
ULTRASONOGRAPHY AS A TOOL IN THE CONSERVATION OF THE AFRICAN RHINOCEROS: *ex situ* and *in situ* applications

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INTRODUCTION

With a demand for horn that is difficult to reduce and ongoing land-use conflict in natural habitats, all species of the rhinoceros remain under threat in the wild - some more critically than others. While the southern white rhino (*Ceratotherium simum simum*) appears relatively stable, with more than 6,000 animals (Walker, 1994), the black rhino (*Diceros bicornis*) has not fared well. Black rhinos have declined by at least 95% in the past twenty years, even by conservative estimates (Walker, 1994; Potter, 1994). While each rhino species faces its own set of problems, managers of wildlife reserves and zoological parks are working with incomplete knowledge regarding normal rhinoceros reproductive biology, information which is fundamental to successful propagation efforts. While African rhinos have been the focus of our research to date and are the subject of this paper, many of the concepts discussed below could potentially be extrapolated to conservation programmes focused on Asian species.

Captive breeding programmes, conceptually designed as insurance policies for African rhino species, have, for the most part, yet to meet their objectives regarding minimal loss of genetic diversity and, at least, replacement-level reproduction (Foose, 1992). While white rhinos survive well in captive settings, overall breeding efficiency appears to be stagnant. Without intervention, many of the founder animals in the captive southern white rhinoceros population will not have reproduced before they die. These genetically valuable animals are probably nearing the end of their reproductive lives. The northern subspecies of the white rhinoceros (*Ceratotherium simum cottoni*) is in a precarious state because of the low number of individuals in its isolated native habitat in Zaire's Garamba National Park (Smith & Smith, 1993), as well as lack of expansion in the captive population. The black rhinoceros has suffered serious losses at the hands of poachers and is being isolated into smaller and smaller protected areas in Africa, with *ex situ* captive populations plagued by a variety of diseases with multi-

factorial aetiologies that appear to be related to captivity itself (Miller, 1994).

Ultrasonography is a tool being applied to captive management to resolve some of the basic mysteries surrounding rhinoceros reproduction. Decisions about managed breeding can finally be based on objective reproductive assessment of individual animals instead of on conjecture. This technology can also be taken into the field where it could provide valuable information about the reproductive functioning of wild rhinos as well. At its most basic level, ultrasonography, at the time of rhino capture, could provide insights into the effects of translocation on embryo/foetal viability during different stages of gestation. For an animal producing one offspring at a time with a long inter-birth interval, this information could prove valuable, considering that rhinos are, by necessity, being more intensively managed in parks, reserves, conservancies, sanctuaries and protection zones throughout Africa.

CASE STUDY

An approximately 12-year-old female southern black rhinoceros (*Diceros bicornis minor*) was captured in Zimbabwe, held in a boma for several months, and then transferred to the Fossil Rim Wildlife Center in Texas, USA, in April 1992. On arrival at Fossil Rim, she was aggressive in nature and remained apprehensive in the presence of humans. In January 1995, a full-time caretaker began intensive conditioning of the rhino to allow hands-on examinations in the hope of eventually performing transrectal, ultrasound evaluations without sedation. The conditioning process involved exposing the female to long hours of human contact along with visual, tactile and auditory stimuli, including the intermittent playing of a radio to add background noise to her normal environment.

The positive conditioning process began with providing food, such as apples and sweet potatoes, as a reward for tolerating the proximity of people.

This soon expanded to the application of human touch on different areas of the rhino's body at the time of feeding. Over a period of several months, the rhino began to trust her human caretakers enough to facilitate twice-daily examination and treatment of a potentially serious hoof crack. The conditioning process was facilitated by

the use of a "free-stall" chute that was designed to allow the rhino to choose its own response to the process (Radcliffe *et al.*, 1995). The rhino was never restrained physically or chemically for the purposes of conditioning, examination, or treatment. Diagrams of the chute design are provided in Figures 1 and 2.

