CONSERVATION PLAN FOR THE BLACK RHINOCEROS *Diceros bicornis* IN SOUTH AFRICA, THE TBVC STATES AND SWA / NAMIBIA

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A policy statement and working document for conservation agencies managing black rhinoceros populations

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E X E C U T I V E S U M M A R Y

The Conservation Plan for the Black Rhinoceros presents specific aims and management guidelines for the conservation of the African black rhinoceros Diceros bicornis in South Africa, the TBVC States and SWA/Namibia. The adoption of this plan and the application of the strategies described therein by the relevant conservation authorities should enhance the survival prospects of the species, both in the region and globally.

1. The Plan must be adopted, and its recommendations applied as a matter of urgency, because:

   a) the black rhinoceros is vulnerable to extinction (IUCN) and numbers have declined dramatically throughout most of its range in Africa :

      - numbers in Africa have decreased from an estimated 65 000 in 1970 to about 3 500 in 1989:

      - 12 African countries have either lost, or are about to lose their remaining black rhinos; and only 6 countries have populations exceeding 100.

   b) the populations in the region have acquired international significance:

      - the estimated 1 051 black rhinos represent 30% of the world population:

      - 3 of the 4 surviving subspecies, namely D.b. minor, (RSA to southern Tanzania), D.b. bicornis (SWA/Namibia and RSA) and D.b. michaeli (E. Africa), are conserved within the region :

      - Only in this region have numbers increased, in fact the region's population of D.b. minor has increased four-fold since 1930 :

      - D.b. bicornis is endemic, not being found anywhere else in the world.

   c) organised international poaching is moving southwards :

      - Zimbabwe is currently waging war against poachers in the Zambezi Valley :

      - isolated incidents of poaching and rhino horn theft have already occurred in the region.

2. The conservation aims for black rhino in the region are :

   a) to develop, as rapidly as possible, and conserve in the long term a genetically-viable population of at least 2 000 black rhinos of the southern-central ecotype Diceros bicornis minor in their natural habitat in the region:

b) to develop, as rapidly as possible, and conserve in the long term a genetically-viable population of at least 2 000 black rhinos of the south-western ecotype D.b. bicornis in their natural habitat in the region:

c) to develop, as rapidly as possible, and conserve a population of at least 100 of the northern-eastern ecotype of black rhino D.b. michaeli in the wild in the region:

d) to support captive breeding programmes for all 3 subspecies, both within and outside South Africa and the African continent, providing they can play a significant and sustained role in maintaining or improving the conservation status of the species.

3. These aims may be achieved through the implementation of co-ordinated management programmes involving :

a) the management of existing populations :

- anti-poaching strategies and legislation :

- maintaining genetic diversity :

- managing for maximum sustained yield :

- habitat manipulation :

- monitoring black rhino populations :

b) the establishment of new populations :

- establishing potential population sizes in current and new reserves :

- assessing and rating reserves for suitability :

c) the support of captive breeding programmes.

4. These conservation management programmes will be co-ordinated by the Rhino Management Group which will :

a) comprise representatives of the organisations actively managing black rhino populations, as well as selected rhino experts :

b) evaluate current management programmes and recommend improvements :

c) develop and co-ordinate appropriate research programmes.

5. Participation in the black rhino conservation programme by a conservation body will be conditional upon its :

a) adoption of the Conservation Plan :

b) observance of any CITES regulations on trade in rhino products that are adopted by the Party States in the region.

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I. INTRODUCTION

The black rhinoceros Diceros bicornis is restricted to the African continent where it was widely distributed in the sub-Saharan region. Although early records lack detail, it is clear that the black rhino has suffered a very severe decline in numbers and in the extent of its range since the turn of the century. It is currently listed as 'vulnerable' both globally and in South Africa (IUCN and SA Red Data Books).

The recent trend has been dramatic, with numbers dropping 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 and about 3 500 in 1989. This represents a decline of over 90% in the last 19 years. In 1970 Selous National Park in Tanzania held more black rhinos than currently survive on the whole of the continent today. In recent years the black rhino has either disappeared from, or is on the verge of extinction in, 12 African countries (Cumming 1987). It is now only found in reasonable numbers (i.e. more than 100) in Zimbabwe, South Africa, SWA/Namibia, Tanzania, Kenya and Zambia.

Poaching for horn is very largely responsible for this massive decline; and the southern sub-continent, where more than two thirds of the remaining black rhinos are conserved, is coming under increasing pressure with the first substantial poaching of rhinos taking place in the Zambezi Valley, Zimbabwe, in 1985.

The black rhinoceros was formerly widespread throughout most of South Africa, but by the 1930's it had been reduced to two relict populations comprising 100 to 150 rhinos of the southern-central subspecies (Diceros bicornis minor) in Hluhluwe-Umfolozi and Mkuzi Game Reserves in Zululand. Numbers increased under protection, so that by 1962 the Natal Parks Board was able to translocate animals to form new populations in reserves within their former range. By September 1989, a total of 165 black rhinos had been moved to other reserves within Natal, as well as to re-establish the subspecies in Pilanesberg and Kruger National Parks (Hitchins 1984) and the Andries Vosloo Kudu Reserve in the Cape. A further 7 have been supplied for captive breeding programmes in the USA. The re-establishment history of D.b. minor in the region is presented in detail in Appendix 1.

In SWA/Namibia a significant population of the arid zone D.b. bicornis survived in the Etosha National Park and relict populations elsewhere in Kaokoland/Damaraland. In 1985, the Directorate of Nature Conservation in SWA/Namibia agreed to relocate 12 rhinos from Etosha to 2 reserves in the arid northwestern Cape region, namely the Augrabies Falls and Vaalbos National Park (Hall-Martin 1985).

There are currently about 1 050 black rhinos in the wild in South Africa, the TBVC States and SWA/Namibia (hereafter termed the "the region"). These comprise about 612 D.b. minor distributed between 9 reserves, 419 D.b. bicornis occurring in 5 areas, and a small but expanding population of 20 D.b. michaeli in Addo Elephant National Park (see Table 1 for details).

In international terms, these populations are becoming increasingly important, not only because they represent 30% of the surviving world population, but also because they are the only ones to have expanded both in numbers and distribution in recent years.

Table 1 Current (1989) population sizes of black rhino in the region.

(Key: 1 - 6 denotes the controlling bodies, see text below)

Species	Location	Population size
D.b. minor	[1] Hluhluwe-Umfolozi GR	220
	[2] Kruger National Park	160
	[1] Mkuzi GR	70
	[4] Ndumu GR	42
	[1] Itala GR	45
	[6] Pilanesberg GR	42
	[1] Eastern Shores NR	19
	[1] Weenen NR	9
	[5] Andries Vosloo Kudu Reserve	4
	(Private land - E. Transvaal	1)
	Total:	612
D.b. bicornis	[3] Etosha NP	300
	[3] Kaokoland/Damaraland	80
	[3] Waterberg Plateau Park	25
	[2] Augrabies Falls NP	6
	[2] Vaalbos NP	8
	Total:	419
D.b. michaeli	[2] Addo Elephant NP	20
	Total:	20

In recent years it was generally accepted that the surviving rhinos in Africa represented 4 subspecies, namely Diceros bicornis minor (southern Africa), D.b. bicornis (SWA/Namibia), D.b. michaeli (East Africa) and D.b. longipes (West Africa). This has recently been challenged and a taxonomic review is underway. However, it was agreed at the African Rhino Workshop (Cincinnati, October 1986) that, for practical management purposes, 4 basic ecological groupings should be recognised. These were the south-western (SWA/Namibia), southern-central (South Africa through Zimbabwe and Zambia to southern Tanzania), northern-eastern (Kenya and northern Tanzania) and northern-western (Cameroun, Central African Republic) groups, which accord closely with the subspecies breakdown given above. The workshop recommended that both in situ and captive management programmes should attempt to maintain the integrity of these ecotypes, i.e. they should not be allowed to interbreed, unless future genetic and other studies indicate that this separation is unjustified.

At its meeting in Zimbabwe in September 1985, the African Rhino and Elephant Specialist Group (AERSG) of the IUCN agreed that all countries should draft National Conservation Plans for the black rhino. These would identify the key concerns requiring action, afford the countries concerned the opportunity critically to evaluate them and provide guidelines for future management action. The southern African representative for the AERSG, Dr P.M. Brooks, was therefore tasked with developing the Plan. This was undertaken with the

assistance of other southern African members of AERSG, namely Dr J.L. Anderson (Kangwane), Dr A.J. Hall-Martin (National Parks Board) and Mr P.M. Hitchins (Kangwane), and other conservationists, in particular, Mr R.F. Collinson (Bophutatswana), Mr P.S. Goodman (Natal Parks Board), the Hon. Richard Emslie (consultant ecologist) and Dr E. Joubert (SWA/Namibia).

