into conservation efforts. In Kenya, the major range state, Eastern black rhinoceros are now managed by a range of stakeholders from a municipal county-council run area, to state-managed parks and fenced, well-protected sanctuaries, some of which are managed by the private sector.

National conservation strategies have also been implemented. Kenya's revised rhinoceros conservation strategy has placed increased priority on improved monitoring and biological management for rapid metapopulation growth following lower than average increases in recent years. The Kenyan Darwin Initiative project has implemented these key elements and the national population estimates over 2004 and 2005 have shown an annual increase of over 5% (Amin, Ouma-Okita *et al.,* this volume).

South-western black rhinoceros
Diceros bicornis bicornis

The original range of this Vulnerable subspecies included Namibia, southern Angola, western Botswana and probably also south-western South Africa. Significant populations have remained in the

desert and arid savannah areas of Namibia and this country is the stronghold for the taxon, conserving 1238 rhinoceros as at the end of 2003 (Emslie, 2004a), with South Africa conserving a further 71. There are no South-western black rhinoceros in captivity.

Threats to South-western black rhinoceros The main threat to this subspecies is poaching. Illegal hunting has been blamed for the disappearance of the South-western black rhinoceros from arid habitats in at least two range states (Angola and Botswana). Since 1979 conservation efforts in Namibia have stemmed poaching activities and the population has increased steadily. As in other range states, declining budgets for conservation are a problem.

Conservation measures The South-western black rhinoceros is included on CITES Appendix I. In Namibia poaching during the war of independence caused public outcry and increasing support for local protection efforts by international and local conservation agencies and communities living in areas with rhinoceros, have stemmed poaching activities in the country and the population has shown a steady increase since 1980 when there were only *c.* 300 animals (Emslie & Brooks, 1999). Effective field protection of South-western black rhinoceros populations has been critical to the rapid increase in numbers. Monitoring has also provided information to guide biological management decision making aimed at managing rhinoceros populations for rapid population growth. This has resulted in surplus animals being translocated to establish new populations. Increasing efforts are also being made to integrate local communities into conservation efforts. Namibia pioneered the use of community-based game guards to protect rhinoceros living in communal areas. Namibia's South-western black rhinoceros are now managed by a range of stakeholders from community conservancies, state parks and the private sector (on a custodianship basis for the state). South-western black rhinoceros have also been reintroduced to South Africa and numbered 71 by the end of 2003 (Emslie, 2004a). At the recent CITES COP, Namibia was granted an annual quota for the sport hunting of up to five surplus South-western black rhinoceros ♂♂. Not only will this deal with the problem of surplus ♂♂ in some populations but also it should generate significant revenue to fund and stimulate conservation efforts. Namibia has indicated that if any surplus ♂♂ are hunted in communal areas, local communities will have access to all the net revenue raised via Namibia's Game Products Trust Fund. In this way Namibia is looking to deliver tangible benefits to the communities that have successfully been conserving the desert rhinoceros in the north-east of the country.

South-central black rhinoceros
Diceros bicornis minor

This Critically Endangered subspecies is the most numerous of the Black rhinoceros subspecies. Historically, this subspecies occurred from western and southern Tanzania through Zambia, Zimbabwe and Mozambique to the northern and eastern parts of South Africa. It probably also occurred in southern DRC and northern Angola. Today its stronghold is South Africa and to a lesser extent Zimbabwe, with smaller numbers remaining in southern Tanzania. The South-central black rhinoceros is now thought to be extinct in Angola and Mozambique but small numbers have been reintroduced into Swaziland, Malawi and, more recently, Zambia and Botswana. The Italian funded Southern African Development Community (SADC) Regional Programme for Rhino Conservation has played an important catalytic role in promoting translocation of rhinoceros between countries and as at May 2004 there were 69 South-central black rhino-

ceros in captivity (Foose & Wiese, this volume).

Threats to South-central black rhinoceros Poaching is still the main threat to the subspecies. Conservative biological management appears to have limited metapopulation growth rates in some key populations (Emslie, 2001). In parts of Zimbabwe, land transformation following re-settlement has negatively affected habitat in some areas and has resulted in a number of snare-related deaths. There is a plan to create an additional intensive-protection zone in Zimbabwe. Declining conservation budgets, an apparent increase in poaching and losses of animals to snaring, and the prosecution of rhinoceros offences under statues without deterrent sentences are of concern.