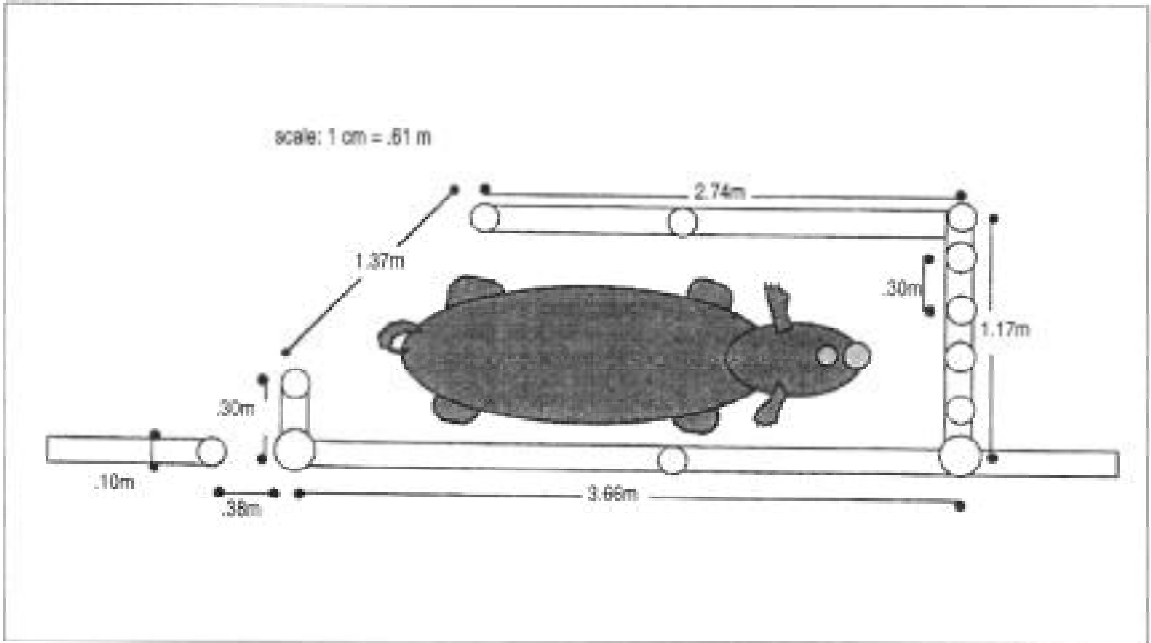


Figure 1. Black rhino in "free-stall" chute. top view.

