BOMA MANAGEMENT OF BLACK AND WHITE RHINOCEROS AT MOMBO, OKAVANGO DELTA – SOME LESSONS

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Abstract
The initial period of a rhino reintroduction programme in Moremi Game Reserve is documented. Notes on the design and construction of rhino holding pens or bomas are presented and the boma management of 20 White Rhinoceros *Ceratotherium simum* and 4 Black Rhinoceros *Diceros bicornis* over a period of two years discussed.

Introduction
Both Black Rhinoceros *Diceros bicornis* and White Rhinoceros *Ceratotherium simum* were historically found in Botswana. While the black rhino was never common, and was probably confined to the Kwando and Chobe areas, the white rhino was more widespread and occurred across northern Botswana (Joubert, 1996). In the 'colonial period', especially the late 19th and early 20th centuries, unrestricted trophy hunting led to the near-extinction of the white rhino, and its probable extinction in Botswana by the 1890's (Emslie & Brooks, 1999).

Following the independence of Botswana in 1966, white rhino were limited to occasional individuals originating in Hwange National Park in the then Rhodesia and wandering across the border (Smithers, 1968). Black rhino numbers were estimated as less than 20 individuals in the Chobe National Park and Selinda area with occasional immigrants from Hwange (Smithers, 1968). An ambitious reintroduction project was then begun and between 1967 and 1981 a total of 94 white rhinos were introduced from South Africa in a joint project between the Botswana Government and the Natal Parks Board (Emslie & Brooks, 1999). All of these rhino were 'free-released' and were not kept in bomas prior to release. The majority was released into the Chobe National Park in north eastern Botswana, with some also being released into the Moremi Game Reserve which encompasses the western half of the Okavango Delta (Myers *et al*, 2004).

By 1984 the white rhino population had reached 190, but in 1992 numbers had crashed as a result of poaching and only 27 animals were thought to survive (Emslie & Brooks, 1999). Black rhino numbers were even lower and had experienced a reduction from 30 in 1980 to only 5 in 1992 (Emslie & Brooks, 1999). The Botswana Defence Force was given a tough mandate to end commercial poaching, and the remaining white rhinos were captured and translocated to small, secure sanctuaries elsewhere in Botswana (Mokolodi Nature Reserve, near Gaborone, and the Khama II Rhino Sanctuary, near Serowe) (Emslie & Brooks, 1999).

The effective protection of these translocated rhinos, combined with further small scale reintroductions from South Africa, ensured that their numbers increased and in 1999 the management plan submitted by Okavango Wilderness Safaris (OWS) in the tender process for the Mombo concession included a formal proposal to undertake the reintroduction of rhinos into the area. The immediate aim of the rhino reintroduction project was to return the white rhino to the Okavango Delta. The overall objective was to re-establish breeding herds of both white and black rhinos in the wild in the Okavango Delta, and in time, in other locations across northern Botswana. Ultimately the goal, in keeping with Botswana's National Rhino Management Strategy, was to make Botswana a significant range state for both species. Benefits from the reintroduction would include increased tourism potential as well as the inclusion of two important mega herbivores in a consequently more complete ecosystem.

In 1994 Chief's Island in the Moremi Game Reserve had been identified by the DWNP as an ideal release site for any potential rhino reintroduction. OWS's proposal to use Mombo, at the northern tip of Chief's Island, as the release site was therefore regarded favourably by the DWNP and Botswana government as it represented good black and white rhino habitat, had a known history of rhino in the area and was a remote location in the heart of the Okavango Delta beyond the reach of poachers. By the end of 2001, the first white rhino had been translocated to Mombo. Prior to their release, the rhino were kept temporarily in a custom-built boma (stockade) facility on the concession. Although common practice in southern Africa today (see: Rogers, 1993b), this release technique differed from the earlier rhino releases in northern Botswana. This article will look at the experience of boma management of both white and black rhinos at Mombo, a total of 20 and 4 individuals of each species respectively. Much was based on what is already known (see: Rogers, 1993a; 1993b; 1993c; 1993d; 1993e) but our experience and the lessons learnt from observing these rhinos during their stay in the bomas are recounted here.

