CONSERVATION PLAN FOR THE BLACK RHINOCEROS

Diceros bicornis IN SOUTH AFRICA

Compiled for the
RHINO MANAGEMENT GROUP
by
Dr Martin Brooks and Keryn Adcock
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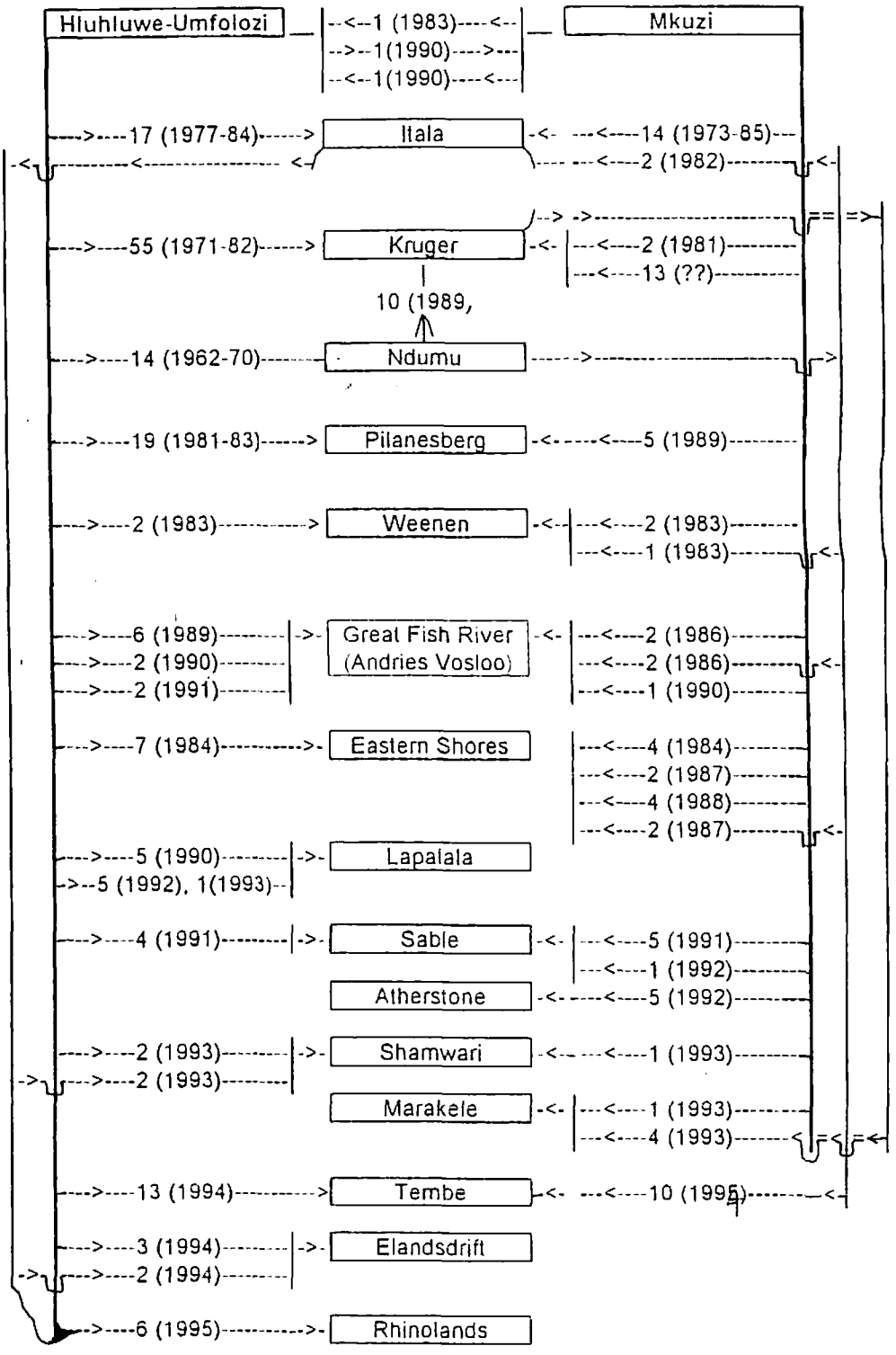
Figure 1: South Africa: Black Rhino Conservation Plan

D.b.minor :

Re-establishment history in South Africa,
September 1962 to December 1995.



1. INTRODUCTION

The black rhinoceros *Diceros bicornis* used to occur throughout most of sub-Saharan Africa. However, since the turn of the century this species has suffered a severe decline in numbers and in the extent of its range. It is currently rated as "Critically Endangered" according to the IUCN's new Red List criteria.

The downward trend over the last 20 to 30 years has been dramatic. Numbers have dropped from an estimated 65 000 in 1970, to 15 000 in 1982, 9 500 in 1984 (distributed between 18 countries), down to 6 000 in 1985, about 3 500 in 1989 and less than 2 450 in 1995 (restricted essentially to 10 countries). This represents a 96% decline in 25 years. Only South Africa, Kenya, Zimbabwe and Namibia have confirmed populations of more than 100 black rhino.

Table 1.1 Black rhino population estimates for African range States, 1995 (AfRSG meeting, February 1996).

Confirmed range States and minimum population sizes		Possible range States, but where numbers are not confirmed
Cameroon	7	Angola
Ethiopia	1	Botswana
Kenya	420	Mozambique
Malawi	2	Rwanda
Namibia	598	Zambia
South Africa	1024	
Swaziland	9	
Tanzania	32	
Zimbabwe	315	
TOTAL	2408	

Poaching for horn is responsible for the massive decline, and only those populations subject to intensive and effective conservation management and security programmes have prospered. The ban on legal trade implemented through CITES, to which South Africa has been a signatory since 1975, has itself conferred little or no protection on the species.

Four ecotypes of black rhino are currently recognised, namely *Diceros bicornis minor* (southern-central Africa), *Diceros bicornis bicornis* (south-western Africa), *Diceros bicornis michaeli* (eastern Africa) and *Diceros bicornis longipes* (central western Africa). The recommendation at the African Rhino Workshop (Cincinnati 1986), that both in situ and captive breeding programmes should attempt to maintain the integrity of these ecotypes, has been generally accepted.

The black rhinoceros in South Africa, reduced to relict populations of 100 to 150 *D.b.minor* in Hluhluwe-Umfolozi and Mkuzi areas by the 1930's, has recovered well. The Natal Parks Board has from 1962 to 1995 translocated 158 and 43 black rhinos from these two reserves respectively, to form new populations within their former range. The National Parks Board brought a small number in from Zimbabwe. Figure 1.1 summarises the translocation history for this ecotype up to the end of 1995. A further seven have been supplied for captive breeding programmes in the USA.

A small population of *D.b.michaeli* was introduced into Addo Elephant National Park in 1961 and 1962. South Africa has also received 20 *D.b.bicornis* from Namibia since 1985 (Figure 1.2). By 1995, the black rhino population in South Africa was an estimated 1024, comprising 962 *D.b.minor* in twelve protected areas, and five private ranches; 29 *D.b.bicornis* in four protected area and one private ranch, and a single population of 33 *D.b.michaeli* (Table 1.2).

South Africa's black rhino, which comprise 42.5% of Africa's total, are critically important to the survival of the species on the continent. The populations in Hluhluwe-Umfolozi Park and Kruger National Park are two of the three largest in Africa. Along with these, South Africa has another two of eleven *key* populations, and six out of sixteen *important* populations, as identified by the African Rhino Specialist Group (AfRSG 1996).

In 1989, a joint conservation plan for the black rhinoceros in South Africa and Namibia was drawn up by the Rhino Management Group, which then comprised representatives from all conservation agencies holding black rhino in these countries. However, Namibia subsequently adopted its own conservation strategy, so this current Plan is exclusive to only South Africa.

The Plan presents clear conservation goals for South Africa's black rhino, and direction on how these may be achieved. The adoption of the Plan's policy and management guidelines by the conservation authorities, together with the advice provided by the Rhino Management Group, should enhance the survival and growth prospects of South Africa's populations.

This document represents the second update of the original Plan, and now excludes reference to Namibia.

References:

Brooks P.M. (1989) Conservation Plan for the black rhinoceros in South Africa, The TBVC States and SWA/Namibia (*Rhino Management Group*).

AfRSG (1996). Proceedings of AfRSG meeting February 1996. *Confidential IUCN SSC African Rhino Specialist Group Report.*

2. CONSERVATION GOALS

The conservation authorities in South Africa have adopted the following conservation goals for the black rhinoceros:

To develop, as rapidly as possible, and conserve in the long term, genetically viable populations of at least 2000 *D.b.minor*, and 200 *D.b.bicornis* within their former range in South Africa.

To develop as rapidly as possible, and conserve in the long term, genetically viable populations of 75 *D.b.michaeli* in the wild in South Africa.

To support captive breeding programmes, both within and outside South Africa, provided they will play a significant role in maintaining or improving the conservation status of the species.

3. THE ROLE OF THE RHINO MANAGEMENT GROUP

The Rhino Management Group (RMG) comprises representatives from each of the following bodies:

State conservation agencies in South Africa, Namibia, Swaziland and Zimbabwe:

South Africa
Cape Nature Conservation
Eastern Cape Nature Conservation
Free State Department of Agriculture and Environmental Affairs
Gauteng Directorate of Nature Conservation
Kwa/Zulu Department of Nature Conservation
Mpumulanga Parks Board
Natal Parks Board
Northern Cape Nature Conservation Service
National Parks Board of South Africa
Northern Province Department of Environmental Affairs and Tourism
North West Parks Board

Namibia
Namibian Ministry of Environment and Tourism

Swaziland
Big Game Parks

Zimbabwe
Department of National Parks and Wildlife Management,

private owners of free-ranging rhinos:

One member represents the joint interests of:
Lapalala Wilderness
Sable Ranch
Shamwari Game Ranch
Elandsdrift Game Ranch
Rhinoland
Tswalu Game Ranch
Mauricedale Game Ranch (1996),

elected rhino experts, and

the Rhino and Elephant Security Group of Southern Africa.*

The Rhino Management Group's role is to assist the various conservation agencies and private land owners in achieving the conservation goals for black rhino.

* The Rhino and Elephant Security Group of Southern Africa's mission is to promote rhino and elephant security in Southern Africa. A Master Plan is available.

Table 1.2. Population estimates of black rhino in South Africa, 1989/90 to 1994/95. (Figures in brackets ( ) are known changes to populations later in 1995, which were used in statistics for the AfRSG, Feb. 1996 meeting.)

YEAR:	89/90	90/91	91/92	92/93	93/94	94/95	
D.b.bicornis ***No. of rhino:***	14	18	21	21	21	21	(29)
No. of populations:	2	2	2	2	3	4	(5)
SA National Parks Board							
Augrabies Falls Nat. Park	6	7	9	8	7	5	
Karoo National Park	x	x	x	x	3	3	
Vaalbos (Hei-lGarib) Nat. Park	8	8	12	12	10	10	
Zuurberg National Park	x	x	x	x	x	3	
	8	8	12	12	10	13	
Private							
Tswalu Game Lodge	x	x	x	x	x	x	(8)
D.b.michaeli ***No. of rhino:***	22	25	27	32	33	33	
No. of populations:	1	1	1	1	1	1	
Addo Elephant National Park	22	25	27	32	33	33	
	22	25	27	32	33	33	
D.b.minor ***No. of rhino:***	679	734	766	809	865	936	(962)
No. of populations:	9	11	11	12	14	16	(17)
SA National Parks Board							
Marakele National Park	x	x	x	x	6	5	
Kruger National Park	155	166	178	189	195	210	
	155	166	178	189	201	215	
Eastern Cape Nature Conservation							
Great Fish River Reserve	8	13	13	14	16	20	
	8	13	13	14	15	20	
Northern Province Dept of Environmental Affairs and Tourism.							
Atherstone Game Reserve	x	x	x	5	5	5	
	0	0	0	5	5	5	
KwaZulu Department of Nature Conservation							
Ndumo Game Reserve	32	37	35	36	43	36	
Tembe Elephant Reserve	x	x	x	x	x	22	
	32	37	35	36	43	58	
Natal Parks Board							
Eastern Shores Nature Reserve	23	18	18	20	20	20	
Hluhluwe-Umfolozi Park	303	320	339	351	362	405	
Itala Game Reserve	60	64	58	61	70	64	
Mkuzi Game Reserve	57	64	67	71	74	77	
Weenen Nature Reserve	9	9	11	12	13	11	
	452	475	493	515	539	577	
North West Parks Board							
Pilanesberg National Park	32	33	35	35	36	44	
	32	33	34	32	36	44	
Private							
Elandsdrift Game Ranch	x	x	x	x	x	4	
Lapalala Wilderness	x	5	4	11	12	13	(15)
Rhinoland	x	x	x	x	x	x	(6)
Sable Ranch	x	5	9	7	8	11	
Shamwari Game Ranch	x	x	x	x	6	6	(7)
	0	10	13	18	26	17	(43)

The RMG's strategies are as follows:

Evaluate the performance and management of each black rhino population in the region at regular intervals based on the annual status reporting programme.

Identify problems or information needs affecting the achievement of the goals for black rhino in each country.

Initiate, develop and coordinate appropriate programmes (meetings, workshops, projects) necessary to provide management advice and to develop appropriate conservation strategies to achieve the goals.

Evaluate project proposals and make recommendations to relevant bodies.

Provide advice on request to conservation agencies.

Liaise closely with all relevant conservation authorities and funding agencies

Manage the Conservation Plan for the Black Rhinoceros in South Africa (SA membership of RMG only), by collecting, analysing and interpreting the information it requires, by keeping it updated and ensuring its continued relevance, and by publicising the results of these activities in appropriate ways.

