# SADC Regional Programme for Rhino Conservation

## THE REINTRODUCTION OF RHINOS TO GONAREZHOU NATIONAL PARK, ZIMBABWE: A FEASIBILITY STUDY

### Institutional, Management and Security Issues

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### Biological Aspects and IUCN Reintroduction Guidelines

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*Feasibility Study for the Development of a Rhino IPZ in Gonarezhou*

*Semester 12a Task 3.1-12.1*

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- The Secretariat of the Southern Africa Development Community (SADC)
- IUCN-ROSA (The World Conservation Union - Regional Office for Southern Africa)
- The IUCN African Rhino Specialist Group
- WWF-SARPO - (World Wide Fund for Nature - Southern Africa Regional Programme Office)
- CESVI (Cooperazione e Sviluppo)

The ***Programme goal*** is to contribute to maintain viable and well distributed metapopulations of Southern African rhino taxa as flagship species for biodiversity conservation within the SADC region.

The ***Programme objective*** is to implement a pragmatic regional rhino strategy within the SADC region following the acquisition of sound information on, firstly, the constraints and opportunities for rhino conservation within each range state and secondly, the constraints and opportunities for rhino metapopulation management at the regional level.

## DISCLAIMER



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## EXECUTIVE SUMMARY

A rhino Intensive Protection Zone (IPZ) is proposed in the northern section (about 1,130 sq. km) of Gonarezhou NP, to receive founder groups of both black and white rhinos. The need to restock the Park with black rhinos arises because a previous reintroduction of this species failed due to poaching (some of which was perpetrated by the staff of the Park) in the late 1980s and early 1990s. White rhinos were never deliberately reintroduced to the Park and the few that strayed in from neighbouring ranches in the 1980s did not persist as a breeding population.

The IPZ proposal is reviewed in this report in terms of a range of issues including security, management, institutional, biological and ecological factors, and is evaluated against international guidelines for wildlife reintroduction programmes. The review highlights a number of strengths as well as a number of weaknesses in the proposal.

The habitats are sufficiently suitable for a founder population of at least 20 black rhinos, with significant expansion potential, but it is inevitable that some black rhinos will move out of the IPZ in due course, especially towards the south and south-east. Release procedures must be carefully planned to minimize initial dispersal. For white rhinos, habitat suitability is more dubious and the introduction of 20 white rhinos should only be done on an experimental basis with a fall-back plan in place to relocate some or all of the rhinos elsewhere if they demonstrate nutritional problems or excessive dispersal.

The security of the proposed IPZ is currently compromised by an invasion of squatters in the north-eastern corner of Gonarezhou NP, which is a manifestation of a long-standing land claim. Resolution of this problem, through a sensitive and sustainable approach rather than through simple eviction of the community, will be a precondition for the establishment of the IPZ, particularly insofar as donor support and private sector investment are concerned. Another major problem is that antipoaching manpower and equipment for the IPZ are likely to remain below recommended levels.

To address the land claim as well as the insufficiency of antipoaching resources, the development of a Public/Private Partnership (PPP) is recommended. This would involve private sector investors who could develop some recently-advertised ecotourism concessions within or adjacent to the proposed IPZ, and would create a shareholding for the local community. To achieve economies of scale, this PPP should be linked with existing ecotourism operations in the area. The PPP could play a significant role in rhino monitoring within the IPZ thereby enabling the limited antipoaching resources to be utilized with maximum efficiency. The concept of a PPP, with a conservation role as well as a commercial role and with community participation, is fully in accordance with the management policies of the Great Limpopo Transfrontier Park.

# OVERVIEW

## SWOT Analysis

- A workshop to review the strengths, weaknesses, threats and opportunities of the proposed IPZ identified the following factors as critical to the success of the plan to reintroduce rhinos to Gonarezhou NP:

  Resolution of the present and any potential future land claims and occupations;
  Securing adequate funding and resources;
  Development of suitable mechanisms for co-operation and co-ordination with potential partners; and
  Improved tourism (and staff) access to the Park and the IPZ.

## Original Populations of Rhinos

- Black rhinos were recorded in the vicinity of the present Gonarezhou National Park during the late 19th century. The last black rhino of the original population was killed probably during the 1930s or early 1940s.
- The earliest records of the white rhinoceros in the vicinity of Gonarezhou NP are rock paintings. The written records of white rhinos closest to Gonarezhou NP are from 1836/37, 100 km west of the southern-most part of the Park.
- There are no material records of the white rhinoceros in Zimbabwe after the 1890s, but there are several unsubstantiated reports of white rhinos in the vicinity of the present Gonarezhou NP during the first 30 years of the 20th century, i.e. after the white rhinoceros was generally thought to be extinct in Zimbabwe.

## The First Reintroduction of Black Rhinos

- Seventy-seven black rhinos were released in the present Gonarezhou NP during 1969-1971. Most were freed north of the Runde River. During the 1970s, a programme for the development of artificial supplies of water for wildlife was initiated, but after 1976 the piped artificial water supplies were closed down for several years. The initiation and then closure of this system may have influenced the dispersal of rhinos. Most sightings of black rhinos were in the northern half of the Park, but two rhinos captured in the north of Kruger NP during 1979-1982 were believed to have come from Gonarezhou.
- Between the Save and Runde Rivers, very few black rhinos were seen in the northern half of this area. Instead most rhinos were seen closer to the Runde River, within 10 km of pools that provided drinking water at the end of the dry season even in drought years. The vegetation of this area during the period when it was occupied by black rhinos was described only broadly, but it included thickets that were probably attractive to the rhinos. Several lines of evidence suggest that their density in this area averaged 1 rhino per 10 sq. km. Surveys of the rhinos differed in methods and study areas, but probably the Park's population at its peak exceeded 100 animals.

## Poaching

- Rhino poaching was recorded soon after the releases, but the number killed increased markedly during 1984. Some staff members of the Department of National Parks & Wild Life Management and some army personnel are alleged to have been involved in this poaching. By 1994, the black rhinoceros was locally extinct for the second time.

## White Rhinos in Gonarezhou NP

- A few white rhinos were seen in Gonarezhou NP during the 1980s, after they entered the Park of their own accord from the adjacent Lone Star Ranch (now Malilangwe Estate). The last of these rhinos was captured and translocated during 1993.

**Artificial Supplies of Water for Wildlife**

- The piped artificial supplies of water for wildlife have not been consistently maintained. From the point-of-view of the animals, these supplies have been opened and closed unpredictably. Cessation of pumping in an area where rhinos have settled can cause social disruption, including intraspecific fighting, and unpredictable dispersal.
- The major disadvantages of an artificial supply of water are that: (a) it causes an increase in the local density of elephants and in their impact on the woody vegetation; (b) it is expensive to install and maintain; and (c) cessation of these supplies can disrupt rhino home ranges, causing dispersion and intraspecies fighting. During the severe 1992 drought, the DNPWLM was dependent on the private sector to overhaul and maintain the artificial supply of water in Gonarezhou NP.
- It is recommended that the rhino reintroductions are planned on the basis that only natural supplies of water will be available for the rhinos to drink.

**Assessment of the Area North of the Runde River as Habitat for Black Rhinos**

- Since the reintroduction of the black rhinoceros, there have been major changes in the vegetation in the Save-Runde area, with the conversion of *Brachystegia glaucescens* woodland to bushed grassland, and the loss of thickets. Changes in these thickets have probably been detrimental to black rhinos, but because there was no detailed description of the thickets in the past, the extent of the recent changes is unclear.
- The area of the Nyachiri, Silililjo and Pombadzi Rivers appeared to be particularly good for black rhinos in the past and, despite the recent vegetation changes, would probably still be suitable. However, if rhinos were released here, it is likely that some individuals will move south across the Runde River, or east towards the Save/Runde confluence and Mozambique. Except where it flows through a steep gorge, the Runde River is not a physical or ecological barrier to rhino movement.

**Assessment of the Area North of the Runde River as Habitat for White Rhinos**

- Much of the ground surface in the Save-Runde area – particularly the area formerly mapped as *Brachystegia glaucescens* woodland - is covered with boulders. These areas would probably be avoided by white rhinos. Within 3 km of the Runde and Save Rivers, white rhinos would probably be in competition for food with hippos. The *Combretum imberbe-Spirostachys africana* wooded grassland includes areas of *Digitaria* grass, which probably would be favoured by white rhinos, but it also includes areas of *Hyparrhenia* and *Hyperthelia* grasses, which white rhinos would avoid.
- Over most of the area north of the Runde, the grasses are burnt each year by wild fires. Whether this is beneficial for white rhinos will depend on whether there is sufficient soil moisture to promote a flush of green grass before the start of the rainy season.
- The *Colophospermum mopane-Urochloa mosambicensis* woodland on basaltic soils in the north-west of the Save-Runde area would be favoured by white rhinos, but most of this area appears to be more than 10 km from natural supplies of drinking water at the end of the dry season during droughts. Furthermore, much of this vegetation community has been settled by squatters who have snared wildlife, destroyed natural vegetation to create fields, and introduced cattle to the national Park.
- During the 1992 drought, the numbers of large grazers (hippos and buffaloes) in the Park declined dramatically as a consequence of malnutrition, despite major and expensive management interventions that included providing hippos with artificial supplies of food. At present, it is very doubtful that this area can support 50 white rhinos in the long-term. It is recommended that an assessment be conducted of the state of the grass layer potentially available to white rhinos at the end of the dry season.
- Any initial introduction of white rhinos should be limited (no more than 20 rhinos) and must be seen as experimental, with close monitoring and with an already-agreed fallback plan to implement in the event that the rhinos disperse too widely or suffer from food shortages, and have to be quickly recaptured and moved elsewhere (e.g. to Save Valley Conservancy).

**Fire in northern Gonarezhou NP**

- The Save and Runde Rivers provide natural fire barriers on three sides of the proposed Intensive Protection Zone (IPZ). But there are frequent fires in this area, usually started by arsonists.
- The area within the proposed IPZ that burned annually has been determined primarily by the fuel load, as influenced by rainfall. Park managers, who have attempted to prevent fires and to extinguish accidental fires, often by backburning, have had little effect on the total area burned each year.
- Within the past 20 years, the vegetation in the proposed IPZ has changed. Woodland and thickets have been reduced to bushed grassland, or shrubland. As trees disappeared, the standing crop of grass increased. This greater fuel load has allowed more intense fires, which are usually impossible to fight manually.
- In order to encourage woody regrowth, and because it is impossible to prevent fires from starting in the IPZ, or to extinguish most wildfires, a different, more focused, fire policy is proposed. It is recommended that, in most vegetation types, management staff deliberately burn early during the dry season, when fires are less intense, with the aim of creating a patchwork of burnt and unburnt areas.

**Rhinos, Tsetse flies and Trypanosomes**

- When rhinos that have never been exposed to tsetse flies and trypanosomes are moved to areas with tsetse flies, there have often been problems, with rhinos dying from trypanosomiasis soon after being moved. White rhinos seem to be particularly susceptible, although all naïve rhinos are at risk if they are in poor condition, or stressed as a consequence of their move. Rhinos in good condition, if exposed to only a mild challenge from tsetse flies immediately after their transfer, will develop premunity (i.e. become infected but not sick).
- Tsetse flies were eliminated from what is now Gonarezhou NP by the early 1970s, but have recently expanded their range from Mozambique into the Mahenye communal land immediately east of the northern part of the Park. It is possible that tsetse flies may extend their range into the Park.
- If naïve rhinos, particularly white rhinos, are moved to Gonarezhou NP after the Park has been invaded by tsetse flies, a well-prepared release strategy and careful management will be needed to ensure that the rhinos are in good condition and not immediately exposed to numerous tsetse flies, otherwise there is likely to be high mortality due to trypanosomiasis amongst the rhinos.
- If tsetse flies invade Gonarezhou NP after rhinos are translocated there, it is probable that the initial low density of tsetse flies encountered by the rhinos will allow them to acquire premunity before the density of tsetse flies peaks. However, if the rhinos are in poor condition, either because of a drought, or because of habitat unsuitability, it is more likely that deaths due to trypanosomiasis will occur.

**Infrastructure**

- The road network is poor. This is despite the expenditure in 2004 of Z$394 million on road reconstruction and maintenance, which opened up 170 km of the road network but the necessary conservation measures like mitre drains were not put in place, as the funds were insufficient to cover that. Wet season access is still very restricted.

**Recent Land Invasions**

- Since May 2000, people from the Chitsa area (immediately adjoining the Park) have illegally settled an area of about 160 sq. km on the north-eastern side of the Park, from which they and their livestock stray widely through the Park.
- This is a major breach of security in the Park, but because the invasion is the result of a long-standing Shangaan land claim the situation has to be handled with sensitivity. A shareholding arrangement for the Shangaan people is proposed, within ecotourism operations that can be established in and around the proposed IPZ.

**IPZ Staffing**

- Information not for public distribution.

**Intelligence Gathering and Reward Systems**

- Information not for public distribution.

**Auxiliary Support**

- Information not for public distribution.

**IPZ Staff Distribution and Accommodation**

- Information not for public distribution.

**Transport and Equipment**

- Information not for public distribution.

**Monitoring of Reintroduced Rhinos**

- Information not for public distribution.

**The Public/Private Partnership Concept**

- Because the proposed IPZ suffers from insufficient anti-poaching manpower and a general lack of resources and funding, as well as a community land claim on the part of the neighbouring Shangaan community, it is suggested that these issues are tackled concurrently through the establishment of a Public/Private Partnership (PPP).
- This arrangement should be presented in the context of the overall TFCA process that seeks to accommodate legitimate land claims while not compromising biodiversity conservation within protected areas.
- This PPP concept was strongly endorsed by a stakeholders' workshop held under the auspices of P&WMA and the Zimbabwe National TFCA Tourism Sub-Committee in April, 2005.
- Relevant regional and international precedents exist for conservation-related PPPs and some key examples (the Makuleke land claim in Kruger NP; Coutada 9, Mozambique; a buffer-zone programme in Nepal) are outlined.
- The concept of a PPP and the involvement of this in aspects of management and rhino monitoring within the proposed IPZ are in accordance with policies expressed within the Joint Management Plan of the Great Limpopo Transfrontier Park (GLTP). Indeed, any attempt to implement a rhino IPZ in northern Gonarezhou NP without significant community and private sector participation, and with inadequate and manpower resources available from P&WMA, would be contradictory to the GLTP policy framework.
- The selection of concessionaires for the ecotourism concessions will have a very significant bearing on the success or failure of the proposed rhino IPZ.
- This feasibility study has outlined the concept of a PPP, explaining its relevance to recently-advertised ecotourism concessions within or adjacent to the IPZ. However, further elaboration of this concept would require participatory planning with the local community and other stakeholders. Because of the sensitivity of such interaction, it cannot be initiated unless the overall PPP concept is endorsed by the Ministry of Environment and Tourism.

**Compliance with International Guidelines for Reintroductions**

- The proposal for reintroduction of both rhino species to the northern section of Gonarezhou NP and to establish Intensive Protection Zones for these species to the north of the Runde River was evaluated using the IUCN's established criteria for reintroductions of wildlife.
- The proposal meets the guidelines in a number of key respects, such as a multidisciplinary approach, the availability of relevant reintroduction expertise, the supply of suitable founder animals (from populations that would not be jeopardized by removals, in fact would benefit from

destocking), conformity with historical distributions of the species, habitat suitability (at least for black rhinos), acceptability of disease risks, etc.

- To conform with some of the other IUCN guidelines, the restocking programme would require particular efforts to be made to deal with the Shangaan land claim (which, if insensitively handled, could catalyze rhino poaching), with other aspects of community outreach and awareness, and with the insufficiency of state resources to ensure appropriate management and protection of the rhinos (hence requiring donor support and private sector involvement).
- Because of uncertainties over habitat suitability and dispersal risks for the white rhinos (far more so than with the black rhinos) the white rhino introduction should be regarded as experimental and should have a pre-determined fall-back plan to rescue the white rhinos if they struggle to establish themselves as a viable breeding group.
- A subset of the IUCN reintroduction criteria relates to the demonstration of long-term political support for the reintroduction programme, reflected in the track record of state-managed conservation efforts for the relevant species and for the reintroduction site. Here, the fact that corruption within state agencies (including the wildlife management authority) was a significant factor in the failure of the last rhino reintroduction programme in Gonarezhou NP, and the fact that rhinos in nearby conservancies remain under severe threat from snaring associated with unplanned (but so far condoned) resettlement, become pertinent factors. In addition, the lack of resolution of the invasion within the Park by the Chitsa community is a contra-indication for rhino introductions in terms of the IUCN guidelines.
- These concerns underline the need for, firstly, the reintroduction programme to be based on innovative approaches that show full recognition of the pitfalls, and secondly, for the P&WMA to demonstrate a very considered approach that allays any concerns that political factors rather than conservation factors are driving the reintroduction process.

# THE REINTRODUCTION OF RHINOS TO GONAREZHOU NATIONAL PARK, ZIMBABWE: A FEASIBILITY STUDY

## Institutional, Management and Security Issues related to the Implementation of a new Rhino Intensive Protection Zone in Gonarezhou National Park, Zimbabwe

***Raoul du Toit and Lovemore Mungwashu***

# Contents

## ACRONYMS

| | |
|---|---|
| CPA | Communal Property Association |
| DNPWLM | Zimbabwe Department of National Parks and Wild Life Management (now P&WMA) |
| DNPWC | Nepalese Department of National Parks and Wildlife Conservation |
| DUAT | Land concession (Mozambique) |
| GPS | Global Positioning System device |
| IPZ | Intensive Protection Zone |
| NP | National Park |
| PCP (Nepal) | Participatory Conservation Programme |
| P&WMA | Zimbabwe Parks and Wildlife Management Authority |
| PPP | Public/Private Partnership |
| PPP (Nepal) | Park People Programme |
| SADC RPRC | SADC Regional Programme for Rhino Conservation |
| SANParks | South African National Parks Board |
| TFCA | Transfrontier Conservation Area |
| TFPA | Transfrontier Protected Area |
| WWF | World Wide Fund for Nature |
| ZESA | Zimbabwe Electricity Supply Commission |

# 1. SWOT ANALYSIS

As a scoping exercise for the feasibility study of the proposed rhino IPZ in northern Gonarezhou NP, a workshop was held at Malilangwe on 11 February, 2005 to undertake a SWOT analysis (review of strengths, weaknesses, threats and opportunities pertaining to the IPZ).

The following factors were identified by the workshop participants as critical to the success of the plan to reintroduce rhinos to Gonarezhou NP:

- Resolution of the present and any potential future land claims and occupations;
- Securing adequate funding and resources;
- Development of suitable mechanisms for co-operation and co-ordination with potential partners; and
- Improved access to the Park and the IPZ, for tourists as well as staff.

Participants were as follows:

| **Name** | **Organisation** |
|---|---|
| D. de la Harpe | The Malilangwe Trust |
| E. Gandiwa | P&WMA Chipinda Pools |
| C. Foggin | Wildlife Veterinary Unit, Division of Livestock & Veterinary Services |
| R. du Toit | SADC Regional Programme for Rhino Conservation |
| C. Nyaguse | PWMA Midlands Province |
| K. Dunham | Freelance Biologist |
| T. Madawo | P&WMA Chipinda Pools |
| B. Clegg | The Malilangwe Trust |
| L. Mungwashu | WWF SARPO |
| C. Wenham | The Malilangwe Trust |
| L. Dodzo | PWMA Masvingo |
| G. Connear | Save Valley Conservancy |

**The results of the SWOT analysis for the proposed Intensive Protection Zone (IPZ) for rhinos**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Increased staff establishment has been approved | Roads are much improved but still inadequate | "CAMPFIRE" project on Mozambique side | Proximity to Mozambique: long and insecure boundary |
| Is a national park: thus institutional capacity exists | Poor communications by radio. No phones | Profile of TransFrontier Conservation Area (TFCA) leads to high awareness and potential for "leverage" | Present and potential future land claims |
| Sheer size of the Park | Rugged terrain | Regional co-operation and support as a result of TFCA | Hostile and hungry neighbours |
| Existence of suitable habitats? | Inadequate funding and therefore inadequate resources | More tourists to visit as result of TFCA | Tsetse fly encroachment: white rhinos susceptible to trypanosomiasis? |
| Natural water supply: little augmentation needed? | People and domestic animals living in the Park, close to proposed IPZ | Rhino introduction will encourage tourist visitation | Other diseases such as anthrax and TB |
| Proximity of multiple sources of potential support | ?Habitats for both species do not coincide? | Leverage TFCA development for improved funding | General breakdown of law and order |
| Proximity of sources of founder stock | Excess fire modifying park habitats | Opportunity for Public-Private Partnership (PPP) | Donor fatigue |
| Ease of integration into regional rhino conservation effort | ?Competition from and habitat destruction by elephants | IPZ can be springboard for reintroductions of other species | |
| Improved regional stability | Lack of natural and other boundaries to the IPZ | | |
| Water distribution may limit expansion of an expanded population into the rest of the Park | | | |
| Wilderness appeal to tourists | Lack of trained and experienced staff | | |
| | Few visitors, therefore limited income generation. Reliance on donors | | |
| | Confusion over status of Park plans | | |

# 2. SECURITY AND INFRASTRUCTURAL REQUIREMENTS

## 2.1 Previous Consideration of an IPZ

Information not for public distribution.

## 2.2 Poaching History

Information not for public distribution.

## 2.3 Infrastructure

Information not for public distribution.

## 2.4 Recent Land Invasions

Information not for public distribution.

## 2.5 IPZ Management Issues

### *2.5.1 Staffing*

Information not for public distribution.

### *2.5.2 Training*

Information not for public distribution.

### *2.5.3 Intelligence Gathering and Reward Systems*

Information not for public distribution.

### *2.5.4 Auxiliary Support*

Information not for public distribution.

### *2.5.5 IPZ Staff Distribution*

Information not for public distribution.

### *2.5.6 Forward Bases*

Information not for public distribution.

### *2.5.7 Transport*

Information not for public distribution.

### *2.5.8 Roads*

Information not for public distribution.

### *2.5.9 Fences*

Information not for public distribution.

### *2.5.10 Accommodation*

Information not for public distribution.

### *2.5.11 Communications*

Information not for public distribution.

### *2.5.12 IPZ Immediate Infrastructural and Equipment Costs*

Information not for public distribution.

Information not for public distribution.

## 2.6 Monitoring of Reintroduced Rhinos

Information not for public distribution.

Information not for public distribution.

# 3. PRIVATE/PUBLIC PARTNERSHIP FOR THE IPZ

## 3.1 Background Considerations

The proposed IPZ faces two significant challenges:

- Insufficient anti-poaching manpower and a general lack of resources and funding;
- A community land claim on the part of the neighbouring Shangaan community.

Both the above factors would undermine the security of rhinos that are re-introduced to the IPZ. In addition, unless the land claim is handled sensitively, the issue could well result in adverse international publicity and pressures from some human rights organizations who take the view that TFCAs are designed to benefit wildlife rather than communities.

On the one hand, the invasion into the Park is completely illegal so these invaders can certainly be described as squatters and forcibly evicted as such. But on the other hand, the invasion is an opportunistic outcome, during Zimbabwe's revolutionary-style land reform process, of decades of dissatisfaction on the part of the Shangaans regarding their eviction from the Park, which was a phased and harsh process and thereby created much confusion and aggravation for the destabilized community. It is therefore important to deal with the issue in a way that recognizes the human rights element (as it has also been recognized in the resolution of the Makuleke land claim within Kruger NP) but does not simply constitute appeasement of the invading group. A politically expedient but narrow solution, such as simply giving the invaders land elsewhere, may create a very difficult precedent for P&WMA in view of invasion pressures in other areas of Parks Estate.

The challenges of the land claim and the lack of IPZ investment may well be addressed concurrently through the development of a Public/Private Partnership (PPP) arrangement that brings in private sector support but also creates a significant shareholding for the Shangaan community. To avoid the impression of a forced response to the current squatter pressures, this businesslike arrangement should involve a wider Shangaan community and should be presented in the context of the overall TFCA process that seeks to accommodate legitimate land claims while not compromising biodiversity conservation within protected areas.

## 3.2 Stakeholder Interest in a PPP in Northern Gonarezhou NP

A stakeholders' workshop was held, under the auspices of P&WMA and the Zimbabwe National TFCA Tourism Sub-Committee, at Malilangwe on 5-6 April, 2005, to discuss tourism development scenarios related to the Great Limpopo TFCA. Participants were drawn mainly from the relevant Rural Districts Councils, but also included some central government officials and NGO representatives.

A major concern to emerge from the workshop was the lack of progress, after more than five years of discussions, in the implementation of actual projects to develop the TFCA within Zimbabwe, particularly in terms of "benefits beyond park boundaries". The participants therefore focussed their debate on four potential projects or programmes that they agreed are feasible and necessary as next steps in the TFCA development. Among these was the development of ecotourism in the northern and southern sections of Gonarezhou NP, where the workshop participants suggested that tripartite arrangements could be developed to link the private sector, P&WMA and local communities into mutually beneficial operations. A working group that explored this concept further identified the key issues as follows:

- Gonarezhou NP is a cornerstone for the TFCA (insofar as Zimbabwe is concerned);
- Initial park plans were for low volume/high value tourism (only 400 tourists in the park at any time), but a greater diversity of tourism operations (including elements of cultural tourism in surrounding areas) may be required;
- Any new operations need linkages with local/regional components to achieve economies of scale, with these components including the existing tourism operations at Mahenye and Chilo Gorge, conservancies, and the rest of TFCA;
- Gonarezhou NP has particular wilderness attraction, but the downside is poor access and limited infrastructure;
- 14 ecotourism concessions have recently been advertised in Gonrezhou NP but P&WMA is likely to have an income-generation motive in selecting concessionaires for these (because

P&WMA is now a parastatal) and may therefore overlook "win-win" opportunities that create benefits for other stakeholders.

The working group identified the constraints to ecotourism development as:

- Development funding is currently limited, either from donors or from Government;
- There is the land claim issue in Gonarezhou NP, currently exhibited through occupation of the north-eastern section, which creates insecurity of investment;
- Gonarezhou NP has poor access and limited infrastructure;
- Gonarezhou NP has low wildlife densities, possibly due to long-term poaching pressures, high frequency of fires and elephant overabundance;
- Tourist support services (particularly air transport) are extremely limited;
- Other local wildlife operations (conservancies) that could help built critical mass (e.g. for air services and marketing) face uncertainties over security of investment;
- External investors see an unfavourable climate for tourism development (poor services, "unfriendly" attitude by customs/immigration officials, negative international political perceptions, insufficient security of investment).

The following assumptions were made:

- There will be resolution of the tenure and political uncertainties that are undermining investment, with a more conducive policy framework established;
- A Tourism Development Zone will be designated to encompass Gonarezhou NP;
- There will be overall improvement in Zimbabwe's image as a tourist destination to gain the confidence of tourist agents and their clients;
- Tripartite agreements, involving communities, will reduce the incidence of fires and poaching in the Park.

Taking the above key issues, constraints and assumptions into account, the workshop recommended that:

- The joint vision of key stakeholders regarding park development should be outlined in an succinct umbrella "constitution", expressing overall policy for management and development of the park, addressing equity issues and encouraging private sector investment;
- Specific development plans should be developed, under this overall park policy, for a.) northern Gonarezhou NP b.) southern Gonarezhou NP, involving tripartite arrangements based on recently-advertised ecotourism concessions.

Overall, the outcome of this workshop was a strong expression of stakeholder interest in PPP arrangements, of immediate relevance to the development of the proposed IPZ.

## 3.3 Some Relevant Precedents for PPPs

### *3.3.1 The Makuleke Land Claim, Kruger NP*

This situation is described by Turner (2004), Steenkamp and Uhr (2000), and Magome (undated).

In 1969, the Makuleke community of about 2,000 people was forcibly removed from a 24,000 ha area in the north-eastern corner of South Africa near the borders of Zimbabwe and Mozambique. The community was resettled in Ntlhaveni, a newly established reserve for Tsonga-speaking people. In 1971, almost all of their area of previous occupation was incorporated into Kruger NP, and the rest was included a military no-go zone along the Limpopo River (the Madimbo Corridor). Forced removal to Ntlhaveni was accompanied by political and economic changes.

First, political authority within the homelands was structured by "traditional" authorities as recognized by the Department of Bantu Affairs. At removal, the Makuleke chief was made a headman, subordinate to Chief Mhinga (a similar process to the demotion of the former Chief Chitsa after the removal of his community from Gonarezhou NP). Because recognized chiefs had considerable discretion over land and revenue allocation, the demotion of the Makuleke chief had material

consequences for his people. Secondly, removal brought a shift in the relative importance of subsistence agriculture and wage labour. The Makuleke were concentrated on a relative small parcel of land, comprising 6,000 ha divided into three villages, and agricultural plots could no longer be scattered. Ntlhaveni lacked the wildlife, wild fruits, lala palm, and fish of the Makuleke area, so the Makuleke had to adapt their farming practices to the different agricultural conditions of the dry savanna. Wage labour became essential to survival, but employment opportunities were limited.

Apartheid's end provided an opportunity for the Makuleke (now comprising some 15,000 members) to reclaim the Makuleke area. The new South African Bill of Rights established the right to restitution for persons and communities who had lost their property as a consequence of racially discriminatory laws; groups could seek individual or collective restoration, alternative land, or compensation. The Makuleke filed a collective restitution claim, and established the Makuleke Communal Property Association (CPA) as the legal vehicle to pursue the land claim and receive title. The CPA membership included all individuals who had lived in the Makuleke area and their descendents, as well as individuals who have joined the Makuleke community.

Representatives of the Makuleke then negotiated with the National Parks Board (now SANParks) and other government ministries. The Makuleke agreed to preserve the Makuleke Region's status as a conservation area early in the negotiation process. Three years after the claim was filed, the parties reached a settlement. In late 1998, Land Claims Court recognized the settlement and ordered the transfer of title to the Makuleke area to the Makuleke CPA.

The court order marked the first successful settlement of a land restitution claim involving a South African national park. The Restitution Agreement included the proviso that the Makuleke area would be administered as a contractual national park for 20 to 50 years. Although SANParks resisted the Makuleke's land claim for most of the negotiation process, the final resolution was portrayed as a "win-win solution." The Makuleke gained the symbolic victory of official recognition of injustice, formal title to the land, and commercial rights. For SANParks, the most important outcome was the retention of the Makuleke area within Kruger NP. In fact, the Park grew slightly with the addition of the 3,000 hectares the Makuleke reclaimed from the Madimbo Corridor. SANParks also gained a formal commitment to continued conservation of the area, and the ability to monitor and sometimes participate in Makuleke decision-making. Because visitors to the Makuleke area enter from a gate outside of its boundaries, SANParks retains gate revenues as well.

