CAPTURE AND TRANSLOCATION OF THE BLACK RHINOCEROS (*Diceros bicornis*) IN ZIMBABWE: MANAGEMENT MODIFICATIONS TO REDUCE STRESS AND MORTALITIES.

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INTRODUCTION

Sixty-five thousand black rhinoceroses (*Diceros bicornis)* inhabited Africa south of the Sahara desert in the early 1970s. Poaching and habitat loss has reduced this number to about 3000, a decline of over 90%. Zimbabwe's current population is estimated at 1500-2000 animals.

Poaching in Zimbabwe from neighboring Zambia has resulted in aggressive anti-poaching practices and translocation of rhinoceroses from the threatened Zambezi Valley to safer areas within the country and to ex-situ breeding programs. More than 300 animals have been translocated in Zimbabwe to private ranches, wildlife estate lands, and overseas since 1986 (Booth and Coetsee, 1989; Kock *et al.*, 1990c). Some have required recapture for investigation and treatment of medical problems, and for relocation after escape from translocation sites.

ADAPTIVE MANAGEMENT

Capture and translocation of black rhinoceroses in Zimbabwe has resulted in unacceptable mortality (13-20%) since 1986. Most deaths have occurred within 12 months of capture, often the result of trauma (horn loss, fighting, etc.) or existing disease conditions (Kock *et al.*, 1991b). Causes of death for some, however, have remained obscure (Kock *et al.*, 1989; 1991a). Examination of the effects of capture, boma confinement and translocation has begun to identify contributing factors in these unexplained mortalities (Kock *et al.*, 1990a). The black rhinoceros is apparently less sensitive to common capture complications occurring at or shortly after chemical immobilization, and more vulnerable to the effects of confinement and translocation afterwards (Kock *et al.*, 1990a). While manifestations of peracute and acute capture stress/myopathy are overtly minimal, physiological responses indicate otherwise. These changes suggest increased predisposition to the effects of further stress (Kock *et al.*, 1990a). Based upon these findings, an adaptive management approach has been adopted in Zimbabwe, attempting to reduce the culmulative stress effect and the high mortality rate associated with capture and translocation. Three compartments where significant improvements to management can be effected have been identified: capture, boma confinement, and translocation.

Capture:

Black rhinoceroses are safely immobilised with a combination of etorphine hydrochloride (M99, C-Vet Ltd., Bury St Edmunds, Suffolk, UK) combined with one of several sedatives or tranquillisers (Flamand *et al.*, 1984; Morkel, 1989; Kock *et al.*, 1990c). Most important in reducing stress initially is short, smooth induction of anaesthesia. High doses of M99 (4-5.5 mg) combined with azaperone (Stresnil, Janssen, Breese, Belgium) (225-250 mg) and hyaluronidase (6000 Units) (Hyalase, Fisons Pharmaceuticals (Pty) Ltd., Old Pretoria Rd, 1624 Chloorkop, South Africa) have allowed rapid induction of black rhinoceroses in Namibia (Morkel, 1989), a protocol that has since been adopted in Zimbabawe. Recent immobilisations in the Chete Safafri Area (Zimbabwe), using high doses of etorphine (4 mg) with xylazine (100 mg) and hyalase (4500 Units) have also been successful, reducing

induction times from 17 ± 2.5 minutes to 7 ± 1.2 minutes (Figure 1), with significant reductions in stress based upon physiological and haematological parameters (Figures 2, 3, 4, 5, 6, 7).

In Zimbabwe, over 300 anaesthetised rhinoceroses have been transported to holding bomas on sleds without obvious complications (Booth and Coetsee, 1998; Kock *et al.*, 1990c), although occasionally transport times have been in excess of three hours. If journeys are expected to exceed 2 hours, however, crating is preferable to sled transport. Crating has not been adopted in Zimbabwe due to logistical and material problems, but future capture operations aims include crating for long journeys.

The establishment of baseline biological parameters for the black rhinoceros in Zimbabwe (Kock *et al.*, 1990b) has enabled evaluation of the stress response for this species (Kock *et al.*, 1990a), as well as the detection of underlying medical problems. Stress indicators, including cortisol, glucose, and other haematological parameters can be measured accurately soon after capture, even in remote areas with the proper laboratory equipment.

