

NORTHEASTERN ILLINOIS UNIVERSITY

RHINOS: THEIR DECLINE, CURRENT POPULATION AND  
GENETIC DEMOGRAPHICS, AND CONSERVATION PLANS

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ENVIRONMENTAL STUDIES

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## INTRODUCTION

The rhino is a magnificent creature. It is huge, strong, powerful and awe-inspiring. These animals are examples of supreme survivors. They have survived for over 50 million years. Their needs are minimal, while their wants are almost nonexistent. They are peaceful, gentle giants, who hurt no other animals and have no natural predators.

"Rhinoceroses belong to the group known as perissodactyls, or 'odd-toed ungulates', which includes horses and tapirs..... The perissodactyls are considered an outmoded group, being replaced by the artiodactyls, or 'even-toed ungulates' that also evolved during the Eocene period." (Penny, 1988, 5). The artiodactyls developed keen senses and well-developed brains, and they were fast movers. They also had efficient cropping and grinding teeth and some became ruminants, making them efficient eaters. Examples of artiodactyls are deer, gazelle, antelope, pigs, giraffe, and camels.

The rhino has come to the end of its evolutionary road. This would be an acceptable fact, if it was happening naturally, the problem is that it is being brought to an accelerated, unnatural extinction due to pressures from man. "What we can do is to reduce the pressure on them from our own species, so that they can become extinct, not in the geological second represented by our brief appearance as a destructive force, but in the natural course of events, many thousands of years from now." (Penny 1988, 10).

There are many reasons for the devastation of the rhino, but all settle to a common force. This is the force that is scourging the natural earth to its farthest reaches. There is no escaping it. This is the almighty force of humankind, in its quest to dominate, posses and develop as much territory as possible. In the human animal's quest to tame the wild and develop the cultural landscape, he views all things in their worth to his species, and categorizes them as either a resource or a resistance. To be considered a potential or actual resource, the human wants to benefit directly and almost immediately. Most of the natural world is first considered a resource, until it is sucked dry and needs to be discarded, then it is considered a resistance.

Where does this leave the rhino? To a small minority of humans the rhino is considered a resource. This small group could contain conservationist, biologist, zoologist, park rangers, eco-tourist, academics, and anyone with an aesthetic interest in the rhino as a masterpiece of nature. Another group to consider the rhino as a resource, is the despicable group that profits from its slaughter. This group could consist of poachers, traders of rhino products, pharmacist that use the products, and the dagger traders of North Yemen.

The rhinos are considered a resistance in their home territories by developers, farmers and land-owners that believe the land they live on would be better utilized to benefit the superior species. In this instance, the rhino is analogous to the Spotted Owl of the Pacific Northwest showing the competition between endangered specie's survival and humans desire for land, lumber, money and jobs.

To the majority of people the rhino is not considered either a resource or a resistance, it simply is not considered. The vast human population is far removed from the natural world, with the possible exception of having to deal with the weather. The powerful influence of man's short existence, is overshadowed by the most recent member, the White Rhino, that has been on earth for five million years. Man, as a predator, has been extremely successful in exterminating other species. As far as most animals go, its only a matter of time. The more I learn about this, the scarier it gets.

"The list of extinctions lengthens in pace with increasing human exploitation of the world's natural resources. Species extinction by man is the very antithesis of the evolutionary progress, as it is characterized by biological impoverishment. Although human rapaciousness, ignorance, apathy, and negligence have led to the annihilation of entire species, it is equally true that man has it within his power to conserve those that remain, if he is so minded."(Simon 1970, 13).

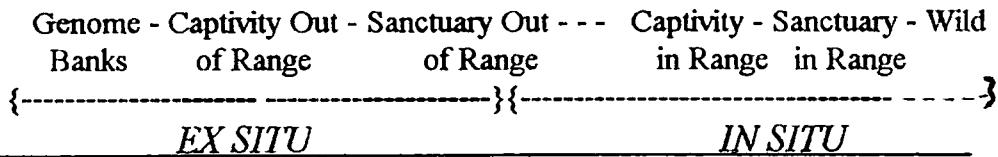
The problem is that all extant species of rhino are in extreme danger of premature extinction, occurring primarily in the last century and specifically in the last twenty years. What is the solution to this problem? The solution is very complicated, because the problem is very complicated. To examine the problem and try to formulate a solution, we need to look at the reasons for the decline of the rhino. This information then leads to an investigation to the use of the products derived from its deliberate destruction. In order to get an idea of our possibility to save the rhino, we need to know how many exist of each species. This leads to the question, how many do we need to for a genetically viable population of each species? The investigation then looks at captive and wild population management programs from the regional to the global level. Can we curb the tide of this cruel wave to eliminate the rhino? Maybe. Should we? Positively.

There are a few operational definitions that should be understood for this study. The rhino is considered a "flagship species, i.e. those species whose conservation will have an important influence on conservation of the entire biotope." (Wheator 1992, 14). The rhino is the second largest land mammal, needing large a fairly large territory to survive. If the rhino is saved, then all the other flora and fauna of that ecosystem is saved. Therefore it is very beneficial to many species to save the rhino. The drawback of this is that the rhino needs such a large expanse of land to survive, which comes in to direct opposition with man's desire to develop and populate all tracts of land.

This paper also investigates whether the rhinos live in captive, semi-captive, or wild situations. In captivity usually refers to animals kept in zoological parks and heavily managed and protected. By heavily managed, I refer to being fed, manipulated in a small areas, intensive veterinarian care, managed for diverse genetic integrity and usually studied and researched.

In semi-captivity usually refers to animals kept on large ranches, sanctuaries, reserves, and in national parks, that are usually protected and lightly managed. By lightly managed, I refer to being fed only when necessary, free range over large areas, with less intensive veterinarian care and genetic management, and sometimes studied and researched. In the wild usually refers to animals living in unprotected remote areas, with little human interference or management. These animals are sometimes researched and studied, if found. It is controversial if any "wild" actually exists, that is not influenced in any way by man, and if it does exist, it is now shrinking as the human population grows.

Another way of distinguishing rhino populations is considering them as "*in situ*" or "*ex situ*" populations. *In situ* are populations found in their natural range, whereas *ex situ* are found outside their natural range. Figure 3, Options for Rhino Conservation, from the "Rhino: Global Captive Action Plan (R:GCAP)" (Foose, 1992) gives a simplified view of these relationships:



I decided to embark on this study because of my intense interest in rhino conservation. I have been an Animal Keeper at the Lincoln Park Zoological Gardens since 1979, and have worked closely with the three rhinos housed there. I have been instrumental in raising funds to support the Ngare Sergoi Rhino Sanctuary in Kenya, which I was fortunate to visit in March of 1993. This paper will assist in furthering my knowledge and career in rhino conservation.

## RESEARCH DESIGN

I collected most of my data from the resources found at the Library of the Lincoln Park Zoological Gardens. There was more information on my subject than I expected there to be. I also used some sources from my personnel collection, which I have accumulated along with my growing interest in the preservation of biodiversity.

The document that was the most valuable to this study is: "Rhino: Global Captive Action Plan, (RGCAP), First Addition, 1 September 1992." It is the result of a workshop conducted at the Zoological Society of London 9-10 May 1992. This is the most comprehensive and current study of the status of the rhino in the wild and captivity, their spatial and genetic demographics, and an overview of programs in action and plans for the future conservation of the rhinos. This document was developed by experts in the field from all over the world.

The next most valuable source is "The World Zoo Conservation Strategy: The role of the zoos and aquaria of the world in global conservation, Second Draft, June 1992." "The purpose of the World Zoo Conservation Strategy is to clarify the roles that zoos are to fulfil in global conservation and to help conserve the Earth's quickly disappearing wildlife." This document was instrumental in gaining understanding of the importance of *in situ* and *ex situ* programs and the necessary collaboration and cooperation between conservation plans and organizations to make a considerable impact.

I used the "International Studbook of the Black Rhinoceros" (Kloss 1990), for specific data on population demographics of Black Rhinos kept in zoos globally. This document also discusses trends in regional programs such as Species Survival Plan (SSP) in North America and the European Endangered Species Program (EEP) in Europe.

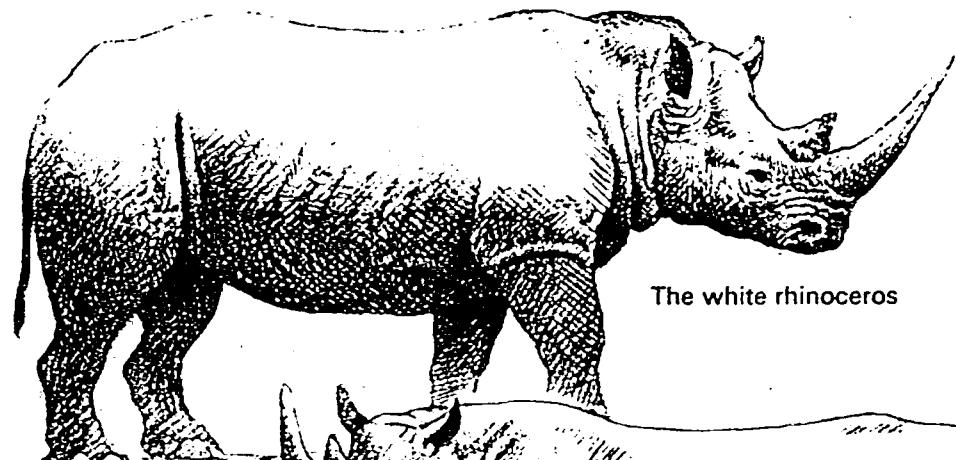
I used Malcolm Penny's book: "Rhinos; Endangered Species" for a reference to general information on the evolution, characteristics, range, and population decline of the five species of rhinos. Malicious book is hoped to educate the academic and the layman about the plight of the rhino.

I used the book: "Run Rhino Run" by Esmond Bradley Martin as an in depth study to the decline of the rhino and the trade and use of rhino products. Esmond Bradley Martin is the global expert in this field. I was fortunate to hear him lecture on rhino conservation and trade of rhino products at the National American Association Zoo Keepers Conference in 1991.

I used the book: "Rhino, At the Brink of Extinction" by Anna Merz, (1991), as a warehouse of insights into conservation and characteristics of rhinos in their natural *in situ* habitat. Anna Merz started a Ngare Sergoi Rhino Sanctuary in 1984, that has become one of the most successful and highly regarded wildlife sanctuaries in Africa.

The article: "Time to Save Rhinoceroses" by Colin Tudge, summarizes the discussions and plans from the International Rhino Conference, San Diego, 9-11 May 1991. This conference was an important catalyst to the collaboration of *in situ* and *ex situ* programs and the development and formation of the Rhino GCAP.

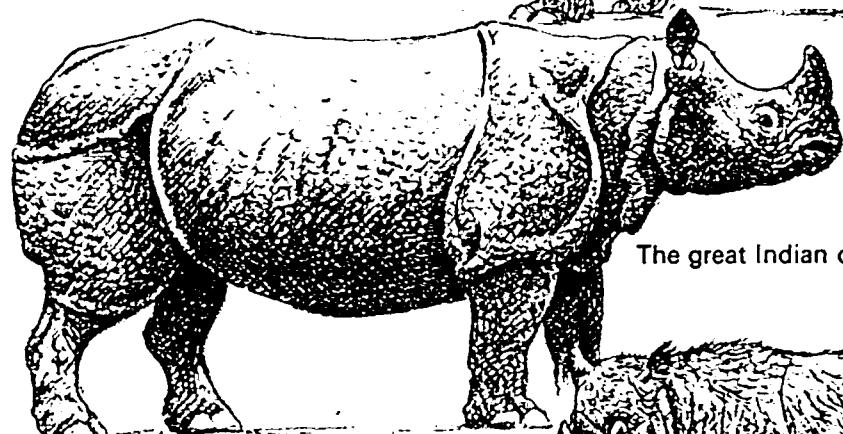
I also gathered information from various conservation periodicals such as Sierra, Audubon, Oryx, Wildlife Conservation and New Scientist.



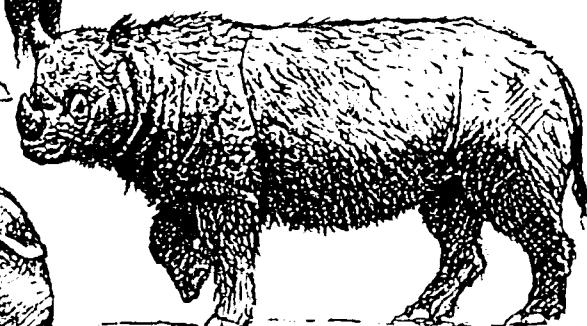
The white rhinoceros



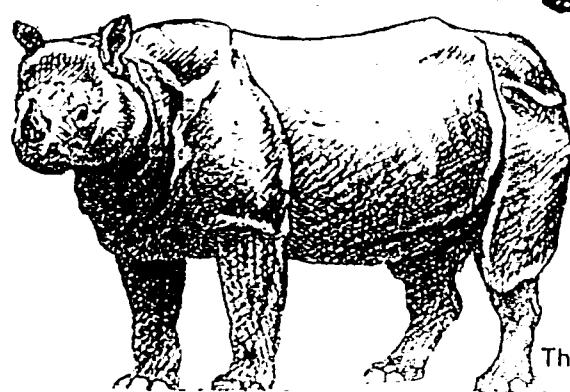
The black rhinoceros



The great Indian one-horned rhinoceros



The Sumatran rhinoceros



The Javan rhinoceros

The five surviving species of rhinoceros

## EXTANT SPECIES OF RHINOCEROS

There are generally considered to be five living species of rhinos. As my study took me deeper, I discovered that there are thirteen distinct living taxa (sub-species). This puts a huge twist in the plan, and forces us to ask more questions. It is unclear if we will be able to save five species of rhino, let alone to save thirteen different taxa. Is it important to save all 13 taxa? Is one species more important than another? Is there space and money available to save viable populations of all the sub-species? Is the genetic variability between sub-species important enough to the survival to try to manage separate populations?

"According to the biocentric world view, each wild species has an inherent right to exist or at least the right to struggle to exist equal to that of any other species. Thus, it is ethically wrong for us to hasten the extinction of any species." (Miller 1990, 320)

Most scientist in the field believe we should try to preserve all taxa or sub-species in their distinct forms as long as possible. From the World Zoo Conservation Strategy (WZCS) : " In principle, the "biological species" should offer a sound, basically uniform taxonomic unit for *ex situ* breeding programmes, since each individual within the species fulfils the biological definition of a species: that is, reproduction between this individual and another specimen of the same species will yield fertile offspring. Species are usually identified and defined according to their external characteristics and anatomical characteristics, while in actuality barriers to mutual fertility can also lie in non-visible genetic or molecular characteristics, or in behavioral characteristics." (Wheater 1992 55).

The study of species and which species should be saved is a very complicated issue, when looking at the decrease in available space, resources and money. Genetic studies are being performed to determine if there are distinct genetic differences to keep the sub-species separate. There is also the issue of different geographical forms of a species that may be reproductively compatible, and management may consider "clumping", or inter breeding of the forms or sub-species as pressures increase. This must be carefully studied and executed because once the clumping is done, it is sometimes irreversible.

Captive breeding programs have become highly developed and organized in the last decade, but were not always as carefully managed. As an example, the Orangutan of Asia has two distinct sub-species, the Bornean and Sumatran, and should be managed as separate populations. Before concentrated breeding programs and professional management, some orangutans were interbred and produced Bornean/Sumatran hybrids. These hybrids are now considered unusable and unwanted in breeding programs because of their genetic inconsistency, and are now occupying valuable space that could be used by genetically pure individuals. This is an example of captive breeding programs learning from their mistakes, the hard way.

The rhino conservation programs support to keep all thirteen taxa "sorted" or separate as long as physically, politically, economically, and genetically possible. This is also called the "policy of minimum regret", where conservationists seek courses of action that are least likely to cause regrets in the future.(Tudge 1991, 30). As the highly regarded conservationist, Aldo Leopold once said, "To keep every cog and wheel is the first precaution to intelligent tinkering." (Miller 1990, 318) .

There are two species of rhinos that inhabit Africa, the Black and the White. These two species differ in size, appearance, and behavior and are easily distinguished.

TABLE 1: RHINO TAXON OF AFRICA

Common Name	Scientific Name	Range
<b>Black Rhino</b>	<u>Diceros bicornis</u>	
1 Southwestern Black	Diceros b. bicornis	Namibia
2 North & West Black	Diceros b. longipes	Cameroon, Central African Republic(CAR)
3 Eastern Black	Diceros b. michaeli	Kenya, N. Tanzania
4 Southern Black	Diceros b. minor	S. Tanzania, Zambia, Zimbabwe, S. Africa
<b>White Rhino</b>	<u>Ceratotherium simum</u>	
5 Northern White	Ceratotherium s. cottoni	Zaire, Sudan
6 Southern White	Ceratotherium s. simum	S.Tanzania, Zambia, Zimbabwe, S.Africa

(Foose 1992, Table 1)

There are three species of rhinos that inhabit Asia: the Indian/Nepali, the Javan, and the Sumatran. These three species differ in size, appearance, behavior and the niches they habitate and are easily distinguishable.

TABLE 2: RHINO TAXON OF ASIA

Common Name	Scientific Name	Range
7 <u>Indian/Nepali Rhino</u>	<u>Rhinoceros unicornis</u>	India, Nepal
<u>Javan Rhino</u>	<u>Rhinoceros sondaicus</u>	
8 Javan (Vietnam)	Rhinoceros s. annamiticus	Vietnam
9 Javan (Java)	Rhinoceros s. sondaicus	Java (Indonesia)
<u>Sumatran Rhino</u>	<u>Dicerorhinus sumaterensis</u>	
10 Bornean Sumatran	Dicerorhinus s. harrisoni	Kalimantan, Sabah, Sarawak
11 Burma Sumatran	Dicerorhinus s. lasiotus	Burma
12 Sumatran Sumatran	Dicerorhinus s. sumatrensis I	Peninsular Malaysia
<u>13 Mainland Sumatran</u>	<u>Dicerorhinus s. sumatrensis II</u>	Sumatra (Indonesia)

(Foose 1992, Table 1)

From the thirteen extant taxa of rhinos, eight taxa are being managed in captive breeding programs. The Southwestern Black, North and West Black of Africa and the Javan rhino of Asia are not part of captive management plans. This is due to their populations being very small, located in remote areas and a desire to increase their population numbers in their natural range before attempting captive breeding. Political influences and lack of faith and confidence in captive breeding are also important factors.