Since the resolution of the land claim, the Makuleke area has been co-managed, in theory, by the Makuleke CPA and SANParks, the parastatal that manages all national protected areas. Because the CPA does not possess sufficient conservation expertise or manpower to manage the region without assistance, SANParks has undertaken day-to-day conservation management. The CPA must present all commercial plans to the Makuleke-SANParks Joint Management Board, compare proposals with the Park's conservation management plan, and conduct environmental impact assessments for each proposal. The CPA must justify its decisions to SANParks, although SANParks' ability to block ventures is limited. Initially SANParks was obligated to bear all operational costs, but with up to 50% of these costs to be borne by the Makuleke CPA once profitable operations are underway.

Because of their general poverty, the Makuleke must partner with other actors who possess material resources and/or necessary expertise to develop wildlife operations. Bid documents clearly state that the private partners will be responsible for financing any joint projects. Although partners are expected to have a reasonable rate of return, they are also required to implement their ventures in a manner that advances the community. Each venture will include provisos for the eventual transfer of lodges built on Makuleke land to the CPA. Although this strategy seeks to protect the Makuleke's interests while advancing their tourism initiative, it may also render the area less attractive to investors. A series of joint ventures have been agreed with private sector partners such as Wilderness Safaris. The Makuleke receive 8% of the income from Wilderness Safaris and other ecotourism operators on their land. Because these operations have had a slow start, limited safari hunting was allowed in the Makuleke area as a way of generating income until ecotourism became established.

The restitution of the Makuleke land claim has not been without controversy, for instance:

- There was great concern about the perceived threat to the integrity of Kruger NP, especially since there was initial consideration by the Makuleke of mining opportunities, followed by the pressure for safari hunting in part of a National Park;

- Power struggles were intensified amongst local communities (between the Makuleke leadership and Chief Mutele);
- Sociologists have expressed reservations about the risk of exploitation and unequal partnership in joint ventures with the private sector;
- Some of the Makuleke have voiced opposition to the TFCA concept, seeing it as a process that will "re-colonize" land that they have won back;
- The inflow of benefits to the Makuleke people as a whole (in the form of community projects) has, so far, been limited and disparities have been perceived when, for instance, some of the community income has been used for transport for the chief.

Notwithstanding these areas of controversy, the overall assessment of one analyst (Turner, 2004) is as follows.

*Although the Makuleke people I interviewed hope that the Makuleke Region will improve economic conditions, that is not the only basis on which they judge success. All indicated that regaining title to their ancestral home was an immense symbolic achievement independent of subsequent commercial success or failure. It was equally evident that the conditions of engagement with SANParks mattered immensely. The Makuleke CPA was explicitly empowered to make commercial decisions; the scope of SANParks authority was limited. This CBNRM initiative is based in explicit recognition of past injustice and the partners meet on somewhat equal ground. Ultimately, participation, rather than development, may prove the determinant of CBNRM "success."*

### *3.3.2 Manica Province, Mozambique*

The following outline is based on a paper by Durang and Tanner (2004).

The Government of Mozambique has been implementing a market-driven rural development programme after years of socialized agriculture. This has encouraged investor interest in apparently unoccupied land, including interest in wildlife operations, but there are concerns that this commercial thrust will threaten local rights and production systems still recovering from civil war. To clarify the policy situation and to minimize conflicts, a National Land Policy was implemented in 1995.

This policy recognizes that security of tenure is essential for both investors and communities. If land tenure and property rights are insecure, any investment project, regardless of its apparent long-term profitability, will employ practices to take out the profit in the quickest way regardless of the environmental consequences. State-allocated land-use rights in Mozambique are given as a formal approval (the Portuguese acronym for which is DUAT) to each investor, but recognizing customary rights of access and management. A DUAT can be conferred through:

- Local community occupation (customary laws and practices);
- Through "good faith" occupation, when a Mozambican national has used the land without objections or counter-claims for at least 10 years;
- Through a formal request to the State (this is the only option available to an external investor, and if granted will be in the form of a 50-year lease).

Investors have to consult and get the approval of local communities before they are able to obtain a DUAT. This process of community consultation still requires streamlining and has led to highly variable levels of conformity between investor expectations and local community perspectives. In Forest and Wildlife Regulations promulgated in 2002, a requirement is entrenched that 20% of public revenues from commercial forest and wildlife ventures are given to local communities to support local development.

A fundamental question for the implementation of these policies is: what is the "local community"? Under the Mozambican Land Law, community delimitation is achieved through a pragmatic process of self-definition of stakeholder groups, breaking away from the more artificial delimitation of communities under local government jurisdictions (as is the case with Communal Land wards, under Rural District Councils, in Zimbabwe).

In Mozambique, the delimitation process is required to identify and register the land unit over which a local community has a DUAT arising from customary occupation. The process centres around a

participatory rural diagnosis in which local people draw upon their own knowledge of their history, land use, and socio-political organisation to define their community. The spatial boundaries identified by a community for their DUAT must also be discussed with and agreed by neighbouring communities, and then are mapped and registered. Once the community DUAT is identified, the land-use rights are managed by a community land committee that represents its local community in all subsequent process that involve the disposal of or shared use of its DUAT, and it is then clear to an investor whom to negotiate with for usage rights within that area.

The delimitation exercise automatically serves as a kind of resource inventory, undertaken in a participatory way that sets the stage for future land-use planning and development initiatives.

To date, the community delimitation process has been slow and fragmentary, and is often driven by NGOs that seek to develop rural development projects and see the need for greater community security over the project areas. In Manica Province, for instance, only 10 community delimitations were completed over the period 2000-2004. One initiative in this Province that has particular relevance to wildlife-based land-use is in Coutada 9, which is a 3,763 sq. km hunting reserve in which a significant local population is resident and is involved in subsistence agriculture, hunting and honey extraction. These activities compromise the viability of safari hunting operations, particularly through habitat degradation and disturbance in key dry-season wildlife refuges and through the unregulated offtake of potential trophy animals. Therefore the safari operator who has invested in this reserve has recognized the rights of the local community, under the overall authority of the Ministry of Tourism (which has jurisdiction over hunting reserves).

A kind of PPP has been developed, with support from FAO, in which Coutada 9 has been zoned as follows:

- A core area, in which the investor manages all the resources and from which ultimately, and at their own free will, the resident people will move;
- A buffer zone that is managed jointly by the investor and the community for two years, and thereafter by the community alone;
- A peripheral community zone in which the community undertakes subsistence agriculture and other non-hunting activities.

The community receives a share of the trophy fees in the core area (25%) and in the buffer zone (76%). A process of community delimitation and registration of the DUAT (or more than one DUAT) is underway to finalize the land-use and business plan for this area.

### *3.3.3 People-Park Programme, Nepal*

The term PPP was modified in Nepal to refer to a “Park People Programme”, initiated by the Department of National Parks and Wildlife Conservation (DNPWC) as a buffer zone programme, supported technically and financially by UNDP from 1995-2001 (UNDP, 2004). After PPP completed its implementation cycle, the Participatory Conservation Programme (PCP) took over from May 2002 with the aim of building on and institutionalizing the successes and achievements of PPP.

The Nepalese PPP and PCP programmes arise from a policy transition by DNPWC which has changed from an agency working in protected areas for natural resource protection and conservation, to one that is now driven by the concept of bringing about sustainable development and a congenial park-people relationship by striking a balance between biodiversity conservation and human needs. To this end, PPP and PCP adopted a participatory approach by taking local communities as partners in the effort. DNPWC/PCP carries out all buffer zone management activities in close consultation and partnership with the various community-based institutions like User Groups, User Committees, and Buffer Zone Management Committees.

DNPWC/PCP has implemented the buffer zone programme in the buffer zones and proposed buffer zones of Royal Chitwan National Park, Royal Bardia National Park, Khaptad National Park, Rara National Park, Koshi Tappu Wildlife Reserve, Parsa Wildlife Reserve and Royal Suklaphanta Wildlife Reserve.

Apart from striving to improve the park/people relationship, the major objectives of DNPWC/PCP's buffer zone programme are:

- To minimize human impact on protected areas;
- To support alternative avenues for fulfilling the natural resource needs of local communities, and to introduce appropriate technologies for sustainable rural development;
- To stimulate local communities to organize themselves into strong, self-governed institutions capable of undertaking pro-conservation and pro-development activities in and around the areas that they inhabit;
- To institutionalize sustainable financial mechanisms (savings and credit programmes) for funding community-centred conservation and development activities in the buffer zones.

The scope of rural development activity of the Nepalese PPP/PCP has gone well beyond basic resource management (which has included agro-forestry activities) to include skill enhancement training such as productive livestock rearing, poultry farming and feed production, fishery and nursery management and operation, vegetable farming, fruit plantations, herbal farming, biogas production, veterinary skills, etc. These interventions are aimed at reducing the dependency of the buffer zone communities on the natural resources of the Parks/Reserves.

Despite recent political turmoil in Nepal, agencies such as WWF have found it possible to continue their support for these holistic activities because they have maintained momentum owing to a high level of local interest and motivation, taking them beyond the political disputes.

### *3.3.4 Salient Points Emerging from these PPP Examples*

Each of the above examples highlights different aspects of relevance to a PPP approach in northern Gonarezhou NP.

- The situation in Coutada 9 of Manica Province illustrates shareholding arrangements that are relevant to the Mozambican situation, which is in turn relevant to the Great Limpopo TFCA because Mozambique is a part of this TFCA and there needs to be some harmonization of policies within the TFCA. This is especially the case since Shangaan communities, closely linked to those around the proposed IPZ, will in due course be likely to be involved in the formalization of their land rights in their areas of Mozambique, adjoining Gonarezhou NP.
- The Makuleke situation similarly illustrates a precedent for community involvement within the TFCA. The restitution of the Makuleke land claim has given rise to various controversies and the overall benefit to the community is sometimes questioned, indicating that a similar process to deal with the Shangaan land claim in Gonarezhou NP through a PPP will not be universally applauded. However, the alternative of doing nothing about the historical land claim, and simply evicting the invaders, will be even less acceptable to sociologists, human rights activists, etc, to say nothing of the local community attitude.
- In amelioration of these criticisms, the Nepalese PPP and PCP programmes highlight the potential of a strong programme for biodiversity conservation to draw in governmental, donor and NGO support for holistic rural development adjacent to a protected area. Enhancement of human livelihoods adjacent to Gonarezhou NP is essential because a community shareholding in the PPP will not in itself constitute sufficient income generation for the people who live in this area, with its poor potential for dryland farming.
- The Mozambican example illustrates a process of community self-delimitation, which is likely to be much more important to the Shangaan community around the proposed IPZ than any local government boundaries.

## 3.4 Conformity with Broader TFCA Policies

The implementation of the Great Limpopo Transfrontier Protected Area (TFPA) is guided by the Joint Management Plan (Great Limpopo Transfrontier Park Joint Management Board, 2002), which outlines general policies to harmonize activities within the sections of Mozambique, South Africa and Zimbabwe that comprise the transfrontier park. It is important to refer to this document when any new initiatives are considered, to avoid the risk of creating an uncomfortable or unacceptable precedent for other member states within the TFPA.

The following policy recommendations, of relevance to a PPP arrangement in the proposed rhino IPZ, are expressed in the Joint Management Plan.

*One of the goals of the Great Limpopo TFPA should be to ensure that neighbouring communities should have the opportunity to acquire equity in the Park and not only in employment.*

*Some form of community involvement in the security of their park must be developed with the neighbouring communities. This is particularly the case with rhino conservation and it has also been shown in several areas that only when communities are convinced that conserving rhino will bring them long-term benefits, will rhino be assured of a long-term future.*

*It is recognized that there are differences in the capacity and resources of the national conservation agencies and the time is now ripe that the private sector should be called upon to undertake some of the wildlife management responsibilities in one or more of the protected areas. It is felt that this change in the traditional paradigm is acceptable, on condition that the conservation objectives of the area are upheld and the standards of the service provided are at least equivalent to those that the conservation agency could provide.*

*It is recognized that many of the GLTP development and management activities can be cost-effectively outsourced to the private sector, either independently or in joint ventures with community organizations or Park management.*

From the above, it is apparent that the concept of a PPP arrangement to reinforce the proposed IPZ is in total conformity with recommendations of the overall Joint Management Plan for the Great Limpopo Transfrontier Park. Indeed, any attempt to implement a rhino IPZ in northern Gonarezhou NP without significant community and private sector participation, and with inadequate and manpower resources available from P&WMA, would be contradictory to the policy framework.

### 3.5 Possible Elements of a PPP in the Proposed Rhino IPZ

By definition, a PPP arrangement can only be elaborated through a significant amount of participatory planning involving all stakeholders. Given that one of the stakeholder groups is the Shangaan community, some members of which are involved in an illegal invasion of the Park, there is potential to create further political tension if a participatory planning process is initiated without official endorsement. Therefore, it has been inappropriate within the current feasibility study to explore the PPP concept in any detail and only a conceptual outline can be presented. If and when the concept is approved, a great deal of participatory planning will be required to develop a detailed outline of the PPP project.

A related issue that has to be resolved by the authorities is the selection criteria for awarding a number of concessions that have recently been advertised for development within the Park. Two of these concession sites (Masasanya, and Lower Pombadzi) are within the proposed IPZ. In addition, the Chilojo lodge site is on the southern boundary of the proposed IPZ in the most likely direction of expansion of the black rhino population. A concession site at Tambahata Pan on the eastern side of the IPZ has also been advertised, and would be relevant to the PPP, although concerns have been expressed about the ecological impact of a lodge at this sensitive site (there is also concern that the Chilojo site requires reconsideration as it will have an aesthetic impact in the scenic area of the Chilojo Cliffs and may unreasonably restrict the access of park visitors). If these sites are allocated to one or more operators who wish to enter into a PPP arrangement and can bring relevant experience into it, then the concept will be feasible. But if the sites are allocated to concessionaires who are unwilling to participate or who are ignorant of basic principles of community involvement, then the PPP will obviously be compromised.

Because ecotourism is at a very low level in Zimbabwe at present owing to negative international perceptions, new ecotourism ventures will struggle to maintain critical mass and therefore the PPP should, if at all possible, be linked with the existing lodges of Chilo Gorge and Mahenye. This will enable the PPP to benefit from existing support and marketing services. Chilo Gorge and Mahenye already have community participation, which is likely to be the reason why the Shangaans living in this area (who have as strong a land claim within the Park as those living in the Chitsa area) did not invade

the Park. By including these existing lodges in an overall PPP for the northern section of Gonarezhou NP, the resolution of land claims can be presented as a general TFPA process to create community shareholdings, rather than as an appeasement process focussed specifically on the Chitsa squatters.

If the PPP option is developed as recommended by this feasibility study, then consideration should be paid to regarding the re-stocked rhinos (that are the "flagship species") as resources that can have an asset value for the PPP. This asset value could be derived from an agreement that in return for providing a rhino monitoring service within the IPZ (as demonstrated through a specific procedure of reporting to P&WMA or maintaining a rhino population database such as WILDb), the PPP will be entitled to a proportion of the value of rhinos that are captured in the area in order to restock other areas. Such an arrangement will create a significant opportunity for incentives-based conservation funding by donors within the TFCA process; by paying an agreed amount per rhino to the PPP, these donors would not only be encouraging the local community to prevent poaching in the IPZ, but would also be maintaining a supply of rhinos to facilitate the restocking of other areas of the TFCA.

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# THE REINTRODUCTION OF RHINOS TO GONAREZHOU NATIONAL PARK, ZIMBABWE: A FEASIBILITY STUDY

## Biological Aspects and IUCN Reintroduction Guidelines

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**Fire in northern Gonarezhou NP**

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## Summary


### Original Populations of Rhinos

- Black rhinos were recorded in the vicinity of the present Gonarezhou National Park (NP) during the late 19th century. The last black rhino of the original population was killed probably during the 1930s or early 1940s.
- The earliest records of the white rhinoceros in the vicinity of Gonarezhou NP are rock paintings. The written records of white rhinos closest to Gonarezhou NP are from 1836/37, 100 km west of the southern-most part of the park.
- There are no material records of the white rhinoceros in Zimbabwe after the 1890s, but there are several unsubstantiated reports of white rhinos in the vicinity of the present Gonarezhou NP during the first 30 years of the 20th century, i.e. after the white rhinoceros was generally thought to be extinct in Zimbabwe.

### The First Reintroduction of Black Rhinos

- Seventy-seven black rhinos were released in the present Gonarezhou NP during 1969-1971. Most were freed north of the Runde River. During the 1970s, a programme for the development of artificial supplies of water for wildlife was initiated, but after 1976 the piped artificial water supplies were closed down for several years. The initiation and then closure of this system may have influenced the dispersal of rhinos. Most sightings of black rhinos were in the northern half of the park, but two rhinos captured in the north of Kruger NP during 1979-1982 were believed to have come from Gonarezhou.
- Between the Save and Runde Rivers, very few black rhinos were seen in the northern half of this area. Instead most rhinos were seen closer to the Runde River, within 10 km of pools that provided drinking water at the end of the dry season even in drought years. The vegetation of this area during the period when it was occupied by black rhinos was described only broadly, but it included thickets that were probably attractive to the rhinos. Several lines of evidence suggest that their density in this area averaged approximately 0.1 rhinos $km^{-2}$ (in other words, approximately 1 rhino per 10 square kilometres). Surveys of the rhinos differed in methods and study areas, but probably the park's population at its peak exceeded 100 animals.

### Poaching

- Rhino poaching was recorded soon after the releases, but the number killed increased markedly during 1984. Some staff members of the Department of National Parks & Wild Life Management (DNPWLM) and some army personnel are alleged to have been involved in this poaching. By 1994, the black rhinoceros was locally extinct for the second time.

### White Rhinos in Gonarezhou NP

- A few white rhinos were seen in Gonarezhou NP during the 1980s, after they entered the park of their own accord from the adjacent Lone Star Ranch (now Malilangwe Estate). The last of these rhinos was captured and translocated during 1993.

### Artificial Supplies of Water for Wildlife

- The piped artificial supplies of water for wildlife have not been consistently maintained. From the point-of-view of the animals, these supplies have been opened and closed unpredictably. Cessation of pumping in an area where rhinos have settled can cause social disruption, including intraspecific fighting, and unpredictable dispersal.
- The major disadvantages of an artificial supply of water are that: (a) it causes an increase in the local density of elephants and in their impact on the woody vegetation; and (b) it is expensive to install and maintain. During the severe 1992 drought, the DNPWLM was dependent on the private sector to overhaul and maintain the artificial supply of water in Gonarezhou NP.

- Of the two dams built to provide water for wildlife, one is commonly dry during the late dry season and the other is spring-fed during this period. Neither provided water for wildlife during the 1992 drought.
- It is recommended that the rhino reintroductions are planned on the basis that only natural supplies of water will be available for the rhinos to drink.

**Assessment of the Area North of the Runde River as Habitat for Black Rhinos**

- Since the reintroduction of the black rhinoceros, there have been major changes in the vegetation in the Save-Runde area, with the conversion of *Brachystegia glaucescens* woodland to bushed grassland, and the loss of thickets. Changes in these thickets have probably been detrimental to black rhinos, but because there was no detailed description of the thickets in the past, the extent of the recent changes is unclear.
- The area of the Nyachiri, Sililijo and Pombadzi Rivers appeared to be particularly good for black rhinos in the past and, despite the recent vegetation changes, would probably still be suitable. However, if rhinos were released here, it is likely that some individuals will move south across the Runde River, or east towards the Save/Runde confluence and Mozambique. Except where it flows through a steep gorge, the Runde River is not a physical or ecological barrier to rhino movement.

**Assessment of the Area North of the Runde River as Habitat for White Rhinos**

- Much of the ground surface in the Save-Runde area – particularly the area formerly mapped as *Brachystegia glaucescens* woodland - is covered with rock rubble or stones. These areas would probably be avoided by white rhinos. Within 3 km of the Runde and Save Rivers, white rhinos would probably be in competition for food with hippos. The *Combretum imberbe-Spirostachys africana* wooded grassland includes areas of *Digitaria* grass, which probably would be favoured by white rhinos, but it also includes areas of *Hyparrhenia* and *Hyperthelia* grasses, which white rhinos would avoid.
- Over most of the area north of the Runde, the grasses are burnt each year by wild fires. Whether this is beneficial for white rhinos will depend on whether there is sufficient soil moisture to promote a flush of green grass before the start of the rainy season.
- The *Colophospermum mopane-Urochloa mosambicensis* woodland on basaltic soils in the north-west of the Save-Runde area would be favoured by white rhinos, but most of this area appears to be more than 10 km from natural supplies of drinking water at the end of the dry season during droughts. Furthermore, much of this vegetation community has been settled by squatters who have snared wildlife, destroyed natural vegetation to create fields, and introduced cattle to the national park. The squatters have been resident since at least 2001.
- During the 1992 drought, the numbers of large grazers (hippos and buffaloes) in the park declined dramatically as a consequence of malnutrition, despite major and expensive management interventions that included providing hippos with artificial supplies of food. At present, it is very doubtful that this area can support 50 white rhinos in the long-term. It is recommended that an assessment be conducted of the state of the grass layer potentially available to white rhinos at the end of the dry season.
- It would be prudent to postpone further consideration of the reintroduction of the white rhinoceros until such time as the establishment of the Greater Limpopo Transfrontier Park has progressed to the stage that there can be free movement of large mammals such as white rhinos between Gonarezhou and neighbouring subpopulations, such as those on Malilangwe Estate and the Save Valley Conservancy. The greater the overall population of white rhinos and the larger its contiguous range, the greater the probability that a viable number of individuals will survive a drought.

**Fire in northern Gonarezhou NP (*Section author: Dr Fay Robertson*)**

- The Save and Runde Rivers provide natural fire barriers on three sides of the proposed Intensive Protection Zone (IPZ). But there are frequent fires in this area, usually started by arsonists. The regular occurrence of arson is probably a reflection of the poor relations that have long existed

between the local communities and the Department of National Parks & Wild Life Management (DNPWLM)/Parks & Wildlife Management Authority (PWMA).

- The area within the proposed IPZ that burned annually has been determined primarily by the fuel load, as influenced by rainfall. Park managers, who have attempted to prevent fires and to extinguish accidental fires, often by backburning, have had little effect on the total area burned each year.
- Within the past 20 years, the vegetation in the proposed IPZ has changed. Woodland and thickets have been reduced to bushed grassland, or shrubland. As trees disappeared, the standing crop of grass increased. This greater fuel load has allowed more intense fires, which are usually impossible to fight manually.
- In order to encourage woody regrowth, and because it is impossible to prevent fires from starting in the IPZ, or to extinguish most wildfires, a different, more focused, fire policy is proposed. It is recommended that, in most vegetation types, management staff deliberately burn early during the dry season, when fires are less intense, with the aim of creating a patchwork of burnt and unburnt areas. Early-burning activities should be concentrated initially on areas where this policy is most likely to succeed.
- Successful implementation of early-burning requires careful planning and great commitment by management staff, over a period of many years.

**Rhinos, Tsetse flies and Trypanosomes**

- When rhinos that have never been exposed to tsetse flies and trypanosomes are moved to areas with tsetse flies, there have often been problems, with rhinos dying from trypanosomiasis soon after being moved. White rhinos seem to be particularly susceptible, although all naïve rhinos are at risk if they are in poor condition, or stressed as a consequence of their move. Rhinos in good condition, if exposed to only a mild challenge from tsetse flies immediately after their transfer, will develop premunity (i.e. become infected but not sick).
- Tsetse flies were eliminated from what is now Gonarezhou NP by the early 1970s, but have recently expanded their range from Mozambique into the Mahenye communal land immediately east of the northern part of the park. It is possible that tsetse flies may extend their range into the park.
- If naïve rhinos, particularly white rhinos, are moved to Gonarezhou NP after the park has been invaded by tsetse flies, a well-prepared release strategy and careful management will be needed to ensure that the rhinos are in good condition and not immediately exposed to numerous tsetse flies, otherwise there is likely to be high mortality due to trypanosomiasis amongst the rhinos.
- If tsetse flies invade Gonarezhou NP after rhinos are translocated there, it is probable that the initial low density of tsetse flies encountered by the rhinos will allow them to acquire premunity before the density of tsetse flies peaks. However, if the rhinos are in poor condition, either because of a drought, or because of habitat unsuitability, it is more likely that deaths due to trypanosomiasis will occur.

**International Guidelines for Reintroductions**

The proposals to reintroduce the black rhinoceros and the white rhinoceros to Gonarezhou NP and to establish Intensive Protection Zones for these species to the north of the Runde River are evaluated using the IUCN's established criteria for reintroductions.

The proposals *meet* the IUCN guidelines with regard to:

- a multidisciplinary approach to the reintroductions, at least at the planning stage;
- Zimbabwe's positive attitude towards reintroductions generally;
- the PWMA's ability to generate publicity in the national media;
- the availability of veterinary expertise within the Wildlife Veterinary Unit to ensure the safe capture and transport of rhinos, to provide health screening, and to advise on vaccinations and quarantine;
- the availability of potential source populations, from which the removal of some individuals would have a positive effect where these populations are at carrying capacity, or threatened by poaching;
- the availability of appropriate numbers of potential founders, of wild individuals, of the correct subspecies;
- which would be released within the species' former range and habitat;
- where they would constitute little risk to human life, or property;
- where their release would constitute a reintroduction, not an introduction, which has permission from the relevant state agencies;
- where anthrax, although probably present, is unlikely to be a serious problem for rhinos;
- where rhinos have not been replaced by other species since their local extinction;
- where there was a previous reintroduction of the black rhinoceros, which is described in this report;
- where, although there have been changes in the vegetation since that reintroduction, the habitat remains suitable for black rhinos; and
- where a positive change in the legal/political environment since that reintroduction has been the creation of the Greater Limpopo Transfrontier Park.

The proposals currently *fail to meet* the IUCN guidelines because of:

- the very serious risk of released rhinos being poached if there is not an amicable settlement of the long-standing land claims within the national park before rhinos are released (bearing in mind that poaching – in part by local people and Mozambicans assisted by them – was responsible for the failure of the previous rhino reintroduction);
- the absence of long-term political support, as indicated by the government's tolerance of squatters and their fields and cattle in the national park since at least 2001;
- the failure to demonstrate the elimination of the corruption amongst some DNPWLM and other officials that contributed to the extinction of the previous reintroduced rhino population;
- the consequential absence of assured, long-term protection for the proposed release sites;
- Zimbabwe's ambivalent attitude towards rhinos (as shown by the PWMA attempting to conserve rhinos on state land, while other state agencies have encouraged the settlement of people on conservancies and the consequential snaring of numerous rhinos);
- the absence of socio-economic studies to assess the impacts, costs and benefits of the reintroductions to local people, and the absence of an assessment of the attitudes of local people;
- the absence of the involvement of the local people in the programme;
- the absence of a local conservation education programme;
- the absence of adequate funding and long-term financial support;
- the shortage of trained and experienced rangers, and inadequate numbers of other staff; and
- the absence of release strategies, policies on management interventions, long-term management plans, and schedules for reviewing and, if necessary, rescheduling or discontinuing the reintroductions.

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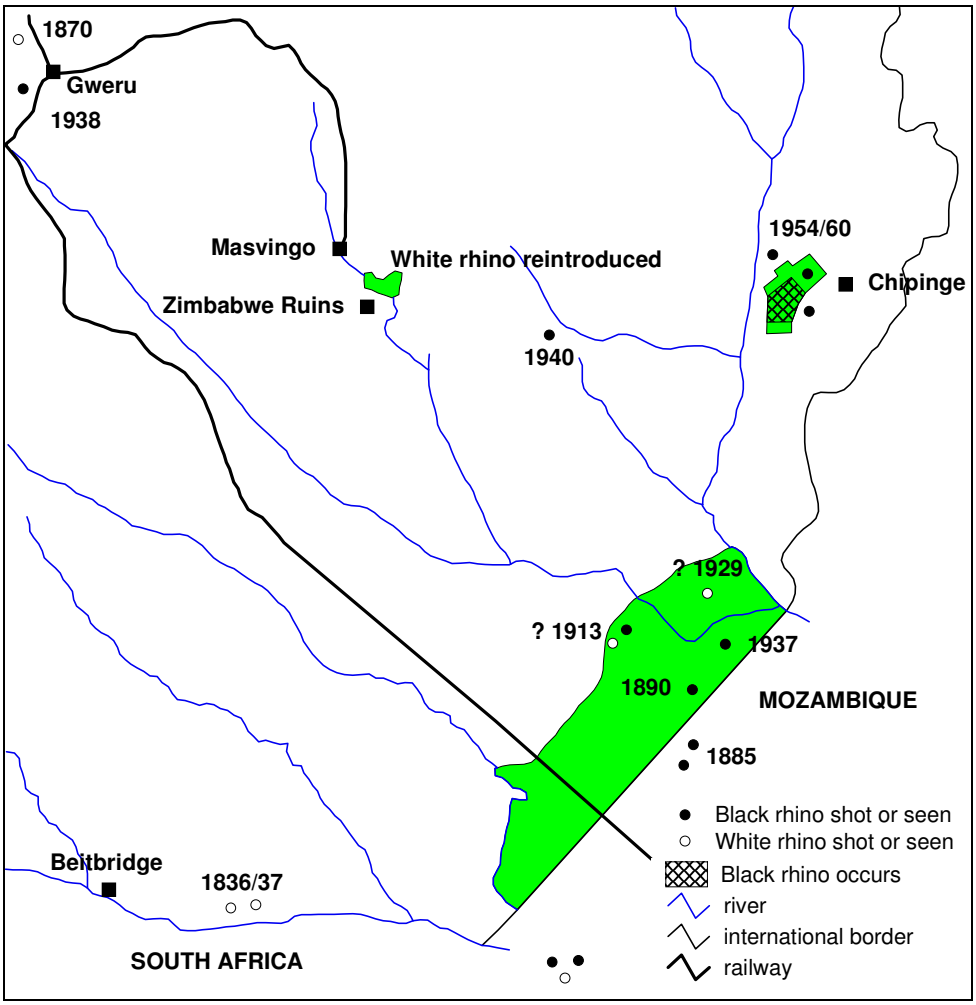
## Original Rhinoceros Populations in Gonarezhou NP

### *Black Rhinoceros*

Black rhinos were recorded 20-50 km south of the Runde River, near the current Zimbabwe/Mozambique border, during the late 19th century (Roth 1967, map 1). The last black rhino in the area was killed during 1934 according to Thomson (1970b), but Denis Townley (cited by Roth 1967) during 1937 obtained evidence of a live rhinoceros south of the Runde River near Fishan. It seems likely that the black rhinoceros became locally extinct during the 1930s or early 1940s, because none were shot on the west side of the Save River when operations commenced during 1946 to kill all large mammals within a controlled hunting area as part of a programme to eliminate tsetse flies and trypanosomiasis (Child & Riney 1987, Booth 1991).

### *White Rhinoceros*

The earliest records of the white rhinoceros in the vicinity of Gonarezhou National Park (NP) are rock paintings and Cooke (1964) mapped two locations, one north and one south of the Runde River (map 2). Whether these can be accepted as proof that white rhinos did once occur in that area and if so, when they occurred there, is uncertain. Most rock art in Zimbabwe was painted probably between 10 000 and 2000 years ago (Garlake 1987). But after inspecting the rock paintings on [the now] Malilangwe Estate, Balsam (1974) suggested that it appeared 'possible and yet wise not to date these paintings back more than 500-700 years'.




