# LESSONS FROM THE INTRODUCED BLACK RHINO POPULATION IN PILANESBERG NATIONAL PARK

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## RESUME

En mison du déclin drastique du nombre de rhino noir, plusieurs Etats de l'aire de répartition du rhino ont entrepris de déplacer le rhino dans des zones de sécurité ayant un habitat convenable comparable à leur ancienne zone. Le but était de rétablir les effectifs du rhino noir aussi rapidement que possible pour préserver à long terme leur diversité génétique et feiner les pertes potentielles liées au braconnage (Brooks, 1988 ; Anon,1993).

Cependant, les réintroductions et la gestion de ces nouvelles populations n'avaient pas été très correctes. Le processus de translocation nécessitait une perfection et de nouveaux problèmes survenus dans l'intrroduction des populations méritaient une attention paliculière.

Au Parc national de Pilanesberg en Afirique du Sud, le rhino noir est une population introduite qui, à travers le suivi intensif en cour, a amélioré notre compréhension sur les caractéristiques actuelles de la population du rhino, influençant les buts de conservation du rhino noir.

Le Parc national de Pilanesberg a été créé en 1979. ll couvre 550km2 de montagnes rocailleuses et de diverses vallées alluviales dans un volcan alcalin érodé. La moyenne pluviométrique atteint annuellement 637 mm. Les introduction du rhino noir ont été menées en plusieurs étapes à partir de 1981 et ont concerné 24 animmaux au total. Avant le début de 1996, la population a évolué jusqu'à 42 animmaux et en Juin cette même année, Pilanesberg devint une réserve donatrice lorsque neuf rhinos noirs ont été transloqués dans la réserve de faune de Madikwe. Ce rapport résume l'histoire et les caractéristiques de la population de Pilanesberg jusqu'à ce stade.

## INTRODUCTION

Due to the drastic decline in black rhino numbers, several rhino range states took steps to translocate rhino to secure areas with suitable habitat within their former range. The aim was to build-up remaining black rhino numbers as rapidly as possible, to preserve their genetic diversity in the long tern, and to provide the biggest possible buffer against future potential poaching losses (Brooks, 1988; Anon, 1993).

However the re-introductions and management of these new populations has not been entirely straightforward. The translocation process needed to be perfected and new problems arose in the introduced populations which required careful consideration.

The black rhino in Pilanesberg National Park South Africa is an introduced population which, through intensive and ongoing monitoring, has improved our understanding of rhino population characteristics currently influencing the conservation goals for black rhino.

Pilanesberg National Park was proclaimed in 1979. It covers 550km$^2$ of rocky hills and broad alluvial valleys in a weathered alkaline volcano. The summer rainfall averages 637mm annually. Black rhino introductions occurred in several stages, beginning in 1981, and involved 24 animals in total. By the start of 1996, the population had grown to 42 animals, and in June that year Pilanesberg became a donor reserve when nine black rhino were translocated to Madikwe Game Reserve. This paper summarises the history and characteristics of the Pilanesberg population up to this stage.

## MONITORING

The black rhino introduced from 1981 to 1983 were closely monitored by Hillman (1982, 1983 and 1984). However, from 1984 to 1989, only the annual helicopter

Photo Credit: Keryn Adcock

game census provided any monitoring information. In 1989, monitoring efforts were increased in response to declining black rhino numbers in countries to the north of South Africa, and in accordance with the new Conservation Plan for Black Rhino in South Africa, the TBVC States (TVBC States refer to Transkei, Bophuthatswana, Venda and Ciskei - former homelands of South Africa) and Namibia (Brooks, 1988).

Wildlife biologists Hans Bjarne Hansen and Hanne Lindemann were contracted to initiate, and later update individual rhino ID-kits in annual intensive helicopter and ground surveys. An ear-notching programme commenced in 1991, which means that all animals in the Park except infant calves, are individually recognisable. Ground monitoring by Parks personnel also developed from 1989 onwards, based on the game scout training program by Sandwith (1989), and in 1984 a black rhino monitoring officer was appointed.