The achievements of the RMG are summarized in Appendix 1.

4. CONSERVATION MANAGEMENT

The conservation management of black rhino is based on the need to prevent extinction due to man-induced changes and to maintain the evolutionary potential of the species.

The actions essential for meeting these needs are:

Managing populations:

Ensuring legal and physical protection of rhino
Facilitating gene exchange and prevention of "excessive" inbreeding
Maximising rhino productivity through sustainable removal of rhino
Habitat management
Monitoring of rhino

Re-establishing populations

Identifying and rating of suitable areas for re-establishment, with respect to security and potential population size (carrying capacity)
Mixing of rhino from different donor gene pools within an ecotype
Perfecting translocation and establishment procedures

Supporting captive breeding

Justifying reasons and rhino candidates for captive breeding
Identifying suitable captive breeding institutions

4.1 PROTECTING BLACK RHINO POPULATIONS

BLACK RHINO MUST BE PROTECTED FROM POACHING.

Rationale:

By far the greatest threat to black rhino in South Africa, as elsewhere in Africa, is illegal hunting for their horn. The species' survival therefore depends to a very great extent on:

a) the ability of the managing authorities to *prevent* or at least minimise poaching; and

b) the success of worldwide conservation efforts to stop or minimise the incentives to hunt rhino illegally and trade illegally in rhino horn.

Considerations:

Strategies to protect rhino from poaching include local, international and socio-economic components. Some of the factors discussed below are within the direct control of rhino management authorities, while the other components require the support and efforts of local, regional and international conservation agencies and governments.

Ground protection has to be sufficiently intensive and well planned, with adequately trained and equipped personnel. A sufficiently high chance of detecting offenders before they poach, is the single best deterrent to poachers.

Rhino cases must be fully and effectively investigated (even if it takes years) to achieve successful prosecution and deter illegal trade and poaching.

Legislation has to provide for sufficiently severe sentences for convicted rhino horn poachers or dealers, or else the deterrent effect is lost. Similarly, the judiciary must be persuaded to give maximum penalties for cases so that defendants are not seen to get off lightly.

The 1977 CITES Appendix 1 listing of black rhino banned any international trade in rhino products (excluding hunting trophies) between signatory countries. However, the ban has done little or nothing to slow the decline in rhino numbers. Evidence exists that economic pressure on, and propaganda against consumer countries, has driven up the price for African horn, potentially increasing incentives to poach. Medical practitioners who prescribe horn for certain life-threatening illnesses and fuel the main demand for horn, are mostly adamant that there is no replacement for horn (Nowell *et. al.* 1992). This makes the possibility of eradicating the demand for horn in countries where traditional Chinese medicine is practised unlikely. On the other hand, the use of horn substitutes for the handles of traditional daggers in North Yemen appears promising (Martin and Vigne 1995).

The ninth meeting of the Conferences of the Parties to CITES (Fort Lauderdale, Florida, 1994) adopted a resolution on the conservation of rhinos in Africa and Asia drafted by the IUCN's African Rhino Specialist Group. This recognised that different opinions exist among range States on the value of the trade ban; and that there was a need for range States to develop self-sufficiency in funding rhino conservation. It also recognised that future policy options should not be foreclosed. Rather, the success of current policies should be evaluated, and policy adjustments made accordingly.

The urgent need to protect rhino from poaching will not be affected by future changes in CITES policies.

Procedures:

Refer to the "Anti-Poaching Training Manual" (Conway *et. al.* 1994), and the Rhino and Elephant Security Group of Southern Africa's Master Plan. These provide comprehensive guidelines on law enforcement related to poaching, and are available from Tony Conway at Natal Parks Board, and Ian Thompson, coordinator, Rhino and Elephant Security Group. Some of the more important basic guidelines are given below.

1. Develop adequate ground surveillance and reaction capabilities

- Secure funding for ongoing ground surveillance and reaction work.
- Staff the reserve at the very least at the level of one game scout per 10 km^2. In larger reserves (over 10 000ha), supplement ground surveillance by deploying a mobile anti-poaching unit of no less than six people.
- Train and motivate staff effectively in anti-poaching procedures.
- Equip and care for staff properly.
- Ensure appropriate boundary fencing, and fence checking once per day at least.
- Implement a well planned and supervised patrolling system.
- Implement a formal, verbal debriefing system for patrols.
- Maintain continuously-updated operational maps of both security incidents, and rhino home ranges, to ensure that rhino monitoring and law enforcement patrols are meaningfully deployed.
- Maintain adequate records of all law enforcement effort and all illegal activities. Use these to assess security effectiveness and for planning future effort.

2 Improve, and maintain good neighbour relations around the reserve

Improving and maintaining good neighbour relations around reserves does not have the aim in itself of improved rhino security. Neighbour relations are relevant in the broader context of conservation (including rhinos), involving interacting biophysical, social, economic, political and cultural components.

- Honour and respect language, culture and the indigenous knowledge of neighbours;
- Strive for good communication based on mutual understanding.

- Institute joint reserve/community decision making and responsibility in conservation and development issues in and around the conservation area.

- Work with a "liaison committee" of elected representatives from diverse interests in the community - schooling, agriculture, crafts, utilities, woman's groups, eco-tourism, civic and local government etc. to:

  - assess the community and reserve's needs and priorities, and available resources and expertise;
  - develop specific plans/programmes for issues of joint concern; and
  - critically evaluate each plan/programme with all stakeholders regularly.

3. Develop intelligence networks

- Develop informer networks according to the stipulated policy of your organisation. Use existing networks of other departments or structures where possible.

- Select the handlers/administrators of the intelligence network carefully.

- Give formal training to handlers.

- To infiltrate an unknown gang or syndicate, use a highly trained specialist (agent).

- Brief *all* reserve staff (including cleaners and admin. officers) on what to do if someone approaches them to elicit information on reserve security, numbers of rhino, disposal of found horn etc. Generously reward any employee who tells reserve authorities about such attempts.

- Many rhino poaching cases in Africa have involved reserve or conservation staff in some way. Make sure staff are well motivated and fairly treated in their employment, and take steps to monitor staff without creating a climate of mistrust.

4. Investigate horn poaching or dealing cases (procedures for effective prosecution)

Horn poaching cases

- For the best chances of successfully investigating and convicting criminals, use a properly trained specialist investigator.

- Persons discovering a rhino poaching incident should immediately alert the officer in charge of the reserve.

- The discoverer, as with all staff, must know and be reminded not to touch anything at the scene, and not to walk around in the vicinity.

- Contact the local police CID and arrange for them to be brought to the scene as soon as possible. Tracker dogs should be requested if the carcass is fresh.

- Contact a veterinarian to come to the scene immediately to do a post mortem after the CID has inspected the carcass.

- Secure the poaching scene, minimising disturbance to the area.

- Assist in the investigation. Mark all items found on a comprehensive map or photographs/videos of the scene. Collect, tag and store any likely evidence. Get detailed statements from all potential witnesses. The entire area surrounding the scene must be searched carefully.

- Activate the intelligence network.

- Alert and brief all relevant conservation and security organisations in the RMG region and in neighbouring States to assist in picking up information on the movements of newly poached horn, the poachers or dealers.

- Know and follow the correct procedures in bringing charges against suspects, and bringing the case to court. Use an expert witness to convince the judiciary of the severity of the crime and the need for adequate sentencing.

Horn dealing cases

- Only the Endangered Species Protection Unit of the SAPS and the SAPS themselves should tackle horn dealing cases. Pass any information you may come across on horn dealing on to them.

- Dealing investigators and agents must use realistic market prices in undercover operations so as not to inflate local prices. This could stimulate the illegal horn market and further poaching.

5. Secure horn stockpiles

- Record details of all rhino deaths on a detailed mortality form (e.g. the RMG black rhino mortality form). Record the dimensions and weight of the horn pieces.

- Tag each piece of horn with a unique number. Microchip transponders of an approved type can be used. "Trovan" is recommended.

- Keep a register of all horn (rhino species, date found, location found, person who found the horn, tag/transponder number, horn weight and dimensions).

- Store the horn in a vault - preferably of secret location. Stockpiles from government reserves will be audited by the Auditor General annually, or at random if necessary.

- Horn from privately owned rhino should also be registered and stored to prevent it entering the illegal market. If it does so, the owner can be prosecuted

6. Undertake horn fingerprinting of rhino populations

Management authorities should provide the African Rhino Specialist Group with horn samples for radio isotope analysis. Such "horn fingerprinting" of each key and important rhino population in Africa, and selected remnant populations (e.g. in Angola, Botswana, Mozambique, Sudan) will in time allow the origin of poached horn to be determined. This will assist in obtaining successful prosecution in many cases, and in improving knowledge of trade routes.

- Obtain 5 samples from different rhino (same subspecies) per area/reserve. Each sample must be 2 cm^3 of material mostly from inside the horn, as the rough exterior cannot be used.

  For introduced rhino (i.e. rhino not born in the area):
  - The sample should come from the horn base.
  - Do not take a sample if the rhino was introduced less than two years ago.

- Label each horn sample with the following information, and package each sample individually in a plastic bag:
  - rhino species
  - date horn wascollected
  - date sample was taken
  - name of reserve/area, and precise location within reserve (provide map)
  - whether removed from a live animal, a carcass *in situ*, or confiscated horn, etc.

- Forward the samples to Dr Martin Brooks, AfRSG Chairman, at Natal Parks Board 's Queen Elizabeth Park, along with separate details of the horn samples collected (numbers, species, locations). For security, these may need to be carried there as personal baggage. CITES permits are required when moving horn from one county to another.

7. Adhere to CITES regulations

South Africa is a signatory to the Convention on the International Trade in Endangered Species (CITES). The black rhino is listed on Appendix 1 of the agreement, which effectively bans the trade in any rhino product. Hunting trophies may be exported under a CITES permit issued by the relevant conservation body, although hunting of black rhino is not currently undertaken in any country in Africa.

The years 1992 to 1994 saw unprecedented pressure being applied to consuming countries to eliminate internal trade in rhino horn through stricter legislation and law enforcement. The targeted governments responded by taking horn trade issues to higher political levels than ever before, becoming CITES signatories, and instituting strict legislation and trade controls backed by law enforcement.

The 9th CITES meeting adopted Resolution Conf. 9.14, which repealed all previous CITES resolutions concerning trade in rhino horn, and created a more realistic framework for dealing with rhino conservation and trade issues (see Appendix 2).

8 **Support efforts to evaluate the effectiveness of the CITES intervention on rhino horn trade in reducing poaching and illegal trade in horn.**

Through CITES resolution Conf. 9.14 paragraph 2, rhino range States are urged to monitor and provide annual statistics on horn trade and each rhino population. The African Rhino Specialist Group (AfRSG) of the IUCN will coordinate data collection on population status, law enforcement efforts and levels of poaching. Similarity, TRAFFIC will take the lead in providing indices of consumer use, horn price and the volume of the horn trade.

Through annual status reports to the RMG (Section 7), the AfRSG can be provided with some of the required information.

9. **Support government legislation**

- Each province has its own legislation. At present, the situation is in flux, as standing laws from previous self-governing territories and provinces are being reviewed.

- In May 1996, a national workshop addressed among other things:
  - implementation of CITES
  - a uniform approach to permit issues
  - the draft Endangered Species Protection Bill
  - obtaining uniform provincial legislation

- A national Endangered Species Protection Bill is being drafted (1996). Black rhino will fall under Schedule 1 of the Act, which contains CITES Appendix 1 species. This will enable cases to be pursued across provincial and State boundaries. In essence:

  Persons contravening the Act or regulations made thereunder shall be liable

  - on first conviction to, a) a fine not exceeding R250 000 or b) imprisonment for a period not exceeding 15 years, or both a) and b);

  - on a second or subsequent conviction for a contravention of the same section or regulation of the Act, persons may receive fines up to R500 000, imprisonment up to 30 years, possibly without the option of the fine, or both a fine and imprisonment.

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4.2 MAINTAINING GENETIC DIVERSITY

EACH BLACK RHINO ECOTYPE IN SOUTH AFRICA SHOULD BE MANAGED TO MAXIMIZE THE MAINTENANCE OF THEIR GENETIC VARIATION.

Rationale:

The persistence of black rhino in the long term (evolutionary time scale) will depend on their ability to adapt to changing environmental conditions. This adaptation works through natural selection, which requires the presence of genetic variation. Genetic heterozygosity is also important for maintaining the current fitness of populations (current reproductive and mortality rates are partly a reflection of this fitness).

Populations with fewer than about 500 breeding-aged individuals suffer accelerated loss of genetic variation, through

- genetic drift (where each new generation has only a random or select sample of the genes of the previous generation, through random matings and pre-breeding deaths), and
- inbreeding (mating between closely related individuals).

Because all our current populations are "small", active management is required to minimise the rate of loss of genetic variation.

Considerations:

Genetic factors must not be seen in isolation, but rather as one of many factors that can affect a population's or species' long-term survival.

D.b.minor, *D.b.bicornis* and *D.b.michaeli* populations will be kept separate, as adaptive traits that may be important for rhino survival in one region may be lost through interbreeding. (The possibility of allowing mixing between *D.b.minor* and *D.b.bicornis* in a few restricted populations at locations where their historical distributions merged, may be considered (see Figure 5.1 for the historical distribution))

Populations of the same rhino ecotype in South Africa should be viewed as one metapopulation. For each ecotype, management should aim to maintain genetic transfer between populations in the metapopulation, and thus maximise genetic diversity.

Larger populations have a greater chance of survival in the long term.