The first objective of the Rhino: Global Captive Action Plan (GCAP) is to:

"Conduct captive breeding programs for selected taxa of rhino. Seven taxa currently selected are:

- (3) *Diceros bicornis michaeli* Eastern Black
- (4) *Diceros bicornis minor* Southern Black
- (6) *Ceratotherium simum simum* Southern White
- (7) *Rhinoceros unicornis* Indian/Nepali
- (10) *Dicerorhinus sumatrensis harrisoni* Borneo Sumatran
- (12) *Dicerorhinus sumatrensis sumatrensis I\** Mainland Sumatran
- (13) *Dicerorhinus sumatrensis sumatrensis II\** Sumatran Sumatran

(\* Peninsular Malaysian and Sumatran populations treated as distinct taxa)"  
(Foose 1992 9)

## DECLINE IN POPULATION NUMBERS

There are many reasons for the population decline in rhinos, and most can be contributed to the direct or indirect influence of human's pressure. Drought, fragmentation of populations and habitats, slow reproductive rate, destruction and reduction of viable habitat, political instability and poaching are the main reasons for the accelerated demise of rhinos.

**DROUGHT:** Drought is a problem that effects the African rhinos more severely than the Asian rhinos, due primarily to Africa's propensity to drought. Rhinos needs are very rudimentary, all they need is a little vegetation and water, and a place to hang out. Drought can put an animal in strong jeopardy, by taking away two of it's three needs. As the populations of wild animals are being more severely crowded together there is more vicious competition for the available resources of food and water, without the added deleterious influence of drought. Central and Eastern Africa experienced terrible droughts in 1991 and 1992, but were granted a reprieve in 1993. In March 1994, they are experiencing the worst drought in ten years. It is believed that the depletion of ozone and increase of global warming, are now and will further influence the dry and hot conditions that put strain on the entire ecosystem and all it's inhabitants. Other natural disasters such as the eruption of the Krakatau volcano in Java, almost completely annihilated the Javan species in the 1880's, and could reoccur at any time.

**FRAGMENTATION OF POPULATIONS AND HABITATS:** With the fragmentation of the natural habitats of the rhino, comes the fragmentation of the rhino populations. Fragmentation is a transitory stage in the process of total destruction, that results in spatial, temporal and biotic isolation of plant and animal populations. Rhinos are coming to a point where they are floating on tiny islands in the vast ocean of human cultural landscape. As the human population swells and they consume more territory, the rhinos and the majority of other plants and animals, are being pushed to the remotest, uninhabitable areas. It's going to get a lot worse before it gets better.

When trying to recover species, the total population numbers could give a distorted view. A more accurate gauge of the success is to look at the "effective population: those animals which are of the right age to breed and which are able to find mates (preferably ones to whom they are not closely related). Generally, only one in five individuals in a wild population is effective (though the proportion in managed captive herds should be much higher)." (Tudge 1991 32) When populations reach low levels, they enter a bottleneck, where there is a loss of genetic variability, a greater chance of inbreeding and a reduction in the evolutionary potential of the population as a whole. The small population is more vulnerable to catastrophe such as epidemic diseases or natural disaster. "With the loss of genetic diversity the gene pools turn into gene puddles that evaporate into extinction. The animals enter the 'extinction vortex', where the small population size leads to increased inbreeding, that causes decreased reproduction and survival, then the growth rate is reduced, leading to even smaller population size. The Javan rhino is now being sucked into the extinction vortex."(Foose lec. 1994)

There are programs now in effect to rescue rhinos that are totally isolated, and place them into situations where they may meet other conspecifics. Some rhinos could be considered loners, making it even more difficult to find a mate, without having to deal with five miles of farms and villages between them.

**SLOW REPRODUCTIVE RATE** : Rhinos are not making it primarily because they are being killed off faster than they can reproduce themselves. The rhino is a mega-vertibrate, along with the elephant and the whale. They develop like an oak tree, slow and strong, and able to withstand the elements and live a long existence. The gestation of rhinos is about 16 months for most taxa, and the newborn will usually stay with the mother for two to five years. Rhinos become sexually mature at around seven, and can probably have babies until they are about 25-30 years old. So that means one female can possibly produce four or five infants if conditions are optimal, and there is an available male to inseminate her when she is in estrus. Since conditions are usually far from optimal, with increasing survival pressures and chances of meeting a desirable mate are slim, the outlook for the rhino, especially in unprotected areas, is grim.

**DESTRUCTION AND REDUCTION OF VIABLE HABITAT:** As the human population increases, the exploitation of the earth's land and water resources increase. Deforestation and clearing land for farmland, buildings, timber and firewood is one of the greatest factors in the decline of global biological diversity. Man has to alter his attitude to more sustainable and long-term exploitation, with some forethought to future generations and sharing the limited resources with other species. Man's influence is polluting the air, water and soil systems, and is not allowing the time for the ecosystems to heal themselves.

**POLITICAL INSTABILITY:** Political instability can pose an insurmountable challenge when trying to save the rhino. Political uprisings, degrading trust in governments, riots, fears of nationalization and the struggle of Apartheid are very real problems facing Africa, its people and all of its wildlife. There are the questions of who controls, who benefits and who suffers from the wildlife? At any given time, it seems that some part of Africa is in political turmoil. "With 80% of all rhinos living in South Africa, 40% of the Black and 90% of the White, this population could be in extreme danger if turmoil of the current political transition becomes severe" (Foose lec. 1994) Asia's political system seems more stable, but struggle with the problem of too many people, not enough space and resources, and while the wildlife being of less importance get stuck with the crumbs.

With the political instability, comes the threat of war. The rhino is one animal that would not survive in a war zone, they are just too big and cannot hide easily. A war not only disturbs the immediate ecosystem and all its inhabitants, but also has deleterious effects on the neighboring regions. This was witnessed in the recent peace-keeping missions of the United States into Somalia, where the Somalian rebels were pushed into neighboring Kenya. These heavily armed soldiers, known as "Shifta", are the main cause for heavy upsurge in slaughter of rhinos and other game in Kenya.

There is much controversy in the arena of bringing wild rhinos into captive *ex situ* situations." All the, sixty or so, surviving Javan rhinos live in two small populations: 12 to 15 along the Dong Nai River in Vietnam; and 50 or so in the 300 square kilometres of the Ujung Kulon National Park in the western tip of Java." (Tudge 1991, 34) This presents a precarious position for this small remnant population, leaving the species susceptible to the pressures of inbreeding, habitat loss and poaching, or a total wipeout by an epidemic. The members of the RGCAP and the Rhino Captive Breeding Specialist Group (RCBSG) "recommend a large proportion of the Ujung Kulon rhinos-18 to 24-should be taken out, and bred in captivity." (Tudge 1991, 34). This has met with strong opposition from the Indonesian government and officials from World Wildlife Fund (WWF), who point to the fact that Javan rhinos have never successfully been kept in captivity, and the lack of success with the captive Sumatran rhinos. Efforts should focus on captivity *in situ* in Indonesia, and more protection against poachers. A similar situation exists in Zaire, where the remaining 30 individuals of the Northern White rhino of Africa, exists in the Garamba National Park. This population is in danger of fires, elephants changing the habitat, potential inbreeding and poaching. Foose points out, " that it is not desirable for the fate of a species or sub-species to be entirely in the hands of a single political regime, whether in Zaire or the US or Britain." (Tudge 1991, 32)

**POACHING:** Poaching is the most powerful and immediate threat to the rhinos existence. If it continues at it's present pace, some species of rhino will be extinct by the year 2000. Rhinos are an easy target to poachers, especially the African species which habitate open expanses of grassland with little cover. They are so large that it is hard to hide their entire body behind a tree. Since the African rhinos are more exposed and occupy larger territories, it is more difficult to protect them, and therefore, cost more for their conservation. The Asian species tend to habitate thicker forested areas, making them less conspicuous, which lowers the cost for conservation but also lowers their eco-tourist potential.

The rhinos have always been hunted by man, for sport, for food, and for clearing of land for agriculture and human settlements. An extreme increase of hunting rhinos came about in the 1960's, being directly correlated with the increase of demand and value of it's horn. The prodigious horn, that sets the animal apart from other species, has become the principal reason for it's decline. Rhinos were once hunted with spears, then with single shot rifles, and now they are slaughtered by organized groups of Shifta with high powered rifles and machine-guns. As the sophistication of the poachers and their artillery has increased, it is increasingly harder to protect them, and they are being murdered at a proportional rate.

The Asian rhinos are harder to locate in the more mountainous and forested terrain and they are more evasive than the Africans. This necessitates that the poachers use other methods of slaughter. The Asian rhinos use regular pathways to travel to and from their feeding and watering sites. "The poachers have taken to employing spiked pits or electric power lines connected to batteries, on these pathways to accomplish their task." (Martin lecture 1991).

In the slaughter of both the African and the Asian species, the poachers sneak in to the area, kill the animal, remove the horn, and get out as fast as possible, leaving the rest of the animal to rot. Sometimes the animal is not even dead while it's horn is removed, and dies a slow, excruciating death. These poachers, in my opinion, are the scum of human existence.

Security in the sanctuaries and reserves that house rhinos has become the most important and expensive factor. There is a large variance in fencing and security personnel, for the varied situation. Some areas are so large that it is financially inconceivable to fence in the entire area. Most areas have 24 hour armed guards on duty, but if a reserve covers 100 sq. miles, it is difficult to guard the entire area. There is a trend, especially in the large parks of Africa, to sequester a smaller area within the park that can be fenced in and heavily protected just for the rhinos. Some parks have one armed guard that stays near an individual rhino, 24 hours a day. . The security personnel must be strong, brave and dedicated to their vocation. It has been said that poorly paid park rangers have been offered three years salary, just to turn their backs to the poachers entering their area. Security measures vary with the size, structure, and vulnerability of the area, the number of rhinos, the threat of poaching, and the finances and manpower available.

## USE OF RHINO PRODUCTS

Rhinos have been slaughtered to some extent for their meat and hide, but the primary cause for their rapid demise, is for the horn they carry proudly on their nose. The horn has been utilized in Asia and the Far East for medicinal purposes for centuries. The demand for rhino horn for Eastern medicine almost wiped out the three species of Asian rhinos, and as a result of their decline, the demand for African rhino horn grew. The horn is used to cure a variety of ailments such as high fever, typhus, laryngitis, bad eyesight, hemorrhoids and even impotence.

A large majority of Americans and Europeans believe that the horn is used in a greater extent as an aphrodisiac, which is a myth, probably exemplified by the human's preoccupation with sex. This myth is derived from the sexual prowess of the male rhino, which can breed for two hours or more, and the belief that some of his sexual power will transcend to the inadequate human. Rhino horn is rarely used as an aphrodisiac, and this is practiced primarily in India. Rhino horn is primarily used to cure high fever and as a pain killer in China, India, Taiwan and the Far East.

The majority of rhino horns are now being shipped to North Yemen, where they are being used to make dagger handles. The daggers, known as *jambias*, were once only worn by wealthy and prestigious, but are now worn by almost every male. The *jambias* are worn as a status symbol, as personal protection, and as a reminder of their tribal heritage. "In the Sanaa souk (Of North Yemen) some rhino horn daggers sell for as much as \$12,000, although apparently a simple one can be purchased for about \$500." (Martin 1982, 67). In recent years it has become common practice for a *jambia* to be presented to a boy at his circumcision, at twelve or fifteen years of age.

"In the early 1970's, demand for rhino horn *jambias* rose rapidly as Yemeni men began to earn high wages in Saudi Arabia and other oil-rich states. Per capita income in Arab Yemen Republic rose from \$80. in 1970 to \$700. in 1979. Yemen's legal imports of rhino horn between 1969 and 1977 totalled 22,645 kg., which has been estimated to represent the death of about 8,000 rhinos." (IUCN 1982,). "Nonetheless, with 50,000 young Yemeni men coming of age every year, this could satisfy only 17% of the potential market." (Martin 1982, 67) "Between 1970 and 1986, as the trade continued, the world population of black rhinoceroses fell from 65,000 to 4,000." (Penny 1988, 80). The table below (Table 3) shows the quantities and values of rhino horn bought from 1980 to 1991 by the main trader in Yemen, which illustrates that as the quantity decreases the value increases:

TABLE 3: RHINO HORN TRADE IN YEMEN

Year	Weight (kg)	Price paid per kg		Exporting African countries
		Rials	\$US	
1980	1050	3500	764	Tanzania, Kenya, Ethiopia, Somalia
1981	1320	3500	764	Tanzania, Ethiopia, Sudan
1982	1545	3600	786	Tanzania, Ethiopia, Sudan
1983	1120	4100	891	Kenya, Sudan
1984	1058	4300	796	Tanzania, Somalia
1985	475	8300	1150	Ethiopia, Sudan
1986	100	10,000	1032	Sudan
1987	c. 200-300	c. 12,000	c. 1035	Tanzania, Kenya, Sudan
1988	c. 200-300	c. 12,400	c. 1035	Tanzania, Kenya, Sudan
1989	c. 200-300	c. 13,000	c. 1035	Tanzania, Kenya, Sudan
1990	c. 333	15,000	1040	Tanzania, Kenya, Sudan
1991	c. 450	30,000	1035	Tanzania, Kenya, Sudan

Table 3 Quantities and values of rhino horn bought from 1980 to 1991 by the main trader in Yemen, who handled over 80 per cent of the business

Source: personal records of and personal communication with the main trader.

Dr. Esmond Bradley Martin also shows the growth of qat use that has increased along with the rise of income and increase in *jambia* possession. Qat (*Catha edulis*) and *jambias* were once the prerogative of the elite ruling-class, but are now an essential part of everyday life for all the Yemenis. Qat is a bushy plant with succulent leaves that is chewed as a stimulant. Qat took over for coffee as the major agricultural product because of its increased use and it provided a quicker and more lucrative return on investment.



TABLE 4: RHINO HORN IMPORTS FROM 1972-78

MINIMUM ESTIMATES OF RHINO HORN IMPORTS  
INTO MAIN CONSUMER COUNTRIES PER YEAR  
FROM 1972 to 1978

Country	Weight (kilos)	
North Yemen (1971/2 to 1976/7) (20% has been deducted from gross imports as this amount is re-exported in the form of chippings to Hong Kong and China)	2,972	roughly, 3 tonnes
Taiwan	943	
Japan	792	roughly, 2 tonnes
South Korea	223	
China Chippings imported from North Yemen and Hong Kong	750	
Other imports	1,000	1.75 tonnes
Others (Hong Kong, Singapore, India, Nepal, Malaysia, Burma, Thailand, Indonesia, Macao, Western Europe, the Americas, etc.)	1,000	1 tonne
Total:		7.75 tonnes

N.B. Entrepots, such as Hong Kong and Singapore, consume relatively small amounts of rhino horn; in this table the estimates refer to their own consumption only.

Sources: Official Import Statistics for North Yemen, Taiwan, Japan and South Korea. Information from dealers, government officers, Correlations of various import-export figures; and government auction figures.

MINIMUM ESTIMATED AMOUNTS OF HORN PRODUCED  
FROM THE DEATHS OF RHINOS IN VARIOUS COUNTRIES  
AND GEOGRAPHICAL AREAS, ON AVERAGE PER YEAR  
BETWEEN 1972 AND 1978

Country (or Area)	No. of Deaths per year	Kilos per year
Kenya	1,500	4,500
Tanzania	690	2,000
Uganda and Central Africa (Sudan, C.A.R., Zaire, Zambia, and Rhodesia)	200 *	900
Republic of South Africa	100	350
Others in Southern Africa (Angola, Southwest Africa, Botswana, Malawi, Rhodesia and Mozambique)	90	300
Asia	80 (?)	100 (?)
Totals:	2,660	7,970 (or 8 tonnes)

\* This figure is adjusted to indicate only the deaths of those rhinos whose horn reached the international market.

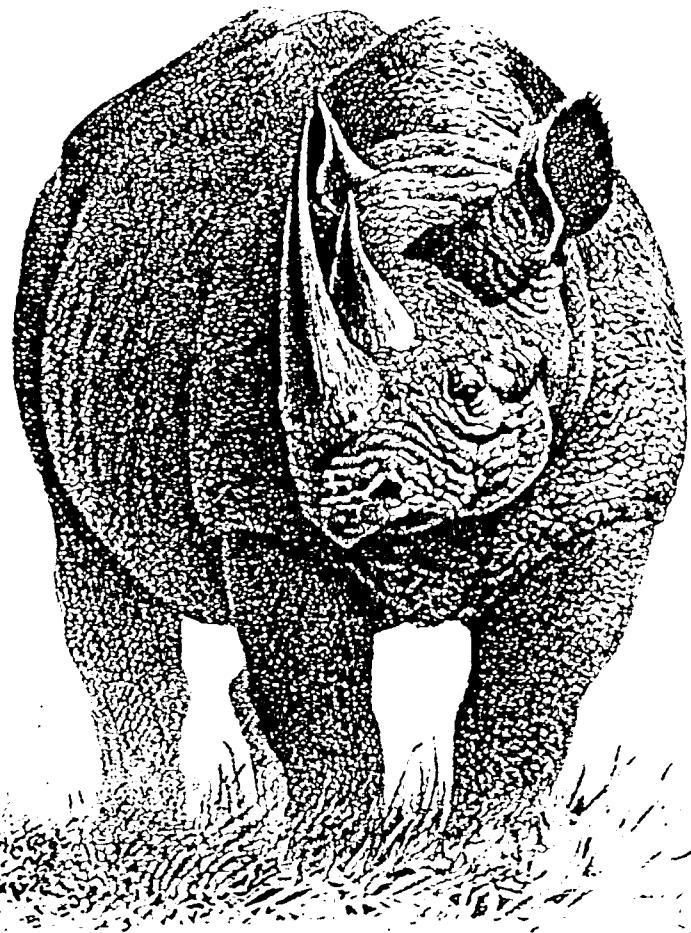
Qat use, only becoming popular in the late 70's, is having a degenerative effect on the culture, both economically and socially. The afternoons are now reserved for qat chewing and the workdays are halved. "Not only is coffee being uprooted for qat, but also the basic staple foods of the Yemenis - millet, sorghum and wheat- have given way to qat cultivation." (Martin 1982 66) The majority of men spend the afternoon and evenings chewing qat, at the expense of their work, homes and families. The prevalence of the wealthy Yemenis to place such high priority on qat chewing and rhino horn daggers shows the power they have over the horn market and the eminent future of the rhino.