This population analysis is derived from the work of wildlife biologists Kes HilIman-Smith (1982,1983,1984) Hans Bjarne Hansen and Hanne Lindemann (1989, 1990, 1991,1992, 1993 and 1995) and Keryn Adcock (1994).

## THE INTRODUCTIONS PHASE

The first months after release in a new area naturally a stressful period for introduced black rhino. Mortality rates are highest around this time (Adcock 1994; Brett, in press). A variety of factors are thought to play a role in translocation success.

## Boma-keeping and body condition

The introductions to Pilanesberg were staggered in time and location. The main introductions from Hluhluwe-Umfolozi Park took place over three years with seven, four, and eight black rhino arriving in 1981, 1982 and 1983 respectively. In 1989 a further five animals were introduced.

Fourteen of the 19 initially released rhinos were neither kept in a boma before transport not prior **to** release in the Pilanesberg. Two were kept in a boma for a few days before being released and three were kept in a boma for around three months in Natal and four to five days in Pilanesberg. The five from 1989 were caught over a four-day period in Mkuzi (Kwa-Zulu/Natal) and were then transported by truck to Pilanesberg and released directly.

The first 19 introductions into Pilanesberg were successful. Hillman (1982 and 1984), however, noted that the rhinos released without on-site boma-keeping were highly disturbed, which increased the rate of these new animals encountering and fighting with previously introduced rhino. Although the introductions also occurred during a major country-

wide drought, adaptation to the local food and habitat apparently did not present a problem. Although the rhino were only little or not at all boma-kept in Pilanesberg, their overall observable condition actually improved after release (HilIman, 1982; 1983 and 1984).

## Age at introduction

The 1981-1983 introductions were put into age-classes by Adcock, based on drawings, photos and notes made by Hiliman, along with photos taken of the rhino in 1989 by Hansen and Lindemann.

Only two males were sub-adult on arrival, and the predominantly adult and near-adult ages of the introduced rhinos may have played a significant role in the success of these initial translocatlons.

The five black rhino (two females and three males) brought from Mkuzi in 1989 were all sub-adult. The three young males - aged according to tooth wear from 15 to 27 months - all died within months of release from fighting injuries in one case, and apparent stress and harassment from established rhino for the others. The two females, who were about two years older than the males, settled down successfully. The death of these males, and deaths in similar circumstances in other areas, have highlighted the vulnerability of young rhino. They become more introduction into a new area than older rhino, they are not able to defend themselves, and are not adept at finding the right food, water and cover. Such knowledge has lead to improved recommendations for translocation procedures based on rhino age and sex (Brett, in press; Morkel, pers corn.; Brooks and Adcock 1997).

## Density of established rhino

In South Africa, Namibia, Zimbabwe and Kenya, the problems of introducing black rhino, especially males, into an already-established population are negatively affecting conservation efforts.

During the early introductions, the abundant space available to the rhino meant that even when conflicts arose between animals, there was room to escape. This probably played a role in the success of these early staggered translocations. Subsequent changes in rhino ranges highlighted the fact that the rhino were not truly established in the reserve until at least three years after release. For the 1989 introductions, the established male density in Pilanesberg was likely a negative factor. Although total established rhino density in 1989 was about 60% of estimated ecological carrying capacity, there were eight adult male rhino, and six other independent males of three to eight years old which commanded the water and main food resources of the reserve, leaving little place for young rhino to settle.

