SADC Regional Programme for Rhino Conservation

MANAGEMENT OF THE WHITE RHINOCEROS IN MOSI-OA-TUNYA NATIONAL PARK, ZAMBIA

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Evaluation of areas for the reintroduction of rhinos to Zambia

Semester 4 Task 1.2-4.1

COOPERAZIONE ITALIANA
ITALIAN COOPERATION
AID 5064

CESVI cooperazione e sviluppe

SADC Southern African Development Community Towards a Common Future

IUCN The World Conservation Union

WWF

SPECIES SURVIVAL COMMISSION
AFRICAN RHINO SPECIALIST GROUP

PUBLICATION CREDITS:

Title:	Management of the white rhinoceros in Mosi-oa-Tunya National Park, Zambia
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Date:	August 2001 (with correction to subspecific name, 2005)
Special acknowledgements:	George Kampamba, Rob Brett

This report is an output from a task of the **SADC Regional Programme for Rhino Conservation**

ABOUT the SADC Regional Programme for Rhino Conservation:

The Programme is funded by the Italian Ministry of Foreign Affairs, Directorate General for Development Cooperation (Project AID 5064).

The Programme is contracted to CESVI and implemented through a regional consortium which comprises:

- 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.

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Summary

- Six white rhinos were introduced to Mosi-oa-Tunya NP, Zambia, from South Africa during 1994. Two animals died within 18 months of release. One calf was born soon after his mother was freed, but none have been born since.
- During July 2001, the population consisted of one subadult male (about 7 years-of-age), two adult males (about 10 years-of-age) and two adult females (one about 11 years-of-age and one older).
- It is likely that the oldest males reached sexual maturity only within the last year or so and hence it is not surprising that no calves have been born during the last six years.
- One adult male appears to behave like an alpha (territorial) male and the other like a beta (non-territorial) male. The beta male was reported by scouts to have mated with one of the females last year. The alpha male has not been observed mating. This suggests that, although the oldest males are now old enough to sire calves, there may also be social inhibitions.
- The principal short-term management recommendations are:
    1. careful monitoring of the rhinos during the forthcoming rainy season, to detect mating, or parturition by the female that was observed mating;
    2. in the absence of mating or births, to introduce to this population at least one mature bull from another population (possibly by swapping males between the populations).

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Introduction

Since a group of the southern white rhinoceros *Ceratotherium simum simum* was introduced to Mosi-oa-Tunya National Park, Zambia, during 1994, only one calf has been born. These animals are the only rhinos known to occur in Zambia and the absence of further breeding is a concern to the Zambian Wildlife Authority. It was for this reason that I visited Mosi-oa-Tunya NP during 24-25 July 2001, accompanied by George Kampamba (Acting Assistant Director (Research), ZAWA) and Victor Siamudala (Senior Ecologist, ZAWA).

The white rhinoceros is not indigenous to Mosi-oa-Tunya NP. In fact, it is debatable whether the white rhino is indigenous to Zambia, but if it ever did occur there, it was south of the Zambezi River, in the south-west of Zambia (Ansell 1959, cited by Ansell 1971).

History of the white rhinoceros population at Mosi-oa-Tunya NP

Introductions

First population

Two white rhino bulls and two cows were taken to Zambia as youngsters from Zululand, South Africa, during 1964 (Anon 1969). One pair went to Mosi-oa-Tunya NP at Livingstone and one pair went to Kafue NP. The male at Kafue died soon after arrival and the Kafue female was moved to Livingstone. The population founded by these three animals went extinct during 1989, when the last animal was killed by a poacher.

Second population

During March 1994, after a period in holding pens, six white rhinos from Sable Ranch, South Africa, were introduced to a fenced area (the 'game park') within Mosi-oa-Tunya NP in order to found a new population. The area is bounded by an electrified fence to the north and east and by the Zambezi River to the south and west. The six animals included two subadult males, two adult females and two subadult females, which were all named (Table 1).

Table 1. Details of six white rhinos introduced to Mosi-oa-Tunya NP during March 1994

Name	Sex	Estimated age at introduction *	Fate
Naughty	Female	Adult	Failed to rise after being dehorned – shot on 14 August 1995
Molly	Female	Adult	Alive in game park, July 2001
Mama	Female	Subadult +/-4 years-old	Alive in game park, July 2001
Mosi	Female	Subadult +/-4 years-old	Last seen 6 November 1994 – believed drowned in Zambezi River
Gumboots	Male	Subadult +/-3 years-old	Alive in game park, July 2001
Fwanya	Male	Subadult +/-3 years-old	Alive in game park, July 2001

* O. Coltman, pers. comm.