Boma confinement and management:

Experience has shown it preferable for black rhinoceroses to be acclimatized in holding bomas prior to translocation. Movement of animals within a week of capture has contributed to mortality (Kock *et al.*, 1990a; 1990c; 1991a). Successful boma management encompasses several essential strategies, for it is during this period that the prognosis for long term survival is established (Kock *et al.*, 1990a).

Nutritional difficulties and trauma incurred during this period may severely compromise health. Trauma-induced horn loss in Zimbabwe has been a significant contributor to mortality. Of the 151 adult and weaned subadult rhinoceroses translocated to private ranches from 1988 to early 1989, 16% (24) lost rostral horns or suffered nasal injuries, and of these, 29% (7) died (Kock *et al.*, 1990a, 1990c). Redesigning of the holding bomas in 1990 was aimed at reducing horn loss in Zimbabwe. Basic design and construction materials were not changed, but a double line of 10 attached bomas were constructed in pairs, separated by 10-20 meters, with anesthesia/recovery bomas at one end of each line. In addition, the size was increased to at least $36m^2$ (previous size $24m^2$), with larger water troughs and the inclusion of a cube trough. Steel swing gates replaced the older wooden ones (Diagrams 1 and 2), and the walls measured at least 2m high, with all sides covered in thatching grass. An important addition was the building of an elevated catwalk along one side, to allow for easy observation, feeding, and veterinary intervention. Rhinoceroses have appeared to acclimatize better in the new bomas, become less agitated, and have been easier to move and re-introduce cow/calf combinations. Feeding from the catwalk has been easier and food intake, more easily monitored.

Specific adaptive management recommendations to reduce stress and trauma during boma confinement include:

Long Acting Neuroleptics (LAN): The use of LAN in animals is a relatively new concept (H. Ebedes and R. Burroughs, pers communication). In humans, LAN are used in the treatment of psychoses, being particularly useful in the treatment of chronic schizophrenia, reducing anxiety, hostility, decreasing motor activity, and moderating excitement (Ayd, 1978). LAN have significantly aided successful acclimatization of black rhinoceroses during boma confinement, reducing agitation, aggression, and trauma. Zuclopenthixol acetate (Clopixol-Acuphase, 50mg/ml, A/S Lundbeck, Copenhagen, Denmark) produces excellent tranquilization, without affecting appetite, during the critical first three days of boma confinement. Combinations of Clopixol-Acuphase and perphenazine enanthate (Trilafon, 100mg/ml, Sherag, Isando, Tvl, RSA) have been used in Zimbabwe and Namibia (Morkel, pers. communication) on aggressive animals. The two are used in combination because the effects overlap, giving good tranquilization for about a week. Clopixol-Acuphase begins to act within an hour, peaks at about 36 hours, and wears off at about 72 hours. Trilafon

begins to act at about 12 hours, and continues to act for about 7 days. It is recommended that all rhinoceroses be treated with Clopixol-Acuphase, and all adult bulls, with a combination of the two drugs. Any excitable adult females, subadults and calves can also be treated with the two drugs in combination. Recommended doses are given in Table 1.

Horn Tipping: The horns of recently captured black rhinoceroses are now "tipped" to reduce the possibilty of trauma induced horn loss, and prevent injury to other rhinoceroses, especially calves. This procedure has significantly reduced the risk of horn loss and subsequent complications during boma confinement. Approximately one third of the front and back horn are removed, prior to anesthetic reversal and the remaining horn rounded and smoothed into a blunt shape.

Nutrition: This is a crucial area of boma management and must be closely monitored. A variety of preferred fresh browse is offered to recently captured rhinoceroses, preferably prior to the animals entering the boma. Good quality lucerne or grass hay is introduced on the first day, with increases such that each animal has at least 15-25kg/day by the second week. A minimum of 40kg of fresh browse per animal must be offered, more so in the late afternoon. Specially formulated rhino cubes have been developed in Zimbabwe (Rumevite Wildlife Feeds, Southerton, Harare, Zimbabwe) and these are offered gradually to the rhinoceroses during the first week, with up to about 8-10kg being consumed/animal/day by the second week.

