Radio transmitter implants in the horns of both the white and the black rhinoceros in the Kruger National Park

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The procedure for implanting radio transmitters into the horns of white and black rhinoceroses is described. Mean transmitter life in the white rhinoceros was 13,9 months which is significantly longer than the 9,7 months in black rhinoceros. In the white rhinoceros a significant sex-related difference in transmitter life was found with the transmitters in males lasting a mean of 12,1 months compared to the 15,3 months in females.

Key words: radio transmitters, Telonics, white rhinoceros, black rhinoceros, Kruger National Park, horn implants, dental acrylic, transmitter life.

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Introduction

Studies on habitat selection by the white rhinoceros *Ceratotherium simum simum* (Burchell, 1817), and black rhinoceros *Diceros bicornis minor* (Drummond, 1876), commenced in the Kruger National Park in August 1988. The objectives were to quantify habitat selection and use by different categories of animals, to ascertain whether seasonal movements took place, to establish territory or home range sizes and to map these accurately. The ability to locate individual animals at regular intervals, in dense vegetation and over a large area was, therefore, a prerequisite and radio telemetry was used to accomplish this.

Telemetry offers the advantage that specific animals can be tracked, and their position regularly plotted on a map without them necessarily being seen. The position of different animals, relative to one another can also be established at any time. Radio telemetry was tested on the black rhinoceros in the Hluhluwe Game Reserve by Anderson & Hitchins (1971) and Hitchins (1972) and on white rhinoceros in the Umfolozi Game Reserve by Owen-Smith (1972, 1973) with varying degrees of success.

Anderson & Hitchins (1971) implanted radio transmitters into the horn of a black rhinoceros because the shape of the animal's neck and head precludes the use of a collar. These authors argued that a collar would slip over the animal's head. Hall-Martin (1980) fitted four black rhinoceroses in the Kruger National Park with radio collars and found that all collars had been lost within one to eight weeks after fitting, even though they were put on fairly tightly. Hillman (1982) achieved slightly better results with radio collars on black rhinoceroses in the Pilanesberg National Park, Bophuthatswana, but most were also lost prematurely.

Materials and methods

For the present study it was decided to use horn implants for practical and aesthetic reasons. A rhinoceros horn has a filamentous structure (Ryder 1962; Lynch *et al.* 1973) and originates from the epidermis. Therefore a cavity can be drilled into the horn without causing the animal any discomfort.

Anderson & Hitchins (1971) and Hitchins (1990) cite moisture penetrating the transmitter as a cause for transmitter failure. It was, therefore, decided to use a sealed transmitter unit to prevent moisture problems as rhinoceroses are partial to wallowing in mud and lying in water to cool off.

Radio transmitters, MOD-125, purchased from Telonics were used. These consist of a sealed, rec-

Fig. 2. Telonics radio tracking equipment: 1. TR-2 Receiver, 2. 'H' Antenna, 3. Earphones, 4. Telonics radio transmitter, MOD-125.

tangular unit with a 300 mm TA-5MT cable antenna protruding at one end. The dimensions of the transmitter capsule itself are 20 x 24 x 41 mm, and it weighs about 50 g (Fig.1). It has a claimed operational battery life of 12 to 15 months on a 15 MS pulse width and 45 beats per minute. The transmitting frequency chosen was a standard wildlife telemetry band of 148-150 MHz. A hand held Telonics H-antenna, model RA-2A was used with a Telonics TR-2 receiver for tracking (Fig.2).

A transmitter chamber was drilled into the side of the horn (27 in anterior horn, 2 in posterior horn), approximately 90 mm from the base, using a hand-held power drill with a 30 mm diameter bit (Fig.3). Power was provided in the field by a small portable genera-