Boma Design and Construction

To ensure minimal disturbance from human activity and game drives, a remote location was chosen as the boma site. An important consideration was the proximity of permanent water that could be pumped to the bomas. A flat open area was chosen in the far north of the Mombo concession, to the south of Lechwe Haven. Using a submersible pump, water was pumped from a permanent channel approximately 300m away.

Six individual holding pens, or bomas, were built, in two rows of three (Figure 1). As rhino liver necrosis failure may be caused by exposure to creosote (Miller, 1994), the bomas were built from untreated gum poles, using a sectional approach whereby regular support poles were sunk into concrete. These vertical poles then supported a framework of horizontal poles that in turn supported further vertical poles dug deeply into the ground, but not cemented. The poles were close set but with space in between each one (see: Figures 2 & 3). Each boma was 8m^2. Shade was provided by a raised roof of corrugated iron which covered approximately 1/3 of the boma area (shaded area in Figure 1). Each boma was provided with a concrete drinking trough. Sliding gates (double-headed arrows in Figure 1) provided by On-Track Engineering were a novel and very practical addition to the usual boma design. They enabled bomas to be opened and closed much more quickly than by using conventional log gates. This is crucial when moving rhinos between bomas or when releasing them, as they can charge at any moving object, and the faster a gate can be opened or closed, the less of a target it presents to the rhino, and the less stress is caused to the animal. The internal gates allowed us to rotate rhinos from boma to boma, for cleaning, feeding, or veterinary purposes. We always held one vacant boma in reserve. Adjacent to the bomas, a viewing platform was built which allowed rhino project staff to observe the rhinos during the day. Staff stayed on site overnight so as to be on hand for any potential emergency. Some design modifications were made to the original bomas as both we and the rhinos learnt about this aspect of the reintroduction.

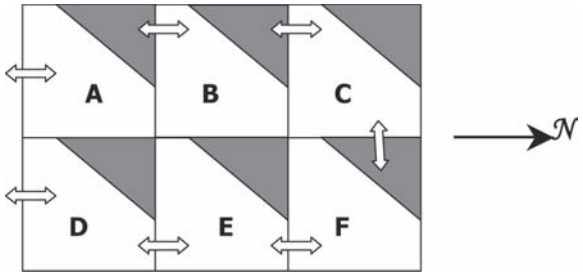

Figure 1: Mombo boma plan

Rhinos are immensely strong animals and one white rhino bull succeeded in knocking down a section of boma fence and escaping. The walls were thereafter reinforced with extra horizontal poles, linking the vertical poles in a more secure fashion to the vertical supports. Additional external diagonal bracing was also installed. The strength of the fence is more important than its height and a height of 2.5m is probably sufficient, since rhinos cannot jump. However, if there are horizontal bars on the inside of the bomas, rhinos can use these to climb and then bring their weight to bear from above on the fences. These reinforcing bars should therefore be on the outside of the fences.

Shade was a persistent problem, as the bomas were built in the open (to facilitate delivery of the rhinos, and later observation) and the corrugated iron roofs were found to be too small to provide sufficient shade at all times of the day. We were able to combat this to some extent by spraying the rhinos regularly with a hose, an activity they seemed to enjoy.

Although the configuration of the gates allowed us a degree of rotation within the bomas, a further internal gate between bomas A and D would have provided a great deal more flexibility. External gates at bomas C and F would also have allowed us more latitude as to the order in which rhinos boma'd together were ultimately released.

Delivery of Rhinos

All rhinos arrived at Mombo by truck, in specially designed rhino crates. Some had only been driven from Maun, others from Serowe or even South Africa. Other South African rhino were also air-freighted as part of their journey to Maun. The minimum journey for any rhino between Maun and Mombo was a 12-15 hour road trip. Rhinos typically spent up to 24 hours in their crates. Prior to this of course they had been chemically captured and further drugs were used to enable safe and stress free transport of the animals.

A mobile crane was used to offload rhino crates from the trucks and the crates then positioned so that its gate was almost adjacent to one of the external boma gates. The open crate doors then formed a short passage through which the rhino was guided into the boma. As they were offloaded each rhino was guided to the farthest vacant boma and the gate to this boma closed before repeating the process until five of the six bomas were occupied. An alternative method was to lower the crate into a closed boma, and open the crate doors allowing the rhino to exit into the boma. This was a more complicated manoeuvre and, due to the risk to both personnel and rhino, was used only when necessary.