*Table 1. Home range sizes.*

| | Females | Males |
|---|---|---|
| Sub-adults, independent | 63km$^2$ | 35km$^2$ |
| Young adults | 48km$^2$ | 36km$^2$ - with wanderings 74km$^2$ |
| Adults | 52km$^2$ | 28km$^2$ |

*Table 2. Home range sizes.*

| Adult Female | Ranges (km2) | Source |
|---|---|---|
| Ndumu Game Reserve | 8.65 | Freese* |
| Weenen Nature Reserve | 10.00 | PulIen* |
| Sam Knott Game Reserve | 11.54 | Fike* |
| Shamwari Game Reserve | 15.00 | Corcoran (1995) |
| Mkuzi Game Reserve | 24.00 | Mulqueeny* |
| Lapalala Game Reserve | 40.00 | Ravenhill* |
| Itala Game Reserve | 49.00 | WoIf* |
| Waterberg Plateau NP | 60.00 | Erb* |
| Etosha NP, Otjovasandu area | 60.00 | Joubert and Eloff (1971) |

*Information provided for RMG carrying capacity assessment.

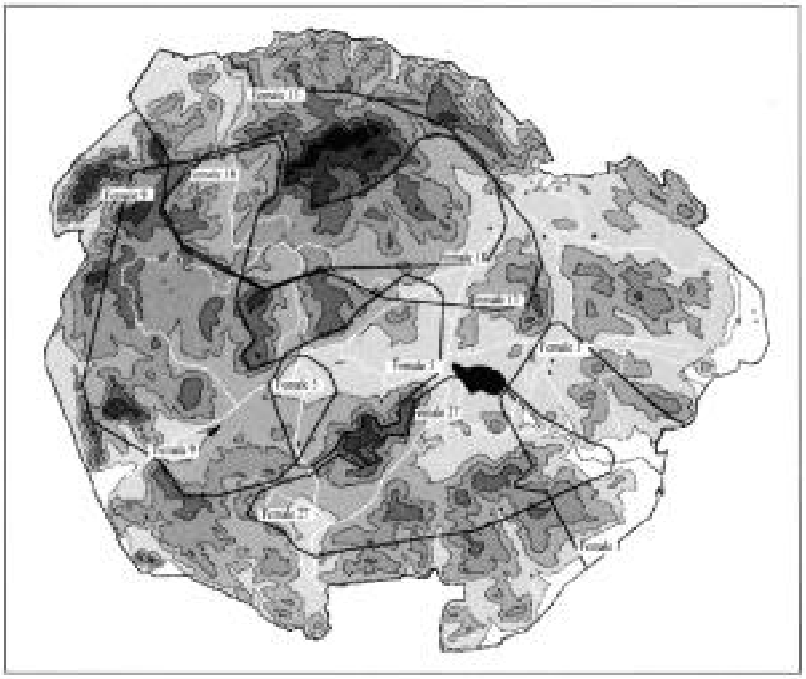


*Figure l. Ranges of older (>15 years) female black rhino in Pilanesberg.*

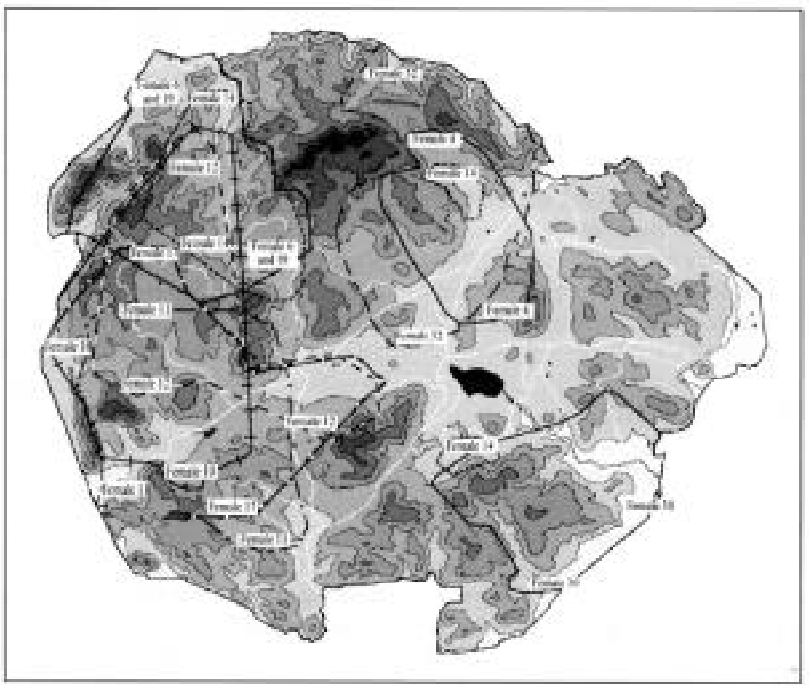


*Figure 2. Ranges of young adult female black rhino in Pilanesberg up to 1996 (F32 died in 1994).*

Photo Credit: Keryn Adcock

## Post release mortality

The combined post-release mortality rate for the Pilanesberg introductions was 12.5% (three out of 24). Hitchins (1984) reports an overall post-release mortality rate of 6% for Natal Parks Board translocations from 1962 to 1984. From 1986 **to** 1995, the post-release mortality rate among South African and Namibian trans locations (excluding those to Pilanesberg) was 8.4% (Adcock, 1995; and 1996). Brett (in press) reported a post-release mortality rate of 16% out of 118 translocations among Kenyan rhino sanctuaries.