The "Conservation Plan for the black rhinoceros in South Africa, the TBVC States and SWA/Namibia" provides detailed information on the current rhino populations and their management history, and presents clear conservation aims for each of the 3 subspecies represented. The adoption of common policy and management guidelines by the relevant conservation authorities, in conjunction with the specialist advice and co-ordination provided by the Rhino Management Group (RMG), should enhance the survival and growth prospects of these populations in the region. This is considered necessary, as the current rhino populations are controlled by no fewer than 6 conservation bodies: the Natal Parks Board[1], the National Parks Board of Trustees[2], the Department of Agriculture and Nature Conservation of SWA/Namibia[3], the KwaZulu Bureau of Natural Resources[4], the Cape Department of Nature and Environmental Conservation[5] and Bophutatswana National Parks[6].

Participation in the black rhino conservation programme (such as eligibility to receive surplus animals) by any conservation body would depend on their adoption of the Conservation Plan and observance of any CITES regulations pertaining to the trade in rhino products that are adopted by the Party States in the region.

While the Plan is restricted to South Africa, the TBVC States and SWA/Namibia, it is hoped that this co-operative approach will extend to the whole of the southern African region, including Botswana, Malawi, Mocambique, Swaziland and Zimbabwe. The adoption of National Plans by these countries would form the basis for discussions on closer liaison regarding black rhino conservation.

The Plan has been accepted by the following 19 conservation authorities and NGOs.

Participating:

- Bophuthatswana National Parks
- Cape Chief Directorate of Nature and Environmental Conservation
- KwaZulu Bureau of Natural Resources
- Natal Parks Board
- National Parks Board
- SWA/Namibia Department of Agriculture and Nature Conservation

Supporting authorities:

- Ciskei Department of Agriculture and Forestry
- Department of Development Aid
- Department of Environment Affairs
- Kangwane Parks Corporation
- KwaNdebele Department of Agriculture and Environmental Affairs
- Lebowa Department of Agriculture and Environmental Conservation
- Orange Free State Directorate of Nature and Environmental Conservation
- South African Defence Force
- Transvaal Division of Nature Conservation

Supporting NGOs:

- Endangered Wildlife Trust
- Rhino and Elephant Foundation
- South African Nature Foundation
- Wildlife Society of South Africa

II. AIMS

It is important that the conservation management programme for black rhinos in the region has clear aims which are accepted by all the relevant conservation bodies, and that it is undertaken co-operatively.

Internationally, it has been agreed that the medium-term aim is the maintenance of a large population of at least 2 000 rhinos of each of the four recognised ecological types, this being required to ensure long-term genetic viability. Smaller populations will lose genetic diversity in time, although this loss will be minimised if population growth is rapid.

Most of the rhinos in South Africa belong to the southern-central ecotype, currently recognised as D.b. minor, which also occurs in Zimbabwe, Zambia, Malawi, Mozambique and southern Tanzania. Together they number just over 2 000 animals, of which about 612 occur in our region (see Table 1). However, there are two reasons why, while co-operating at all levels possible with our northern neighbours, we should take steps to ensure that a viable population is maintained within South Africa itself, and not depend on the populations to the north for long-term viability. The reasons are, firstly, that the Zambian and Tanzanian rhinos have already been depressed to critically low numbers and the large Zimbabwean population (ca. 1 600) has recently been experiencing heavy poaching pressure; and secondly, that political differences may prevent any interchange of animals across the Limpopo.

The south-western ecotype D.b. bicornis only occurs in SWA/Namibia and the south-western Cape, so clearly the responsibility for maintaining a viable population rests solely with the conservation bodies in these areas. The "Conservation programme for rhinoceroses in SWA/Namibia", which was designed in December 1988, accords this ecotype the highest priority status.

Conservation aims for black rhino in the region

The primary aims are:

To develop, as rapidly as possible, and conserve in the long term a genetically-viable population of at least 2 000 black rhinos of the southern-central ecotype Diceros bicornis minor in their natural habitat in the region.

To develop, as rapidly as possible, and conserve in the long term a population of at least 2 000 black rhinos of the south-western ecotype D.b. bicornis in their natural habitat in the region.

To develop, as rapidly as possible, and conserve a population of at least 100 of the northern-eastern ecotype of black rhino D.b. michaeli in the wild in the region.

To support captive breeding programmes for all 3 subspecies, both within and outside South Africa and the African continent, providing they can play a significant and sustained role in maintaining or improving the conservation status of the species.

III. ROLE OF THE RHINO MANAGEMENT GROUP

Subject to the autonomy of each conservation authority, the conservation management programme and other related programmes described in this Plan will be co-ordinated by the Rhino Management Group. The group, which will comprise one representative from each organisation actively involved in black rhino conservation management (currently the 6 bodies with black rhino populations specified in the Introduction) and selected rhino specialists, will act in an advisory capacity for the various Nature Conservation authorities by:

1. Updating the National Plan as new strategies and procedures are developed.

2. Evaluating the effectiveness of management programmes being applied and providing advice for their improvement.

3. Assessing the relative importance of potential new areas for black rhino establishment.

4. Recommending rhino offtakes and relocation areas in accordance with policy laid down in the Plan.

5. Developing and co-ordinating an integrated research programme to meet the conservation needs of the species.

Each conservation body will be required to provide an annual report on the black rhino populations under its control to the RMG. This should be submitted by 1 March for the preceding calendar year, and will include information on the latest population estimates (including details of methods and dates), population structures, the marking of rhino, personal history records, births, re-establishment exercises, mortalities, poaching and any cases of the illegal trade in rhino products.

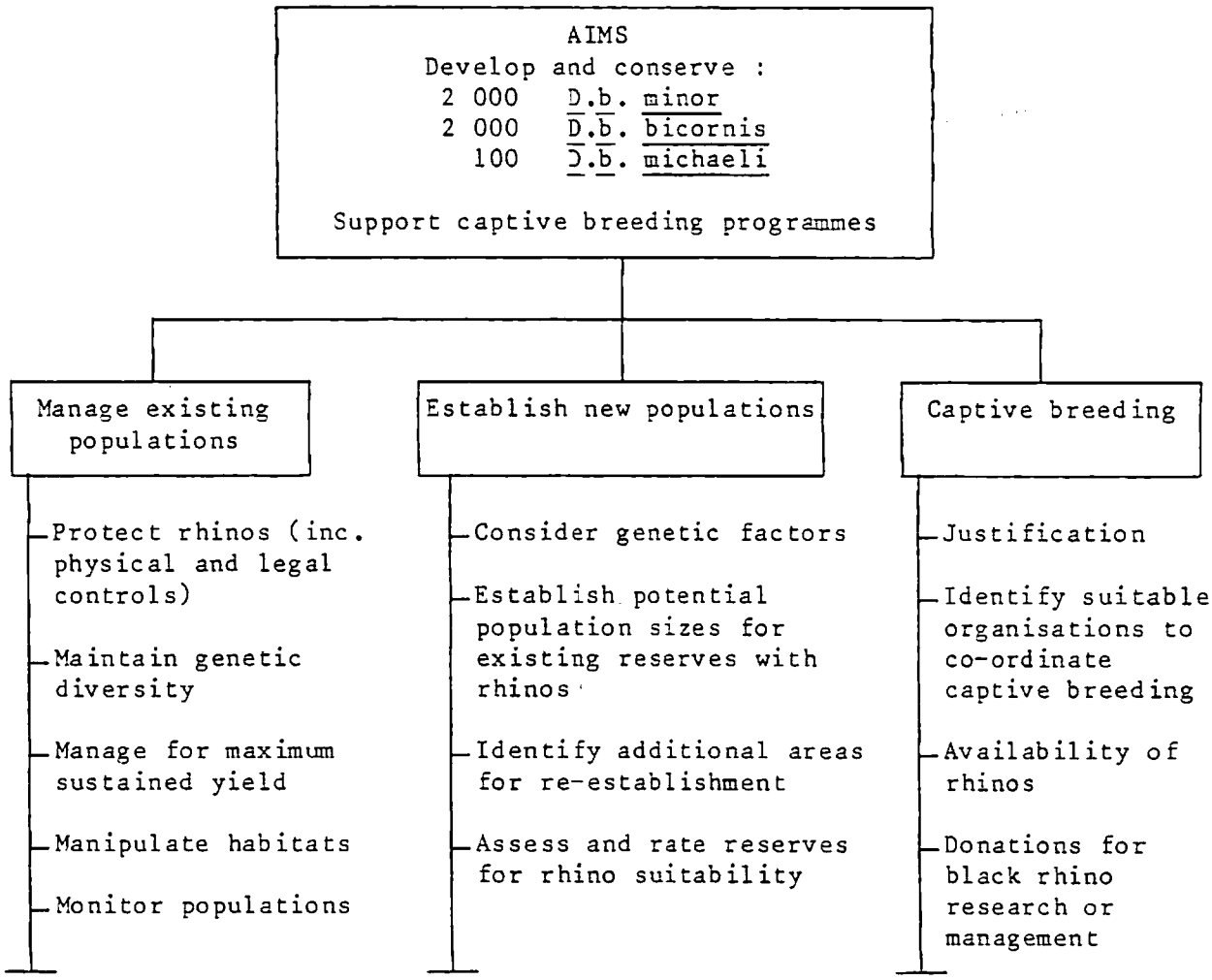
The group will meet at least once each year to discuss these annual reports and other priority issues, and recommendations will be forwarded to the relevant conservation bodies for their consideration.