The most recent trend is the stockpiling of rhino horn for speculation to ensure quantities for future medical supplies and dagger stock. As the rhinos become extinct, the value of the remaining horn increases proportionally, and traders and entrepreneurs in Africa and Asia are banking on this commodity. The speculators are controlling the price rather than the consumer market.

This leads to another controversy, of what to do with the stockpiles in existence since the trade in rhino horn is illegal. "Although Taiwan has five to six tons of horn and China has amassed 8.5 tons, Zimbabwe and South Africa are also sitting on stockpiles worth millions of dollars. At the CITES meeting in Kyoto, Japan, in 1992, both Zimbabwe and South Africa argued that lifting the ban would lower the price of rhino horn, thereby undermining the black market and supplying countries with needed money for rhino protection." (Speart 1994, 83). This is a valid point that illustrates the controversy that keeps the factions from working together towards a solution to curb the demand for the horn.

On the following page, Table 4 shows the amount of rhino horn entering the consumer countries per year from 1972-1978, showing about 7.75 tons per year. Table 5 shows the geographical areas that the rhinos are harvested from and number of deaths per year for this same time frame.(IUCN 1982).

# The Black Rhinoce<sup>ros</sup>



# THE BLACK RHINOCEROS

Scientific name: *Diceros bicornis*

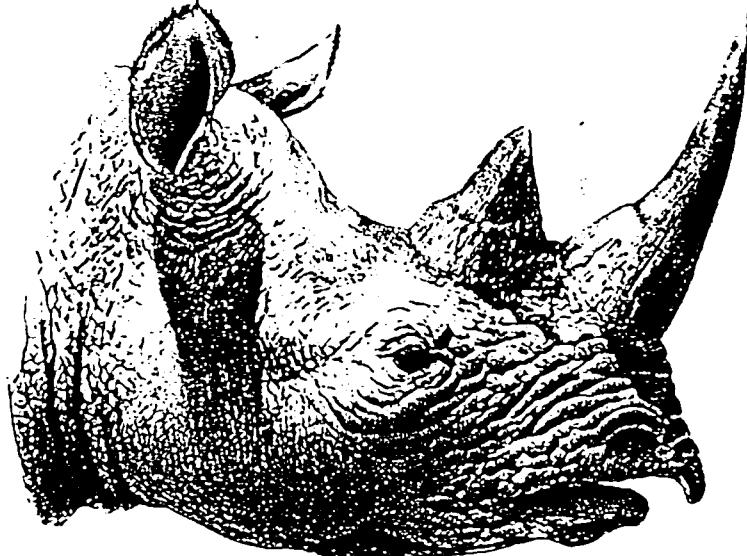
Common names: Black Rhinoceros, Prehensile-lipped rhinoceros,

Browsing rhinoceros

<u>Stats:</u>	Length of head and body	10 ft-12 ft 6 in.	(3.0-3.8 m.)
Height at shoulder	4 ft 6 in-6 ft	(1.4-1.8 m.)	
Weight	2,195-3,000 lb.	(996-1,362 kg.)	
Length of front horn	20 - 52 in.	(50-135 cm.)	
(Penny 1988, 22)			

The black rhinoceros is not black and the white rhino is not white. Both are of similar color, being brown to grey, and this misleading nomenclature is used to differentiate the two species, which are quite different. The black rhino is a browser, and feeds on leaves and twigs from a wide variety of shrubs in the acacia woodland community and prefers the edges of small wooded areas. "As a browser, it can colonize areas of rugged hilly terrain where grass is scarce, up to heights of 9,000 ft. (2,700 m.)." (Penny 1988, 23) It uses the strong, agile prehensile upper lip, like a hand, to put food into its mouth, as shown in figure 2.

FIGURE 2: HEAD OF THE BLACK RHINO



The black rhinoceros has a prehensile upper lip, typical of a browsing animal. However, it can also feed on fruits, and plants such as clover

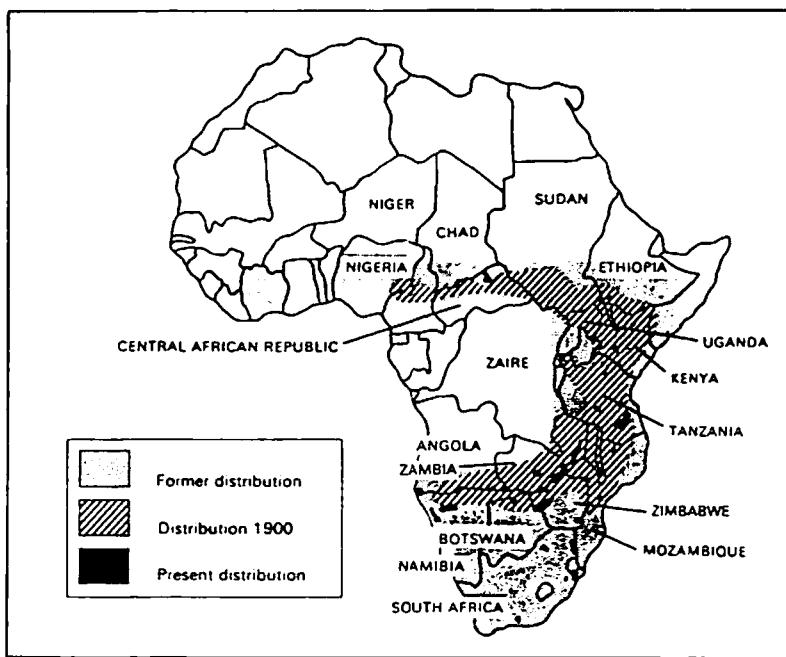
The black rhino feeds in the morning and evening, and spends the heat of the day in the shade or in a wallow. The black rhino is considered to be the anti-social rhino, because of their solitary existence, especially the males. Their territories are centered around their water source and they form loose communities called 'clans'. The territorial boundaries are defined by urine-spraying and dung heaps, which are continually updated and confirmed, especially by the males. The females are more tolerant of other rhinos, unless they are with a fresh calf, at which time they are intolerable to any other animal presence. The males will tolerate close association of other rhinos as long as they are members of the resident clan, but are intolerable to strangers.

The black rhino reaches sexual maturity at about seven years of age. The gestation period is about 15 months, at which time the female goes into seclusion for a few weeks to raise her vulnerable infant. The newborn calf weighs between 55-88 lb. ( 25-40 kg.) and is most vulnerable to hyena attack at this stage. A female breeds only every two to five years, and will continue raising the previous calf until the new one is born.

The black rhino is very agile and quick on its feet, being able to charge at up to 30 m.p.h.(50 k.p.h.). The black rhino is also considered the most ferocious of the rhinos, and is the species most commonly associated with charging people and jeeps, such as in the movie "Datari". The black rhino is surely more dangerous and high-strung than the white rhino, which could be a factor of it's habitat, the black is more likely to be taken by surprise in the thick bush than the white rhino in the open grassland. When the black rhino is startled, its first response is to charge at the source, in order to bluff it and put the stranger on the defense. There are few men or beast that would stand in the way of a charging black rhino. Zoos in the past have been weary of housing black rhinos due to their wicked reputation, but the black rhino has proven to mellow and become tractable in the captive situation, yet always retaining its edge.

"There was a time when the range of the black rhinoceros was determined by the climatic conditions: it inhabited forests and woodland everywhere unless they were too dry, as in parts of East Africa, or too hot and humid, like the lowland forests to the west of the Rift Valley. Now, its range is determined by the reach of the financial resources of countries to whom the horn is valuable as the material for dagger handles." (Penny 1988, 25). Map 1, shows the former distribution, in the 1900's and present day:

**MAP 1: PAST AND PRESENT DISTRIBUTION OF THE BLACK RHINO**



The population numbers fluctuate with any given source, especially before the 1970's. Esmond Bradley Martin's Book "Run Rhino Run", states that in 1820 the estimated black rhino population was probably around 400,000(p.35), and down to about 200,000 by 1900(p. 12). In 1970, the population was estimated at about 65,000, and for the next 24 years it has taken an extreme nose dive, losing 98% of the living population primarily due to poaching. The numbers in Kenya have dropped from 20,000 in the 1960s to only 300 in the late 70s, then presently up to 400 after placing them in protective care (Tudge 1991 30). The numbers have declined so rapidly, that the statistics in books are outdated before they are published.

The following chart shows the sharp decline of black rhino population:

CHART 1  
BLACK RHINO POPULATION

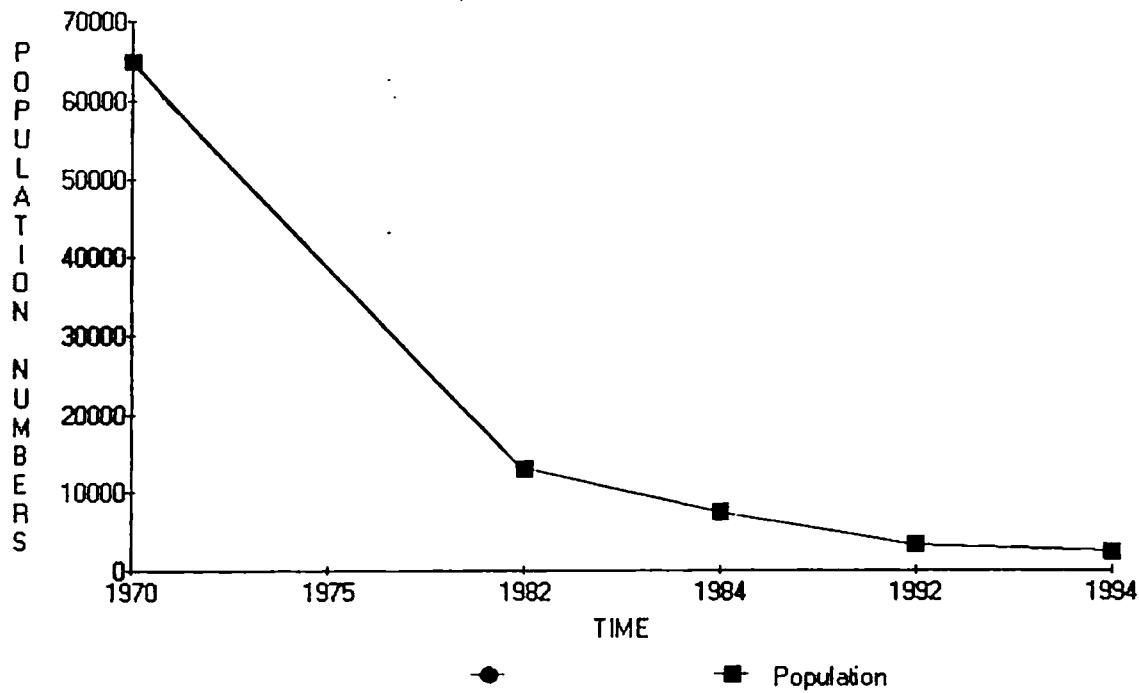


Table 6 shows the estimates of Black rhinos living "in situ":

TABLE 6: BLACK RHINO 'IN SITU' POPULATIONS

Range		Population Numbers		
		A. 1982	B. 1984	C. 1992
<b><u>Diceros bicornis</u></b>				
1 D.b. bicornis (S.W. Blk)	Namibia	345	400	400
2 D.b. longipes (N.&W Blk)	Cameroon, C.A.R.	1500	280	<100
3 D.b. michaeli (E. Blk)	Kenya, N.Tanzani	5573	3895	600
4 D.b. minor (S. Blk)	Tanzania, Zambia, Zimbabwe, S.Africa	<u>5680</u>	<u>2970</u>	<u>2300</u>
		13098	7545	3400
		(IUCN 1982)	(Penny 1984)	(RGCAP 1992)

Chart 2 shows a graphic illustration of the above data:

CHART 2

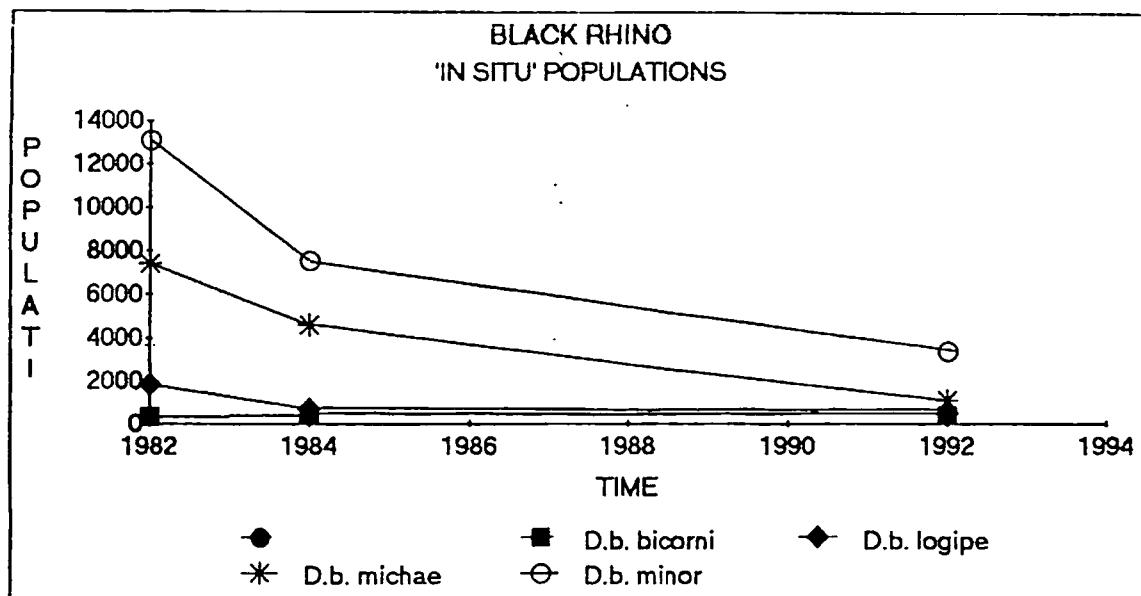


Table 7 shows the estimates of Black rhinos living "ex situ" in captivity:

TABLE 7: BLACK RHINO 'EX SITU' POPULATIONS

	WORLD		AFRICA		ASIA		AUSTRALIA		EUROPE		N.A.		S.A.	
	WILD	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV	CPTV
	POP	POP	TRGT	POP	POP	POP	POP	POP	POP	POP	POP	POP	POP	POP
<b>Diceros bicornis</b>														
1 D.b. bicornis	400	0	0	0	0	0	0	0	0	0	0	0	0	0
2 D.b. longipes	<100	0	0	0	0	0	0	0	0	0	0	0	0	0
3 D.b. michaeli	600	163	200	5	35	2	55	67	6	6	30	0	0	0
4 D.b. minor	2300	42	175	4	2	0	6	97	6	61	30	0	0	0
	3400	205	375	9	37	2	61	97	6					

(RGCAP 1992, TABLE 2)

The black rhino is in for a tough fight the way its numbers are plummeting. Its decline has come so fast, that there is little time to adapt to the environment changes, without being ruthlessly hunted for the trophy you carry on your nose. At a lecture by Thomas J. Foose, of the International Rhino Foundation (IRF), he stated some eerie statistics. "In Uganda all of the Black and White rhinos were exterminated during the seventies; In Kenya the black rhino was estimated at 20,000 in 1970 and down to

500 in 1985, and at this time it is stabilized and recovering. In Zambia, the black rhinos of the Hwange Valley which numbered 4000 were annihilated between 1980-1985; The black rhinos of Tanzania numbered over 5000 in the late 80's and only 200 today; Zimbabwe is the latest case with 1,700 in 1991, shot down to only 300 in 1993."(Foose Iec. 1994). These numbers are illustrative of a volatile trend in the last 10-15 years.

