A new method for implanting radio transmitters into the horns of black and white rhinoceroses

Adrian M. Shrader[1]* *and Brian Beauchamp*[2]

[1] Centre for African Ecology, Department of Animal, Plant and Environmental Sciences
University of the Witwatersand, Private Bag 3, WITS 2050, South Africa
e-mail: Adrian@gecko.biol.wits.ac.za

[2] Manager, Technical Development, Game Capture, Southern Parks, South African National Parks
PO Box 110040, Hadison Park 8306, Kimberly, South Africa
e-mail: gamecap2@kimnet.co.za

* corresponding author

Abstract

The most successful method of attaching radio transmitters to both white and black rhinoceroses has been to implant them into either the anterior or the posterior horn of the animals. This paper describes a procedure by which the transmitter plus the antenna is implanted inside the anterior horn, thereby protecting them from being damaged through horn rubbing. Transmitters placed following this procedure were still functioning 22 months after being implanted.

Resumé

La méthode la plus efficace pour attacher un émetteur radio aux rhinocéros, tant blancs que noirs, consiste à l'implanter à l'intérieur de la corne antérieure ou postérieure de l'animal. Cet article décrit un procédé grâce auquel l'émetteur et l'antenne sont implantés dans la corne antérieure, ce qui les protège lorsque l'animal se frotte les cornes. Les émetteurs placés de cette façon fonctionnaient encore 22 mois après leur implantation.

Introduction

The factors that influence the movements of subadult white rhinos (*Ceratotherium simum simum*) in the Umfolozi Game Reserve were the purpose of a study started in April 1999. To achieve the aims of the study, we found it necessary to use radio telemetry to locate specific subadults at regular intervals.

Radio telemetry has been used previously in research projects on both black (*Diceros bicornis*) (Anderson 1971; Anderson and Hitchins 1971; Hitchins 1971; Pienaar and Hall-Martin 1991) and white rhinos (Owen-Smith 1971). Previously transmitters have been attached by using collars or ear tags or through implanting the transmitter into either the anterior or the posterior horn. The shape of the neck of both black and white rhinos, however, has made attaching and using radio collars problematic (Hofmeyr 1998). A rhino's head is smaller than its neck, and thus the collar slips over the rhino's head and falls off (Anderson and Hitchins 1971). If the collar is attached tightly, it may be prevented from slipping off, but it may cause lesions on the animal's neck (Hofmeyr 1998). Eartag transmitters have also been tried, but they are suitable only in small reserves that use aerial telemetry (Hofmeyr 1998).

The method that has had the most success and is most widely used with rhinos has been to implant the transmitter into either the anterior or the posterior horn (Anderson 1971; Anderson and Hitchins 1971; Hitchins 1971; Owen-Smith 1971; Pienaar and Hall-Martin 1991). Early studies implanted transmitters into the posterior horn as it was felt that the anterior horn should not be damaged because it was the rhino's main weapon (Anderson and Hitchins 1971). However, recent implantations of transmitters into the anterior horn have not weakened the horn or compromised the rhino's ability to use it (Pienaar and Hall-Martin 1991).

The implantation method discussed in this paper adapts the method described by Pienaar and Hall-Martin (1991) but improves on it by addressing two problems: 1) damage to the transmitter antenna if the rhino extensively rubs its horn, and 2) the difficulty associated with routing grooves up the back of the rhino's anterior horn.

Methods

The equipment used consisted of a 750-watt drill, two drill bits, a tungsten hinge-rebating bit 35 mm in diameter, and an 8-mm bit that was 300 mm long with the flute along the whole bit (fig. 1), a portable petrol generator, a hacksaw with 18 or 24 teeth per 25 mm in the blades, dental acrylic, and the radio transmitters that were to be inserted (fig. 2).

For the white rhino movement study, MOD-125 transmitters from Telonics[1] were used. To insure that the antennae would fit into the short anterior horns of the subadults, we reduced the transmitter antennae to 250 mm (10"). The shortened antennae, however, reduced the range of the transmitters. To compensate for this, the amperage of the transmitter was increased to 18 mA. As the study was to be conducted over a two-year period, the battery life of the MOD-125 transmitter, which is 9 to 18 months, had to be increased. This was achieved by duty cycling the transmitter so that it was on for 15 hours (0400–1700) and off for 9 hours (1700–0400). This adjustment resulted in a projected battery life of 22.7 months.