Due to the significantly higher risk of morbidity and mortality (Kock *et al.*, 1990a; 1990c) if rhinoceroses are translocated too soon, it is recommended that all rhinoceroses remain in boma confinement for at least three weeks. In Zimbabwe, biological data collected at capture is compared to baseline values (Kock *et al.*, 1990b), and any implied health problems are investigated. The development of a body scoring system has aided in health evaluation at capture and prior to translocation. At the time of capture, each rhinoceros is scored on body condition (1=emaciated, 2=poor, 3=fair, 4=good, 5=excellent). Animals that score 4-5 can be translocated after 3 weeks confinement. Those animals that score 3 are evaluated carefully, and the following blood parameters are objectively assessed (RBC $\geq 4 \times 10^6/\mu l$, Hb $\geq$ 14 g/dl, PCV $\geq$ 35%, and total protein $\geq$ 7 g/dl). It is recommended that if at least three of these parameters are not met and body condition maybe closer to 2 than 4, translocation should be delayed until improvement occurs. Rhinoceroses with body scores of 1-2 should not be translocated. Nutrition should be re-evaluated and medical treatment instituted if necessary. This system of a combined assessment (both subjective and objective) of the health status of boma confined black rhinoceroses, prior to translocation, will be evaluated further in 1991/1992.

TRANSLOCATION:

More than 300 black rhinoceroses have been translocated in Zimbabwe since 1986, 151 to private land and the remainder to wildlife estate land. A few of the early animals were free-released at their destinations, but most were placed in bomas prior to release. The practice of free-release is not recommended because the animals often immediately move a long distance away, making it impossible to monitor them in the new environment. In addition, medical problems due to transport may go unnoticed.

During acclimatization in the holding bomas, rhinoceroses should be gradually introduced to the crates that they will later be transported in. This is achieved by placing lucerne and cubes into the crates, and allowing the animals to move into and out of the crates of their own accord. Loading a rhinoceros into a crate prior to transport is best achieved with a small dose of etorphine (0.25-0.5mg for subadults and adults). A dose of Clopixol-Acuphase should be given to all rhinoceroses, either early on the day of transport or after crating (Table 1). Prior treatment with etorphine and/or Clopixol-Acuphase will prevent agitation in most animals, and ensure a tranquil state during transport.

Boma design at the translocation site should conform to the minimum standards given above. Attention to nutrition must be continued at the translocation site, preferably with initial maintenance on lucerne and cubes, gradually introducing local browse, especially if it differs from that in the capture area. Weaning the animals off the lucerne and cubes and onto the browse should be done over a 2 week period. Consumption should be about 30-40kg of browse per day at the time of release (2-3 weeks after transport). At this time the animals should score 4-5 on body condition.

All rhinoceroses in boma confinement at a single location should be released during the night and into early morning, at hourly intervals. Increasing the interval (days) between individual releases may augment territorial behavior and increase the likelihood of fighting. Introduction of other animals months to years later, especially bulls, often results in territorial battles in which the newly introduced animals may be killed.

CONCLUSIONS:

An adaptive management program in the capture and translocation of black rhinoceroses in Zimbabwe is still in the process of being implemented. Data collected so far indicates reductions in stress related to chemical immobilization, transport, and boma confinement. Significantly, trauma induced medical complications have been virtually eliminated during boma confinement with the use of LAN and other changes. Long term survival data will have to be collected carefully over the next few years to determine if there is an improvement in the overall mortality rate of 13%.

Recent experience suggests that unless a high standard is maintained at all levels of management, when implementing an adaptive management program, the program is unlikely to be successful. For example, failure to maintain these standards after translocation, whilst animals are in bomas prior to release, can negate any positive gains acheived at capture and during boma confinement, with the potential of a high mortality rate.

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Table 1: Recommended doses for Clopixol-Acuphase and Trilafon to aid in the taming and training of black rhinoceroses (*Diceros bicornis*) during boma confinement and for transport.