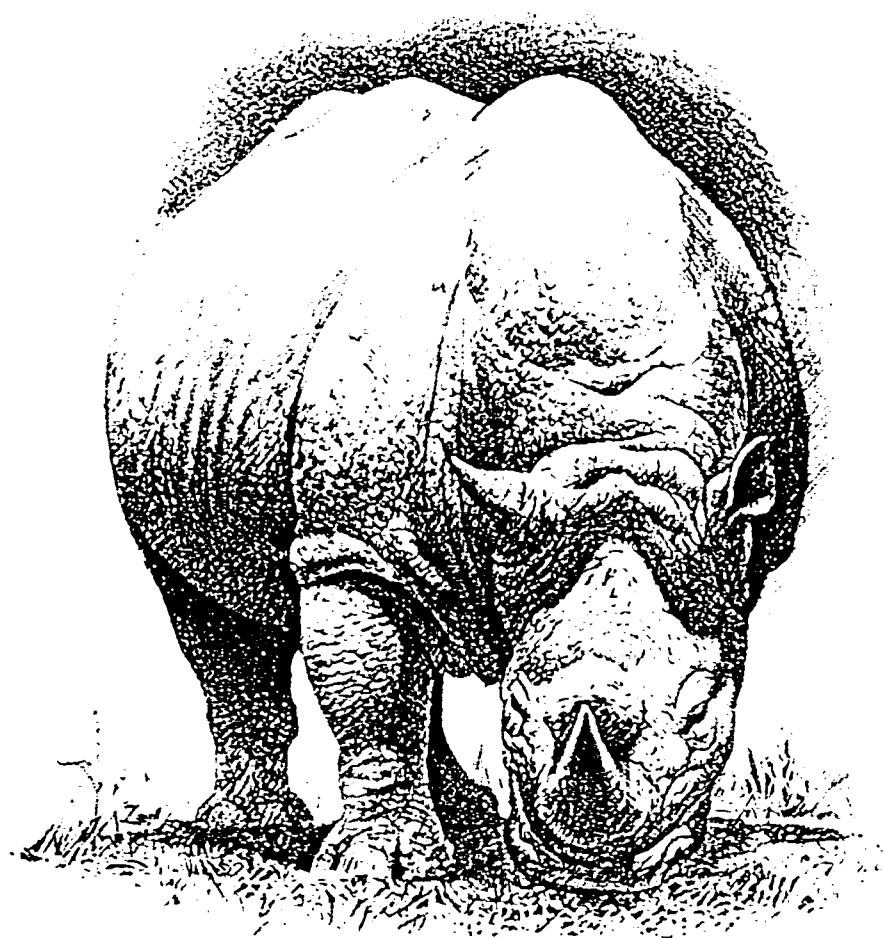
Saving the black rhino 'in situ' will necessitate strengthening the protection of them. Individuals or remnant populations need to be put into a protected situation, where Kenya is taking a lead in consolidating rhinos into protected areas. The Rhino Gcap has compiled a list of priority sanctuaries for the black rhino, shown in table 8:

TABLE 8: PRIORITY SANCTUARIES FOR THE BLACK RHINO

<u>Scientific name</u>	<u>Common name</u>	<u>Sanctuaries</u>
<i>Diceros bicornis</i>		
1. <i>D.s. bicornis</i>	Southwestern Black	Damaraland, Etosha, Kaokoland
2. <i>D.s. longipes</i>	North & West Black	Cameroon
3. <i>D.s. michaeli</i>	Eastern Black	Aberdare, Masai Mara, Nairobi, Nakuru, Tsavo, Solio, Lakipia
4. <i>D.s. minor</i>	Southern Black	Selous, Hwange/Matetsi, Sebungwe, Zambezi, Central Highlands, Hluhluwe, Kruger, Mkuzi (RGCAP)

The Black rhinos are doing fairly well in captivity, and the management, husbandry and research is expanding. At this time the captive numbers of the sub-species are disproportionate, with only two of the four being represented. The Eastern Black (*D.b. michaeli*) has 163 in captivity now, which is targeted to increase to 200, primarily thru natural breeding. They want to increase the birth rate by moving non-reproductive animals into reproductive situations, and increase the size and quantity of holding spaces. The Southern Black (*D.b. minor*) has 53 in captivity now, which is targeted to increase to 175 rhinos. This will be achieved by increasing the captive population size by recruitment from the wild and increasing quantity and size of holding spaces, especially in Australia and North America. "Michaeli should be kept in Africa, Asia (excluding Australia), North America, South America & Europe. Minor should be kept in Africa, Australia & North America." (RGCAP 1992)

# The White Rhinoceros



# THE WHITE RHINOCEROS

Scientific name: *Ceratotherium simum*

Common names: White rhinoceros, Square-lipped rhinoceros,

Grass rhinoceros

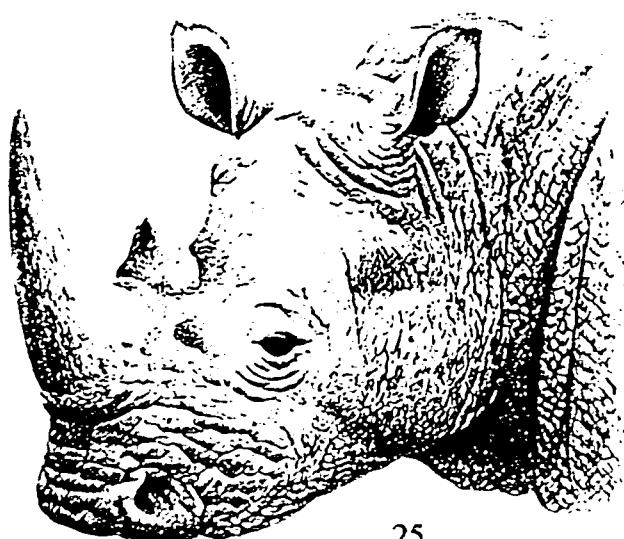
Stats: Length of head and body	12-14 ft.	(3.6- 4.2 m)
Height at shoulder	5-6 ft.	(1.5-1.85 m)
Weight	2,195-3,000 lb.	(2,300-3,600 kg)
Length of front horn (Northern.)	37-40 in	(95- 101 cm)
(Southern)	37-79 in	(95- 200 cm)

(Penny 1988, 36)

The white rhinoceros is not white, as the black rhino is not black, as they are both grey to brown.

"The name 'white' is a corruption of the Afrikaans *weit*, which describes the *wide* mouth of the species." (Penny 1988, 22). The white rhino is a grazer, using its large square lip like a lawnmower, it is well adapted for the open grassland of Africa. The white rhino's physical morphology allows it to utilize a different niche than the black rhino, although they are found in similar ecosystems. Figure 3 shows the broad lip of the white rhino:

FIGURE 3: HEAD OF THE WHITE RHINO

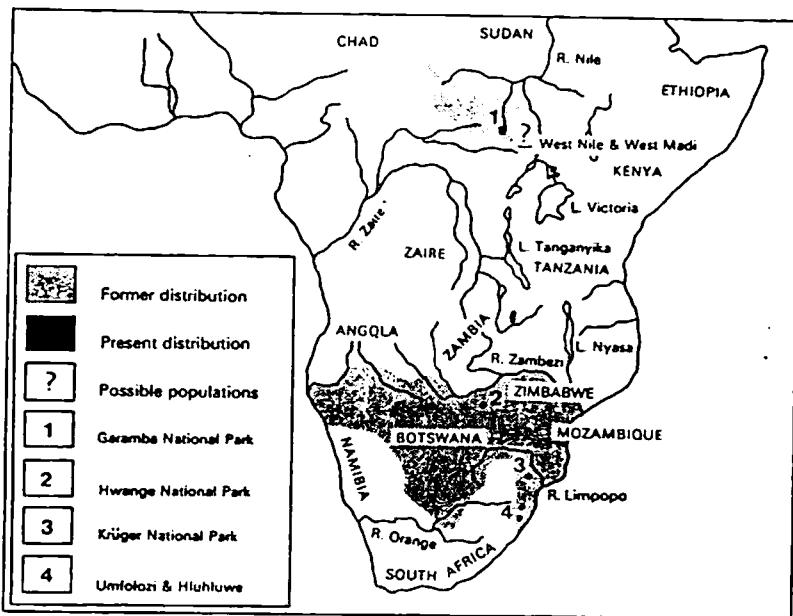


There are two distinct races of the white rhino, the northern race (*Ceratotherium simum cottoni*) and the southern race(*C.s.simum*). They occupy different areas of Africa, but utilize similar niches and habitats. The southern race has done very well in comparison to the other species, with over 5,500 individuals, which is about one half of the total surviving rhinos of all taxa. "The Rhino GCAP is recommending that the captive population of Southern White Rhino be reduced while the populations for the other rhino taxa are recommended to increase" (RGCAP 1992, 7).

This has been a success story, in that they were believed to be extinct in 1892."However, a few individuals survived in the valley of the Umfolozi River, in Natal: when they were found, in 1897, the government of South Africa declared the valley a preserve. From then on the population increased steadily, until in 1930 there were thought to be about 30. By 1960, the population numbered 1,500, there and in the neighboring Hluhluwe Reserve."(Miller 1988, 45) They then began shipping them to other parks and to zoos around the world. Twenty rhinos (8.12) were shipped to form a breeding herd in Whipsnade Park in England, which has produced more than 35 calves since 1970. South Africa and Zimbabwe, whose large populations of Southern Whites has reached its carrying capacity, is applying pressure to allow trophy hunting and sale of rhino horn to raise needed funds for conservation programs.

The story for the Northern White is more tragic, with the numbers being reduced from 1000 to 100 during the Congo Civil war. Between the 1960-1985 the remaining population was hunted to near extinction. In 1980 there were 821 inhabiting areas in Sudan and Zaire, which then plummeted to a surviving herd of 17 being started in 1986 in the Garamba National Park in Zaire. This is now the rarest of the rhino taxa, with the population at Garamba N.P. numbering 31 individuals, in a politically unstable arena, and 10 in captivity in the US and Europe.

## MAP 2: PAST AND PRESENT DISTRIBUTION OF THE WHITE RHINO



The white rhino is similar to the black, in that it spends the morning and evening feeding and the majority of the day resting or wallowing. The white rhino lives a more communal existence than the black. The dominant or alpha male holds a feeding and breeding territory, which he will defend against all males. "Typically, where the population of white rhinoceroses is at full density, a male's feeding territory is about 3/4 sq. mile(2sq km)." (Penny 1988, 40) The alpha male will allow the subsidiary males to feed in their territory, as long as they respond to the dominants challenge by making the correct sounds and gestures. The female has a larger territory than the male, "about 4 sq. miles (10 sq. km)" (Penny 1988, 41), and they overlap freely with other females. The territories are also marked by dung heaps and urine spraying. Adolescent whites will be gregarious, but otherwise the white rhino "move in small groups of females and young of various ages, wending their way between the solitary males." (Penny 1988, 41)

The white rhino reaches sexual maturity at about seven years of age, and the gestation period is about 16 months. The calf is born in seclusion, at which time she chases away the previous offspring, which is similar to the black. The calf of the white rhino walks in front of the mother, whereas the calf of the black rhino walks behind the mother.

The white rhino is agile and capable of galloping up to 25 m.p.h.(40 km) for short distances. Compared to the other species of rhinos, which the white is the largest, it is considered the lunker, moving slowly with its head close to the ground. White rhinos adapt readily to a captive situation, capable of being housed with cospecifics and conspecifics. They also become tolerable of close human contact, which is not part of the other rhinos repertoire.

Table 9 shows the estimates of White rhinos living "in situ":

TABLE 9: WHITE RHINO "IN SITU" POPULATIONS

Range	Population Numbers		
	A. 1982	B. 1984	C. 1992
<u><i>Ceratotherium simum</i></u>			
5 C.s. cottoni (Northern White) Zaire, Sudan(?)	<700	17	31
6 C.s. simum (Southern White) S.Africa, Kenya, Zimbabwe	2,861	3,920	5,560
	3,561	3,937	5,591

(IUCN 1982) (Penny 1988) (RGCAP1992)

Chart 3 shows a graphic illustration of the above data:

CHART 3

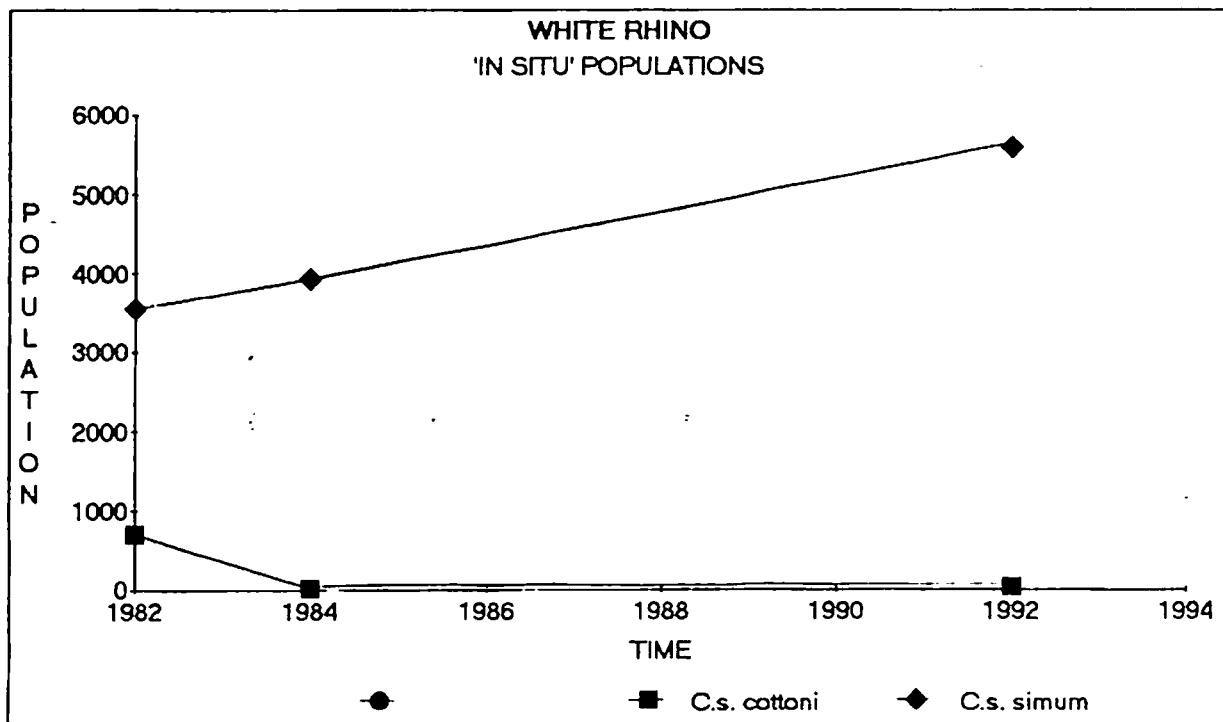


Table 10 shows the estimates of White rhinos living "ex situ" in captivity:

TABLE 10: WHITE RHINO "EX SITU" POPULATION

	WORLD			AFRICA		AUSTR ALASIA	EUROPE		N.A.		S.A.	
	WILD POP	CPTV POP	CPTV TRGT	CPTV POP	CPTV POP		CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP	
<u><i>Ceratotherium simum</i></u>												
5. <i>C.s. cottoni</i> (N. Wht.)	31	10	7	0	0	0	6	4	0			
6. <i>C.s. simum</i> (S. Wht.)	5,560	570	300	24	150	14	210	132	40			
	5,591	580	300	24	150	14	216	136	40			

(RGCAP 1992)

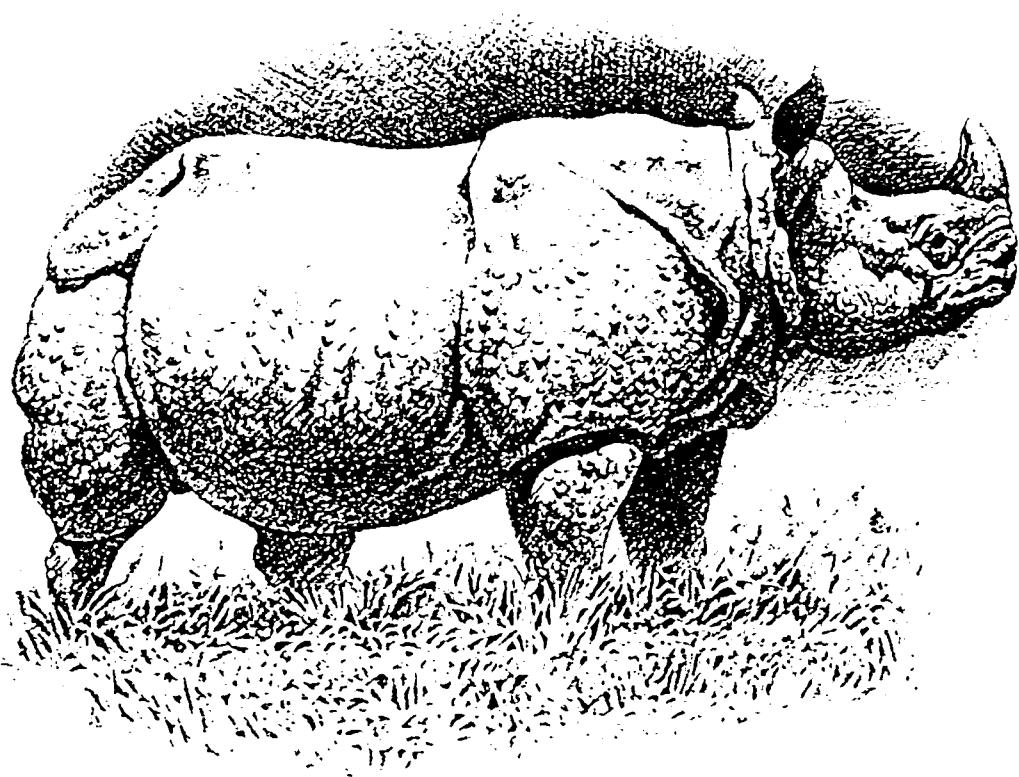
The Northern White is the most endangered of the rhinos, with a population of 31 in Garamba Reserve in Zaire, and 6 in Dvur Kralove in Czechoslovakia and 4 in San Diego Wild Animal Park., only 41 left in this world! On the other hand the Southern White is increasing and is reaching its captive and wild carrying capacity. Countries with large populations want to harvest the surplus selectively for large revenue. The concentration is to keep the Southern White population stable and protected. The table below shows the priority sanctuaries for the White rhinos:

TABLE 11: PRIORITY SANCTUARIES FOR WHITE RHINOS

Common name	Scientific name	Sanctuaries
<i>Ceratotherium simum</i>		
5. <i>C.s. cottoni</i>	Northern White	Garamba in Zaire (pop. 31)
6. <i>C.s. simum</i>	Southern White	Hluhle/Umfolozi (pop. 1988), Itala (160), Mkuzi (132), Pilanesberg (201), Krueger (1065), Hwange (100)

(RGCAP 1992)

# The Great Indian One-horned Rhinoceros



# THE INDIAN/NEPALI RHINO

Scientific name: *Rhinoceros unicornis*

Common names: Great Indian one-horned rhinoceros,  
Indian rhinoceros

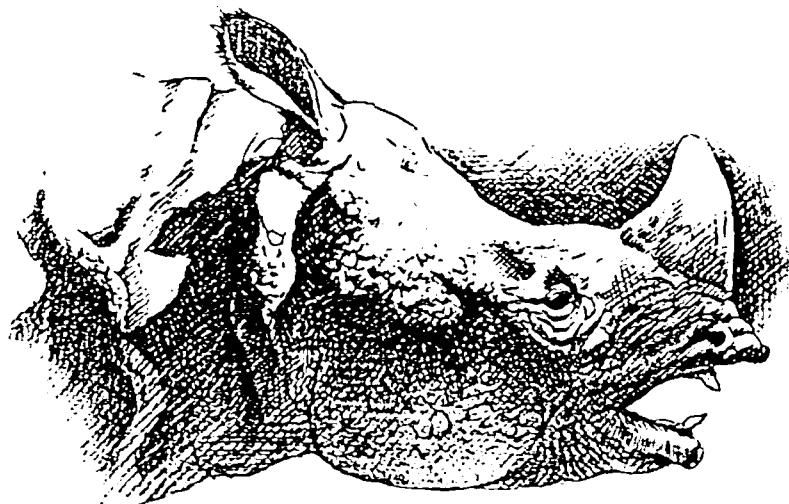
## Stats:

Length of head and body	7 - 14 ft.	(2.1 - 4.2 m.)
Height at shoulder	3.5 - 6.5 ft.	(1.1 - 2.0 m.)
Weight	3,300 - 4,400 lb.	(1,500 - 2,000 kg.)
Length of horn	8 - 24 in.	(20 - 61 cm.)