Naughty was described in the NPWS report on the 1995 dehorning exercise as the largest animal and so I deduce that she was one of the adult females. And Molly gave birth soon after release and so I assume that she was the other adult female. Naughty and Molly had been sent to Sable Ranch by Natal Parks Board, while the other four animals were conceived at Sable Ranch, where the white rhino herd consisted of two bulls and eight cows (including Naughty and

Molly). Thus, Mama, Gumboots and Fwanya were fathered by one or other of the two bulls. So too was George, because he was conceived before his mother left Sable Ranch. Gumboots went to Livingstone with his mother, who must have been either Naughty or Molly. If their estimated ages are correct, Mama, Gumboots and Fwanya would all have had different mothers. All six rhinos that went to Zambia were in bomas for 9-12 months before shipment, two animals in each of three 10 x 12 m bomas. The free-ranging rhinos at Sable Ranch were given lucerne as supplementary feed during the dry season.

Management interventions

First population

Few details are now available of the management of the first population of white rhinos, which lived in the fenced game park from 1964 until 1989. It is known that they were given supplementary food during the dry season, but they were not given as much as the current population. During 1973, two rhinos from Mosi-oa-Tunya were taken to the presidential palace.

Second population

Four of the founders of this population were dehorned before they left Sable Ranch and the other two were dehorned before they were freed from their bomas into the game park during March 1994. Electrification of the boundary fence was underway at this time, but (because of political pressures) the rhinos were freed before it was completed. Consequently, two rhinos (Gumboots and Mama) escaped from the game park on 22 March 1994, but were recaptured and returned to the park two days later.

During August 1995, Gumboots, Mama, Fwanya and Naughty were darted and dehorned by NPWS staff. Fwanya and Naughty has difficulty rising after being dehorned: Fwanya eventually managed to rise and walk away, but Naughty (who was the biggest animal and consequently had been given a greater dose of the drug M99) never rose and, a week later, was shot.

Since the second population was established, supplementary feed in the form of bales of hay (dried grass) has been provided throughout each dry season. At the time of my visit, one of the game scouts reported that two rhinos (Molly and George) were visiting the hay regularly, but that the other three did not eat the hay.

Individual breeding performance

First population

Little information is available on the breeding performance of animals in the first population. One of the two females from the first founder population produced the first calf during January 1969, 4-5 years after she was introduced to the game park (Anon 1969). The other female must have given birth later during 1969, because there were reported to be five rhinos in the population by December 1969 (Ministry of Lands & Natural Resources 1972). The population number was unchanged by December 1970, but there were the original three adults plus three calves in the population by mid 1971 (Ansell 1971). This suggests that the first female to give birth had produced a second calf and ZAWA records mention a birth on 22 April 1971, which would indicate an inter-birth interval of about 27 months.

Although no further breeding records are available for individual females, the population bred successfully, despite the death of one of the founder females during December 1971 (ZAWA records). Between mid 1971 and 1981, the population number increased from 6 to 13, despite the deaths of at least four animals. Thus, a minimum of 11 calves were born during the decade 1971-81. If the two rhinos that were taken to the presidential palace during 1973 were not returned to Mosi-oa-Tunya (ZAWA records do not indicate their fate), then at least 13 rhinos were born during that decade.

Second population

The breeding performance of the second rhino population is better known. Only one calf has been born since these animals were released during 1994. Molly gave birth to a male calf (now called George) during August 1994. The only other surviving female, Mama, has not produced a calf. In Matobo NP, Zimbabwe, the age of individual white rhinos at first calving varied from 6.5 to 11.5 years, with animals in a high-density population tending to be older when their first calf was born, compared with individuals in a low-density population (Rachlow & Berger 1998). Mama is about 11 years-of-age and so is at the upper end of the range of ages-at-first-birth observed at Matobo.

Survival

First population

Mortality records for the first population of rhinos are incomplete, but ZAWA records list the following deaths:

- 5 December 1971 – 1 founder female became sick and died
- 24 April 1972 – 1 young rhino died (believed to have been attacked by the male)
- 6 June 1973 – 1 baby male rhino died
- November 1979 – 1 male killed by 'freedom fighters'
- 3 November 1984 – 1 rhino died after becoming stuck in mud
- 26 April 1986 - 3 rhinos killed by R. Mbewe (a NPWS employee who later died in prison)
- 10 August 1988 – 1 rhino killed
- 11 January 1989 - 1 rhino killed (this was the last member of the first population)

The number of rhinos in the first population peaked at 13 during 1981 (Table 2). The last rhino in this population was poached during January 1989. Of the 13 rhinos that died during 1981-89, ZAWA records note the deaths of six, five of which were killed by poachers.