Placement of the rhinos in the series of bomas required consideration. For obvious reasons, large rhino bulls were housed singly and with a boma between them and any other bull in every direction – in other words in bomas A and F, or in bomas D and C. Placing large bull rhinos in adjacent bomas would run a very high risk of them damaging the internal boma walls in an attempt to reach each other. This

could also result in injuries to the rhinos. In the event that one was able to break into another's boma, a fight in such a confined space could easily be fatal.

No mother/calf pairs were transported, but in several instances we had rhinos that were acquainted with each other – usually because they were from the same park or reserve –and in these cases we often boma'd two or three rhinos together, using two or even three bomas together to house the group, with the internal gates between these bomas left open. Younger rhinos in particular seemed to be more relaxed, and less prone to distress vocalisations and to testing the fence, when they were boma'd in a group, or with an older rhino. This was particularly the case with newly independent rhinos (aged 3-4 years) that would only recently have separated from their mothers.

As a result of veterinary regulations, which require a one-month quarantine period and regular blood tests before wild animals can be moved between countries, all except one rhino (Serondela) which were kept in the Mombo bomas had previous boma experience of at least a month at some stage of their lives (both those rhino transported from South Africa for this project and also those from Mokolodi who had originally come from South Africa a few years previously). Veterinary considerations also influenced the source of our rhinos. Rhino from South Africa's Kruger National Park or Hluhluwe-Imfolozi Parks were not considered due to the risk of Bovine Tuberculosis, to which rhino are known to be susceptible (Miller, 1994), potentially infecting the Buffalo *Syncerus caffer* of the Okavango which are currently free of the disease. Consideration was also given to the potential of rhino to carry Foot and Mouth disease. In addition the first white rhino (translocated to Mombo in October 2001) were vaccinated against one possible local risk: Trypanasomiases (nagana or sleeping sickness) as they had not been previously exposed to it and stress from translocation has been implicated in the development of this disease (Meltzer, 1994). Subsequent aerial insecticide spraying effectively removed the Tsetse Fly *Glossina morsitans*, the insect vector for this disease, from the Okavango Delta, and Trypanasomiases was not considered a threat to later rhino reintroductions.

Boma Experience – White Rhino

The purpose of keeping the rhinos in the bomas was of course to assist in their acclimatisation to the Mombo area. Although Chief's Island is good white rhino habitat, this was regarded as a necessary procedure to reduce stress and assist in rapid establishment of the rhinos in the area post-release. Additionally, the capture drugs would continue to cycle through the rhinos' systems for some days after the initial darting, and in an area with high predator concentrations, especially Lion *Panthera leo* and Spotted hyaena *Crocuta crocuta*, and many bodies of water, it was prudent to boma the rhinos for some time prior to their release into the wild. Current thinking in conservation circles is divided over the advantages of initial boma periods prior to release, sometimes known as 'soft release', as opposed to free-release without any boma period.

The first four white rhinos held in the Mombo bomas comprised two adult bulls, an adult cow, and a subadult female. This represented the rhinos that were immediately available, rather than an ideal sex and age ratio, and all four came from sanctuaries in southern Botswana, and had spent four weeks at a boma facility in Serowe (central Botswana) before finally being moved to Mombo. At Serowe, a combination of the novelty of the experience of confinement, and the age and (in some places) relative weakness of the boma structures, prompted repeated assaults on the boma walls by all three adult rhinos, with the adult cow and the smaller of the two adult males being the most persistent in their attempts to escape. We had to make frequent repairs to the bomas, with the rhinos testing the fences at night, and exploiting any weakness that they found. In particular, they became adept at sliding poles along wires, and forcing apart elements of the fence where they could insert their anterior horns in a gap and use them as a lever.

One male rhino ('Sergeant') did succeed in knocking over an entire section of boma fence and escaping into the rhino sanctuary where he was recaptured and returned to the repaired and reinforced boma. Only one rhino escaped from the Mombo bomas, a wild caught bull from Chobe National Park ('Serondela'), known to have originated in Zimbabwe and not to have been confined to a boma before.