## THE SETTLING DOWN PHASE

Hillman (1982, 1984) found that the newly introduced black rhino stayed predominantly in the main valley in Pilanesberg which runs from south-east **to** north-west. Ranges overlapped greatly among both males and females. Only two males and two females moved out of this valley into areas unoccupied by other black rhino. Given the extent of range overlap, especially between the males in 1994, and the altered rhino distributions found from detailed monitoring since 1989, it appears that most black rhino took over three years to settle down and establish proper home ranges.

## THE ESTABLISHED POPULATION

Males seemed less inclined than the females **to** explore remote parts of Pilanesberg in search of a home range. They finally settled in the main valleys near their release sites, while the females found ranges in suitable areas throughout most of Pilanesberg.

## Range sizes

Range sizes in Pilanesberg seem to depend on the age and sex of the black rhino. Range size was estimated from the area enclosing most sightings, ie. excluding those outside the usual ranges of the rhino. Also hills judged to be unusable - too steep or without normal food plants for black rhino - were excluded from the home range calculations.

Female ranges were larger on average than male ranges. The rugged terrain with low habitat suitability included in the estimates result in larger home range sizes in Pilanesberg as compared with other places.

## Range overlap and distribution

Adult females have a 10 to 60% range overlap (Figure 1). This level of overlap among females has been documented

