
DARTING AND MARKING BLACK RHINOCEROS ON FOOT: PART OF A MONITORING AND POPULATION ESTIMATION TECHNIQUE IN HLUHLUWE-UMFOLOZI PARK, SOUTH AFRICA

Norman S. Galli and Jacques R.B. Flamand

Natal Parks Board, Hluhluwe Game Reserve, PO Box 25, Mtubatuba, 3935, South Africa

INTRODUCTION

It is well known that the number of black rhinos (*Diceros bicornis*) in Africa has declined in recent years and is now estimated at less than 2,550. Black rhinos are currently listed as "vulnerable" both globally and in South Africa (according to IUCN and South African Red Data books). At a meeting to discuss black rhinos in Zimbabwe in September 1985, the Africa Elephant and Rhino Specialist Group (AERSG) of IUCN agreed that all participating countries should draft a National Conservation Plan for the black rhino. The South African/Namibian plan sets out specific goals for black rhino conservation in the region and gives advice on necessary management and monitoring. This plan was adopted in 1989 by all the conservation departments in South Africa and Namibia which are responsible for looking after rhinos. The plan was designed to provide regional goals for the black rhino, as well as guidelines to facilitate their achievement. The primary goals of the plan are to develop, as rapidly as possible, and to conserve, in the long term, genetically viable populations of at least 2,000 *Diceros bicornis* minor and 2,000 *D. b. bicornis* in their natural habitats, and at least 100 *D. b. michaeli* in the wild in the region.

The Rhino Management Group (RMG) was formed in 1989 by all the relevant conservation departments to give support to the plan. The RMG debates the concerns raised by conservation agencies and private owner representatives, develops appropriate strategies, provides advice and co-ordinates certain activities to assist the various agencies in achieving their goals for black rhinos in the region. Annual status reports of all the black rhino populations in the region are submitted to the RMG for comparative data analysis. This analysis helps the reserve management authorities to make sound biological management decisions, which are seen against the regional meta-population goals set out in the plan. The provision of the revised population estimates is a key part of the annual status report.

Close monitoring of rhino numbers is essential to provide revised population estimates for the annual RMG report. According to Brooks (1989), the details

of each monitoring programme vary according to the characteristics of the area, the existing population of black rhinos in that area, available manpower and financial constraints. All monitoring programmes need to be strictly controlled, with the appropriate techniques applied, in order to ensure that they are effective in providing field managers with the information required.

As a follow-up to the work of Hitchins on black rhinos in the Zululand Game Reserves, the black rhino monitoring programme in Hluhluwe-Umfolozi Park (HUP) evolved from a concern, expressed by management and research staff, over population numbers. As a result, a monitoring programme was implemented at the end of 1988. Field managers were required to obtain reliable estimates of population size, age and sex structure, and performance of the black rhino population. The monitoring programme was essentially in two parts: 1) the collection of individual black rhino sighting: re-sighting data from the field, and 2) the analysis and interpretation of this data, including the estimation of population size using the "RHINO" Bayesian Mark-Recapture Analysis computer programme (Emslie, 1993). This approach allowed many field managers and game guards to be involved in the monitoring programme from its initial stages, and to develop a personal interest in it.

While "RHINO" can estimate the size of a clean (i.e. unmarked) population segment, confidence intervals around clean estimates are larger than around the estimates of the identifiable population segment estimate (Emslie, 1993; Adcock, 1994). Therefore, one way to increase the precision around the total population estimate is to reduce the proportion of the population that is clean by darting and ear-notching animals. In other words, the higher the proportion of the population that is clean, the higher the sample sizes required to obtain precise estimates (Emslie, 1993). Notching has other benefits which allow the reproductive performance of individual females to be monitored.