Age[a]	Weight Range (Kg)	Clopixol-Acuphase	Trilafon
Calf	100-350	0.67-1 mg/kg (200-250 mg)[b]	0.5-0.8 mg/kg (100-200 mg)
Subadult 300-500	300-500	0.67-1 mg/kg (250-300 mg)	0.6-0.8 mg/kg (200-300 mg)
Adult	500-1200	0.24-0.41 mg/kg (300-600 mg)	0.2-0.6 mg/kg (300-500 mg)

[a]All animals regardless of sex should receive Clopixol-Acuphase, adult females may or may not need Trilafon, males and calves/subadults should receive Trilafon.
[b]Total dose range

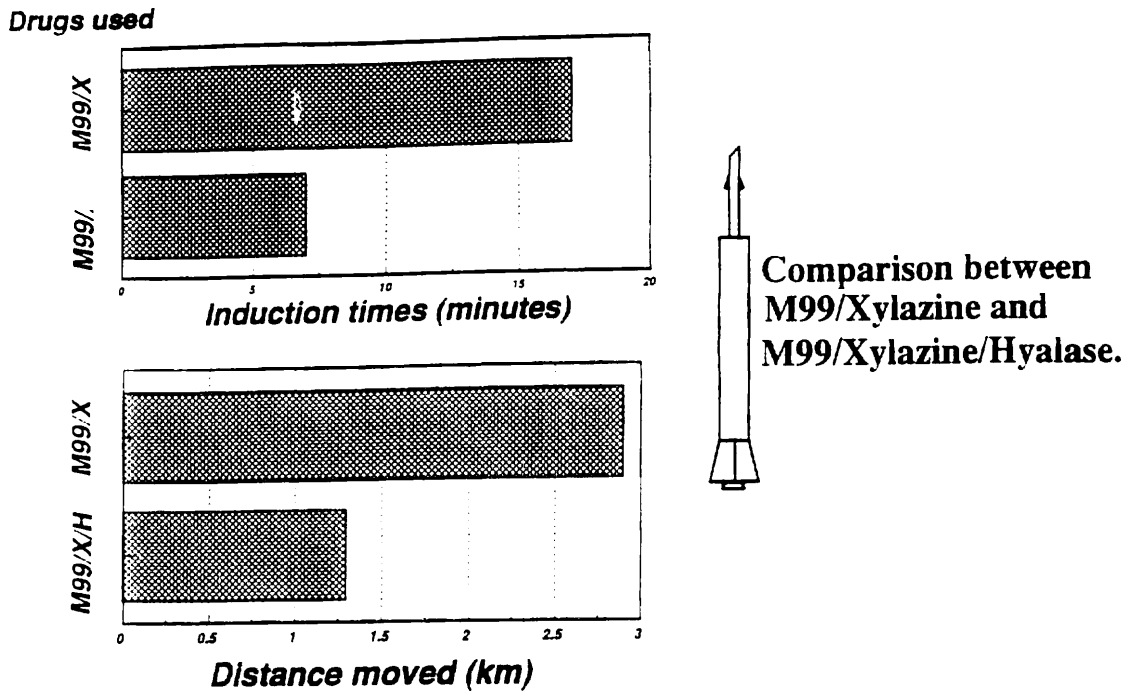

Figure 1: Comparison of induction times and distances moved following darting using M99 (3mg) and xylazine (100mg) or M99 (4mg), xylazine (100mg) and hyalase (4500U), in the chemical immobilization of the black rhinoceros (Diceros bicornis) in Zimbabwe.