(Penny 1988, 48)

The Great Indian rhino is a magnificent sight, looking similar to the dinosaurs of the past. Its body is covered with shieldlike folds of skin, and rivet-like bumps, giving the appearance of impenetrable body armor. The Germans call this rhino the *Panzernashorn*, and have used it as an image of strength and impenetrability shown in the *Panzer* division of their army and their *Panzer Tank*. The Indian rhino is both a grazer and a browser, preferring swampy areas and grassy riverine plains, although it will also move into drier grassland and higher wooded areas. It possesses a semi-prehensile upper lip which enables it to feed on tall grasses and slender twigs, and can be folded out of the way when it needs to graze on short, fresh grass. Figure 4 shows the head of the Indian Rhino:

FIGURE 4: HEAD OF THE INDIAN RHINO



The Indian rhinoceros, like all the Asian species, retains its incisors, and occasionally uses them as weapons

The Indian rhino has a more peaceful and leisurely life than the African species, since it spends little time or energy in conflict. It is considered more nomadic than territorial. In the late afternoon it spends time in shaded areas and goes into open feeding areas in the evening. It feeds in the evening until about Midnight, then settles and rests in the feeding area. In the morning it heads for cover, only to emerge in the early afternoon to head for the wallows. From midday until late afternoon they congregate in the wallows, any combination and number of adults and young in large social groupings (rhino hot-tubs). Wallowing serves to protect the rhinos from insects, sunburn and overheating, and also keeps their skin supple.

The grass jungle of the Indian Rhino is divided into 'public' and 'private' areas. Public areas are made up of the wallows and large feeding areas. Private areas are the sleeping areas in the grass and some pathways. They use communal dung heaps as social directories rather than territorial markers.

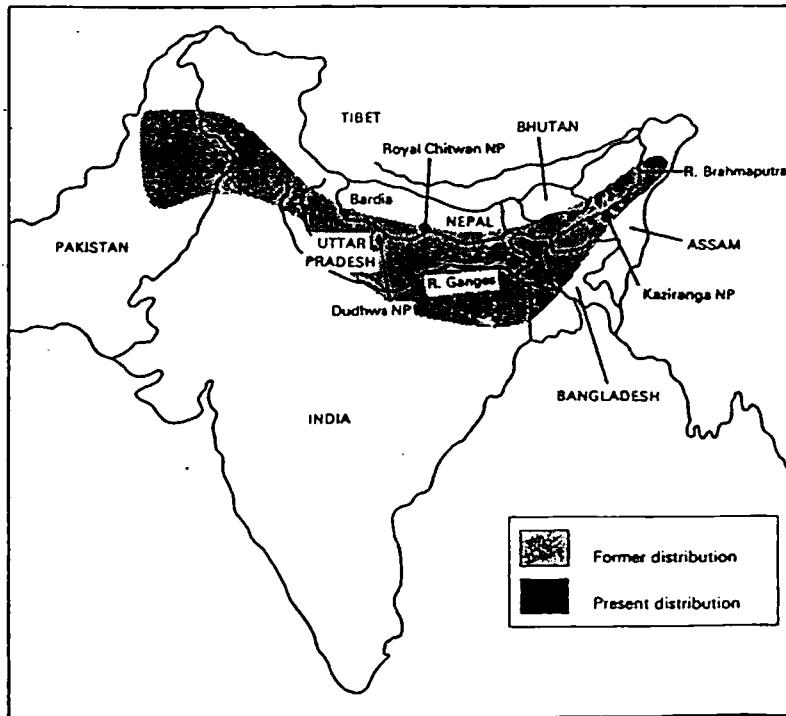
Females sexually mature at three years and males at seven to nine years. Gestation period is 16 months and a newborn calf weighs 145 lb. (65 kg.). The calf follows close behind the mother at an early age, but begins to travel in front of her as it matures. The Indian rhino rarely fights with conspecifics, but uses grunts and snorts to vocally communicate. If a fight does ensue between a bull and an intruder, they will use their sharp lower incisors during these territorial skirmishes.

"The great one-horned rhinoceros once ranged extensively across the plain of the Ganges, from the Indus Valley in the west all the way to Assam.... However, its population dwindled sharply during the nineteenth century, under pressure from the expanding human population, for whose crops it was a very efficient competitor.... The second cause of its decline was the very heavy hunting which developed to satisfy the demand for its meat, blood and horn for medicinal and ritual uses." (Penny 1988, 49)

The Indian rhino occupies eight protected areas in India and two in Nepal. The Kaziranga N.P. in India holds the largest population, with about 1,100 individuals, and the Royal Chitwan N.P. in Nepal holds the second largest population, with about 400 individuals. Rhinos have been relocated from these two parks to fortify 'in situ' and 'ex situ' situations.

Map 3 shows the past and present distribution of the great one-horned Indian Rhino:

### MAP 3: PAST AND PRESENT DISTRIBUTION OF THE INDIAN/NEPALI RHINO



About 1550, the Indian rhino was to have numbered in the hundreds of thousands. Their numbers dwindled quickly as rhino hunts came into vogue. "But already in the sixteenth century human populations were increasing and the rhino had to give way to new settlements in fertile flood plains and lowland grass areas, which he so favoured....As late as 1896, the government of Bengal was paying a bounty of 20 rupees for every rhino killed...It was the introduction of modern fire-arms by British soldiers which was the rhino's undoing...the luckless creature was also threatened by another and more subtle foe : tea.... The transformation of his habitat, the tremendous influx of people and, finally, a railway linking Assam with other parts of India left little chance for his continued survival. By 1908 there were only twelve rhinos left alive in the Kaziranga area of central Assam, which had once had the greatest concentration of these animals." (Martin 1982, 31)

Table 12 shows the current estimates of Indian/Nepali rhinos living 'in situ':

TABLE 12: INDIAN/NEPALI RHINO 'IN SITU' POPULATIONS

<i>Rhinoceros unicornis</i> Range and numbers	(1985)	(1992)
INDIA		
Kaziranga	1,195	1,000
Manas	75	80
Pabitara	67	40
Orang	60	65
Laokhowa	40	5
Jaldapara	20	40
Other locations	30	18
<b>Total in 10 locations</b>	<b>1,487</b>	<b>1,348</b>
NEPAL		
Chitwan	400	400
Bardia (1986)	4	40
PAKISTAN		
Lal Suhana	2	?
<b>Total world 'in situ' population</b>	<b>1,893</b>	<b>1,700</b>
(Penny 1988, 48) (RGCAP 1992.)		

Table 13 shows the estimates of Indian/Nepali rhinos living 'ex situ' in captivity:

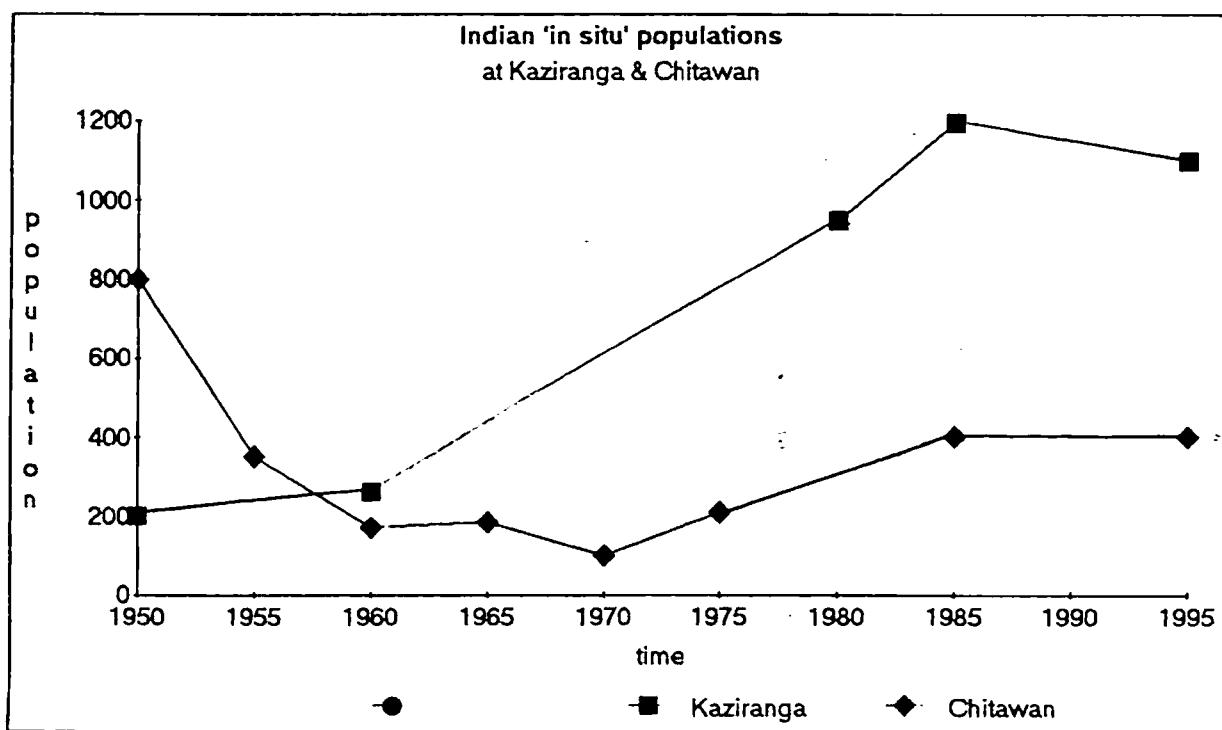
TABLE 13: INDIAN/NEPALI RHINO 'EX SITU' POPULATION

WORLD	AFRICA		ASIA		AUSTRALASIA		EUROPE		N.A.		S.A.	
	WILD POP	CPTV POP	CPTV TRGT	CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP	CPTV POP
	1700	120	230	0	45	0	210	132	40	40	40	40
<i>Rhinoceros unicornis</i>												

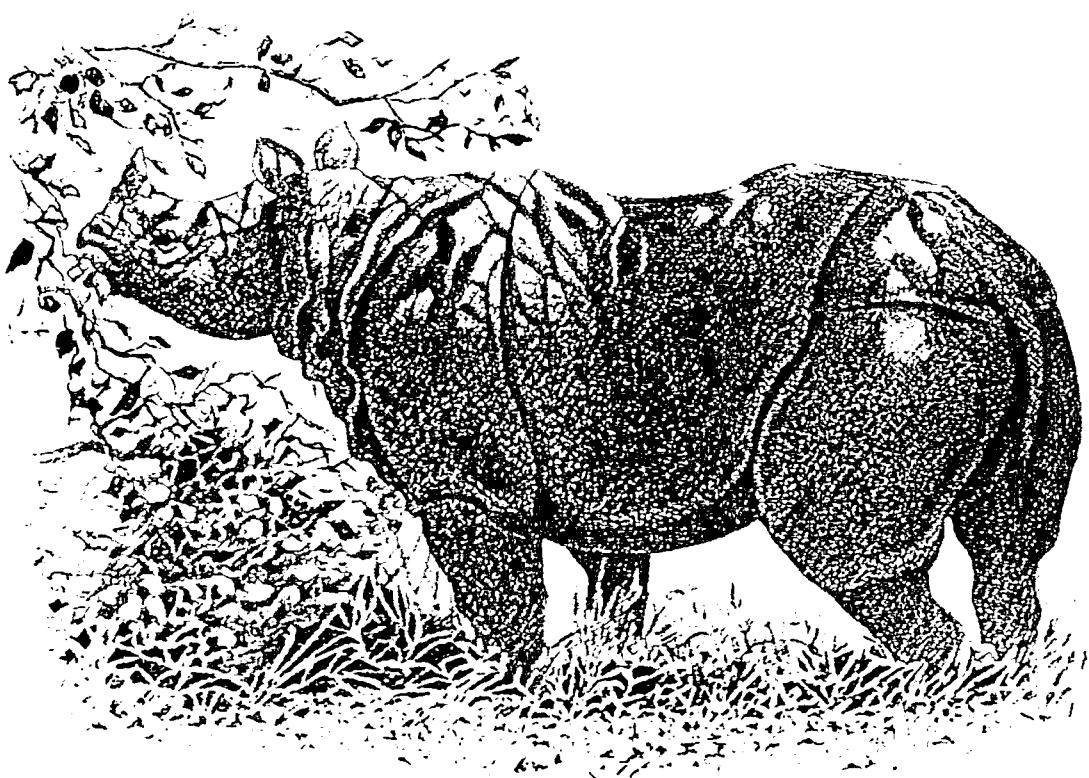
In India, rhino hunting was abolished in 1910, and soon afterwards the state governments started to protect the areas where rhinos still survived. Kaziranga became a sanctuary in 1916, and was plagued by poachers until it was open to the public in 1938. In 1959 the population was estimated at 260 and has grown steadily. But poaching and flooding continually threaten the population. "It was here that between 1979 and 1989, 500 Indian rhinos were poached." (Speart 1994, 31). Kaziranga N.P. contains the largest population of Indian rhinos, yet it is slackening in its tourist potential. "One of the major drawbacks is the annual flooding of the Brahmaputra river which means the park must be closed between May and late September... and it is also difficult to reach Kaziranga...the nearest airport is 90 kilometres away. Almost a

million tourists go to India in a year, but only about one in a thousand of these currently visits Kaziranga."(Martin 1982, 118)

In Nepal, the rhinos didn't reach extinction till the middle of the twentieth century. Between the 1930's and the 1950's the rhinos and tigers of Chitwan were hunted for sport and trophies for the royalty and their guests. Between 1950 and 1960 the government was unstable and "human population of the valley rose from 36,000 to 100,000, and 70% of the forests and grasslands were cleared for cultivation, destroying much of the rhino's natural habitat"(Martin 1982, 31) and the poachers took control. In 1962, the government sent in 500 armed guards and poachers were dealt with severely. Since this time, poaching has been controlled, And Chitawan became a National Park covering 546 sq. km. in 1973. In 1977 it was expanded to 907 sq. km. and this is one of the most stable rhino populations. They have successfully translocated 43 rhinos from here to Bardia N.P. from 1989-1992. If a rhino dies of natural causes at Chitawan, all the parts except the feet and horn are made available to the people. Chart 4 shows the population fluctuations at Chitawan and Kaziranga from the 50's to present:



# The Javan Rhinoceros



# THE JAVAN RHINOCEROS

Scientific name: *Rhinoceros sondaicus*

Common names: Javan rhinoceros, Lesser one-horned rhinoceros

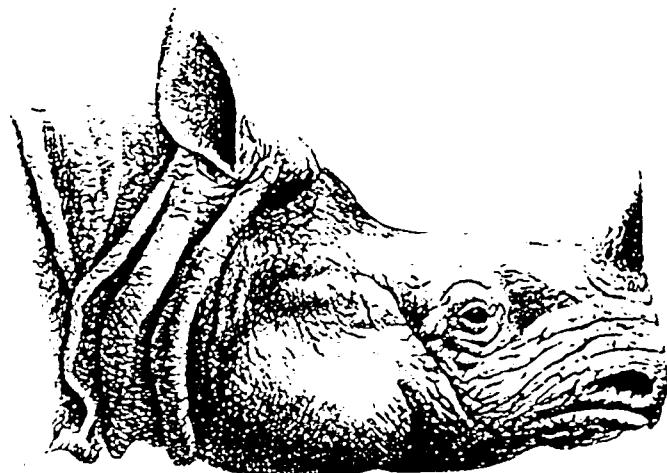
<u>Stats:</u>	Length of head and body	11 ft 6 in	(3.5 m)
	Height at shoulder	6 ft	(1.8 m)
	Weight	3,527 lb	(1600 kg)
	Length of horn	10-10.5 in	(25-27 cm)

(Penny 1988, 58)

The Javan rhino is a smaller and more refined version of the Asian rhinos. They are so elusive that there is so little information on them, they will be gone before we know of them. Until very recently, they were indistinguishable to most from the Indian rhino, so we do not have accurate census data. They are not kept in captivity and never have been. There are less than 100 individuals left on this planet, at the high estimate. Viable breeding populations may not survive till the year 2000. They are presently teetering on the edge, to save this animal from immediate extinction is a monumental task.

The Javan rhino is a browser, preferring secondary growth in forested areas. They feed on a variety of trees and shrubs, and will bend the saplings to reach the leaves or fruit. They have a upper prehensile lip, which resembles that of the Black rhino more than the Indian. They prefer covered, forested areas in higher altitudes. Figure 5 shows the head of the Javan rhino:

FIGURE 5: HEAD OF THE JAVAN RHINO

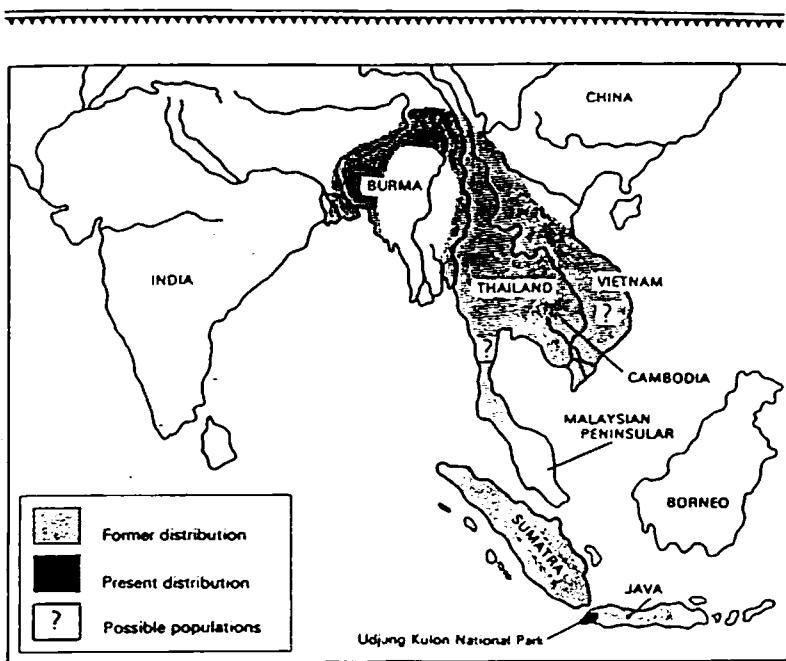


The similarity between the Javan and Indian rhinoceroses (they are members of the same genus) led to confusion until the species were separated in 1822.

The Javan rhino has plated skin similar to the Indian but its skin is a more mosaic of armadillo-like scales. Males are sexually mature at six and the females maybe as young as three. It is the only species of rhino where it is believed that the female does not grow a horn, only a flat knob; although this fact is disputed, which illustrates how little we know of them. They are believed to have tusks similar to the Indians.