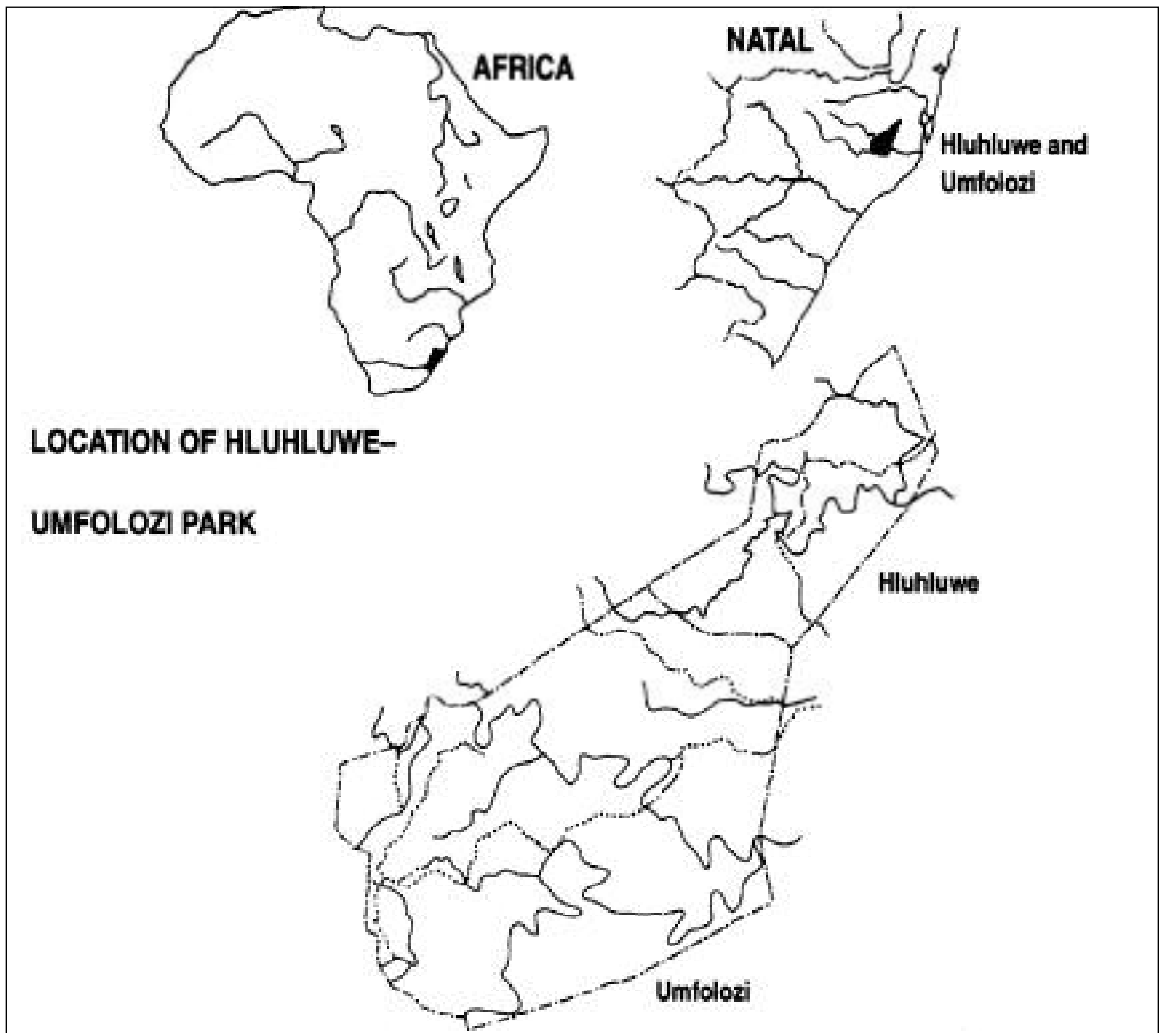
Provided that the number of sightings is adequate, and if there is a high proportion of clean animals in a population,

“RHINO” still produces unbiased estimates of population size (Adcock, 1994). However, the distribution of the means in surveys with a high proportion of clean animals has been found to be peaked with wide tails. This can affect the likely accuracy of any one single estimate by increasing the chance of getting an extremely high or low single estimate, although in the long term (provided sample sizes are big enough) the estimates will, on average, be unbiased (Adcock, 1994). The variance around clean estimates is higher than around identifiable animals (Emslie, 1993). More explicitly, the marking of clean animals increases both the likely accuracy of population estimates as well as the precision thereof (Emslie, 1993; Adcock, 1994).