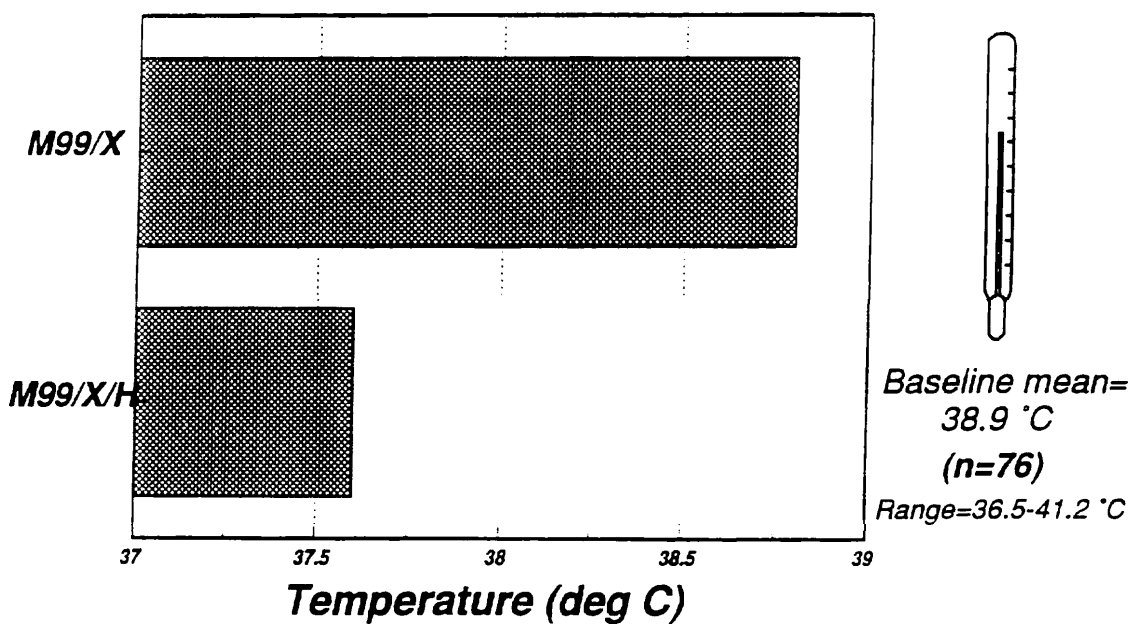

Figure 2: Comparison of temperatures measured after successful immobilization of black rhinoceroses (Diceros bicornis) with either M99 and xylazine or M99, xylazine and hyalase.

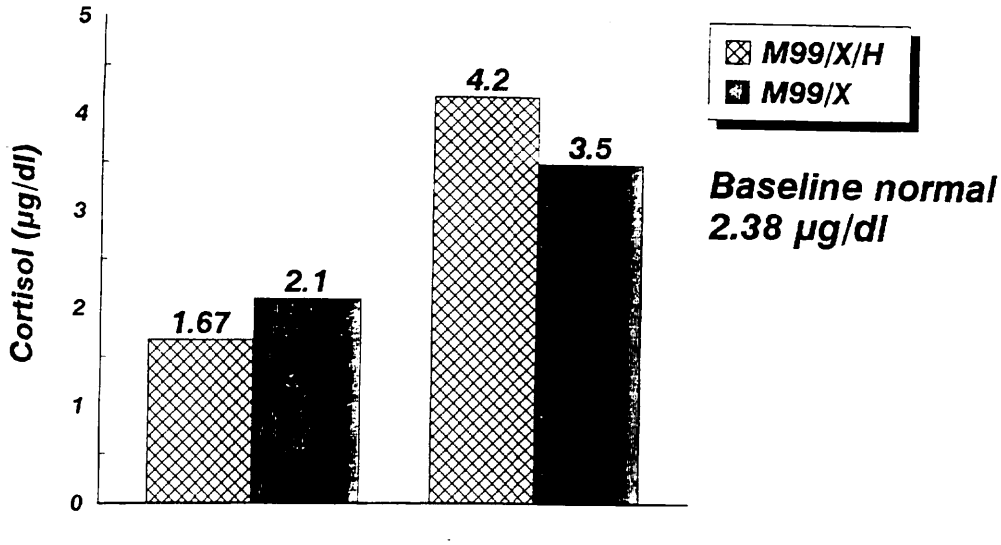

Figure 3: Comparison of cortisol (Ig/dl) levels measured from black rhinoceroses (Diceros bicornis) chemically immobilized with either M99 and xylazine or M99, xylazine and hyalase. The first bar group represents sampling soon after capture, the second bar group represents sampling after transport.