They prefer thick dark forest, and make tunnels thru the shrubbery.. Their trails have been used by local travelers to find a water source, and unfortunately some of their trails in the remote parts of Java have become roads. The Javan is said to have poor eyesight and rely more heavily on their hearing and sense of smell. They use urine spraying more as a social directory than a territory marker. They are agile climbers and prefer forested hill country at over 6500 ft.(2000 m). The majority of the Javans live in Udjung Kulon National Park in western Java and possibly a few in Vietnam. Map 4 shows the past and present distribution of the Javan rhinoceros:

MAP 4: PAST AND PRESENT DISTRIBUTION OF JAVAN RHINO



*Past and present distribution of the Javan rhinoceros*

"The decline of the species in Java has coincided with the eruption of the human population, which Talbot shows to have risen from an estimated 3 to 4 million in 1800 to 11 million in 1850; 28 million in 1900; 41 million in 1930 and 57 million in 1958...As Talbot states: "with the tremendous population growth in Java the rhinos would have been excluded from most of the island by agriculture, even if they had not been hunted to death for their horns".(Simon 1970, 145) Now the largest population inhabites the Udjung Kulon Peninsula at the western most tip of Java. "The peninsula was set aside as a Nature Monument in 1921, with the particular aim of protecting the Javan rhinoceros, the Javan tiger, and the banteng. Protection was only nominal, however, and poaching was of regular occurrence. In 1937 the status of the area was upgraded to that of a Nature Reserve, from which all human settlement was excluded."(Simon 1970, 146)

Udjung Kulon is at the foot of the Krakatau Volcano, which last erupted in 1883 causing an ensuing tidal wave that wiped out all human settlement and destroyed most of the lowland primary forest. The rhinos that survived this are the ancestors of the surviving population. World Wildlife Fund started helping in 1964, and provided assistance in the form of a boat, a Land Rover, guard posts, and funds to supply the guards with regular wages, uniforms and medicaments. The population at Udjung Kulon has been estimated from 1959-1985 to fluctuate between 25 and 50 individuals, on the 300 sq. km. reserve. Table 14 shows the estimates of the Javan rhino living 'in situ'.

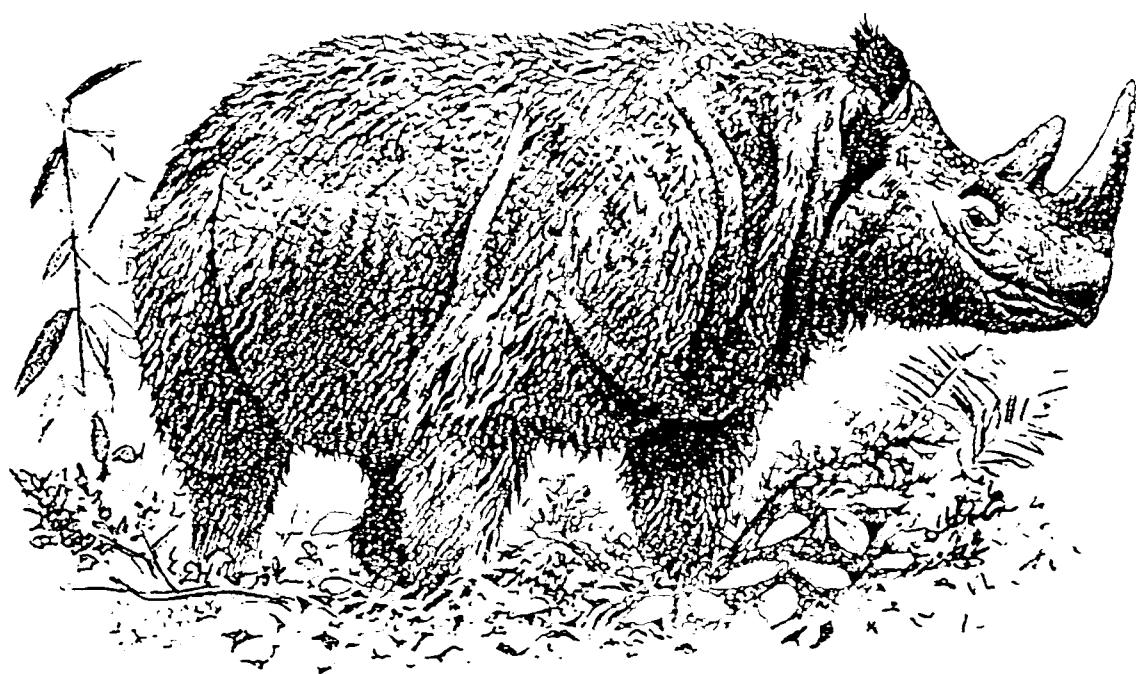
TABLE 14: JAVAN RHINO 'IN SITU' POPULATIONS

	<u>Range</u>	<u>Population numbers</u>	
		<u>A. 1985</u>	<u>B. 1992</u>
<u>Rhinoceros sondaicus</u>			
8. <i>R.s. annamiticus</i>	Vietnam	?	<25
9. <i>R.s. sondaicus</i>	Java (Indonesia)	50 (Penny 1988)	<75 (RGCAP 1992)

The Vietnam population is very unstable because they are not protected. They are comprised of two small populations in the Nam Cat Tien N.P. along the Dong Nai River, and some estimates say there are only 12-15 individuals. The population of Udjung Kulon is usually estimated at 50-60 individuals. The Javan tiger which also inhabited this reserve, was estimated at a dozen in 1966, has been considered extinct since 1985, was a minor threat to rhino calves. The Udjung Kulon is considered to have reached its carrying capacity for rhinos and the population is stagnating. "We have come to the conclusion that poaching is preventing an increase of population." (Foose lec. 1994) The saplings and plants that comprise the rhino's diet are scattered and scarce, and in many parts of the reserve have been replaced by unfavorable plant species.

Members of the Rhino Captive Breeding Specialist Group (CBSG) carried out a 'population viability analysis' of the Udjung Kulon population in 1989. They recommend that 18 to 24 rhinos should be translocated to captivity or to other reserves 'in situ'. This has met with strong opposition from the Indonesian government and WWF, who want more protection for Udjung Kulon. This is a controversial and complicated issue that leans toward 'in situ' captive breeding.

# The Sumatran Rhinoceros



# THE SUMATRAN RHINOCEROS

Scientific name: *Didermoceros sumatrensis*

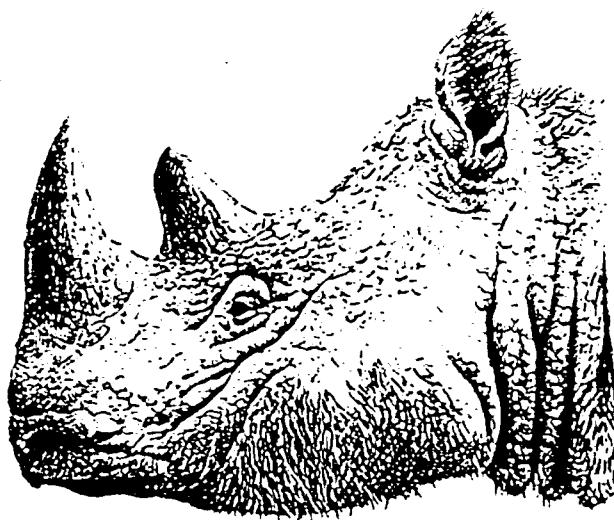
Common names: Sumatran rhinoceros, two-horned Asian rhinoceros

<b>Stats:</b>	Length of head and body	8-9 ft	(2.5-2.8 m)
	Height at shoulder	3-5 ft	(1.0-1.5 m)
	Weight	2,200 lb	(1,000 kg)
	Length of front horn	10-31 in	(25-80 cm)

(Penny 1988, 64)

The Sumatran rhino is a descendent of the Wooly rhino and is believed to be the most primitive. It differs from the other rhino species in that it is covered in reddish hair, especially when younger. It is the only Asian rhino that possesses two horns. The Sumatran rhino browses on leaves, twigs, bamboo shoots and fruits, with its prehensile upper lip. Figure 6 shows the head of the Sumatran rhino:

FIGURE 6: HEAD OF THE SUMATRAN RHINO

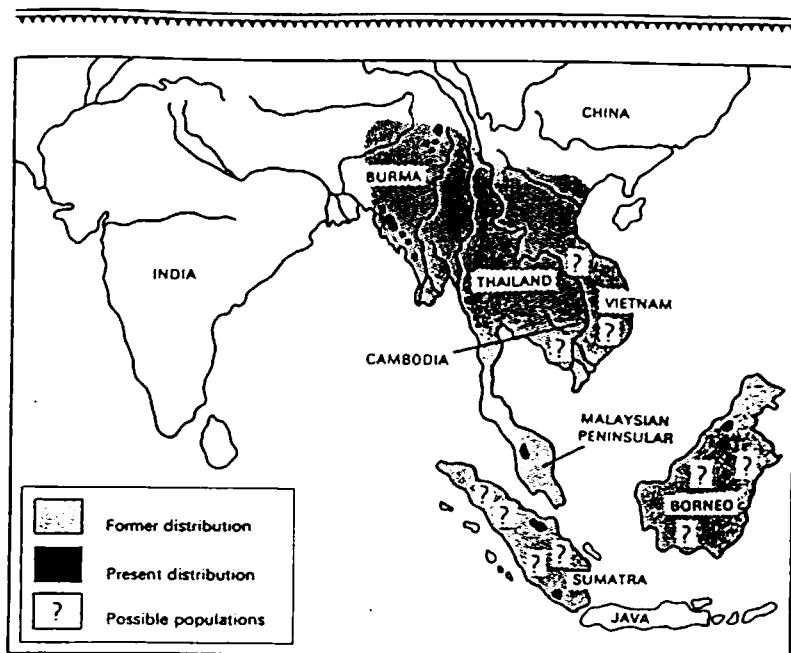


The hairy coat and fringed ears of the Sumatran rhinoceros show it to be a very old species, in evolutionary terms

Little is known about the biology of the Sumatran rhino, due mainly to its elusiveness and remote habitat. They are believed to be solitary, but males and females are seen together during courtship and breeding. They feed in the early morning and the evening, and spend the hot day and late evening wallowing or in a sheltered place. They prefer higher elevation rainforests, with rough terrain characterized by thick dense vegetation cover on steep upgrades in excess of 5,000 ft (1,400 m). The Sumatran rhino employs tunnels thru the thick vegetation, similar to the Javan. The Sumatran is also known to be the most vocal of the rhinos, emitting a large variety of squeaks and grunts, especially while wallowing.

The Sumatran rhino shares the same range as the Javan rhino, and once ranged from eastern India to Indonesia except in Java. The Sumatran prefers highland rainforest habitat, which has suffered less from development than the lowland forests inhabited by Javan rhinos. However, the higher elevation rainforests are now being rapidly logged and cleared for agriculture and housing in Sumatra and Malaysia. This development both destroys and fragments habitat, dividing the rhinos into isolated populations that are difficult to protect. Map 5 shows the past and present distribution of the Sumatran rhino:

#### MAP 5:PAST AND PRESENT DISTRIBUTION OF THE SUMATRAN RHINO



*Post and present distribution of the Sumatran rhinoceros*

The Sumatran rhino is believed to be in extreme danger of immediate extinction, although it has a larger population than the Javan or the Northern White. The former two are in more stable and protected areas than the majority of Sumatrans. The Sumatran populations are widely scattered and individual populations are too small to be viable, and some are even reduced to single animals."With the combination of low numbers, as few as 500 in 35 locations, and a decline rate of 50% over the last 10 years, the Sumatran is considered the most endangered rhino."(Foose lec. 1994) Many are outside the national parks and are being picked off by poachers, while others are in forests that are being felled around them. Table 15 shows the estimates of the Sumatran rhino in the wild:

TABLE 15: SUMATRAN RHINO 'IN SITU' POPULATIONS

<u>Dicerorhinus sumatrensis</u>	<u>Range</u>	<u>Population numbers</u>		
		<u>1987</u>	<u>1992</u>	<u>1994</u>
10. D.s. harrisoni	Borneo	100-200	100	
11. D.s. lasiotus	Burma	10-11	?	
12. D.s. sumatrensis I	Peninsular Malaysia	68-106	150	
<u>13. D.s. sumatrensis II</u>	<u>Sumatra</u>	<u>305-560</u>	<u>600</u>	
		483-877	850	500
		(Penny 1988)	(RGCAP 1992)	(Foose lec.1994)

Table 16 shows some priority sanctuaries for Sumatran rhinos:

TABLE 16: PRIORITY SANCTUARIES FOR SUMATRAN RHINOS

<u>Scientific name</u>	<u>Common name</u>	<u>Sanctuaries</u>
Dicerorhinus sumatrensis		
10. D.s. harrisoni	Borneo Sumatran	Kayan Mentarang, Tabin, Danum Valley, Ulu Limbang
12. D.s. sumatrensis I	Mainland Sumatran	Taman Negara, Endau Rompin
13. D.s. sumatrensis II	Sumatran Sumatran	Kerinci Seblat, Gunung Leuser, Barisan Selatan, WayKambas (RGCAP)

The story of Sumatran rhinos held in captivity is a horny issue."... The first rhino born in captivity was a Sumatran at the Calcutta Zoo in 1889. Another was born in 1895, and the two of them eventually became part of Barnum and Bailey's menagerie."(Penny 1988, 66). Discussions began in 1983 to start an 'ex situ' captive population, and "in 1985, the Sumatran Rhino SSP and the Sumatran Rhino Trust were brought about to help ensure survival of this rapidly declining species. ... The Bronx, Cincinnati, San Diego and Los Angeles Zoos established a cooperative agreement with the government of Indonesia...to establish breeding groups, both in the United States and Indonesia. (RGCAP 1992). But, the success of capturing the Sumatran, putting it in captivity, keeping them alive and breeding them has yet to be seen. Of the 35 (14.11)\* Sumatran rhinos captured for captive breeding programs between 1984 and 1992, twelve (5.7) have died, giving us a 33% mortality rate, and only one has been born to a female that was captured pregnant. This program has been heavily criticized because of the large amount of money spent to translocate the rhinos, and the need of the money for "in situ" protection.(\*(male,female,unknown))

The rhino conservationists contest that the program is still in its infancy, and as husbandry and management improve, so will their success. A very successful Indonesian Rhino Workshop was held in Bogor, Indonesia in October 1991, addressing management, research and conservation of the Javan rhino and Sumatran rhinos A major factor is the low population in 'ex situ' captivity, where in some cases they are kept singularly. They want to obtain additional founders from the wild for several of the taxa to be propagated in captivity in order to provide a viable genetic foundation for the population:

TABLE 17: CURRENT CAPTIVE AND TARGET  
SUMATRAN FOUNDERS

Taxa	Existing	Additional	Total
Borneo Sumatran	02	18	20
Mainland Sumatran	08	12	20
Sumatra Sumatran	13	07	20

(RGCAP 1992)

Table 18 shows the Sumatran rhino living in captivity as of 09/92:

TABLE 18: SUMATRAN RHINO IN CAPTIVITY

<u>COUNTRY</u>	<u>INSTITUTION</u>	<u>MALES</u>	<u>FEMALES</u>	<u>TOTAL</u>
<b>Indonesia</b>	Jakarta	1	1	2
	Suabaya	1	1	2
	Taman Safari	1	2	3
<b>Malaysia Peninula</b>	Malacca	0	2	2
	Sungai Dusun	1	4	5
<b>Sabah</b>	Sepilok	2	1	3
<b>United Kingdom</b>	Port Lympne	1	1	2
<b>United States</b>	Cincinnati	1	0	1
	Los Angeles	0	1	1
	New York	0	1	1
	San Diego	1	1	2
<b>WORLD TOTAL</b>		<b>9</b>	<b>15</b>	<b>24</b>

(RGCAP 1992)

# CONSERVATION PLANS, PROGRAMS AND PROBLEMS

There are many rhino conservation plans already in place, at regional and global levels. There is a need to get the plans to coordinate and work together towards the goal of saving the rhino, which is the focus of the Rhino Global Captive Action Plan (RGCAP), the World Zoo Conservation Strategy (WZCS), the International Union of Conservation of Nature/Species Survival Commission (IUCN/SSC), the International Rhino Foundation (IRF), the Captive Breeding Specialist Group (CBSG), the Taxon Advisory Groups (TAGs), and a plethora of others. The chart of Appendix 1 shows the interrelationships of the Global and regional strategic action plans, while Appendix 2 shows a glossary of global and regional captive strategic programs, both taken from the RGCAP. Appendix 3 illustrates regional breeding program organizations specific to various countries, taken from the World Zoo Conservation Strategy.

## Conservation in Captivity.

Now that we have a fairly accurate inventory of rhinos and their corresponding population demographics, plans are now under way to achieve target captive populations and their subsequent housing: "Attain designated target populations for the taxa in captivity within one rhino generation (~ 15 years) for the Eastern Black, Southern White, and Indian/Nepali; within two generations (~30 years) for the Southern Black and the three Sumatran taxa;

TABLE 19: CURRENT AND TARGET CAPTIVE POPULATIONS

Taxa	Current Pop.	Target Pop.	% Increase	
			Total	Per Year
Eastern Black	163	200	22%	1.3%
Southern Black	52	175	337%	4.0%
Southern White	570	300	-49%	4.2%
Indian/Nepali	120	230	92%	4.5%
Borneo Sumatran	2	150	750%*	7.0%
Mainland Sumatran	8	150	750%*	7.0%
Sumatra Sumatran	13	150	750%*	7.0%

(\*) Based on premise that Current Population, consisting of founders, will be rapidly augmented by rescue of more rhino from wild so that initial number will be 20.  
(RGCAP 1992, 10)

The RGCAP recommends..."Expanding the captive capacity for rhino from 928 to 1355 by creating 427 new spaces, which is an increase of 46% over a 15 year period (i.e. 1 rhino generation). This rate of expansion will require creation of about 30 new spaces/year in zoos worldwide." There is also a need to..."Reallocate existing rhino space (785 African spaces of which 570 are for southern white rhino; 143 Asia spaces) to achieve the target distribution of 675 African spaces, 680 Asian spaces. A conclusion of these calculations is that most new rhino spaces will need to be Asian." (RGCAP 1992, 10).