Conservation measures The subspecies is included on CITES Appendix I. Effective field protection of rhinoceros populations has been critical. Increasing efforts are being made to integrate local communities into conservation efforts. A range of stakeholders, from state-run conservation agencies to privately owned sanctuaries, manage this subspecies. Increasing numbers have enabled translocations of surplus animals to establish new populations within the former range of the subspecies. However, overly conservative removals from some South African populations in the past resulted in density increases and declining population performance. Removal levels appear to be on the increase. Ongoing monitoring of individual rhinoceros occurs in the majority of populations and annual status reporting and improved estimates of ecological carrying capacities provide useful information to assess performance and assist biological decision making. Individual rhinoceros populations form part of a bigger metapopulation and there have also been occasional transfers for genetic-conservation reasons. Efforts are also made to investigate and prosecute poachers effectively to act as a deterrent.

Although threats to some managed populations on state and private land in Zimbabwe cause concern, some of the South-central black rhinoceros populations in that country have been among the best performing in Africa. Like Namibia, at the recent CITES COP, South Africa was granted annual quotas for the sport hunting of five surplus South-central black rhinoceros ♂♂. Sport hunting should generate significant revenue to help fund and stimulate conservation efforts. Similar to the limited Southern white rhinoceros hunting, the hunting quota for South-central black rhinoceros represents $<0{\cdot}5\%$ of the population and, therefore, will be sustainable. Indeed it has been argued that the removal of old surplus ♂♂ may counter-intuitively help increase overall metapopulation performance (Emslie, 2004b).

ASIAN SPECIES

There are three species of Asian rhinoceros and all three are threatened with extinction: two are Critically Endangered and one Endangered as listed by IUCN (2004) (Table 2).

Asian greater one-horned or Indian rhinoceros

Rhinoceros unicornis

The Endangered Indian rhinoceros was once abundant throughout the floodplains of the Ganges, Brahmaputra and Sindh Rivers and their large tributaries between Indo–Burmese border in the east and Pakistan in the west. Currently, rhinoceros are restricted to protected areas mainly in India and Nepal. In India, the majority are in Assam (Kaziranga NP, Pobitora WS and Orang NP) but also in West Bengal (Jaldapara WS and Gorumara WS) and a few in Uttar Pradesh (Dudwa NP). In Nepal rhinoceros occur mainly in Royal Chitwan NP but have also been reintroduced to Royal Bardia NP and Royal Suklaphanta Wildlife Reserve

	INDIAN RHINOCEROS *Rhinoceros unicornis*		JAVAN RHINOCEROS *Rhinoceros sondaicus*				SUMATRAN RHINOCEROS *Dicerorhinus sumatrensis*			
	TOTAL	TREND	*sondaicus*	*annamiticus*	TOTAL	TREND	*sumatrensis*	*harrissoni*	TOTAL	TREND
India	2100	up								
Indonesia			40–50		40–50	stable	200		200	stable or up
Malaysia							75	25	100	stable
Nepal	400	down								
Vietnam				<5	<5	down				
TOTAL	2500	down			40–50	down			300	stable or up

Table 2. Approximate numbers of Indian, Javan and Sumatran rhinoceros in Asia as at 2005, presented by country and subspecies. A third subspecies of Javan rhinoceros *Rhinoceros sondaicus inermis,* **formerly in India and Bangladesh, is extinct. A third subspecies of Sumatran rhinoceros** *Dicerorhinus sumatrensis lasiotis,* **may survive in very small numbers in northern Myanmar and on the India–Myanmar border.**