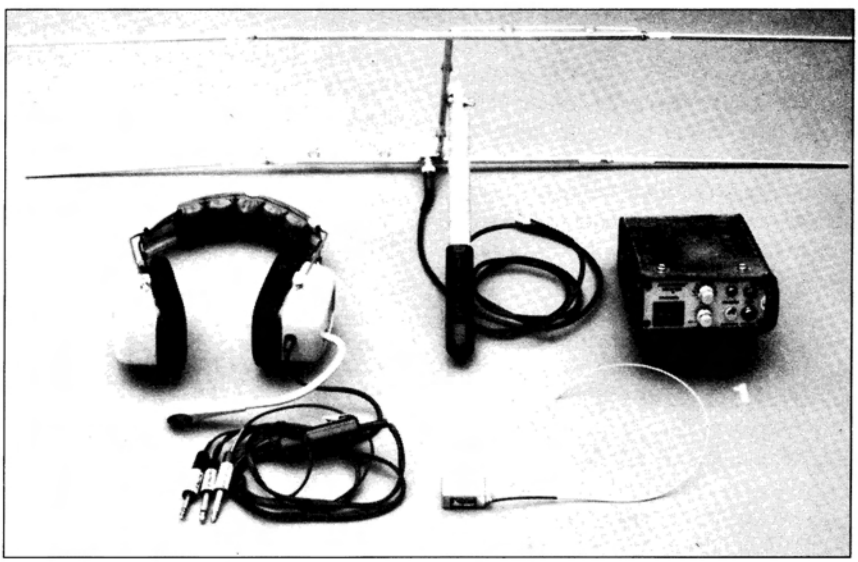

Fig. 1. Equipment used during the radio transmitter implanting procedure: 1. Dental acrylic, 2. Masking tape, 3. Router, 4. Hand-held power drill, 5. Drill bits (30 mm & 6 mm), 6. Telonics radio transmitter,
MOD-125.

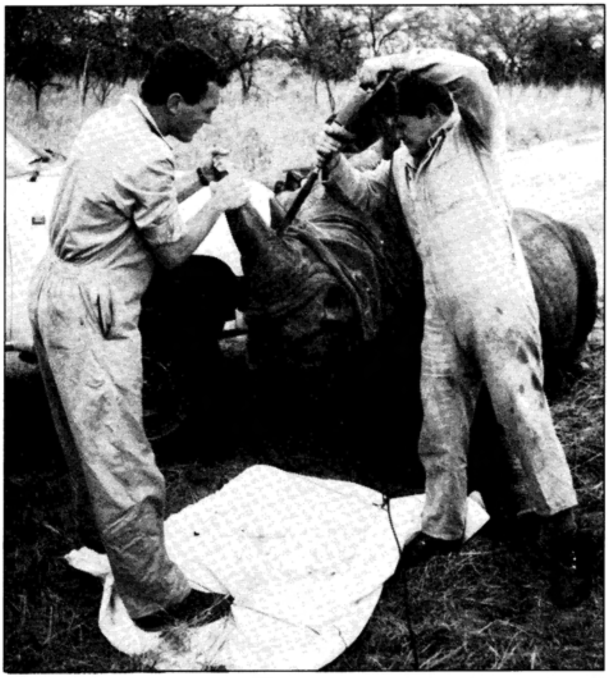

Fig. 3. Drilling the transmitter chamber into the side of the anterior horn of an adult white rhinoceros.

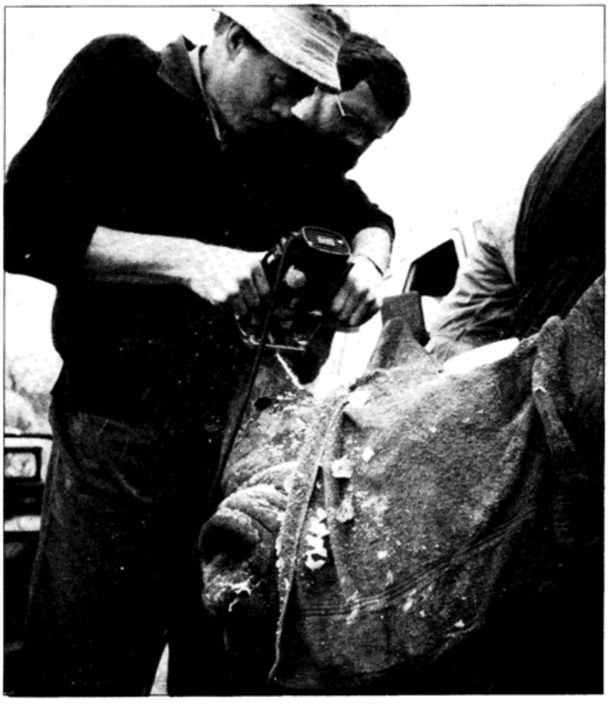

Fig. 4. Cutting the antenna groove with a router on the posterior surface of the anterior horn.