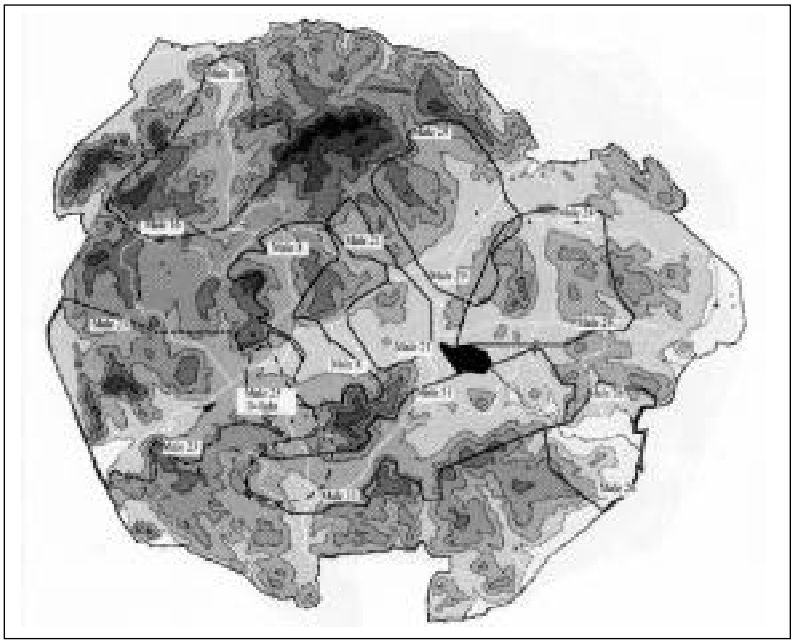


*Figure 3. Ranges of older adult males of> 15 years around 1991 (solid lines). Old males 26,24 and 8 have since died. The young adult M23's core area is shown and the range of M25 who was killed in a fight. M16 was an old sub-adult at this time.*

in other black rhino populations (Kiwia**,** 1989; Morgan Davies, 1995; Hitchins, 1983).

Sub-adult females range more widely than adult black rhino (Figure 2) (Hansen and Lindemann, 1990). Once they approach adulthood, they appear to settle down in a smaller, more defined area to have their first calf. The range sizes of these young adult females are similar **to** those of older females.

Adult males greater than 15 years of age have little range overlap (Figure 3), indicating that black rhino in Pilanesberg behave territorially:

- only one mature male occupies a given range.
- males demarcate their "territories" by urinating and scraping on dung piles.
- fighting is the major cause of death among male rhino (Adcock, 1995; Brett, in press), including those in Pilanesberg.

The male ranges seem **to** be keyed **to** permanent water supplies, and it is probably because of the water distribution that only part of Pilanesberg is occupied by adult male black rhino.

Sub-adult and young adult male ranges overlap those of mature bulls. These young males - a**t** least until age eight and often longer - are generally tolerated by the mature bulls. The sub-adult male ranges ac often similar to their mothers.

## Male social behaviour

Male black rhino seem to mature socially later than females. In Pilanesberg female calves become independent of their mothers at a younger age than males (averages equal two years one month [four females] versus three years [seven males]). The average for both sexes is two years nine months). Sub-adult males are frequently seen with their mother beyond three years old, while young females wander more, and associate temporarily with other mature females, but only occasionally their own mother (Hansen and Lindemann 1990).

Based on sightings of five males, from eight to ten years old and onwards, the males wandered farther afield than before - their ranges still overlapping each other and those of old bulls. It is suppose that by this age such bulls have still not established a home range or a territory. Some of these bulls had not fully settled even at 14 to 15 years of age. Figure 4 gives the ranges up **t**o 1996 of the young adult male black rhino.

The tolerance that established bulls can show for sub adult and young adult males and the frequent lack of

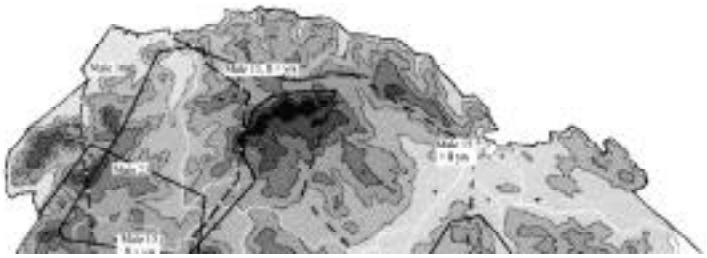


*Figure 4. Ranges of young adult male black rhino in Pilanesberg up to 1996. These rhino started to wander further afield than usual in the few years up to 1996, especially male 15, 16 and 23, who's ranges previously did not overlap.*

knowledge on the ages of individual rhinos, could be why some workers have concluded that black rhino are non territorial (Hitchins and Anderson, 1983; Goddard, 1967; Schenkel and Schenkel-Hullinger, 1969). In Ngorongoro Klingel and Klingel (1966) and in Serengeti Frame (1980) found, however, that black rhino males were territorial in a similar way to white rhino (Owen-Smith, 1974).