Second population

Since the second population was established, two founders have died:

- 6 November 1994 - female Mosi was last seen alive on this date and it is believed that she drowned in the Zambezi River soon afterwards
- 14 August 1995 - female Naughty was shot, after she failed to rise after being dehorned a week earlier

Table 2. Number of white rhinos in the game park at Mosi-oa-Tunya NP

Year	Population Number	Data source
1963	0	Anon 1969
1964	3	
1965	3	
1966	3	
1967	3	
1968	3	
1969	5	Ministry of Lands & Natural Resources 1972
1970	5	
1971	7	ZAWA records
1978	9	
1981	13	
1985	6	
1989	1	
1990	0	
1991	0	
1992	0	
1993	0	
1994	6	
1995	5	
1996	5	
1997	5	
1998	5	
1999	5	
2000	5	
2001	5	

The Game Park in Mosi-oa-Tunya NP

Present fenced area

The size of the game park in Mosi-oa-Tunya NP has increased over the years. During 1970, it was enlarged by about 2.5 km^2, to give a total area of 7.7 km^2 (Anon 1970), and during 1985 another 3 km^2 were added (Ministry of Lands & Natural Resources 1989). A fence along the Zambezi River frontage was removed during the early 1990s. The current boundary fence was erected during 1994. I used a GPS receiver to record the location of the fence and the tarred river road, which runs close to the Zambezi River bank, and I calculated that there are 11.4 km^2 between the fence and the river road. When allowance is made for the generally narrow strip of land between the river road and the Zambezi, the true area of the game park is probably closer to 12 km^2. Because the game park is larger than 10 km^2, the Mosi-oa-Tunya rhino population would qualify as a 'wild population', in terms of the definitions adopted by the African Rhino Specialist Group (Emslie & Brooks 1999), living in a 'rhino sanctuary'.

The game park includes one large patch (about 40 ha) of grassland that appeared to be subject to waterlogging during the rainy season. At the time of my visit, the area was largely dry and the grass brown. The principal vegetation types in the game park are riverine woodland (which has been severely modified by elephants that enter the park after swimming across the Zambezi River from Zimbabwe) and mopane woodland. Neither woodland carried a great standing crop of grass, but there were areas of green perennial grassland (e.g. *Cynodon dactylon*) growing in low-lying areas close to the Zambezi River. These short perennial grasses grow in association with the tall, coarse *Vetiveria nigritana* grass, which elsewhere along the Zambezi River grows in places susceptible to flooding when the river level is high. Some rhinos were seen feeding on these short perennial grasses where grazing by rhinos (and hippos ?) had created grazing lawns. Other rhinos were seen eating the dead, standing, annual grasses in the mopane woodland, some areas of which appeared to be growing on sodic soils. Over a few small areas, the grasses had been burnt by management staff to encourage the growth of green shoots.

Other large mammal species in the game park include elephant (their number varies as they swim backwards and forwards across the Zambezi to Siloka Island), zebra (I counted 60 at one time on the large patch of seasonally-waterlogged grassland), impala, wildebeest, giraffe, waterbuck, warthog, bushbuck, baboon and vervet monkey. I saw buffalo spoor and was told that hippopotamus feed in the park at night. The last wildlife count was during 1995. There are no recent reports of lions, leopards or hyaenas in the park. In some small, enclosed parks, ticks occur at high density and may be numerous on large mammals. However, the staff do not regard ticks as a problem in Mosi-oa-Tunya game park.

The fence along the northern and eastern sides of the game park is 8.3 km long. It is 1.5 m tall with 10 horizontal wire strands, approximately equally spaced. If the lowest wire is wire 1, then wires 2, 4, 6, 7 and 9 are electrified, while the others are all earthed. Wires 2 and 9 are on outriggers on the inside of the fence. There is a strainer every 10 m along the fence, the outrigged wires are supported every 20 m and there is a fence pole with angled supports every 100 m. The energiser for the fence is located at the east end, in the gateguards' room. For at least the last two years, there have been complaints about the low voltage along the fence (1.8 kV according to the display on the energiser at the time of my visit), but the voltage immediately increased to 7.7 kV when I disconnected the fence from the energiser. This suggests that there is a short somewhere in the system, probably between earth and one of the electrified wires on the fence. Despite this, the fence appears to be reasonably effective, with only the occasional break caused mainly by elephants.

Options for expansion of the fenced area

There are extensive developments (e.g. hotels, customs and immigration department offices, the road and railway going to Victoria Falls bridge) in the south-eastern half of the national park and so expansion of the game park towards the south-east is not considered a practical option at present. There are fewer developments to the north-west and there are two options for expanding the game park in this direction.

Option 1 – western Zambezi River frontage

Under this option, the game park is enlarged to include the area between the present western boundary fence of the game park, the Sinde River that forms the western boundary of the national park, the Zambezi River and the railway (map 1). The area that would be added to the game park totals about 5.3 km^2, including 6 km of Zambezi River frontage. The advantage of this option is that the more-productive zone of riverine vegetation would be added to the game park, but that sections of the Livingstone-Mambova tar road and the Livingstone-Mulobezi railway would be excluded. The new fence would be built over relatively flat ground (which would facilitate fence construction) to the south of the railway and to the east of the Sinde River. There is one tourist lodge within this proposed extension (Thorntree Lodge) and a second is currently under construction. These developments should be given the opportunity to fence

themselves out of the enlarged game park, using electrified fences around their tourist and staff buildings. If the game park is enlarged following option 1, consideration should be given to realigning the present access tracks to these tourist lodges, so that only one gate is needed in the new fence running to the south of the railway line.