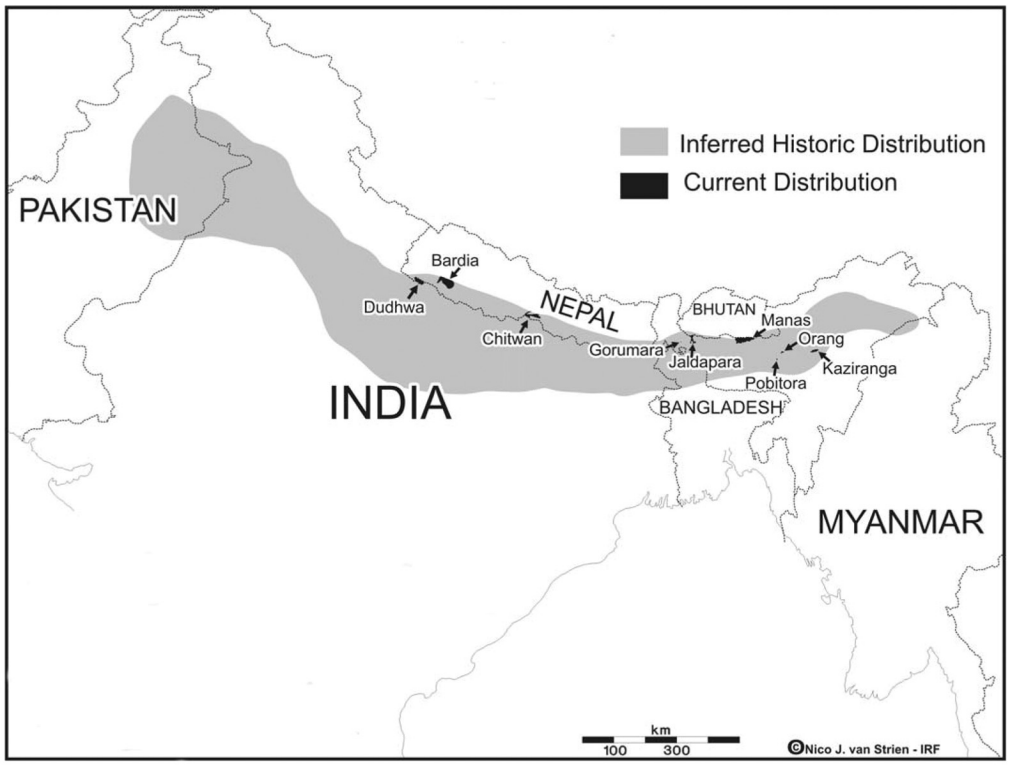

Fig. 3. Historic and current distribution of Indian rhinoceros *Rhinoceros unicornis.*

(Fig. 3). Reintroduced Indian rhinoceros populations in Duduwa NP in Uttarpradesh, India and Royal Suklaphanta WR, Nepal, are small with only Bardia NP so far receiving a founder number greater than the minimum 20 recommended.

Indian rhinoceros numbers have recovered from <200 earlier in the 20th century and the total wild population has increased from 600–700 individuals in 1975 to *c.* 2500 in 2006. Periodic outbreaks of insurgency in parts of its range has often resulted in certain populations being eradicated or reduced significantly. The two major range states, India and Nepal, have invested significant commitment, effort, manpower and resources in protecting and conserving this species and, as a result, there have been notable successes.

The largest population of Indian rhinoceros is conserved in Assam's Kaziranga NP (also a World Heritage Site), which celebrated its centenary in February 2005. The recovery of numbers in this Park under protection in many ways mirrors the recovery of Southern white rhinoceros numbers. By 1905 numbers may have been as low as ten individuals but the last census estimated a population of 1850 by 2006. However, in contrast to the Southern white rhinoceros recovery, in the past little attention was paid to biological management or expanding the number of populations and range. As a result there have been few translocations and Kaziranga NP holds at least two-thirds of the remaining Indian rhinoceros numbers in the wild. Apart from the strategic dangers of having so many 'eggs in one basket',

there are clear signs of a density-dependent reduction in population performance and possible habitat degradation following the increase in numbers (R. Emslie, pers. obs). In an encouraging development the Assam government has recently approved and launched a range expansion project called Rhino Vision 2020, which will use translocations from Kaziranga NP to re-establish Indian rhinoceros in other parks with the aim of conserving 3000 rhinoceros in Assam by 2020 (Williams *et al.,* 2005).