IV. CONSERVATION MANAGEMENT PROGRAMME

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

The actions most essential for achieving these conservation aims are the management of existing populations, the re-establishment of new populations and the support of captive breeding programmes. The rhinos need to be protected, their habitats conserved and the species managed to maximise the rate of population increase and to maintain genetic diversity.

These, and other related actions and needs, are summarised below and are elaborated on later in this chapter.



1. Management of existing populations

The survival of black rhinos in their natural habitats is the key aim of both this "Conservation Plan" and the "Continental Strategy for the conservation of black rhino" (AERSG draft, July 1986).

The black rhino populations and their habitats need to be managed to protect the current resources, to maximise recruitment and survival so as to provide animals for re-establishment elsewhere, and to maintain genetic diversity. At the very least, recruitment into the adult population from breeding must balance the animals lost.

Protection of rhino populations

The major threat to the rhino populations in the region, as elsewhere in Africa, is illegal hunting for the horn. Their survival therefore depends largely on the ability of the relevant conservation bodies to control poaching through direct law enforcement supported by intelligence work and adequate legislation, and through national and international trade bans and propaganda campaigns.

Legal status

The legal status of the black rhinoceros and the penalties for illegally killing rhino, or trading in rhino products, varies throughout the region. The species is classified as Protected Game in the Transvaal, Specially Protected Game in Natal, Bophuthatswana, SWA/Namibia, and KwaZulu, and as an Endangered Species in the Cape. The penalties for a first offence vary from maxima of R200 or 200 days imprisonment (KwaZulu) to R100 000 or 10 years (Bophutatswana). Apart from Bophutatswana, the next highest penalties are found in Natal (R2 000 or 2 years) and in the Transvaal (R3 000 or 1 year).

There is a clear need to standardise the legal status, and in particular to increase the penalties for illegal activities throughout most of the region. This is supported by the recommendation from the CITES meeting held in Canada, July 1987, namely that..."an increase in penalties for individuals/companies convicted of relevant (rhino) offences...." is one of the measures necessary to halt the catastrophic decline in numbers throughout Africa.

In early 1988, the Natal Parks Board motivated for such an increase, to bring legislation in line with that operating currently in Zimbabwe (min. Z$15 000 or 5 years) and Bophutatswana (max. R100 000 or 10 years), and the National Parks Board also took similar action. These and other initiatives were co-ordinated at the Rhino Conservation Workshop (Skukuza, September 1988), which resulted in a proposal representing the views of all the Nature Conservation authorities in South Africa being drawn up by the Department of Environment Affairs and being submitted to the Department of Justice for consideration. The proposal allows for a maximum penalty of R100 000 or 25 years imprisonment. If accepted, the Nature Conservation authorities will have to amend their ordinances accordingly. In the case of SWA/Namibia, increased penalties of R100 000 or 10 years imprisonment have been proposed.

Control of Trade

While South Africa is the only signatory to the Convention on the International Trade in Endangered Species of wild fauna and flora (CITES), the TBVC States and SWA/Namibia also abide by the CITES regulations. The black rhino is listed under Appendix 1 of the agreement, which effectively means that any trade in rhino products is banned. Hunting trophies may, however, be exported under a CITES permit issued by a relevant conservation body, although hunting of the black rhino is currently not allowed in any country in Africa. However, a proposal to have the South African populations of the Rhinoceratidae transferred from Appendix I to Appendix II was submitted to CITES in May 1989 in an attempt to establish a legal trade in rhinoceros products. This proposal was delayed in transit and therefore was not allowed onto the agenda for the CITES meeting in Lausanne in October 1989.

Anti-poaching

The poaching of rhino for its horn is sporadic and of low intensity in South Africa, and is not associated with well-organised, armed gangs as in the rest of Africa. However, there are no grounds for complacency, and conservation authorities need to be constantly on the alert.

Efficient and intensive ground surveillance is clearly essential to detect illegal activities within reserves, but because the levels of poaching can be difficult to determine, this cannot work independently of intelligence work in the surrounding areas and information on the rhino populations themselves.

Procedures are particularly required to ensure that the causes of death of rhinos in the field are adequately investigated and, once the horns have been collected, that the carcass cannot be mistakened at a later date (see rhino mortalities). The security of the horns is also important, and the effectiveness of safes or strongrooms used for storage needs to be evaluated accordingly.

Close monitoring of rhino numbers also provides invaluable information. Census techniques should be precise enough to detect clear trends, and any unusual declines investigated (see Monitoring black rhino populations). Intelligence work comprises obtaining inside information, investigating any possible illegal activities (including trade) and co-ordinating, or co-operating with, a variety of law enforcement and conservation agencies. The adequacy of such operations needs to be constantly re-evaluated. An initial attempt to pool expertise was made at the Illegal Hunting of Rhino Workshop convened by Mr N.A. Steele and held at Treasure Beach from 21 to 23 June 1989 : a number of resolutions and recommendations for protecting rhino populations were made.

Maintenance of genetic diversity

It is important that the potential genetic concerns for the black rhinoceros be kept in perspective with the other factors affecting the conservation of the species, such as the need for physical protection. Genetic management should therefore be viewed as a long-term insurance policy should the protective and other conservation measures succeed. However, as genetic considerations give direction to, while not dictating, the management programmes described in this plan, a brief overview of these considerations is warranted.

The major genetic concern relates to the size of the black rhino populations in the region, with only 3 of the 15 populations numbering more than 100 individuals (see Table 1). The loss of genetic variability in such small populations is a potential threat to their survival, and so, in the absence of specific information on the genetic characteristics of our black rhino populations, an attempt has been made to draw up sound conservation management guidelines based on genetic principles. This was undertaken at a CSIR workshop entitled "Population genetics for conservation management", which was held in Pietermaritzburg on 7 - 9 July 1987. The following (abridged) guidelines for the genetic management of existing populations were forthcoming from this workshop and subsequent discussions:

- The management goals of 2 000 D.b. minor and 2 000 D.b. bicornis should be achieved as rapidly as possible, as this would provide the best insurance against significant loss of genetic diversity. Similarly the rapid expansion of the populations of D.b. michaeli, albeit to a lower target level, would also minimise genetic losses.

- Until the population targets are reached for the various subspecies, each population should be managed at a level below ecological carrying capacity to maximise rates of increase.

- An alternative short-term (± 200 years) strategy would be to interchange animals between sub-populations at the rate of one per generation, as this would maintain a large proportion of genetic diversity. However, this approach is not currently recommended as the same results can be achieved through the first option given above with less disturbance and without the risks inherent in relocating animals into high density situations.

- An effective population size (Ne) of 50 represents a critical threshold. Below this, the rate of loss of genetic diversity exceeds 1% per generation, which is highly undesirable.

- Random gene flow is generally undesirable. However the exchange of individuals of different sub-species or ecotypes may be considered in transition zones where ecotypes would have mixed naturally in the past or when interbreeding is required to prevent the extinction of one ecotype.

- The selective removal of individuals is useful for maintaining heterozygosity in very small populations for which pedigrees are available. This requires personal history records to be kept for, and possibly nuclear DNA finger printing to be undertaken on, all rhinos in very small populations.

The genetic considerations applying to the establishment of new populations are presented separately later.

Managing populations for maximum sustained yield

Four reserves in the region, namely Hluhluwe-Umfolozi, Mkuzi, Ndumu (Hitchins 1984) and Etosha have provided black rhinos for re-establishment into other reserves. These removals have been conservative, with the only capital reduction taking place in Hluhluwe-Umfolozi in an attempt to drop the population below ecological carrying capacity and hence to stimulate

breeding and survival (Brooks et al. 1980). In Ndumu, which has a rate of population increase of 8 - 9 % pa (Conway and Goodman, in review), removals of 5% are implemented each year; while in Mkuzi, such removals average 3% each year, although in this case the addition of more land has enabled the population to expand in both size and range. Translocations from Etosha have, so far, been limited to the 12 animals supplied to the National Parks Board since 1985.