**Map 1.** Historical records of Black Rhino & White Rhino in south-eastern Zimbabwe (from Roth 1967)

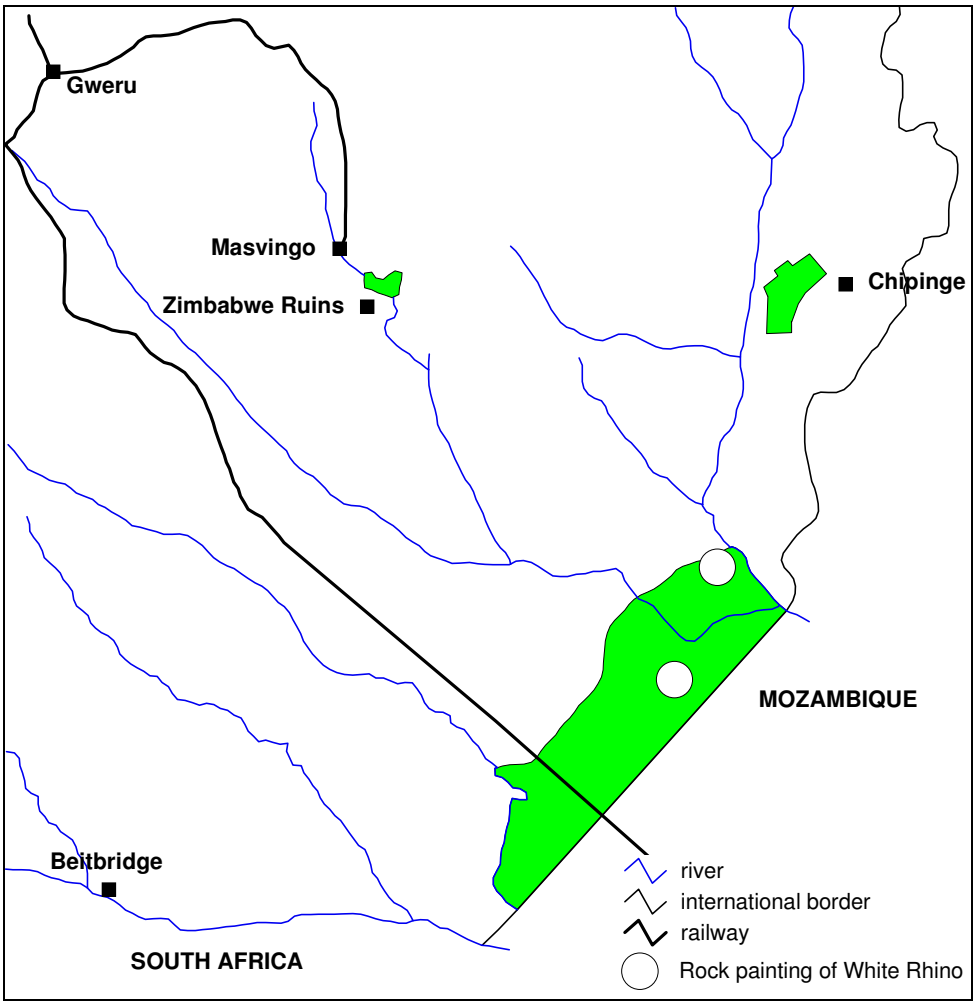
Roth (1967) found no original records from European hunters of rhinos in the Save Valley. The records of white rhinos closest to Gonarezhou NP are those from 1836/37 on the north side of the Limpopo River, about 100 km west of the southern-most part of Gonarezhou NP; and 19th century records from the Lemkombo (Lebombo) Hills to the south, along the border between the Kruger NP and Limpopo NP (map 1).

It is generally assumed (e.g. Player & Feely 1960) that the southern white rhinoceros was extinct in Mozambique by the start of the 20th century, but Sidney (1965) presented a photograph of a white rhinoceros shot in central Mozambique circa 1935. Although this Mozambican population probably became extinct soon afterwards, that it existed at all after the start of the 20th century seems to have escaped the notice of international conservationists for 60 years.

There are no material records of the white rhinoceros in Zimbabwe after the 1890s (Rookmaaker 2003). However, there are several unsubstantiated reports of white rhinos in the vicinity of the present Gonarezhou NP during the first 30 years of the 20th century and, given what we now know about the central Mozambican population, it would be unwise to dismiss out-of-hand these reports from the south-east lowveld of Zimbabwe:

1. Bulpin (1954), 'in his biography of a locally well-known ivory hunter [S.C. 'Bvekenya' Barnard], described in detail the occurrence of white rhinoceros on the Tshingwezi River just north-west of the present [Gonarezhou NP] …and dates this 1913' (quote from Roth 1967).
2. 'The late Mr Macdougal, founder of the Triangle Sugar Estates, told me that when he entered Southern Rhodesia, circa 1920, he saw three White Rhinoceros near the junction of the Sabi and Lundi Rivers. He also told me that two of these had been shot soon afterwards, but he had lost track of the third one' (quote from Cooke 1964).
3. Kemp (1964, cited by Roth 1967), 'an experienced hunter who should have been able to distinguish the two species, in 1929 observed at a short distance a bull and cow white rhinoceros at a pan between Chipinda Pools and the Sabi River, not far from the Mozambique border' (quote from Roth 1967).
4. J.F. Fleming (writing on 12 January 1931 to Shortridge (1934)) reported that seven white rhinos still existed on the Portuguese-Nuenetsi border and that the Africans who had seen these rhinos referred to them by the name *M'fura*, the local name for the white rhinoceros.

If indeed the white rhinoceros survived until 1930 in the south-east lowveld, it is likely that, like the black rhinoceros, it became extinct soon afterwards. However, in summary, it should be emphasised that the only material records of the white rhinoceros in the vicinity of Gonarezhou NP are rock paintings.




**Map 2.** Locations of rock paintings of White Rhinos in south-eastern Zimbabwe (from Cooke 1964)

## The First Reintroduction of the Black Rhinoceros to Gonarezhou NP

### *Release of Rhinos*

The reintroduction of the black rhinoceros to Gonarezhou NP (then the Gonarezhou Game Reserve to the south of the Runde River and the Lower Lundi Controlled Hunting Area to the north of it) started during 1969 when two adult females from the Chipinge area were released in the Chihunja Hills to the north of the Runde River (National Parks 1970). An additional 41 rhinos were released during 1970 and 34 were released during 1971, bringing the total number freed in the park to 77 (Table 1). Six other rhinos died during the capture operations, either near their capture site, or during transport to Gonarezhou, or when penned at Gonarezhou (Thomson 1970c, Coetsee 1971).

The rhinos spent up to two weeks in pens near their capture site before being moved to Gonarezhou (Thomson 1970b,c). Once there, usually they were placed in pre-release pens (to allow them time to water and feed before being released (Coetsee 1971)) at night, but they never stayed more than 9 hours in the pre-release pen. During 1970 at least, the released rhinos were ear-notched so that each was individually identifiable (although it appears that post-release studies – e.g. Thomson (1971b) - did not rely on identifying recognisable individuals).

Most rhinos were freed from pre-release pens on the north side of the Runde River (map 3), but a few were released directly from their travelling crates near the Sibonja Hills on the Runde south bank and a few were freed in the alluvial woodland between the Runde River and the Chilojo Cliffs (B.Y. Sherry, pers. comm.).

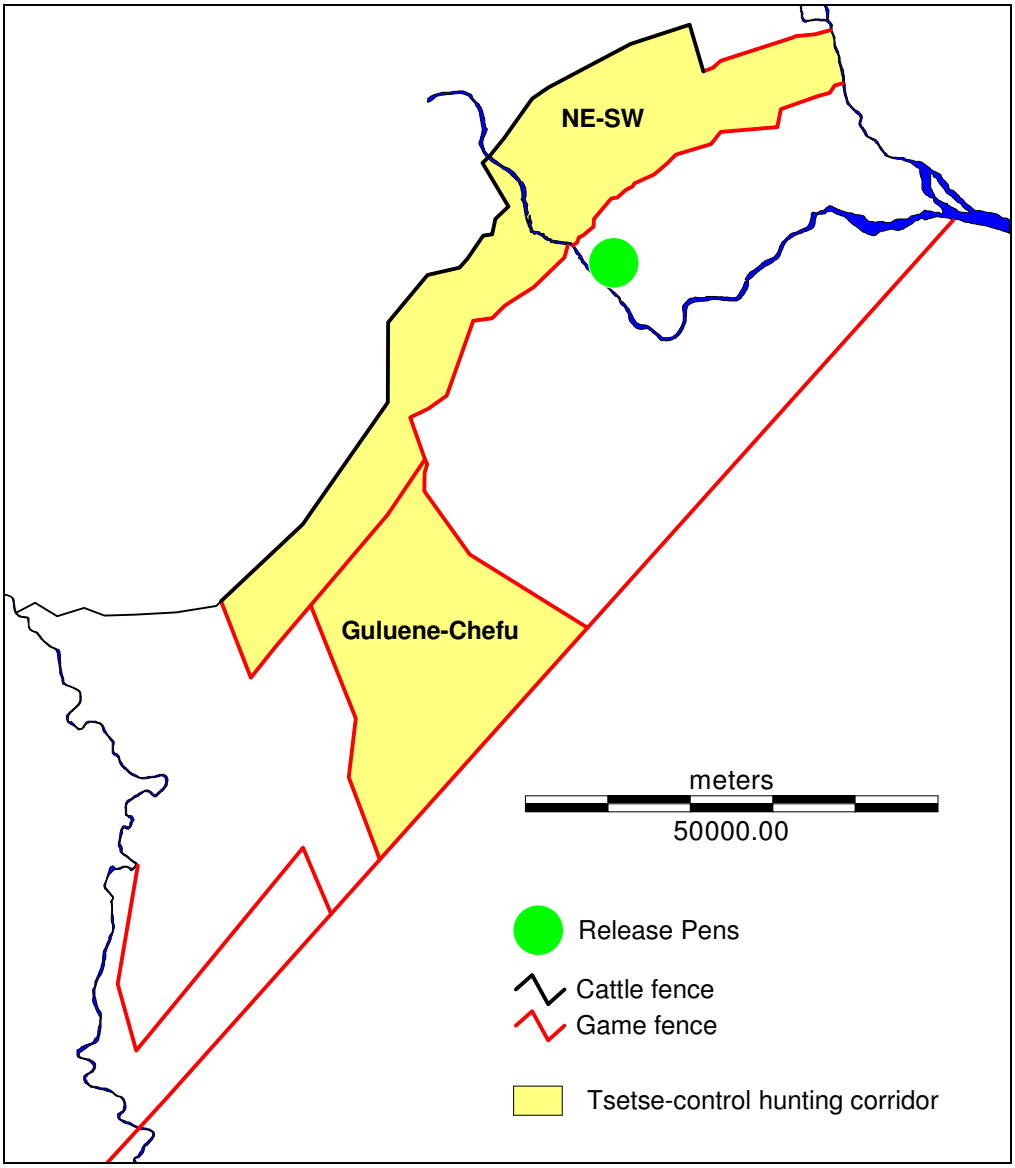
At the time of the releases, the area into which the rhinos were freed was bounded by game fences along the international border to the south-east and along tsetse control hunting corridors to the south-west and north-west (Sherry 1975, map 3). Only along the Save River was the area unfenced. However, these game fences were not entirely rhino-proof: one rhino was reported on Lone Star Ranch (to the north of the hunting corridor) just five days after being released (Coetsee 1971). The straight-line distance from the release pen to the southern boundary of this ranch is 22.5 km. This rhino was recaptured and returned to Gonarezhou.

### *Post-Release Period*

A three-day survey (Thomson 1971b) of the area between the Save and Runde Rivers during June 1971 (by which time 49 rhinos had been released) found that:

- at least two rhinos were on the south bank of the Runde River;
- at least one rhino (a young bull called ‘Norman’, which had been kept in a pen near Chipinda Pools during 1970) had died; and
- at least three calves had been born since their mothers were released.

The survey was based mainly on the observation of spoor near waterpoints and Thomson (1971b) claimed that 45 rhinos (including the three new calves) were accounted for during the survey, 43 of them on the north side of the Runde River (map 4).




**Map 3.** The main release site of Black Rhinos during the 1969-1971 reintroduction programme. The area into which the rhinos were released was surrounded by game fences, except along the Save River (map after Sherry 1975).

**Table 1. Number, age, sex and capture sites of Black Rhinos released in Gonarezhou, 1969-1971**
Data compiled from letters and reports by Thomson (1969a,b, 1970a,b,c, 1971a,b) and Coetsee (1971).

| Year | Capture area | Number captured | | | | | | | Mortality during capture or transport to Gonarezhou | Number released in Gonarezhou |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | | | Female | | | Total | | |
| | | Adult | Subadult | Calf | Adult | Subadult | Calf | | | |
| 1969 | Chipinge | 0 | 0 | 0 | 2 | 0 | 0 | 2 | | |
| *Subtotals for 1969* | | *0* | *0* | *0* | *2* | *0* | *0* | *2* | *0* | *2* |
| 1970 | Umfurudzi/ Mazoe R. | 5 | 0 | 3 | 8 | 1 | 3 | 20 | | |
| | Ruya River (Mount Darwin district) | 5 | 3 | 2 | 8 | 0 | 5 | 23 | *1 female calf* [a] | |
| *Subtotals for 1970* | | *10* | *3* | *5* | *16* | *1* | *8* | *43* | *1 female calf* [a] *&* *1 adult female* [b] | *41* |
| 1971 | Sessami (Gokwe) | 0 | 0 | 0 | 2 | 1 | 0 | 3 | | |
| | Umi River | 2 | 0 | 1 | 2 | 0 | 1 | 6 | | |
| | M'sampa | 5 | 0 | 3 | 10 | 2 | 3 | 23 | | |
| | Tenda Springs (Gokwe district) | 2 | 0 | 1 | 2 | 0 | 1 | 6 | | |
| *Subtotals for 1971* | | *9* | *0* | *5* | *16* | *3* | *5* | *38* | *2 adult males* [c] *2 adult females* [d,e] | *34* |
| **Totals captured** | | **19** | **3** | **10** | **34** | **4** | **13** | **83** | | |
| **Totals released** | | **17** | **3** | **10** | **31** | **4** | **12** | | | **77** |

[a] 1 calf from Ruya died after its mother stopped lactating, after she was operated on in the pen to remove a wire cable snare

[b] 1 cow fell over a 4-meter cliff while semi-drugged; she aborted in the pen 3 days later and died

[c] 2 bulls died after capture, having been previously wounded by poachers (one with a .303 rifle and the other with a muzzle loader)

[d] 1 cow was shot by National Parks staff after the truck transporting it from the capture site to Gonarezhou overturned

[e] 1 cow died an hour after falling over a cliff while semi-drugged

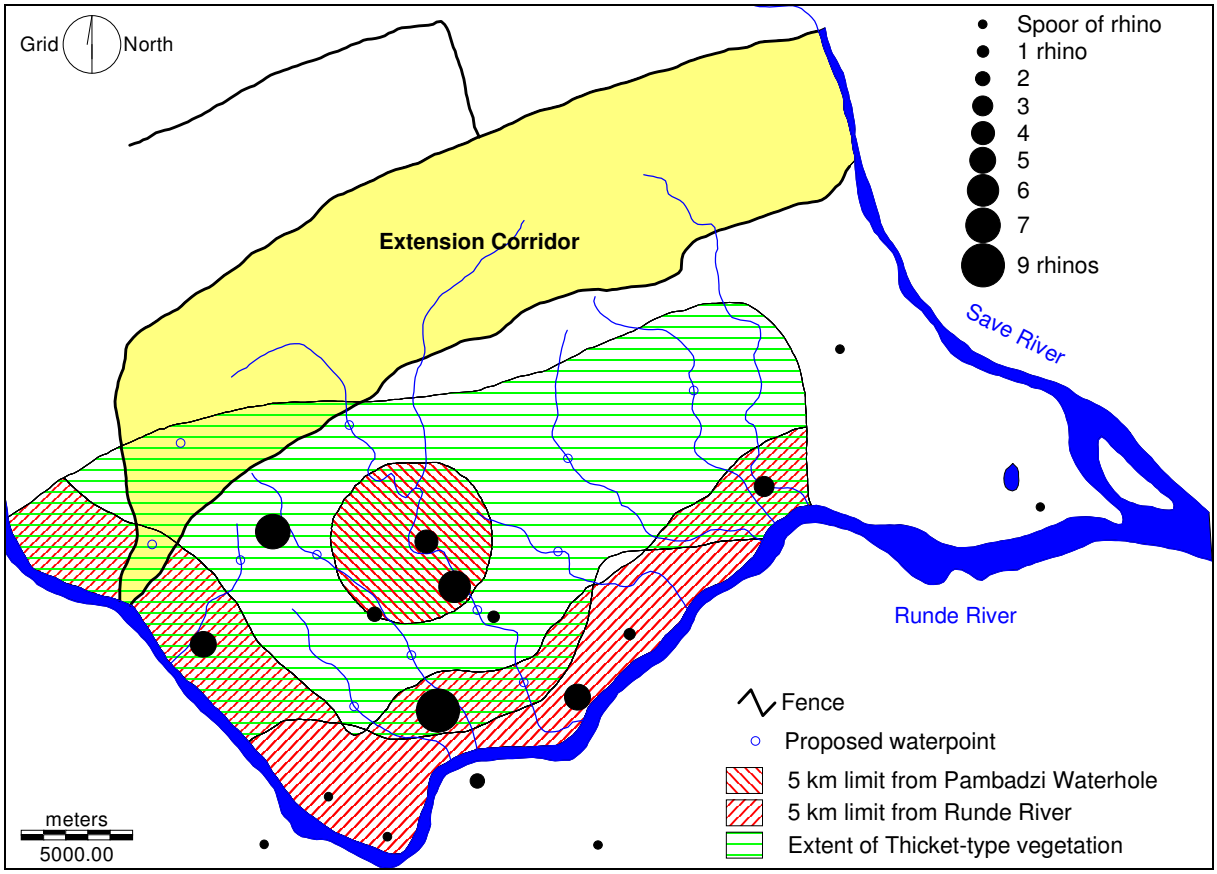
### *Population Status and Number*

Rhino populations are not easy to survey. The only reliable way to estimate the number of rhinos in a population is using uniquely marked (usually ear-notched) individuals. For small numbers of rhinos, it is possible to have all individuals in a population marked, but for larger numbers it may be necessary to have just some individuals marked and then to use mark-resighting techniques to estimate the total population number. However, although most or all of the rhinos released in Gonarezhou were marked with ear-notches, it appears that no surveys of the population were based on sightings of recognisable individuals.

The following section brings together various reports of the number of rhinos in Gonarezhou NP, or parts of it, in chronological order. The methods and extent of the study areas often differed between surveys.

1971 After the last rhinos were released, Sherry (1971) estimated that there were approximately 80 rhinos in Gonarezhou NP. This estimate was probably based on the knowledge that 77 rhinos were released (Table 1) and that, while some had died, several calves were born after their mothers were freed (Thomson 1971b).

1973 A survey by W.R. Thomson during April/May 1973 suggested that at least 61 rhinos were established in the Chihunja Hills (Sherry 1973). An earlier survey by Thomson seemed to depend largely on differentiating individual rhinos from their footprints (Thomson 1971b). The reliability of this technique is questionable, but if one accepts this population estimate and assumes that the study area was the 600 $km^2$ to the north of the Runde River and the south of the tsetse-control hunting Extension Corridor (map 4), this implies a mean population density of approximately 0.1 rhinos $km^{-2}$.




**Map 4.** Distribution of Black Rhinos in northern Gonarezhou during June 1971.
The survey was undertaken partway through the reintroduction programme (original map by Thomson 1971b).

1974 Rhinos were reported to be well-established in the Chihunja Hills and the Sibonja Hills (the latter being on the south side of the Runde River, south of Chipinda Pools) and appeared to move freely throughout northern Gonarezhou (Sherry 1974).

1982 Park population estimated to number between 120 (based on an aerial survey during 1982) and 225 (I. Coulson, former ecologist in Gonarezhou NP, cited in annex 9 of the Gonarezhou park plan (DNPWLM 1998)). The basis for the figure of 225 is not known.

1983 'Intensive ground survey' of the area between the Nyachiri and Pombadzi Rivers suggested the presence of about 20 rhinos there (Sharp 1985c). The survey methods and the northern boundary of this study area are not described, but this population estimate implies a local density of approximately 0.15 rhinos $km^{-2}$.

1984 A sample (10.3 %) aerial survey – designed to estimate elephant numbers - during April 1984 produced an estimate of 29 rhinos, which compared with a 'field estimate' of about 100-120 – both figures being for the entire national park (Sharp 1984). A second aerial survey, during late September 1984, produced an estimate of 65 rhinos (Sharp 1985c). (Aerial surveys are notorious for often seriously underestimating numbers of rhinos (Goddard 1967).)

1986 An aerial survey during August 1986 produced an estimate of 21 rhinos.

1987 No rhinos were seen during an aerial survey in May 1987.

1988 During a sample aerial survey – specifically of rhinos - in the area north of the Runde River and of a small area south of it, five rhinos were seen inside the search strips and two outside (Conybeare 1988). These sightings gave a population estimate of 49 rhinos, equivalent to a mean density for the entire 1300 $km^2$ study area of 0.04 rhinos $km^{-2}$. The rhinos seen to the north of the Runde River were between the Sililijo and Pombadzi Rivers, while those to the south of the Runde were between the Bengi River and the Sibonja Hills (see map 6).

1989 No rhinos were seen during an aerial survey of the park during 1989 (Gibson 1989).

1990 During a survey by walking teams from the Wildlife Society of Zimbabwe, one white rhinoceros and the spoor of seven black rhinos were seen (Anon. 1991).

1991 No rhinos were seen during waterhole counts by members of the Wildlife Society during the 1991, nor during any of the following three years (Wildlife Society of Zimbabwe Lowveld Branch 1994).

1993 'Ground counts' during 1993 suggested that there were no more than five rhinos in the park (Tafangenyasha 1993).

There is no indication that any rhinos survived in Gonarezhou NP after 1993.

### *Spatial Distribution*

1971 The first survey of rhinos in Gonarezhou – undertaken part way during the release programme – revealed that most of the freed rhinos were north of the Runde River (where most were freed), but that a few were on the south bank (map 4).

1985 A map of sightings of rhinos and their spoor in the park during the years 1971-1974 and 1979-1984 (with 76 % of sightings made during 1980-1984) was prepared by Sharp (1985c) (map 5). Rhinos had been seen throughout the park, including near the Mwenezi River on the park's southern margin, but most sightings were in the northern half of the park. Three areas of relatively high concentration were recognised: near the Save/Runde confluence; the Nyachiri, Sililijo and Pombadzi Rivers; and the Bengi River. Rhinos in the vicinity of the Save/Runde confluence were reported to range into Mozambique (Sharp 1984). It is unclear to what extent this distribution map reflects the distribution of rhinos and to what extent it reflects the distribution of observers. Presumably it reflects some combination of the two. In any case, the range of the black rhino population expanded southwards during the 1970s, after the release of individuals in the north of the park.

There were few sightings of rhinos within 10-15 km of the northern boundary of the park. The absence of rhino sightings here probably reflects the genuine absence of rhinos, because distribution maps for other species, e.g. Lichtenstein's hartebeest (DNPWLM 1998), reveal that there were observers here. Between the Mwenezi River in the south of the park and the Guluweni River in the centre of the park (and flowing south-east into Mozambique), there were few sightings of rhinos, or of roan antelopes,

Lichtenstein's hartebeests, or ostriches (DNPWLM 1998, Tafangenyasha 1995), to mention the only other species for which distribution maps have been published.

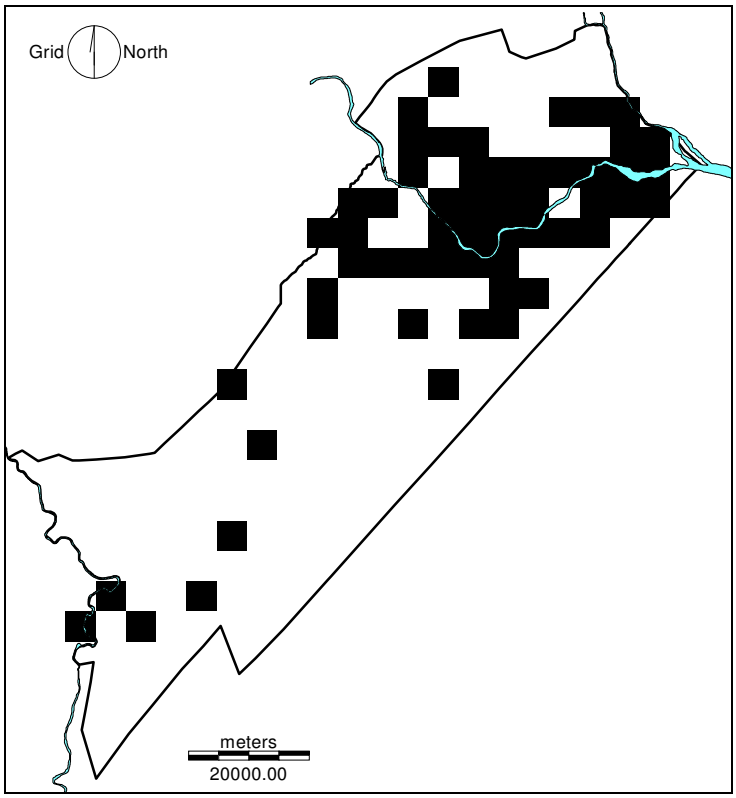
1993 By 1993, when the population had been reduced to a very few individuals, rhinos were confined to the Gulugi River catchment in the north, and near the Mwenezi River north of Mabalauta in the south (Tafangenyasha 1993).

### *Movements*

During 1983 and 1984, there was a programme to use radiocollars to study the movements of black rhinos in the park. Two rhinos (one adult female in the Bengi area and another near the Sililijo River) were collared during August 1983, and three adult males and two adult females (three near the Sililijo and Pombadzi Rivers, one near the Runde River north of Chinguli, and one north of Bengi weir) were collared during August 1984 (Sharp 1984, 1985c). Both the rhinos captured during 1983 were carrying wire snares, which were removed.

Unfortunately, this research programme suffered several problems, including collars falling off rhinos, the poor range of the radiotransmitters (even assuming that they continued to function after attachment to the rhinos) and the frequent non-availability of a plane to conduct aerial tracking. During a tracking flight in October 1984, only two rhinos were found. Both had moved more than 20 km since last located: the rhino collared near Bengi during August that year had crossed the Runde River and moved towards the Pombadzi River; and the rhino collared near Chinguli had moved east to Chitove.

Long distance dispersal by black rhinos is discussed separately, later in this report.




**Map 5.** Distribution of Black Rhinos in Gonarezhou NP, from records for 1971-1974 and 1979-1984. Records were sightings of rhinos, their spoor, or middens. Each black square indicates the presence of one or more records for that 5 km x 5 km map square, with a total of 122 records. Original map prepared by Sharp (1985c).

### *Poaching*

The poaching of rhinos started soon after the reintroduction, with at least two rhinos killed by poachers during 1973 (Sherry 1973). Low-intensity poaching of rhinos probably continued during the next decade (Cumming 1987). Some people from the Mahenye area, who until the late 1960s lived within the bounds of the present park, have been blamed for illegally hunting wildlife within the park and for assisting notorious hunters to shoot elephants (Booth 1991). The two rhinos that were captured for radiocollaring during 1983 both carried wire snares (Sharp 1984).

The available figures indicate that there was a significant increase in the poaching of rhinos during 1984 (Table 2). Sharp (1985c), who as park ecologist at the time was well-placed to know, believed that 22 rhinos were poached in the park during 1984. One infamous poacher (Shadrek) was believed to have shot seven rhinos during first six months of 1984. Rhinos from the area of the Save/Runde confluence ranged into Mozambique and were poached there (Sharp 1984). One of the rhinos poached during 1986 was snared (Sharp 1986a), but most poached rhinos appear to have been shot.

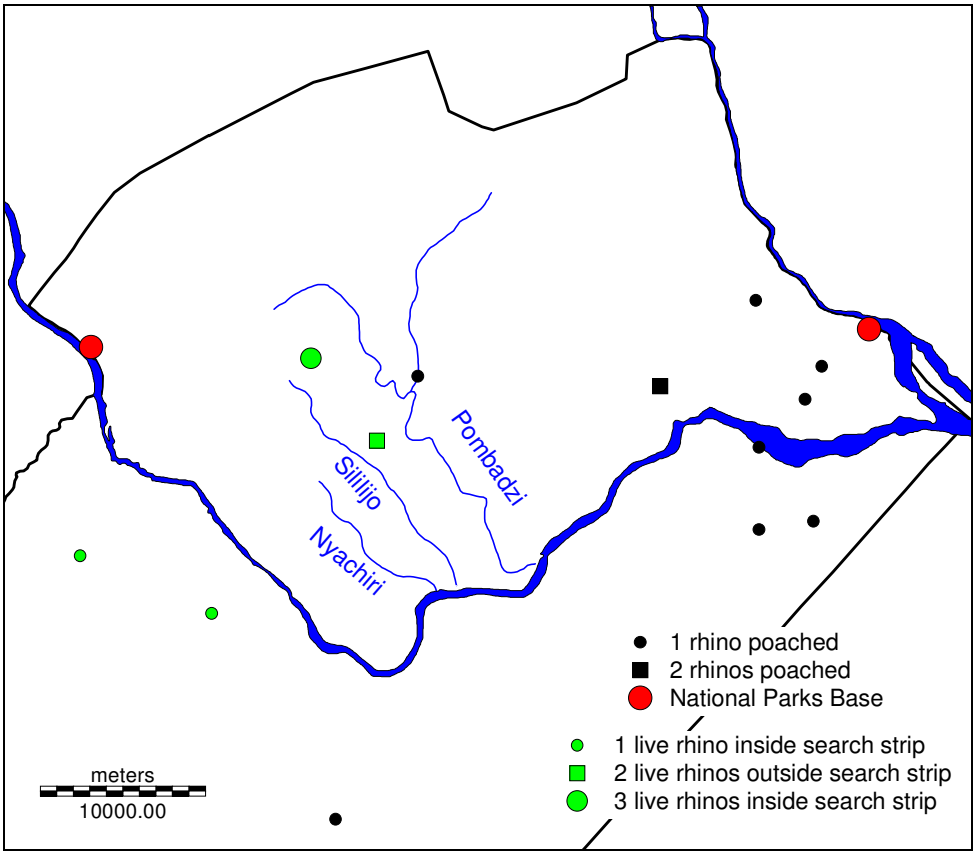
During the 1980s, there was a civil war in Mozambique. Supply lorries for the Frelimo side in this war, accompanied by armed personnel, travelled through Gonarezhou NP to Mozambique. Zimbabwe army personnel were based in Gonarezhou NP, which was closed to the public. Poaching in the park was a major concern both locally ('every month yet another rhino kill was reported, usually by non-Parks staff, and the reporting of shots and poaching activity to the [DNPWLM] field staff produced little visible results' (Davy 1987)) and nationally (Anon. 1988). One international non-governmental organisation stated that their inquires confirmed that the poaching was carried out by Zimbabwe army personnel (EIA 1989). The same organisation stated that 'the warden of the Park is said to be implicated in the poaching of elephants and the illegal trade in their ivory'. In one incident during this period of poaching, two DNPWLM investigations staff were shot in cold blood in Gonarezhou NP and a game scout was abducted, never to return.