In Foose's lecture and in the RGCAP they stress that "Captive propagation is to support survival and recovery of rhino species in the wild, and not a substitute for the wild population." (Foose lec. 1994). Captive breeding in zoos provides important support: 1) in providing reservoirs of animals and genes; 2) for research to help in wild and captive small population management; 3) to educate all levels of society and attract financial and political support. To assure that the rhino is not altered by captivity, it should be maintained in as natural state as possible, and must be managed both genetically and demographically. The target populations listed above, need to be large enough to avoid any genetic or demographic problems.

There is a large emphasis on doing research with the captive and wild populations, and it is far easier and less costly to use the captive populations. Genetic research to determine if there are significantly large genetic differences between the geographic forms or sub-species, to justify their maintenance as separate populations. There is ongoing reproductive research to determine estrus cycles to facilitate breeding, and the collection of genomes (eggs and sperm) for the future possibility of artificial insemination. There is active research being conducted on health problems occurring in the captive population, the Black rhino is especially afflicted with ulcerations on the skin and mucous membranes, liver dysfunction and Hemolytic Anemia

There is a current trend to move rhinos to expanded areas outside the traditional zoos. This is a good trend for the rhinos, who prefer larger areas without the close human contact. Currently there are ranches (reserves) in Ohio, Florida and a few in Texas that house rhinos. These facilities have been very successful and will be the models in the allocation of needed space to reach the desired target populations.

### 'In Situ' Conservation

Conserving the rhinos 'in situ' is ideally the best situation for the rhinos, but realistically is somewhat unstable. Lacking finances, pressures from a growing human population with a growing desire for resources, and unsympathetic governments puts 'in situ' conservation into the low-priority bracket. There are ten countries with significant rhino populations; five in Africa and five in Asia. Globally, they are some of the most overcrowded and poverty stricken areas. The Rhino Specialist groups of the IUCN/SSC conduct a Population and Habitat Viability Analysis (PHVA) to assess the status of the current population and where they should be for recovery of the target population, and the suitability of the habitat. They have conducted PHVA's on the Javan, Sumatran, Indian, and the Blacks of Kenya. The information attained from the PHVA's is then used to develop Action plans for Priority Sanctuaries in the range states. The Action plans are used to manage fragmented, remnant populations as a single, large 'Metapopulation' and to get single animals into protected areas.

"There are Priority sanctuaries in 40 major areas worldwide. A discouraging fact is the time for recovery, which will be much slower than their decline due to their slow reproductive rate. The rhinos have only a 7%/year optimal growth rate if conditions are good." (Foose lec. 1994)

"Georgina Mace, of the Zoological Society of London, and Russell Lande, of the University of Chicago, have now proposed a way to quantify the status of any kind of animal. They seek to define more precisely the categories employed in IUCN's Red Data Books: critical, endangered or vulnerable. (Tudge 1991, 34) The Mace/Lande categories and criteria of threat (Appendix 4) are used by the RGCAP in evaluating the rhino populations:

"The proposed system defines 3 categories for threatened taxa:

Critical: 50% probability of extinction within 5 years or 2 generations, whichever is longer

Endangered: 20% probability of extinction within 20 years or 10 generations, whichever is longer

Vulnerable: 10% probability of extinction within 100 years (RGCAP 1992, 4)

This information is then used to formulate Global Captive Action Plans to determine Target population sizes for the captive and wild rhinos:

<u>Captive Recommendation</u>	<u>Level of Captive Program</u>
90% / 100 Years I	Population sufficient to preserve 90% of the average heterozygosity of the <u>wild gene pool for 100 years, developed as soon as possible (1-5 years)</u>
90% / 100 Years II	Population sufficient to preserve 90% of the average heterozygosity of the <u>wild gene pool for 100 years but developed more gradually (5-10 years)</u>
Nucleus I	A captive nucleus (50-100 individuals) to always represent 98% of the wild gene pool. This type of program will require periodic, but in most cases modest immigration/importation of individuals from the wild population to maintain this high level of genetic diversity in such a <u>limited captive population. Reproductive technology will facilitate this strategy.</u>
Nucleus II	A well managed captive nucleus (25-100) for taxa not of conservation concern but <u>present in captivity or otherwise of interest.</u>
Elimination	Taxa are not of conservation concern and are not otherwise of interest. <u>The population should be managed to extinction</u>

Captive programs at the 90%/100 I level are recommended for 7 taxa of rhino: Eastern Black, Southern Black, Southern White, Indian/Nepali, and 3 geographical varieties of Sumatran Rhino. Additionally, a last, crash effort is recommended to attempt to develop a successful breeding program with the Northern White Rhino in captivity.(RGCAP 1992, 6)

"Foose has used the "MacLande criteria" to show that rhinos in general need effective populations of about 500 to provide reasonable safety; that is, to retain about 90% of present genetic variation for about 100 years. Only about one in five individuals in a wild population are effective, so the actual population for each type should be 2500. Assuming there are three types of Black rhino, two of White, one each of Javan and Great Indian and two of Sumatran (Malaysian and Indonesian), this gives a total "safe" world population of 22,500.....And Foose stresses that the figure of 2500 for each type is really a minimum: twice that figure would be preferable...For a really safe array of rhinos, then, with 5000 of each present type in the wild, and 150 to 200 of each type in captivity, the world would need to spend \$34 million in the wild, and another \$10 million in zoos: \$44 million in total. For that we could otherwise buy, say, the front end of a fighter 'plane."(Tudge 1991, 35)

## CONSERVATION PROGRAMS

The estimate of \$44 million, is quite a tall sum, and raising this amount is not an easy task. A majority of this money is sought from zoos in 'hard currency' countries which house rhinos and could afford to help support the conservation programs. There is effort in getting zoos, other conservation organizations, and big corporations to support 'in situ' population by the 'adopt-a-park' program. The American Association of Zoo Keepers (AAZK), an organization to promote professionalism in Zoo Keepers and further knowledge of captive animal husbandry, holds an annual 'Bowling-for-Rhinos' with most of the major city zoos. This grass roots event has been so successful in raising the operating cost for the Ngare Sergoi Rhino Sanctuary in Kenya (~\$100,000) for the last five years, that it has expanded to use any additional money to support the Javan rhino in Udjung Kulon.

There are many organizations and fund raising efforts working diligently to conserve the rhino. "The International Rhino Foundation (IRF) was formed last year as a service organization for rhino conservation to provide technical, administrative and financial support in partnership with other conservation organizations and institutions." (Foose lec. 1994) The IRF functions to give the organizations direction in what programs to concentrate on to make a substantial contribution.

A powerful tool that is used and needs to be expanded is that of educating the public to the plight of the rhino. The general public, especially in developed countries, now have access to large amounts of information about the plight of rhinos and other animals. Public awareness is increased thru a large array of information from nature programs on television, movies, books and magazines, showing that the 'Information Highway' could be beneficial to conservation. Zoos, aquariums, and museums also play a significant role in conservation thru public awareness.

The governments of 'Hard Currency' countries can also play a role in 'in situ' conservation. "There is currently a bill in Congress to pass the 'Rhino Conservation Act', which would provide \$5 million per year for five years" (Foose lec. 1994). Also by applying strong political pressure:... "The President (Clinton) informed China and Taiwan in November that they would face trade sanctions unless they stemmed their trafficking in rhinos and tigers, which are listed as endangered species and protected under the Convention on International Trade in Endangered Species, or CITES. Clinton gave the two nations a March deadline....A decision to impose sanctions would mark the first time the United States ever has taken such action to protect endangered species." (Beamish 1994, 7) The Chicago Sun-times on April 12, 1994 reported in the 'World Briefings' that "President Clinton said the United States will ban imports of certain products made from wildlife from Taiwan in response to its continued trade in endangered tigers and rhinoceroses." This is a watered down version of the sanctions recommended and is mostly symbolic, but it is still a powerful move in the right direction.

### ALTERNATIVE CONSERVATION PLANS

DEHORNING: Of all the plans to conserve the rhino, one of the most controversial has been the dehorning issue. "In the Wainke National Park in Zimbabwe, the population of Southern White rhino dropped from 100 to 6 individuals between January to May 1993 due to poachers. Almost all the rhinos killed had previously had their horns removed by the Wildlife Department to deter poaching." (Foose lec. 1994) Dehorning is a drastic measure that is frowned upon by the majority of the conservation organizations. It has been a high profile operation since the 80's garnishing a lot of attention and large funding, being done extensively in Zimbabwe and to a smaller scale in Namibia. It is a conservation measure with uncertain effects. Female rhinos without horns in Namibia have had their calves predated upon by hyenas and were unable to protect them.

Henry Reuter, the managing editor of *Safari* magazine, summed it all up with the following comments: "If we start the nonsense of removing the horns of rhinos to save their lives, why not extend the concept. We could, for example, de-tusk all the nation's elephants so as to make them less attractive to poachers. But we must not stop there, for poachers also seek the hairs of the elephant's tail for the making of bracelets ... We must remove the elephant's ears, because these are coveted as basic material for the making of boots and shoes. And while we are at it, we should perhaps remove a leg or two, because who knows when there will be a ready market for elephant foot umbrella stands?"

But wait! Our vivisection campaign to save the wildlife is only just beginning. All the must of course be removed from the antelopes. The lions, leopards and cheetahs must be made to surrender their teeth and claws which are so much in demand by the modern jewelery trade, to say nothing of their skins ..." (Martin 1982, 124) This illustrates the general tone of the preservationists feelings toward the concept of dehorning. The government and wildlife organizations are under suspicion of harvesting the horns for their own consumption or stockpiling, or even just wanting to get the horns before any one else does.

There are many reasons for the poaching of the dehorned rhinos: The poachers may kill the animal out of spite, especially if he's been tracking it for a long time; they could be after the horn residue which grows back at 1-3 in./year and is worth more than gold; they could shoot them before they notice that they are dehorned, especially in the thick bush; It is an organized effort, where the poachers are under orders to cause the extinction, so that the stockpiles become priceless; the poachers get rid of the animal so they do not waste their time tracking it again; and they will sometimes take an ear so their boss knows that they were working.

### CONTROLLED HARVESTING

"In 1980, Leslie Brown proposed to a meeting of the African Rhino Group of the IUCN/SSC that both the black and white rhinos be raised for commercial hunting in South Africa. The main purpose of his idea was to produce various products for legitimate sale on the world market, under IUCN supervision. He thought that the supply would be ample enough to depress prices and to take some of the pressure off poaching." (Martin 1982, 124) This contains some valid ideas that are being reconsidered in areas with large populations of rhino.

Trophy hunting is currently being done in Zimbabwe and South Africa, where Americans and Europeans will pay mega-bucks to go on a rhino hunting safari. These countries argue that the money raised from the hunters could have a more positive effect on the total population than that one rhino could have. They select aging or surplus animals, that are not beneficial to the current population. The trophy that the hunter receives, a photo or body parts, depends on the situation, who is being paid, and how much?

On a softer side, is trophy hunting without victims. "In a 'darting safari', sport hunters pay big bucks to fire tranquilizer darts at rhinos that are slated for translocation or de-horning. In South Africa the hunter's trophy is a photograph taken with the rhino. In Zimbabwe the hunter gets to keep the horn that is removed (as a token, and not to be used for commercial purposes). ... Many conservation groups oppose the idea, saying it will erode the United States's ability to pressure consumer nations to stop the rhino horn trade. (Ricciuti 1993, 30)

DRASTIC MEASURES: Extreme conditions demand extreme reaction. The rhino is being annihilated by the poachers, why not kill the poachers? The poachers are the problem, so why not eliminate the problem? Because it is impossible to stop the poachers, there are too many of them. They come from every walk of life and the reward is too great when they are wallowing in desperation. Many are soldiers that are currently not engaged in battle, trained, tough and armed.

In 1985, Zimbabwe and other areas of Africa adopted a shoot-to-kill policy that entitled the guards to shoot any trespasser believed to be a poacher. In 1986, Operation Stronghold was started in the Zambezi Valley, Zimbabwe which was being besieged with poachers. "With radios and two small aircraft supplied by SAVE, and the helicopter from the WWF, 1988 was Operation Stronghold's best year. Brightman counted only 61 rhino carcasses, less than half the number killed in the previous year. ... More than 60 poachers-and one National Parks scout- have been killed in firefights since the advent of Operation Stronghold, with no apparent deterrent effect. The poachers keep coming, stealing across the river at night in their dugout canoes with AK-47 rifles slung over their shoulders. (Knox 1989, 61) Francis Dyer the sanctuary manager at Ngare Sergoi in Kenya, whom has never shot a poacher, told me that he would kill the poacher without mercy, skin him, and hang the skin on top of the gate to show they mean business. This illustrates the extreme mindset of the warriors engaged in the direct battle of protecting the rhinos from the poachers insurmountable attack.

## SUMMARY

This paper analyzed the magnificent rhino and its place in the modern world. From an evolutionary outlook, it has reached the end of its existence, and should become extinct in a few thousand years. But from a realistic outlook, living in man's cultural landscape, it will probably be exterminated in as little as twenty years. The advancement of human civilization is the reason for the decline of the rhinos. At the turn of the century, they were hunted to make room for settlements and advancement of agriculture. In the early twentieth century until today, they have been hunted for sport. The 1970's have shown the most severe carnage, the rhino populations being decimated mainly for the horn they carry in their nose. This horn is considered more valuable than gold, with the horn of the Asian rhino selling for ~\$50,000/kg. (~\$25,000/lb.). With this price on its head, the rhino is viewed by those involved in the rhino trade as worth more dead than alive. The rhino horn is used to make decorative dagger handles in North Yemen, and as medicinal supplies in the Far East. The market in rhino products is flourishing although it is illegal, because it is not strictly enforced. The officials that should be enforcing the trade are profiting from it.

There are five living species of rhino, which is further divided into thirteen taxa or sub-species. The Southern White rhino of Africa numbers over 5,500 individuals, and is considered to have a stable population, which contrasts the rest of the rhino taxa. The Javan rhino of Asia, which numbers less than 100, and the Northern White rhino, which numbers 31 individuals, are in extreme danger of imminent extinction. Saving a substantial number of each species, and possibly of all thirteen taxa, leads to some formidable obstacles. Major obstacles include lack of available space, lack of funding and unstable governments in the rhinos home range. There has been a recent increase in conservation organizations working together to organize efforts to overcome these obstacles.

Saving the rhino will require getting the remnant populations into protected areas in their home range, and successful breeding programs outside of their home range. All of the rhinos must be managed collectively as a single large metapopulation, to support genetic integrity for long term survival.

## CONCLUSION

Most rhinos are in danger of becoming extinct within the year 2000, if current poaching trends continue at their accelerated rate. Looking at the current population numbers, the destruction rates and the positive conservation programs, the prognosis for the rhino is guarded at best. By using the Mace/Lande statistics, one taxa is considered vulnerable (Southern White), four are considered endangered (Southwestern Black, Southern Black, Indian/Nepali, Sumatran Sumatran), and eight taxa are considered critical (North & West Black, Eastern Black, Northern White, Javan from both Vietnam and Java, and the Mainland, Bornean and Burma Sumatran). Keeping all the taxa separate is difficult and costly, leading me to believe there will be pressure to clump some of the taxa, especially the Javan and Sumatran. This will be further defined by results from genetic studies of the sub-species and the funding and success of current and future conservation programs.

Plans and programs for the conservation of rhinos are becoming highly organized in correlation with the power and organization of their enemies. Many efforts are specializing to work with individual populations, while working holistically with other efforts to preserve the metapopulations. Progress in this field is impeded primarily due to lack of financial support.

The Rhino GCAP estimates it will cost ~\$20 million per year to manage the target population of 23,500 rhinos (detailed in Appendix 5). This is a huge amount of money and this target number of rhinos would also require a huge amount of space. I believe that these targets are idealistic more than realistic, and will be difficult, if not impossible, to attain. Foose and the RGCAP are striving for lofty numbers, but realistically are probably expecting far less support and success. To justify this large expenditure on just one species, Foose points out that the rhino is both a 'Flagship' species with power to attract money for conservation, and a 'Umbrella' species which requires a large habitat be conserved, so that other species survive for conservation and biodiversity.

Intensive management and protection is the only hope for saving the rhino. More attention must be put into protection of the 'in situ' populations which are more at risk and where the money has a stronger impact. Concentration must be placed on moving small remnant populations and single individuals into protected areas with other rhinos. Rhinos need to be managed genetically and demographically as a metapopulation. I agree with the shoot-to-kill policy for poachers as a deterrent, but it needs to be strongly reinforced by the wildlife agencies and governments to be successful.

As for the trade in rhino products, I am initially and idealistically against it. I think it should be strictly enforced with severe penalties for violators. The markets in North Yemen should be closed down, with all the rhino horn being confiscated, whether unprocessed or in the form of jambias. The North Yemenis could trade in their daggers for gift-certificates to 'Sportmart' or have them confiscated without reward. The rhino products should be pulled from the shelves from the pharmacies of the Far East. It is illegal to trade rhino products, yet it is done openly and without fear of penalties. We need strong and powerful enforcement of the laws. This reminds me of the 'War on Drugs' being fought in the United States.

On the other side, I see the realistic side in the trade of rhino products. The rhinos are being slaughtered to feed a hungry market, that is fueled by wealthy and powerful people. Although, we are fighting hard to save the rhino, we are losing the battle slowly but surely. We are losing the rhino faster than it is able to reproduce itself. "In contrast to other endangered species like the California Condor or the Spotted Owl, the rhino are spectacular examples of species disappearing much more rapidly than their habitat." (Foose lec. 1994) I see strong validity in the theory to sell the ~15 tons of rhino horn that is stockpiled, to flood the market and lower the worth and demand for rhino horn. These horns were taken from dead or dehorned rhinos anyway, and are not doing the living rhinos any good anyway. This would give a brief reprieve for the surviving populations, and pour millions into conserving and protecting the living rhinos. Although I am not naive enough to believe that all the money will go to rhino conservation without first filling the pockets of the powers that be.

Trophy hunting of non-effective members of the population to raise money for conservation runs in the same vain, it is not an idealistic approach, but holds validity in this extreme situation. Elephants are currently being culled throughout Africa, because the habitat can not sustain the large population requirements. I also see the merit in Brown's proposition to raise Black and White rhinos for commercial hunting, and the income derived being used to for conservation. I do not know of any plant or animal which was raised for human consumption, that has become extinct. Drastic measures may call for drastic means.