To achieve the primary conservation objectives for the species, it is essential to manage all the black rhino populations for maximum sustained yield. Such management would ensure that both the rates of population increase and the numbers of rhino available for relocation would be maximised. However, currently we lack the information on the response of black rhino populations to different levels of harvesting under changing environmental conditions required to design such a programme.

The Rhino Management Group will consider the options available for maximising the production of rhinos for translocation, and will forward recommendations to the relevant conservation authorities for their consideration.

These options may include:

(i) An adaptive management approach. Three or more levels of removal intensity are applied to different populations for at least two generations to determine equilibrium offtake. (This would test the partial compensation model that Caughley (1985) suspects will be appropriate for most large herbivores in fairly stable environments). Such experimentation should ultimately provide the best basis for sound management.

(ii) Fixed stocking rate strategy. This could be applied to the rhino population in each reserve at a level below the ecological carrying capacity (ECC), i.e. below the threshold equilibrium level at which negative feedback from the food resources, social interactions and other environmental factors significantly reduces the rate of population increase, but at a sufficient density to ensure that all available females are mated.

The optimum stocking rate could be fixed at about 75% of the estimated ecological carrying capacity, with numbers being permitted to build up by 5 - 10 animals, depending on overall population size, before removals take place. These periodic removals which, under ideal conditions, would take place at 3 - 4 year intervals (assuming a 4% annual rate of increase), would optimise the efficiency and cost-effectiveness of the removal programmes, would minimise the disturbance to the animals and would allow time for annually-repeated surveys to provide reliable population estimates or trends.

Such management would have to be based on accurate population estimates, particularly where the black rhino populations are small (see Monitoring black rhino populations), and improved assessments of ecological carrying capacity.

The implementation of this strategy would, assuming a 4% rate of increase, provide about 150 black rhinos for translocation in the first ten years from Hluhluwe-Umfolozi, Mkuzi, Ndumu and Itala Game Reserve (see Appendix 2).

(iii) Recruitment rate. Age structure is a good performance indicator, both within and between populations (see Monitoring black rhino populations). Such information can assist decision-making either by itself, as in Brooks et al. (1980), or in conjunction with other strategies, such as (i) and (ii) above. For example, removals or increased removals might be indicated should the proportion of calves or immatures in the population not reach certain threshold levels over a period of years.

Habitat manipulation

The aim of habitat manipulation would mainly be to counter any adverse effects that vegetation change within a reserve might have on its ability to support black rhinos. Any persistent deterioration would not only threaten the survival of the rhinos in the reserve, but would also adversely affect the programme through a reduced rate of increase and fewer becoming available for translocation.

Management must be able to detect any significant declines in ecological carrying capacity for black rhinos and if this is considered to threaten the achievement of the conservation goal for the species, they must be prepared to take appropriate action. This might comprise an immediate capital reduction to stimulate breeding and increase survival rates, followed by habitat manipulation.

The possiblity of setting aside special rhino reserves and managing the habitat specifically for the species could also be considered.

Clear guidelines on how to improve habitat suitability for black rhino are not currently available, but a study being undertaken in Zululand (Emslie 1987) should provide direction.

Monitoring black rhino populations

To achieve the stated aims for black rhino, as presented in Chapter II, information is required on the size and dynamics of each population, the causes, and extent, of mortality and long-term genetic fitness.

The details of each programme will vary according to the characteristics of the area, its rhino populations and financial or manpower constraints, but certain minimum requirements need to be met, namely:

(i) An absolute estimate of population size, or a precise index of abundance, with performance indicators at least every 3 years, but preferably annually.

(ii) Detailed rhino-death records indicating numbers, location and causes of death.

All monitoring programmes need to be strictly controlled and appropriate techniques applied if they are to be effective in supplying the information required by management. Monitoring guidelines are given below along with recommended procedures developed specifically for the black rhino programme.

Population estimates

The accuracy, or precision, of estimates and their frequency will determine their use to management. The requirement is for accurate estimates (or at least precise indices of abundance) that allow the sizes, or trends, of the rhino populations to be assessed at intervals of 1 - 3 years, but preferably annually.

Various census techniques are suitable for counting black rhinos, their selection depending mainly on the number and density of animals present:

(i) Known animals: highly suitable for small populations (less than 100) where every individual is recognisable—through ear notching (see Marking rhino for individual identification) or natural characteristics, eg. sex, age, horn, sores, ear tears or damaged tails. Estimate is accurate, and allows precise management through personal history records kept on all individuals (see Personal history records).

(ii) Mark-recapture: estimates based on pattern of resightings of individually-recognisable rhinos seen on successive surveys (see Hitchins in prep.). Most suitable for small to medium-sized populations (50 - 150) at moderate densities. Estimate has confidence limits, with accuracy depending on sampling design.

(iii) Line transect sampling (Burnham, Anderson and Laake 1980). Suitable for large populations (100 +) that are evenly distributed. Estimate precise (potentially biased) with confidence limits, thereby giving reliable trends.

Aerial techniques, except when used in (i) or (ii) above, are not sufficiently accurate or repeatable (precise) for use on black rhino populations in heavily-wooded areas (Knott and Brooks, in prep.).

Recruitment rate

A variety of limiting factors may operate to reduce the rate of population increase in growing populations and to determine the level at which ecological carrying capacity is reached. These factors don't necessarily need to be identified nor the rate of increase determined because, providing adult mortality is not abnormally high (eg. significant poaching), the rate at which young rhinos are recruited into the population can provide a good measure of the population's performance. This is because population regulation normally operates through reduced breeding and increased mortality amongst calves and immatures.

The age structure of each population should be monitored annually, either by ground or aerial sampling, or through the maintenance of personal history records.

The field criteria for ageing immature black rhinos are described by Hitchins (1970), and are presented in pictorial form on the reverse side of the form presented in Appendix 6. These should be strictly followed when undertaking surveys. The minimum requirement is to differentiate 3 age classes, namely 0 - 1 year (size classes A and B), 1 - 2 y (C) and 2 y + (D, E and fully grown); while specific studies should attempt to identify all 5 calf and immature classes (A - E) and fully-grown adults (F).

Information collected at either level allows not only the performance trend of a population to be followed as rhino densities and habitat conditions change, but also provides comparative information between populations on which management decisions can be based.

Personal history records

Detailed records of individual rhino can provide a wealth of information useful to management. The regular sighting of known individuals provides data on reproduction (age of first parturition, calving intervals, mating, lineage), movements (home range size, dispersion), territorial behaviour (indicating reproductive dominance), numbers, density (high and low density zones to guide removals and re-establishments respectively), body condition (after Keep 1971), and survival and mortality (vulnerable ages, problem regions which can give early warning of poaching and seasonal or cyclical peaks).

For such personal history records to be effective, individual rhino must be clearly identifiable to a number of observers. The best way to achieve this is to mark the animals, and the recommended method is ear-notching (see below).

Once an individual becomes recognisable, a personal history record sheet is drawn up (see Appendix 3). This records the characteristics of the animal, its origin, each resighting and a variety of behavioural observations. The creation of computerised data bases will facilitate the analysis of results and the exchange of relevant information between the various management authorities and the Rhino Management Group.

Marking rhino for individual identification

External characteristics

It is recommended that all rhino immobilised for research purposes, treatment or translocation be individually ear-notched according to the system described below. Ear-notching of additional animals specifically for monitoring purposes is also highly desirable. The presence of marked animals not only facilitates censusing, but also allows individual records to be kept of the individual's behaviour, reproductive performance and lineage which can assist management.

The marking system utilises V notches (2,0 - 2,5 cm deep) and occasional "triangular" notches cut from the perimeter of the ears, and also single holes through one or both ears. Treating males and females separately, this system allows for the individual marking of 764 rhinos of each sex (1 528 rhino in all) without duplication. A detailed description of the marking system is given in Appendix 4.

Numbers are allocated to each reserve with a black rhino population to avoid duplication either within or between reserves as shown in Appendix 5. A previously unmarked rhino being relocated to another reserve would be marked using a number allocated to the donor reserve.

The use of semi-circular notches as applied in SWA/Namibia in 1985 deserves further consideration, as this shape might be less vulnerable to tearing.