The risk of total metapopulation extinction through disease or catastrophes should be reduced through the establishment of viable populations in a diverse range of environmental situations, but where feasible within the historical range of the ecotype.

Procedures:

- Assess populations for long-term viability through population and habitat viability analyses (PHVA, e.g. using VORTEX - Lacy, Hughes and Miller 1992)

  These analyses integrate data on population genetics, biology and ecology with

probabilities of stochastic demographic and catastrophic events (including, for example, poaching). They predict probabilities of population survival and rates of loss of genetic heterozygosity. The aim is to identify how much each factor contributes to ecotype survival and to minimising genetic loss, so that management actions can be taken accordingly.

- Achieve the Plan's goals of 2000 *D.b.minor* and 200 *D.b.bicornis* as rapidly as possible

  - Maximize rates of population (and thus metapopulation) increase by maintaining rhino numbers below ecological carrying capacity (as in Section 4.3).

  - Obtain an overall average metapopulation growth rate of at least 5% for each ecotype.

  Maximising population growth rates and thus the numbers of each ecotype is vital to retain as much of existing genetic variation as possible.

- Increase the number of populations with effective founder numbers of at least 20 for each ecotype.

  Compared to populations with smaller founder numbers, such populations will have reduced negative effects of genetic drift and inbreeding on fitness and heterozygosity. Also, the chances of such populations going extinct due to demographic stochasticity will be lower. By not having "all the eggs in one basket", there will be less genetic loss to the ecotype as a whole in case of a local catastrophe affecting an important population.

  Such populations should have good potential for rapid population growth, that is, optimal sex and age structures, and ECCs of 50 or more.

  For each of the two endemic ecotypes, priority should be given to establishing as many separate key populations (AfRSG definition) as possible, each with at least 50 animals (i.e. with ECCs of 67 or more).

- Establish new populations using founder rhino from a combination of original genetic sources, with as few relations between founders as possible.

- Every rhino generation (c. 14 years), introduce and establish one new breeding individual from a different donor area into each population. This is very effective in reducing the risks of inbreeding and loss of genetic heterozygosity in a population.

  Such "new blood" should be an adult, preferably female. Methods to ensure the successful establishment and breeding of such animals should be developed. Current knowledge suggests that the introductions should be made into low density or "vacuum" zones (possibly created by the removal of some rhino from that area), or into fenced-off areas that can later be opened up to the rest of the population/reserve.

- **Maintain detailed pedigrees (family trees) for all known animals.** This would involve all the rhinos in small populations, or a subset of identifiable animals in large populations that can act as indicators of genetic inter-relatedness.

- **When removing rhinos from a population, do so such that remaining animals have the least possible genetic relatedness between them.** This will help to avoid undue inbreeding in the donor population.

- **Monitor genetic diversity (if feasible).**

  The procedures, practicalities and costs of properly monitoring black rhino genetic variation still need to be determined. This will involve addressing the following factors:

  Field Sampling
  Skin, blood, or other tissue?
  storage mediums.
  When should the survey be repeated?

  Field storage
  Sterility needs, time span, sampled?

  Sample size, frequency
  What as a percentage of the population should be

  DNA extraction and analysis techniques
  Fibroblast cell cultures, Alloenzymes, RAPDS or Microsatellites (PCR primers) ?
  Nuclear DNA vs Mitochondrial DNA.
  Gel electrophoresis or Gene sequencing.
  Restriction enzyme approach?

  Statistical analytical techniques
  How many loci should be monitored?
  Which loci /gene sections?
  Which tests for loss of genetic fitness or heterozygosity?

  Long term storage of samples
  How? At how many different locations in case of storage failure?

  Institutes and genetic workers
  Which institutes and people can do this work? Formal contracts will be required.

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4.3 MANAGING FOR MAXIMUM PRODUCTIVITY

EACH POPULATION OF BLACK RHINO SHOULD BE MANAGED AT ITS ESTIMATED MAXIMUM PRODUCTIVITY CARRYING CAPACITY (MPCC), I.E. 75% OF ESTIMATED ECOLOGICAL CARRYING CAPACITY

Rationale:

Black rhino numbers need to be increased "*as rapidly as possible*" to preserve their genetic diversity in the long term, or at least to minimise loss of heterozygosity; and to provide the biggest possible buffer against poaching losses.

Considerations:

For large mammals like rhino, it seems (based on observations of actual populations), that maximum sustainable yield is around 75% of estimated (long-term) ecological carrying capacity (ECC). The RMG has provisionally adopted this figure; and is aware that it might need to be adjusted in future in the light of improved information from regional status reporting.

Stocking rates of rhino should in any case be kept below ECC on average, as a "minimum regret" strategy. This will minimise the negative effects of social pressure and of sustained browse pressure on dry season food; and will reduce drought impacts on the rhino, such as increased mortality or reduced calving.

Procedures:

- Estimate the ecological carrying capacity of the reserve area available to black rhino (as in Section 4.4). Monitor habitat quality every 2 to 3 years; and if necessary adjust ECC estimates and concomitant rhino stocking rates to maintain maximum productivity. Stocking rates of other species which browse may also require management.

- Determine the number of black rhino in the reserve, and their sex and age breakdown and pedigrees at regular intervals (see Section 4.5).

- Allow numbers to build up to about 80% of Ecological Carrying Capacity. Numbers may be allowed to build up to higher than this (e.g. 90% of ECC) only if the population comprises a high proportion of <7 year old animals - that is, animals of lesser biomass which exert less browsing pressure. Should the population remain at these high stocking levels for more than one dry season, or comprise mostly adult rhino, dry season food resources can be adversely affected, lowering the long-term carrying capacity of the area for black rhino.

  In arid areas (<400mm), stocking rates should be not be allowed to build up much beyond 75% of ECC, because of the unpredictable nature of rainfall and the greater environmental fluctuations that characterise these areas.

  Also, areas with low soil fertility, or with little riverine or termitaria vegetation should

also keep numbers well below ECC, because of the greater potential of over-browsing dry-season food resources in such areas.

- Remove rhino so that the population is reduced to below 75% of ECC. Reduction below 60-65% is not recommended.

- Decisions on the numbers, age and sex of rhino to remove, and how often to make removals, should take into account the following factors, especially for populations of less than 50 animals:

  - the need to leave a population with enough potentially breeding males and females to maintain the population, now and in the future;

  - the need to minimise the genetic relatedness between the remaining rhino (and so minimise inbreeding from mating of mothers and sons, fathers and daughters etc.);

  - the need to prevent the stocking rate of mature males exceeding male carrying capacity;

  - the need to form a breeding group from the removed rhino alone, or in combination with rhino removed from other areas; and the need for the translocated group to have as little genetic relatedness among members, and as diverse an original genetic base, as possible (Section 4.2, Section 5).

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4.4 ESTIMATING CARRYING CAPACITY

THE ECOLOGICAL CARRYING CAPACITY OF EACH AREA WITH A BLACK RHINO POPULATION MUST BE DETERMINED AS ACCURATELY AS POSSIBLE. FOR POPULATIONS OF LESS THAN 70, AN ASSESSMENT OF MATURE MALE CARRYING CAPACITY SHOULD BE MADE. ASSESSMENTS SHOULD BE REVISED PERIODICALLY IN THE LIGHT OF IMPROVED KNOWLEDGE ON BLACK RHINO, AND HABITAT CHANGES IN THE AREA.

Rationale:

Ecological carrying capacity assessments are needed to determine the maximum productivity stocking rate for the area (75% of ECC). This will allow management of black rhino for maximum population growth, and thus help to achieve the conservation goals for the ecotypes as rapidly as possible.

Knowledge of ecological and male carrying capacity allows the population to be managed at levels that minimise rhino deaths or poor population performance due to social pressures or food limitations, especially during drought.

Considerations:

Knowledge of black rhino habitat and ecological carrying capacity in one area cannot be transferred directly to estimate ECC in another area, without accounting for differences in geology, vegetation and climate.

The best information we have on ECC so far comes from comparisons between well-established populations, where there is knowledge of rhino population performance and habitat, and in some cases home range sizes and distributions. Luckily such "baseline" areas cover a wide range of habitats in South Africa, Namibia, Zimbabwe and Kenya.

Population data from these countries strongly suggest that in fenced areas with ECCs of less than about 70, the carrying capacity for "socially mature" male black rhino (10 years old or more) is far less than that for females.

The population data from these countries also strongly suggest there is a time lag between a population reaching or exceeding ECC, and the corresponding reduction in the population's performance. Populations can thus overshoot carrying capacity before declining.

Procedures:

- Get one or more persons with proven experience in estimating black rhino ecological carrying capacity to do the assessment.

  Although the guidelines given below will go a long way in helping to estimate ECC, reliable understanding and interpretation of habitat characteristics only comes from experience. It requires an integration of concepts and assessed features that is difficult to convey through written guidelines.

- Understand, and make an assessment of these factors for the area under consideration:

Average annual rainfall (long-term)

ECC increases with average annual rainfall, except on lower nutrient soils where, above about 800mm, ECC declines. Modal rather than average rainfall may be used in arid areas (<400mm/yr).

Average soil nutrient status

ECC increases greatly with soil nutrient status after *about* 350mm average annual rainfall. The main underlying geology is a good indicator of average soil nutrient status (see table 4.4.2). The greater the extent of valley or bottomland terrain versus hills, the better, as these generally hold the more fertile soils in the soil catena.

Frost incidence, severity, and location with respect to rhino habitats.

(Frost incidence is estimated by average nights per year where minimum temperature is less than 3° C in a Stevenson's screen). A single frost event can lead to woody plant die-off and/or leaf drop. Severe frost affects vegetation more extensively, and affects larger trees and shrubs. The occurrence of frost virtually halves ECC compared to frost-free areas. Take into account that frost usually occurs in low-lying areas that may also harbour important dry-season food reserves of black rhino. Low lying areas often have no meterological stations - perhaps look at average numbers of nights with temperatures under 5°C or 6°C for such cases.

Length of the dry season

Determine the number of dry months (e.g. months with <10mm of rainfall on average): the shorter the dry season the better for rhino (7dry months is long, 3 is short).

Phosphorus availability through the seasons

This is related to the soil moisture and fertility, and thus rainfall spread through the year and soil type - the longer phosphorous is available to plants through the year, the better the ECC for rhino.

Woody plant species composition, size structure and density

List and describe vegetation types, and estimate their area (in hectares, and as a % of the reserve). List rhino food species and rate them for abundance and suitable height structure:

- The greater the variety of palatable species and habitats in the reserve, the better for black rhino.
- Black rhino feeding is generally in the <2m height range, with plants (especially acacias) of <1m being most favoured (although *Spirostachys africana*s of about 1.5-2.5m are most preferred).
- The greater the abundance of food plants within rhino feeding height, the better for rhino. Note that very dense thickets that impede movement are less preferred.

Extent of drainage line woody vegetation

Drainage line woody vegetation is very important in providing dry-season food for black rhino. Such food has a higher moisture content, palatability and nutrient status than food growing higher up on the catena. The greater the extent of such habitat, and its quality in terms of soil moisture and nutrient status, the better for rhino.

Prevalence of termitaria with bush clumps

Termitaria have a higher nutrient status than surrounding soils. They usually carry nutritious food plants, and relatively evergreen species which are important in providing "green bite" for black rhino for the dry season (however, not all termitaria woody plants are palatable). Bush clumps of other origin (e.g. plants growing in the shade of a tall spreading tree), are also of value for dry season fodder, for similar reasons.

The prevalence of forbs

Palatable forbs can form an important part of black rhino diet when available (as in East Africa). Forb abundance and the number of months over which they are available will determine their impact on ECC. Long grass interferes with forb accessibility to rhino.

Surface water distribution for both late winter (i.e. perennial water) and summer (i.e. temporary water), with respect to black rhino habitats

Rhino generally stay within 15km of water. Well-distributed water with a good surrounding food supply will lead to a higher ECC than a few isolated or artificial water points. Restricted winter water supply will limit ECC. A widespread summer water distribution can help to spread rhino and alleviate pressure on winter feeding areas near perennial or ground water, as well as social pressure.

Terrain accessibility to rhino

Rhino do not like steep areas, but will tackle them if they harbour good food or water, or if good food, water or shelter lies beyond them.

Rockiness

Rocky areas are usually avoided, and limit plant growth and ECC. However, especially in arid areas, rocky places can harbour good food plants sought by rhino. Rocky areas have the benefit of channelling and concentrating nutrients and water, and reducing local frost incidence through their heat radiation properties.

Grass Height

Areas with long grass (>0.75m tall) are avoided by black rhino, and woody plants with grass interference are not fed on as much as those without. If grass is long for large parts of the year over a wide area, ECC will be lowered.

Reserve shape with respect to black rhino habitats.

Long thin reserves can have a lower ECC per unit area than more circular reserves. A long shape can limit the spatial arrangement of food in a home range to a linear distribution, which is inefficient to access.

Browse condition and density of other browsing game

The browsing of other game species has an impact on black rhino food plants. When browser density in a reserve has been high for a few seasons, the vigour and productivity of especially broad-leaved and dry-season food plants can be reduced, and levels of secondary plant chemicals (tannins etc.) in the vegetation can be elevated. This will negatively affect black rhino, and lower carrying capacity. Eland, kudu, Impala, nyala, and springbuck can exert the greatest negative impact when at high densities.

- Look for signs of sustained heavy browse impact on palatable acacias, *Dichrostachys*, and especially on the palatable plants in bush clumps and along drainage lines. Most plants will have bite and nibble marks on sprouts and twigs, and will appear hedged or bonsi'd. Branches and twigs on the outside of the plant will look thicker and stumpier than normal for the species, branches may be interlinking, or all lining up to form a boundary around the plant, with sprouts, if present, being much thinner than the twigs, and coming from sprout nodes spaced closer together than normal.