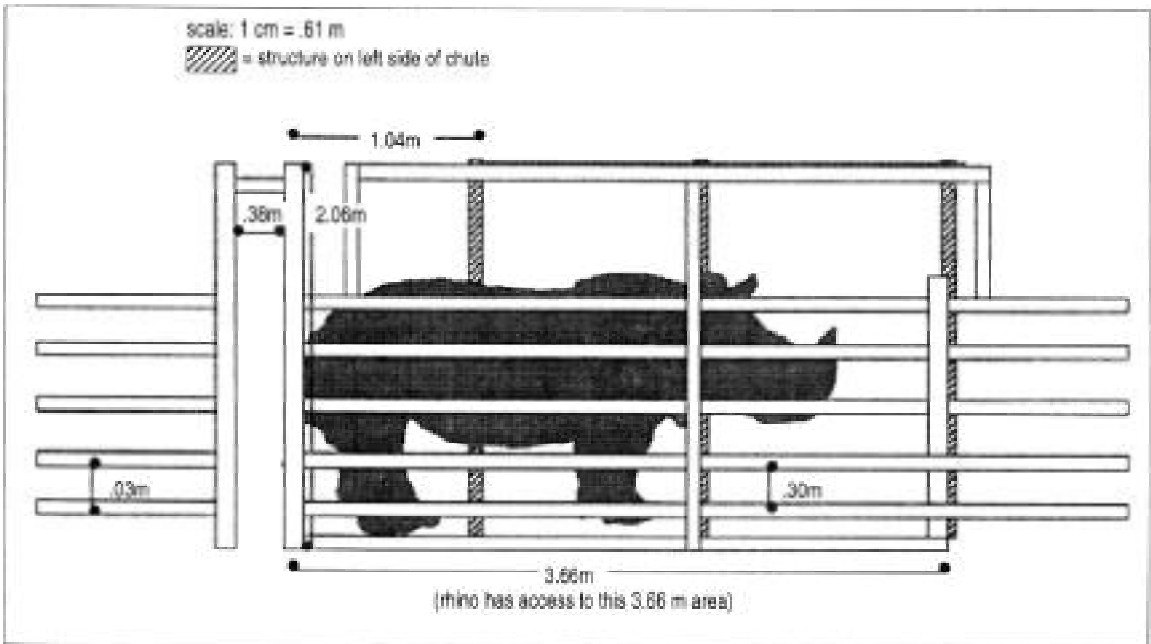


Figure 2. Black rhino in "free-stall" chute, right side view.

Starting in July 1995, the female was exposed to daily rectal examination in the chute without chemical restraint. Within two weeks, the application of transrectal ultrasound was successful, again without sedation. The foetal, ultrasonographic images obtained, correlated well with a breeding date approximately 11 months earlier. Important anatomical features of the rhino foetus can be visualised in Figures 3 and 4. The foetal skull can be observed as an echogenic (white structure) on ultrasound. The head is facing to the left and several structures can be identified from the ultrasound image. The foetal eye (bony orbit) is located to the far right and appears non-echogenic, or as a black circle. The bony protuberance that supports the horn bud of the developing rhinoceros can be seen as a bump on the tip of the nasal portion of the skull. The amniotic membrane appears as an echogenic line just dorsal to the skull and within the foetal fluids. The molars are very echogenic and can be observed in sagittal sections through the foetal skull, as illustrated in Figures 3 and 4. If sufficient data were collected to document and chart foetal dimensions, such as eye diameter or skull length, as has been done in the horse (Ginther, 1995), gestational age charts could be developed for the rhino.

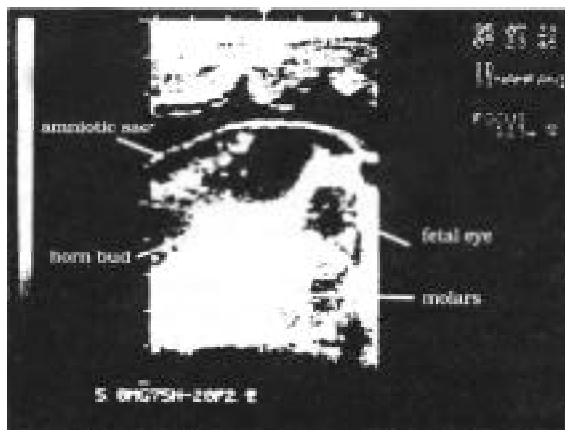


Figure 3. Transrectal ultrasonographic image of the head of a late-term southern black rhinoceros foetus illustrating identifiable structures, oblique sagittal view. All foetal images were obtained with an ALOKA 500V ultrasound unit using a MHz linear array transducer.

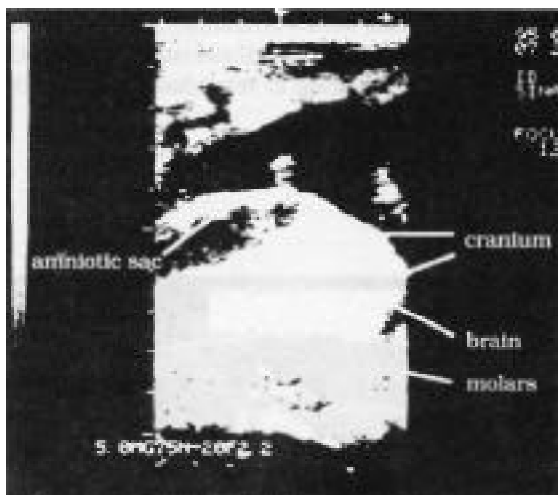


Figure 4. Transrectal ultrasonographic image of the head of a late-term black rhinoceros foetus, mid-sagittal view.