Cryptic labelling

Techniques are being investigated for the cryptic labelling of both black rhino horns and the rhino itself, as follows:

(i) Chemically labelling of horn by impregnation, or metabolic deposition, to render the horns permanently indentifiable (either on an individual reserve, or combined reserves, basis) to conservation authorities, but not to illegal traders lacking the required sophisticated equipment or technology. This concept, the details of which should remain confidential for obvious reasons, would involve immobilising the rhino and giving the required treatment, so that should the horn subsequently enter the illegal trade and be seized, the origin of the horn could be determined. Alternatively, horns in storage could be similarly labelled. Both would hold obvious benefits for securing convictions.

(ii) Electronic labelling of the body of the rhino, using a strategically placed transponder, pre-programmed with a unique and unalterable code. This would allow one to establish the identity of a carcass at any time in the future even if the ears and other identifying external features had been mutilated.

Rhino mortalities

The detection, examination and disposal of rhino carcasses, as well as the maintenance of meticulous records, is a critical part of the black rhino conservation programme. If handled correctly, this operation will provide management with early warning of a variety of potentially serious problems, such as nutritional deficiency, disease and, in the current climate, especially poaching. Mismanaged, it will provide a cover, and even provide additional opportunities, for rhino poaching and the increased availabilty of rhino products on the black market.

Serious consideration should be given to the routine implantation of transmitters which are only activated on death of the individual rhino. This could enhance the timeous location of carcasses and the early detection of poaching.

The programme has a number of important components:

(i) Initial inspection on discovery
- Presence/collection of horns
- Distinguishing natural characteristics / ear notches
- External examination for cause of death

(ii) Post-mortem
- Veterinary surgeon
- Geiger counter
- Activation of transponder

(iii) Collection or destruction of skull/carcass

(iv) Marking, measuring and weighing horns, and handling to maintain security.

(v) Marking and storage of skulls, for later ageing and taking of morphometric measurements.

(vi) Completion and distribution of a standard rhino mortality form (see Appendix 6), including date, location, age, sex, horn measurements and disposal, skull details, cause of death (copy of post-mortem report to be attached), names of individuals finding the carcass and completing the form.

(vii) Checking of game death forms for completeness and accuracy, analysis for trend in numbers, distribution throughout reserve, detection rates by different grades of personnel etc.

2. Establishment of new populations

The translocation of black rhinos from well established populations, either to create new populations or to bolster small, existing populations, is a major component of this Conservation Plan.

Decisions on which reserves or areas should receive rhino preferentially have to be based on a wide variety of considerations. Strategically, a network of small populations provides protection against disease outbreak and localised, extreme climatic changes; and small reserves are arguably easier to police than larger areas. Conversely, large areas provide increased possibilities for natural population expansion and, in the long-term, will maintain higher levels of genetic diversity without management intervention. A balance needs to be struck between these strategic and genetic considerations, in conjunction with biological suitability, and decisions taken according to perceptions at the time.

Genetic considerations

Some genetic considerations (in addition to those mentioned earlier under Maintenance of genetic diversity) of direct relevance to the re-establishment programme were identified at the workshop held in Pietermaritzburg in July 1987, and these should be borne in mind when making decisions. They are:

- Preference should be given to the rapid achievement of the minimum founder number in any given area, so as to reduce the risk of mortality caused by fighting with resident rhinos.

- Priority should go to areas with the highest potential population sizes.

- There are no compelling genetic reasons for adding more founders to KNP, as the 70 re-established are adequate in numbers and diversity of origin.

- The ideal situation would be at least one large population and several others over 200.

- The primary reservoir of genetic diversity is likely to be the largest population. When filled to capacity, it should become the primary source for the repopulation of new areas.

Potential population sizes of black rhino in existing reserves

The estimated ecological carrying capacities of these reserves for black rhinos are presented in Table 2. However, many of these estimates are based on fairly superficial information, and more accurate assessments are required particularly for the smaller reserves. This is necessary if the reserves are to be effectively screened for suitability and rated for genetic potential (see Rating procedure for reserves).

Table 2 Potential sizes of existing black rhino populations in reserves in the region.

Species	Location	Potential pop. size
D.b. minor	Kruger National Park	3 500
	Hluhluwe-Umfolozi GR	300
	Pilanesberg GR	120
	Eastern Shores NR - Sodwana State Forest	100
	Mkuzi GR	70
	Itala GR	60
	Andries Vosloo Kudu Reserve	50
	Ndumu GR	40
	Weenen NR	10
	TOTAL:	4 250
D.b. bicornis	Etosha NP	500
	Kaokoland/Damaraland	200
	Waterberg Plateau Park	50
	Vaalbos NP	40
	Augrabies Falls NP	30
	TOTAL:	820
D.b. michaeli	Addo Elephant NP	30
	TOTAL:	30

Detailed information on these populations, such as numbers, trends and population structures, as well as brief descriptions of the habitats, will be included in the Conservation Plan in due course.

The size of the D.b. minor population in the region is not currently limited by lack of available conserved habitat. The reserves holding this ecotype amount to about 22 million hectares, and have an estimated ecological carrying capacity (ECC) of over 4 000 animals (see Table 2), or about double the target figure of 2 000. Kruger National Park could hold by far the largest population of about 3 500, followed by Hluhluwe-Umfolozi (300), Pilanesberg (120) and Eastern Shores - Sodwana (100); the remainder all having carrying capacities of less than 100. It would, nevertheless, from a strategic viewpoint, be preferable to have the population more widely spread.

In the cases of D.b. bicornis and D.b. michaeli, there is currently insufficient space in reserves for either to achieve their minimum target figures of 2 000 and 100 respectively, although there are up to about

4 million hectares of rhino habitat suitable for D.b. bicornis in Kaokoland and Damaraland. Additional reserves, or significant extensions to current reserves, will be required.

Additional areas for re-establishment

A number of reserves have been proposed as being possibly suitable for black rhino, and these will be assessed by the RMG in due course. A standard procedure will be adopted, which may necessitate a new assessment being done for reserves evaluated in the past so as to get a good indication of relative suitability.

Some potential new areas are listed below.

D.b. minor	Sam Knott NR	- Cape Province
	Pongola NR	Transvaal
	Loskop Dam NR	
	Langjan NR	
	Messina NR	
	Timbavati Private NR	
	Hans Merensky NR	
	L.L. Sebe National Reserve	- Ciskei
	Borakalalo NP	- Bophutatswana
	Songimvelo GR	Kangwane
	Mthethomusha GR	
D.b. bicornis	Kaudom GR	SWA/Namibia
	Eastern Bushmanland	
	East Hereroland	
	Caprivi GR	
	Mangetti Game Camp	
	Naukluft	
	Hardap GR	
	10 private properties	
	Karoo NR	Cape Province
	Karoo NP	
	Richtersveld NP (Proposed)	
	Riemvasmaak Military Training Area	
D.b. michaeli	Zuurberg NP	- Cape Province

Assessing the suitability of reserves

The success of the re-establishment programme, measured in terms of the achievement of the stated conservation goals (see Conservation aims), depends largely on the identification of those areas most suitable for rhino population growth and survival.

The selection of areas will be based on an assessment of all areas potentially suitable for black rhinos. This assessment will provide the information required for an initial screening of reserves and the subsequent rating of suitable reserves for their biological, genetic and security potential. This exercise will be undertaken by the Rhino Management Group, and recommendations forwarded to the appropriate conservation authorities for consideration.

Initial screening of reserves

The initial-sorting of reserves and areas into those potentially suitable and those unsuitable for the re-establishment of black rhinos is based on a set of minimum standards. If any of these standards, which are given below, are not met, then the area is disqualified from further consideration.

- The habitat must be suitable.
- Areas of less than 10 000 ha must have physical boundaries preventing dispersion.
- Poaching threat should not be severe, or if it is, effective control must be demonstrated.
- No threat of deproclamation must be apparent.
- Current or proposed land-use must be compatible with conserving the species.
- Potential rate of increase in recipient area must be greater than in donor population.
- Potential effective founder population must be at least 10 rhinos.
- Number of founders must not exceed 50% of ecological carrying capacity.
- Current population size must not exceed 75% of ecological carrying capacity.
- Ecological carrying capacity must be at least 20 rhinos.
- If previous re-establishment was unsuccessful, causes must have been rectified.
- Re-establishment must not adversely affect another Red Data Book species with a more critical conservation status.
- Veterinary clearance must be granted.

Those reserves that meet the minimum standards are then rated for relative suitability according to the ecotype or subspecies (D.b. minor, D.b. bicornis or D.b. michaeli) allocated to them.

Rating procedure for reserves

The rating system, which identifies three major areas of concern (biological, genetic and security), provides for flexibility as the decision-making climate changes. Improved biological or genetic knowledge can be integrated and changes in the security situation can be taken into account without a complete re-assessment being necessary.