Royal Chitwan NP holds the second largest population of the species. Its population recovered through intensive protection from 60–80 individuals to *c.* 540 by 2000 (DNPWC, unpubl.). However, poaching has escalated dramatically in recent years following the removal of many of the army anti-poaching units from the Park because of the Maoist insurgency in the country. A recent census (2005) identified only 372 individuals, representing a 31% decrease since 2000. Since that 2005 census 15 or more rhinoceros have been poached. As at 2004 there were 154 animals in captivity worldwide (Foose & Wiese, this volume).

Threats to Indian rhinoceros Human population growth has resulted in significant habitat loss. Figure 3 shows that the reduction in the range of the Indian rhinoceros has been caused mainly by the disappearance of alluvial plain grasslands. Despite this there are still several potential areas and parks for reintroduction. However, proposed hydroelectric schemes in the Bramhaputra River pose a major threat to the habitat of this species.

The existing populations in India and Nepal remain vulnerable to poaching. Records of poaching in India show that 266 rhinoceros were poached between 1989 and 1993. Manas NP had an estimated population of 90–100 rhinoceros in 1990 but during a period of insurgency virtually the entire population was lost, although a few Indian rhinoceros that may have eluded the poachers or emigrated from refuge in Bhutan have reappeared. The population in Orang NP had been reduced by poachers from *c.* 100 to *c.* 50 by 1999, with poaching still occurring (three more were lost in 2005). Nevertheless, overall protection has improved and the most recent census in 2006 located 81 rhinoceros including 13 calves. There has also been recent poaching in Pobitora WS. In Nepal, the rise in Maoist insurgency has also led to a significant increase in poaching, with numbers declining in Royal Chitwan NP by about a third in the last 5 years: 544 in 2000 to *c.* 350 today. In Royal Bardia NP, at least 40 of 100 Indian rhinoceros have been lost (K. Chapagain, *Kathmandu Post,* 2 August 2005; C. Williams, pers. comm.).

Increasing conflicts between Indian rhinoceros and people inhabiting the vicinities of the parks and reserves has also created negative attitude towards the conservation of this species among some local communities. The economy of the marginalized communities in the buffer-zone areas is particularly affected by crop damage caused by the species.

In addition, domestic grazing pressure and illegal burning of grassland has resulted in further habitat degradation. Encroachment of invasive alien plant species, such as *Micania micarantha* and *Lantana camara,* over natural riparian vegetation has further increased the risk of survival of the Endangered megaherbivores that primarily inhabit the riverine environment (G. J. Thapa & S. R. Jnawali, pers. comm.).

Conservation measures The Indian rhinoceros has been included on CITES Appendix I since 1975 and has been intensely protected by the Indian and Nepalese wildlife authorities. However, poaching has remained high and conservation efforts will require continued support. New anti-poaching strategies are being implemented by the Nepal parks following significant losses. The recently