During 1989, an aerial survey of the elephants in Gonarezhou NP by staff of the Branch of Terrestrial Ecology of the DNPWLM revealed a high density of elephant carcasses and a high ratio of dead to live elephants, both evidence of 'serious problems', i.e. an unusually high mortality of elephants (Gibson 1989). The carcasses were seen mainly close to roads, indicating a high level of illegal activity in the park, with the poachers operating from vehicles.

The increase in rhino poaching in Gonarezhou coincided with similar increases in rhino poaching in other parts of Zimbabwe during the 1980s (Tatham 1988). North Korean diplomats based in Harare were alleged to be involved in the illegal trade in rhino horn and the names of several government ministers also tended to be mentioned in connection with this trade (EIA 1989). An official enquiry followed the allegations that some Zimbabwean government officials were heavily involved in poaching in Gonarezhou and the government's failure to make publicly available the results of this enquiry give credibility to these allegations (Cunliffe 1993). No DNPWLM or army personnel have yet been prosecuted for their alleged involvement in the poaching in Gonarezhou NP.

The extinction of the reintroduced population of the black rhinoceros in Gonarezhou NP was entirely due to poaching. At least 51 carcasses of poached rhinos were reported found in Gonarezhou NP during the years 1984 to 1992 inclusive (DNPWLM 1993). Only for a few of these is the location of the carcass available (map 6). Eight of the mapped carcasses were found westwards of and within 15 km of the DNPWLM Save/Runde base camp. A minimum-area convex polygon enclosing the locations of these eight carcasses has an area of 84 $km^2$ (including part of the Runde riverbed), suggesting an approximate local density of 0.1 rhino $km^{-2}$. Of course, these rhinos – before they were poached - probably ranged more widely that the area enclosed by the polygon (behaviour which would reduce the estimated local density), but there were probably additional rhinos, alive or with their carcass location unplotted, to those mapped (in which case, the estimated local density would increase).

Even after the demise of the black rhino in Gonarezhou NP, there were continued allegations that some DNPWLM staff members were poaching in the park, now killing other wildlife species to provide meat for commercial purposes.




**Map 6.** Distribution of Black Rhinos: (a) killed by poachers during 1986-1987; and (b) seen during the 1988 survey.
Although >50 poached rhinos were reported by DNPWLM staff (Table 2), only for a few is the location of the carcass available(black symbols). Green symbols indicate the locations of rhinos seen during the 1988 sample aerial survey.

**Table 2. Number of Black Rhinos poached in Gonarezhou NP, according to differing sources**

| Year | Data Source | | | | |
|---|---|---|---|---|---|
| | DNPWLM (1993) [a] | DNPWLM (1998) | Martin *et al*. (1997) [b] | Tafangenyasha (1993) | Sharp (1985c) |
| 1980 | 0 | - | - | - | - |
| 1981 | 0 | - | - | - | - |
| 1982 | 0 | - | - | - | - |
| 1983 | 0 | - | - | - | - |
| 1984 | 7 | - | 1 | 13 | 22 'believed poached' |
| 1985 | 1 | - | 2 | 13 | - |
| 1986 | 7 | - | 2 | 14 | - |
| 1987 | 15 | - | 7 | 4 | - |
| 1988 | 1 | - | 41 [c] | 7 | - |
| 1989 | 14 | - | 5 | 6 | - |
| 1990 | 4 | - | 1 | 2 | - |
| 1991 | 1 | - | 0 | 1 | - |
| 1992 | 1 | - | 1 | 1 | - |
| 1993 | 0 | 1 [d] | 0 | - | - |
| **Total** | **51** | **-** | **60** | **61** | **-** |

[a] actual number of carcasses found, as stated in the Operation Stronghold report. Figures for 1993 refer to the months January to March inclusive.

[b] Martin *et al*. (1997) report that their data were provisional and required confirmation, but were based on the Operation Stronghold 1993 report and DNPWLM station reports.

[c] Martin *et al*. (1997) adjusted the figure for 1988 upwards, because elephant poaching in Gonarezhou NP during the late 1980s was much greater than suggested by the number of carcasses reported found by management staff (Gibson 1989) and Martin *et al*. assumed that the same was true for rhinoceros.

[d] presumably at least 1 rhino was poached, because 2 horns were recovered by management staff (Annex 9 of management plan (DNPWLM 1998)).

## The White Rhinoceros in Gonarezhou NP

No white rhinos have ever been released in Gonarezhou NP. A few white rhinos from Zululand were freed on ranches in the Chiredzi district during the 1970s and three animals moved onto Lone Star Ranch (now Malilangwe Estate) adjacent to the northern boundary of the park (Du Toit 1994, R. Sparrow pers. comm.). These animals favoured the vegetation on basaltic soils. By 1983, the population had increased to approximately 20 animals. During the 1983 dry season, four white rhinos from Humani Ranch (now part of the Save Valley Conservancy) and 13 from Lone Star Ranch were penned at Lone Star (Pitman 1983). At least six died, but the remainder lived on a diet of sugarcane tops. The survivors were later released, three on Humani and the remainder on Lone Star. After release on Lone Star, one cow moved eastwards. She was captured close to the international border with Mozambique, returned to Malilangwe and penned (R. Sparrow pers. comm.). But when again released, she again moved eastwards, into Mozambique and was killed there. There were nine white rhinos on Lone Star Ranch when ranch ownership was transferred to the Malilangwe Trust (S. Clegg pers. comm.) and a population of white rhinos still exists on Malilangwe Estate.

Some white rhinos from Lone Star Ranch occasionally moved into the park. The first formal record was from Thomson (1983), who saw three white rhinos (and black rhinos) at Chidyambani pan, south of the Runde River, during July 1983. This pan is 37 km, as the crow flies, south-east of the ranch. But because it is just south of the Chilojo Cliffs, one can be certain that these rhinos walked much further than 37 km to get there. A well-worn path to the pan suggested that these white rhinos had been using this pan for some time before Thomson (1983) saw them. But these three rhinos first entered the park during the 1970s and they moved between the ranch and the park several times, before they were killed by poachers (R. Sparrow pers. comm.).

During 1992, a white rhino bull – also from Lone Star Ranch - was reported near Chipinda Pools, in the Gulugi River drainage, apparently cut off from the animals on Lone Star Ranch when a foot-and-mouth-disease-control fence for buffalo was erected between the ranch and the park during the late 1980s (DNPWLM 1992). During December 1993, a single adult male – the last white rhino in the park – was captured in the Sibonja Hills, approximately 15 km south of Chipinda Pools, and moved to the Save Valley Conservancy (R. du Toit, pers. comm.).

## Dispersal and Movements by Black Rhinos in Gonarezhou NP

When the black rhinos were released in Gonarezhou NP during 1969-71, the area into which they were freed (approximately 2066 $km^2$) was ring-fenced by tsetse-control game fences, except along the Save River. When the reintroduction was proposed (Thomson 1969a), it was believed that these fences would prevent rhinos moving out of the area. But that one rhino travelled through the fenced North-east/South-west Corridor to Lone Star Ranch within five days of release (Coetsee 1971) showed that these fences were not complete barriers to rhinos. With the extermination of tsetse flies in this area by the early 1970s, the tsetse-control game fences of the North-east/South-west Corridor and the Guluene-Chefu Corridor were removed. Removal started during 1972 and by 1974 the Guluene, Chefu, NE-SW (North) and the NE-SW Extension game fences had been dismantled and fences for a new corridor were erected adjacent to the international boundary with Mozambique (B.Y. Sherry, pers. comm.).

During the 1970s, the programme for the development of artificial supplies of water for wildlife was initiated (B.Y. Sherry pers. comm.). From early 1970 to 1976, the series of pumped supplies was developed and two dams were constructed. The entire area received National Park status during late 1975, but Zimbabwe's pre-independence war broke out in this area during early 1976 and, as a consequence, most management was shelved. Effective policing in the area became minimal and there was little control over the killing of wildlife by local people, or the security forces. Fire management largely fell away and all the piped artificial water supplies were closed down.

By 1976, the range of the black rhinoceros within Gonarezhou NP extended south of the Rutenga/Maputo railway line (B.Y. Sherry, pers. comm.). Smithers & Lobão Tello (1976) reported that 'within recent times' a black rhinoceros was seen in *Coutada* 16 (now Limpopo NP) near the Limpopo River in Mozambique. There was doubt about the origin of this rhino, but Smithers & Lobão Tello considered it unlikely that it came from Kruger NP and thought instead it may have been one of those released in Gonarezhou NP. The Limpopo River in Mozambique is at least 125 km southwards of the Runde River.

During 1979, a young cow rhino that had entered the north of Kruger NP, possibly from Zimbabwe, was captured and moved to the south of Kruger (Pienaar 1994a). And sometime during 1980-1982, a second black rhino, a bull, possibly also originally from Zimbabwe, was captured in the north of Kruger NP and released in central Kruger. It is possible that one of these animals was the individual that had been seen in Mozambique a few years earlier.

There are recent, but unconfirmed, reports that two or three black rhinos (presumably from Gonarezhou NP) are resident in the Chefu area of Mozambique, adjacent to the national park (C. Stockil, pers. comm. to R.F. du Toit).

### *Implications for future reintroductions of rhinos*

It is unclear if these long-distance movements occurred immediately after release (and went undetected until several years later), or whether they occurred some years after the releases. The conditions under which the 1969-1971 releases occurred – numerous rhinos released in close proximity to each other after only a few hours in the same set of pre-release pens – would undoubtedly have promoted social conflict between individuals, and hence encouraged immediate post-release dispersal over long distances. Alternatively, the removal of the fences and the development of the system of artificial water supplies during the years after the releases may also have encouraged rhinos to move southwards, only to move again when the water supply was suddenly cut off.

It is noteworthy that even during the 1980s, long after the rhinos were released and had presumably settled into new home ranges, the two movements reported were by radiocollared rhinos that moved >20 km sometime during the period August-October 1984 (Sharp 1985c). One had moved across the Runde River, illustrating that, if an Intensive Protection Zone (IPZ) is established north of the Runde, the river will form only an administrative boundary, not a physical or ecological one. Twenty kilometres is a large move for an adult black rhino to have made and suggests that either these rhinos had particularly large ranges; or that these moves were unusual and thus prompted by unusual circumstances. Widespread poaching of rhinos started during 1984 and may, in some way, have prompted these moves. But because so little data are available from this radiotracking study, one can only speculate.

Long after the post-release dispersal period, there was movement of black rhinos between the vicinity of the Save/Runde confluence and Mozambique (Sharp 1984). If more black rhinos are released into Gonarezhou NP, it is likely that some individuals will move eastwards and across the international border.

The available, though limited, information about the movements of white rhinos that entered the park is that during both the 1983 and 1992 droughts, the rhinos moved southwards across the Runde River. These moves suggest that: (a) the area north of the Runde did not meet their habitat requirements during a drought year; and (b) again the Runde River was no barrier to movement (at least not during the dry season).

Translocated white rhinos often wander far and wide after release. Some white rhinos released into Kruger NP moved more than 75 km before settling down (Pienaar 1994b) and some released in Hwange NP, in the vicinity of Main Camp, moved into Botswana (Wilson 1975). If white rhinos are released into Gonarezhou NP it must be expected that they will wander far and wide, including across the international border.

## Availability and Spatial Distribution of Drinking Water for Rhinos

### *Natural supplies of permanent water in Gonarezhou NP*

One major river, the Runde, runs through Gonarezhou NP and two, the Save and the Mwenezi, border it. All three rivers run through gorges, with waterfalls and rapids, where they have cut through the bedrock. During the rainy season, water flows along the numerous tributaries of these rivers and these streams, as well as seasonal pans, provide abundant drinking water for wildlife during the wet season. Most seasonal pans away from the major rivers generally hold water until about July or August, when they dry up (Sharp 1986b).

During the dry season, the riverbeds of the three major rivers contain pools of water in the gorges and upstream of rock bars. Downstream of the gorges, the river beds are generally sandy. In all three rivers, surface flow ceases during the dry season, but some pools remain. These pools are important sources of drinking water for a variety of large mammals during the dry season and some pools remain even in drought years. However, during recent years flow in the Mwenezi River has been greatly influenced by the upstream Manyuchi Dam, particularly after seasons of below-average rainfall.

Within Gonarezhou NP, most tributaries of the three major rivers flow only seasonally, but some tributaries of the Runde retain pools of water during the dry season. These reportedly include the Massassanya, Pombadzi and Muwawa Rivers on the north bank of the Runde and the Tchingwizi, Lumvuma, Madumbeni and Machaniwa Rivers on the south bank (DNPWLM 1998, annex 5). However, which pools contain surface water throughout the dry season, even in drought years, and their locations appear not to have been adequately documented. Certainly there is permanent water at the site of an old Tsetse Control department camp alongside the Pombadzi River (Thomson 1971b). There may be other pools between there and the junction of the Pombadzi and Runde Rivers that last throughout the dry season in drought years, but even so they will not change the map of areas within 10 km of water at the end of the dry season.

### *Artificial supplies of water in Gonarezhou NP*

During 1970, the first steps were taken in the development of an artificial water supply for wildlife in what is now Gonarezhou NP (Sherry 1976). The Department of Water Development installed a system to pump water from the Mwenezi River eastwards to three seasonal pans, namely Manyanda, Mafukus and Lipakwa (C. Saunders pers. comm.). Manyanda was the largest pan and often when water from the Mwenezi was in short supply, or the pumps were not running efficiently, Manyanda was kept full in preference to Lipakwa and Mafukus. Later, the national railways agreed that water could be pumped to another seasonal pan (Nyamugwe) from their borehole at Twiza siding, on the railway line to Maputo.

During the 1960s, the Tsetse Control department had drilled several boreholes south of the Runde River, at points where it established camps. After Tsetse Control department staff left the area, the DNPWLM fitted pumps to some of these boreholes to provide water for the wildlife. Three boreholes came into service in the Nyamasikana drainage during 1974 (National Parks 1975). By the following year, four pipeline schemes were functioning in the Runde sub-region, but two boreholes produced inadequate or saline water (National Parks 1976). During 1975, Bengi dam filled for the first time and the Massassanya dam was completed. Earlier, a borehole had been drilled to provide water in the Gulugi drainage, north of the Runde, for the Lichtenstein's hartebeest reintroduced during the early 1970s. But soon after the development of the artificial water supply system, Zimbabwe's pre-independence war broke out in the area and, as a consequence, most management in Gonarezhou NP was shelved. By 1977, all piped artificial water supplies had been closed (Sherry 1977).

Later, during the 1980s, some additional boreholes were drilled (DNPWLM 1998), although it is not clear if these supplied water for wildlife.

During 1990, it was reported that only one borehole (Centre borehole, supplying Chidyambani pan) of seven in the northern half of Gonarezhou NP had been working, but that one was broken by soldiers from the Zimbabwean army (Anon. 1990). During the 1992 drought, three boreholes were operating, and a borehole in the Gulugi area and three elsewhere in northern Gonarezhou NP were opened. All pumps in the Mwenezi sub-region were working 'for the first time in years' (Tayler 1992). But by the early 1990s, Massassanya dam was dry during the late dry season (DNPWLM 1998) and Bengi dam, although spring-fed during the dry season, was extensively silted (Lamont 1994). Neither provided

drinking water for wildlife during 1992 drought: Massassanya was dry early during the year and the spring at Bengi weir was polluted by animal carcasses (Tayler 1992).

It is clear that, from the viewpoint of wildlife, the artificial water supplies have been unpredictable in space and time.

### *Disadvantages of an artificial supply of water for wildlife*

One of the consequences of artificial water supplies for wildlife is that there is usually extensive modification of the vegetation in the vicinity of the waterpoints, especially by elephants. Hence, the desirability of artificial water supplies is highly questionable. Experience in Gonarezhou NP during the 1992 drought suggested that only a few specific artificial waterpoints are essential in this park, to provide extended dry season ranges for Lichtenstein's hartebeest and roan antelope (Magadza, Coulson & Tafengenyasha 1993, DNPWLM 1998).

An additional disadvantage of an artificial system of water supplies for wildlife is the expertise and money required to operate and maintain such a system. For example, during 1992, after the very low rainfall during the 1991/92 wet season, the DNPWLM was dependent on extensive help from the private sector to repair and operate the water pumps in Gonarezhou NP (Tayler 1992).

### *Drinking water requirements of rhinos*

White rhinos are dependent on regular access to drinking water (Pienaar 1994c). During the rainy season they will drink once or twice daily, but during the dry season, when surface water is less available and they may have to travel further to reach it, white rhinos may drink only once every 2-4 days. Black rhinos are also dependent on regular access to drinking water and, in Pilanesburg, areas more than about 10 km from permanent surface water were not occupied during the dry season (Adcock 1994). The spatial distribution of the territories of male black rhinos was determined by the distribution of drinking water at the end of the dry season.

### *Implications for future reintroductions of rhinos*

Given the above disadvantages of an artificial supply of water for wildlife, it cannot be assumed that such a system will be maintained in Gonarezhou NP consistently and in the long-term. If an artificial water supply system is discontinued after translocated rhinos have settled in their new home ranges, the disruption of end-of-dry-season water supplies is likely to lead to social disruption and unpredictable dispersal, as the rhinos move in search of water. When these animals move into or through the territories or home ranges of other rhinos, there are likely to be antagonistic encounters including fights, which occasionally are fatal to one of the protagonists (Adcock 1994).

It is important that the long-term viability of any rhino population that is established in Gonarezhou NP should not be dependent on artificial water supplies. The natural pools where rhinos living north of the Runde would be able to find drinking water at the end of the dry season during drought years were described by Thomson (1971b), C. Saunders (pers. comm.) and R. Waters (pers. comm.) and the area within 10 km of these is mapped (map 7). Pools of water are also present in the Save gorge, but the steep sides to this gorge limit – although do not completely prevent – access to them.

## Food, Habitat and Carrying Capacity of White and Black Rhinos

### *Diet of the Black Rhino*

No information is available about the diet of the black rhinoceros in Gonarezhou NP. Thomson (1971a) commented that *Colophospermum mopane* was one of the first species to be eaten by the released rhinos, although it was seldom eaten in other areas, where he captured rhinos. Elsewhere, the black rhino is a browser and commonly eats herbs and low bushes (Goddard 1970a, Emslie & Adcock 1994). The plant genera that rank high in the diet of black rhinos in southern Africa are *Acacia*, *Aloe*, *Bauhinia*, *Commiphora*, *Croton*, *Diospyros*, *Diplorhynchus*, *Disperma*, *Euphorbia*, *Vitex*, and the fallen fruits of *Kigelia africana* (Smithers 1983). Genera that are eaten in Namibia, East Africa and Zimbabwe include *Acacia*, *Bauhinia*, *Combretum*, *Cordia*, *Euphorbia* and *Grewia*. Plant size is important to black rhinos, which show a marked preference for plants that are shorter than 1 m (Emslie & Adcock 1994).

### *Habitat Preferences of the Black Rhino*

Despite the reintroduction in Gonarezhou NP, no information is available about the habitat preferences of the black rhinoceros there. Elsewhere, rhino densities are generally low in grassland and greater in shrubland (Goddard 1970b, Frame 1980, Emslie & Adcock 1994, Tatman, Steven-Woods & Smith 2000). The importance of woodland and forest to black rhinos depends greatly on the availability of preferred browse within the reach of rhinos. Riverine areas are often important and, at Hluhluwe, the margins of evergreen forests were preferred areas during the wet season.

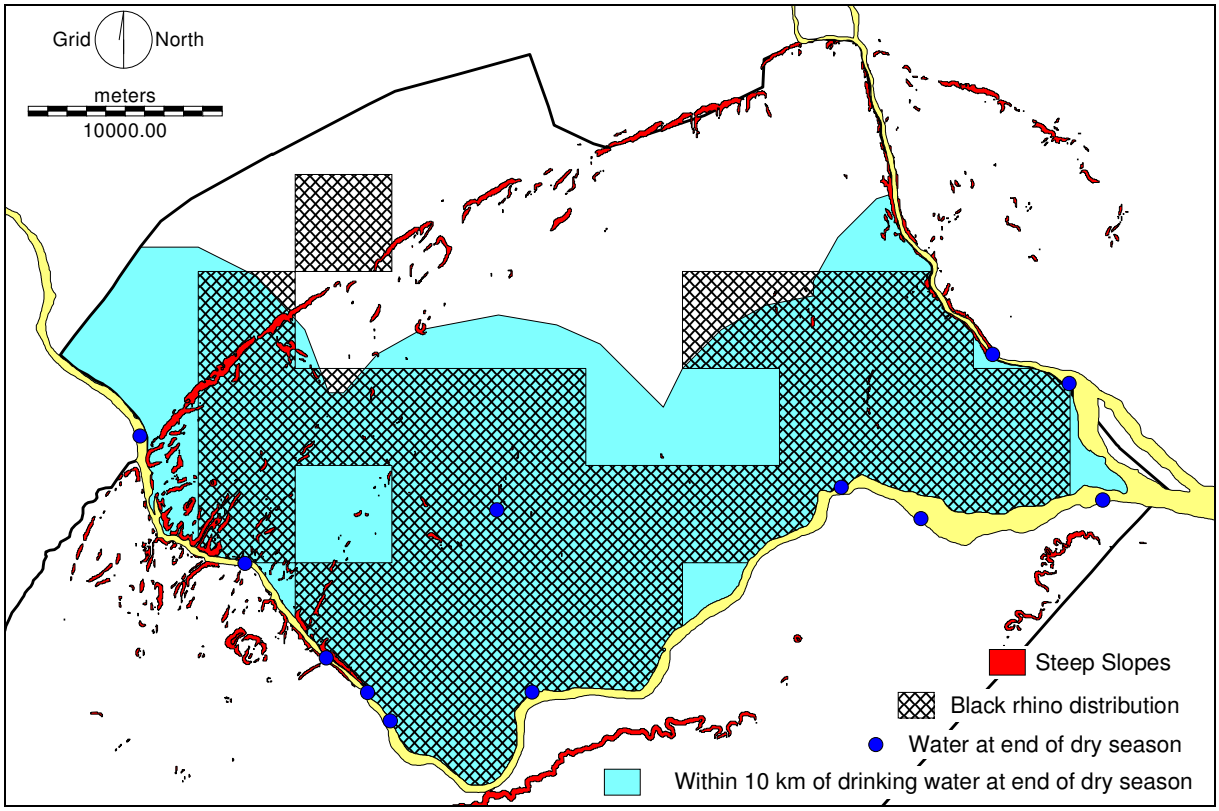
### *Factors influencing the distribution of the Black Rhino*

The distribution of surface water during the dry season has a major influence on the distribution of black rhinos, which drink regularly. The importance of riverine areas to black rhinos probably reflects both the close proximity of this surface water and the favourable soil moisture regime in these areas ensuring that plant productivity continues even after the end of the rainy season (Emslie & Adcock 1994). Areas of dense bush are important to black rhinos for providing shelter and a place to keep cool during the heat of the day (Goddard 1970b, Frame 1980, Emslie & Adcock 1994, Tatman, Steven-Woods & Smith 2000), but may be less important for feeding. The importance of different vegetation types depends greatly on the availability of preferred (as food) browse within reach of the animals. Browse more than 2 m above the ground is unavailable to black rhinos.

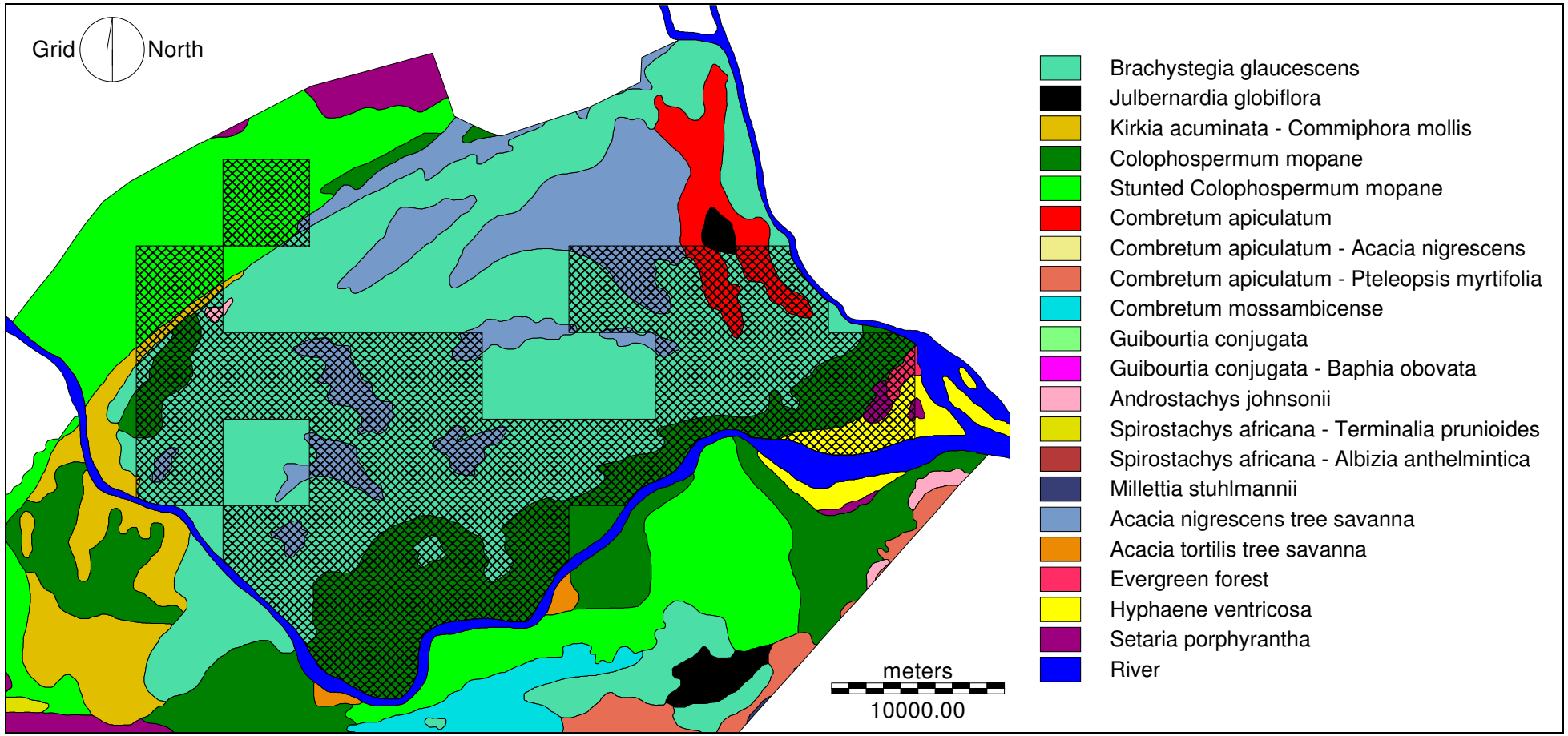
Sharp's (1985c) map of rhino distribution in Gonarezhou NP (map 5) was modified by adding two map squares in which poached rhinos were found during 1986-1987 (map 6) and considering only the area north of the Runde. It is found that most rhino sightings were within 10 km of end-of-dry-season water (map 7) (and those that were not may well have been made during the wet season, or during a period when the borehole in the Gulugi watershed was operating).

Black rhino distribution was also compared with Farrell's (1968) map of the vegetation types in the area (map 8) and Thomson's (1971b) map showing the extent of 'thicket-type' vegetation (map 9). Thomson (1971b) did not claim that all this area was thicket – simply that most of the thickets present were within the area that he delimited. Although Farrell's (1968) published map does not show these thickets, he did say, in his description of the *Brachystegia glaucescens* woodland, that 'dense thickets occur in the woodland … made up of *Gardenia resiniflua*, *Monodora junodii*, *Canthium frangula*, *C. wildii*, *Capparis kirkii*, *Vitex mombassae*, *Markhamia acuminata*, *Xeromphis obovata*, *Boscia albitrunca*, *Bauhinia petersiana*, *Artabotrys brachypetalatus*, *Manilkara mochisa* and *Maerua* spp.'. In some areas of *Brachystegia glaucescens* woodland, there was an understory of *Millettia usaramoensis* and *Androstachys johnsonii*. Nearly pure stands of *Androstachys johnsonii*, with a few *Hymenocardia ulmoides* and *Croton pseudopulchellus*, occurred on rocky outcrops within mopane woodland near the Save River (Wild 1955). *Spirostachys africana* was common along water courses (Farrell 1968) and in a small, mapped area near the confluences of the Silililjo and Runde Rivers, and the Nyachiri and Runde Rivers (O'Connor & Campbell 1986a). *A. johnsonii*, *H. ulmoides, C. pseudopulchellus* and *S. africana* are all members of the Euphorbiaceae, a plant family often preferred as food by black rhinos: *Spirostachys africana* formed >20 % of the woody diet of rhinos in Hluhluwe-Umfolozi, South Africa (Emslie & Adcock 1994).

From maps 8 and 9, it can be seen that most sightings of rhinos were in mopane woodland close to the Runde River, or in the *Brachystegia glaucescens* woodland with thickets, or in the vicinity of the Save/Runde confluence, where the attractions probably included forbs and *Kigelia africana* fruits.




**Map 7.** Distribution of sightings of Black Rhinos north of the Runde River in relation to distance to drinking water at the end of the dry season.
Steep slopes limit access to the Save and Runde gorges. Slopes derived from a (90 m resolution) digital elevation model of the area. Map of rhino distribution based on map by Sharp (1985c).