We drilled a 35-mm hole (the transmitter chamber) horizontally into the side of the anterior horn using the hinge-rebating bit powered by the portable generator (fig. 3). To prevent the drill bit from becoming jammed inside the horn, we removed it periodically when drilling. This removed any excess horn shavings and thus kept the hole clear. The transmitter chamber was drilled so that it sat at approximately 90 degrees in relation to the side of the horn (fig. 4a). We determined where to locate the chamber by measuring the diameter of the base of the horn, dividing this distance in half (thus obtaining the radius), and then using the radius as the distance between the bottom of the horn and the lowest point of the transmitter chamber (fig. 5). The minimum radial distance must be 7 cm, even if the diameter of the horn is less than 14 cm. This is because 7 cm is the minimum safe distance, for both subadult and adult rhinos, to avoid drilling into the bone of the skull or into the

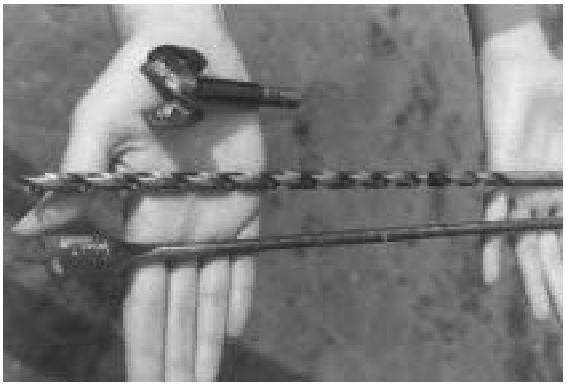
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Figure 1. Hinge-rebating (top), 300 x 8-mm (centre) and 19-mm spade drill bits used in the implantation procedure. A standard 19-mm bit similar to the 300 x 8-mm bit is recommended over spade bits (as pictured), as the shaft on a spade bit can bend.

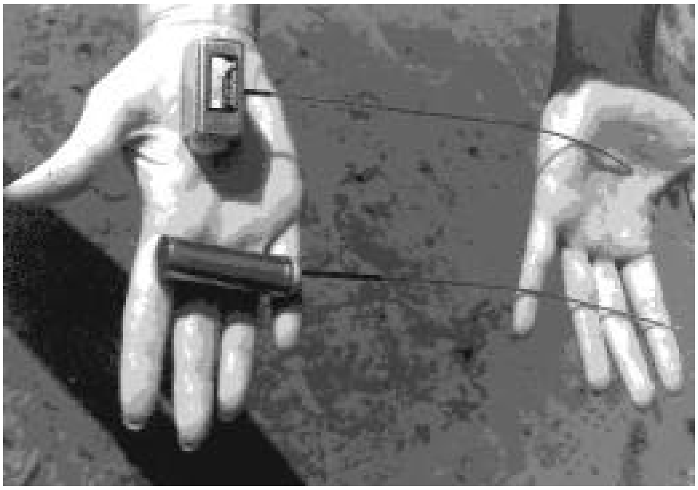
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Figure 2. MOD-125 (above) and MOD-050 (below) radio transmitters, which are implanted into the horns of rhinos.

[1] Telonics, 932 E. Impala Ave., Mesa, AZ, USA; tel: +1 480 892 4444; www.telonics.com

Figure 3. Drilling the transmitter chamber into the anterior horn of a white rhino.

germinal layer of tissue, which lies between the bone and the horn (Peter Morkel pers. comm. April 2001).

If the animal had a long horn, we used a distance a little greater than the radius to prevent drilling into the germinal layer of tissue for the transmitter chamber. The transmitter chamber was drilled so the transmitter, once inserted, would sit centrally with a minimum distance of 20 mm from the end of the transmitter to the edge of the horn (fig. 4a).

Once the transmitter chamber was drilled, we removed the tip of the horn using a hacksaw to provide a flat surface from which to drill the antenna chamber (fig. 4a, b). Factors that influenced the amount of horn that needed to be removed were the length of the 8 x 300-mm drill bit and horn curvature. In horns that were relatively straight, only the length of the bit determined the amount of horn that was removed. However, with horns that had a high curvature, precisely how to position the antenna chamber was the main factor that influenced the amount of horn to be removed. The antenna chamber was drilled so that it would run through the middle of the horn down into the transmitter chamber (fig. 4a, b, fig. 6.).

Figure 4 (a and b). Front (a) and side (b) views of anterior horn showing how both the transmitter and the antenna chambers are placed for MOD-125 and MOD-080 transmitters.