Option 1 would require erection of 7.2 km of new fence (plus any around the tourist lodges) and the removal of 0.9 km of existing fence.

Option 2- the entire north-west

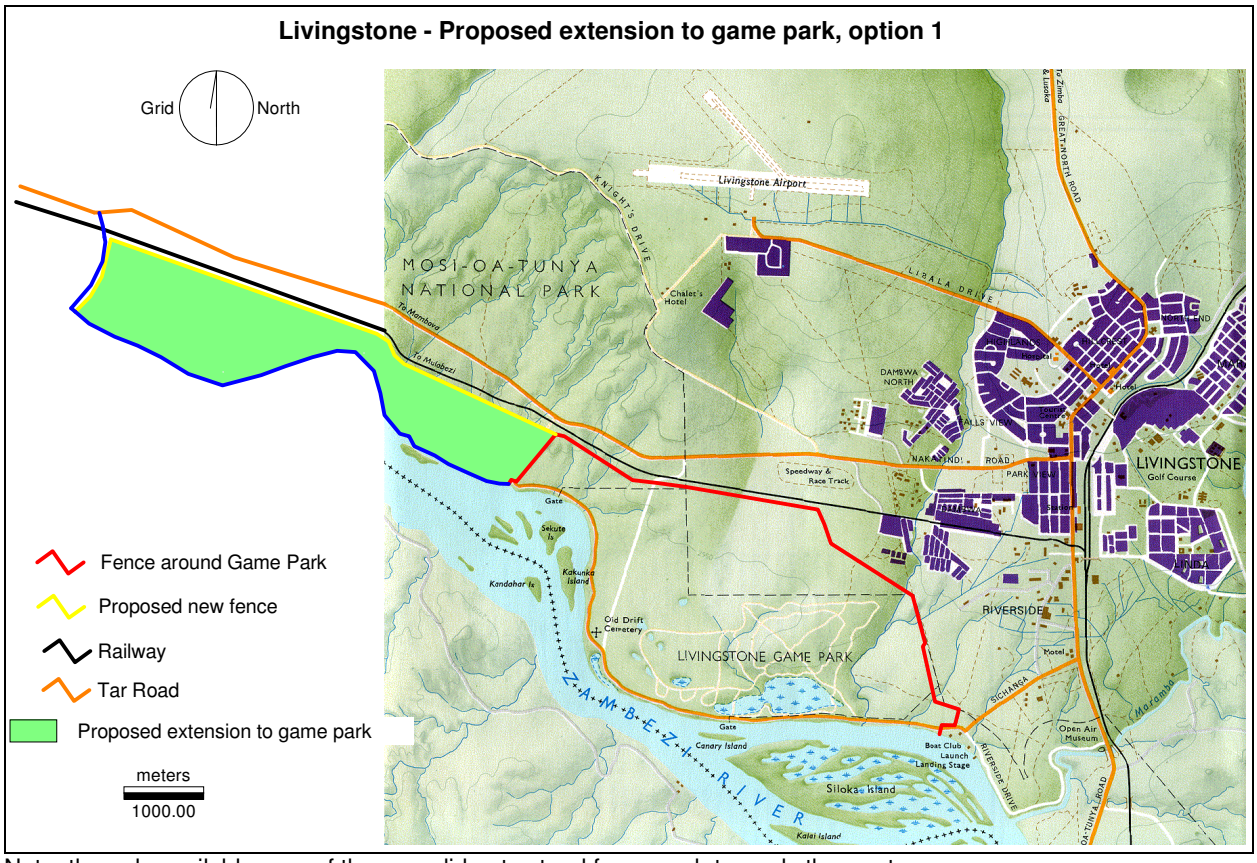
Under this option, the entire area of the National Park to the north-west of the existing game park would be fenced along the national park boundary, except for the Zambezi River frontage (map 2). In other words, the extension proposed under option 1 would be added, together with another 14.6 km^2 to the northwards, giving a total addition of about 20 km^2. This is the option currently favoured by ZAWA, which also proposes to drill boreholes to provide additional drinking water supplies for wildlife. The most northerly part of the proposed extension (that furthermost from the Zambezi River) is about 4 km from the Zambezi.

One advantage of this option is that the area of the game park would more than double. A second advantage is that fencing of the national park boundary would discourage other land uses from encroaching into the park. But there are several disadvantages:

1. The proposed extension would include sections of the Livingstone-Mambova tar road and the Livingstone-Mulobezi railway and so the new boundary fence would twice cross the railway and twice cross the tar road. This would add significantly to the capital cost of building the new fence, and to the cost of maintaining the game park if the road/fence crossings were gates that had to be staffed 24-hours per day, 365 days per year. Cattle grids at the points where the fence crosses the road would probably be effective barriers to most large mammals in the game park, but probably not to elephants or rhinos.
2. Both trains and vehicles using the tar road are likely to cause deaths amongst the wildlife (Drews 1995, Newmark *et al.* 1996), although the number of deaths could be reduced by measures that reduce the speed of vehicles.
3. Most of the land within the proposed extension and to the north of the railway is covered by *Combretum-Terminalia* shrubland or *Baikaea* woodland, the latter growing on deep and infertile sands. It is unlikely that the inclusion of this area within the game park would significantly increase the carrying capacity of the game park for white rhinos or other grazers. The most likely benefactor of adding this area to the game park is elephant, which, given the area's proximity to water, would probably modify the woody vegetation extensively, as they have done within the existing game park.
4. The fence along the northern boundary of this proposed extension would be over steeply-sloping ground and extensive anti-erosion measures must be taken if the fence is built here.
5. The two tourist lodges that would be sited in the game park under option 1 would also be within the proposed extension under option 2. There would be no need to realign their access tracks under Option 2.