## Surplus males

Although the sex structure of the whole Pilanesberg population was generally biased towards males until 1995, the number of mature males has remained almost constant at around eight or nine since the first introductions (Table 4). The total number of males has also stayed around 16. The experience from Pilanesberg. together with events in other, newer populations (Adcock, 1995; Brett, in press) suggest that there is a limit to the number of males an area can carry.

These findings have important implications for the translocation and conservation management of black rhino in smaller populations (<75 animals). Excess male black rhinos should ideally be removed to promote population performance in restricted areas. However, these surplus males cannot be easily placed in established populations for reasons mentioned above. Male-only sanctuaries could be setup, but this is expensive and wasteful, as funds and land for translocations to start new breeding populations of black rhino are at a premium. Few private landowners are prepared to pay for animals that are expensive to protect and that cannot be used for anything but tourism.

In 1990 the benefits of hunting surplus - preferably old or aging - male black rhino was put forward (Hansen and Lindemann, 1990). In this way, excess males could be removed to the benefit of black rhino population performance by generating income for the required intensive security and monitoring. Unfortunately, international issues have prevented this solution from being adopted so far. Still, surplus male rhino has become a critical issue inmost black rhino conservation areas in South Africa and elsewhere.


Photo Credit: Keryn Adcock

## MORTALITIES

Fifteen male and three female black rhino mortalities have been recorded in Pilanesberg. When possible dead rhino were aged according to the tooth wear classes by Hitchins (1978). The number of fighting incidents among the male deaths again suggests that social pressure is a significant factor.

From 1981 to 1995, the yearly mortality rate averaged 3.6%. However, during the first six years no mortalities where recorded, while over the last nine years, mortality averaged 6%. If the three young males introduced in 1989 are excluded from calculations, the rate averaged
5% from 1987.

## REPRODUCTION

### Age at first calving

In Pilanesberg, the average age at first calving was 7.5 years (range 6.8 -8.8 for the seven females). Ages at first calving (AFC's) of around 7 to 8 are found in populations performing satisfactorily (Adcock 1996). AFC's of less than 6 years has been recorded, but this is rather rare. Lindemann (1982) found females in captivity reach sexual maturity (ability to conceive) at 5.5 - *6.5* years but only produce their first calf at 8.3 years on average.

### Interval between calves (ICI)

The frequency distribution of observed intervals between calves is skewed (Figure 5). While the average observed inter-calving interval in Pilanesberg's black rhino is 34 months (Hansen and Lindemann 1995) or 2.8 years, the most likely ICI (mode) is 2.6 years (from 20 observations, range 2.1 years to 5.8 years). Pilanesberg's females have shown an average breeding performance, as southern African modes have been 2.3 *(D.b. bicornis)* to 2.7 *(D.b. minor)* years (Adcock 1998).

The ICI distributions indicate that some calves have died early or been aborted and therefore never having been detected. ICI is thought to decline with female age, however there has been no indication as yet that the older females (ranging from c. 15 to c.33 years old) in Pilanesberg had longer interval between calves than the younger females.

### Overall population performance

The population growth rate has averaged 5.77% per year (ie. the modelled Pilanesberg population growth