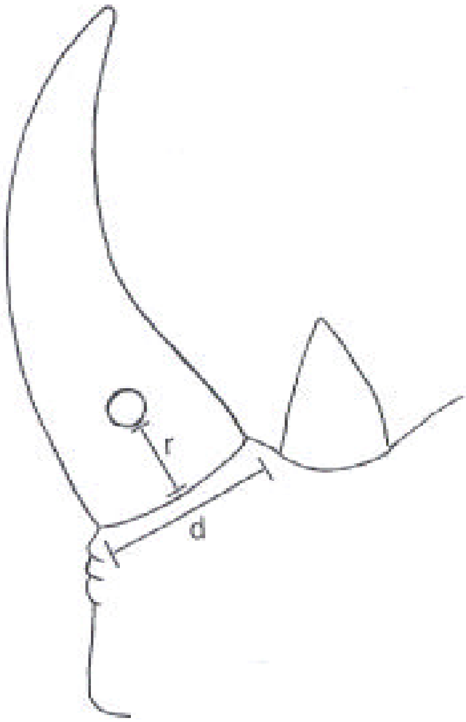

Figure 5. Side view of a white rhino's anterior and posterior horns showing how the transmitter chamber is placed in the anterior horn. The chamber is drilled so that the distance separating the bottom of the horn from the bottom of the chamber (the radius (r)) is a minimum distance of 7 cm. This minimum distance is used even if the diameter (d) of the horn is less than 14 cm.

Both chambers were then filled with dental acrylic, poured into both chambers while it was fluid. The acrylic took approximately 30 to 45 minutes to solidify and harden. To prevent it from draining out before then, we dammed up the transmitter chamber by wrapping masking tape around the horn. When both chambers were filled, we completely covered both holes with masking tape before reviving the animal. The entire implantation procedure took approximately 20 minutes from the moment the unconscious rhino was approached until it was revived.

The horns of black rhinos are smaller than those of white rhinos, so either the Telonics MOD-080 (33 x 18 x 23 mm) or the MOD-050 (cylindrical, 17 mm diameter x 56 mm; fig. 2) with a 213-mm (8.5") antenna can be used. For the MOD-080 a smaller diameter tungsten hinge-rebating bit is used to drill the transmitter chamber (as in fig. 4a, b). For the MOD-050, however, we used a drill bit of 19 x 300 mm to drill a single chamber (transmitter and antenna combined) from the tip into the centre of the anterior horn (fig. 7a, b). The transmitter was then placed in the chamber and the chamber filled with dental acrylic.

When the MOD-050 transmitter is placed into the chamber it should not be placed so that the top of the transmitter (where the antenna is attached) is toward the centre of the horn with the antenna bent so that it runs back up the side of the transmitter. If the antenna touches the transmitter, it effectively shortens the length of the antenna and thus reduces the signal range.

Both the MOD-080 and the MOD-050 have a shorter battery life than the MOD-125 (MOD-080, 6–8 months; MOD-050, 4–6 months) and thus which

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Figure 6. Drilling the antenna chamber down through the middle of the anterior horn of a white rhino.