DISCUSSION

The potential applications of transrectal ultrasound in large, non-domestic animals, have been recognised recently (Adams *et al.*, 1991). The management implications of this work are obvious with regard to captive rhinoceros propagation. In this case, a decision to postpone immobilisation of the female for more aggressive treatment of the hoof crack was based partly on ultrasonographic confirmation of late-term pregnancy. Furthermore, the conditioning process not only allowed for the transrectal ultrasound examinations, but enabled successful treatment and monitoring of the hoof problem in a previously intractable rhino.

This same technology has also been used to elucidate the oestrous cycle of one of Fossil Rim's southern white rhinoceros females (cycle length approximately 35 days), as well as to document early embryonic loss in one female. The latter is believed to have been caused by an uterine infection and, like endometritis in the horse, was characterised by intrauterine fluid collections in late di-oestrous. Pregnancies as early as 15 days have been detected in Fossil Rim white rhinos using transrectal ultrasound. An early black rhino pregnancy has also been detected (Figure 5). Fertility problems are certainly bound to be more prevalent in captive situations than in the wild:

information gleaned from wild animals could help zoos to identify environmental, social and nutritional factors that may be contributing to reproductive failure in captivity.

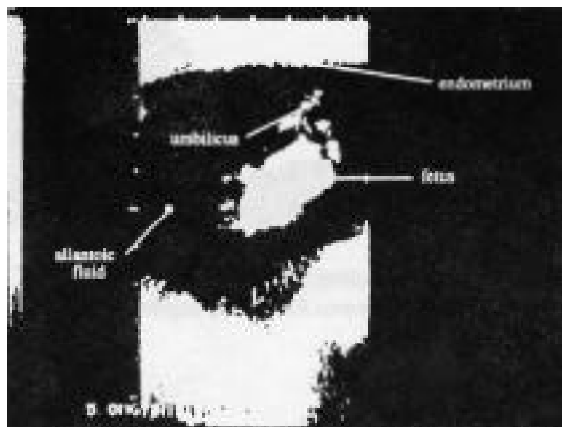


Figure 5 Black rhinoceros foetus, estimated at 50-60 days old

The application of this work in rhino range states remains open to debate. The stresses associated with immobilisation, transport and boma confinement, can result in abortion in a wide variety of species, including rhinos; the detection of an embryo/foetus could potentially change the course of management during boma confinement or during translocation. Data collected from scanning females in the field could also provide managers with a measure of a rhino population's reproductive health. This would facilitate sound management decisions, enabling the differentiation between populations which could sustain translocation of individuals to other areas, and those requiring more intensive conservation efforts.

Detecting the stage of an oestrous cycle of a female rhino on one examination would be difficult, but this has been done in the horse based on size and echogenicity of the corpus luteum (Ginther, 1986). Since both the rhinoceros and the horse, as perissodactylids, share a common evolutionary history, it seems reasonable to look for similarities in their reproductive biology as part of ongoing research efforts.

CONCLUSIONS

The utilisation of transrectal ultrasonography for research and for management of captive black and white rhinoceros has been beneficial in elucidating normal and abnormal reproductive functioning in female rhinos without sedation. The authors are not suggesting that wild rhinos should be subjected to immobilisation simply to be scanned by ultrasound. This would be an inappropriate use of financial and technological resources in most contexts. It may, however, be worth integrating a 10-15 minute scanning procedure into some capture and translocation protocols which are already in place, for a variety of reasons. By scanning rhinos opportunistically, managers of free-ranging rhinos may obtain practical information, while simultaneously enhancing their understanding of the causes of infertility in captive specimens. The selective application of transrectal ultrasonography could help to shape management decisions that underline the maintenance of healthy conservation units both *in situ* and *ex situ*.

ACKNOWLEDGEMENTS

The authors would like to thank Fossil Wildlife Center and Rhino Care Specialist Adam Eyres, the International Rhino Foundation, and ABC/Kane Productions for supporting this project. We would also like to acknowledge Chuck Boland of Aloka for generous contributions of ultrasound equipment.