Since its implementation, the black rhino monitoring programme in HUP has been carried out on a regular

basis with the support of occasional, intensive surveys. The first intensive survey was conducted in 1989 using a fixed-wing aircraft to locate the animals. A ground crew was then dispatched in a helicopter to the exact location of the animals, which were identified, categorised and recorded. Subsequent to the success of this operation it was decided that these surveys should be carried out every second year, depending on the availability of funds.

In 1991, an intensive survey was augmented with the darting and ear-notching of unmarked animals from a helicopter. Ear-notching was also introduced in other parks and reserves within the RMG region as part of the national plan (eg. Mkuzi and Itala Game Reserves, Pilanesberg National Park). The next survey in HUP was due to take place in 1993, but the budget of R25,000 (\$6,945) was insufficient to cover the costs of using a



Map of Hluhluwe-Umfolozi Park (HUP), showing its location in South Africa.

fixed-wing aeroplane and a helicopter. The average cost per rhino in 1991 was approximately R5,000 (1,390). Requests for additional funds in 1993 were unsuccessful and the field managers of the Umfolozi section of the HUP proposed that the entire intensive survey be carried out on foot, with the assistance of a suitably experienced wildlife veterinarian.

This paper now describes the ground darting technique used and evaluates the success of the technique in the context of the HUP black rhino monitoring programme.

MATERIALS AND METHODS

The Umfolozi section of HUP covers 46,000ha of Zululand thornveld (see map). In applying the ground darting technique, the administrative boundaries in the Umfolozi section of HUP were used. This entailed working in four different areas, spending three to five days per area and working in conjunction with the relative section ranger and his staff. There is a network of roads in three of the areas, which facilitated vehicle access. Roads were limited, however, in the fourth area, known as the Wilderness Area.

Locating the rhino

An initial appraisal of the distribution of black rhinos in each area was carried out by the section rangers. Data collected from the ongoing monitoring programme were used. Areas with the highest concentration of clean (i.e. unmarked) black rhinos were mapped and any females with calves that were old enough (i.e. two years or older) to dart were noted. These areas were used as starting points for game guard patrols. Patrols set out at dawn to locate any clean, black rhinos. Roving patrols on horse-back were also used to locate clean animals and where the terrain permitted, game guards were positioned on high points to survey areas with binoculars and spotting scopes. As soon as a clean animal was sighted, the section ranger was contacted by radio and the darting party was dispatched.

Materials

Four people usually made up the darting group: a section ranger, the veterinarian and two good trackers. They carried everything they needed in two backpacks. The contents of the packs included immobilising drugs: Etorphine hydrochloride (M99, C-Vet), Acepromazine maleate, Azaperone, antidotes Diprenorphine (M5050), Nalorphine and Naloxone

(Narcan), Doxpram (Dopram), a long-acting injectable penicillin (Compropen), an intramammary antibiotic (Streptopen LC), an antibiotic spray (Airbiotic), a number of 1ml, 3ml, 10ml and 20ml syringes, 20 and 18 gauge hypodermic needles, plastic 1.1 ml Kruger National Park darts with needles, notching equipment (V notcher, circular punch and hammer), and two artery forceps. A folding gun cleaning rod was also taken to remove darts from the barrel when a dart had to be changed. Also included in the packs was a camera with a 300mm lens, film to record new ear notches, at least five litres of water in various small plastic containers, two towels, a pair of pliers, and the spares for darts and gun. A powder charge dart gun (Palmer long-range projector, adapted to take Kruger National Park darts) was also carried. A cane knife and bow saw were in hand as were two mobile hand-held radios.