These initial rhinos were less aggressive while in the Mombo bomas, perhaps because they were now more accustomed to being in a boma, and also because the new Mombo bomas stood up well to their early, exploratory pushing and shoving attempts. The two female rhinos, which were familiar with each other from Mokolodi Nature Reserve, were boma'd together, and this had a calming influence on the younger of the two, 'Kabelo'. The two adult males were kept at opposite ends of the boma complex.

Figure 2: The excitement of boma life!

Figure 3: Initial rhino releases, November 2001

The rhinos soon ate and trampled flat all the grass growing inside the bomas and were provided with two types of cut grass: lucerne *Medicago sativa* and teff *Eragrostis tef*. The rhinos showed a marked preference for the greener and more palatable lucerne, but a diet comprised exclusively of lucerne can result in the rhinos developing diarrhea and other intestinal complaints, and lucerne was mixed with teff in an effort to regulate the diet. Some early noticeable effects thought to result from excess lucerne consumption, such as bloating and lethargy, were all remedied by increasing the ratio of teff to lucerne and the majority of the food given was teff.

Feeding took place in the morning and evening, with the larger quantity of feed being given in late afternoon to last through the night. Quantities given to each rhino were initially estimated, and then adjusted to the amounts actually consumed. Large bull rhinos were fed approximately $1^{1}/_{2}$ bales per day, and the two females boma'd together were fed up to 2 bales per day. These quantities were adjusted up or down on a daily basis, depending on how much the rhinos had actually eaten. Approximately 1/3 of the food was given at dawn and 2/3 in the late afternoon. One ongoing problem we were unable to solve was that of sand ingestion caused by the rhinos eating feed placed directly on the ground. No temporary solution suggested itself; in the longer term, some sort of low feeding platform might prove suitable.

For much of the day, the rhino rested in the shade provided by the metal roofs although, as mentioned above, this was frequently insufficient. Water troughs were refilled regularly throughout the day as needed. Due the effects of evaporation it was impossible to estimate what each individual rhino's water intake was. It has been estimated that an adult rhino can drink up to 40–50l of water per day, although they can go without for two or three days if it is not available locally, and they have to travel to find it (Rogers, 1993c). Each boma was cleaned at least every second day and we were careful to remove any wet or damp earth as such conditions can be conducive to the development foot rot. For the purposes of cleaning, the rhino were rotated between bomas by a combination of tricks which ranged from placing fresh food in an adjacent boma, to waving a white cloth through the boma fence to attract the rhinos' attention.

Accumulated uneaten food was removed, and most dung. Some dung was left however to make the rhinos feel more established, and to encourage the formation of middens by the rhinos, which is indeed what happened. Very special care was taken to prevent any foreign objects getting inside the bomas, in particular the orange twine and thin wire used to bale the food. Either of these, if ingested, could kill a rhino by knotting or piercing its intestines. All lucerne and teff bales fed to the rhinos were broken open to make smaller pieces (more palatable for the rhinos) and to check for any mould which can cause severe health problems if ingested. A quantity of the supplied feed had to be discarded for this reason.

Boma Experience – Black Rhino

The care of black rhinos in a boma situation is very different to white rhino. The changes in approach are necessitated primarily by the differences in diet and temperament.

Although far fewer black rhino have been handled in the Mombo bomas, several lessons were learnt that will benefit planned future reintroduction efforts. All four animals (2 males, 2 females) were released in November 2003 and are currently the only free ranging members of their species in Botswana. All are members of the historically occurring subspecies, *D. b. minor*, and were obtained from Marakele National Park in South Africa. Again this was perhaps not an ideal sex ratio, but it was felt that the most important factor was the symbolic value of restoring some black rhino to the wild in Botswana.

The same boma facility was used for the black rhinos as for the white. For various reasons no modifications were made, but ideally we would have fitted some sort of screen along the boma walls so that the black rhinos could not see each other (although of course they would still smell and hear each other). Rubber conveyor belting would have been perfect for this, as it would have provided a degree of cushioning as well as screening. Even without this however, the black rhinos did not attempt to break the fences to escape or to reach each other. All four rhinos were kept separately, with the bulls at opposite ends of the boma facility.