- Determine the exact size of the area available to black rhino.

This should account for area on slopes (i.e. it should include topography, not just the flat-projected area) and should exclude large water bodies, houses and fenced-off areas, yards etc.

- **Use Table 4.4.1.**

  Find the section with the annual rainfall range that encompasses that of the area under consideration. Look for areas with similar annual rainfalls, frost ratings and nutrient statuses to your's. If there are no listed reserves with equivalent values, look at those that fall "above"and "below" your area in terms of these factors. Read the terrain and vegetation descriptions, noting their likely ecological carrying capacity ranges. Speak to people who know those areas. Considering as many factors as you can, evaluate whether your area is better or worse than the "benchmark" areas, and so determine the likely ECC range of the area.

- **Convert the likely ECC range (rhino density in number per square kilometre) into rhino numbers as follows:**

  Area available to rhino (in km^2) x ECC density (# /km^2)

- **Estimate the number of mature males (i.e. older than about 9 years) your area can carry.**
  Mature male home ranges are determined by water availability and distribution, and food habitat density and distribution, and constraints imposed by reserve shape and topography. Their ranges will not usually overlap significantly, except

  - in areas where scattered temporary water dries up in winter, and there is one or more perennial water course available to them which also has abundant dry-season browse, in which case their dry season ranges will overlap quite a bit adjacent to the water (but because the water is spread out they can generally still avoid each other); or
  - in arid areas (<300mm) where the rhino are forced to adapt to sharing water points for much of the year, provided food resources are well spread out further away from the water.

  The sizes and shapes of home ranges vary within a population. Below are some average range sizes for different areas. Find areas similar the in rainfall and vegetation to the one being assessed. This will give you some ballpark *male* range figures to work with - adjust the range estimates up or down depending on how your area compares to the benchmark area in terms of the factors given in the first part of this section. "Fit" ranges of this size into the reserve, arranging them to account for dry season water distribution, habitat quality for black rhino, and terrain and other constraints

	Home range size of adult rhino in hectares	
	Males	Females
Great Fish River	1035	822
Shamwari GR	833	
Hluhluwe-Umfolozi Park	1200-1900	1300-2300
Mkuzi GR	1645	2191
Ndumo GR	1030	1105
Pilanesberg NP	3300	3690
Lapalala	3463	3940

If you already have rhino at a fair density (>2/5 of ECC), monitor the mature male ranges closely to get better estimates specific to your area.

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Table 4.4.1. A Review of estimated ecological carrying capacities of reserves for black rhino in South Africa and Namibia.

ARID AREAS:			Annual rainfall 100-250mm	
	Frost rating	Nutrient status	Avg. ann. rain	ECC density #/km^2
Augrabies Falls NP	rare	medium	104	0.04-0.06
Flat terrain with frequent rocky outcrops and dry river beds; or Orange river banks and floodplain. Vegetation is dominated by *Xygophyllum* and dwarf shrubs, with succulent plants on rockier sites, and *A.mellifera* and *Schotia afra*, especially in the watercourses. The runoff is concentrated into the plains and watercourses, increasing its effectiveness. Leguminous forbs abound at certain times of year. The river banks and floodplain have *A.karroo/ Euclea* dominated thickets.				
Kunene West	medium	fair	175	0.01-0.02
Very rocky, rough terrain with stony plains (escarpment dissected by drainage lines). Rich in *Euphorbia* species, with some mopane, *Acacia*, *Commiphora*, *Boscia* and succulent and dwarf shrubs. Rockiness, water distribution and competition with livestock limit the black rhino ECC.				
Hardap GR	bad	low	177	0.05 - 0.07
Plains with rock outcrops. Grassland and dwarf shrub vegetation with *A.mellifera* and other *Acacia* species. A large dam occurs in the reserve.				
Karoo NP	bad	fair-med	210	0.04 - 0.056
Sheer cliffs and platteau terrain, with dry river beds descending to flat plains. Karroid dwarf shrub vegetation predominates, with *A.karroo* along the watercourses				

SEMI-ARID AREAS — Annual rainfall 250-450mm

	Frost rating	Nutrient status	Avg. ann. rain	ECC density #/km^2
Etosha NP	med	med-fair	350	0.048 - 0.07

Flat to undulating terrain, with small hills, and mainly calcrete soils. Vegetation is characterised mainly by mopane, *Combretum*, *Terminalia prunicides* woodland and *A.reficiens* shrubland. Water distribution from pans and springs is limiting to the black rhino ECC. Density is for the area excluding the pan itself and areas > 15km from water

Hei!-garib NP	bad	fair-low	350	0.05 - 0.07

Flat terrain and sandy soils occur, with *A.mellifera*, *A.tortilis*, *A.erioloba* thornveld vegetation and grasslands with *Tarcananthus*. *Boscia* sp, *Salsola* sp and *Rhigozum* sp also occur.

Waterberg PP	med	low	380	0.08 - 0.11

A sandstone plateau, with rocky outcrops and generally shallow, sandy soil. Vegetation is mainly *Combretum/ Terminalia* sourveld. Natural springs are abundant.

Kruger NP Far North	rare	low	380	c. 0.15

Sandveld vegetation. Mainly *Combretum / Terminalia / Peltophorum* veld.

Great Fish River Reserve	rare	high	388	0.35 - 0.45

Very rugged, eroded terrain, with underlying shales. Vegetation is predominantly succulent valley bushveld with a good Euphorbiaceae component, (bush is not as dense as Addo). Also present are some karroo scrub areas, open grasslands and forest patches in ravines. Two major perennial rivers flow through the area. Rain falls during summer and winter. The soils maintain high phosphorus levels throughout the year

Addo ENP	rare	high	400+	0.49- 0.7

This has gently undulating terrain. Vegetation is mainly dense succulent valley bushveld with a high Euphorbiaceae component. Karroid and coastal scrub occur in places. Rain falls during summer and winter. Soils maintain high phosphorus levels throughout the year.

Shamwari GR	rare	medium	400	0.2 - 0.3

Undulating terrain, consisting of a series of ridges and valleys raking the width of the reserve. Degraded succulent valley bushveld vegetation with acacia bush occurs on the lower slopes and valley bottoms, with coastal scrub and open grasslands on the shallow soiled ridges and upper slopes. Rain falls during summer and winter. Soils maintain high phosphorus levels throughout the year.

Mangeti Game Camp	medium?	low	430	c. 0.1

Unknown - probably dominated by Kalahari sands and acacia thornveld.

Kruger NP: NE Ecca shales/basalt	v.rare	medium	450	0.22 - 0.25

Plains with dark clay soils overlying calcrete. Vegetation is scrub mopane veld, and *A.higrescens* woodlands with *Spirostachys* in the drainage lines. Also present is Lebombo mountain bushveld with *Combretums*. Perennial rivers occur

SEMI-ARID SAVANNAS. Annual rainfall 450-580mm

	Frost rating	Nutrient status	Avg. ann. rain	ECC density #/km^2
Kruger NP: NW granitic	v.rare	low	500	0.2
Gently sloping terrain with sandy soils *Combretum* vegetation with scrub mopane and *acacia*				
Atherstone GR	medium	medium	540	0.12 - 0.13
NW arid bushveld plains. One third *Combretum*/maroela sourveld on shallow soil, or *Terminalia* and *A.mellifera/ A.erubescens/Grewia* on red Kalahari sands; and the remainder mixed *acacia* sweetveld ecotones with *A.tenuispina* black turf floodplains, calcrete zones, and some *Spirostachys* along drainage lines. Occasional frost on the turfs can affect browse in winter				
Lapalala Wilderness	medium	low	550	c. 0.13
Waterberg sandstone, flat or very steep, with shallow soils, plus a section with alluvial soils and a perennial stream. Vegetation is sourveld, with a fair species diversity including a good succulent and Euphorbiaceae component. A patch with *A.nigrescens* occurs on a dolerite dyke.				
Kruger NP: SE basalt/Ecca/rhyolite	v.rare	medium	550	0.23-0.28
Lebombo mountain bushveld with *Combretum A.welwitschii* veld occurs on fertile Ecca shales, with *A.nigrescens* on dark clays overlying calcrete. Perennial rivers occur				
Marakele NP	medium	low	555	c. 0.125
Terrain is either high plateau, cliffs and kloofs or bottomland plains The Waterberg sandstone plateau dominates, with shallow soils and *Combretum* veld Areas of kloof forest occur, and *Terminalia sericea/Burkea africana* sandveld and sweeter *Acacia tortilis / A.erioloba* veld is found on the bottomlands.				

INTERMEDIATE SAVANNAS: Annual rainfall 580-660mm

	Frost rating	Nutrient status	Avg. ann. rain	ECC density #/km^2
Pilanesberg NP	medium	low	603	c. 0.126

Very hilly terrain of volcanic origin, but with wide, gently sloping valley bottom areas. Sourveld occurs on hillsides, and sweeter acacia veld and evergreen termitaria bush clumps occur on uneroded valley bottoms; with *Spirostachys / A.mellifera* thicket in eroded drainage lines. Species diversity is a relatively low, but a diverse patchwork of habitats exists. One perennial river and artificial water points occur. Inaccessible steep terrain is excluded from this carrying capacity density estimate.

Sable Ranch	medium	fair	620	c. 0.182

Gently undulating terrain with granite koppies. *Acacia/Dicrostachys* thickets and mixed *Grewia/Lannea/Croton* patches occur in an otherwise sour landscape of *Combretum/Terminalia* vegetation. Surface water and dams are plentiful.

Mkuzi GR	v.rare	fair	630	0.25 - 0.35

Terrain slopes down from Lebombo mountain (rhyolite) Combretum veld to flatter terrain. Here, vegetation varies from sandforest / bushland on an ancient dune ridge to cretaceous clays with *A.luderitzii / Euclea divinorum* bush, and mixed *Acacia* sp. bushveld. Riverine forest patches, *A.tortilis* and *A. xanthophloea* occur on the alluvial soils near the major rivers, which are non-perennial. There is a pan with permanent water. ECC is affected by the growth stage of the acacia areas.

Ndumo GR	0	fair	630	0.34 - 0.426

Generally flat terrain with alluvial foodplains, sandy soils and sand dune areas, and calcareous clay soils. Vegetation and species composition is diverse, with reedbeds, riverine and sand forest, Mahemane thicket with a low-growing *Euphorbia* species, and *Acacia* and *Albizia* woodlands. A perennial river, floodplain and pans with permanent water occur in the area.

Hluhluwe-Umfolozi P (Makhamisa)	0	medium	635	0.37 - 0.5

Hilly terrain with eroded, gently sloping plains. Vegetation is predominantly acacia veld with *Spirostachys* areas and *Euclea/A.ludeniii* thickets. A fairly good dry season food supply occurs along drainage lines. A long section of the White Umfolozi river runs through the area. ECC is determined by the successional stage of the vegetation.

Weenen NR	medium	medium	653	c. 0.294

This area has relatively flat areas and some steep slopes down to the perennial Bushman's river. Slope vegetation is valley bushveld with a succulent component. Eroded areas are invaded by thorn scrub; and midlands sourveld grasslands with acacias occur on flatter areas.

Kruger NP: SW_granitic	rare	low	655	0.22 - 0.25

Terrain is undulating with rocky hills. Vegetation is characterised by *Terminalia sericea / Combretum* veld with *A.nigrescens* woodlands. Clay soils with *Spirostachys* and other acacias occur near the drainage lines. Some major rivers cross the area.

MOIST SAVANNAS:			Annual rainfall 660-780mm	
	Frost rating	Nutrient status	Avg. ann. rain	ECC density #/km^2
Tembe Elephant Reserve	0	quite low	717	0.23-0.28

Tembe lies on a system of parallel sandy paleodunes of low nutrient status, underlain by relatively nutrient rich sediments which are exposed (or close to the soil surface) in the dune slacks (inter-dune area). Water occurs seasonally in pans between the dunes, and permanently in the Muzi drainage line and scattered boreholes. Vegetation includes grasslands, much open woodland (*Terminalia sericea, maroela, A.burkei, D.cinerea, Strychnos*) with some forest (*Newtonia, Albizia, Terminalia, Cleistanthus, A.burkei*), thicket (*Strychnos, Balanites, Spirostachys*), and closed woodland (*Spirostachys, Commiphora, A.senegal, A.bonei, A.burkei, A.nilotica, A.robusta, Euclea, Grewia*)

Hluthuwe-Umfolozi P (Mbhuzane)	0	medium	660-700	0.4 - 0.55

This has undulating terrain, acacia scrub, *Spirostachys, Euclea* bush and donga-dissected thickets occur; with a high species and habitat diversity. Fairly good dry season food supplies are found around drainage lines. Long lengths of the perennial White and Black Umfolozi river run through the area. ECC is determined by successional stage of acacia veld away from rivers.

Hluhluwe-Umfolozi P (Masinda)	0	medium	770	0.4 - 0.55

Terrain is undulating, acacia scrub, and some *Spirostachys* vegetation occur, with a medium to high species diversity. Fair dry season food supply is found around drainage lines. The perennial Black Umfolozi runs along the southern border. ECC is determined by the successional stage of acacia veld away from major drainage lines.

MOIST SAVANNAS:			Annual rainfall 780-1000mm	
Hluhluwe-Umfolozi P (Nqumeni)	v.rare	fair	790	0.35 - 0.5

Undulating terrain occurs, with acacia scrub and *Spirostachys* and *Euclea* areas. Vegetation has a fairly high patch and species diversity. Good dry season food supply occurs around drainage lines The perennial Hluhluwe river runs along the northern border. ECC is determined by successional stage of acacia veld away from rivers, and by grass interference.