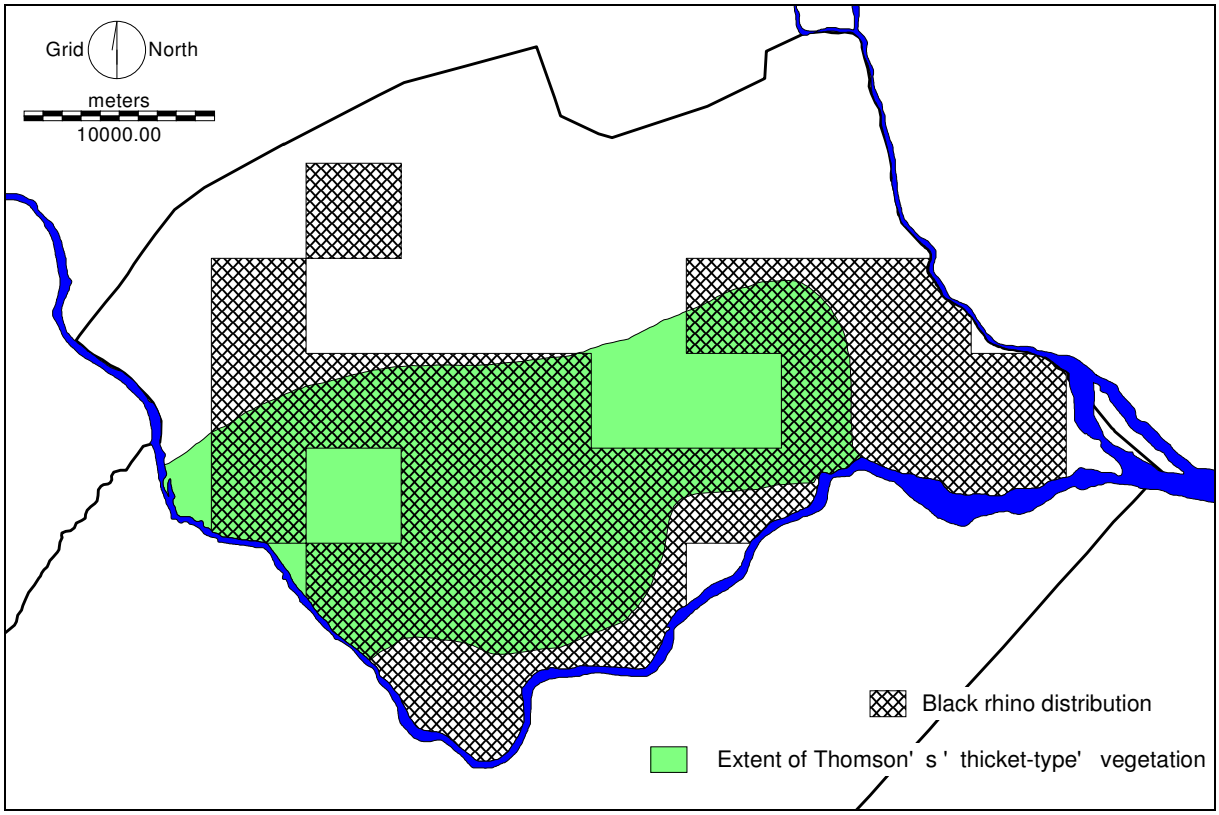



**Map 8.** Distribution of sightings of Black Rhinos north of the Runde River in relation to vegetation.
Map of rhino distribution based on map by Sharp (1985c). Original map of vegetation types prepared by Farrell (1968).

### *Carrying Capacity of the Black Rhino*

The area of the Pombadzi and Sililijo Rivers (map 6) consistently appeared to have been a good area for black rhinos after the first reintroduction. This was where Thomson (1971b) located signs of many rhinos during 1971, where Sharp (1985c) found one of three clusters of rhino sightings and where he found several rhinos for radiocollaring, and where Conybeare (1988) saw five rhinos during his 1988 survey. One estimate (guestimate?) of the number of rhinos in this area suggested that the local density of rhinos was about 0.15 $km^{-2}$. This figure can be compared with density estimates of 0.1 rhinos $km^{-2}$ over the southern half of the Save/Runde area during 1973, 0.1 $km^{-2}$ on the basis of the carcasses of poached animals near the Save/Runde confluence during 1986-87, and 0.04 $km^{-2}$ during the 1988 aerial survey (after many rhinos had been poached). A density of 0.1 rhino $km^{-2}$ seems to be a reasonable estimate for black rhinos in the southern half of the Save/Runde region prior to the poaching of the 1980s.

To the south of the Runde River, the map of rhino sightings suggests that it was along the Bengi River and northwards into the Sibonja Hills, and near the Save/Runde confluence, that rhinos were at their highest density (Sharp 1985c). Further southwards, there were few sightings and the absence of natural supplies of water in this area at the end of the dry season in all years suggests that the rarity of sightings here may genuinely reflect the absence – or at least low density - of rhinos in this region, at least until close to the Mwenezi River with its perennial pools.




**Map 9.** Distribution of sightings of Black Rhinos north of the Runde River in relation to the extent of Thomson's (1971b) 'thicket-type' vegetation.
Map of rhino distribution based on map by Sharp (1985c).

Since the black rhinoceros was reintroduced to Gonarezhou NP, there have been major, but inadequately documented, changes in the vegetation north of the Runde River. The *Brachystegia glaucescens* woodland has disappeared, replaced by bushed grassland, with a significantly greater grass standing crop than there used to be in the *Brachystegia glaucescens* woodland. The fires which always used to burn this area almost annually are much more intense than in the past. The reason for the change is not clear: clearance by the Tsetse Control department, drought, elephants, or fire - or an interaction between any two, three, or all of these factors – may have been responsible. Many of the thickets have disappeared, at least as thickets. A preliminary, but current, map of the vegetation communities is provided by B. Clegg (pers. comm.) (map 10).

In the absence of descriptions of these vegetation communities, particularly plant species and size classes, any discussion of the effects that these vegetation changes have had on black rhino carrying capacity is very speculative. If the changes have resulted in an increase in the biomass of woody plants below 2 m, carrying capacity may have increased. Similarly, if the changes have reduced the biomass of woody plants below 2 m, carrying capacity may have declined. But even if there has been a decline in carrying capacity, there is certainly no reason to believe that the area cannot support at least 20 black rhinos. However, one of the several unknowns is the current direction of vegetation change. Is the structure and species composition of the vegetation still changing? If so, will there be a parallel decline in black rhino carrying capacity? Or has the vegetation simply moved to a new equilibrium, with a new, but approximately constant, carrying capacity for black rhinos?

During the previous reintroduction, most rhinos were released from pens near the Nyachiri River, a short distance westwards of the Sililijo and Pombadzi Rivers. If another black rhino reintroduction was going to take place, this is probably, at least from the points of view of food and water, still a good area for a reintroduction. However, it is by no means certain – in fact unlikely – that all released rhinos would stay in this vicinity. Dispersal southwards across the Runde River and eastwards towards the Save/Runde confluence is likely.

### *Diet of the White Rhino*

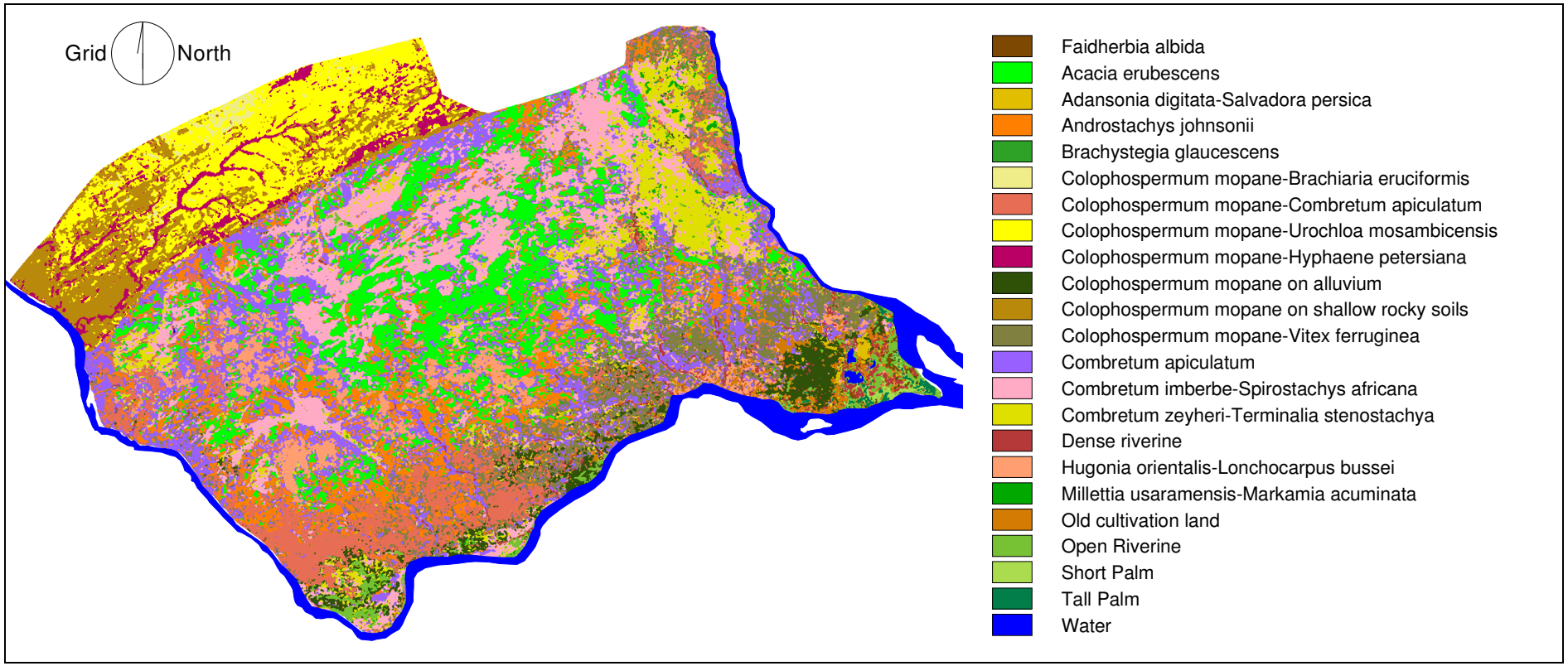
The white rhino is a selective grazer, with a preference for short grasses (Pienaar 1994c). In Kruger NP, it eats grasses such as *Panicum maximum*, *Sporobolus nitens*, *Dactyloctenium aegyptium*, *Panicum coloratum*, *Urochloa mosambicensis* and *Digitaria* species (Pienaar, Bothma & Theron 1992, Pienaar 1994c). *Themeda triandra* was grazed only after a fire when it was freshly sprouting. In Umfolozi Game Reserve also, *Urochloa*, *Panicum* and *Digitaria* were frequently eaten and *Themeda triandra*, although the dominant grass in the area, was not preferred (Player & Feely 1960).

### *Factors influencing the Habitat Preferences of the White Rhino*

The distribution of white rhinos seen during aerial surveys of Kruger NP, in relation to landscape type, was studied by Pienaar *et al*. (1992, 1993a), who calculated the mean density of white rhinos in each landscape type and determined which landscapes were preferred or avoided. The landscapes that were preferred had the following characteristics (Pienaar *et al*. 1993a, Pienaar 1994c):

1. undulating topography with uplands, bottomlands and watercourses;
2. sandy soils with few stones or rocks on the soil surface;
3. access to permanent water sources (for drinking, although white rhinos can go for up to three days without drinking);
4. a moderate to dense grass layer of good quality grasses (i.e. an abundance of high quality food);
5. an open to moderate low-shrub (<2 m) layer (a dense layer of low shrubs is likely to reduce grass production and interfere with the rhinos' feeding);
6. a moderately dense tree layer (to provide shady resting sites during the midday heat); and
7. the presence of small pans (for wallowing in mud).

White rhinos are partial to freshly burnt areas, selecting as food the post-fire flush of green grass, although they have also been seen to eat burnt grass stubble the day after a fire (Pienaar 1994c, Traill 2004).




**Map 10.** Preliminary map of the vegetation communities to the north of the Runde River.
Map prepared by B. Clegg (Malilangwe Trust) during 2003.

In Umfolozi GR, Player & Feely (1960) identified four factors that had a major influence on the distribution of white rhinos:

1. the quality of the grazing, because this determined the rhinos' food supply;
2. the availability of surface water throughout the year for drinking and for wallowing in wet mud during the hot months;
3. cover, in the form of clumps or extensive areas of thick bush, to provide shelter from very hot, or cold, windy weather; and
4. the absence of rugged topography.

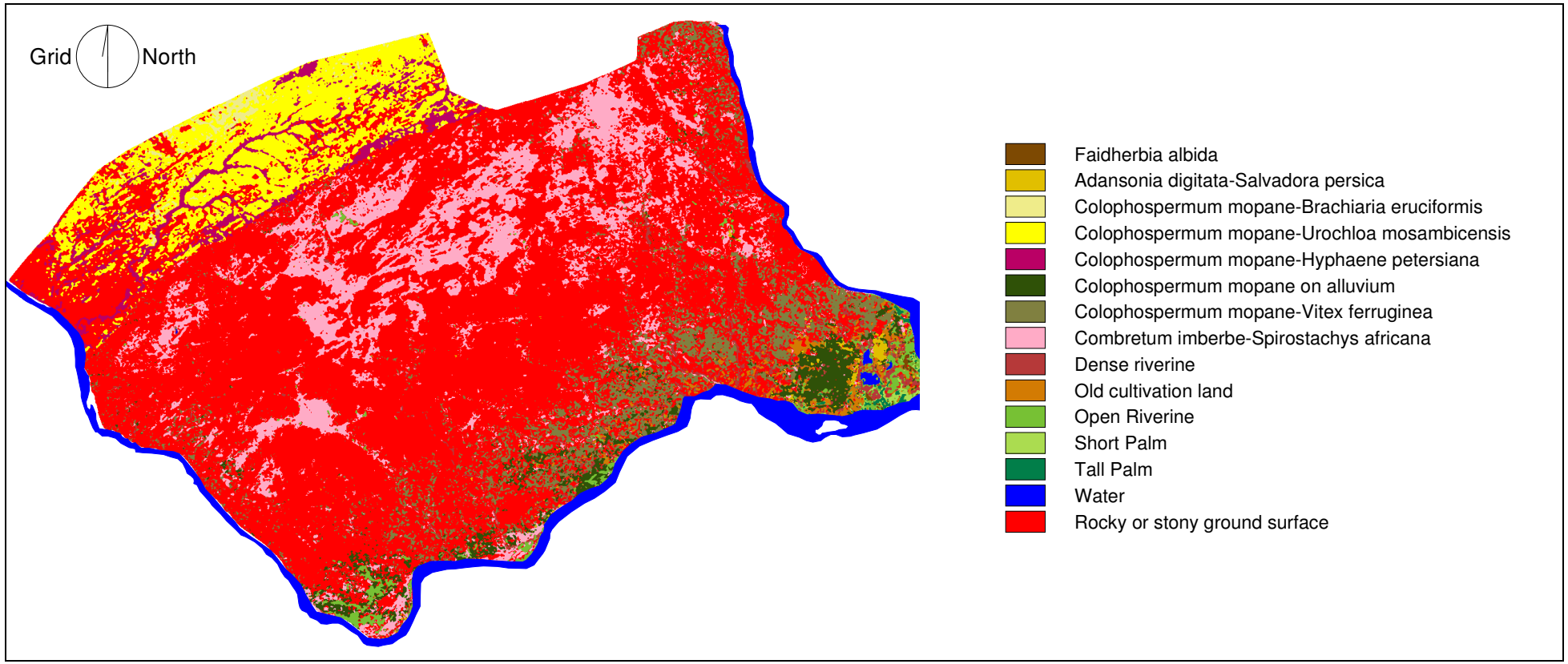
Owen-Smith (1988) observed that, during the dry season, white rhinos feed in areas of the landscape where the soil nutrient-rainfall combination causes grasses to accumulate only moderate levels of indigestible fibre in their leaves. In regions (e.g. the Zimbabwean highveld) where grasses are mostly highly fibrous and lack nutrients in their above-ground parts during the dry season, white rhinos feed mostly in those areas of the landscape where soil nutrients accumulate, for example around termite mounds and along the margins of vlei grassland.

### *Carrying Capacity of the White Rhino*

White rhinos prefer landscapes with few stones or rocks on the soil surface (Pienaar *et al*. 1993a, Pienaar 1994c, Traill 2004). But north of the Runde River in Gonarezhou NP, the ground surface is very stony or littered with rock rubble in many of Clegg's vegetation communities (map 10), particularly those in areas earlier mapped as *Brachystegia glaucescens* (Farrell 1968) (map 8), but also in at least one mopane community ('mopane on shallow rocky soils'). The black rhinoceros is often found in more rugged landscapes than the white rhinoceros, but even during the early days of the black rhinoceros reintroduction in Gonarezhou NP, it was noted that black rhinos tended to avoid the areas of rock rubble associated with *Brachystegia glaucescens* (Thomson 1971b). When the present vegetation communities with rock rubble or numerous stones on the ground surface are mapped, it is found that 703 $km^2$ (62 %) north of the Runde River are deemed as largely unsuitable for white rhinos on this basis alone (map 11). There are four major regions without a stony or rocky ground surface: the communities within a few kilometres of the Runde River; the alluvium near the Save/Runde confluence; the *Combretum imberbe-Spirostachys africana*; and the mopane shrubland and woodland on basaltic soils in the north-west.

Along the Runde River and near the Save/Runde confluence, it would be expected that the grasses growing there that white rhinos would prefer to eat (e.g. *Panicum maximum*, *Urochloa mosambicensis* and *Digitaria* spp.) are already being utilised by hippos, at least within 3 km of the Runde River (Mackie 1976, O'Connor & Campbell 1986b).

The *Combretum imberbe-Spirostachys africana* community (which encompasses the areas earlier mapped by Farrell (1968) as *Acacia nigrescens* tree savanna) is wooded grassland. It includes areas where the grass layer is dominated by the tall, relatively fibrous grasses *Hyparrhenia* and *Hyperthelia*, and other areas where *Digitaria* sp. grass is dominant. The two grassland types have not been separately mapped . White rhinos favour short grasses and tall *Hyperthelia* was ignored by white rhinos in Kruger NP (Owen-Smith 1988). Hence, it is unlikely that the where tall *Hyparrhenia* and *Hyperthelia* grasses occur would support a significant number of – if any - white rhinos. However, white rhinos do feed on *Digitaria* grass and the areas where this is the dominant grass would possibly be utilised for feeding. However, many of the areas of *Combretum imberbe-Spirostachys africana* wooded grassland are more than 10 km from natural sources of drinking water at the end of the dry season (map 12).




**Map 11.** Extent of vegetation communities with a rocky or stony ground surface to the north of the Runde River. Based on a map of vegetation communities prepared by B. Clegg (Malilangwe Trust).

The mopane communities on basaltic soils in the north-west of the area – in effect the Gulugi watershed – particularly the *Colophospermum mopane-Urochloa mosambicensis* probably would also provide food for white rhinos: *Urochloa mosambicensis* is a grass favoured by white rhinos in Kruger NP and Umfolozi GR (Player & Feely 1960, Pienaar 1994c). This vegetation community covers 97 $km^2$. This is the area that has often been used by the white rhinos that have entered the park from Lone Star Ranch/Malilangwe Estate (Tayler 1992, C. Wenham pers. comm.).

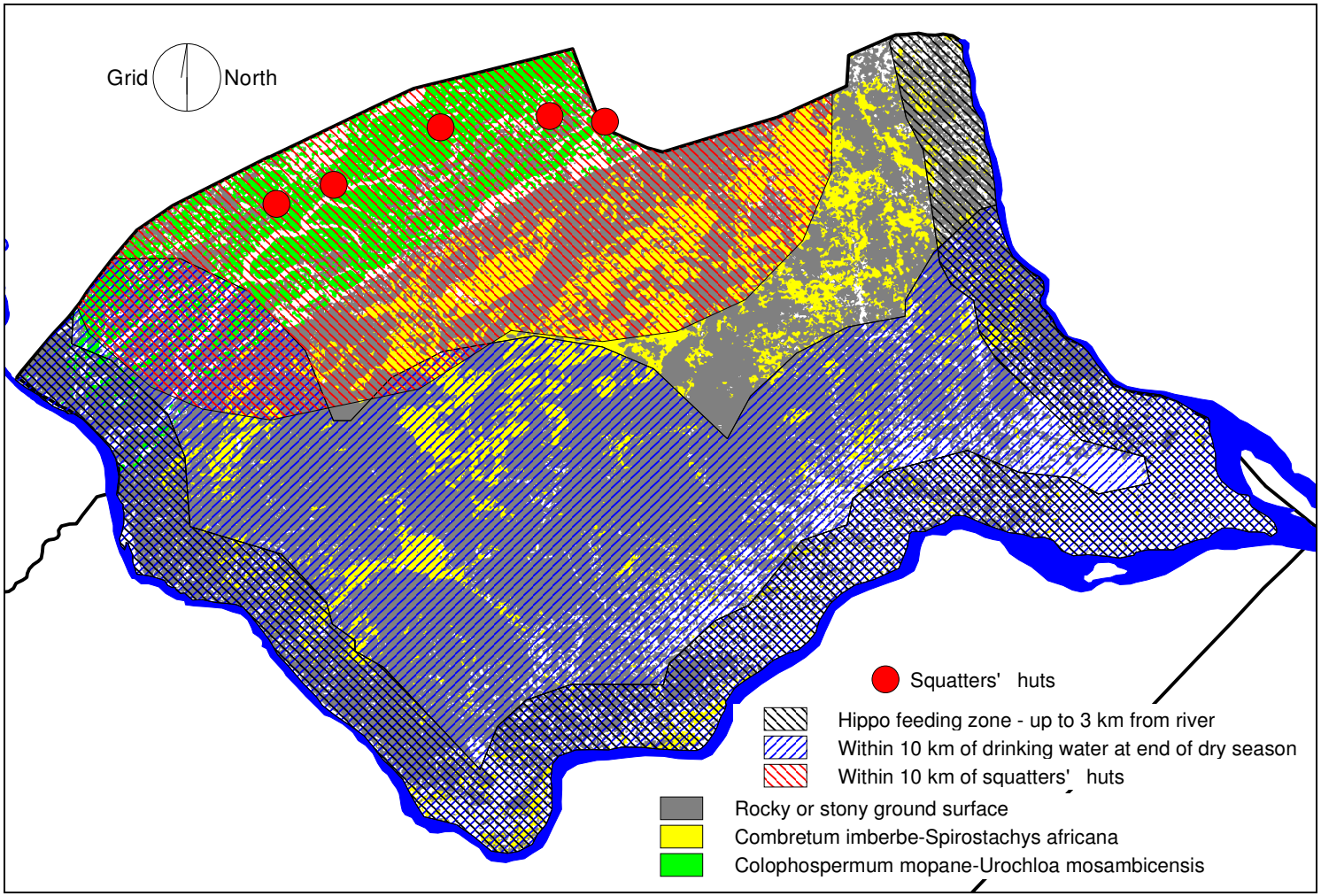
However, there are several reasons why the areas that provide suitable grazing for white rhinos would probably not support 20, let alone 50, white rhinos on a long-term basis:

1. Only 14.6 $km^2$ of the *Colophospermum mopane-Urochloa mosambicensis* woodland is within 10 km of natural sources of drinking water at the end of the dry season (map 12).
2. Most of the *Colophospermum mopane-Urochloa mosambicensis* woodland is settled by squatters, who have destroyed wildlife habitat to create fields and have destroyed wildlife directly by snaring. Any released rhinos would be seriously threatened by this snaring. The squatters also herd cattle inside the park. These cattle are competing with large, wild, grazing mammals for food and their entry to the park risks introducing infectious diseases and tick-born parasites that may affect wildlife. For example, the bacterium *Mycobacterium bovis*, which causes bovine tuberculosis, was introduced to Kruger NP when infected cattle mixed with wildlife (Vosloo, Bastos, Michel & Thomson 2001). The disease now affects a variety of wildlife species, particularly buffalo (Rodwell *et al*. 2001, Caron, Cross & Du Toit 2003) causing veterinary problems within Kruger NP and the Greater Limpopo Transfrontier Park.

   There has been no recent survey of the extent of the area of northern Gonarezhou that is affected by the squatters. Hence, on map 12 the locations for squatters' huts are those recorded during the 2001 aerial survey. The area that is adversely affected by the squatters is assumed to stretch for a (rather arbitrary) 10 km from the observed huts, but it could be a great deal larger: a few years ago, domestic goats were seen on the Runde River bank just north of Chitove camp. The origin of these goats is unknown, but their presence indicated that the map may greatly underestimate the extent of the area that is adversely affected by the squatters.
3. During the 1992 drought, many grazers in Gonarezhou NP either died from malnutrition, or were captured because it was believed that otherwise they would die (Tayler 1992). The large grazing species, the buffalo and hippopotamus, suffered particularly badly. It is very likely that, if the white rhinoceros was reintroduced to Gonarezhou NP and there was another drought similar to the 1992 one, there would be significant mortality amongst the white rhinos. Or a need for major and expensive management interventions.

Each dry season, extensive and intense fires burn the grass over large areas of the landscape north of the Runde River. The immediate effect of any grass fire is to destroy the food source for grazing animals. But if the soil retains some moisture from the last rains, or if some rain falls soon after the fire, the green grass flush that results is likely to be attractive to a range of large grazers, including white rhinos. However, the magnitude of the green flush is usually directly dependent on soil moisture – and hence rainfall – and so it cannot be relied upon as a dry-season food source for large grazers.

Even if an amicable settlement was reached to remove the squatters from Gonarezhou NP – be it by the squatters moving out, or the park boundary being realigned in order to exclude them – there remains considerable doubt about the area north of the Runde River to support – in more than the short-term – a viable population of white rhinos. More study is needed of the grazing resources likely to be available in this area at the end of the dry season. Particular attention should be paid to possible competition for food between white rhinos and hippos (a subject on which the scientific literature appears silent). Frequent grazing of the same patch of grassland can cause changes in the species composition and structure of the grassland and so, at least in theory, it is possible that grazing by white rhinos might change the present sward in ways that are beneficial to the rhinos, e.g. by encouraging the growth of short, good-quality (i.e. relatively low fibre) grasses that are adapted to frequent grazing. However, frequent large fires – such as occur over much of the area north of the Runde River- can prevent areas of heavy grazing from persisting and thus can limit the spread of grazing-adapted grasses (Archibald, Bond, Stock & Fairbanks 2005).




**Map 12.** Major factors likely to influence habitat selection by White Rhinos north of the Runde River.
The distribution of vegetation communities with a rocky or stony ground surface, the *Colophospermum mopane – Urochloa mosambicensis* woodland and the *Combretum imberbe – Spirostachys africana* wooded grassland is based on the map by B. Clegg (Malilangwe Trust). The locations of squatters' huts are derived from the 2001 aerial survey (the most recent of the park).

## Fire in northern Gonarezhou NP (*Section author: Dr Fay Robertson*)

### *Fire ecology of northern Gonarezhou*

Fire requires:

- Sufficient fuel to carry a fire without it dying out;
- A fire starter; and
- Suitable weather for burning.

#### Fuel load

The fuel for fires in south-eastern Zimbabwe is grass. Grass fires burn with difficulty or not at all if the fuel load is less than 1 tonne $ha^{-1}$ (Trollope & Potgieter 1983). The standing crop of grass at the beginning of the dry season depends largely on how much rain has fallen during the preceding wet season, on vegetation/soil type and on grazing pressure.

We made visual estimates of the fuel load in many of the vegetation types within the IPZ in early March 2005. At the time of the visit, rainfall (314.7 mm at Malilangwe HQ) was approximately 240 mm below the seasonal average. Rainfall during the previous season (755.7mm at Malilangwe HQ) had been 200 mm above-average.

Fuel loads ranged from 1 tonne $ha^{-1}$ in grassland growing on rocky ground under mopane woodland, to 5-6 tonnes $ha^{-1}$ in wooded grassland along major tributaries of the Runde River and on the watershed plateau (Table 3). Most of the communities on the granophyre hills carried a fuel load in excess of 2 tonnes $ha^{-1}$. Little dead grass remained from the previous season, because most areas had burned during 2004.

There are too few large grazing mammals in the proposed IPZ for their grazing activities to reduce significantly the fuel load, with the probable exception of hippo grazing in the riverine, alluvial and mopane communities along the Save and Runde Rivers and cattle grazing in the areas occupied by squatters.

#### Fire starters

If all fires in the proposed IPZ crossed into the Park from outside, the IPZ would be relatively easy to protect. The broad sandy beds and rocky gorges of the Save and Runde Rivers provide effective natural fire barriers on three sides. Only the northern boundary lacks a natural fire barrier. There is an effective fire-management programme on the Malilangwe Estate and negligible danger of fires spreading into the Park from there. Fires burning into the IPZ can come only from the Sangwe communal land to the north.

However, natural barriers are an ineffective protection against burning in the proposed IPZ, because most of the fires lit in this area are not accidental, but are deliberately lit by people - often well inside the Park (Tafangenyasha 1991). Sharp (1987) reported that arsonists caused major fires within the IPZ during at least eight successive years. On occasion, five or six separate fires were lit, more or less simultaneously (Francis 1975, Sharp 1985b). People who burn to make hunting with dogs easier (because, as they said when asked their reason for burning, 'Dogs could not be expected to chase animals in the long grass' (Francis 1975)), or who allow fires to escape during honey collection, or while making fields inside the Park provide a variety of sources of ignition. Fire starters are so many and so widely spread throughout the dry season, that where there is grass to burn, it will probably burn, if not this year, then the following year.

Deliberate fire-lighting is a long-standing problem, unlikely to be solved without the resolution of the other deep-rooted problems that have caused poor relations between the DNPWLM/PWMA and the people in the Sangwe and Mahenye Communal Lands.

**Table 3. Fuel loads during March 2005 in some of the vegetation types of the proposed IPZ in northern Gonarezhou NP**

| Current vegetation type | Dominant grasses | Fuel load = dry mass of grass standing crop (tonnes $ha^{-1}$) |
|---|---|---|
| *Colophospermum mopane* on rocky ground on basalt plain | *Urochloa mosambicensis, Enneapogon scoparius* | 1 - 2 |
| Mixed *Kirkia*, *Adansonia* escarpment woodland (*C. apiculatum*) on the Chionja Escarpment | *Digitaria eriantha, Urochloa mosambicensis* | 2 - 3 |
| Mopane woodland on granophyre plateau | *Digitaria eriantha* | 4 |
| *Androstachys* wooded grassland on steep granophyre hills | *Digitaria eriantha* | 2 - 3 |
| *Combretum imberbe- Spirostachys africana* bushed grassland (was *Acacia nigrescens* tree savanna) along watercourses on granophyre | *Digitaria eriantha, Urochloa ?trichopus, Heteropogon contortus* | 5 - 6 |
| *Acacia erubescens* bushed grassland (was *Brachystegia glaucescens* woodland) on granophyre hills | *Digitaria eriantha, Heteropogon contortus* | 2 - 3 |
| *Colophospermum mopane-Combretum apiculatum* woodland and shrubland on rocky granophyre slopes | *Heteropogon contortus, Digitaria eriantha,* | 1 - 3 |
| *Brachystegia-Adansonia* bushed grassland on granophyre watershed (was *Brachystegia* woodland) (Clegg mapped this as part of the *Combretum imberbe-Spirostachys africana* wooded grassland) | *Hyparrhenia* spp., *Hyperthelia dissoluta, Heteropogon contortus* | 5 - 6 |
| *Combretum zeyheri-Terminalia stenostachya* shrubland on granite hills | *Digitaria eriantha* | 2 - 3 |
| *Julbernardia globiflora-Terminalia sericea* woodland and shrubland on granite hills | *Digitaria eriantha, Stereochlaena cameronii* | 1 - 2 |

There are no accounts of lightning fires in the DNPWLM records, although without an eye-witness to the strike, they would be impossible to distinguish from arson fires. Thunderstorms are less frequent in the south-east lowveld than anywhere else in Zimbabwe (Kreft 1972b). There are about 16 thunderstorm days from May to November each year. These might be expected to produce about one lightning strike to the ground each year for every two square kilometres of the IPZ (Frost 1992). Lightning fires are most likely to be caused by strikes during dry-storms in the transition between the late dry season and the early wet season. But most lightning strikes do not cause fires. In the proposed IPZ, arson is the most likely cause of any fire whose origin is unknown.