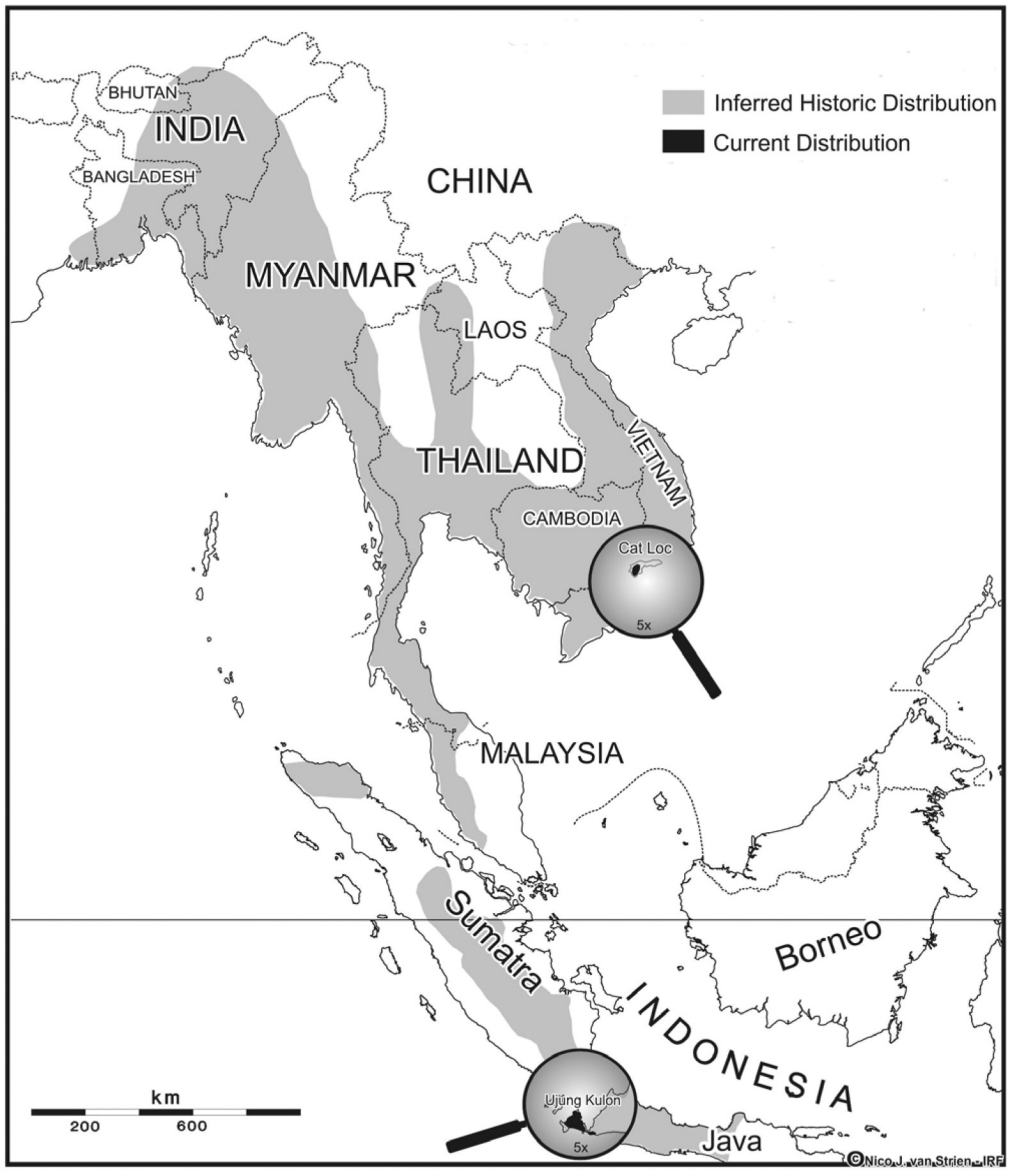

Fig. 4. Historic and current distribution of Javan rhinoceros *Rhinoceros sondaicus.*

launched rhinoceros range-expansion project (Rhino Vision 2020) in Assam is a major positive development that will contribute to both increased metapopulation growth rates as well as having strategic benefits (Williams *et al.,* 2005).

More extensive education and community programmes are being planned by the authorities in Nepal and India to improve awareness so that the communities living around the reserves are sympathetic to and benefit from the Indian rhinoceros.

Asian lesser one-horned or Javan rhinoceros

Rhinoceros sondaicus

This Critically Endangered species once ranged over a vast portion of south-east Asia, occurring in three distinct subspecies inhabiting coastal plains and river valleys. The dominant form *Rhinoceros sondaicus sondaicus* survives only in Ujung Kulon NP. *Rhinoceros sondaicus inermis,* once found in Bengal, Assam and Myanmar, is now extinct and a third subspecies, *Rhinoceros sondaicus annamiticus,* was feared extinct until the 1980s, when a population of <10–15 animals was discovered in an unprotected forest in Vietnam (Fig. 4). The area has subsequently been included in the Cat Tien NP but the number of Javan rhinoceros in that area is now probably less than five and no successful breeding has been observed since 1998.