Itala GR	rare-med	low-fair	797	c. 0.22

Very hilly or mountainous terrain occurs, with shallow soils, and quartzite rock. Sourveld vegetation occurs in upland areas and slopes, where acacias occur on old lands. Acacias, donga thickets and riverine woodland occur in drainage lines and valley bottoms. Two major perennial rivers occur in the area. The density estimate is for the area excluding cliffs.

Hluhluwe-Umfolozi P (Manzimbomvu)	v.rare	fair	850	0.3 - 0.42

Very hilly terrain, with broad-leaved mistbelt forests; lowland forests and woodlands; acacia veld and *Spirostachys* areas. Three permanent rivers and natural springs occur in the area. Species and habitat diversity is high. ECC is limited by lowland forest development and grass interference.

			Annual rainfall >1000mm	
Eastern Shores	0	low	1360	0.2 - 0.27

Coastal sand dunes and sand plains occur, which have low nutrient status. Vegetation consists of forest patches, open grassland and various pans and wetlands. 40% of annual rain falls in winter.

4.5 MONITORING BLACK RHINO POPULATIONS

THE BLACK RHINO POPULATION SIZE SHOULD BE ESTIMATED TO WITHIN 10% OF ITS TRUE SIZE EVERY 1 TO 3 YEARS. POPULATION DYNAMICS, BREEDING PERFORMANCE AND BEHAVIOURAL CHARACTERISTICS SHOULD ALSO BE MONITORED ON AN ONGOING BASIS.

Rationale:

Biological monitoring of each population is needed to:

- determine and predict progress towards South Africa's conservation goals for each ecotype, in terms of rhino numbers and rates of increase;
- improve management of the populations for maximum productivity, allowing wise decision-making on rhino removals with respect to numbers, ages and sexes, pedigree and frequency;
- improve our understanding of factors affecting population performance, namely breeding rates, mortalities, social behaviour, rhino distribution in relation to other rhino, food and water, and rhino density in relation to estimated carrying capacity and climatic and management events;
- refine estimates of ecological carrying capacity.

Procedures and considerations:

- Keep personal history records for individually identifiable black rhino, and monitor all rhino using continuous ground-based sightings from routine bush patrols, and/or from special or intensive ground or aerial surveys. Proper staff training will be needed - e.g. Sandwith 1990.

  Experience from throughout Africa over many years has shown that identification and monitoring of individuals is by far the best approach to estimating a population's size, and is invaluable for determining the dynamics, breeding performance, and other important biological and social characteristics of the population.

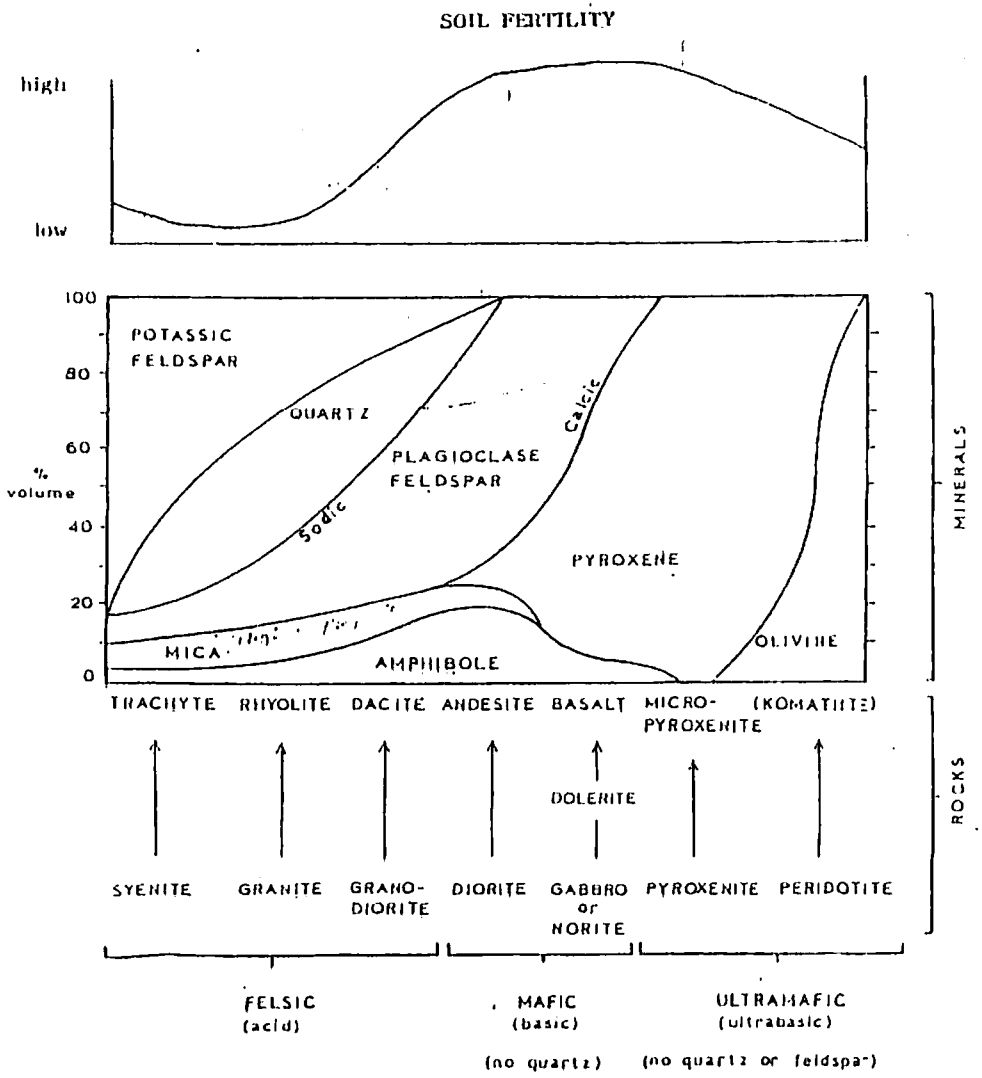
  Personal history records should include the following data where relevant or possible:

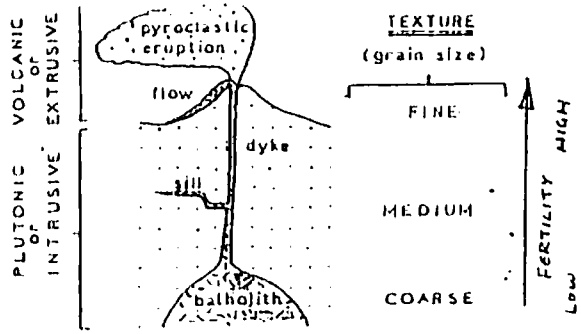
Rhino ID (a unique name/number)	Identifying features	Date of first identification
Mother	Father	
Birth date	Death dates	
Age at first calving	Calving dates	Calf IDs(names/numbers)

  Mating dates and identity of mate
  Sighting records: location and group structure of each sighting
  Home range size and location
  Other events: eg. injuries (type, date and case history), date immobilized, immobilization records, dates photographed etc.

TABLE 4.4.2.

Classification of igneous rocks and relation to soil fertility





Classification of clastic sedimentary rocks and relation to soil fertility

GRAIN COMPOSITION	>50% grains of rock fragments and silicate minerals		
GRAIN SIZE	Rock group	Rock name	Soil fertility
Boulder >256 mm	rudaceous (mainly rock fragments)	conglomerate (rounded clasts)	LOW
Cobble 256 mm – 64 mm		breccia (angular clasts)	
Pebble 64 mm – 4 mm		diamictite (or tillite) (poorly sorted)	
Granule 4 mm – 2 mm		grit	
Sand 2 mm – 63 µm	arenaceous (rock and mineral fragments)	sandstone	LOW
Silt 63 µm – 4 µm	argillaceous (mainly mineral fragments)	siltstone; loess (wind-blown silt)	MEDIUM
Clay <4 µm		claystone	HIGH

Dimensions:

Notches:
2 to 2.5 cm wide
2.5 to 3 cm deep

Holes:
+- 1.5 cm diameter

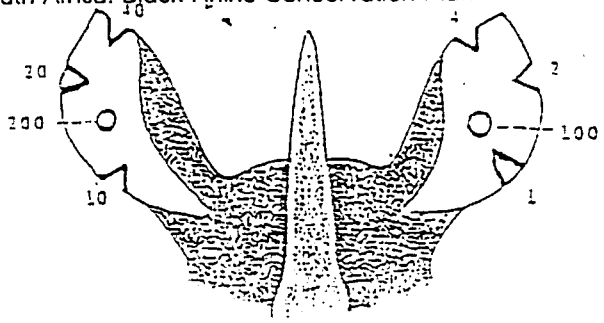
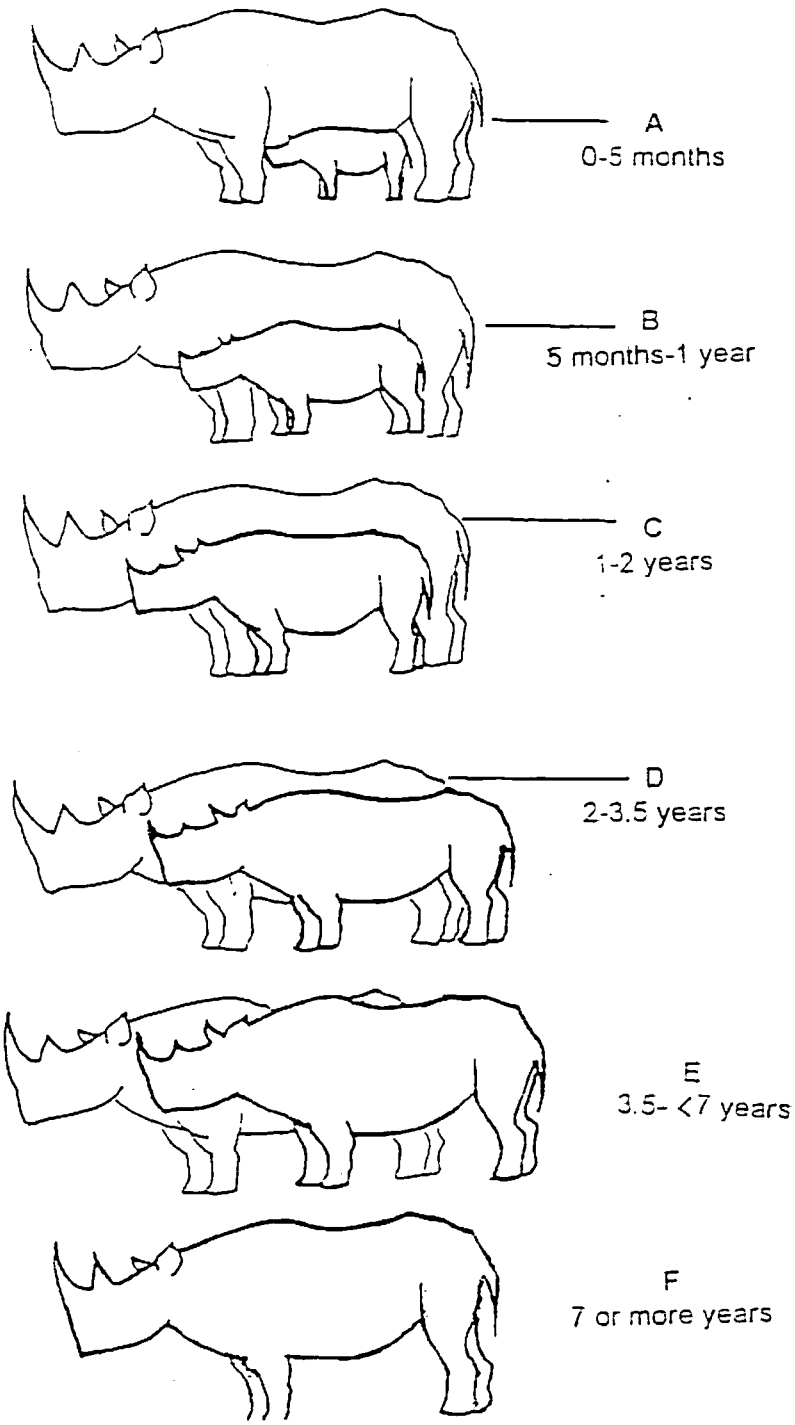


Figure 4.5.1. Notching positions and notch numbering for black rhino.



- **Mark rhino for individual identification.**

  It is recommended that all rhino immobilised for research or monitoring purposes, treatment or translocation be individually ear-notched. In large populations with few known rhino, regular ear notching programmes to increase the proportion of known rhino are recommended. Darting can be done from a helicopter, or from the ground (e.g. Galli and Flamand 1995).

  Microchip transponders should be implanted into the horns and shoulder of each immobilized rhino (*Travon* transponders are recommended). This will allow tracing of horn should the rhino be poached and later recovered; and identification of the carcass should the rhino die and its ears be scavenged.

  Rhino in the same reserve should receive a unique ear notch pattern, but notches can be duplicated across different reserves - Figure 4.5.1 gives notching positions and numbering.

- **Estimate population size every year, or at least every third year.**

  Sufficiently accurate population estimates will generally require that a good proportion of rhino in the population are known individually, through applied ear-notches or natural features such as ear tears, damaged tails, horn configurations and body scars.

  Mark-recapture estimation
  Mark-recapture estimates can be made from continuous sighting data for those populations that are not completely known, and for those that have a proportion of unidentifiable "clean" rhino. The Bayesian mark-recapture program RHINO (Emslie 1993) is available for data analyses, and the manual explains much of the field and data processing procedures. If the proportion of clean animals is high (>50%), many sightings (>2.5 times the real population size) will be needed to produce precise estimates.