**Weather**

Fires are most severe when the grass is dry, relative humidity is low, and air temperatures and windspeed are high. About 84% of rain falls from November and March, and grass will be dead by early June during most years. Mean relative humidity drops steadily as the dry season progresses and is lowest from August to October. The hottest months are September to March (mean daily maximum temperature 30.6 - 32 $^{o}$C), while the coolest months are April to July. Maximum temperatures may reach 42.2 $^{o}$C during November.

The prevailing winds blow from the south-east (Kreft 1972a, Anon. 1978b). The wind is strongest (16-17 km hour$^{-1}$) between about 1400 and 1600 hours during October and November. The least windy month is May, when windspeeds drop below 11 km hour$^{-1}$, even in the afternoon which is the windiest time of day. Windspeeds drop rapidly at dusk and night-time winds are half the speed of daytime winds.

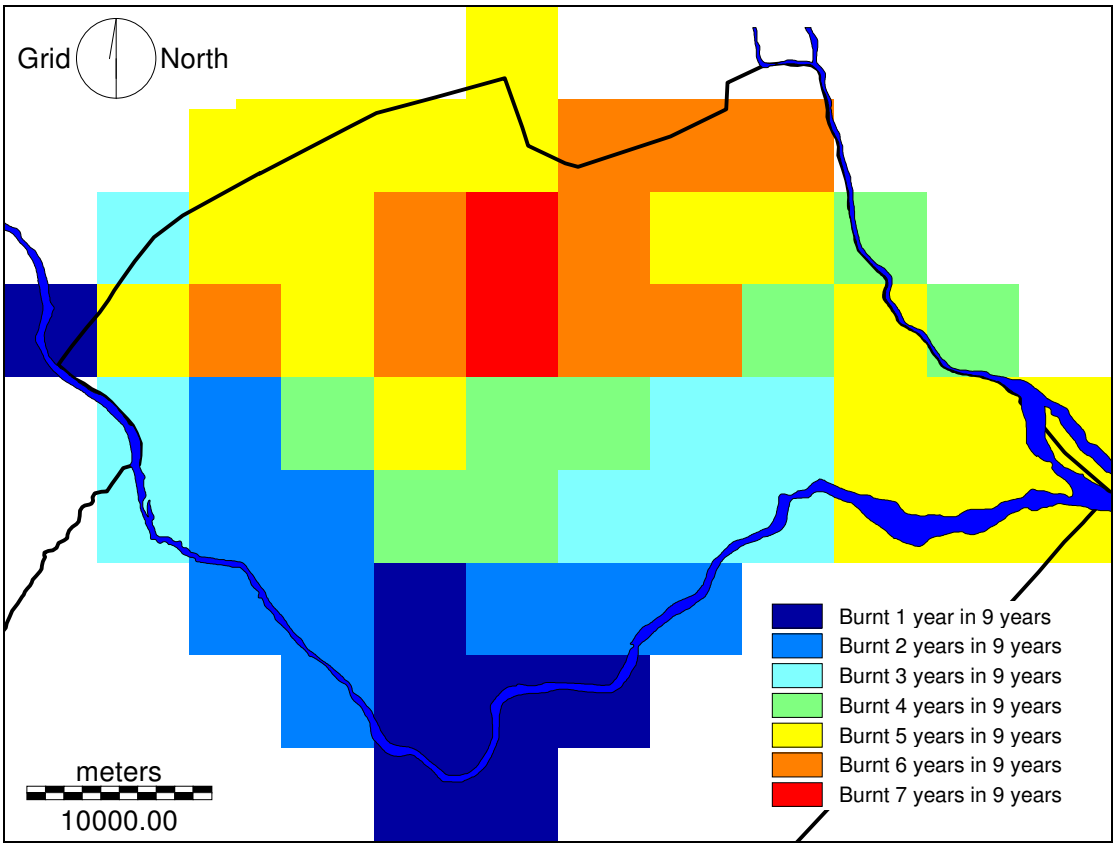
The time of greatest fire hazard is between the hours of 2.30 p.m. and 3.30 p.m. during September and October (Laing 1978), when weather factors combine to maximise fire intensity. However, cool drizzly weather associated with south-easterly winds may blow in off the Mozambique Channel at any time of year, considerably reducing the fire hazard.

### *Fire regime during 1969-1986: before the 1991/1992 drought*

**Fire frequency**

The fire frequency map for the period 1969-1978, i.e. during and immediately after the black rhino re-introduction, showed that no large area (>25 km$^2$) within the proposed IPZ escaped burning for the entire nine years (Map 13). Most of the IPZ, including the basalt plains, the greater part of the hills and the alluvial area at the Save-Runde junction, burned (on average) at least once every two years.

Mopane woodland on basalt close to Chipinda Pools, probably heavily grazed by hippos and protected by roads acting as a fireguards, also seldom burned.




**Map 13.** Fire frequencies in northern Gonarezhou NP from 1969 to 1978 (excluding 1972). Original map by Peek (1978).

Sharp (1987) updated the fire frequency maps by adding another eight years of records, but the fire frequency pattern changed little. Most of the communities on the hills, the basalt plain and the Save-Runde alluvium burned, on average, at least once every two or three years. The area just north of the

Runde River burned no more than once in four years and the fire interval here was often seven or more years. Tafangenyasha (2001) added a few more years of fire records and found a similar pattern of fire frequencies.

### Patchiness

The standing crop of grass in the proposed IPZ was spatially variable before the 1991/1992 drought, because the vegetation structure varied from dense woodland and riverine forest - where trees suppressed grass growth - to bushed grassland along the drainage lines. Further variability in the fuel load was provided by the differing rates at which the grass died and cured. Grasses in streamlines and vleis stayed green well into the dry season, providing barriers to fires until about August.

Thirty years ago, fires extended over hundreds of square kilometres and burned for many days, but many small patches within the boundaries of the overall burned area did not burn. For example, although 85% of the proposed IPZ was mapped as burned during 1975, a large area of the *Brachystegia glaucescens* woodland, which had no grass cover, was not burnt (Francis 1975). At that time, the *Brachystegia* woodland occurred in a mosaic of medium-sized patches together with thickets and grasslands, often in a catenal pattern with woodland at the top of the slope and wooded grassland in the streamlines (Farrell 1968).

### Area burned and rainfall

During the 1970s and 1980s, there was a good correlation between the area of the Save-Runde subregion that burned (the subregion included parts of the Park south of the Runde, outside the IPZ) and rainfall (Sharp 1985b, 1986c, 1987). The season's rainfall (July-June), or the sum of that season and the previous season's rainfall, could be used to predict the area of the subregion that would burn during the dry season ($r^2 = 0.5596$):

$$y = 0.0655.x - 31.322$$

where $y$ = area burned (in $km^2$)

and $x$ = sum of two previous seasons' rainfall (in mm).

This relationship suggests that it was rainfall (acting on grass growth and so controlling the fuel load) that largely determined the total area of the sub-region that burned. Wherever sufficient grass fuel was available, good weather conditions for burning, especially after August, combined with the arsonists to ensure that the area would burn. Any fire management actions that were undertaken seldom succeeded in preventing large areas of the IPZ from burning after a wet year, although extinguishing a fire may have delayed burning in that particular area until later during the dry season.

### Fire policy and management

Until 1985, the DNPWLM wardens responsible for Gonarezhou attempted to protect the entire Park from burning by maintaining fire breaks and extinguishing fires whenever possible (Sharp 1985a). In the Save-Runde subregion they were not successful. Following a good rainy season, fires always burned across hundreds of square kilometres of the Park, usually between August and October (Peek 1978, Sharp 1985b).

Extracts from the warden's report on fires in the proposed IPZ during the 1975 dry season (Francis 1975) illustrate the difficulties faced when the staff tried to extinguish fires during a dry season that followed one or two years of above-average rainfall.

- In **August**, people 'set alight the area between the Chuhunjas and the cattle fence, behind Chipinda Pools on six separate occasions. Because of high winds we could only fight fires at night, so steadily lost ground, particularly due to the lack of firebreaks.'
- Later in **August** people from Sangwe CL started a small fire which burned out the north-east of the Park near the Save River.
- In **September** tourists set alight the area on the Runde north bank opposite Chitove. 'We fought it on Pombadzi River where it jumped and got away from us; we fought it again on access road to Chilojo Camp where it was contained.'

- In **October**, 'fires started near the Tamboharta road and at Tamboharta, swept through all the Junction area and the vleis on the top of the Chuhunja plateau and were contained in the top western corner. With no fire guards in the area, the high winds and extreme temperatures, any major action in control was severely hampered. It was eventually contained near Makandima by backburning.

By November 1975, only about 15% of the proposed IPZ had not been accidentally burned. All the fires had burned after the beginning of August - late in the dry season, when weather and fuel conditions favour intense fires.

The DNPWLM recognised that the policy of total fire protection was not working. A revised fire policy for Gonarezhou, written during 1985, identified areas at high risk of arson and vegetation communities requiring special protection from fire (Sharp 1985a). Only one of these communities (the vegetation on alluvium at the Save-Runde junction) was within the proposed IPZ. Vulnerable vegetation communities were to be protected by a variety of methods including preventative early-burning, fire-fighting and extinguishing fires. Because resources were limited, little attempt was to be made to manage fire elsewhere in the Park.

In the event, even protecting the high-risk communities proved difficult due to constraints that included logistics (for instance, sometimes the rains ended unusually early and fires began in February/March, well before the early-burning that was planned for July), staff and finance (Sharp 1985b, 1986c,1987). However, a deliberate early burn on the west bank of the Save River between the Chivirira Falls and Ndali Gate was thought to have been successful at preventing later, hotter burns (Sharp 1986c).

### *Fire regime from 1992 to 1999: since the 1991/1992 drought*

**Reductions in the woody layer and increased grass production**

At some time between the early 1980s and the mid 1990s, many canopy trees and shrubs in the IPZ died. Losses were particularly severe in the *B. glaucescens* woodland and the *Androstachys johnsonii* thickets, but also in other thicket types and in the mopane and the *Terminalia-Combretum* communities (Tafangenyasha 1997, 2001). Many of the vegetation communities described as woodland and thicket by Farrell (1968) have been so transformed by the loss of mature individuals of vulnerable woody species that they are now shrubland or grassland and dominated by different, more resilient species. Farrell's vegetation types (Map 8) are barely recognisable in Clegg's recent map (Map 10) Fires, elephant and drought may have been jointly responsible for the disappearance of the *Brachystegia* woodland (Tafangenyasha 2001). Other observers have suggested that *Brachystegia glaucescens* is vulnerable to drought and that it was eight years of below average rainfall during the 1980s and early 1990s, six of which were consecutive, culminating in the catastrophic drought of 1991/1992 that killed many of the trees (N. Chauke, A. Conybeare, Th. Müller, C. Sharp, pers. comm.) Only 92.7mm of rain fell at Chipinda Pools during the 1991/1992 season.

Trees suppress grass growth, probably through competition for water. Accordingly, the standing crop of grass has probably increased since the trees have died, although this increase may have been partly offset at least in the short-term in some communities by changes in grass species composition, away from robust perennial grasses to shorter-lived species (O'Connor 1997). Kelly & Walker (1976) estimated a standing crop of grass of 0.25-1 tonnes $ha^{-1}$ in a dry year (rainfall <300 mm) to 1.2-2 tonnes $ha^{-1}$ in a wet year (*c.* 600 mm of rain) in mopane communities growing on the basalt plains of Malilangwe and Gonarezhou. There are no estimates of the fuel load in the other vegetation communities of the IPZ before the 1980s, but Wild (1955) noted a 'very poor ground cover' in the *Brachystegia glaucescens* woodland and 'no grasses whatever' under the *Androstachys* thickets.

A fire in the *B. glaucescens* woodland during August 1985 did not cause any significant damage to the woody vegetation, because the fuel load was insufficient, although the same fire completely burned the communities in the drainage lines (Sharp 1986c). Another fire during early August 1985 did little damage to the *Brachystegia* woodland or to the *Androstachys* thickets on the Chionja Hills, probably because of the low fuel load, but severely damaged mopane vegetation on the basalt plain. Today almost all the trees have gone from those areas that were once *Brachystegia* woodland and *Androstachys* thicket, and there is a standing crop of largely perennial grass of 2-3 tonnes $ha^{-1}$.

By contrast, fuel loads on the basalt plain have probably been reduced by an increase in shrub density, especially in the area in the north-west mapped by Farrell (1968) as *Setaria porphyrantha* (= *Setaria incrassata*) grassland that is now mopane shrubland.

**Increased windspeeds**

Once woody vegetation has been removed, windspeeds at ground level increase, especially when the previous vegetation was thicket or dense woodland. Faster winds allow even light fuel loads to burn effectively. This could set up a positive feed-back in vulnerable communities: a few tree deaths allowing fire into communities that were protected from fire by a lack of fuel and low windspeeds, leading to more tree deaths, greater fuel loads and greater windspeeds. This may have happened in some thicket communities. *Androstachys johnsonii* communities on slopes that are at an oblique angle to the prevailing wind, and so less exposed to intense fires, seem to have survived better than those that face south-east.

**Reduced patchiness**

The uniform and increased standing crop of grass can support fires almost everywhere, once the grass is dry enough to burn. The only remaining source of patchiness is the differing rates at which grasses die and cure, which depends mostly on differences in soil moisture. Only fires burning early in the dry season, before the grass is uniformly cured, will be patchy.

**Increased fire frequency**

There are no DNPWLM fire frequency maps after 1991, but the areas burned during 1995, 1996 and 1999 were mapped individually. The latest available fire map of northern Gonarezhou (Map 14) is based on satellite observations made between April and October 2003 using the new MODIS instrument (Roy, Lewis & Justice 2002).

If these four years (out of thirteen) of fire maps since the drought are typical, they suggest that most of the hills and the basalt plains burned once every two years. The area north of the Upper Pombadzi burned every year. The mopane communities in the rough country north of the Runde did not burn even once in four years. Most importantly, for the habitat of the black rhino, the frequency of fires in the vegetation communities around the middle and upper Sililijo rivers had increased to three years in four.

**Rate of fire spread**

The increasing speeds at which fires spread across the IPZ as the dry season progresses can be modelled by using weather data from Buffalo Range (Anon. 1978a, 1978b) and recent estimates (Table 3) of fuel loads in a fire model developed for Australian grasslands (Noble, Bary & Gill 1980). In April, presuming that about 80% of the grass was dead and dry, a fire burning through an average fuel load of 2.5 tonnes $ha^{-1}$ would spread at about 0.4 km $hour^{-1}$. During October, a fire burning through the same fuel load of 2.5 tonnes $ha^{-1}$, now fully cured and air dry, would spread at an average of about 1.1 km $hour^{-1}$. At this rate of spread, a fire front burning with the prevailing south-easterly winds would move about 26 km in one day. This is the straight-line distance from Tambaharta Pan to the Ndali gate.

The weather conditions used in the model are 24 hour averages for each month. Under extreme weather conditions, for instance at midday in a windy month during October, a fire could spread through a fuel load of 6 tonnes $ha^{-1}$ at 3.4 km $hour^{-1}$. Such a fire could travel at nearly 7 km $hour^{-1}$ when burning with the wind up the steeper slopes of the Chionja hills, because the rate of forward spread doubles for every ten degrees of slope.

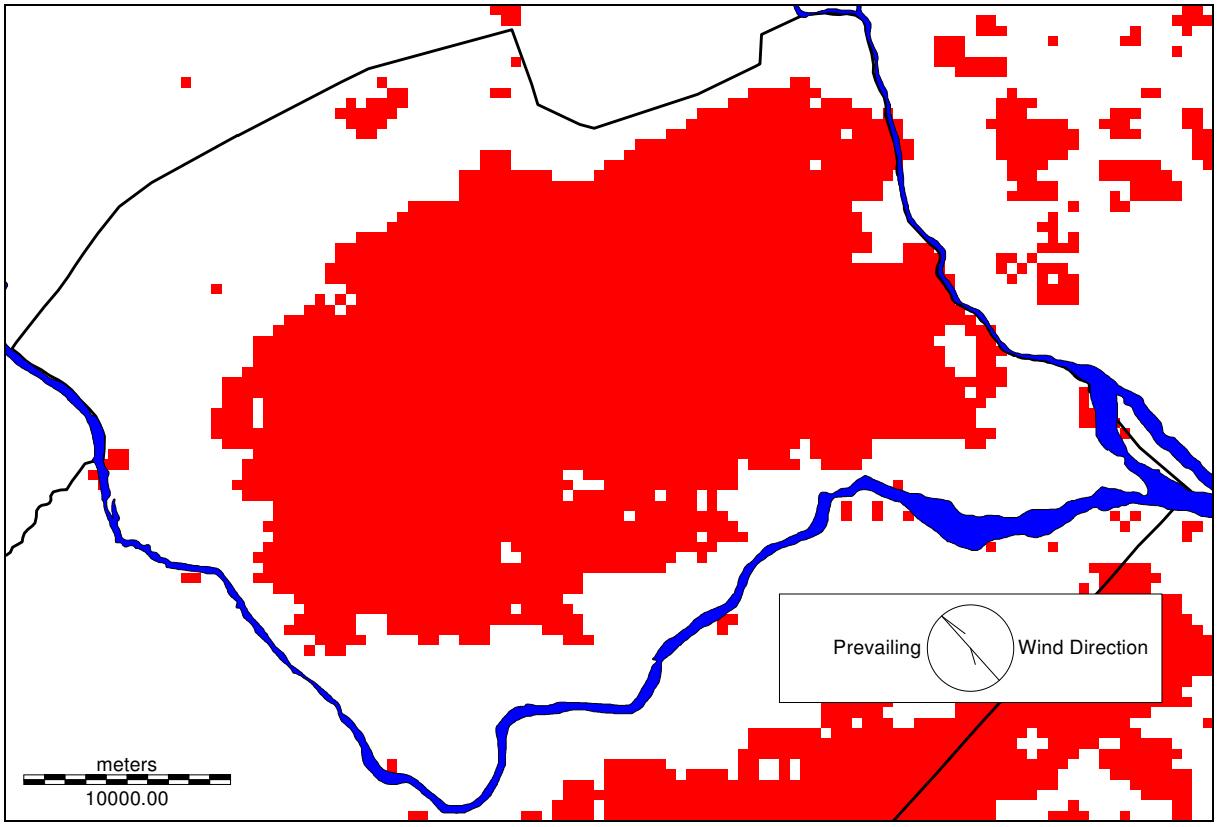
**Fire intensity**

Fire intensity can used to predict how difficult a fire will be to control and how much damage it is likely to cause to woody plants. It can be modelled for the IPZ using weather data from Buffalo Range (Anon. 1978a, 1978b) and our recent estimates of fuel loads in a fire model developed in Kruger National Park (Trollope *et al.* 2002).

At 1400 hrs during October, a fire burning an average fuel load of 2.5 tonnes $ha^{-1}$ would have a fire intensity of about 2400 kilojoules $second^{-1}$ $metre^{-1}$. Flames are about 2.8 m long in a fire burning at this intensity. The heat load on anyone within 10 m of such flames is dangerous. Manual firefighting

methods, such as beating, are not usually possible when fire intensity exceeds about 350 kJ $s^{-1}$ $m^{-1}$ (Deeming, Burgan & Cohen 1978).

Fire intensity during October would be even greater if the fuel load were greater, or on a steep slope facing the prevailing winds. Fires during October are not controllable, except by backburning. But the back burns themselves are likely to be escape control unless they are set from a wide and secure firebreak, and water in a bowser is freely available to dampen the grass on the edges of the break.




**Map 14**. Burned-areas in northern Gonarezhou NP during April-October 2003.
MODIS satellite data provided by D. Roy (pers. comm.).

**Current management policy and actions**

The current fire policy for Gonarezhou National Park requires Parks & Wildlife Management Authority (PWMA) staff to reduce the extent and frequency of fires and suggests that protecting the Park against fire requires 'the preparation of border and internal firebreaks, a fire detection system and a reaction plan in the event of fire' (DNPWLM 1998).

There are no internal firebreaks within the proposed IPZ, although it is hoped by PWMA staff that the newly-bulldozed roads within the IPZ will act as firebreaks. This will require clearing the roads of the grass that grows over them every wet season. This would require mowing, hoeing, or grading the roads to remove the grass at the beginning of every dry season. A difficult task, when boulders litter the roads, interfering with machinery, and a man can 'scoffle' no more than about half a kilometre per day. Even if clearing the tracks effectively were possible, a fire burning with the wind in the mid-late dry season would leap a single track road without difficulty. Neither would such a road be a safe place to stand and fight a mid to late dry season fire, except where the fuel load was exceptionally low or still green.

The new roads do provide access to fires, but not rapid access. Because of the terrain, especially the granophyre boulders, the roads are rough. Getting a team of fire fighters together and driving to say the area around Marakeet Pan, which burns during most years, would take at least five hours. During

that time, an October fire could have moved 6 kilometres on a broad front. This analysis suggests that a fire tower in the IPZ to permit the early detection of fires(as recommended in the park management plan (DNPWLM 1998)), would not be particularly useful, because a rapid response to most of the fires detected would not be possible.

For practical reasons, backburning is the only method of fire control currently practised in the proposed IPZ, although backburning is not recommended in the current management plan (DNPWLM 1998). If backburning from roads was always successful at combating fires, it would still involve the sacrifice of 50-150 $km^2$ of the proposed IPZ per fire, because this is the approximate area of the blocks within the road network.

Given the difficulties experienced by DNPWLM staff in extinguishing wildfires during the 1970s and 1980s, when fires were much less intense, because fuel loads were less and more patchy, recommending fire control by extinguishing wildfires to protect the vegetation of the IPZ is not a sensible option.

### *Recommended fire management policy: Early burning*

Fires in the northern Gonarezhou are fast-spreading, intense, cover hundreds of square kilometres within a few days and are usually impossible to beat out manually. There is no water available in the hills to fill water bowsers. Arson is a recurrent problem. Given the rugged terrain and fire ecology of the IPZ, early-burning is probably the best option to restore some of the woody vegetation that has been lost within the last thirty years. The aim of early-burning would be to reduce the extent and area of the most damaging (for woody vegetation) late dry-season fires.

Early-burning was developed in the 1970s and 1980s as a solution to the problem of late-hot fires in the *Brachystegia* woodlands of the Zambezi escarpment (Robertson 1993a). Total exclusion of fire by means of firebreaks had been tried and failed. Early-burning is done at a time of year (early dry season) when the grass is still partially green and the weather conditions mild and hence fires are not intense. The aim of early-burning is to produce a patchwork, of burnt areas with unburnt areas in between. Thus not all areas burn every year and any late fires started accidentally die out against previously burnt areas and cannot cover large areas.

Plants are most vulnerable to fire when they are actively growing. Because grasses and woody plants differ in their phenology, location of their growth points and resource allocation, the timing of the burn affects these two life forms differently. Burning early in the dry season kills the stems of some woody plants, generally those shorter than 1-2 m, but reduces the grass fuel load and the probability of late dry season fires, favouring relatively fire-resistant woody plants. Late, hot fires favour perennial grasses, largely by suppressing woody plants that would otherwise compete for water and nutrients.

A successful early-burning programme requires advance planning every year, using terrain maps, rangers' knowledge of current fuel conditions, rainfall records and maps of burns during previous years. It also requires considerable flexibility as rangers may be required to go out and light fires as early as March, or as late as July, often over a period of several weeks, until the desired patchwork of burns has been achieved. Unexpected guti conditions, or late rain, may disrupt plans. Most of all, successful early-burning requires knowledgeable commitment to an early-burning policy.

### *Probable changes in the structure of vegetation communities with and without a successful early-burning programme*

The woody species of arid woodlands and grasslands are resilient. Although woody plants have their buds aboveground, many also have substantial root stocks and can coppice by producing new buds just below-ground level if the aboveground parts are removed by fire. Different fire regimes are more likely to create differences in the horizontal and vertical structure of the vegetation communities than to eliminate completely any woody species.

#### Mopane communities on the basalt plain

Fire management is difficult in the mopane communities on the basalt plains, which are vulnerable to fires spreading in from the Sangwe communal land, as well as to fires lit by the squatters. These mopane communities burn every year that there is sufficient fuel to carry a fire, which is about every second year since the 1991/1992 drought. Although the standing crop of grass is not especially high

(Kelly & Walker 1976, O'Connor 1997), mopane leaves contribute to the fuel load and increase the fire intensity. Mopane leaves contain resin which allows shoots to burn even while green (Trollope & Potgieter 1983). The resin can volatilise, causing spectacular, fast-moving crown fires under hot, dry weather conditions.

Burning at any time during the dry season reduced the canopy volume and height of mopane shrubs, but increased the number of coppice stems, in the south-east lowveld of Zimbabwe (Walters 2000) and in shrub mopane in Kruger National Park, South Africa (Gertenbach & Potgieter 1979). As mopane coppices vigorously from underground rootstocks, repeated dry-season burning may produce dense mopane shrubland, especially if the burning is followed by a period of protection from fire.

These mopane communities are still dominated by woody plants, although there may be fewer canopy trees than in the past, and so encouraging woody regrowth should not be a priority here. It is more likely that bush encroachment is a problem. The area of wet, perennial grassland on the basalt plain has been reduced by prolonged desiccation and catastrophic drought (Clegg 1999). *Setaria porphyrantha* (*S. incrassata*) grassland has been invaded by mopane shrubs and the robust perennial grass has been replaced by lower-yielding short-lived species (Maps 8 and 10).

Early-burning may not be the ideal option on the basalt plains. If the frequency of accidental fires could be reduced, occasional late dry season burns to at least temporarily reduce bush encroachment and remove moribund grass would probably be the best option (O'Connor 1997, Walters 2000).

**Mopane communities in the hills**

Unlike the mopane communities on basalt, these vegetation types seldom burn. Rough terrain, stony ground and low fuel loads have protected them, as has their location - downwind and downslope of most arson fires. Early-burning is unnecessary here, but early-burning in the surrounding communities would help to reduce the risk of late dry season fires. Elephant-use is more likely to change the structure and species composition of the tree and shrub layer in these communities than fire.

***Acacia erubescens* bushed grassland (was *Brachystegia glaucescens* woodland) on the hills**

The once-dominant *Brachystegia glaucescens* has almost disappeared as a canopy tree, except in the east of the IPZ, where isolated individuals remain. This species is not tolerant of intense fires, although the lowveld ecotype can coppice in response to damage, unlike the highveld ecotype. The short (1-2 m) heavily-coppiced individuals that have survived drought, fire and elephant-use will not grow taller under the current regime of frequent, hot fires. The likelihood that coppice will regrow into woodland is greater the longer the interval between fires (Frost 1996). Once the dominant trees have reached a height of 2-3 m, they are less vulnerable to burning and begin to suppress grass growth, creating a positive feedback between lower fuel loads, more rapid regrowth by trees and shrubs and more effective competition with grass (Robertson 1993b). If fires are frequent, the regrowth may remain trapped in a shrub or grassland phase, where *Brachystegia* plants are still present as suffrutices, but *Combretum, Acacia* and other shrubby species dominate (Starfield, Cumming, Taylor & Quadling 1993).

Successful early-burning should encourage the woody plants in this vegetation type to increase in size and density. The current fire regime of frequent, hot burns will maintain this vegetation type as bushed grassland and perhaps further reduce the shrub layer. This community covers large areas of the hills and, depending on the resources available for early-burning, it might be better to concentrate initially on smaller areas where (owing to terrain, wind-direction, and a relatively low fuel load) an early-burning policy would be more likely to succeed.

**Thickets on the hills**

The remains of the *Androstachys johnsonii* thickets that once grew on steep slopes on the hills are still visible as standing stumps. There is some *Androstachys* coppice, largely hidden in the grass layer. This species appears to be particularly sensitive to burning and should ideally be completely protected from fire if it is to regrow. Careful early-burning of surrounding communities, especially where the remnants of thickets still survive on north-facing slopes, may help to exclude fires and so encourage regrowth, but it is likely to be a slow process.

Areas where *Lonchocarpus bussei* thickets survive, especially in the north-east, might also be protected and encouraged to expand by early-burning the surrounding grassland communities.

**Bushed grassland along watercourses in the hills**

*Acacia nigrescens* trees have disappeared from this bushed grassland. Occasional *Spirostachys africana* trees and shrubs, and a variety of fire-resistant shrubs including *Acacia welwitschii, Combretum imberbe, C. mossambicense* and *Alchornea laxiflora* grow among the tall grass layer. Trial plots in similar vegetation in the Kruger National Park that were burned once every three years had increased densities of woody plants, while the best chance to grow beyond a fire-sensitive height occurred in plots burned every two years (Enslin *et al*. 2000). The slightly longer fire-return-period seemed to increase seedling recruitment and density, but suppressed height increase, because of topkill as a result of the accumulation of dead grass (fuel).

Early-burning in this moist grassland community would be patchy and should allow the density of shrubs to increase.

**Bushed grassland with termite mounds on the high watershed (not mapped separately)**

The high, flat watershed north-east of Marakeet pan is covered in robust perennial grasses. In especially wet places, these include *Hyparrhenia* spp. and *Hyperthelia dissoluta*, grasses that are usually associated with the highveld. Fuel loads are high (4-6 tonnes $ha^{-1}$). Judging by the woody remnants, which include both healthy baobabs and dead or dying *Brachystegia glaucescens* trees, this area was probably once a mosaic of wooded grassland and woodland with large termite mounds. According to Wild (1955), termite mounds near the Save-Runde junction were once covered in shrubs, mostly evergreen members of the Capparidaceae, but this distinctive flora has since disappeared and been replaced by grasses.

This is probably the most difficult area in the proposed IPZ in which to manage fire, because of the high fuel load and because the structural transformation of this vegetation type is so far advanced. Fire management should not be a priority here, until the incidence of arson has been considerably reduced and the early-burning policy has been successfully implemented elsewhere in the IPZ.

***Combretum-Terminalia* and *Julbernardia globiflora* communities on granite hills**

These communities are confined to a granite inclusion in the east, near the Save Gorge (Map 10). A successful early-burning exercise was carried out here during the mid-1980s (Sharp 1986c). Fuel loads here are relatively low, shrubs and trees are still numerous and early-burning in this area should be successful at maintaining structural and species diversity.

**Riverine and alluvial communities**

Riverine communities do burn, but are usually grazed so severely by the end of the dry season that there is little grass to carry a fire. Although the fire frequency maps show frequent burns at the Save-Runde junction, the burns have probably always been patchy. *Hyphaene* palm communities are often considered fire-sensitive, but areas of short palms have succeeded in growing into tall-stemmed palms since Farrell (1968) mapped the area. As elephant-use is the most likely cause of changes in vegetation structure here, fire management should not be a priority.