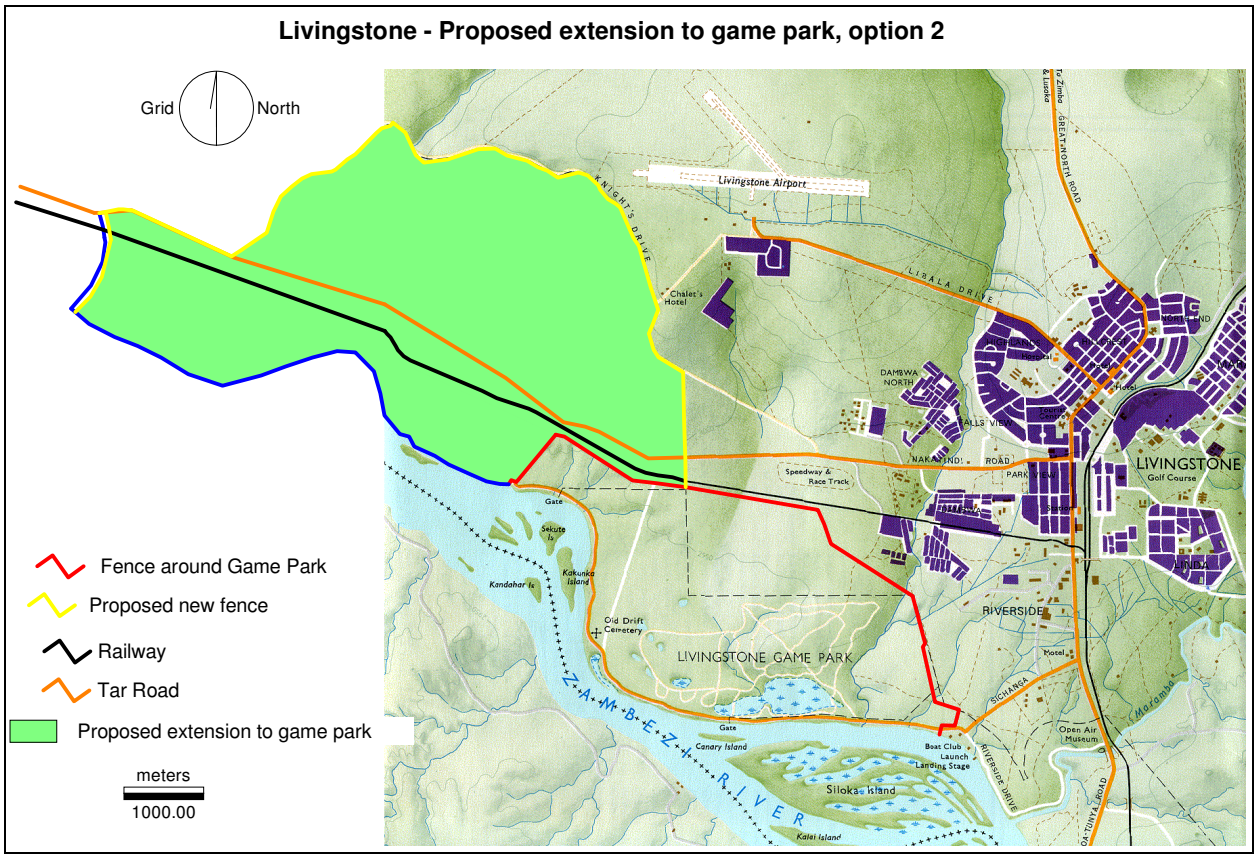
Option 2 would require erection of about 13.2 km of new fence (excluding that around the tourist lodges) and the removal of 2.7 km of existing fence.

Map 1



Note: the only available map of the area did not extend far enough towards the west

Map 2



Advantages of perimeter fencing

1. It protects people living alongside the game park (particularly alongside the eastern fence of the game park) by forming an efficient barrier between them and large mammals that are potentially dangerous to people, e.g. elephants, buffalo.
2. It protects the wildlife by reducing the potential for human-wildlife conflict, thereby removing the need for any animals to be shot in protection of human life or property.
3. It discourages illegal entry into the park by people for the purposes of collecting wood or snaring. If the fence was operating at its proper voltage, it might form a greater deterrent.
4. It demarcates the boundary of the park in a way that cannot be ignored by local people. At present, a graveyard on the immediate, unfenced boundary of the national park has been extended across the boundary track and into the national park.