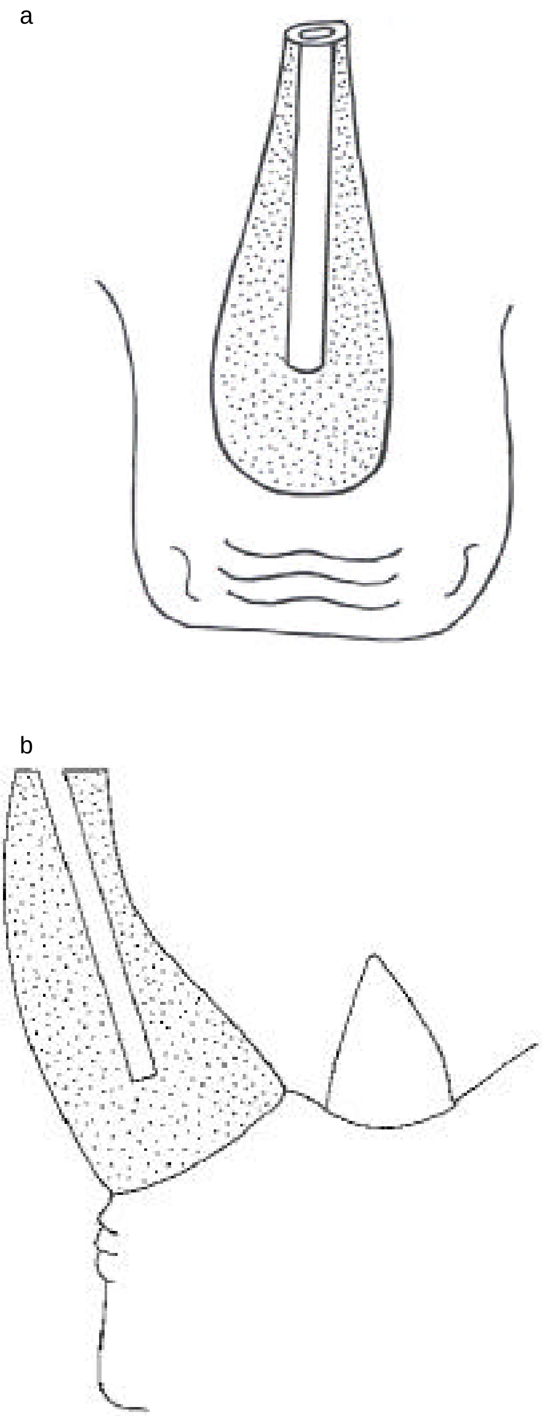

Figure 7 (a and b). Front (a) and side (b) views of anterior horn showing how the combined transmitter and antenna chamber for the MOD-050 transmitter is placed.

transmitter is used will depend on how long the animal is to be monitored. However, like the MOD-125, the battery life of both transmitters can be extended through duty cycling.

Discussion

All the rhinos used in the study had rubbed the masking tape off their horns within two days of implantation and the dental acrylic had dried. An added advantage of wrapping the horn with masking tape was that animals that already had radio transmitters implanted could easily be spotted from the helicopter and thus were not redarted.

Despite the shortened lengths of the transmitter antennae, rhinos were located easily from the ground with signal ranges between 5 and 8 km, the longest at approximately 12 km. This study, however, was conducted in open rolling savanna (Natal lowveld bushveld; Low and Rebelo 1996). In Addo Elephant Park, the range of implanted transmitters was less because of thicker vegetation (xeric succulent thicket; Low and Rebelo 1996), with signal ranges of only 3 to 4 km on foot and 6 to 8 km from the air (Michael Knight, pers. comm. April 2001).

After 22 months all 10 transmitters that had been implanted were still functioning. Observations made of each individual showed no noticeable signs of damage either to the dental acrylic covering the transmitters or to the horns. A problem with the Pienaar and Hall-Martin (1991) method was that by placing the transmitter's antenna in a groove up the back of the anterior horn, the rhinos could rub through the dental acrylic and damage the antenna. If, however, the antenna is placed up through the middle of the horn, rubbing cannot damage it. The second concern with the Pienaar and Hall-Martin (1991) method was that routing up the back of a horn with large curvature could be extremely difficult and time consuming. Eliminating this aspect of the procedure and placing the antenna up through the middle of the horn reduces the time required to conduct the procedure and thus the time required to keep the rhino sedated.

As with the Pienaar and Hall-Martin (1991) method, implanting a transmitter using this method is an irreversible procedure. Once the dental acrylic has hardened, the transmitter cannot be replaced or removed. The only way a new transmitter can be placed in the same animal is if the previous transmitter has grown out of the horn. However, as the intrinsic anterior horn growth of both white and black rhinos is only between 36.5 and 59.9 mm annually (Pienaar et al. 1991), it is unlikely that implanting a second transmitter will be a viable option for most studies.

In this study, the MOD-125 proved to be too large for subadult white rhinos that were five years of age or younger. In future, a smaller transmitter, possibly one of the ones used for black rhinos, will be used.

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References

Anderson, F. (1971) Design of radio-tracking systems used in South Africa and problems encountered in their application. In: *Proceedings of a Symposium on Biotelemetry.* University of Pretoria, Pretoria.

Anderson, F., and Hitchins, P.M. (1971) A radio tracking system for the black rhinoceros. *Journal of the South African Wildlife Management Association* 1, 26–35.

Hitchins, P.M. (1971) Preliminary findings in a radio telemetric study on the black rhinoceros in Hluhluwe Game Reserve, Zululand. In: *Proceedings of a Symposium on Biotelemetry*. CSIR, Pretoria.

Hofmeyr, M. (1998) Comparison of four different radio transmitter attachments on black rhino in Madikwe Game Reserve. *Pachyderm* 26, 14–24.

Low, A.B., and Rebelo, A.G. (1996) *Vegetation of South Africa, Lesotho and Swaziland.* Department of Environmental Affairs and Tourism, Pretoria.

Owen-Smith, N. (1971) The contribution of radio telemetry to a study of the white rhinoceros. In: *Proceedings of a Symposium on Biotelemetry.* CSIR, Pretoria.

Pienaar, D.J., and Hall-Martin, A.J. (1991) Radio transmitter implants in the horns of both the white and the black rhinoceros in the Kruger National Park. *Koedoe* 34, 89–96.

Pienaar, D.J., Hall-Martin, A.J., and Hitchins, P.M. (1991) Horn growth rates of free-ranging white and black rhinoceros. *Koedoe* 34, 97–105.