***Implications for future reintroductions of rhinos to Gonarezhou NP***

**White rhinos**

Occasionally, fires directly affect rhinos, with a few white rhinos in Kruger NP having been killed by bush fires (Pienaar 1994b). But generally the effects of fire on rhinos are indirect, acting through the fire effects on the vegetation. Sometimes white rhinos will feed on burnt grass stubble the day after a fire (Pienaar 1994c). If there is sufficient moisture in the soil to promote a post-fire flush of green grass, white rhinos will select this fresh growth (Pienaar 1994c, Traill 2004). But during a dry season following a wet season of very low rainfall, there may be insufficient soil moisture to promote grass growth after a fire. For example, during the 1992 drought, white rhinos in northern Kruger NP fed in a

landscape that they generally avoided, after most of their preferred landscape was burnt and did not produce a post-fire flush of grass (Pienaar *et al*. 1993a).

This observation is relevant to the long-term viability of white rhinos in Gonarezhou NP, because it emphasises the importance of heterogeneity in both landscapes and fire frequency within their range. If – as happens currently - intense fires burn the grass across almost the whole of northern Gonarezhou, there is likely to be a shortage of food for white rhinos during dry seasons following wet seasons of below-average rainfall.

**Black rhinos**

The removal of grass by fires may temporarily improve habitat suitability for black rhinos, particularly following wet seasons of above-average rainfall, by increasing the accessibility of small woody plants, e.g. *Acacia* bushes, that were previously hidden by grass (Emslie & Adcock 1994). In Hluhluwe-Umfolozi, dry-season fires are common and black rhinos preferred to feed where the fire effects were slight, or medium, rather than severe. They would sometimes eat burnt twigs. Later, post-fire coppicing of *Acacia* shoots provided another preferred food source. Often, burnt areas also experienced a post-fire flush of forbs that the rhinos ate.

Infrequent fires may reduce habitat suitability for black rhinos, if the infrequency of the fires permits short woody plants, i.e. those less than 2 m tall and within reach of feeding rhinos, to grow beyond the their reach. In Hluhluwe, bush encroachment and the development of woodlands during a period of infrequent fires was correlated with a decline in the density of black rhinos.

However, it cannot be assumed that frequent fires would also be good for black rhinos in Gonarezhou NP. The northern section of the park has experienced major vegetation changes during recent years, including the loss of thickets that were converted to shrubland and bushed grassland. There are no data to show whether changes are still occurring and, if so, just what those changes are. If the biomass of palatable woody plants within reach of rhinos is increasing, this is likely to lead to an increase in the carrying capacity for black rhinos. But if intense fires are reducing the reachable biomass of palatable woody plants, there will be a reduction in the carrying capacity for black rhinos.

If the black rhinoceros is reintroduced to the park for the second time, the importance of monitoring vegetation changes within its range is emphasised. Even a ‘quick and dirty’ technique of vegetation monitoring, such as photopanoramas, is far better than no monitoring at all. However, some information about the size and density changes of the commoner shrubby species (which photopanoramas cannot always provide) would greatly improve our ability to predict the likely effects of vegetation changes on black rhinos. The existing photopanorama points in the park are generally concentrated near water and are not distributed across the whole range of vegetation types (Tafangenyasha 1997). The locations of the points to the north of the Runde River would not have allowed adequate monitoring of the vegetation changes that have occurred. In any case, it is not clear how often – or even if - the points have been rephotographed since the mid-1980s.

## Tsetse flies, Trypanosomes and Rhinos

### *Tsetse Flies in Gonarezhou NP*

Tsetse flies *Glossina* spp., the vectors of trypanosomes, were absent from the south-east lowveld of Zimbabwe after the rinderpest epidemic of the 1890s that killed many hundreds of thousands of large mammals across Africa. But during the 1950s, tsetse flies reinvaded the area of the present Gonarezhou NP from Mozambique (Robertson & Kluge 1968). In Mozambique, there were mixed belts of *Glossina morsitans* and *Glossina pallidipes*, but most of the flies caught in Zimbabwe were *Glossina morsitans*. Both species feed on rhinos (Phelps & Vale 1978).

By the early 1970s, tsetse flies had been eliminated from the south-east lowveld, after a campaign that included the slaughter of thousands of large mammals, the destruction of many square kilometres of natural vegetation, and the use of ground teams to spray large areas with insecticides (Robertson & Kluge 1968, Child & Riney 1987). These activities occurred both inside and outside the area of the present Gonarezhou NP. The programme to eliminate tsetse flies was an international effort involving Rhodesia (as it then was), Mozambique and South Africa. The programme continued on the Mozambique side of the international border, but was interrupted by the Mozambican pre-independence war and the Mozambican civil war.

Now, tsetse flies and trypanosomiasis are again present in the Mahenye communal land near the Save-Runde confluence and there are concerns that, in the absence of an effective campaign of trapping, tsetse flies will once again invade Gonarezhou NP. If this happens, any rhinos translocated to Gonarezhou NP are likely to be bitten by tsetse flies and infected with trypanosomes. The westward invasion of tsetse flies has also occurred elsewhere along the Zimbabwe-Mozambique border, with *Glossina pallidipes* apparently more common than in the past (Thakersi 1991, 1992).

Both the black rhinoceros and the white rhinoceros evolved in the presence of tsetse flies and usually rhinos do not suffer from trypanosomiasis in areas where rhinos and tsetses are naturally sympatric. However, when naive individuals (i.e. rhinos that have never been exposed to trypanosomes) have been translocated to areas where tsetse flies are present, the mortality rate of the rhinos has often been unacceptably high, most probably as a result of deaths due to trypanosomiasis.

### *Rhino Reintroductions/Introductions and Trypanosomiasis*

#### White Rhinos in Matusadona NP, Zimbabwe

During 1983, five white rhinos were introduced to Matusadona NP, Zimbabwe (Taylor 1986). Four animals died and the fifth disappeared 8-10 weeks after release. Circumstantial evidence suggested that the deaths were due to trypanosomiasis.

#### White Rhinos in Maasai Mara and Nakuru, Kenya

There are few published accounts of the introduction of the white rhinoceros to the Maasai Mara National Reserve and Nakuru NP in Kenya. The following account is based largely on accounts by Steve Mihok (pers. comm.), Willie Roberts (pers. comm.) and Richard Kock (pers. comm.).

Southern white rhinos were introduced to the Maasai Mara during 1994 (Granier 1995). Two years earlier, a small test was conducted using two white rhinos from the Lewa Conservancy in Kenya (Mihok, Kock & Masake 1995). They were moved to the Maasai Mara and protected by the deployment of about 100 tsetse traps over a few square kilometres. The test was well-managed and the animals lived under a lower tsetse challenge as a result of the trap deployment. Although these rhinos became infected with *Trypanosoma brucei*, they were not treated and, about a year later, were apparently healthy when moved back to Lewa.

During September and October 1994, ten white rhinos were moved to Maasai Mara National Reserve from South Africa, as an official donation to Kenya. By that time, the local community had lost interest in maintaining the tsetse traps, so these rhinos were moved into an area with many tsetse flies. These animals performed poorly, with early deaths. Examination of blood samples from sick rhinos revealed that they were infected with trypanosomes, with *Trypanosoma brucei* being the main parasite. *Trypanosoma brucei* was transmitted by *Glossina pallidipes*. The rhinos were treated with various trypanocides: sometimes they got clinically better and sometimes they did not. By April 2002, seven rhinos had died, reportedly of trypanosomiasis (Daily Nation on the Web;

www.nationaudio.com/News/DailyNation/Today/News/News45.html; accessed 16 April 2002). As with the white rhinos from Lewa, two white rhinos from Solio Ranch, Kenya, (and a calf born to one of the South African animals) were apparently unaffected by trypanosomiasis.

Parallel to the move of the South African white rhinos to Maasai Mara, another ten animals were sent to Nakuru Park, Kenya (Granier 1995), where there are no tsetse flies, or trypanosomes. These rhinos survived without any major problems (S. Mihok, pers. comm.).

**White Rhinos in Meru, Kenya**

The white rhinoceros was first introduced to Meru NP in Kenya during 1966, when three males and three females were translocated from South Africa (Foster 1967, Vincent 1968). Chronic trypanosome-related health problems, including abortions, were reported to have occurred in these rhinos (Mihok, Olubayo & Moloo 1992). This small population of semi-tame rhinos was eventually eliminated by poachers (Anon. 1977, Mallinger & Mallinger 1980).

Starting during 2002, a second attempt was made to introduce white rhinos to Meru. The theory behind the management of these animals is to maintain their body condition so that they will have time to gain immunity to trypanosomiasis (M. Jenkins, pers. comm.). So far, 21 animals have been introduced to the park and three have been born. To date, there have not been any problems with the trypanosomiasis, although there are tsetse flies in the park, but not at high density. Management staff fenced holding areas for the rhinos, starting with 5 $km^2$ and now, after 3 years, up to 30 $km^2$. The fence is a simple four-strand electric fence attached to trees and with a road along both sides. Within the fenced area, there are tsetse traps to reduce the density of tsetse flies. The longer-term goal is to remove the fence in two years' time, after having introduced a total of 50 white rhinos. To date, management staff have not recorded any signs of trypanosomiasis in the rhinos. However, the management is regarded as experimental and the rhinos have not yet experienced a drought that will cause them to lose body condition. It is under these circumstances that the rhinos are thought to be most likely to suffer from trypanosomiasis.

**Black Rhinos in Tsavo West NP, Kenya**

*Trypanosoma brucei*, *Trypanosoma congolense* and *Trypanosoma vivax* have been reported in black rhinos, and mortalities due to trypanosomiasis have occurred amongst young black rhinos soon after their capture (McCulloch & Achard 1969, Clausen 1981, Mihok, Olubayo & Moloo 1992). It has been suggested that infected rhinos may develop trypanosomiasis owing to the stress of capture and transfer to a new environment. Mihok, Munyoki, Brett *et al*. (1992) studied tsetse populations and trypanosome infections in the Ngulia rhino sanctuary in Tsavo West NP, Kenya.

***Implications for future reintroductions of rhinos to Gonarezhou NP***

**Species of trypanosome**

Four species of tsetse fly are present in Mozambique, with *Glossina pallidipes* and *G. morsitans* found in the area to the east of Gonarezhou NP (website: http://www.fao.org/paat/html/moz.htm, accessed 14 March 2005). There are also four species of trypanosome, with *Trypanosoma brucei*, *T. congolense* and *T. vivax* found in cattle and *T. simiae* in pigs. Experience in Kenya suggests that *Trypanosoma brucei* represents the biggest threat to white rhinos. Elsewhere in eastern Zimbabwe, where *Glossina pallidipes* and *G. morsitans* have also invaded from Mozambique, *Trypanosoma brucei* appears to be rare (Thakersi 1992).

**Reintroduction of the white rhinoceros after Gonarezhou is reinvaded by tsetse flies**

Given the problems encountered when white rhinos were introduced to Matusadona NP in Zimbabwe and the Meru NP and Maasai Mara NR in Kenya, concern has been expressed about possible health problems and mortalities if the white rhinoceros is reintroduced to Gonarezhou NP while there is a westward invasion of this area by tsetse flies.

If tsetse flies invade the section of Gonarezhou NP north of the Runde River before white rhinos are freed in the area, the reintroduction will need to be carefully managed, ensuring that:

- the rhinos suffer as little stress as possible during their capture, transfer and confinement;
- the rhinos are in good condition;
- the pre-release pens in Gonarezhou NP are built in an area where the density of tsetse flies is low at all times of the year;
- the rhinos are moved to these pens at a time of year when the density of tsetse flies is low and, if it varies seasonally, declining, not increasing; and
- the condition of the rhinos is monitored (via blood samples) regularly while the rhinos are in the pre-release pens.

Even if these guidelines are followed, the rhinos will still be stressed, they will still be bitten by tsetse flies and they will still become infected with trypanosomes. But experience in Kenya showed that if enough care was taken in their management, it is not necessary to treat the rhinos with a trypanocide, even though they developed some anaemia and some depressed immunity (reduced white cell counts) when they became infected (S. Mihok, pers. comm.). The important thing is to ensure that the initial challenge from trypanosomes is mild, and that the rhinos get proper care until their stress levels subside. Then the rhinos can cope with the first few infections and gradually build up their immunity. In Kenya, most black rhinos were freed after about 6-8 weeks in pre-release pens.

Tsetse traps are useful as a monitoring tool (e.g. to know where the flies are and how their density varies seasonally). But to "protect" animals in pre-release pens with tsetse traps, or insecticide-impregnated targets, would require a high density of traps over a large area in order to have a significant impact on fly populations. A drug used for treating camels infected with trypanosomiasis was quite useful for treating white rhinos infected with *Trypanosoma brucei* in Maasai Mara, but it was only a temporary solution (R. Kock, pers. comm.). It is not prophylactic and cannot be used continuously to prevent infection with trypanosomiasis.

In summary, if white rhinos are reintroduced to Gonarezhou NP after it has been reinvaded by tsetse flies, experience from Kenya and Zimbabwe should be used to make a sound management plan, and trouble should be expected (R. Kock, pers. comm.). The reintroduction should be managed to reduce the challenge from tsetse flies and trypanosomes, but staff of the Parks & Wildlife Management Authority (PWMA) should be prepared to seek assistance to treat rhinos suffering from trypanosomiasis. Clearly, the planning, pre-release and early post-release phases of any reintroduction programme will require the involvement of a wildlife veterinarian with rhino expertise and a tsetse/trypanosome expert.

**Invasion of Gonarezhou by tsetse flies after the reintroduction of the white rhinoceros**

If tsetse flies were to reinvade Gonarezhou NP after white rhinos have been released there, the situation is different to the scenario just outlined. Assuming that the released rhinos were not bitten by tsetse flies until after they had settled into their new ranges, the likely outcome will probably depend on two factors, namely the condition of the rhinos and the intensity of the challenge from tsetse flies. It appears that if rhinos are in generally poor condition, they are more likely to suffer from trypanosomiasis when they become infected with trypanosomes (Clausen 1981). If white rhinos were to be released in Gonarezhou NP, it can safely be assumed that their condition a year or more after they are freed will be dependent largely on habitat quality. If this is good, the rhinos will probably be less likely to suffer from trypanosomiasis than if the habitat quality is poor.

When tsetse flies invade any area, there is likely to be an increase in their density between the front and rear of the invasion front. If tsetse density at any point in the invaded area increases slowly, it is likely that the rhinos, while being bitten by tsetse flies and infected with trypanosomes, will become premune. But if tsetse density increases rapidly, it is more likely that frequent bites by tsetse flies and a heavy challenge from trypanosomes will cause the rhinos to develop trypanosomiasis. The obvious question is: how rapidly does tsetse fly density increase as an area is invaded?

While the question is simple, the answer is less so. The dispersal rate of tsetse flies is likely to be depend on various factors, including the species of tsetse, the vegetation type (different species of tsetse fly have preferences for different structural vegetation types) and the density of host animals (not just the density of rhinos). Bursell (1970) considered evidence from several areas across Africa and suggested that the dispersal rate was of the order of 10 km per year. However, when tsetse flies invaded northern Gonarezhou NP during the 1950s, the tsetse fly front moved at about half this rate, i.e. approximately 5 km annually (Robertson & Kruge 1968). But, since the 1950s, there have been

major changes in northern Gonarezhou, both in the vegetation structure – with extensive areas of woodland converted to bushed grassland – and probably also in the density of tsetse host species.

Increases in tsetse catches at bait oxen during the months after chemical spraying reduced tsetse density suggest that tsetse catches can increase to pre-spray levels within a year or two (Robertson & Kruge 1968). If these rates of increase are applicable to an invasion front of tsetse flies, it is likely that it will take approximately a year or so for the density of tsetse flies to reach an equilibrium and this will probably be sufficient time for the white rhinos to acquire premunity to trypanosomiasis.

Nonetheless, it may be necessary to monitor the numbers and spatial distribution of tsetse flies as the flies invade the park. Simultaneously, individual white rhinos should be closely monitored to check on their condition and survival. During any reintroduction programme, the causes of any deaths should be determined, but this will be particularly important during a tsetse invasion. This will certainly require assistance from a wildlife veterinarian with rhino expertise. However, diagnosing the problem is different from dealing with it. Once white rhinos have been released into the Save/Runde area, the options for their management will be limited. In northern Gonarezhou NP, there are few vehicle tracks, they are in poor condition, and off-road the ground is often very rocky: recapturing rhinos would be a difficult option.

## Evaluation of the Proposals to Reintroduce the Black Rhinoceros and the White Rhinoceros to Gonarezhou NP in the context of the IUCN Reintroduction Guidelines

The proposals to reintroduce the black rhinoceros and the white rhinoceros to Gonarezhou NP and to establish Intensive Protection Zones for these species in the area north of the Runde River are evaluated using established criteria for reintroductions generally, prepared by the IUCN's Reintroduction Specialist Group (IUCN 1998), and for rhino reintroductions in particular, prepared by the SADC RPRC (Du Toit 2001). Some of the IUCN guidelines tend to overlap each other, but for the sake of completeness, all the guidelines are given here, even though this has occasionally caused some repetition in the comments that follow each guideline.

### *Multidisciplinary approach*

**IUCN guideline**: A reintroduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from government natural resource management agencies, non-governmental organisations, funding bodies, universities, veterinary institutions, zoos and private animal breeders, with a full range of suitable expertise.

***Black Rhino & White Rhino*** The project feasibility studies have involved experts from government departments (the Ministry of Agriculture's Wildlife Veterinary Unit), non-governmental organisations (the WWF SARPO Rhino Conservancy Project and the SADC Regional Programme for Rhino Conservation (SADC RPRC)), potential donors and private-sector managers with rhino experience. Parks & Wildlife Management Authority (PWMA) staff do not have the full range of skills required to form a suitable multidisciplinary team.

### *Pre-project activities: Biological*

#### Feasibility study and background research

**IUCN guideline**: Individuals to be released should preferably be of the same subspecies as those that were extirpated.

**SADC RPRC guideline**: Founders to be from more than one source population of the same subspecies.

***White Rhino*** It is proposed to release white rhinos of the subspecies *Ceratotherium simum simum*, the southern white rhinoceros. This is the same subspecies as that which used to occur in Zimbabwe (Emslie & Brooks 1999). All living southern white rhinos are descended from a relatively small number of animals that lived in the Umfolozi Game Reserve (GR) complex, South Africa, during the early 20$^{th}$ century (Player & Feely 1960). Thus, whatever the direct source of the rhinos that are released into Gonarezhou NP, they will be genetically similar to those in Umfolozi GR. On theoretical grounds, it would be expected that the population in Umfolozi GR would have greater genetic variability than the Zimbabwean population derived from individuals removed from Umfolozi GR. Thus, on theoretical grounds, it would be valuable if the white rhinos to be released in Gonarezhou NP included some individuals from Umfolozi GR. However, the practical value of this might be questionable, given that all previous reintroductions of white rhinos have been (at the biological level) successful, so long as the reintroductions involved sufficient individuals and occurred in areas that were definitely within the former distributional range of the southern white rhinoceros.

For the reintroduction to Gonarezhou NP, it is proposed that 10 founders will come from Mutirikwe (Kyle) Recreational Park and 10 from Chivero (McIlwaine) Recreational Park and Nyamaneche. The degree of genetic relatedness of these subpopulations to each other is not known to me.

***Black Rhino*** It is proposed to release black rhinos of the subspecies *Diceros bicornis minor*, the south-central black rhinoceros. This is the same subspecies as that which used to occur throughout Zimbabwe (Emslie & Brooks 1999). For the reintroduction to Gonarezhou NP, it is proposed that 10 founders will come from the Midlands of Zimbabwe, five from Malilangwe Estate, five from Chiredzi River Conservancy and four from Chipinge A Safari Area.

**IUCN guideline**: Detailed studies should be made of the status and biology of wild populations to determine the species' critical needs.

***White Rhino*** The ecology of the white rhino has been studied in detail (Player & Feely 1960, Condy 1973, Conway & Goodman 1989, Pienaar *et al*. 1992, 1993a, 1993b, Pienaar 1994b, 1994c, Rachlow

1998, Rachlow, Kie & Berger 1999). The status of the white rhinoceros was summarised recently (Emslie 2004).

It is recommended here that additional assessments are needed in Gonarezhou NP before a decision is made whether to release white rhinos in this park. These assessments should be conducted at the end of the dry season in order to determine, at that time of the year: (a) the quantity and quality of the grasses available as food for white rhinos (particularly for 50 animals, which is intended to be the long-term minimum population number in the IPZ); and b) the natural supplies of surface water available for drinking within the vicinity of any suitable food. These assessments must also take account of the likely food availability for 50+ white rhinos during the dry season of a drought year similar to 1983 or 1992.

***Black Rhino*** The ecology of the black rhinoceros has been studied in detail (e.g. Roth & Child 1968, Goddard 1968 1970a 1970b, Hall-Martin & Penzhorn 1977, Hitchins & Anderson 1983, Conway & Goodman 1989, Adcock, Hansen & Lindemann 1998, Brett 1998). The status of the black rhinoceros was summarised recently (Emslie 2004). It is not considered necessary to undertake additional studies of the status and biology of the black rhinoceros prior to this reintroduction.

**IUCN guideline**: The species, if any, that has filled the void created by the loss of the species concerned should be determined: an understanding of the effect the reintroduced species will have on the ecosystem is important for ascertaining the success of the reintroduced population.

***White Rhino*** As far as is known, no species has filled the void created by the elimination of the white rhino from Gonarezhou NP. Within a few kilometres of permanent pools of water, the white rhino's most likely competitor for food will be the hippopotamus.

***Black Rhino*** No species has filled the void created by the elimination of the black rhinoceros from Gonarezhou NP. The black rhino's most likely competitor for food may be the elephant.

**IUCN guideline**: The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the number of years necessary to promote establishment of a viable population.

**SADC RPRC guideline**: Each population should be established with 20 or more effective founders (i.e. unrelated individuals) and the sex ratio of the founder group should be as close to parity as possible. Where there are plans to release just a few animals initially, there should be a clear plan to introduce the additional founders, up to the target of 20 or more.

***Black Rhino & White Rhino*** It is proposed to release initially 20 individuals of each species in the park. There has been no mention of the sex ratios of these founder populations, but it is recommended here that the ratios should be close to 1:1. It should be noted that a calf, when released with its mother, does not constitute an *effective* founder, because it is closely related to at least one of the other founders, its mother. The suggestion by the IUCN that the released population should be modelled is probably superseded by the SADC RPRC guidelines, which are based on extensive experience of rhino reintroductions.

**IUCN guideline**: A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term management.

**SADC RPRC guidelines**: Each population should be established with 20 or more effective founders. For purposes of genetic management, there should be periodic exchange of effective breeders between populations of the same subspecies. Rapid rates of population growth should be maintained.

***Black Rhino & White Rhino*** Long-term management of the reintroduced populations has not yet been addressed. However, rhino populations within Zimbabwe are managed within a metapopulation framework, with co-operation between the PWMA and other landholders. As a consequence, there is often exchange of rhinos between the various (generally small) populations within Zimbabwe.

***White Rhino*** It is questionable if a population of 50 or more white rhinos can survive in Gonarezhou NP in the long-term. Rainfall at Chipinda Pools during 1991-92 was 92.7 mm, just 19 % of the long-term mean (DNPWLM 1998). Records from nearby Malilangwe, which has a longer record, reveal that this was the worst drought in more than 50 years (S. Clegg pers. comm.). During it, there were major and expensive management interventions in Gonarezhou NP aimed at ensuring the survival of viable populations of large mammals. Species of very large grazers, e.g. the hippopotamus, fared very badly: two groups in the Save River, on the Gonarezhou/Mahenye border, were regularly given artificial

supplies of food (Tayler 1992). Other grazers were captured and penned for the duration of the drought. The one white rhino that was in the park during 1992 seems to have survived (assuming that the lone individual captured during 1993 was the one reported during 1992), but it may not be entirely coincidental that this animal moved to the south bank of the Runde River (i.e. outside the area of the proposed IPZ). Similarly, during the 1983 drought, the white rhinos that had moved into the park from the then Lone Star Ranch travelled to the Runde south bank, where they appear to have been more than passing visitors (Thomson 1983). While the south bank of the Runde River appears very unlikely to meet the long-term habitat requirements of a significant number of white rhinos, these movements may suggest that the white rhinos themselves judged the landscape north of the Runde River not to meet them either, at least not during a drought year.

It recommended here that further consideration of the reintroduction of the white rhinoceros to Gonarezhou NP is postponed until such time as the establishment of the Greater Limpopo Transfrontier Park (GLTP) has progressed to the stage that there can be free movement of large mammals such as white rhinos between Gonarezhou and neighbouring subpopulations, such as those on Malilangwe Estate and the Save Valley Conservancy. The greater the overall population of white rhinos and the larger its contiguous range, the greater the probability that a viable number of individuals will survive a severe drought similar to the 1992 one. Although the free movement of large mammals across international borders is one of the theoretical aims of the Transfrontier Parks, in practice it seems likely that disease-control fences, especially those aimed at buffalo, will restrict the movement of rhinos between Zimbabwe and the Kruger and Limpopo NPs.

***Black Rhino*** The previous reintroduction of the black rhinoceros to Gonarezhou NP was successful at the biological level, but failed because of inadequate protection of the rhinos from poaching. The woody vegetation north of the Runde River has changed – to the likely detriment of black rhinos – since the previous reintroduction, with the loss of thickets. Although these changes have most likely reduced the carrying capacity for black rhinos, they have not made the area totally unsuitable. However, it is not known whether there is a continuing loss of woody vegetation, or whether a new grass/woody balance has now been reached.

### Previous reintroductions

**IUCN guideline**: Thorough research into previous reintroductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing the reintroduction protocol.

***Black Rhino & White Rhino*** This feasibility study includes a review of the previous reintroduction of the black rhinoceros to Gonarezhou NP and is part of a process that includes contacts with persons having expertise in rhino reintroductions (e.g. experts from the WWF SARPO Conservancy Project, the SADC RPRC, the Wildlife Veterinary Unit and private-sector managers with rhino experience).

### Choice of release site and type

**IUCN guideline**: The reintroduction site should be within the historic range of the species. For a reintroduction, in order to prevent disease spread, social disruption and the introduction of alien genes, there should be no remnant population. A reintroduction may have to be made into an area which is fenced, but it should be within the species' former natural habitat and range.

***Black Rhino & White Rhino*** Gonarezhou NP appears to be within the historic range of the black rhinoceros and the white rhinoceros, although there is no recent, material (and thus unambiguous) evidence of this for the white rhinoceros. There are no remnant populations of rhinos in the park. Parts of the area to the north of the Runde River within Gonarezhou NP appear to be within the former habitat and range of the two species.

Along approximately the northern boundary of Gonarezhou NP there is a foot-and-mouth-control fence aimed at preventing the movement of buffalo and cattle. Although the design of this fence is such that it will not prevent the movements of rhinos, it is likely to restrict them. There is no fence to prevent rhinos moving south of the Runde River, or south-eastwards into Mozambique.

It is possible, at least in theory, to fence just part of the area north of the Runde River to form a rhino sanctuary (*sensu* Emslie & Brooks 1999), using a low fence designed to restrict the movements of rhinos but few other animals. This approach is being successfully applied in North Luangwa NP, Zambia. However, this feasibility study suggests that in Gonarezhou NP separate sanctuaries would be required for black rhinos and white rhinos, because there is negligible spatial overlap of their preferred vegetation communities. Furthermore, given that much of the landscape to the north of the Runde River has a rocky ground surface, a shortage of trees (to serve as living fence posts), an

abundance of grass (to fuel fires) and rugged terrain, the construction and maintenance of fences would be difficult and expensive.

**IUCN guideline**: A conservation/benign introduction should be undertaken only as a last resort when no opportunities for reintroduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.

***Black Rhino & White Rhino*** The proposed releases of rhinos in Gonarezhou NP would be *reintroductions*, not conservation/benign *introductions*.

**IUCN guideline**: The reintroduction area should have assured, long-term protection.

***Black Rhino & White Rhino*** The proposed reintroduction sites in Gonarezhou NP do not have assured, long-term protection. Despite the area's legal status as a national park, since at least 2001 squatters have been permanently resident in the north of the park, where they have built huts, planted crops and introduced cattle.

### Evaluation of reintroduction site

**IUCN guideline**: Reintroductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the foreseeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/political or cultural environment since the species' extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the reintroduced population and support a viable (self-sustaining) population in the long run.

**SADC RPRC guidelines**: Ideally, each population should be established in an area with a carrying capacity of at least 100 rhinos. If the available habitat is insufficient for 100 rhinos, the population must be managed as one population within a metapopulation framework, with definite opportunities for exchanges apparent at the outset of the reintroduction programme.

***White Rhino*** That a white rhino apparently survived in the northern half of Gonarezhou NP during the 1992 drought suggests that the park meets the habitat and landscape requirements of the species. However, it remains doubtful that the park can support at least 100 white rhinos in the long-term. South of the Runde, most of the vegetation types are very woody and do not provide the abundance of perennial grasses preferred by white rhinos. Furthermore, the centre of the park lacks natural supplies of surface water for drinking during the late dry season.

North of the Runde, there are several aspects that limit the carrying capacity for white rhinos. Much of this area is now relatively open, with an abundance of grass after seasons of average or above-average rainfall, but: (a) much of the area is covered with rock rubble or stones, which white rhinos will probably avoid; (b) the grass layer in many areas without rock rubble is dominated by tall, poor-quality *Hyparrhenia* and *Hyperthelia* grasses which white rhinos prefer not to eat; and (c) over a high proportion of the region, fires occur annually during the dry season and burn the grass. The areas that appear suitable for white rhinos are not likely to support 100 individuals, especially during a drought.

***Black Rhino*** The number of individuals in the previous reintroduced population of black rhinos in Gonarezhou NP was never estimated reliably. Nonetheless, it seems likely that at times there were >100 black rhinos in the park. Many of the vegetation types within the park are dominated by woody plants and would support black rhinos if within range of drinking water at the end of the dry season. While the provision of artificial supplies of water during the dry season might appear to be beneficial to black rhinos, it is likely that this would be detrimental in the long-term. The provision of an artificial water supply is commonly followed by local increases in elephant density close to the waterpoints, and consequently greatly increased impacts by elephants on the nearby woody vegetation.

There have been vegetation changes in the north of Gonarezhou NP during the past 20 years. These changes have not been formally documented, but include the conversion of *Brachystegia glaucescens* woodland to bushed grassland, and the loss of thickets. The latter change has probably reduced the carrying capacity for black rhinos of the area north of the Runde River.

***Black Rhino & White Rhino*** There have been many changes in the legal/political environment since the reintroduction of the black rhinoceros into Gonarezhou during 1969-1971, including the establishment of the area as a national park during 1975. But there have been major, and more immediately relevant, changes in the legal/political and cultural environments during the past five years. The most obvious examples of these are: the entry of squatters into the national park and their establishment of huts and fields; and the government's tolerance of these illegal activities.