Disadvantages of perimeter fencing

1. It restricts the movements of wide-ranging species, e.g. elephant, and may lead to increased tree felling and mortality by elephants within the game park.
2. It prevents dispersal acting as a method of population regulation for white rhinos (see Owen-Smith 1981) and other large mammal species living in a small area without large predators.
3. It prevents all large mammals moving in search of better food supplies when the food supply is limited during drought years.
4. It is expensive to erect.
5. Maintenance costs are relatively high, because an electric fence must be checked regularly and must be repaired quickly if damaged by people or elephants.

Potential function of the perimeter fencing

In places where the national park boundary is not fenced, a fence would greatly reduce the danger that other land-uses will encroach into the national park. The national park is situated close to an urban area and housing has already been built right alongside the eastern fence of the game park.

Factors possibly limiting the viability and performance of the rhino population

Habitat and capacity of fenced area

Between 1971 and 1981, the number of white rhinos in the first population increased from 7 to 13 animals. They lived in a fenced area that was smaller than the present game park, but was part of it. Unless there has been a dramatic and permanent decline in grass productivity within the game park, it is unlikely that the five rhinos presently living in the park are short of food. During my visit, I judged them to be in fair to good condition, on the basis of Reuter & Adcock's (1998) criteria. The game park was described as overgrazed during the relatively-dry 1980s (Anon 1988) and it is not uncommon during droughts for rhinos to died after becoming stuck in mud (Dunham 1985), as one did during 1984. But rainfall was average or above-average during four of the five years since the second rhino population was freed (unpublished rainfall data for Victoria Falls, Dept of Meteorological Services, Harare, Zimbabwe). Certainly, I would not have described the area as overgrazed at the time of my mid-dry season visit.

One afternoon, we saw three rhinos grazing (singly, not in one group) on short, green grass growing in low-lying areas near the Zambezi River. The game scout accompanying us

(Chambwa Simakando) confirmed that these were favoured feeding areas for the rhinos. However, I would expect them also to be favoured feeding areas for other grazers, particularly hippos and buffaloes (although I did not see any of the latter during my visit). Because they can occur at high densities, are large and therefore require lots of food, both these species could be serious competitors for food with the rhinos during drought years. Buffalo are resident in the game park and therefore their numbers should be easy to monitor. But the hippos live in the Zambezi River during the day and enter the game park along the unfenced river bank at night. Monitoring the number of hippos using the game park would be less easy, but probably important because hippo populations can increase at 10 % per annum (i.e. their population number can double in just 8 years).

Hence, while there is no evidence that the rhino population is currently limited by a shortage of food, it is possible that this could happen in the future.

Staff, security and monitoring

The game park is managed by one ranger and 12 scouts. Most of the later are resident inside the game park, while others live outside. The park entrance gate is staffed by two scouts. Two other uniformed scouts, equipped with AK47 rifles, patrol near one of the rhino groups throughout the morning, before handing over responsibility (and their rifles) to another two scouts for an afternoon patrol. At night, a group of about three scouts patrols in the game park and along the perimeter fence. One of the park's scouts has attended a training course for rhino monitors. Of six handheld radios provided to the park during 1994, only three can now be accounted for and one of these is broken. The ranger and the gate scouts are equipped with the functioning radios. Ammunition is in short supply and the scouts have not fired their rifles on the range since some time during 2000. ZAWA had not paid its staff during the three months prior to my visit.

NGO involvement in the management of the white rhinos involves the provision of a four-wheel drive vehicle to ZAWA by the Save the Rhino Trust.

Because the rhinos are regularly monitored, there seems little likelihood that births occurred but were not detected by staff.

Management

Three of the five surviving rhinos were dehorned during 1995, but because one rhino died following that exercise, there has been no further attempt to dehorn the rhinos. All the rhinos now have significant horns.

The rhinos are provided with hay bales every dry season, apparently regardless of rainfall during the previous rainy season. At the time of my visit, only two of the five rhinos were reported to be using the hay.

Reproductive and social behaviour

Adult female Molly gave birth to George seven years ago. In Matobo NP, Zimbabwe, intervals between births varied from two to six years (Rachlow & Berger 1998) and so Molly might have been expected to have produced another calf by now. Mama is about 11 years-of-age and most females have produced a calf by this age (Rachlow & Berger 1998).

Scout Chambwa Simakando reported that Gumboots scatters his dung with his hindlegs after defecating, but that Fwanya had not been observed to do this. This suggests that Gumboots is an alpha adult male (*sensu* Owen-Smith 1975) and that Fwanya is a beta adult male. In other words, Gumboots is a territorial male, while Fwanya does not have a territory, but is tolerated by Gumboots in his territory. When we saw Gumboots, he had blood and scratches on his flank and our guide commented that Gumboots often fought with Fwanya. When asked about

observations of rhino mating, Scout Simakando reported that some of his colleagues had observed Fwanya mating with adult female Molly during 2000. In his detailed study of white rhino social behaviour, Owen-Smith (1975) found that beta males mated with females only under special circumstances.