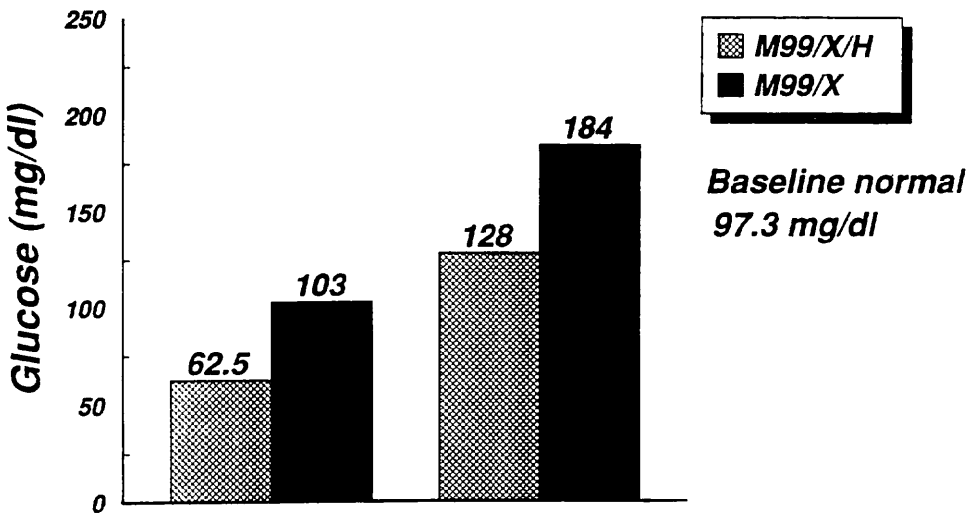

Figure 4: Comparison of glucose (mg/dl) levels measured from black rhinoceroses (Diceros bicornis) chemically immobilized with either M99 and xylazine or M99, xylazine and hyalase. The first bar group represents sampling soon after capture, the second bar group represents sampling after transport.

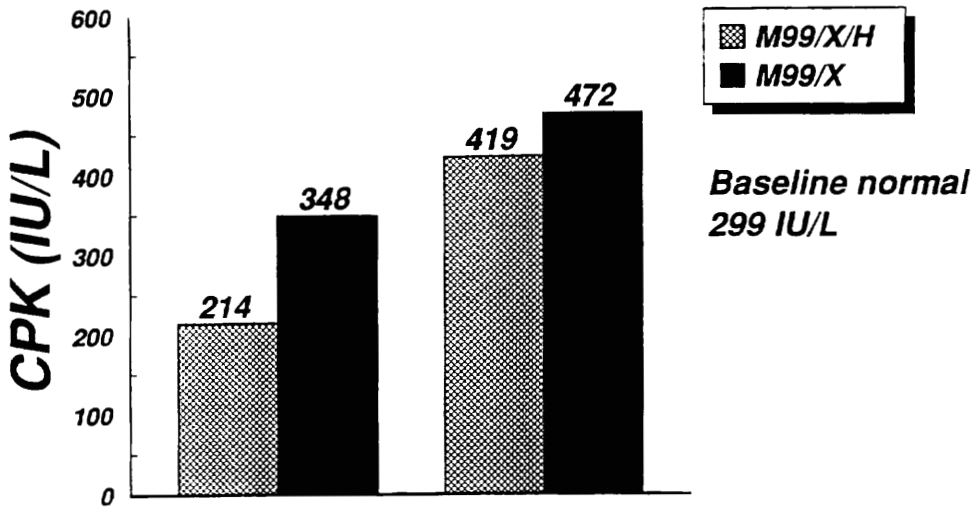

Figure 5: Comparison of creatine phosphokinase (CPK) (IU/L) levels measured from black rhinoceroses (Diceros bicornis) chemically immobilized with either M99 and xylazine or M99, xylazine and hyalase. The first bar group represents sampling soon after capture, the second bar group represents sampling after transport.