Another recent change in the political environment is the tri-nation agreement to establish the Great Limpopo Transfrontier Park, which includes Gonarezhou NP, Kruger NP and Limpopo NP. Kruger NP and Limpopo NP are adjacent to each other and there is extensive co-operation between the authorities in these two national parks. Limpopo NP is newly-established, undeveloped and still contains numerous people and cattle, but it is enjoying significant funding from international donors to, among other things, prepare a plan for the voluntary resettlement of these people to areas outside the park. Gonarezhou NP is more isolated than Kruger or Limpopo, in terms of geography, politics and relationships with international donors.

**IUCN guideline**: Identification and elimination, or reduction to a sufficient level, of previous causes of decline.

***Black Rhino & White Rhino*** Excessive hunting was the likely cause of the elimination of the white rhinoceros and the black rhinoceros from what is now Gonarezhou NP. Poaching, allegedly involving some DNPWLM staff and military personnel, caused extinction of the reintroduced black rhino population during the early 1990s. That the government is failing to make available to the public the official report into this poaching, and that the DNPWLM and military staff accused of poaching have not yet been brought before the courts, will cause many – including potential donors – to question whether the official corruption that is alleged to have been responsible for this extinction really has been eliminated.

The number of PWMA junior staff based in northern Gonarezhou NP was increased recently with the posting of 32 extra rangers to the area, although these are recent recruits with little training and no experience. Even with these extra staff and even if all rangers are deployed north of the Runde River (although the staff at Chipinda Pools are also responsible for law enforcement in >1000 $km^2$ of park south of the Runde River), the ranger density will be less than the density of 1 ranger per 9-19 $km^2$ recommended by Leader-Williams, Albon & Berry (1990) after their analysis of rhino poaching and law enforcement in the Luangwa Valley, Zambia. Given that new recruits form the majority of the ranger complement and are, as yet, untrained and inexperienced, it will probably require monthly and detailed analyses of patrol effort and illegal activity over a period of several years to convince potential donors that law enforcement is effective and that illegal activities are under control.

Although the PWMA has recently increased the number of rangers at Chipinda Pools, there has not been a commensurate increase in the numbers of other staff. Bell & Clarke (1986) produced rules-of-thumb for staffing levels in protected areas and their recommended density of junior staff was similar to that later recommended by Leader-Williams *et al*.'s (1990) analysis of rhino poaching and law enforcement. Bell & Clarke's (1986) recommendations suggest that the 50 rangers at Chipinda Pools should be accompanied by seven management officers (two senior and five middle-level), two administrative staff, two ecologists and 17 support staff and general hands. (These figures do not include tourism staff.) The increase in the number of rangers at Chipinda Pools has also not been accompanied by a commensurate increase in the budgets for capital items (e.g. housing, vehicles and patrol equipment), or operating costs (e.g. subsistence and transport). Bell & Clarke (1986) recommended that the budget for recurrent costs should be approximately three times the salary bill and divided about equally between salaries, transport and other expenditure.

If rhinos are released in Gonarezhou NP without first ensuring that security is adequate, it is possible that not only will these rhinos be poached, but that successful (from the poachers' point-of-view) poaching of these rhinos may encourage the poachers to extend their operations to other rhino populations in the south-east lowveld, populations that have so far been relatively unaffected by poaching.

An additional security measure would be to insert a transponder microchip into each horn of all rhinos released in Gonarezhou NP and all rhinos that are captured there for whatever reason. While the presence of a microchip will not prevent rhinos being poached, it would make it easier to establish the provenance of any rhino horns recovered by law enforcement officers.

**IUCN guideline**: Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the reintroduction is carried out.

***Black Rhino & White Rhino*** The vegetation to the north of the Runde River has undergone changes during the past 20 years, including the loss of thickets. Very probably a black rhino would regard the loss of thickets as degradation, but whether this change was caused by human activity is unclear. Certainly it was not caused directly by human activity.

### Availability of suitable release stock

**IUCN guideline**: It is desirable that source animals come from wild populations, which ideally should be closely related genetically to the original native stock and show similar ecological characteristics to the original sub-population.

***Black Rhino & White Rhino*** The black rhinos in the Midlands, Malilangwe Estate, Chiredzi River Conservancy and Chipinge A Safari Area and the white rhinos in Mutirikwe Recreational Park, Chivero Recreational Park and Nyamaneche are wild animals. There is no reason to believe that these animals are not closely related to and show similar ecological characteristics as the original stocks in Gonarezhou NP.

**IUCN guideline**: Removal of individuals for reintroduction must not endanger the captive stock population or the wild source population. Stock availability must be guaranteed to meet the project protocol.

***Black Rhino & White Rhino*** The removal of white rhinos from Mutirikwe Recreational Park, Chivero Recreational Park and Nyamaneche and of black rhinos from the Midlands, Malilangwe Estate, Chiredzi River Conservancy and Chipinge A Safari Area will not endanger these source stocks. Some of these source populations are small and need to be managed within a metapopulation framework. It has already been determined that sufficient numbers of rhinos are available to provide the founder populations for Gonarezhou NP.

**IUCN guideline**: Individuals should be removed from a wild population only after the effects of translocation on the donor population has been assessed and it is guaranteed that these effects will not be negative.

**SADC RPRC guideline**: The above IUCN guideline is considered not applicable when the source population is regarded as nonviable, because it contains few individuals and the survival of these individuals is threatened.

***Black Rhino & White Rhino*** The removal of rhinos from Mutirikwe Recreational Park, Chivero Recreational Park, Nyamaneche, the Midlands, Malilangwe Estate, Chiredzi River Conservancy and Chipinge A Safari Area has been proposed because it is believed either that animals in these populations are threatened with poaching (e.g. black rhinos in Chiredzi River Conservancy), or that the populations are at carrying capacity (e.g. black rhinos on Malilangwe Estate). For populations at carrying capacity, removal of some animals would probably be positive, both reducing social strife and leading to an increase in the population's rate of increase.

**IUCN guideline**: If captive stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.

***Black Rhino & White Rhino*** It is not proposed to release captive rhinos in Gonarezhou NP.

**IUCN guideline**: Reintroductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.

***Black Rhino & White Rhino*** The decision to remove some individuals from the proposed source populations is insufficient as the sole justification for the proposed reintroductions of rhinos in Gonarezhou NP.

**IUCN guideline**: Prospective release stock must be subjected to a thorough veterinary screening process *before* shipment from original source. Animals infected with or positive for non-endemic or contagious pathogens with a potential impact on population levels should not be shipped. The uninfected, negative remainder must be quarantined and retested before shipment.

***Black Rhino & White Rhino*** All rhinos to be moved to Gonarezhou NP should be captured by a veterinarian with rhino experience and examined thoroughly before being moved to Gonarezhou NP. The Ministry of Agriculture's Wildlife Veterinary Unit has considerable experience of and expertise with rhinos and would undertake appropriate health screening of captured animals.

**IUCN guideline**: Minimise risk of prospective release stock becoming infected with serious disease *during* shipment.

***Black Rhino & White Rhino*** All rhinos intended for release should be moved to Gonarezhou NP in individual crates. The travelling time to Gonarezhou NP will be a matter of hours, with little chance of the rhinos becoming infected with disease during transport.

**IUCN guideline**: Prospective release stock must meet health regulations prescribed by the veterinary authorities of the recipient country and adequate provision for quarantine must be made if necessary.

***Black Rhino & White Rhino*** If the Ministry of Agriculture's Wildlife Veterinary Unit plays a major role in the reintroduction programme, particularly the capture operations, this unit will ensure that the appropriate health regulations are met. At present, it appears unnecessary for the rhinos to spend time in quarantine.

### Release of captive stock

**IUCN guideline**: Most mammals and birds rely on individual experience and learning as juveniles for their survival. They should be given the opportunity to acquire the necessary information to enable survival in the wild through training while captive. A captive-bred individual's probability of survival should approximate that of a wild counterpart.

***Black Rhino & White Rhino*** It is not proposed to release captive rhinos in Gonarezhou NP.

**IUCN guideline**: Potentially dangerous captive-bred animals should not be so confident in the presence of humans that they might endanger local people or their livestock.

***Black Rhino & White Rhino*** It is not proposed to release captive rhinos in Gonarezhou NP.

### *Pre-project activities: Socio-economic and legal requirements*

**IUCN guideline**: Reintroductions are generally long-term projects that require the commitment of long-term financial and political support.

***Black Rhino & White Rhino*** The reintroduction has the support of the PWMA. However, the failure of the government to address the squatter problem in the north of Gonarezhou NP raises serious concerns about whether the government is committed to maintaining all of Gonarezhou as a national park (as defined in terms of current legislation) and as an area where conservation is the primary land-use. That the official enquiry into poaching in Gonarezhou NP during the 1980s has not been made available to the Zimbabwe public will cause potential donors to question the government's sincerity and commitment to conservation.

Elsewhere in Zimbabwe, the PWMA has several other intensive protection zones for rhinos (e.g. Sinamatella in Hwange NP, Matusadona NP). During the past two years, there has been significant poaching of rhinos in Sinamatella IPZ and there is a strong argument that says that no new IPZs should be established until it has been clearly demonstrated that the PWMA is able to provide the existing IPZs with adequate financial and human resources.

**IUCN guideline**: Socio-economic studies should be made to assess impacts, costs and benefits of the reintroduction to local people.

***Black Rhino & White Rhino*** No socio-economic studies have been made to assess the impacts, costs and benefits of the reintroduction of rhinos to local people.

There are two tourist lodges in the Mahenye communal area on the east bank of the Save River that operate in ways that can provide financial benefit to the people resident in that area. In theory, the reintroduction of rhinos to Gonarezhou NP would probably increase the attractiveness of these lodges as tourist destinations. In practice, the number of international tourists visiting Zimbabwe has been very small for the past five years because of the political situation. There is no likelihood that the number of international tourists will increase until there has been a significant change in the political environment in Zimbabwe.

**IUCN guideline**: A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long-term protection of the reintroduced population, especially if the species' decline was due to human factors. The programme should be fully understood, accepted and supported by local communities.

***Black Rhino & White Rhino*** No assessment of the attitudes of the local people to the reintroduction of rhinos has been carried out. It is likely that the reintroduction programme will not be fully supported by all the local communities, particularly the community that is illegally resident in the park. It is likely that these people will be hostile to the reintroduction, possibly believing that it will be a justification for evicting them from the park. But if they are forcibly evicted from the park, they may poach rhinos, or assist others to do so, as an act of revenge. Strained relations between the DNPWLM/PWMA and the local people have been a feature of Gonarezhou ever since some local people were evicted from the present park during the late 1960s (Booth 1991). Snaring and the introduction of cattle into the park appear to have been common in the past and are still features of northern Gonarezhou.

It is recommended here that no rhinos are moved to Gonarezhou NP until after the squatters have voluntarily left the park under an arrangement that they support.

**IUCN guideline**: Where the security of the reintroduced population is at risk from human activities, measures should be taken to minimise these in the reintroduction area. If these measures are inadequate, the reintroduction should be abandoned, or alternative release sites sought.

***Black Rhino & White Rhino*** If rhinos were released in Gonarezhou NP today, they would be at serious risk from human activities, especially snaring by the squatters in the north of the park and probably other local people also. While this poaching is not currently aimed at rhinos, in regions where snaring occurs, rhinos are frequently caught in wire snares and suffer horrific wounds. These usually require expensive veterinary intervention and can be fatal.

If the proposed reintroduction north of the Runde River proceeds before the PWMA and other state agencies have reached an amicable settlement with the squatters (and any other local people with land claims in Gonarezhou NP) and the squatters have been removed from the park, the reintroduction would be in contravention of this IUCN guideline.

Even if the threat from local people is removed, or at least significantly reduced, there remains a major threat from Mozambican poachers, especially given the close proximity of the proposed reintroduction area to Mozambique – it is just 2 km from the international border to the Save/Runde confluence.

**IUCN guideline**: The policy of the country to reintroductions and to the species concerned should be assessed.

***Black Rhino & White Rhino*** In the past, there have been various reintroductions of the white rhino to state-owned areas in Zimbabwe, namely Mutirikwe (Kyle) Recreational Park, Matopo NP, Victoria Falls NP, Chivero (McIlwaine) Recreational Park and Hwange NP (Condy 1973). Most of these reintroductions were successful, although there are currently no white rhinos in Victoria Falls NP and so this reintroduction must be regarded as a failure. There have also been reintroductions of the black rhinoceros to both state-owned areas, e.g. Hwange NP and Gonarezhou NP, and private land.

If rhinos are reintroduced to Gonarezhou NP, it will be with the support of the PWMA and thus, in theory, with the support of the government. However, in practice, Zimbabwe's recent policy towards rhinos has been ambivalent, with the PWMA attempting to conserve rhinos on state land, while other state agencies have encouraged the settlement of people on conservancies (e.g. Bubiana) that contain – or used to – significant numbers of rhinos. As a consequence, numerous rhinos have been snared: by early 2004, 15-25 rhinos had died and >20 treated for wounds caused by snares (Brooks 2004).

**IUCN guideline**: Reintroduction must take place with the full permission and involvement of all relevant government agencies of the recipient country. This is particularly important in reintroductions in border areas, or involving more than one state, or when a reintroduced population may expand into other states, provinces or territories.

***Black Rhino & White Rhino*** After the previous reintroduction of the black rhinoceros to Gonarezhou NP, some individuals moved across the international border (which is also the park's eastern boundary) into Mozambique where they were reportedly killed. At least one white rhinoceros from Lone Star Ranch, adjacent to Gonarezhou NP, also moved across the international border and was killed. If rhinos are released in Gonarezhou NP, it is likely that some individuals will cross the international border into Mozambique and be at serious risk of poaching. The management of these

emigrants (either their protection in Mozambique, or their capture and return to Zimbabwe) has not been addressed and must be discussed with the relevant Mozambican government agencies.

**IUCN guideline**: If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary.

***Black Rhino & White Rhino*** Rhinos pose little risk to human life, or property. Rhinos are generally not aggressive animals, although given their poor eyesight and large size, there is always the slight risk of a mishap or accidental injury to the unwary person, walking in their range, who comes across them at close quarters. But even under these conditions, the most likely reaction of a rhino will be to run away.

### *Planning, preparation and release stages*

**IUCN guideline**: Approval of relevant government agencies and land owners, and co-ordination with national and international conservation organisations.

***Black Rhino & White Rhino*** The proposed release sites are in Gonarezhou NP, which is managed by the PWMA and so the proposed reintroductions have the PWMA's approval. The proposed source populations of white rhinos (Mutirikwe and Chivero Recreational Parks and Nyamaneche) are all on state land. One of the proposed source populations of black rhinos is on state land and the removal of rhinos from there has the PWMA's approval. The landowners of Malilangwe Estate, Chiredzi River Conservancy and Sebakwe Black Rhino Conservancy have approved, in principle, the proposal to remove rhinos from their properties. Not all landowners in the Midlands have approved the proposal to remove rhinos from their estates.

The SADC Regional Programme for Rhino Conservation is sponsoring this feasibility study.

**IUCN guideline**: Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.

***Black Rhino & White Rhino*** As stated earlier, the PWMA has access to expert technical advice from the staff of the Wildlife Veterinary Unit, the WWF SARPO's Rhino Conservancy Project, the SADC Regional Programme for Rhino Conservation, and Gonarezhou's private-sector neighbours with experience of managing rhino populations (Malilangwe Estate, Save Valley Conservancy and Chiredzi River Conservancy). Prior to this feasibility study, people with a wide range of experience of rhinos participated in a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the proposal to reintroduce rhinos to Gonarezhou NP. It is recommended here that this multidisciplinary approach be continued for all other stages of the proposed reintroduction programmes.

**IUCN guideline**: Identification of short-term and long-term success indicators and prediction of programme duration, in the context of agreed aims and objectives.

**SADC RPRC guidelines**: An annual population growth rate of 5 % is a minimum target. The average intercalving interval of adult females can be monitored and should be no more than 3 years (ideally, nearer 2 years), while the average age at which each female has her first calf should not exceed 8 years (ideally, nearer 6 years). Rhinos are relatively slowly-breeding animals and therefore their management during a reintroduction programme must be proactive (potential breeding constraints must be avoided before they arise), rather than reactive (simply responding to problems once they become apparent).

***Black Rhino & White Rhino*** Short-term success indicators should include a post-release survival rate of >90 %. Long-term success indicators should include a mean intercalving interval (for surviving calves) of <3 years, a mean age for females at first calving of <8 years, and a mean exponential rate of increase for the population number of >0.05.

**IUCN guideline**: Secure adequate funding for all programme phases.

***Black Rhino & White Rhino*** At present, the funding available for this reintroduction project is completely inadequate. However, one of the purposes of this feasibility study is to identify the long-term requirements (institutional, material, human and financial) that must be met if the project is to be successful.

**IUCN guideline**: Design of pre- and post-release monitoring programme so that each reintroduction is a carefully designed experiment, with the capacity to test methods with scientifically collected data. The monitoring of the health and survival of individuals is important, because intervention may be necessary.

***Black Rhino & White Rhino*** It is recommended that there should be intensive monitoring of the reintroduced populations and this subject is addressed in more detail elsewhere in this report. In brief, all rhinos should be ear-notched before release, so that they are individually identifiable. PWMA rangers should be trained so that they can recognise individual rhinos and recording their location, physical condition, survival and breeding. The age of a female when she produces her first calf and the interval between consecutive births are useful measures of a population's wellbeing, once the immediate post-release phase is over. The PWMA should maintain a database of this information.

**IUCN guideline**: Appropriate health and genetic screening of release stock, including stock that is a gift between governments.

***Black Rhino & White Rhino*** If the Ministry of Agriculture's Wildlife Veterinary Unit plays a major role in the reintroduction programme, this unit will conduct appropriate health screening of the release stock before the animals are freed. It is not considered necessary to conduct genetic screening of the release stock, because all the proposed source populations are reintroduced populations with founders of known origins.

**IUCN guideline**: If release stock is wild-caught, check that stock is free of infectious or contagious pathogens *before* shipment; and will not be exposed to vectors of disease agents that may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.

**SADC RPRC guideline**: An area that shows repeated outbreaks of anthrax is an undesirable reintroduction site.

***Black Rhino & White Rhino*** Tsetse flies, which are the vector for *Trypanosoma* spp. (the parasites that cause trypanosomiasis) are currently absent from Gonarezhou NP, but trypanosomiasis was recorded during 2003 in the adjacent Mahenye communal land. Now, tsetse traps and targets are located in this communal land and near the Save/Runde confluence. There are no reports of tsetse flies there within the past few months (although comments from people who have seen the traps and targets cause one to wonder if the absence of reports indicates the absence of tsetses, or simply the absence of trap maintenance).

Tsetse flies, trypanosomes and rhinos are considered in detail elsewhere in this report. Naive white rhinos appear to be particularly vulnerable to severe infection after being moved to areas where tsetse flies are present, when they may be stressed and in poor condition as a result of their transfer. If naive white rhinos encounter tsetse flies some time after their release and while in good condition, it is likely that they will be infected with trypanosomiasis, but survive the infection. However, given the doubts about the long-term suitability of the habitats in Gonarezhou NP for white rhinos, it is possible that trypanosomiasis will be a serious problem if tsetse flies invade the park at a time when the white rhinos are in poor condition.

Black rhinos in Zimbabwe appear not to be particularly vulnerable to severe infection after being moved to areas where tsetse flies are present, although problems have been noted during black rhino translocations in Kenya.

Anthrax epidemics occurred during 2004 on Malilangwe Estate and in the Save Valley Conservancy. Although some rhinos in these areas were vaccinated against anthrax, most were not. Nonetheless, there were no deaths due to anthrax amongst the black or white rhinos in these two areas. Anthrax epidemics occur regularly in Kruger NP and it is likely that anthrax is present in Gonarezhou NP. Kudu and buffalo are the species principally affected in Kruger NP (Bengis 2000) and in Malilangwe and Save Valley Conservancy. However, there have been occasional cases amongst white rhinos in Kruger NP (R. Bengis, pers. comm.). Nonetheless, even though rhinos can catch anthrax, they are regarded as not behaviourally-susceptible to it in Kruger NP (R. Bengis, pers. comm.). Furthermore, the success of the rhino reintroductions in Kruger NP suggests that anthrax will not be a concern (at least for rhino management) in Gonarezhou NP.

**IUCN guideline**: If vaccinations are required prior to release, allow sufficient time for the development of acquired immunity.

***Black Rhino & White Rhino*** If rhinos are captured within Zimbabwe for release in Gonarezhou NP, it is likely that no vaccinations will be necessary.

**IUCN guideline**: Appropriate veterinary measures as required throughout the programme, including adequate quarantine arrangements, especially where founder stock crosses international borders.

***Black Rhino & White Rhino*** Within Zimbabwe, there is considerable expertise in the safe and efficient capture and care of rhinos (e.g. within the Wildlife Veterinary Unit and the WWF SARPO's Conservancy Project). If the PWMA makes use of this expertise, there are unlikely to be any significant veterinary problems. No founders would cross international borders on route to Gonarezhou.

**IUCN guideline**: Development of transport plans, with special emphasis on ways to minimise stress on the individuals during transport.

***Black Rhino & White Rhino*** Within Zimbabwe, there is considerable expertise in the safe and efficient transport of rhinos (e.g. within the Wildlife Veterinary Unit and the WWF SARPO's Conservancy Project). If the PWMA makes use of this expertise, there are unlikely to be any significant transport problems. Rhinos should be moved to Gonarezhou NP in individual travelling crates of a size appropriate to each individual's size and age. Calves should not be transported in crates designed for adults.

**IUCN guideline**: Determination of the release strategy (i.e. acclimatisation of release stock to release area, behavioural training, group composition, number, release patterns and techniques, timing).

**SADC RPRC guideline**: Rhinos have more complex social systems than is generally realised. Transfers of individuals will disturb these systems, leading to an increased risk of intraspecies fighting and maybe deaths due to fighting. But in natural populations, fighting is not a major cause of mortality. Hence, injuries and deaths from fighting amongst translocated rhinos should not be accepted as normal, but as a sign of a management problem.

***Black Rhino & White Rhino*** Release strategies have not yet been developed. The rhinos to be freed in Gonarezhou NP should be kept in pre-release pens within the park and the period that they spend in these pens should be greater than the few hours that was customary during the 1969-71 reintroduction programme. It is particularly important to develop a release strategy that removes, or at least minimises, the risk of death as a result of fighting between already-released and newly-released rhinos, or even between two nearly-released adult males. The temporal and spatial pattern of releases is particularly important in this regard. Ideally, all 20 founders should be released within a few days, so that they are all equally disorientated in their new environment, and adult males should be released at separate locations. If the founders are released during more than one phase, the risk of fighting and death is greater not only for adult males, but – at least amongst black rhinos - also for young males and even females (Adcock 1994).

**IUCN guideline**: Establishment of policies on interventions.

**SADC RPRC guideline**: Rhinos are relatively slowly-breeding animals and therefore their management during a reintroduction programme must be proactive (potential breeding constraints must be avoided before they arise), rather than reactive (simply responding to problems once they become apparent).

***Black Rhino & White Rhino*** Policies on management have not yet been developed. It is recommended here that if the health or wellbeing of any individual rhino is threatened, then PWMA staff should arrange immediately for expert intervention to remedy the problem. The intervention polices must also address, amongst other things: the management of any rhinos that cross the international border into Mozambique; and the action to take if white rhinos are released in Gonarezhou NP (despite the doubts expressed here about habitat suitability) and monitoring reveals that during the next drought the white rhinos are starving, moving far and wide across the countryside, or both.

**IUCN guideline**: Development of conservation education for long-term support; professional training of individuals; public relations through mass media and local community; involvement where possible of local people.

***Black Rhino & White Rhino*** Every opportunity should to be taken to train appropriate PWMA staff in the skills needed for rhino protection, monitoring, research and veterinary medicine. Staff at PWMA head office should be well placed to promote public relations at the national level through the national media. However, the PWMA does not have a programme of conservation education in the local schools. The proposed reintroductions do not yet involve the local people, even though poaching by some local people (or by Mozambicans assisted by them) played a significant role in the failure of the previous reintroduction of the black rhinoceros in Gonarezhou NP, and is a major threat to the success of the proposed reintroductions.

**IUCN guideline**: Welfare of animals for release is of paramount concern through all stages.

***Black Rhino & White Rhino*** The importance of this statement is reiterated here. It is recommended here that on no account should political or other considerations be placed before the welfare of the rhinos. In order for the planned reintroduction to conform with this guideline, rhinos should not be transferred to Gonarezhou NP until there has been a significant improvement in the security situation in the park, an improvement that must include an amicable and permanent solution to the squatter problem.

### *Post-release activities*

**IUCN guideline**: Post-release monitoring is required of all, or a sample of, individuals.

***Black Rhino & White Rhino*** It is recommended that there should be intensive monitoring of the reintroduced populations. All rhinos should be ear-notched before release and any born in Gonarezhou NP should also be ear-notched, so that most (ideally all) rhinos are individually identifiable. There is a need for some PWMA rangers to receive training in the monitoring of rhinos, so that they can recognise individuals and record their location, physical condition, survival and breeding. The age of a female when she produces her first calf and the interval between consecutive births are both useful measures of a population's wellbeing, once the immediate post-release phase is over. The PWMA should maintain a database of the information collected by its staff. The SADC RPRC has developed a computer database that is suitable for the management of these data. Several staff members of the PWMA who are resident in Gonarezhou NP should be trained in data entry for this database and in procedures for making – and securing - backup copies of important computer files.

Monitoring of the released rhinos will be facilitated if each released rhino is fitted with a radiotransmitter implanted in one of its horns. However, the rugged nature of much of the landscape to the north of the Runde River will make locating radiotagged animals difficult on the ground, especially given that habitat considerations suggest that rhino density will not be great and rhino home ranges are likely be relatively large. In these circumstances, locating each radiotagged rhino from a light, fixed-wing aircraft at regular intervals should be part of the post-release monitoring programme.

**IUCN guideline**: Demographic, ecological and behavioural studies of released stock must be undertaken.

***Black Rhino & White Rhino*** If the above recommended monitoring programme is implemented, analysis of the data collected will allow determination of demographic trends (e.g. births, deaths) and, if there are sufficient sightings of individual rhinos, some aspects of the animals' behaviour, such as spatial and social organisation and dispersal.

**IUCN guideline**: Study the processes of long-term adaptation by individuals and the population.

***White Rhino*** Given the serious concerns about the suitability of the vegetation in northern Gonarezhou to support a viable population of white rhinos, post-release studies should include studies of the use and selection of vegetation types and microhabitats (and the effects of fire on their use and selection), and diet composition.

***Black Rhino*** If the recommended monitoring programme is followed, other studies of the reintroduced black rhino population would probably be of low priority, because frequent monitoring of

the location of recognisable individuals will provide information on aspects such as dispersal, home range size and distribution, and reproduction. Nonetheless, it is noteworthy that just two studies of the diet of the black rhinoceros in Zimbabwe have been published in the scientific literature (Jarman 1971, Matipano 2003) and neither can be regarded as comprehensive.

**IUCN guideline**: Record and investigate any mortalities.

***Black Rhino & White Rhino*** Recording mortalities and determining the causes of death are part of the recommended monitoring programme. If tsetse flies invade Gonarezhou NP, special attention should be given to the possibility of trypanosomiasis as a cause of death, particularly of white rhinos. All PWMA staff in Gonarezhou NP should be trained to recognise a tsetse fly and its puparium (pupal case) and to record in PWMA reports the absence or presence and relative abundance of tsetse flies.

**IUCN guideline**: Management interventions (e.g. veterinary aid) when necessary.

***Black Rhino & White Rhino*** It is recommended here that, if the health or wellbeing of any rhino is threatened, PWMA management staff should immediately arrange for expert intervention to remedy the problem.

**IUCN guideline**: Decisions for revising, rescheduling, or discontinuing the programme where necessary.

***Black Rhino & White Rhino*** The progress of the rhino reintroduction programmes should be reviewed annually by PWMA staff and independent experts. The PWMA must be prepared to modify or discontinue any reintroduction programme if it is not succeeding (as judged by the short-term and long-term success indicators already detailed). This guideline is particularly relevant for the proposed reintroduction of the white rhinoceros, because of the doubts about habitat suitability in northern Gonarezhou, particularly during a drought, and the possible consequences of unsuitable habitat for the dispersal of white rhinos.

**IUCN guideline**: Habitat protection or restoration to continue where necessary.

***White Rhino*** The reintroduction of the white rhinoceros to Gonarezhou NP is not dependent on a habitat restoration programme. The suitability of the area north of the Runde River as habitat for the white rhinoceros is doubtful, but the fires that sweep most of this area annually will impact on that suitability. Whether fire is beneficial for white rhinos is likely to vary between years, being dependent on the soil moisture regime (itself dependent on the previous season's rainfall): the availability of soil moisture during the dry season will determine whether there is a post-fire flush of green grass and, if there is, how much grass grows.

***Black Rhino*** The reintroduction of the black rhinoceros to Gonarezhou NP is not dependent on a habitat restoration programme. Nonetheless, the high and increasing density of elephants in the park may (during the medium-term and long-term) have a significant and negative impact on a reintroduced black rhinoceros population, directly through competition for food and indirectly through the effect that the elephants have on woody vegetation in the park.

**IUCN guideline**: Continuing public relations activities, including education and mass media coverage.

***Black Rhino & White Rhino*** Gonarezhou NP bears the dubious distinction of being an area in which the black rhinoceros has twice gone locally extinct. There is likely to be scepticism about PWMA's proposal to reintroduce rhinos to Gonarezhou NP, especially given the history of alleged poaching by some corrupt DNPWLM officials; the failure to prosecute those individuals; the current acute underfunding of management in the park; the presence of long-term squatters and their cattle; and the close proximity of the proposed reintroduction area to the international border. The PWMA's reputation is also compromised by public statements by some government officials that are contradicted by the evidence on the ground (e.g. *Government relocating illegal Gonarezhou settlers* is a headline from the *Financial Gazette* of 22 January 2004 - article posted on the website of the Peace Parks Foundation at http://www.peaceparks.org/new/news. php?pid=161&mid=360).

**IUCN guideline**: Evaluate the cost-effectiveness and success of reintroduction techniques.

***Black Rhino & White Rhino*** The proposed rhino reintroductions in Gonarezhou NP should use well-established techniques that have succeeded during other rhino reintroductions. Nonetheless, there is nearly always scope for the continued evaluation of the cost-effectiveness and success of differing management techniques.

**IUCN guideline**: Regular publication in scientific and popular literature.

***Black Rhino & White Rhino*** Regular publication in the scientific and popular literature is recommended here as part of any conservation programme. During the initial stages of the previous reintroduction of the black rhinoceros, articles about the reintroduction appeared in the popular press and it featured in a popular book (Gordon Davis 1972). But no articles appeared in the scientific press, largely because there were few studies. Even those studies that were conducted have remained obscure: for example, Thomson (1971a, page 48), while discussing the diet of the black rhinoceros, mentions 'observations from the Gona-re-Zhou' but gives no indication of their diet in Gonarezhou, other than stating that it included *Colophospermum mopane*.

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