  Adequate staff training must be given to ensure accurate data recording of sightings, and proper record keeping. Where relevant, the same attention must be paid to clean rhino sightings as to sightings of recognisable rhino.

  Individual Identification of all rhino
  For smaller populations (e.g. <70), or populations where every rhino is potentially individually recognisable (including where good photographs are taken of all sightings which show small features used to identify animals), known animals can represent an accurate estimate of numbers.

  References relevant to individual rhino monitoring and population estimation are given at the end of this section.

  Ground-based Distance Sampling
  Ground-based Distance Sampling (Burnham *et.al.* 1993) is not generally suitable as too few sightings are obtained after considerable effort, even in large, high density populations; and confidence intervals are always too wide.

Aerial estimation techniques

Aerial techniques that simply count rhino (and do not use individual identification) are not sufficiently accurate in almost all rhino areas, except perhaps very small, relatively open areas (<3000 ha) or those with *very* open vegetation. Such counts are very variable, and are gross underestimates (as shown by data from Tanzania (Goddard), Hluhluwe-Umfolozi Park (NPB count records) and Pilanesberg National Park (NWEC count records).

Aerial distance sampling in large populations in flat terrain and quite open vegetation may be an option, if sufficient effort can be put in to achieve the desired confidence intervals.

An aerial block sampling approach may also be an option in large populations, in any terrain or vegetation type. A Global Positioning System with real-time map viewing capabilities is needed. Stratified randomly designated blocks of 2-4 km^2 are used. Each block is flown intensively to flush and count every rhino therein. Different sample blocks should be flown until the desired confidence intervals are reached.

- Determine the population sex and age structure

The ageing criteria in Figure 4.5.2 should be used to age black rhino from field sightings. This system is used in most RMG areas, and in Tanzania and Kenya. The criteria are based on the original "Field criteria for aging black rhino" by Hitchins (1970), with refinements by Emslie et.al. (1993), and Adcock et.al. (1996) that better fit the biological life stages of rhino.

For *D.b.minor*, guidelines on aging non-adult rhino (up to c.6.9) years, and adult rhino by horn configuration, horn dimensions, tooth emergence and wear are available (Adcock et.al. 1996).

In completely known populations, the sex and age structure will be known quite reliably at any point in time. However, often there is a lag between the time calves are born or rhino die, and the time calves and carcasses are first detected, which means that sex and age structures generally have to be continually backdated to be accurate.

Sex and age structure estimation for populations with many clean or unknown animals is problematic. Biases are introduced from trap-happy/trap shy rhino, area-biased effort, females hiding with very young calves; and incorrect ageing and sexing by observers that are unmotivated, inexperienced or inadequately trained.

- **All immobilized rhino should be aged as accurately as possible.** Take tooth impressions if circumstances permit (Wucher 1994). This will improve the accuracy of age structure information, especially for animals over c.7 years old. When it involves animals whose birthdate is known with some certainty, it will allow area- or ecotype-specific refinements to the tooth emergence and wear criteria to be made.

- Examine and record all black rhino mortalities

Attempts should be made to detect all black rhino mortalities. A vet or experienced person should be called to conduct postmortems on all deaths. Certain potential causes of death can be ruled out even if cause cannot be firmly established, even from old decayed carcasses.

Collect: Horns
Skull and jaws for later aging by tooth wear
Tissue samples for genetic studies

Determine and record on a mortality form (see Section 7 tables):

Time since death
Cause of death
Date and location of mortality
Identity of deceased rhino
Age and sex of rhino (incl. Age by tooth wear)
Name of individual who found carcass, and how it was found.

Horn weights, lengths and basal circumferences
Horn and skull storage location, and tag/microchip number

References:

Adcock K -compiler, with work from J Goddard, P Hitchins, K Adcock, Dr P Morkel, Dr P Goodman, H Hansen, H Lindemann, R Emslie, Dr B Keffin, C Reed (1996). Aging the southern central black rhinoceros (*Diceros bicornis minor*) by horn size and configuration, tooth emergence and wear. *Wild Solutions*

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Zululand. *South African Journal of Wildlife Research* 8: 71-80.

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Sandwith TS (1991). A training programme for game-scouts involved in the monitoring of black rhino populations. *Natal Parks Board.*

Wucher M (1994). A technique for making dental impressions and casts of immobilised black rhinoceros *(Diceros bicornis)* and white rhinoceros (*Ceratotherium simum*). IN Proceedings of a Symposium on Rhino as Game Ranch Animals. *South African Veterinary Association Wildlife Group.*

Table 5.1. Black rhino reserve sizes, and their estimated ecological carrying capacities. The ECC estimates are for the potential areas available to t rhino, which are given in bold type. In many reserves, the entire area does not currently, or cannot, hold black rhino.

Ecotype / Managing authority	RESERVE NAME	Size of area with rhino (hectares)	Size of the total area (hectares)	Notes	Estimated ECC Density (rhino/km2)	Est. ECC in rhino numbers	1995 population size	Average annual rainfall (mm)
D.b.bicornis								
National Parks	Augrabies Falls Nat. Park	8900	15200	Total area not available to rhino	0.045	4	5	104
National Parks	Vaalbos (Hei-!Garib) Nat. Park	18120	18120		0.050	9	10	167
National Parks	Karoo National Park	7148	37000	Presumably the entire reserve will become available	0.04-0.056	15-21	3	310
National Parks	Zuurberg	+-1200	25000	Rhino are temporarily in small fenced sub-areas	0.4-0.6	100-150	3	4667
Private	Tswalu Game Lodge	22244	47000	The entire 557000 ha is not available to the rhino	0.043-0.064	20-30	8	250-400
D.b.michaeli					Total	c.180	29	
National Parks	Addo Elephant National Park	10063	10063	Elephant camp	0.497-0.7	50-70	33	466
D.b.minor					Total	c.60	33	
National Parks	Kruger National Park*	900000	2000000	The south currently has by far the bulk of black rhino	0.161	2578	215	547
National Parks	Marakele National Park	8000	42000	Rhino are temporarily in small fenced sub-areas	0.125	53	5	555
Eastern Cape	Great Fish River Reserve	14000	44000	Only Andries Vosloo currently has black rhino	0.407	179	20	388
Mpumulanga	Atherstone Game Reserve	14000	14000		0.129	18	5	540
KwaZulu	Ndumo Game Reserve	10100	10100		0.396	40	36	630
KwaZulu	Tembe Elephant Reserve	30000	30000		0.260	78	22	717
Natal Parks	Eastern Shores Nature Reserve	7500	15000	The rest of the area is not used by rhino	0.270	20	20	1360
Natal Parks	Hluhluwe-Umfolozi Park	96453	96453		0.446	430	405	750
Natal Parks	Itala Game Reserve	26688	29653	Cliffs excluded	0.225	60	64	797
Natal Parks	Mkuzi Game Reserve	36761	36761		0.320	118	77	630
Natal Parks	Weenen Nature Reserve	4422	4422		0.294	13	11	653
North West	Pilanesberg National Park	41270	55000	Area excludes inaccessible, steep terrain	0.126	52	44	603
Private	Elandsdrift Game Ranch	8800	8800		0.180	15	4	510
Private	Lapalala Wilderness	10000	25650	Only the sanctuary area has black rhino	0.130	33	15	550
Private	Rhinoland	10000	10000		0.129?	13	6	540?
Private	Sable Ranch	2200	2700	Part of the total area is fenced off	0.182	8 with feeding?	11	620
Private	Shamwari Game Ranch	6000	8000	The area with lion is fenced off from the rest	0.280	16	7	520
					Total	3724	962	

* Greater Kruger, including adjoining private areas

5. ESTABLISHING/AUGMENTING NEW POPULATIONS

D.B.MINOR AND *D.B.BICORNIS* SHOULD BE TRANSLOCATED FROM WELL-ESTABLISHED POPULATIONS TO CREATE ADDITIONAL POPULATIONS IN SUITABLE AREAS WITHIN THEIR HISTORICAL RANGE.

Rationale:

A network of large (>50) and small black rhino populations throughout South Africa will help to provide a buffer against localised poaching, disease outbreaks and extreme climatic changes.

Well-established populations require removals to keep them productive. When productive, they will continually provide black rhino for new or understocked areas, especially as the conservation goals of the two local ecotypes are far from being achieved.

Considerations:

Table 5.1 gives the area sizes, 1995 population sizes and potential ecological carrying capacities of current black rhino reserves.

Most of the older well-established *D.b.minor* populations are near their estimated ecological or maximum productivity carrying capacities, while progress to the goal of 2000 of this ecotype is only just over half way. To achieve the goal as quickly as possible, these populations need to be kept productive, and surplus rhino need to go to augment or start new populations.

The Kruger National Park alone has the capacity to meet the goal, but although rhino numbers in this area should be augmented with further introductions, for strategic purposes other areas need to be developed to hold viable black rhino populations in the longer term.

For *D.b.bicornis*, progress to the goal of 200 is barely 15%. More introductions from Namibia are required to improve South Africa's numbers and genetic base. Only one area with significant carrying capacity is available for this ecotype, and new areas with potential for large populations need to be identified.

Procedures:

- Properties should be identified which have suitable habitat and management capability for black rhino. Property owners/managing authorities who wish to receive black rhino must have their property assessed (see Section 5.1).

- Properties identified as suitable for black rhino should be rated according to carrying capacity and security potential, and the rating should be used to guide and prioritise decisions on translocations by donor organisations.

- Assuming security and management capacity are acceptable, a property should have

a long-term ecological carrying capacity of at least 20 rhino. However, priorities should be given to properties in the order given below:

Top priority	Properties with ECCs of over 67 animals, i.e. that can hold a "key" AfRSG population of 50 or more animals at maximum productivity carrying capacity (MPCC, 75% of ECC).
Second priority	Properties with ECCs of 50-66 animals, where the highly desired effective founder number of 20 or more rhino can be introduced, making them "important" AfRSG populations.
Third priority	Properties with ECCS of 27-50, where 20 or more rhino can be held at MPCC, making these "important" AfRSG populations.
Fourth priority	Properties with ECCs of 20-26, where MPCC is less than 20 rhino.
Lowest priority	Properties with ECCs of less than 20 rhino.

- To ensure rapid initial population growth, and to minimise the need for disruptive removals soon after a population is established, the founder number introduced to a new property should not exceed half the ECC, and should preferably be around 37% of ECC (that is, equal to half the maximum productivity carrying capacity).

- Founder groups of black rhino destined to start new populations should have as little genetic relatedness between them as possible, and should include rhino from different original genetic sources, namely Mkuzi and Hluhluwe-Umfolozi for *D.b.minor*, and Etosha and Kunene West for *D.b.bicornis*.

To facilitate the fulfilment of these genetic considerations, increased liaison between donor organisations is required to mix and match rhino where possible to form suitable breeding groups for introductions.

5.1. ASSESSING AREA SUITABILITY FOR INTRODUCTIONS

FOR AN AREA TO RECEIVE BLACK RHINO, IT SHOULD ACHIEVE A PASS SCORE ON ALL THE PROPERTY ASSESSMENT CRITERIA.

1. The property should ideally have a long-term ecological carrying capacity of at least 20 rhino.

2. The property should be in the range of the black rhino ecotype involved. There should be no chance of mixing of different ecotypes. (See Figure 5.1 for the historical distribution)

3. The rhinos should be free-ranging.

4. The property must have a low poaching threat or acceptable security measures in place.

   Section 4.1 gives guidelines on securing properties against poaching.

   The property should be acceptable with respect to staff density, staff skills, willingness to cooperate/attitude, apparent management competence, past conservation record, poaching detection and reaction ability, staff conditions and apparent motivation.

   Other considerations are: distance to a national border, security status in South Africa, type and frequency of previous poaching incidents on the property.

4. For properties of less than 10 000 ha, property owners must have or be prepared to put in a fence which at least meets minimum set standards.

5. The park's socio-political circumstances should be acceptable, especially the security of land tenure, and the relationship with neighbours.

6. Veterinary assessment of the threat of Anthrax or Trypanosomiasis should be not be high.

7. Other considerations:
   Current and future land use must be compatible with black rhino conservation.

   Black rhino introduction must not adversely affect another Red Data Book species with a more critical conservation status.

   Difficult terrain for rhino capture should be listed as a negative factor, especially for populations with estimated carrying capacities of less than 20, which will undoubtedly have to be intensively managed (through captures for translocation) in future.

References:

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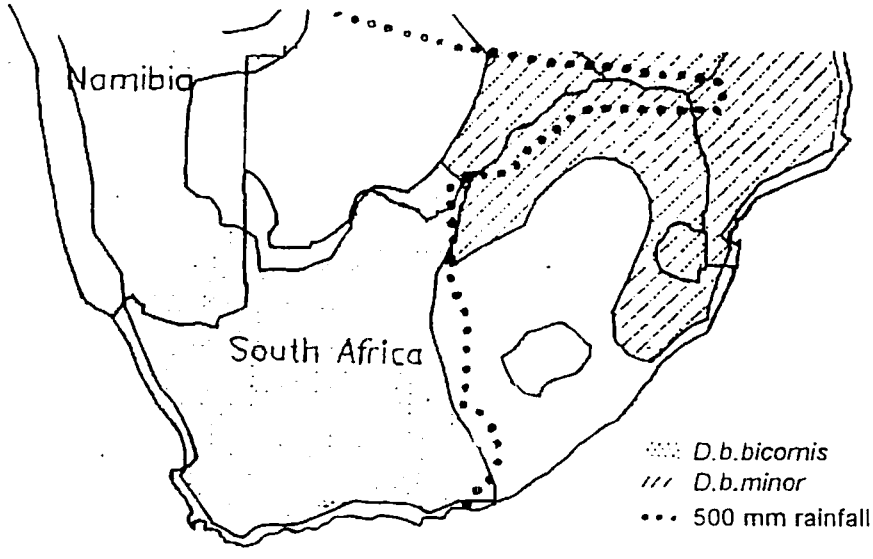

Figure 5.1. Probable historical distribution of black rhino in South Africa.