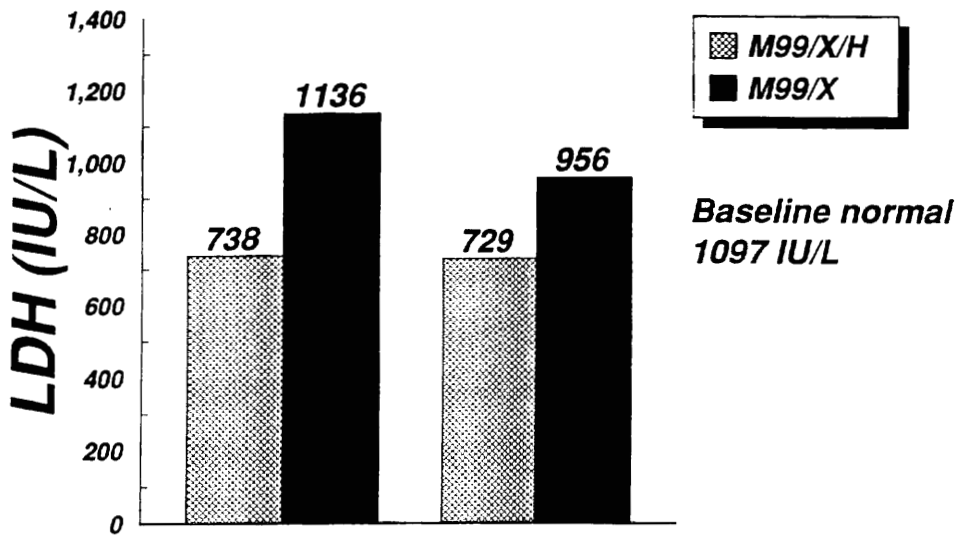

Figure 6: Comparison of lactic dehydrogenase (LDH) (IU/L) levels measured from black rhinoceroses (Diceros bicornis) chemically immobilized with either M99 and xylazine or M99, xylazine and hyalase. The first bar group represents sampling soon after capture, the second bar group represents sampling after transport.

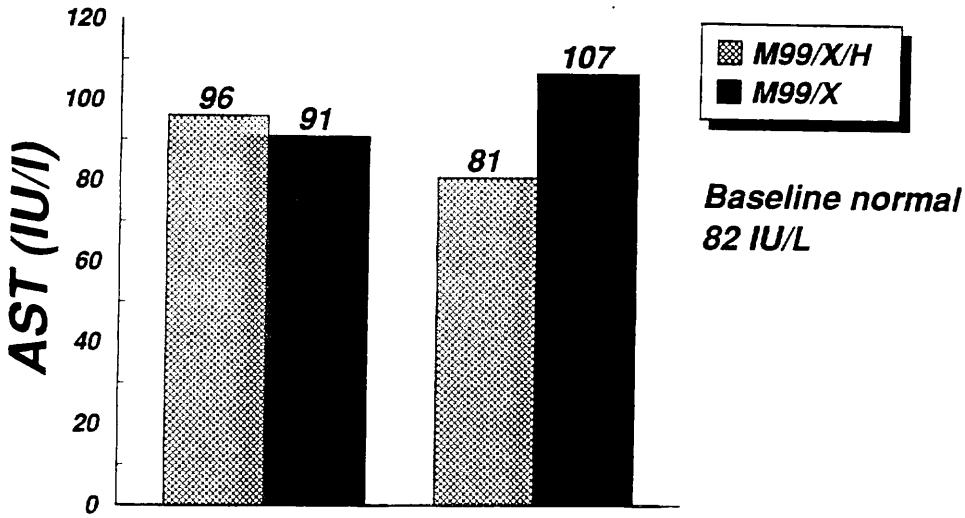

Figure 7: Comparison of aspartate transaminase (AST) (IU/L) levels measured from black rhinoceroses (Diceros bicornis) chemically immobilized with either M99 and xylazine or M99, xylazine and hyalase. The first bar group represents sampling soon after capture, the second bar group represents sampling after transport.