A variety of factors falling under the three areas of concern are scored for each reserve as shown below.

(i) Biological concerns

Habitat suitability: 1 - 10

This is based on a wide variety of observations, such as base level of soils, availability of palatable browse, and condition and performance of browsers. Ideal habitat scores 10.

Predation threat: 1 - 3

Assuming that large predators, eg. lions and spotted hyaenas, inflict some mortality, scoring varies from a high density of such predators (1) to there being no significant predators (3).

Disease threat: 1 - 3

This may vary from a known risk affecting the rate of increase of the re-established or resident population (1) to no known risk (3).

(ii) Genetic concerns

Potential population size: 1 - 10

Long-term genetic viability increases and the need for interchange management decreases with increasing population size.

Scoring:				
	(1)	20 - 29 rhinos	(6)	100 - 149
	(2)	30 - 39	(7)	150 - 249
	(3)	40 - 49	(8)	250 - 349
	(4)	50 - 74	(9)	350 - 499
	(5)	75 - 99	(10)	500 +

Number of founders present: 1 - 3

The genetic risk decreases as the number of founders increases. The allocation of additional animals where founder numbers are low is therefore encouraged.

Scoring:		
	(1)	40 + founders
	(2)	20 - 39 founders
	(3)	10 - 19 founders

(iii) Security concerns

Poaching threat: 1 - 10

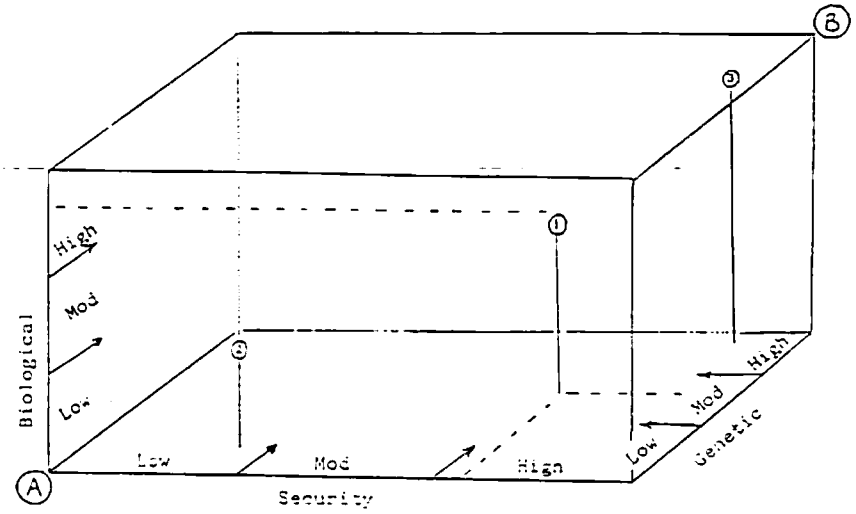
Aspects considered include distance to political (national) boundary, extent of organised crime, security status of region, previous incidents of poaching. Scores increase as the threat decreases.

Management control: 1 - 10

This is a measure of the intensity and effectiveness of policing in the reserve and in surrounding areas, the effectiveness of the

boundary fence (especially in smaller reserves) and the security of land tenure. Excellent control rates 10.

The scores for the biological, genetic and security concerns are then presented three-dimensionally for each reserve as shown below.



The three reserves shown have the following characteristics:

Reserve	Biological suitability	Genetic viability	Security status
(1)	High	Moderate	High
(2)	Moderate	Low	Low
(3)	High	High	High

This presentation results in reserves with similar characteristics being clumped together, with the least suitable tending towards (A) and the most suitable towards (B). Also those that rate highly for any particular concern can be easily identified.

3. Captive breeding

While accepting that in situ protection and conservation of black rhino populations in Africa is the highest priority, it is recognised that these efforts may be unsuccessful for one or more of the 4 recognized ecotypes. The alternative is captive propagation.

The African Rhino Workshop (Cincinnati, October 1986) strongly recommended that viable foundation populations should be established immediately for those ecotypes not presently well represented in zoos. Genetic analyses suggest that a viable captive population should be based on at least 20 founder individuals that will reproduce. Of the 4 ecotypes, only the East African

D.b. michaeli is well represented in captivity. In July 1989 there were 64 D.b. michaeli and 18 D.b. minor in captivity in North America: the other two ecotypes were not represented.

Captive breeding can serve two purposes, namely:

i) to produce surplus rhinos for the on-going exercise of re-establishment in reserves; however such a breeding programme, which could be based in Africa, can only be justified if rhino husbandry is developed to the stage where the population growth rate in captivity exceeds that in natural habitats: or

ii) to insure against the worst-case scenario, that of economic or political collapse within the region resulting in the loss of all rhinos: in which case the breeding programme must be based outside Africa and lower population growth rates would be acceptable. The purpose would be to maintain genetically diverse populations for re-establishment in natural habitats within Africa should conditions return to normal. The implication is that this is a very long term programme, with no return expected in less than 10 - 50 years.

Availability of rhino

Limited numbers of D.b. minor are currently available each year for relocation from Natal's reserves, and consideration needs to be given as to whether some might be made available for captive breeding programmes.

Rhinos do occasionally become available that are not suitable for release back into the wild. These would include orphaned calves that need to be hand-reared or which are not old enough to risk introducing into occupied areas in the wild, or adults that have recovered (in captivity) from injury but which are to some extent handicapped and which would therefore be disadvantaged. Provided these animals are potentially suitable for captive breeding, they should continue to be offered for this purpose.

Donation for black rhino research or management

Black rhinos destined for captive breeding programmes may be donated or sold according to the preference of the management authority concerned. However it is recommended that at least some financial benefit should accrue to the organisation which can then be used to fund priority research or management programmes.

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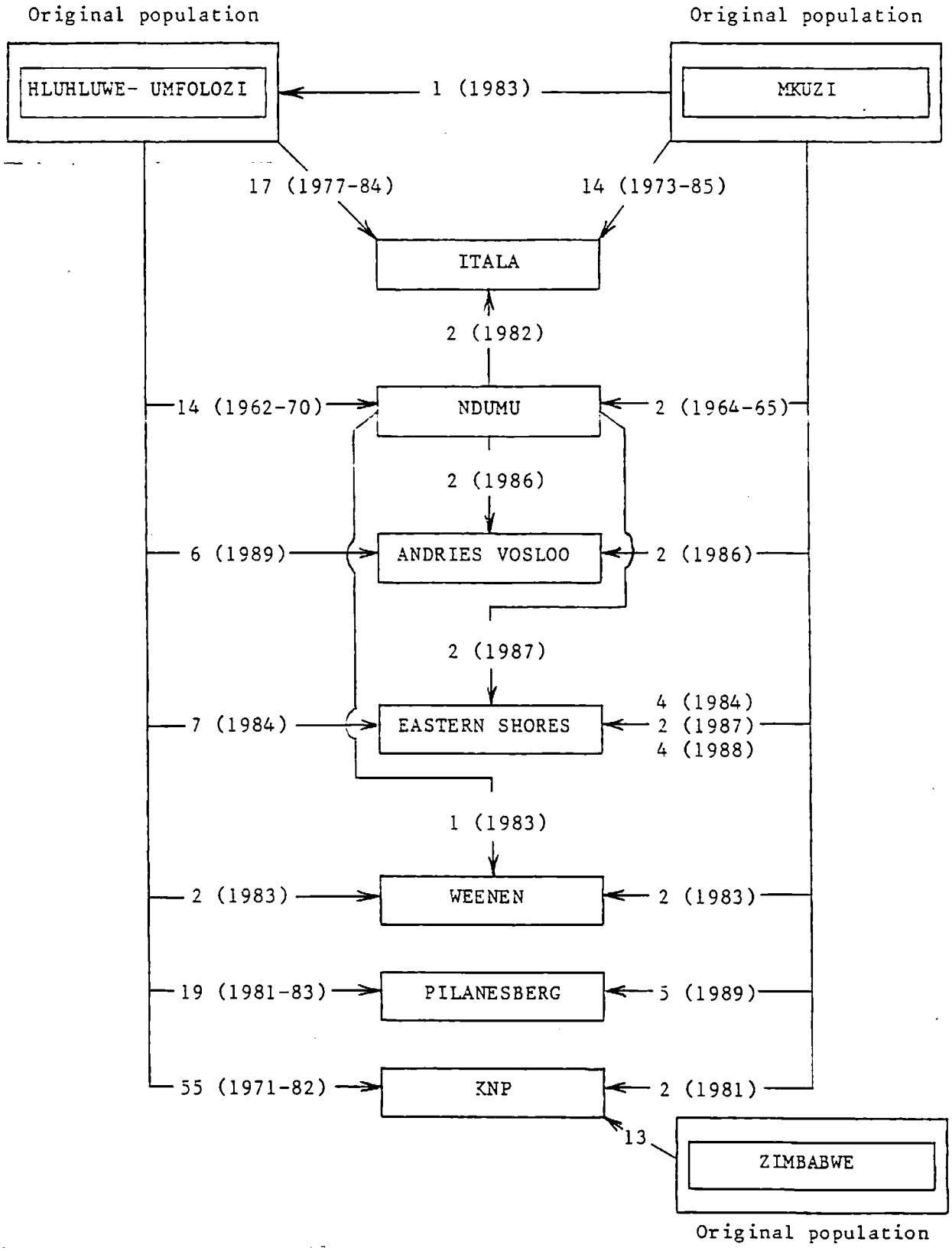
Appendix 1 . Re-establishment history of D.b. minor in the - region (September 1962 - September 1989)