As has been experienced elsewhere, the black rhinos were generally much more relaxed in a captive situation than the white rhinos. We were even able to scratch them behind the ears through the boma fence and hand feed them, although as a rule we minimised human contact as we wanted to release them as fully wild rhinos, not partially habituated ones who might seek out human company around safari lodges. Interestingly, many of the rhinos seemed to be able to differentiate between voices – they would approach the fence eagerly if they heard any of

the staff involved in feeding approaching, but were more nervous with 'strangers'. The subadult cow in particular was very playful, and her agility was an education to anyone who thought of rhinos as ponderous. All the black rhinos enjoyed being sprayed with cool water.

In contrast to the fairly simple feeding regime employed with the white rhino, feeding black rhino can be a laborious and time-consuming exercise. Black rhinos require fresh browse twice a day. All browse was collected locally and, as we could not replicate the Marakele diet, this was at first done on an experimental basis. Branches were cut from almost every species of tree and shrub growing in the immediate area, and the response of the rhinos observed.

It was extremely interesting to see which species the black rhinos preferred. All four animals were very selective as to which species, and even which branch, they would eat, but once an acceptable branch was found, leaves, twigs and thorns alike were all consumed leaving the characteristic 45° angled bite mark on branches up to 10mm in diameter. They immediately began eating Magic Guarri *Euclea divinorum* and also ate branches from scrub Jackal-berry *Diospyros mespiliformis* and Large Fever-Berry *Croton megalobotrys*. Much Acacia, such as *Acacia hebeclada, A. nigrescens,* and *A. erioloba,* that was presented did not appear to be attractive to the rhino although branches of Umbrella Thorn *A. tortilis* were taken. Some Buffalo Thorn *Ziziphus mucronata* was also eaten. Perhaps the most favoured species was Bluebush *Diospyros lycioides*, an abundant plant on many of the islands in the Okavango.

To simulate natural conditions as closely as possible, branches were suspended from the fences and hung at 1.0-1.5m above ground inside the bomas. The fresh browse was supplemented with broken open bales of lucerne to provide bulk, and also approximately 5kg per animal per day of 'game cubes' (feed for game animals comprised mainly of maize and enriched with vitamins and minerals). It was not found necessary to provide salt licks, and water troughs were kept full at all times. Each morning, any browse remaining from the previous day was removed, as wilted browse can cause prussic acid poisoning (Rogers, 1993e). Dung was also removed daily, meaning of course that we had to move each rhino from its boma each day. This proved to be very difficult and the black rhino were much more reluctant to leave their 'home' bomas than the white rhino, much persuasion and enticement being necessary to achieve this.

Release

Whilst in the bomas, both black and white rhinos were again immoblised so that vital pre-release work could be carried out on them. The most important task was to fit each animal with a radio transmitter - sealed into a cavity drilled into the horn. Placing the radio transmitters inside the horns is a much better approach with rhinos than using radio collars. The physique of a rhino – particularly a white rhino with the nuchal hump of muscle in the neck – means that it is very difficult to design a collar that will remain in place. Rhinos also habitually wallow in mud and then rub vigorously against trees and termite mounds, often wearing through the collar. We experimented with several different designs of radio collar at Mombo, both heavy-duty and lightweight, and all either slipped and began to cause abrasions or were shed entirely by the rhinos within months. One possible disadvantage of placing a transmitter in the horn is that it might create a weak point, a line along which the horn may fracture. Subsequently a significant number of the released rhinos have broken their anterior horns at a point approximating to where we inserted the transmitters. We have not had the opportunity to examine any of these rhinos at close range, but it seems likely that at least one of the reasons for these breakages is as a result of the transmitter installation. This disadvantage is probably outweighed by the fact that should a rhino be poached, the poachers could potentially be tracked using the transmitter in the horn that they had taken.