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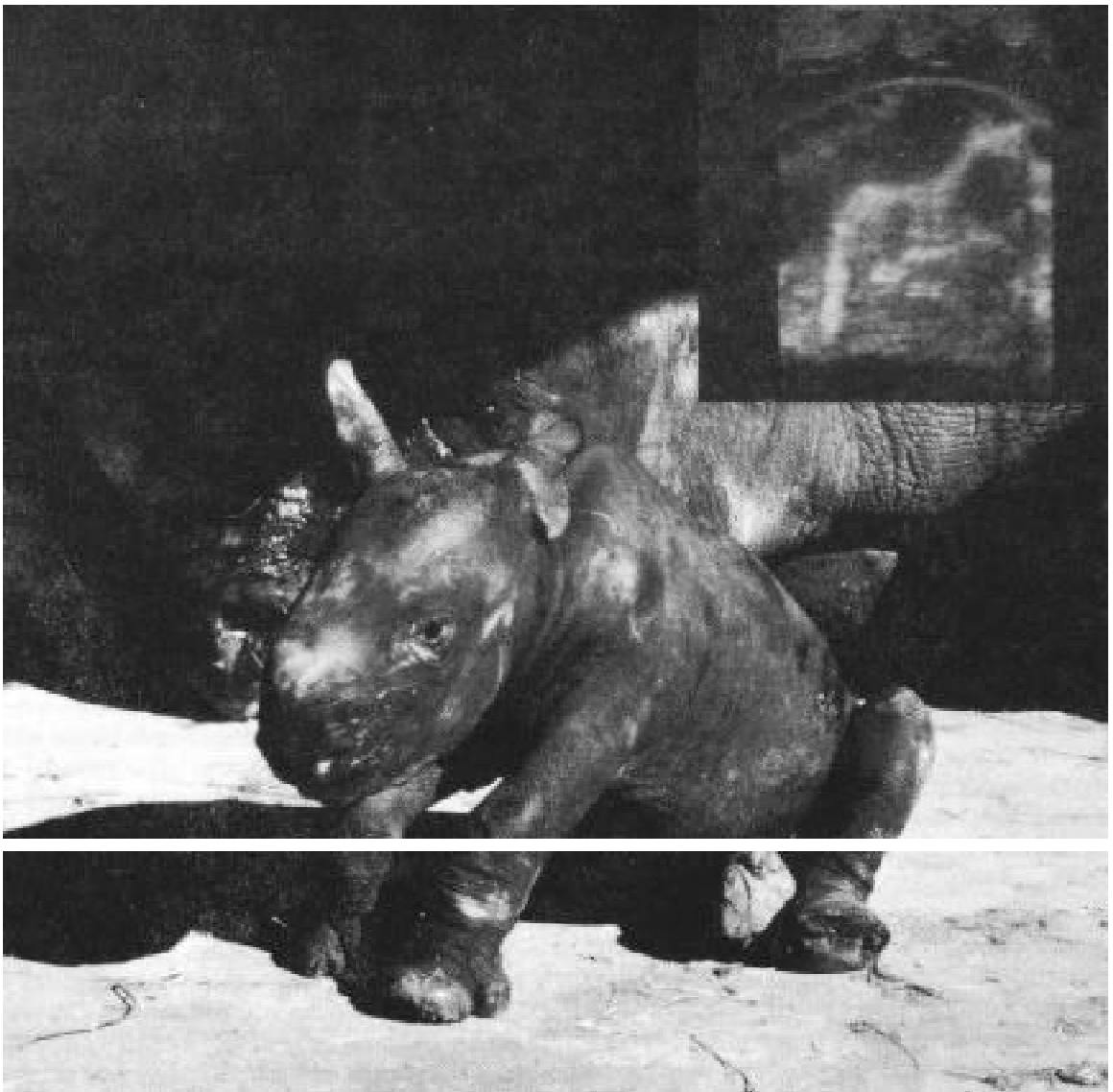
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A one-week-old southern black rhino calf recently born as a result of captive breeding efforts at the Fossil Rim Wildlife Center in Texas, USA. The inset shows an ultrasound picture of the calf as a foetus.