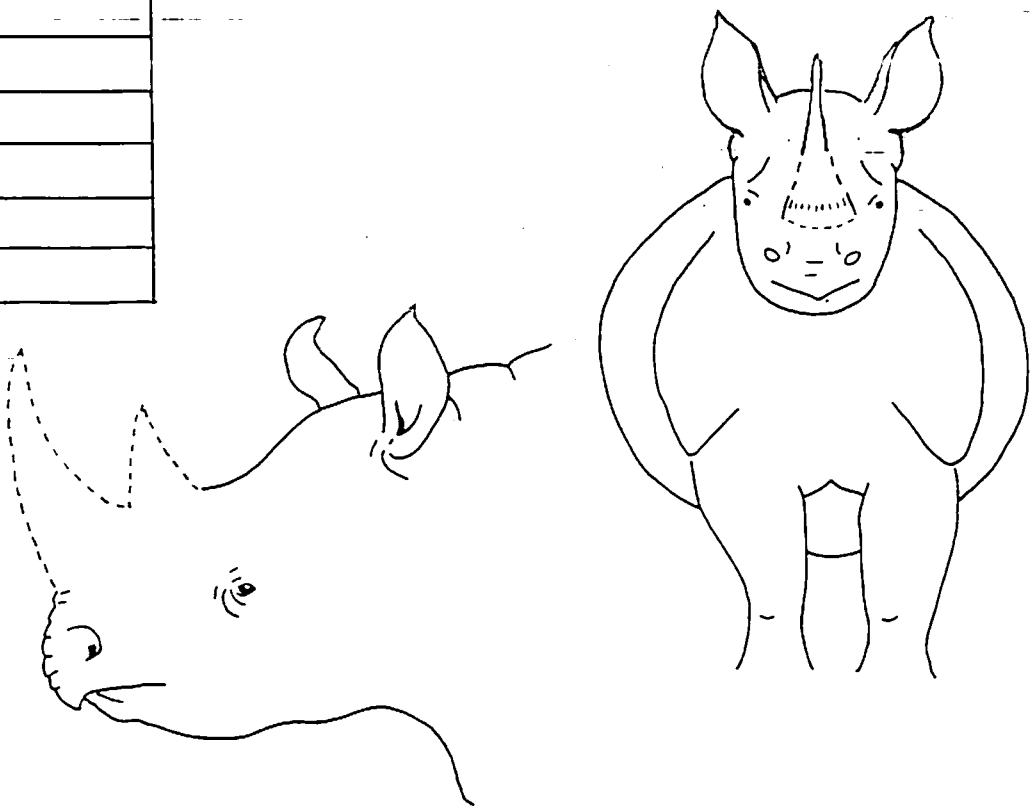


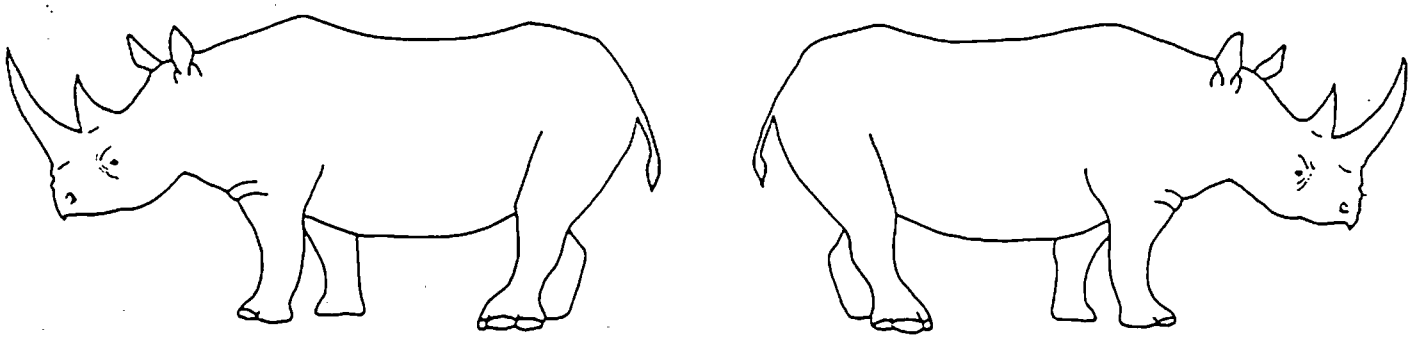
Appendix 2 Availability of black rhinos for translocation over a 10 year period from 1988 if populations managed at 75% of ecological carrying capacity.

Reserve	Current population size	75% ECC	Removals									
			Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
HGR-UGR	220	225	-	13	9	9	9	9	9	9	9	9
Mkuzi	70	53	17	-	-	7	-	-	7	-	-	7
Ndumu	42	32	10	-	-	-	5	-	-	-	5	-
Itala	35	45	-	-	-	-	-	-	-	-	5	-
		TOTALS	27	13	9	16	14	9	16	9	19	16

Appendix 3. Black Rhinoceros personal history record.

Reserve	
Rhino code no.	
Ear-notch no.	
Date identified	
Sex	
Age class	





Identification	Ears			
	Horn			
	Sores/scar			
	Tail			
	Other			
Origin	Mother		Date	
	Donor reserve			
Death or Removal	Date			
	Cause/reason			
	Skull no.			
	Housed			

SIGHTINGS

Sighting no.	Grid ref	Date	Body condition	Observations (eg with calf (age,sex), mating, fighting spray urinating, immobilisation, treatment etc)

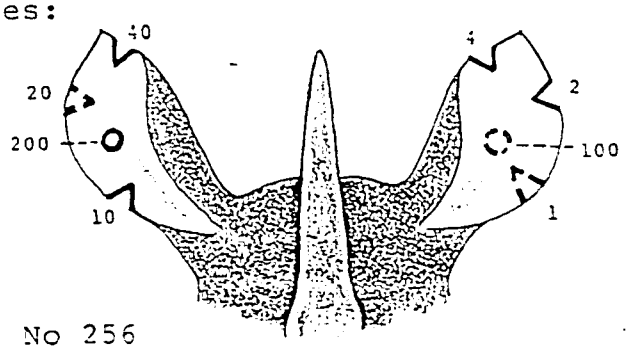
Calves	Date born	sex	Rhino code no.	Ear-notch no.	Remarks (inc. death(date), trans-location, destination etc.)

L.W. March 1991

Appendix 4. Ear-notch marking system for black rhino Diceros bicornis in the region

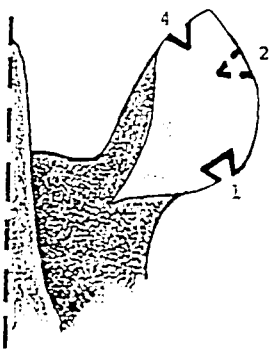
The ear-notching system is based on V and inverted triangular (⊤) notches cut from the perimeter of the ears and holes punched through the ear pinnae as shown below.

V notches:



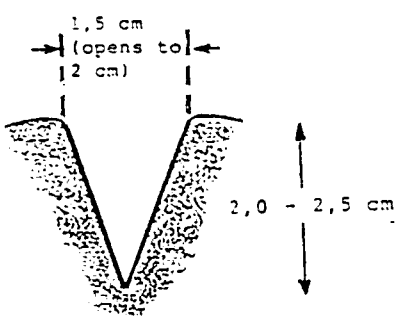
No 256

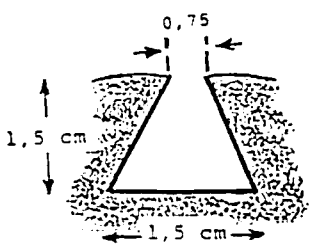
Triangular:



No 5 (T1)

Actual size:





Each black rhino will receive an individual number code, derived from the number of notches or holes cut in the ears, and whether or not a triangular notch is present. The types of marking are:

(i) V notches only. This allows 63 individuals (1 - 7, 10 - 17 etc) of each sex to be marked without duplication.