At the same time that the transmitters were fitted, tiny microchips (which can be read by a handheld barcode reader) were injected into each horn and into the neck; this would allow any horns recovered from poachers, and any rhino carcass located (however mutilated by poachers or naturally decomposed) to be identified. Blood samples were taken for DNA analysis and to establish 'blood books' for Botswana's wild rhino herd and finally, ear notches were cut. Ear notches are probably the easiest way to identify a rhino (in combination with sex, size, and horn shape and size). By cutting a unique pattern of triangular notches into the ears of each rhino, we made it possible for them to be relatively easily differentiated in the field from quite a distance. Being able to positively identify a rhino is crucial to the monitoring effort: it allows us to say with certainty where and when any given rhino was last seen, and also assists in future management work (e.g. if female rhinos of a certain age were required to be moved to a different area). Many of the rhino are currently of a similar age and size, and so the ear notches are the only sure way to identify a rhino. At least 95% of all rhinos seen in the bush by monitoring teams and professional guides are positively identified in this way. We adhered to a strict numbering system when cutting the ear notches, and have kept to this system for subsequently released rhinos.

The initial four white rhinos were kept in the Mombo bomas for almost three weeks. This is slightly longer than was planned and was due to the timing of the release ceremony in the presence of the Vice President of Botswana, Lt Gen Ian Khama, other Botswana dignitaries and international tourists. The release of the two cows on 9 November 2001 was a fantastic occasion for all involved. Not only did it mark the historic return of a locally extinct species to one of Africa's most important conservation areas, but also a successful conclusion to almost two months of boma

care of these rhinos, and many more months of planning and preparatory work. The two bulls were subsequently released an hour apart the following morning to minimize the risk of them encountering each other.

In total a further 16 white rhinos passed through the Mombo bomas, all being successfully released without any significant setbacks such as injuries, diseases or deaths. The decision to release each rhino was made on a case by case basis. Typically rhino were held for between two and three weeks, with ten days regarded as the minimum period, and decisions on the release of specific animals were taken after assessing the condition and behaviour of each animal over the length of the boma period. This decision was taken by the project vet in consultation with the boma management team.

The black rhino were held in the bomas for between 14 and 16 days, and were released in the late afternoon and early evening, so that they would spend their first few hours in the Okavango under cover of the sheltering night. One bull was extremely reluctant to leave the bomas, and actually left and re-entered several times over a three-hour period, finally leaving only once it was fully dark. White rhinos generally were in a more of a hurry to leave the bomas, although at least two subsequently returned to and slept in the empty bomas.

As each rhino was darted again whilst in the bomas, it was necessary to wait a further 48 hours after the fitting of radio transmitters before the rhino could be released to allow for drug cycling and metabolic breakdown of introduced toxins. As chemical capture in boma situations typically involves much lower doses of drugs, the rhinos recovered commensurately faster than they did from the initial capture and transport experience.

The design of the bomas played an important part in the release of the rhinos, as clearly the rhino in boma A or boma D would have to be released before any of the animals behind it could be released. However, if for example the rhino in boma D could not be released for some reason, rhinos could be released in the order A, B, C, F, E, using only the external gate in boma A, and rotating them through the internal gates. Typically, female rhinos and subadults were released in small groups, whereas large males were released singly. White rhinos tended to stay for some weeks – and in a few cases, for many months, in the groups in which they were boma'd and released.

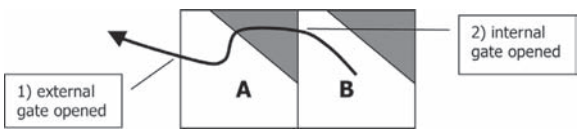

Figure 4: Release technique

Where possible, we made sure that the last gate to be opened was the one immediately in front of the rhino (Figure 4). Rather than suddenly confront the rhino with the outside world, we opened the external gate first and only then the gate(s) between the rhino and the boma with the external gate, so that it could make its own way stage by stage out of the bomas. Obviously this was not possible with rhinos kept only in bomas A and D. Where a group of rhinos was kept in, say, bomas D and E, they would be first confined to boma E prior to their release. The external gate in boma D could then be opened first, followed by the internal gate between bomas D and E.

Each time a gate was opened and more rhinos took their first steps into the Okavango Delta was an important conservation landmark for Botswana and a very moving and rewarding experience for everyone involved. Once the rhinos had been released into the wild, we could begin the process of monitoring and studying them.

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