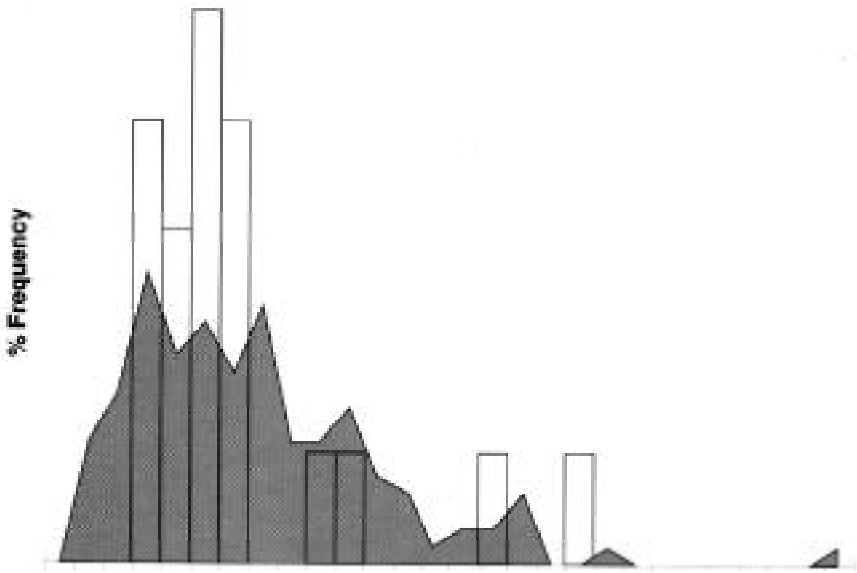
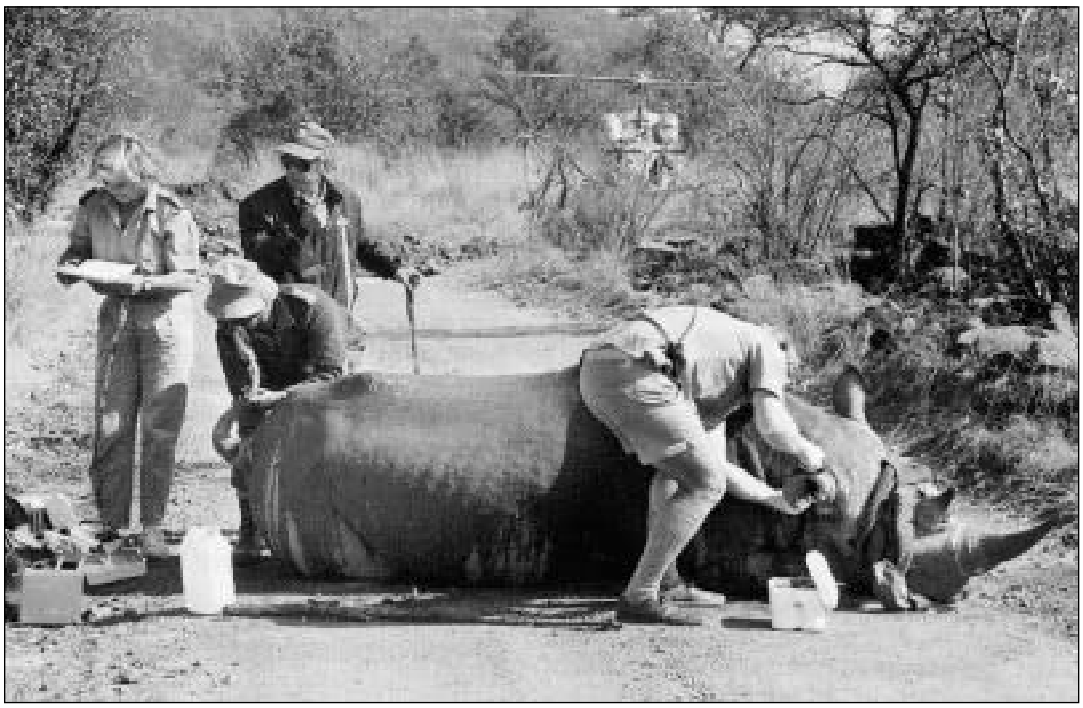



***Figure 5. Frequency distribution of inter-calving intervals from Pilanesberg (bars) versus those in other in the rest of South Africa and Namibia (shaded area) - from data submitted to the Rhino Management Group.***

Photo Credit: Keryn Adcock



rate from 1981 (seven rhino) to 1995 (42 rhino), accounting for introductions). Growth rates in other South African populations range from -8.9% to 11.3%.