5.2. GUIDELINES FOR BLACK RHINO INTRODUCTION AND ESTABLISHMENT

PROCEDURES FOR TRANSLOCATION, INTRODUCTION AND ESTABLISHMENT SHOULD BE ADOPTED THAT ENSURE THE SUCCESS AND IMPROVED PERFORMANCE OF NEW BLACK RHINO POPULATIONS.

Rationale:

RMG status reporting has shown that mortality of translocated animals - from capture to three months post-release - was c.9%, while a further 15% of translocated rhino died from various mishaps within two years in their new homes. Female breeding performance in newer populations has also been far poorer than could reasonably have been expected.

Black rhino translocation, introduction and establishment procedures have been honed to a high degree of perfection. However, the processes involved do still pose a risk, and are disruptive and stressful for the animals involved, so that there is a need continually to review and update procedures to reduce mortalities and improve reproductive performance in newly established rhino.

Considerations:

Many deaths in re-established black rhino populations have been through what may be seen as unfortunate accidents, which seem difficult to prevent. However, information from South Africa, Namibia, Kenya and Zimbabwe has highlighted the following factors as worthy of attention for ensuring the successful introduction and establishment of black rhino populations:
(after Brett 1996, Du Toit pers.comm., Morkel pers.comm., Rogers pers.comm. and Adcock 1995).

- Founder density
  Rhino should be put in at densities well below ecological carrying capacity of the area. Mature males must similarly be introduced at numbers below the male carrying capacity. This is to minimise social (fighting) and nutritional stresses in the early establishment phase of the introduction process. Preferably the founder population should be about 35-40% of ECC, not more.

  Because of the founder density effect, experience has shown that the larger the new area and its ECC, the better the introduction goes.

  - The higher the local (absolute) density of rhino at introduction, the greater the risks. If local high rhino densities could result at release, or if the introduction is not a once-off process, rhino release sites should be spread out. Rhino should be released into areas where they can disperse easily.

  - Having more than one or two sources of drinking water near the release area helps to alleviate social stresses after introduction, by helping to minimise contact between the rhino.

- Single versus multiple introductions to establish the founder population
A property should be stocked with its complete founder population of rhino in as short a time as possible. If possible, introduction should be a once-off process. In large areas (ECC >=50 rhino) introductions into different sections of a property can be staggered, especially where natural barriers hinder movement between sections.

- Age and sex of introduced rhino
The younger the rhino, the greater the risk of mortality after release. Even rhino of 5-6 years are susceptible.Young rhino are insecure and stressed due to the lack of companionship and familiar surroundings. They are not as good as mature rhino in their ability to find enough of the right food and avoid hazards in new areas. They often seek out the company of other rhino, which gets them into trouble if these do not know them or accept their presence. Young females are seemingly at additional risk from adult bulls which try to mate with them when they cannot cope with the situation Young bulls can easily get killed by adult rhino unless they have space in which to hide away

    - As in natural populations, male rhino, including adults, are at greater risk of fighting than females. However, Kenyan data shows sub-adult (<7 years old) females to be the age/sex group at most risk during introductions. Fully adult females seem to be the best survivors.

    - Black rhino younger than 4 years old should in general not be captured for translocation.

    - Introduction groups should be made up of animals of similar ages or age classes, for example adults only, or E age sub-adults only. In the latter case rhino of 3-4 may be used. Do not to mix adults and subadults, although cow/calf pairs may need to be moved under certain circumstances (see below)

    - Finding adult females for translocation that are not pregnant or with a calf at heel is difficult, especially if many rhino are to be removed. ***Methods of successfully relocating cow-calf combinations may need to be developed after careful discussion among those vets and capture teams experienced with black rhino.*** Cow/calf combinations are problematic in translocations. In boma'ing, calves not yet weaned cannot easily be kept with the mother for suckling. At release, the mother may not reunite with her calf, or may move long distances, putting the calf at risk of being left behind, or becoming exhausted. Such calves have a high risk of death.

- Boma'ing
Boma'ing the rhino at the release site is important to successful introductions where the new habitat of the rhinos is different in vegetation, climate and disease agents to their original home. The boma'ing should be long enough to ensure that dietary adaptation has taken place, ie that the rhino's gut flora have changed to cope with digesting new species and combinations of browse material. This could take 3-6 weeks.

Monitoring of the rhino's body condition, eating patterns and faeces by an

experienced person is vital during this boma'ing. It will help greatly to have a photograph of each rhino taken soon after capture as a reference for checking that the animals are not losing condition in the bomas.

Boma'd rhino *tend* to be calmer, and move and fight less after release than "free" released rhino. They settle down more easily, and are less likely to run into trouble with natural hazards like cliffs, mud, rivers and elephants. The release process is more controlled.

Another important advantage is that the rhino will take supplementary feed after release if the veld is poor, or if individual rhino are having trouble settling in (eg are not finding enough good food, or are afraid, "lost" and lonely).

- Boma care must be of the highest standard (see references below).

- Free release, that is without boma'ing at capture or release, can be considered under the following conditions:
  - there are no established rhino in the release area
  - the release area is large
  - the veld (browse) is in excellent condition and there is plenty of surface water
  - the rhino come from an area of similar vegetation and climate,
  - the rhino all come from the same area and know each other.

- Horn-tipping

  Horn tipping (at capture, usually) is essential in black rhino translocation, *unless the rhino are going in to a population of rhino with untipped horns*. The horn tipping must be enough to ensure very blunt front and back horns. Removing just a few centimetres is not good enough.

  If there are one or more small rhino in a group, *their* horns should *not* be tipped

- Release

  Before releasing the rhino, they should be calm, in good body condition, and used to local browse and climate.

- Releases in the evening rather than in full daylight, result in more relaxed rhino, which do not move as far, and which usually start eating immediately. Release into thick bush rather than open veld also makes the rhino feel more at ease. Definitely avoid showy releases with noisy spectators, vehicles and flashing photographers.

- Time of year for translocations and release

  It is better to translocate rhino early in the dry season - April, May, June - when rhino are still in good condition, and abundant browse and surface water is still available in their new home.

  Problems with moving rhino too late in the dry season include:
  - they may be in poor condition,
  - browse will be difficult to come by during boma'ing
  - after release the rhino may suffer increased stress due to their already poor body condition, lack of good browse in the veld, and limited availability of surface water

- the animals may be susceptible to cold weather - pneumonia and other health problems.

Capture and translocations in summer are impractical and can be dangerous, due to heat and rain (mud).

- Introducing rhino into an already-established population
  This is risky for the new arrivals, however if there is sufficient space and water around, there may well be no problems. Such introductions should really only be made into areas with suitable habitat not currently occupied by rhino, or where there are very few. Steps that can be taken to reduce risks include boma'ing the new arrivals on the site. Some people recommend spreading the dung of the new rhino around in a wide outside the boma for some time before release, so any resident rhino to get used to their scent, and so that the new rhino encounter familiar smells when they are released.

- Documenting introductions
  Document in as much detail as possible the introduction procedures used, problems encountered, successes, and lessons learned, and copy such information to the RMG. Such information will be shared with other black rhino managers, vets and capture teams, towards improving future introductions.

Procedures:

- A minimum founder group of 8 rhino is recommended.This represents about 37% of the maximum productivity carrying capacity of a property with the minimum recommended ECC of 20 rhino, and allows plenty of room for the population to settle, establish and grow before removals will be needed.

- The services, advice and help of a reputable capture team experienced with black rhino must be obtained. Capture, boma'ing, transport and release procedures are detailed in references given below.

- The considerations given above should be accounted for in any re-introduction programme.

- Monitor the rhinos after release, particularly looking out for breakouts (daily fence patrols are needed - advise neighbours to be on the lookout), and injuries or illness. If an injury is suspected, or if a rhino is losing condition, get the animal properly examined by an experienced rhino vet, and immobilized and treated if necessary. Don't wait until the rhino is in poor condition before acting - by then it may be too late to save it.

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6. CAPTIVE BREEDING

CAPTIVE BREEDING OF BLACK RHINO SHOULD BE SUPPORTED, PROVIDED THIS DOES NOT DETRACT EFFORT, FUNDS OR SUITABLE BREEDING RHINO FROM *IN SITU* CONSERVATION EFFORTS WITH FREE-RANGING RHINO.

Rationale:

The RMG sees the role of captive breeding as follows:

- in the worst-case scenario of economic or political collapse within South Africa resulting in the loss of all wild rhinos, captive genetically-diverse populations based outside Africa can be used to re-establish *in situ* populations should conditions return to normal;

- if rhino husbandry develops to a level where captive population growth rates exceed those in the wild, surplus rhino can be produced for the ongoing undertaking of establishing black rhino in new reserves (such captive breeding could take place in Africa or overseas).

Considerations:

From Foose (1996):

The captive breeding community does not, and has no plans to, handle *D.b.bicornis* (south-western black rhino).

As of March 1995, the world captive population of *D.b.minor* was 47, which is more than double the 20 minimum reproductive founders required (The African Rhino Workshop, Cincinnati, October 1986). Australian captive breeding efforts however still apparently require 6 more founders of this ecotype.

From 1981 to 1995, the captive breeding efforts have produced a zero growth rate for the ecotype, as opposed to the 5.8% being achieved in South Africa by free-ranging populations from March 1989 to March 1995. However, the captive breeding community is moving towards using larger and more natural conditions for rhino under their management, and their rates of success may improve.

The costs of proper *in situ* conservation are far less than for captive breeding. However, the captive breeding community is increasingly supporting *in situ* conservation programmes with funds and equipment.

The concerns about the ability of captive-bred rhino to survive in the wild, especially when added to existing wild populations, need to be addressed.

The world captive population of *D.b.michaeli* was 176 rhino as of March 1995.

Procedures:

- To receive rhino from South Africa, the credentials and track record of the captive breeding institute should be entirely satisfactory. It should either have a proven record of positive growth of rhino populations, or be able to prove their programme is likely to achieve this.

- The following categories of black rhino can be made available to captive breeding:

    - An animal unsuitable for release into the wild, e.g. young orphans, or subadults and adults handicapped through injury.

    - Male black rhino surplus to the breeding and genetic needs of its own and other wild populations (see Section 4.3).

  It is recommended that suitable financial or material benefit from the transfer should accrue to the donor organisation for use in its *in situ* black rhino conservation programmes. This should especially be the case if rhino not fitting into the above categories are made available (i.e. heathy subadult or adult rhino, especially females).

References

Foose T (1996). Report for the African Rhino Specialist Group meeting, Itala Game Reserve, February 1996.

7. REGIONAL STATUS REPORTING

MANAGING AUTHORITIES IN SOUTH AFRICA SHOULD SUBMIT ANNUAL STATUS REPORTS TO THE RMG ON EACH BLACK RHINO POPULATION. A SUMMARY AND INTERPRETATION OF STATUS INFORMATION SHOULD BE PRODUCED BY THE RMG FOR FEEDBACK TO BLACK RHINO CONSERVATION AGENCIES.

Rationale:

Status report summaries allow the assessment of progress on the conservation goals for each ecotype. Population characteristics are compared between populations using standardised performance indicators. This facilitates and encourages improved decision making towards achieving the goals, through the identification of successful and problematic management and conservation strategies, and the interchange of biological information and management expertise.

Black rhino status reporting (including similar reporting going on in Kenya and Zimbabwe) has set, and largely achieved, high standards for population monitoring and record keeping. It is providing a detailed source of management and biological information on around 95% of the planets' black rhino, a situation probably unparalleled for any other free ranging wild animal species.

Procedures:

1 For each black rhino population in South Africa, the relevant authorities should complete an annual status report to the RMG according to the format given in Appendix 3.

2. The chairman of the RMG should maintain files of all submitted status reports.

3. The chairman of the RMG should contract a suitable person to compile a summary of status report information annually. This summary should be copied to all authorities involved with black rhino conservation.

4. The authorities managing each population should evaluate the summary information and recommendations provided by the RMG, especially their relevance to their own population and conservation efforts.

5 Managing authorities should feed back the (non-confidential) regional summary information to all staff involved with black rhino monitoring and management. This is very important, helping to keep staff informed and motivated, and aware of how their rhino populations are performing relative to others.

APPENDIX 1 : ACHIEVEMENTS OF THE RHINO MANAGEMENT GROUP

The Rhino Management Group (RMG) has contributed to black rhino conservation throughout South Africa and elsewhere in Africa, through training and strategy-building workshops, the exchange of information and the provision of advice. A key role of the RMG is to assess the progress being made towards achieving the conservation goals for black rhino in the region, and to evaluate the effectiveness of management programmes designed for this purpose.

RMG meetings:

The RMG meets at least annually to bring the membership up to date with international and national developments and trends, to review progress towards the black rhino conservation goals, to develop appropriate strategies, and to exchange ideas and information. This interaction is necessary to effect cooperative approaches towards metapopulation management.

Annual black rhino status reports:

Annual reports on the status and management of each individual black rhino population are submitted by the conservation authorities and private owners. These reports are analysed and synthesised by the RMG to provide a regional overview of trends and performance: the four summary reports produced up to 1996 have contributed significantly to our understanding of rhino conservation management. The Kenyan rhino programme is keen to adopt a similar approach to their data collection to ensure compatibility.