At time of writing 40–50 animals remain in Ujung Kulon NP on the westernmost tip of Java. This only surviving viable population has been stagnant for the last 30 years. Either limited poaching continues to cancel out births, although no poaching has been recorded since 1991 and the rhinoceros are protected and monitored by three Rhino Protection Units, or (more probably) the population has reached carrying capacity and population performance has been negatively affected as a result. To date there has not been an attempt to establish a second population elsewhere. This is unfortunate on biological-management (demographic and genetic) and strategic grounds. However, the recently formulated and adopted (by the government) Indonesian Rhino Conservation Strategy, known as the Rhino Century Project (Proyek Abad Badak), is proposing a vigorous initiative to establish a second population. The only other Javan population, currently estimated to be less than five individuals, is at the Cat Loc part of the Cat Tien NP in Vietnam. There are no Javan rhinoceros in captivity.

Threats to Javan rhinoceros The increasing human population means that the demand for land is high in the two protected areas that Javan rhinoceros are known to exist. Clearance of forests for agriculture and commercial logging are occurring in and around these protected areas and poaching is an ever-present threat.

The lack of growth in the main population is of concern as numbers of this species are low and in order to minimize loss of genetic diversity it is necessary to increase the population as soon as possible. The low number of individuals in a single viable population makes the species extremely vulnerable to extinction because of uneven sex ratios, unbalanced age structure, reduced rates of reproduction, natural catastrophes, disease, poaching, political disturbances and genetic drift. If no reproduction occurs in the Cat Loc population it is doomed. The lack of appropriate wildlife-conservation laws and effective field law enforcement in Vietnam are major threats to the survival of the Cat Loc population (P. Hartley pers. comm.; G. Polet, pers. comm.).

Conservation measures Protecting the Javan rhinoceros has been the primary conservation focus. There are currently three trained and well-equipped Rhino Protection Units (RPUs) maintaining patrols in Ujung Kulon NP. The RPUs have been highly successful with no known improbable losses of Javan rhinoceros in the last 5 years.

Faecal-DNA analysis and camera traps are being used to assess the population structure in Ujung Kulon NP as the population in the region is poorly known. Studies are being carried out on habitat and food availability, and to determine if Banteng *Bos javanicus* are limiting population growth of the Javan rhinoceros by competing for food. The feasibility of translocating rhinoceros to establish a new viable population in another suitable habitat is also being considered in order

to initiate the recovery of numbers. The population in Cat Loc Reserve is heading for extinction partly as a result of human pressure, a lack of appropriate laws and penalties, and inadequate law enforcement.

Asian two-horned or Sumatran rhinoceros

Dicerorhinus sumatrensis

The Critically Endangered Sumatran rhinoceros once ranged from the foothills of the Himalayas in Bhutan and eastern India, through Myanmar, Thailand and the Malay Peninsula, and on the islands of Sumatra and Borneo. At the beginning of the 20th century, the Bornean form of the Asian two-horned rhinoceros *Dicerorhinus sumatrensis harrissoni*, also known as the Eastern Sumatran rhinoceros, was fairly widespread and common throughout Borneo, in both the Malaysian (Sabah and Sarawak) and Indonesian (Kalimantan) parts of the island.

The population was *c.* 600 in 1994 but has declined to *c.* 300 worldwide in 2006. About 200 occur in Sumatra but are confined to only three national parks, except for a few solitary animals in remote locations. Bukit Barisan Selatan NP and Gunung Leuser NP are the highest-priority areas each with *c.* 60–85 Sumatran rhinoceros. About 20–25 Sumatran rhinoceros occur in Way Kambas NP.

Outside Sumatra small populations occur in a few areas in Malaysia. In Peninsula Malaysia, the only populations with more than a few Asian two-horned or Sumatran rhinoceros are in Taman Negara NP and the Belum Forest Complex. Danum Valley (with an estimated minimum of 13 rhinoceros) and Tabin WR in Sabah, Malaysia on the island of Borneo, contain the only known populations of the subspecies *Dicerorhinus sumatrensis harrissoni.* The status of the species in other parts of the region is unknown (Fig. 5), although a few are likely to survive in remote parts of Thailand and Myanmar, and possibly also in Kalimantan. In Sarawak the species is no longer found. There are ten Sumatran rhinoceros in captivity: four in North American zoos, four at the Sumatran Rhino Sanctuary in Sumatra and two at Sepilok in Borneo. The attempt to develop a captive-propagation programme as part of the conservation strategy under the auspices of the AsRSG has been very challenging. From the inception of the programme in 1984 until 2001, mortality was high and no reproduction occurred among the 40 'doomed' rhinoceros rescued from unviable situations in the wild. However, two births have occurred (in 2001 and 2004) at the Cincinnati Zoo & Botanic Garden and there is renewed hope that the captive-propagation programme for this species can now succeed, especially with the guidance of the Global Management and Propagation Board (GMPB) that has been formed for Sumatran rhinoceros.