While female breeding performance in Pilanesberg has been favourable, it is still below optimum population growth (>7% per year, ICI near to two years), probably due to the following factors:

- many male deaths through fighting (social pressure).
- longer average inter-calving intervals than can be achieved.
- loss of calves in late pregnancy or around the time of birth.

Additional factors that can affect the future population performance are:

- the skewed sex ratio of calves born (no female calves were born between 1989 and 1993).
- social pressure among males continues unless alleviated by further removals.
- slower calving rates of the six older females.
- deaths among the three remaining older bulls, and their replacement by younger bulls, may disrupt mating patterns and affect calving success.
- inbreeding.

## AGING RHINO

The near-annual photographic records and ear-notching immobilisations of Pilanesberg's black rhino have provided relative body size and horn growth pattern information, improved aging criteria and age-class definitions for this species (Adcock, 1997; Emslie *et al.,* 1993; Adcock, *et al.,* 1996). Specifically this demonstrated that black rhino are not fully grown (adult) until at least their seventh to eighth year. The basal diameter of the rear horn (reflecting skull dimensions) stabilises after this age. Body weight is known **to** affect fecundity, and young rhino would need to approach 80% of their adult body weight before successfully conceiving (Owen-Smith, 1988). That this commonly occurs when the females are about 6.2 years, giving average ages at first calving of 7.5 years, supports this.

## RHINO DENSITIES AND PILANESBERG'S ECOLOGICAL CARRYING CAPACITY

The density of the black rhino in Pilanesberg was 0.076/km$^2$ for the population level of 42 rhino reached in 1995. if only suitable black rhino habitat (ie. about 60% of the park) is considered, the maximum density was about 0.15/km$^2$ However local densities in some areas of the Park reach levels of over 0.22 rhino perkm$^2$. The overall density in Pilanesberg is nevertheless low compared to areas of similar rainfall, like 0.3/km$^2$ in Ndumu, 0.42/km$^2$ in Hluhluwe/Umfolozi, 0.2/km$^2$ in Itala and 0.22/km$^2$ in Mkuzi.

Pilanesberg's population is still below its ecological carrying capacity (ECC). However no formal survey of Pilanesberg for black rhino habitat use and impact has yet been made, and estimates of ECC have varied widely:

Knowledge on rhino ecology from Pilanesberg and other rhino areas in the region, indicate that Pilanesberg's ECC is influenced by the:

- generally poor nutrient status of the Park, based on the geology and derived soils.
- extent of steep, rocky and inaccessible terrain.
- influence of frost on browse quality.
- impact of other browsers.
- length of the dry season.

*Table 4. Reported rhino densities*

| Black rhino per km$^2$ | Number of rhino | Reference |
|---|---|---|
| 0.218 | 120 | Goodmari-Collinson arid Ferrar, 1989* |
| 0.109-0.145 | 60-80 | Patrickson, 1988* |
| 0.145-0.1818 | 80-100 | Thompson, 1986* |
| 0.105 | 58, but also thought to be >50, up to 100 | HilIman, 1982:1983. |
| 0.96 | 50 | Emslie arid Adcock, 1993 |

* internal Bop. Parks Board reports

Photo Credit: Keryn Adcock

## A DONOR POPULATION

Information gained from monitoring the black rhino of Pilanesberg National Park has contributed towards the understanding of many factors affecting black rhino populations in Africa Pilanesberg and North West Parks and Tourism Board also made a direct contribution to black rhino conservation by becoming a donor population in 1996, when nine black rhino were translocated to found a new population in the nearby Madikwe Game Reserve.

## ACKNOWLEDGEMENTS

We thank George Phiri for his dedication **to** the black rhino in Pilanesberg. The work of Dr Keffen in monitoring and darting the rhino is also greatly appreciated, as well as the ground-based work of game scouts and rangers and the never failing interest and assistance from Senior Warden Johnson Maoka. We are also grateful for the sponsorship and support from Endangered Wildlife Trust, Mazda Wildlife Fund and Stocks and Stocks Lodges.

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