Darting the black rhino

Reaching the located animal with minimal delay was a priority, and radio contact was essential to achieve this. During the initial stage, vehicles, horses and foot were used to reach the area. The mode of transport depended on the type of terrain and its accessibility.

On arrival, the black rhino was carefully observed by the section ranger and the veterinarian before its suitability for darting was confirmed. The age, condition of the animal, natural ear notches or other distinguishing marks, were all factors taken into consideration. The time of day was also an important factor, and more specifically, a minimum of two hours of daylight to search for a darted animal was considered essential. Careful observation of the particular animal was also required to avoid confusion and to ensure that the right animal was followed after darting, especially if there was more than one animal present prior to darting. On confirmation that the animal was suitable for darting, the darts were prepared by the veterinarian. Game guards were carefully positioned at observation posts and the follow-up team was debriefed. A plan of action was important because as soon as an animal had been darted it often headed for thick vegetation. Before darting, wind direction was always noted. Darting was done from as close as possible to the black rhino, using available vegetation as cover. This distance ranged from 10m to approximately 25m. Animals lying in the shade or in pans were found to be the easiest to approach and to dart. The side of the neck or rump were the targets of choice for darting.



A blind-folded, immobilised black rhino in HUP.



Ear-notched black rhinos in HUP

Follow-up and notching

Once darted, the rhino would normally run off; it would be kept in sight by the game guards at their observation posts and by the follow-up team. Every effort was made not to frighten the animal during the follow-up period. The darted animal usually slowed down after an initial run. As soon as the rhino was immobilised, it was blind-folded by draping a towel over its eyes. This had a calming effect on the animal and protected its eyes from direct sunlight. Its vital signs were checked constantly and corrections made accordingly. Dart wounds were treated with the intramammary antibiotic to prevent infection and a long-acting antibiotic was injected intramuscularly. Ophthalmic ointment was put into each eye to prevent corneal desiccation and infection.

Notches were cut in each ear (V-notches, 3.5cm wide and 3.5cm deep) and the details recorded on a history sheet. The location was noted. Close-up photographs of ear notches were taken and these were later attached to the animal's history sheet. Section rangers are required to keep a file of each marked animal in their area, which includes initial drawings of ear notches, any other recognisable feature/s, age and sex, photographs and a record of all subsequent sightings of the animal. Sighting information is also transcribed onto a map to reflect home ranges.

Once all the materials were packed and personnel were safely positioned in trees or had left the scene, the antidote was administered intravenously. Photographs of the standing animal were also taken where possible.

As soon as it was safe to do so, the darting party would then leave to dart the next rhino. No more rhino were darted if it was late in the afternoon, with less than two hours of daylight remaining.

Post-operation follow-up

At the conclusion of the darting and notching programme in each area, a follow-up operation was initiated by the relevant section ranger. This involved an intensive two-week search by the section game guards. It was considered important to establish whether cows and calves had re-united. Darted animals which, for some reason, were not immobilised, were also checked.

RESULTS

Twenty-six black rhinos were darted and marked in 13 days. No injuries or deaths occurred. Most of the cows and calves had re-united by the following day and all within the two-week follow-up period. Three rhinos failed to be immobilised after darting and three darts missed their target.

The time from darting to release ranged from 30 minutes to a maximum of 120 minutes.

DISCUSSION

The reason for embarking on the 1993 ground darting exercise was to implement a cheaper method for marking a number of black rhinos. It was initially thought that one or two animals could be darted each day; in fact the figure was nearer four to six. Rather than being a better technique than that used routinely by the Natal Parks Board to capture rhinos, it is a useful alternative when funds are limited.

The method described unquestionably takes longer to implement than working from the air. From a helicopter, rhinos can be found, checked for markings, darted and followed up until immobilisation in a few minutes.