Threats to Asian two-horned or Sumatran rhinoceros The Sumatran rhinoceros survives in several small isolated populations so some metapopulation management for genetic-conservation reasons may be necessary in the longer term. With few animals surviving in each population there is a much greater chance of the reproductive process being disrupted by an uneven sex ratio, unbalanced age structure or declining reproduction. Evidence suggests that this has already occurred in many areas, most recently in the Kerinci-Seblat NP in central Sumatra (van Strien, pers. obs.).

Poaching is the major threat for this species. The financial commitment given to Asian two-horned or Sumatran rhinoceros conservation by the two main range states is also less than that provided by the Greater one-horned rhinoceros range states or the major range states in Africa. The threat is still severe in most areas because of the continuing demand for Asian rhinoceros horns for the TCM market. Strict protection of the rhinoceros

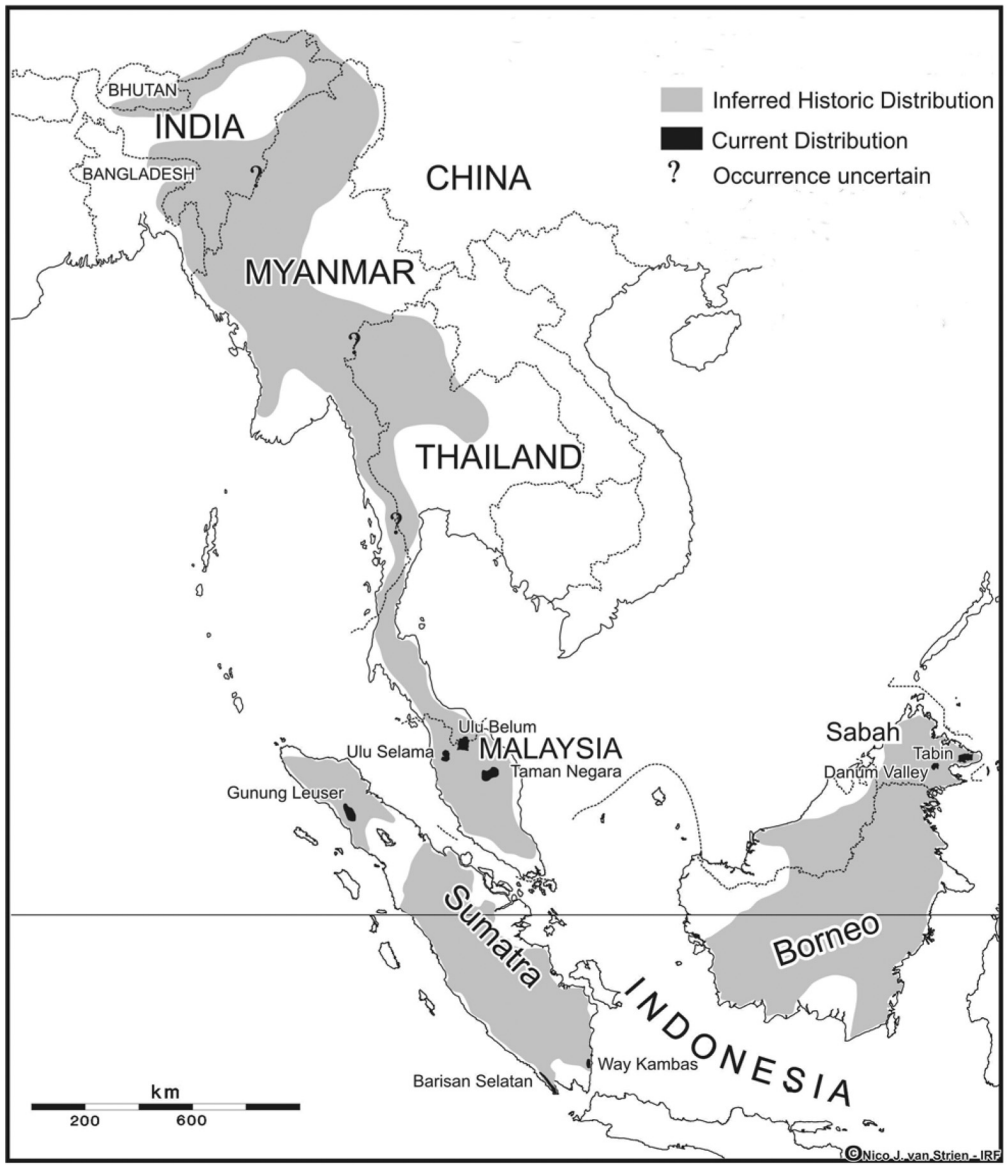

Fig. 5. Historic and current distribution of Sumatran rhinoceros *Dicerorhinus sumatrensis.*

in their habitat is, therefore, currently the only conservation option. In the past, anti-poaching patrolling inside the national parks was inadequate. However, in recent years the introduction of field anti-poaching teams known as Rhino Protection Units (RPUs) has made a significant difference, in Indonesia and Malaysia. In addition, more vigorous prosecution of wildlife crimes means that poaching has ceased almost completely in several key areas, such as Bukit Barisan Selatan NP, Way Kambas NP and Gunung Leuser NP.

Habitat encroachment is a more serious problem in most areas. The land surrounding rhinoceros habitat is generally densely populated and large parts are under severe pressure for land and resources. Significant areas within the national parks, and often all of the protected forests in the buffer zones, have been converted for agriculture. Occasionally important habitat is de-gazetted for logging and illegal logging is also increasing, particularly in Sumatra. Over the last 15 years *c.