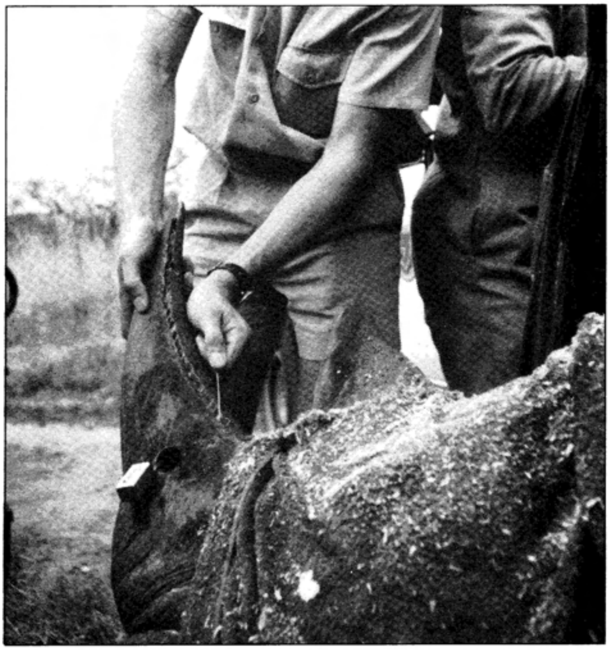

Fig. 5. The antenna is threaded from the transmitter chamber, through the antenna channel, preparatory to being laid in the antenna groove. The transmitter is visible outside the transmitter chamber.

Fig. 6. Filling the transmitter chamber and the antenna groove with dental acrylic and closing with masking tape.

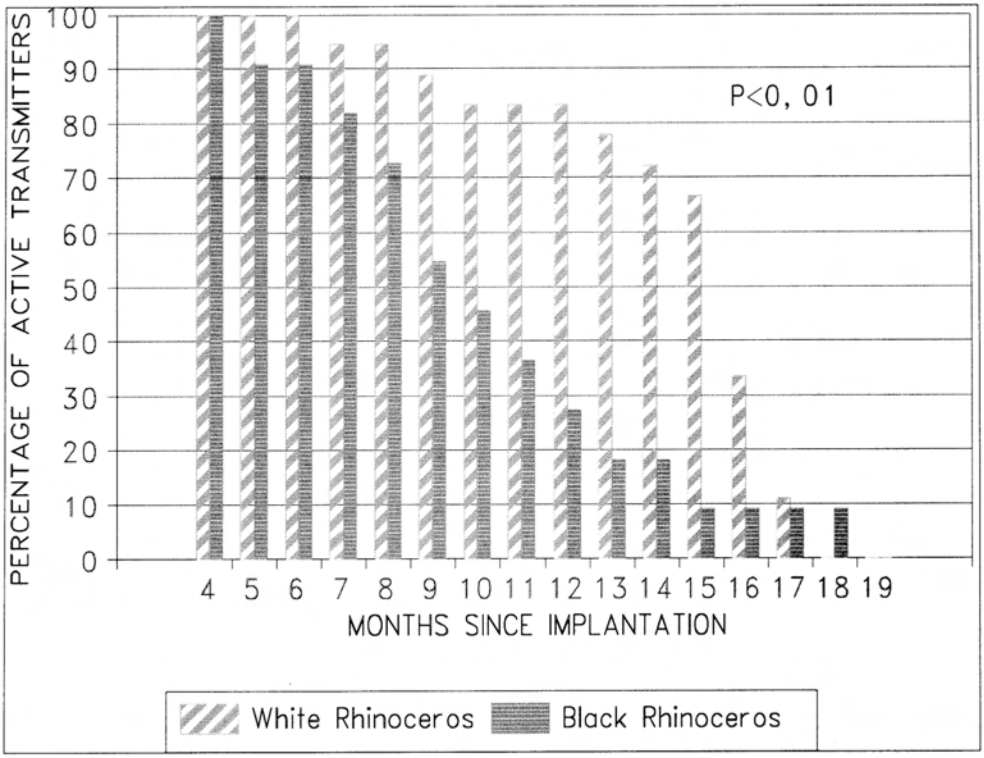

Fig. 7. The comparative transmitter life (months) of radio implants in the horns of 18 white rhinoceroses and 11 black rhinoceroses in the Kruger National Park.