(ii) One triangular notch (at positions 1, 4, 10 or 40) plus V notches. Gives 128 combinations for each sex, with numbers allocated to individual rhino being post-fixed by T1, T4, T10 or T40 depending on the triangular notch used to avoid confusion with (i) above. Errors due to failure to detect the triangular shape of the notches are avoided due to similar codes, eg. 15, 15(T1), 15(T4) and 15(T10) being allocated to different reserves.

(iii) Holes in one or both ears, i.e. 100, 200 or 300. Used in combination with the V notch and triangular notch systems, the holes add 189 and 384 combinations respectively for each sex.

Use of the above system allows for the individual marking of 764 rhino of each sex. Each reserve is allocated certain numbers as shown in Appendix 5, these having been carefully selected to avoid recording errors.

When marking animals, numbers in the table in Appendix 5 should be preferentially selected from left to right. This is because:

- If marking is restricted to numbers appearing in columns 1 - 10 (i.e. restricted to simple V and triangular notch systems) then individuals can be identified without sexing or, in fact, distinguishing between V and triangular notches.

- When marking is extended to columns 11 - 16 (i.e. V notch and holes) the same conditions apply as above. However, if there is difficulty in detecting the holes (denoting hundreds), then animals must be sexed to avoid confusion with those marked earlier. For example, if No 150 (male) is read as 50, reference to the table in Appendix 5 reveals the error, as No 50 is a female.

- When marking is extended beyond column 16, the need to detect triangular notches and holes and to record sexes increases if errors are to be avoided.

Appendix 5. Allocation of ear-notch numbers to black rhino *D. b. minor* in the SA region

(Excludes rhino marked before 1 January 1980, * combinations of △ (T) notch + V notches + hole(s) not shown as allocated)

Reserve	V notches only		△ (T) notch plus V notches								V notches plus hole(s)						*	Number of ear-notch combinations allocated	
			T1 notch		T4 notch		T10		T40		Hole 100		Hole 200		Hole 300				
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female		Male	Female
Hluhluwe-Umfolozi GR	7, 20-27	6, 47, 50-57	61, 63, 65-67	11, 13, 15, 17	74, 75, 76, 77	34, 35, 36, 37	-	-	-	-	150-157	120-127	210-217	260-267	330-337	370-377		41	42
Mkuzi GR	44, 46, 47, 50-57	45	21, 23, 25, 27	31, 33, 35, 37	14, 15, 16, 17	-	-	70-77	60-67	-	130-137	150-157	270-277	220-227	-	310-317		43	37
Itala GR	30-37	-	51, 53, 55, 57	1, 3, 5, 7	24, 25, 26, 27	14, 15, 16, 17	-	-	70-77	60-67	101-107	140-147	260-267	230-237	310-317	320-327		47	40
Weenen NR	-	1	11, 13, 15, 17	-	64, 65, 66, 67	44, 45, 46, 47	-	-	50-57	70-77	No more allocated							16	13
Eastern Shores NR	10-17	60-67	71, 73, 75, 77	21, 23, 25, 27	34, 35, 36, 37	-	-	-	-	50-57	160-167	130-137	220-227	201-207	-	-		32	35
Ndumu GR	3	20-27	31, 33, 35, 37	71, 73, 75, 77	44, 45, 46, 47	4, 5, 6, 7	10-17	50-57	-	-	120-127	110-117	-	240-247	No more allocated			25	40
Kruger NP	60-67	-	-	51, 53, 55, 57	4, 5, 6, 7	74, 75, 76, 77	30-37	10-17	-	40-47	140-147	101-107	250-257	-	320-327	330-337		44	39
Pilanesberg GR	70-77	10-17	1, 3, 5, 7	41, 43, 45, 47	54, 55, 56, 57	64, 65, 66, 67	-	30-37	-	-	110-117	170-177	230-237	240-257	No more allocated			32	40
Andries Vosloo NR	-	30-37, 70-77	-	-	-	24, 25, 26, 27	50-57	-	40-47	-	-	160-167	201-207	-	-	-		16	12
New reserves 1.	-		-	-	-	-	-	70-77	-	-	-			-	340-347	350-357		23	24
2.	-	-	41, 43, 45, 47	-	-	54, 55, 56, 57	-	-	-	-	170-177	-	-	210-217	301-307	-		19	12
3.	-	-	-	61, 63, 65, 67	-	-	-	-	-	-	-	-	240-247	270-277	350-357	301-307		16	19
Rensfinder	-	-	-	-	-	-	-	-	-	-	-	-	-	-	360-367 370-377	340-347 360-367		16	16
																	TOTAL	370	369

Appendix 6. Black rhinoceros mortality record

Reserve _____

Month _____ Year _____

Code Numbers		Date	Location		Age Class (A-F)	Sex (M, F)
Rhino death	"Known" death		Area	Grid ref		

Horns

Present	Collected	Marked	Measurements (nearest mm or g)						Disposal	
			Front			Rear			Destination	Date
			Length	Circum	Mass	Length	Circum	Mass		

Skull

Collected	Destroyed	Marked	Aged	Measurements				

Post-mortem

Undertaken	Vet's Name	Report Attached	Cause of death		If predation, then:	
			Code		Predator	
			Details		Evidence (A-E)	
					Details	

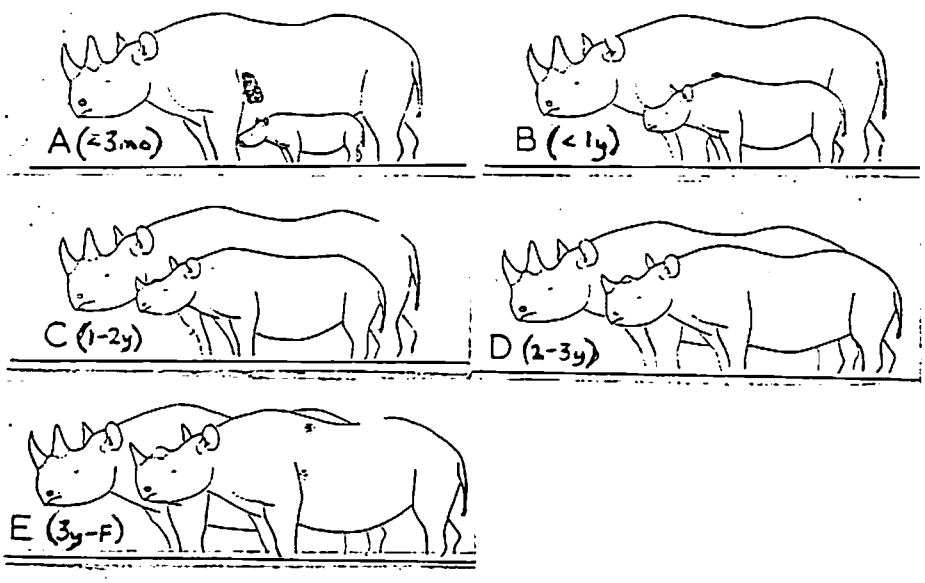
Individual reporting death _____

Officer completing form _____

All horns and skulls to be marked immediately with the game death code number, initially using permanent marker pen and later permanent labels.

Age classes:

Size Class Description	A	B	C	D	E
Size in relation to adult	Level with inguinal region of adult female	Top of shoulder level with ventral part of vulva	Shoulder level with base of tail	Shoulder height at a level between base of tail and sacral region	Slightly smaller than adult
Skin lesions	Absent	Absent	Start appearing on chest. Absent on sides.	Present on chest. Absent on sides.	Present on chest, start developing on sides, but generally not in the usual position - being the shoulder
Horns	Absent	Anterior horn small and 'knob' like (approx. 3 inches in length). Posterior horn not noticeable	Anterior horn approx. 4 inches in length. Posterior horn noticeable	Anterior horn approx. 6 - 12 inches in length. Posterior horn approx. 2 - 4 inches.	Anterior horn approx. 10 - 12 inches in length. Posterior horn approx. 2 - 4 inches



Horn measurement :

These are taken in accordance with Rowland Ward and Safari Club International specifications.

Length : Measure length of the horns on the front surface along the curve from the lowest point in front to the tip.

Circumference : Measure along the edge of the base as close to the head as possible. This does not have to be at right angles to the axis of the horn.

Cause of death codes:
P - poacher
C - carnivore
F - fighting injury
I - other injury
B - capture
D - destroyed
U - unknown

Evidence of predation:
A - observed killing
B - heard killing
C - seen at carcass
D - spoor at carcass
E - signs of struggle