Foose stated that: "The Indian and Northern White rhinos were almost lost in 1900, where both species had a population of less than 100 individuals. Effective protection have reversed this trend, showing that recovery is possible, if we can manage to protect them." (Foose lec. 1994)

This investigation was initiated to learn about the various species of rhino, their population demographics, and regional and global conservation programs. The RGCAP, which became the backbone of this paper, recommends bringing more rhinos into captivity, especially the Asians. In order to achieve the target populations, we must "Expand the captive capacity for rhino from 928 to 1355, i.e. 427 new spaces, an increase of 46% over a 15 year period (i.e. 1 rhino generation)" (RGCAP 1992, 10). Once again, I believe these to be lofty aspirations, but there will be some implementation and I want to be part of the development of these new spaces.

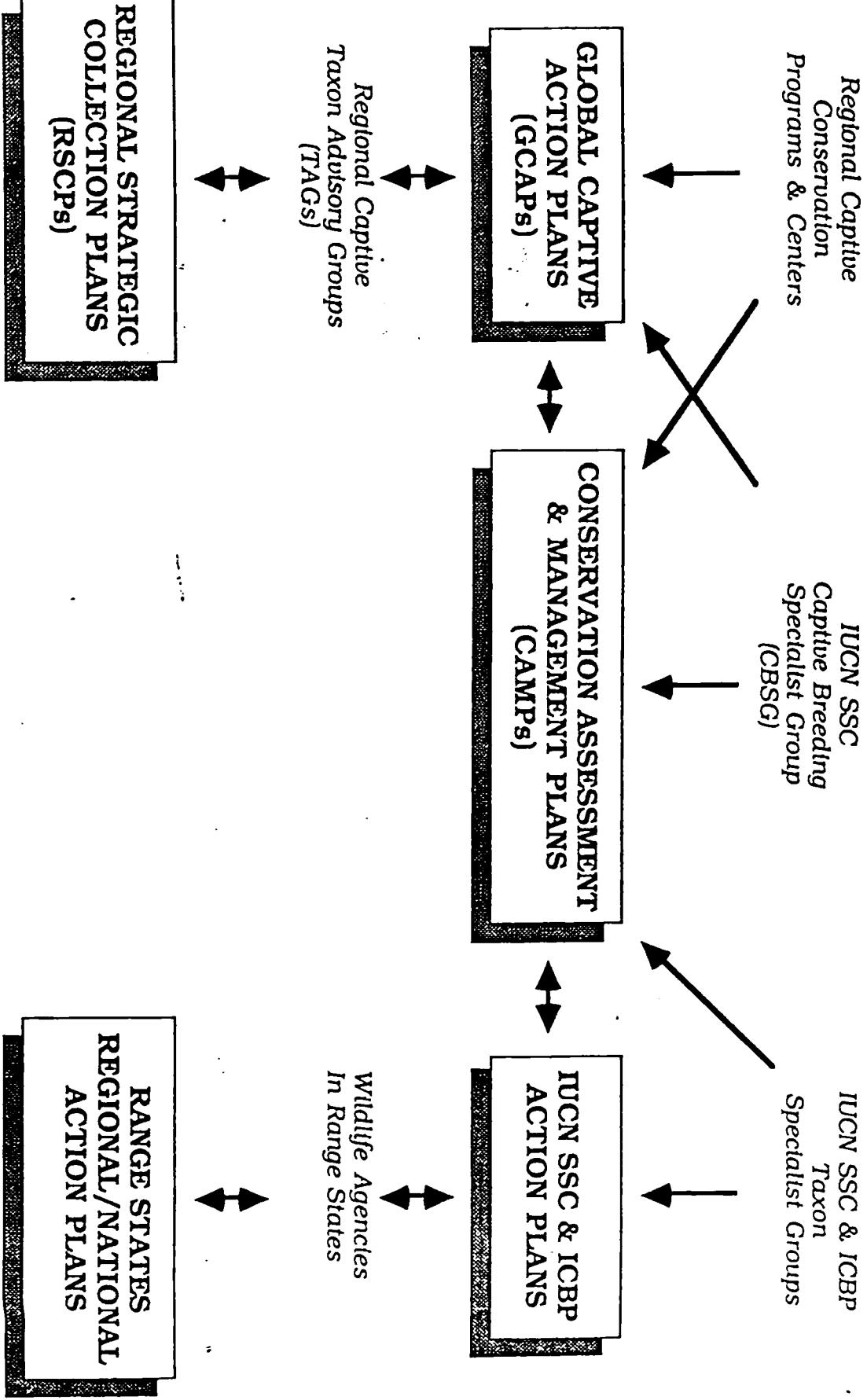
I am doing my thesis on the design and development of a conservation sanctuary for endangered species, with emphasis in rhino husbandry. This paper set the groundwork and gave me direction to develop my thesis study. One of the most difficult parts is learning the power structure and inter-relationships between all the organizations. The International Rhino Foundation (IRF) and the RGCAP seem to be trying to coordinate and streamline the rhino conservation programs , especially in captivity, to make a considerable impact. Lastly, I know that this paper is exhaustive and I may have taken on too much.. I was general with many parts that I would have liked to have gone further in depth, such as the special parks and conservation programs or the target population analysis. I should have concentrated on just one species and made a more in depth study. Oh well, always a student and always learning!

## **APPENDIX**

- APPENDIX 1:** Global and Regional Strategic Conservation Action Plans
- APPENDIX 2:** Glossary of Global & Regional Captive Strategic Programs
- APPENDIX 3:** Regional Breeding Programme Organizations
- APPENDIX 4:** Mace/Lande Categories and Criteria of Threat
- APPENDIX 5:** Annual Costs for Conservation of Viable  
Populations of Rhino

## APPENDIX 1:

# GLOBAL AND REGIONAL STRATEGIC CONSERVATION ACTION PLANS



## APPENDIX 2:

### GLOSSARY OF GLOBAL & REGIONAL CAPTIVE STRATEGIC PROGRAMS

#### CAMP A Conservation Assessment and Management Plan (CAMP):

- (1) reviews the wild and captive status of each taxon in a defined broad group of taxa (e.g. an order, family, subfamily, community);
- (2) assesses the degree of threat for each taxon according to the Mace/Lande categories;
- (3) recommends intensive management and information collection action to mitigate threat: PHVAs, *in situ* management, conservation oriented research (surveys, taxonomy, etc.) captive breeding, genome banking.

CAMPs are developed as collaborative efforts of the Captive Breeding Specialist Group and the other Specialist Groups of the SSC and ICBP, wildlife agencies, and the Regional Captive Programs.

#### A CAMP provides:

- (1) a resource for the development of IUCN SSC and ICBP Action Plans;
- (2) a strategic guide for intensive conservation action;
- (3) the first step in the Global Captive Action Plan (GCAP) process.

*A CAMP considers multiple taxa.*

#### GCAP A Global Captive Action Plan (GCAP) also considers a broad group of taxa and:

- (1) recommends:
  - (A) which taxa in captivity should remain there;
  - (B) which taxa in captivity need not be maintained there for conservation reasons;
  - (C) which taxa not yet in captivity should be there to assist conservation efforts;
- (2) proposes a level of captive breeding program in terms of genetic and demographic objectives which translate into recommendations about global captive target populations;
- (3) suggests how responsibilities for captive program might be distributed among the Regional Programs, i.e. this function translates into recommendations for regional captive target populations;
- (4) identifies priorities for technology transfer to and for financial and other support for *in situ* conservation.

GCAPs are developed by a Working Group which consists of representatives of the Regional Programs, especially the Chairs and selected members of the Taxon Advisory Groups (TAGs), with advice and facilitation from the IUCN SSC Captive Breeding Specialist Group (CBSG). The GCAP Working Group will also normally include representatives of the range-country wildlife community and scientists who can resolve problems of systematics. A CAMP can provide a first step of the GCAP process. The GCAP is developed further in an interactive and iterative process involving the Regional Programs and their own Regional Strategic Collection Plans (RSCPs). The GCAP is a dynamic process and mechanism that enables the Regional Programs to coordinate development of their Regional Strategic Collection Plans (RSCPs) in response to the conservation needs of taxa (as identified initially by the CAMP) but also to the circumstances and interests of the regions. Hence the GCAP is a facilitation and forum for the regional programs to integrate themselves into the best global conservation effort possible.

*A GCAP considers multiple taxa.*

**RSCP** A Regional Strategic Collection Plan (RSCP) is a set of recommendations developed by a Regional Taxon Advisory Group (TAG) on the taxa in a defined broad group for which Regional Captive Propagation Programs (RCPP) should be developed. An Regional TAG will consider the recommendations of the CAMP and initial GCAP as one factor in preparing the first drafts of the RSCP. However, the RSCP also considers other factors such as the realities of Regional space and resources in the Region as well as other interests the Region may have in maintaining taxa. As stated above, the GCAPs and RSCPs are interactively and iteratively developed in an effort to maximize effectiveness in using captive space and resources for taxa in need of captive programs for their conservation. An extension of the RSCP for defined broad groups of taxa is an overall strategic collection plan for all organisms to be maintained by institutions participating in the Regional Program. The Australasian Region has already embarked on this kind of overall strategic collection plan.

*An RSCP considers multiple taxa.*

**ICP** An Institutional Collection Plan is a strategic design for the taxa that a particular zoo, aquarium, or other captive facility will maintain and propagate. Ideally, an ICP will develop its collection to contribute as much as possible to RSCPs and ultimately GCAPs.

**TAG** A Taxon Advisory Group is a committee which is formed within the organized Regions of the Zoo/Aquarium World and which consists of zoo professionals and other experts. A primary function of a TAG is to formulate and implement Regional Strategic Collection Plans and by extension development of the GCAP. TAGs also recommend priorities for establishment of studbooks, development of Regional Captive Propagation programs, and research priorities.

*A TAG considers multiple taxa.*

**RCPP** A Regional Captive Propagation Program (RCPP) is one of the organized collaborative programs within a Region to breed and manage a designated, usually threatened, taxon. Examples include an AAZPA SSP in North America, an EEP in Europe, a JMS in the U.K., an ASMP in Australasia, an SSCJ in Japan, an IESBP in India, an APP in Sub-Saharan Africa. Other Regions are initiating similar programs. RCPPs develop Regional Masterplans for propagation and management of the taxon.

*An RCPP normally considers a single taxon (e.g. a species).*

**GASP** A Global Animal Survival Plan (GASP) is a program for management and propagation of a single taxon at the international level. A GASP provides the facilitating framework for the Regional Captive Propagation Programs

- (1) to adopt global goals, in part by considering CAMP and GCAP recommendations,
- (2) to divide responsibility, e.g. especially target population sizes, for achieving the global goals among the Regional Programs.
- (3) to arrange interactions, especially animal or germplasm exchanges, among the Regional Breeding Programs toward achieving global and regional goals.

Analogous to the RCPP, a GASP develops a global masterplan to guide propagation and management of the taxon at the international level.

*A GASP normally considers a single taxon.*

**PHVA** A Population and Habitat Viability Analysis (PHVA) is an intensive analysis of a particular taxon or one of its populations. PHVA's use computer models:

- (1) to explore extinction processes that operate on small and often fragmented populations of threatened taxa
- (2) to examine the probable consequences for the viability of the population of various management actions or inactions.

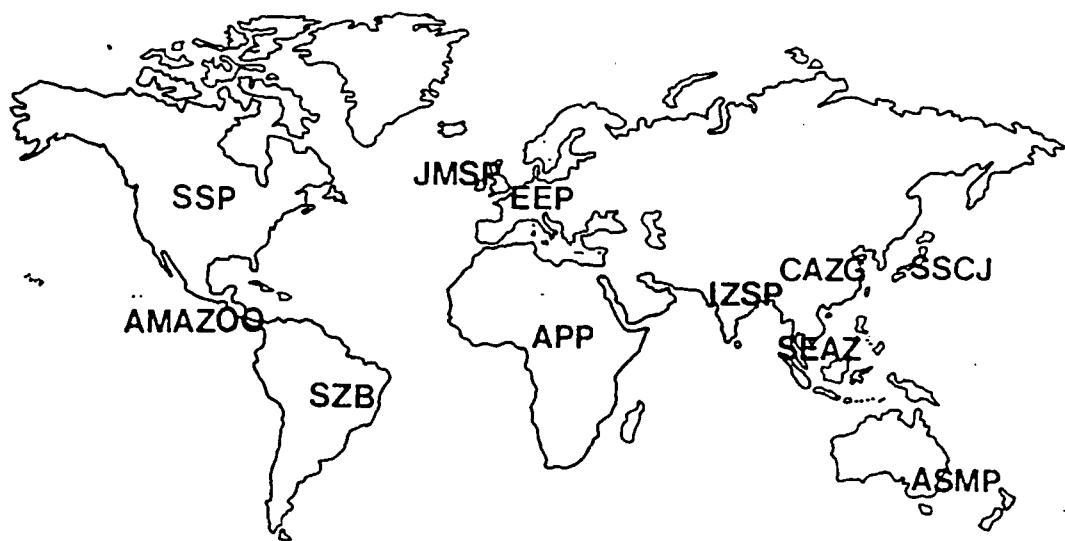
The models incorporate information on distributional, demographic, and genetic characteristics of the population and on conditions in the environment to simulate probable fates (especially probability of extinction and loss of genetic variation) under these circumstances. PHVAs use models to evaluate a range of scenarios for the populations under a variety of management (or non-management) regimes. As a result of the different scenarios modelled, it is possible to recommend management actions that maximize the probability of survival or recovery of the population. The management actions may include: establishment, enlargement, or more management of protected areas; poaching control; reintroduction or translocation; sustainable use programs; education efforts; captive breeding.

*A PHVA normally considers one taxon at a time.*

T.J. Foose  
CBSG  
August 1992

### APPENDIX 3:

#### *Regional Breeding Programme Organizations*



**SSP:** Species Survival Plans, conducted by the American Association of Zoos and Aquaria (AAZPA)

**EEP:** European Endangered Species Programme, conducted by the European Association of Zoos and Aquaria (EAZA)

**JMSR:** Joint Management of Species Programme, conducted by the Federation of Zoological Gardens of Great Britain and Ireland (these nations also participate in the European Endangered Species Programme, EEP)

**APP:** African Propagation Programmes, being initiated by the Pan African Association of Zoological Gardens, Aquaria and Botanic Gardens (PAAZAB)

**AMAZOO:** Regional captive breeding programmes being initiated by the Association of Meso American Zoos (AMAZOO)

**ASMP:** Australasian Species Management Programme, conducted by the Australian Regional Association of Zoological Parks and Aquaria (ARAZPA)

**SSCJ:** Species Survival Committees Japan, conducted by the Japanese Association of Zoological Gardens and Aquaria (JAZGA)

**CAZG:** Captive breeding programmes being initiated by the Chinese Association of Zoological Gardens (CAZG)

**SZB:** Captive breeding programmes being initiated by the Brazilian Zoo Society (SZB)

**IESBP:** Indian Endangered Species Breeding Programmes, conducted by the Central Zoo Authority of India

**SEAZ:** Regional captive breeding programmes being initiated by the South East Asian Association of Zoos (SEAZ)

**APPENDIX 4:**  
**MACE/LANDE CATEGORIES AND CRITERIA OF THREAT**

POPULATION TRAIT	CRITICAL	ENDANGERED	VULNERABLE
Probability of Extinction	50% within 5 years or 2 generations, whichever is longer	20% within 20 years or 10 generations whichever is longer	10% within 100 years
	<b>Or</b>	<b>Or</b>	<b>Or</b>
	Any 2 of following criteria	Any 2 of following criteria or any 1 CRITICAL criterion	Any 2 of following criteria or any 1 ENDANGERED criterion
Effective Population $N_e$	$N_e < 50$	$N_e < 500$	$N_e < 2,000$
Total Population N	$N < 250$	$N < 2,500$	$N < 10,000$
Subpopulations	$\leq 2$ with $N_e > 25$ , $N > 125$ with immigration $< 1/\text{gen.}$	$\leq 5$ with $N_e > 100$ , $N > 500$ or $\leq 2$ with $N_e > 250$ , $N > 1,250$ with immigration $< 1/\text{gen.}$	$\leq 5$ with $N_e > 500$ , $N > 2,500$ or $\leq 2$ with $N_e > 1,000$ , $N > 5,000$ with immigration $< 1/\text{gen.}$
Population Decline	$> 20\%/\text{yr.}$ for last 2 yrs or $> 50\%$ in last generation	$> 5\%/\text{yr.}$ for last 5 years or $> 10\%/\text{gen.}$ for last 2 gens.	$> 1\%/\text{yr.}$ for last 10 years
Catastrophe: Rate & Effect	$> 50\%$ decline per 5-10/ yrs or 2-4 gens.; subpops. highly correlated	$> 20\%$ decline/5-10 yr, 2-4 gen $> 50\%$ decline/10-20 yrs, 5-10 gen. with subpops. correlated.	$> 10\%$ decline/5-10 yrs, $> 20\%$ decline/10-20 yrs, or $> 50\%$ decline/50yrs. with subpops. correlated.
<b>Or</b>			
Habitat Change	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects
<b>Or</b>			
Commercial Exploitation or Interaction/Introduced Taxa	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects

**APPENDIX 5:**  
**ANNUAL COSTS FOR CONSERVATION**  
**OF VIABLE POPULATIONS OF RHINO**

TAXON	TARGET POPULATION	DENSITY (km/rhino)	AREA (km <sup>2</sup> ) REQUIRED	COST per km <sup>2</sup>	ANNUAL COST
N. Black	2,000	3	6,000	\$400	\$2,400,000
S. Black	2,000	3	6,000	\$400	\$2,400,000
S.W. Black	2,000	3	6,000	\$400	\$2,400,000
N.W. Black	2,000	3	6,000	\$400	\$2,400,000
N. White	2,000	1.5	3,750	\$400	\$1,500,000
S. White	2,500	1.5	3,750	\$400	\$1,500,000
Indian/Nepali	2,500	0.5	1,250	\$250	\$300,000
Borneo Sumatran	2,000	10	20,000	\$100	\$2,000,000
Sumatra Sumatran	2,000	10	20,000	\$100	\$2,000,000
Mainland Sumatran	2,000	10	20,000	\$100	\$2,000,000
Javan	2,500	5	12,500	\$100	\$1,250,000
<b>TOTALS</b>	<b>23,500.00</b>	<b>50.50</b>	<b>105,250.00</b>	<b>\$3,050.00</b>	<b>\$20,150,000.00</b>

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