tor. The transmitter chamber was drilled deeply enough so that the transmitter could be embedded with its outermost edge set at least 25 mm into the horn. A second small channel, 6 mm in diameter, was drilled from the posterior surface of the horn to intersect the transmitter chamber centrally. A router was then used to cut a groove for the antenna (Fig.4). This outer groove commenced at the entrance of the secondary channel, and was directed upwards along the posterior surface of the horn towards the tip. The antenna was then threaded from the transmitter chamber, through the antenna channel, preparatory to being laid in the antenna groove while the transmitter capsule was still held outside the entrance to the transmitter chamber (Fig.5).

Freshly mixed dental acrylic was then poured into the transmitter chamber. The transmitter capsule was slowly pushed into the dental acrylic in the chamber, while the antenna was pulled gently out through its channel at the same time. The chamber was then filled with dental acrylic and the entrance closed with masking tape (Fig.6). The antenna was laid in the antenna groove and the groove was also filled with dental acrylic. The entire horn was then wrapped with masking tape to prevent the loss of acrylic from the antenna groove or transmitter chamber, as the acrylic takes about 30 minutes to set properly.

While the transmitter was being implanted into the horn, V-shaped notches were cut into the ears of the rhinoceros following the system described by Brooks (1989). These ear-notches make possible the permanent visual identification of individual animals. The V-shaped notches were cut 40 mm deep to distinguish them from natural nicks and tears. The ears were photographed for future reference. Standard body and horn measurements were taken of every rhinoceros. The implanting and marking procedure took 20 to 30 minutes per animal.

The animals were tracked regularly until the transmitters stopped functioning. Notes were made of any sudden change in signal strength. This was later found to indicate the point at which the animal had rubbed through the cable antenna.

The Wilcoxon Rank Sum Test was used to test for differences in transmitter life between black and white rhinoceroses. The same test was used to ascertain whether the sex of the rhinoceros concerned had an influence on transmitter life.

Results

Eighteen white rhinoceroses (10 males, 8 females) and 11 black rhinoceroses (7 males, 4

Fig. 8. Radio transmitter capsule visible near the tip of the anterior horn of an adult black rhinoceros cow. All the dental acrylic covering the transmitter has been rubbed off.

females) were fitted with radio transmitters. When tracking the rhinoceros on the ground or from a vehicle, strong signals could be picked up at distances of 4-10 km using a hand-held Telonics H-antenna. The strength of the signals depended on the animal's locality in the landscape and the topography of that landscape. Stronger signals were picked up when the animal was on the watersheds than when it was down along the watercourses. Signals could be heard at a 15 to 20 km range on a line-of-sight path when tracking from high points such as hills or rock outcrops.

Mean transmitter life in white rhinoceroses was 13,9 ± SE 0,75 (range 6-17) months compared with 9,7 ± SE 1,18 (range 4-18) months for the black rhinoceroses (Fig.7). Therefore, the white rhinoceros transmitters lasted a mean of 4,2 months longer than those of the black rhinoceros, a significant difference. At 10 months, 50 % of the black rhinoceros transmitters had stopped working whereas 50% of the white rhinoceros transmitters had stopped working after 15 months of implantation.

Transmitter life, as well as the time lapse from implantation until when the transmitters registered a sudden reduction in signal strength, were compared between males and females in both species.

The mean transmitter life in black rhinoceros females was 12,5 ± SE 2,22 months (n=4) compared to 8,1 ± SE 1,06 months in males (n=7). However, this difference is not significant (P=0,130; n=11), probably because of the small sample size. The mean time lapse from implantation until signal strength reduction, was 7,4 ± SE 1,0 months in males (n=7) and 11,3 ± SE 3,2 months in females (n=4), which is also not significant (P=0,298; n=11).

The mean transmitter life in the anterior horn of white rhinoceros females was 15,3 ± SE 0,59 months (n=8) compared to 12,1 ± SE 1,17 months in males (n=8), but this difference is again not significant (P=0,078; n=16). However, the mean time lapse from implantation until signal strength reduction was 13,9 ± SE 1,34 months for females (n=8) compared to 9,8 ± SE 1,25 months for males (n=8) and this difference is significant (P=0,044; n=16).