In Umfolozi, South Africa, males aged up to 8-9 years generally showed no sexual interest in females (Owen-Smith 1975, 1988). Young males were regarded as adult once they became solitary between 10 and 12 years-of-age and assumed alpha male or beta male behaviour patterns. The youngest dominant territory holder was 12 years-of-age. Both Gumboots and Fwanya are now about 10 years-of-age (O. Coltman, pers. comm.) and so have only recently reached adulthood. But, in the absence of dominant males, subadult males can mate successfully: in an enclosure in Kruger NP, where there were no mature bulls, a young male sired his first offspring at the age of 7.9 years (by mating with his mother) (Owen-Smith 1988). When his first offspring was born, this male would have been 9.2 years-of-age, only slightly younger than Gumboots and Fwanya are now (assuming that their ages are correctly estimated). This would suggest that until recently they were too young to be fathers and that it is not altogether surprising that no animals have been born at Mosi-oa-Tunya during the past six years.

Both Gumboots and Fwanya should now be old enough to sire offspring. But the only mating reported to us was by Fwanya, a beta male, whereas one would expect the male exhibiting alpha male behaviour, Gumboots, to be the one mating. Molly may be Gumboots' mother and Fwanya, Mama and Gumboots (or any two of the three) may share the same father. Thus, the degree of relatedness between these rhinos is generally high. While this is not good from the viewpoint of genetic management of this small, closed population, it does not necessarily preclude mating, as the mother-son mating in the Kruger enclosure shows (Owen-Smith 1988).

Even unrelated young white rhinos that grow up together in captivity may develop sibling relationships, and failure to breed is a common problem (Emslie & Brooks 1999). Even in wild populations, most subadults not with an adult female were accompanied by another subadult, of the same or opposite sex (Owen-Smith 1975). Although the population at Mosi-oa-Tunya is not captive, it is more similar to a captive population than a wild one when account is taken of the small population number and the resulting limit on possible social interactions. It is eight years since the rhinos now at Mosi-oa-Tunya were placed in bomas at Sable Ranch, prior to their move. Thus, it is too late to find out about their social associations while they were free-ranging at Sable Ranch. But these animals spent some 9-12 months in bomas prior to their move and, on arrival in the game park, were penned again, in the same combinations. Gumboots shared a pen with his mother and so Fwanya must have been with one of the other females, for about a year. The other two females, although in a separate pen, were, literally, right next door to both males.

- I conclude that the absence of any conceptions during the 5-6 years immediately following the introduction of white rhinos into the game park during 1994 could be explained by the immaturity of all the males in the population. However, the absence of observations of Gumboots, who now appears to be an alpha male, mating with either female suggests that there may also be social inhibitions within this small group.

Recommendations for Rhino Management

Short-term

Monitoring of rhinos

Before adopting expensive measures to remedy the perceived social problems, it is important to ensure that the absence of births is not simply due to the fact that the older males are late developers.

- The scouts monitoring the rhinos should be briefed to be especially watchful for mating during the forthcoming wet season, because this is the season when most white rhino conceptions occur (Owen-Smith 1988). Every individual rhino must be located daily: courtship often lasts no longer than one day and copulation less than half an hour.

It was reported to me (second-hand) that some scouts had seen Molly mating with Fwanya. Maybe she is already pregnant.

- The date of these reported observations must be ascertained and the monitors instructed to pay particular attention to Molly during the period about 16 months (= gestation period for white rhinos) afterwards.
- New observations of courtship, or its absence, should be included in a written, monthly report that the ranger should compile, from the scouts' observations, about all aspects of the rhinos. This report should be sent to the ZAWA chief ecologist.

Introduction of another mature male rhino

- If careful monitoring records no courtship and no births during the 2001-2002 rainy season, at least one mature bull from another population should be introduced to the game park. The closest population to Mosi-oa-Tunya is at Hwange NP, Zimbabwe, and there is also a population at Matobo NP.
- The introduction needs to be executed in a manner that minimises the risk of deaths due to fighting between George or Fwanya and the new bull(s). There are at least two ways of doing this:
    - Remove George and Fwanya from the game park and swap them for two mature bulls from another population.
    - Introduce the new male(s) to the fenced extension of the game park (leaving the fence between the present park and the extension temporarily in place) and let these males establish themselves in their new home before removing the fence between the two areas.
- If rhinos are added to or removed from the game park, consideration must be given to the genetic consequences of any moves (see below).

Maintenance of perimeter fence

- Several staff members at the game park should be given specialised training in the maintenance of electric fences, so that faults can be easily, correctly and quickly diagnosed.
- Staff should be provided with a voltmeter for fence testing, and with copies of the WWF booklet on the maintenance of electric fences (WWF 1999).
- A vehicle track should be established on the inside of the boundary fence. This will:
    - facilitate fence maintenance (especially if staff use bicycles);
    - assist security patrols (especially if the track is wide enough not to be crossed by an intruder without him or her leaving footprints).