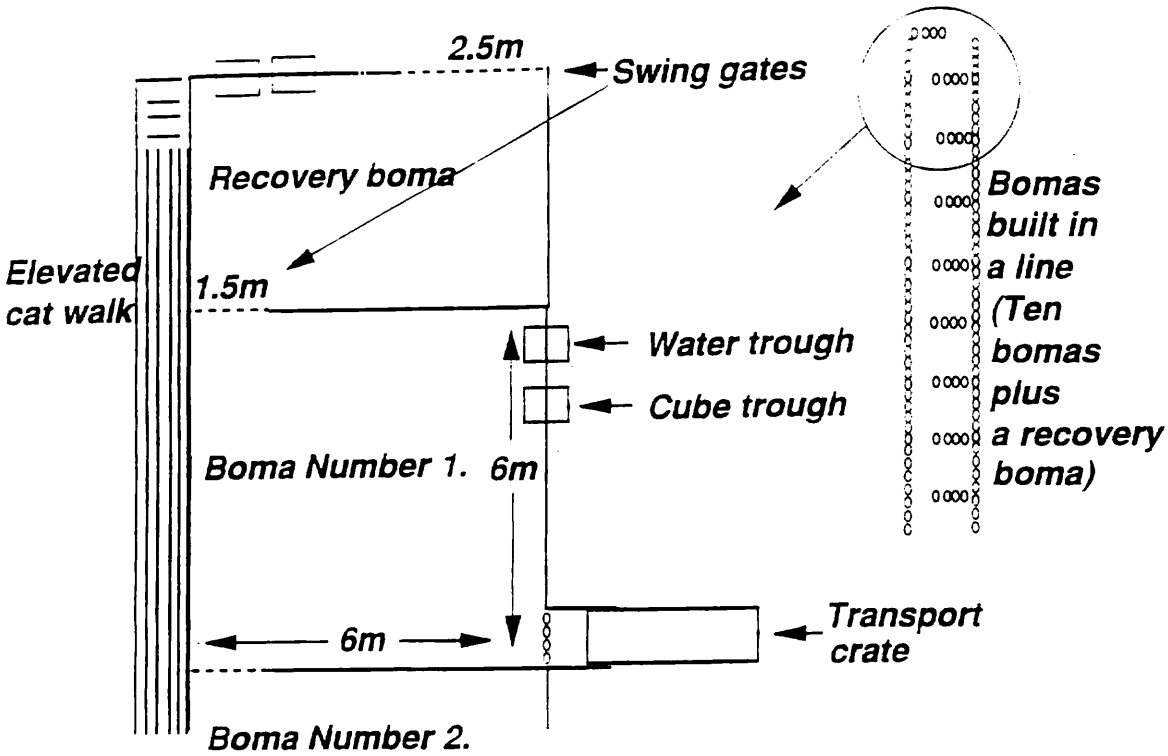

Diagram 1: Basic black rhinoceros (Diceros bicornis) boma design, Chete Safari Area, Zimbabwe, 1990.

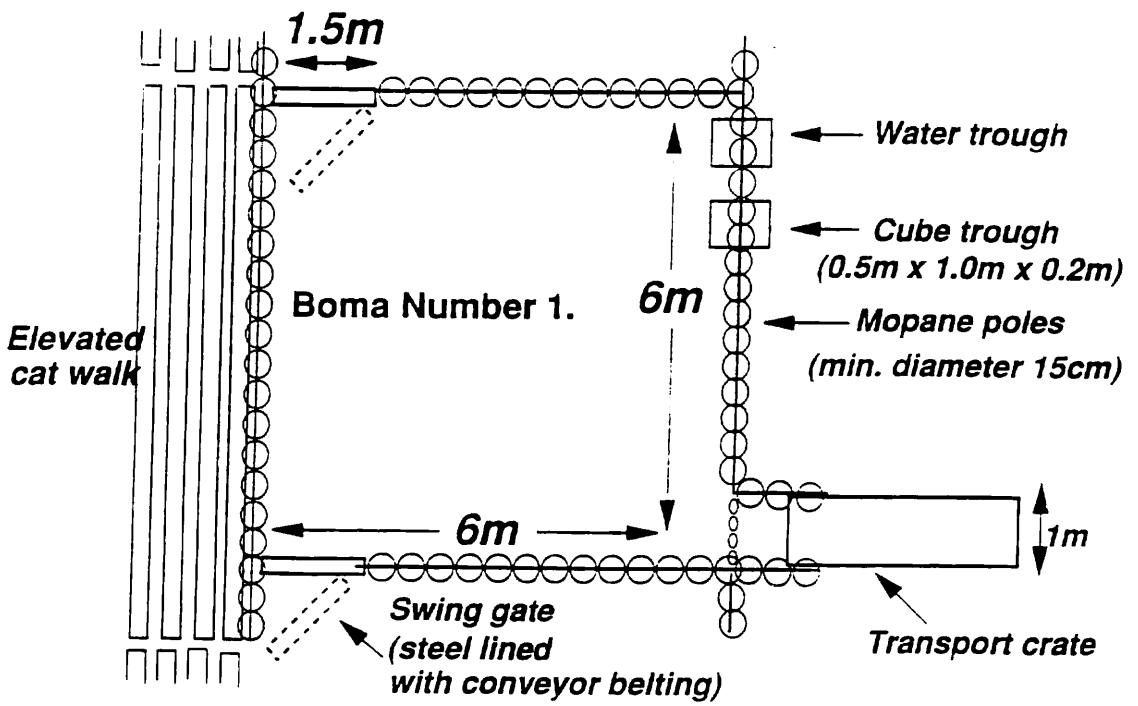

Diagram 2: Details of design of single black rhinoceros (Diceros bicornis) holding boma, Chete Safari Area, Zimbabwe, 1991.