* 30% of Bukit Barisan Selatan NP has been converted and Way Kambas NP has lost 15% of its area. Fortunately, in Way Kambas NP, little of the actual rhinoceros habitat has been lost but if the trend continues, the entire Park is in jeopardy. Natural disasters may also impact the survival of this species, either directly, such as the El Niño induced fires of 1997, or indirectly, such as the tsunami in December 2004, which may have long-term repercussions on economic and political development thus intensifying the pressure on the conservation areas.

Conservation measures The Asian two-horned or Sumatran rhinoceros has been included on CITES Appendix I since 1975. Anti-poaching, habitat protection, and captive-breeding, research and monitoring programmes have been initiated by local and international organizations, in co-operation with governmental authorities and local communities. Perhaps the longest-running and most effective programme is the RPUs, which have been operating since 1995. The RPUs operate in all key areas, concentrating on anti-poaching and law enforcement, and have been highly successful.

In Bukit Barisan Selatan NP a mobile Intelligence and Law Enforcement Unit has been established to assist the RPUs and the National Park to detect and apprehend poachers. With the assistance of the Intelligence and Law Enforcement Unit many cases of wildlife poaching have been prosecuted successfully. Because of the effective RPUs and more vigorous prosecution, poaching of the Asian two-horned or Sumatran rhinoceros has ceased almost completely in a number of areas including Bukit Barisan Selatan NP, Way Kambas NP and Gunung Leuser NP (Foose & van Strien, 1998, 2005). A number of external agencies have contributed financially and technically to the development of the RPU programme. Major new initiatives to invigorate efforts to protect the Sumatran rhinoceros have been inaugurated in Indonesia (Project Rhino Century) and Malaysia (Rhino Rescue).

There are also ongoing efforts to develop captive-breeding centres in Indonesia and Malaysia (N. van Strien & T. Foose, pers. obs). While so far these have not been successful as more deaths are recorded than births, there is renewed optimism based on the success that has recently been achieved in reproducing this species as well as the advent in captivity of younger and presumably more fertile animals (van Strien, 2005).

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