Data analysis:

The development of tailor-made software (RHINO) jointly by Ecoscot Consultancy and the Statistical Analysis Sub-Group of the RMG. This software has found users in Kenya, Namibia, Zimbabwe and the USA. It appears that it could also be used to successfully estimate population sizes of the threatened Javan and Indian rhinos.

Black Rhino Monitoring Workshop: 24-25 April 1990, Douglas Mitchell Centre, Pietermaritzburg:

The workshop examined the available monitoring techniques and recommended improvements to existing programmes. As a result, many monitoring programmes were reevaluated and upgraded to provide the quality information required for effective management.

Game Scout Training Workshop : 12-14 August 1991, Kruger National Park:

The proposed training curriculum was adopted for implementation, and the need for more advanced training was identified. Additional training courses were subsequently held.

Security Committee:

The Security Committee meets regularly to discuss all aspects relating to rhino security, to ensure maximum cooperation between the conservation and law enforcement agencies, and to formulate appropriate strategies and programmes. During 1996 it was decided, in view of the committee's involvement in elephant and white rhinos, to sever the formal link with the RMG. The Committee was reconstituted as the Rhino and Elephant Security Group.

Remote sensing:

The possible individual identification of rhinos using an implanted transponder, which is remotely sensed at 100-200 metres using either laser or microwave technology, is being actively pursued. The use of other implantable transponders for other purposes is also being examined.

Assessment of area suitability:

The RMG has assisted private landowners, the Natal Parks Board and other provincial conservation agencies with property assessments.

Rhino Boma Workshop, Skukuza, Kruger National Park - 25 February 1991:

This workshop addressed the issues of boma design and construction, and the management of black rhino in temporary captivity.

Post-release monitoring:

Recipients of black rhinos have been encouraged to study post-release movements and behaviour.

Private Ownership Workshop : 13-15 November 1990, Lapalala:

The various "ownership" models available were evaluated in response to concerns about the auctioning of black rhino expressed by some of the private owners and conservation authorities. A draft Contract of sale was drawn up to demonstrate the type of controls that could be implemented.

Black Rhino Property Assessment Workshop, Pilanesberg N.P. 3rd-5th August 1993:

Recommendations were drafted on criteria for the selection and evaluation of properties for the potential introduction of black rhino.

Interbreeding subspecies:

Cases in captivity and in the wild, where it appeared that interbreeding between different subspecies might take place, were discussed. In each case, appropriate action was taken by the relevant conservation agency to avoid such an occurrence.

Requests for information or assistance:

The RMG has been requested to evaluate both research and management project proposals for funding agencies, and to comment on captive breeding programmes and dehorning as a conservation measure.

Conservation Plan:

The original Black Rhino Plan for South Africa and Namibia (1989), and the RMG, were referred to as ideal models by several African delegates from several African countries at the International Symposium on Rhinoceros Biology and Conservation held in San Diego (May 1991), and have since been used by a number of range States in formulating national plans.RMG members have contributed directly to the formulation of plans for Tanzania, Kenya, Cameroon and Zimbabwe.

APPENDIX 2: CITES RESOLUTION

RESOLUTION OF THE CONFERENCE OF THE PARTIES Conf. 9.14:
Conservation of Rhinoceros in Asia and Africa

deeply concerned that many rhinoceros populations have continued to decline drastically and that four of the five species are threatened with extinction;

recalling that the Conference of the Parties included all species of rhinoceros in Appendix 1 of the Convention in 1977 and adopted Resolution Conf. 3.11 on the Trade in Rhinoceros Horn (New Delhi 1981) and Resolution Conf. 6.10 on the Trade in Rhinoceros Products (Ottawa 1987);

recalling further that, at its eighth meeting (Kyoto 1992), the Conference of the Parties directed the Standing Committee to address rhinoceros conservation problems;

noting the detailed consideration given to rhinoceros conservation at the 28th (Lausanne 1992), 29th (Washington D.C. 1993), 30th (Brussels 1993) and the 31st (Geneva 1994) meetings of the Standing Committee, and the recent actions of the committee;

noting also the recommendations of the Animal Committee (Harare 1992, Brussels 1993);

recalling the resolutions and recommendations of the United Nations Environment Programme Conference between the Rhinoceros Range States, Consumer States and Donors on Financing the Conservation of the Rhinoceros (Nairobi 1993);

commending the efforts made by range States to protect their rhinoceros populations against illegal hunting, often under very difficult circumstances;

commending further the recent measures taken by countries to control and reduce use of rhino horn, especially countries where use is part of a cultural tradition extending back many centuries;

concluding that all the above measures have not arrested the decline of rhinoceros populations;

recognising that the illegal trade in rhinoceros horn is now known to be a global law enforcement problem, extending beyond the range States and traditional consuming countries;

aware that, given the social, economic and cultural realities in many producer and consumer States, emphasis solely on law enforcement has failed to remove the threat to rhinoceroses;

conscious that stocks of rhinoceros horn continue to accumulate in some countries and that the call for their destruction, as recommended by Resolution Conf. 6.10, has not been implemented and is no longer considered appropriate by a number of Parties

concerned that destruction of stocks of rhinoceros horn could in all probability increase the risks to remaining rhinoceros populations;

recognising that recent international measures had a number of unintended consequences, including driving the trade further underground and have coincided with a rise in price in some consumer countries;

recognising further that there is a diversity of opinion as to the most effective approaches to the conservation of rhinoceroses in Asia and Africa;

concerned that the direct threat to rhinoceros populations are not being reduced, and that the

cost of ensuring adequate security for them is increasing and can not easily be met by a many range States under the present conditions;
THE CONFERENCE OF THE PARTIES TO THE CONVENTION
URGES

a) those Parties that have legal stocks of rhinoceros horn to identify, mark, register and secure all stockpiles;

b) all Parties to Implement adequate legislation, including Internal trade restrictions, aimed at reducing illegal trade in rhinoceros horn;

c) range States be vigilant in their law enforcement efforts and to place increased emphasis on the prevention of illegal hunting and on early detection of potential offenders;

d) that the law enforcement co-operation between States be increased in order to curtail trafficking in rhinoceros horn; and

e) the consumer States to work with traditional-medicine communities and industries to develop strategies for eliminating the use and consumption of rhinoceros parts and derivatives;

DIRECTS the Standing Committee to continue to pursue actions aimed at reducing illegal trade, ensuring that:

a) such activities are accompanied by evaluations of their effectiveness;

b) standard indicators of success are developed to measure change in levels of illegal hunting and of the status of rhinoceros populations in range States; and

c) the policies guiding Interventions are responsive to the outcome of evaluations and are modified accordingly

RECOMMENDS that each range State develop for its rhinoceros population a recovery plan that, *inter alia*:

a) is appropriate for the situation in its country;

b) will not adversely affect rhinoceros conservation in other range States;

c) Includes provision for the reinvestment of revenues derived from use of rhinoceros that is consistent with the Convention, in order to offset the high costs of their conservation; and

d) aims toward a long-term goal of sustaining, on a basis of self-sufficiency, their rhinoceros conservation efforts;

URGES

a) potential donors to assist with the funding efforts of range States to implement rhinoceros recovery plans; and

b) the Global Environment Facility to fund the protection of rhinoceros populations within the context of broadly based projects for the conservation of biological diversity;

CALLS for constructive engagement amongst all Parties to the Convention to achieve the aims of this Resolution; and

REPEALS the Resolutions listed hereunder:

a) Resolution Conf. 3.11 (New Delhi 1981) - Trade in Rhinoceros Horn, and

b) Resolution Conf. 6.10 (Ottawa 1987) - Trade in Rhinoceros Products.

APPENDIX 3: ANNUAL BLACK RHINO STATUS REPORT FORMAT

SECTION 1] REPORT UPDATES

- INFORMATION OUTSTANDING OR CORRECTED FROM PREVIOUS REPORTS

SECTION 2] 1994/95 POPULATION SIZE

- POPULATION ESTIMATE(S):

Known Populations:	<---------- Incompletely known populations: ---------->					
Reserve / Area name	ACTUAL Popn	Official Estimate	Minimum CP I/ CI	Maximum CPI / CI	Minimum	Maximum

DISCUSSION:

- ESTIMATION METHODS

INTENSIVE SURVEYS

SECTION 3] AGE AN SEX STRUCTURE

- DISCUSSION

SECTION 4] POPULATION PERFORMANCE

- BLACK RHINO MORTALITIES
- FEMALE REPRODUCTIVE PERFORMANCE
- POPULATION GROWTH RATE
- OVERALL POPULATION PERFORMANCE AND TRENDS

SECTION 5] TRANSLOCATION

SECTION 6] RE-ESTABLISHMENTS

SECTION 6] RE-ESTABLISHMENTS

SECTION 8] BEHAVIOUR/SOCIAL OBSERVATIONS

SECTION 9] SECURITY

- RHINO & ELEPHANT LAW ENFORCEMENT
- OTHER COMMENTS

SECTION 10] NEIGHBOURS PROGRAMME

- PROGRESS MADE IN 1994/95
- PROBLEMS ENCOUNTERED
- SUGGESTED NEW APPROACHES

SECTION 11] RESEARCH

SECTION 12] BLACK RHINO REPORTS/PUBLICATIONS

SECTION 13] GENERAL TOPICS

- TOPICS/PROBLEMS YOU FEEL COULD BENEFIT FROM FURTHER DISCUSSION
- COMMENTS ON RMG AND RMG STATUS REPORTING

SECTION 14] RAINFALL

SECTION 15] REFERENCES

Fill in this table for each area/section of the park if relevant, and/or for different data sets, E.G. All clean sightings, all sighting from accredited observers, all complete sightings etc.
Fill in just the number of sightings in each age/sex class (no need to calculate %s)

RESERVE:

RMG Sex and age structure of population Estimated from sighting data						
Area name:						
Description of data set:						
Dates covered:						
AGE CLASS	SEX					
A	male					
A	female					
A	?					
A	total					
B	male					
B	female					
B	?					
B	total					
C	male					
C	female					
C	?					
C	total					
D	male					
D	female					
D	?					
D	total					
E	male					
E	female					
E	?					
E	total					
F	male					
F	female					
F	?					
F	total					
	TOTAL					

RMG HISTORY TABLE OF POPULATION ESTIMATION DATA (for populations that are not completely known)

RESERVE:									
AREA NAME:									
	Note #s of each feature at the end of each status period.								
POPULATION FEATURE	89/90	90/91	91/92	92/93	93/94	94/95			
KNOWN ID rhino									
Tot.# independent ID rhino actually seen									
Tot # of calves of ID animals actually seen									
Calves born during year to ID animals									
Calves leaving ID rhino during year									
# of ID independent sightings (INCL. trap happy rhino)									
# of ID independent sightings (EXCL. trap happy rhino)									
Final estimated # of ID rhino + their calves									
CLEAN RHINO									
Best estimate of % clean+ calves in population									
# of accredited clean sightings									
# of clean sighting: all observers									
% clean estimated from intensive surveys									
MORTALITIES									
Known ID rhino									
Clean rhino									
(uncertain -ears scavanged)									
REMOVALS									
Known ID rhino									
Clean rhino									
(uncertain - ears scavanged)									

RMG FEMALE BREEDING PERFORMANCE TABLE

RESERVE:

RHINO														
1stKNOWN														
1stADULT														
Birthday														
Cl-bday														
DateFC														
AgeFC														
Cl-FC														
Births														
Calf-a														
Cl-a														
Calf-b														
Cl-b														
Calf-c														
Cl-c														
Calf-d														
Cl-d														
Calf-e														
Cl-e														
Calf-f														
Cl-f														
Calf-g														
Cl-g														
Calf-h														
Cl-h														
Calf-i														
Cl-i														
Calf-j														
Cl-j														

Cl = Confidence about the date

? = No idea
0 = likely out by more then a year
1 = correct to within 1 year
2 = correct to within 6 months
3 = correct to within ? months

1stKNOWN — Date female was first known/introduced
1stADULT — Date female reached F class
Birthday — Date of birth of female
Cl-bday — Confidence around her birthdate
DateFC — Date the female first calved
AgeFC — Age of the female at first calving

NB. IF A FEMALE HAS NOT BEEN SEEN FOR >2 YE
OR IF YOU SUSPECT YOU MISSED A CALF,
ENTER THE NEXT CALF AFTER LEAVING ONE CA
SPACE EMPTY

RMG SECURITY TABLE

RESERVE:		
AREA NAME		
EVENT	Number	Comments
POACHING:		
Black Rhino		
White Rhino		
Elephant		
Other Large Mammals		
SNARING:		
No. of SNARES		
Black Rhino		
White Rhino		
Elephant		
Other Large Mammals		
Encounters		
Arrests		
Convictions		

RMG WHITE RHINO MORTALITY TABLE

DATE	AGE	SEX	CAUSE of Death	Time Since Death	How Found?

RMG MONTHLY RAINFALL TABLE

AREA/STATION	PERIOD	January	February	March	April	May	June	July	August	Sept.	October	Novemb.	Decemb.	TOTAL

LONG TERM MEAN RAINFALL DATA

AREA/STATION	PERIOD	January	February	March	April	May	June	July	August	Sept.	October	Novemb.	Decemb.	TOTAL

RMG MONTHLY RAINFALL TABLE

AREA/STATION	PERIOD	January	February	March	April	May	June	July	August	Sept.	October	Novemb.	Decemb.	TOTAL

LONG TERM MEAN RAINFALL DATA

AREA/STATION	PERIOD	January	February	March	April	May	June	July	August	Sept.	October	Novemb.	Decemb.	TOTAL