The three white rhinoceros transmitters that ceased transmitting first, had been implanted into the anterior horns of white rhinoceros males. In one of the animals it could be seen clearly that the animal had rubbed through the dental acrylic and the transmitter casing. In contrast the two transmitters that were implanted in the posterior horns of two white rhinoceros males lasted for 15 and 16 months respectively.

The V-shaped ear-notches facilitated the easy visual identification of specific rhinoceroses on the ground and from the air. After 27 months the ear notches were still perfectly visible and no ears were torn as a result of the notches. Notches should not be cut too small as it was found that redbilled oxpeckers *Buphagus erythrorhynchus* (Stanley 1814) peck at the fresh wounds. This can cause thickening of the ear tissue so that the notch could become less visible or U-shaped, resembling a natural nick.

Discussion

Anderson & Hitchins (1971), Hitchins (1990) and Owen-Smith (1972) used the posterior horn for the radio transmitter implantations because they thought it unwise to tamper with the anterior horn which is a rhinoceros' main weapon. The posterior horn of a white rhinoceros is usually comparatively small and short, it could only be used on two occasions on white rhinoceros bulls during the current study. The base of the anterior horn is more massive and can accommodate a transmitter comfortably. The dental acrylic that was used as bedding material set very hard and it bonded well with the rhinoceros' horn. The horn was not significantly weakened by the implantation procedure, and no horn breakage in radio-fitted animals was reported in either species.

Ten marked rhinoceroses were immobilized after 27 months and their horns were examined. No indication that the horns were weakened in any way, could be found. The dental acrylic was worn down with the horns as a result of the rhinoceros' rubbing activities. The horns were not deformed as a result of the dental acrylic causing uneven horn wear. Dental acrylic is therefore an acceptable bedding material as it bonds well with rhinoceros horn, sets quickly and is easy to prepare.

Hitchins (1972, 1990) used fibreglass to cover the rhinoceros' horn in order to protect the transmitter. The average installation time was about 85 minutes and the transmitters lasted an average of about 5 months (n=20). Dental acrylic seems to be better than fibreglass as a bedding material.

The longer transmitter life in the white rhinoceros can probably be ascribed to the relative size of the horn in the two species. Because the anterior horn of an adult black rhinoceros is comparatively smaller than that of an adult white rhinoceros, the radio transmitter and antenna could not be implanted to the same depth (Pienaar *et al.*). With anterior horn growth of about 60 mm per year in young adult rhinoceros (Pienaar *et al.*) the radio transmitter and antenna move upwards more rapidly into the more slender part of the horn in a black rhinoceros, than in a white rhinoceros. When the antenna or the transmitter reaches the slender part of the horn or the horn tip, the antenna or the transmitter capsule is rubbed through, causing sudden reduction in signal strength, or the termination of the signal (Fig.8).

The reason why the transmitters in the anterior horns of white rhinoceros males do not last as long as for the females is probably because the males rub their horns more than the females. Observations on immobilized white rhinoceroses showed that the base of the anterior horn of the adult white rhinoceros males is usually rubbed smooth whereas the base is often frayed and fibrous in an adult white rhinoceros female (Pienaar *et al.*).

- As the anterior horn of an adult rhinoceros grows at a rate of at least 50 mm per year, care must thus be taken to implant the transmitter as near to the centre of the horn as possible. The transmitter will eventually move towards the tip of the horn where it will be rubbed off, as has already happened with some of the black rhinoceroses in the present study.

Conclusions

It is recommended that the posterior horn be used for radio transmitter implantation in white rhinoceros males where possible, as the transmitters there seem to last longer than in the anterior horn. With white rhinoceros females and black rhinoceroses the anterior horn can be used for radio transmitter implantation as the posterior horn is usually too small to accommodate the Telonics transmitter. The Telonics radio transmitters performed to expectations, although the possibility of an even smaller transmitter with similar battery life must be pursued, as this will ease the implantation procedure in smaller horns.

The results of this study indicate clearly that a radio implanted in the horn of a rhinoceros is an efficient method for keeping track of an individual animal's movements in extensive conservation areas, for limited periods of time. The application of this technique is useful for research and monitoring and can also be used for security purposes.

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