Community education and relations with local communities

- Establish a community relations programme with the specific task of finding ways to increase the benefits that local people receive from living next door to a game park from which they are currently excluded.
- Establish an education programme that provides children at all local schools with the opportunity to visit the game park, free of charge, and to see the rhinos (which are the only rhinos known to be in Zambia).

Supplementary feeding of rhinos

Every dry season, bales of dried grass are provided as supplementary food for the rhinos.

- Throughout the dry season, the monitoring scouts should record how often each individual rhino visits the hay and approximately how much it eats. They should also record its condition score each month.

It is normal for rhinos to lose some condition during the dry season (Rachlow & Berger 1998). During dry seasons following wet seasons of high rainfall, it may be unnecessary to provide supplementary food, or maybe food need be provided only during the late dry season.

- The provision of supplementary food should be dependent on the condition of the rhinos and not necessarily an annual event. Ideally, the rhinos should survive without supplementary food.
- If supplementary food is necessary, it should probably be high-quality herbage (e.g. lucerne), not dried grass (unless this is also in short supply in the game park, which may be the case in drought years).

Rhino horns and dehorning

Since the death of one animal during a dehorning exercise, ZAWA's policy has been not to dehorn these animals. It is six years since any rhinos in the game park were dehorned and they carry significant horns.

- In collaboration with international colleagues and the SADC RPRC, ZAWA should conduct regular (at least annual) security assessments to determine the likely poaching threat to these rhinos. The threat from poaching can then be balanced against the probability of any animals dying during a dehorning exercise.

Long-term

Expansion of the game park

- Conduct a brief assessment of the vegetation in the area of national park to the west and north-west of the game park, to determine the vegetation types present, their approximate areas and locations, and their value as habitat for the different herbivores in the game park.
- In the light of this assessment, consider expanding the game park to include the western Zambezi River frontage (Option 1 above).

Management of large herbivores

Buffaloes and hippos may compete for food with rhinos feeding on the alluvial grasslands adjacent to the Zambezi River. Even if the park is extended, it will still be relatively small, enclosed and without large predators. In the absence of significant poaching, the numbers of

large ungulates will increase during years of high rainfall. But these animals will suffer a shortage of food during years of low rainfall and some drought-related mortality can be expected. In years of very low rainfall, significant mortality can be expected in the absence of management to reduce herbivore numbers.

- The number of each large mammal species in the game park should be estimated annually, using objective, standardised methods (which may vary between species).
- Following wet seasons of low rainfall, and especially those that end relatively early during the year, the number of large herbivores in the game park should be reduced. This should be done early during the dry season, before the herbivores have significant and long-term effects on the vegetation. Ideally, the surplus animals should be removed by capture.

Genetic management of the rhino population

Four of the five rhinos in the game park were fathered by one or other of the two bulls at Sable Ranch during the early 1990s.

- If any animals are added to or removed from the Mosi-oa-Tunya population in order to improve the breeding prospects, as recommended above, this opportunity should also be used to increase the number of effective founders for the Mosi-oa-Tunya population.

The Mosi-oa-Tunya rhino population will never be numerous enough to be genetically and demographically viable in the long-term.

- The Mosi-oa-Tunya population should be managed with other white rhino populations, perhaps those in neighbouring Zimbabwe, as a single metapopulation.

Capture and removal of rhinos as a means of population regulation

If the rhino population in this small, enclosed game park does breed successfully, one day the population number will exceed the carrying capacity of the park and rhinos must be removed if deaths, or adverse impacts on the vegetation, are to be avoided. ZAWA should conduct an assessment of places possibly suitable as reintroduction sites for white rhinos, including Sioma Ngwezi NP, which is the only Zambian national park that might be in the original range of the white rhino (Ansell 1959, cited in Ansell 1971).

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Appendix – Terms of Reference

Contracted for 18 days to make an evaluation of specific areas in Zambia for rhino conservation

Evaluation of white rhino management at Mosi-oa-Tunya NP

1. Review the history of protection and management of the small white rhinoceros population at Mosi-oa-Tunya NP, including the detailed history on introductions, management interventions, and records on individual breeding performance and survival.
2. Examine the present fenced area for white rhinos and options for expansion of the fenced area to include a larger area (or the whole) of the National Park, including wider implications for management and protection of other species, and advantages, disadvantages and potential function of perimeter fencing for the PA.
3. Following assessment of all aspects of the current management, identify those factors (habitat, capacity of fenced area, monitoring, management, security, staff) limiting the viability and performance of the white rhino population at Mosi-oa-Tunya, and provide short-term solutions and longer term management recommendations.
4. Produce independent report for ZAWA, containing all recommendations in a form that could be easily included within a management plan for Mosi-oa-Tunya NP.

- **Evaluation of feasibility and reintroduction options for black rhinos in North Luangwa NP (with South Luangwa NP as an alternative/future reintroduction site)**

  (See separate report)