Not only did it take a long time to reach a rhino, but the odd rhino could not be found rapidly due to difficult follow-up conditions. (It is important to consider the time of year to undertake such an exercise, to facilitate optimum conditions for tracking.) After darting, almost all animals became frightened and tended to run up-wind and towards riverine areas. They were immediately followed on horseback and on foot, but even so, it was sometimes difficult to find a rhino once it was immobilised, due to it falling into a gully or retreating into thick bush or reed beds. The use of horses, where the habitat allowed, was an essential element for the successful follow-up of most of the animals. Horses made up, in part, for the lack of a helicopter to guide ground teams to a stray rhino. Experience indicates that about two horses are needed. Whilst still keeping the darted rhino in sight, one has to stay as far back as possible and to remain quiet, to avoid stressing the animal and to minimise the chance of it running even further away.

When a cow and calf were to be darted, the calf was darted first. This resulted in much less running (as little as 200m on one occasion) because if the cow was unaware of human presence, she did not charge off. Once the calf had gone down, the cow was reluctant to leave. Furthermore, once darted, the cow still tended to remain with her calf until the effects of the immobilising drug were felt.

Examining the costs per rhino, it is obvious that considerable savings can be made by using the slower, ground technique. A total of 26 black rhinoceros were darted and notched in the 1993 exercise described here. This compares favourably with the number of rhinos darted in the 1991 exercise when 36 animals were immobilised in eight days using a spotter aircraft and a helicopter. The final total cost for drugs and darts in 1991 was R4,290 (\$1,190), which includes the cost of missed and malfunctioning darts. This is less than the cost of darting and notching one animal in 1991 using the spotter aircraft and helicopter. The table below summarises the additional budget required to dart a rhino over and above the cost of horses, vehicles and staff (including a vet) which the National Parks Board has at its disposal. The true economic cost of notching rhinos is therefore greater than the figures given in the table.

Table. Average additional costs (helicopter/ fixed-wing aircraft/ drugs) required to dart a black rhino from a helicopter and on foot (excluding the costs of staff, horses and vehicles). Values in South African rands (R) and US dollars.

Year	Helicopter	On Foot
1991	R5,000 (\$1,390) Umfolozi Game Reserve	-
1993	R2,000 (555) Mkuzi Game Reserve	R165 (\$46)

*The 1991 costs for the Umfolozi section of HUP include the spotter aircraft and helicopter whereas the 1993 costs for Mkuzi Game Reserve reflect the use of a helicopter to dart animals already located.

Besides the considerable saving in overall costs, there are other advantages to darting on foot, as follows:

- The greater participation of staff at all levels, particularly the game guards, benefits the monitoring programme directly in that it involves them with an animal from the start, motivates them and helps them to realise the importance of collecting sighting data. In addition, their presence during the notching exercise helps them to familiarise themselves with the newly marked black rhino. They thus find it easier to record data and the field data become more meaningful to them.
- The programme offered game guards a much needed opportunity to change their routine from the monotony of law enforcement. It also familiarised them with areas they might otherwise not have visited on patrols.
- The game guards with limited tracking experience had a valuable opportunity to learn and practise such skills.
- Darting black rhinos on foot causes less disturbance to the remainder of the population, and indeed to other species, than a low-flying helicopter.

CONCLUSIONS

The method described here was used extensively in the past with success. Over the years it was replaced by the use of the helicopter, a more efficient tool. The transition was largely brought about by the demise of the black rhinoceros in general, and by the international attention which the animal received as

a vulnerable species. Funding for using the more efficient helicopter to monitor black rhino populations had been forthcoming up to 1992.

It is well known that the black rhino is still at risk. However, one must realise that in the current economic and political transition that South Africa is experiencing, managers in southern African game reserves where black rhino still occur must face the realities of financial constraints. All managers are, and will be faced with the risk of, losing black rhinos. The cost of continued monitoring programmes and increased law enforcement needs will escalate. The monitoring programmes already in place are considered essential to the ultimate protection of this species. Darting and marking on foot is an important way of ensuring the continuity of Umfolozi's biennial intensive survey of black rhinos.

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