DEHORNING OF BLACK (*Diceros bicornis*) AND WHITE RHINOCEROS (*Ceratotherium simum simum*): THE ZIMBABWEAN EXPERIENCE

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Abstract - In Zimbabwe, during the period 1991-1993, 478 immobilisations of both white (*Ceratotherium simum simum*)(n = 156) and black (*Diceros bicornis*)(n = 322) rhinoceroses were carried out. Of these, 360 animals were dehorned (white rhino, n = 136; black rhino, n = 224) as part of a management program to reduce the incentive to illegal hunters entering Zimbabwe from Zambia. Nineteen white rhino that were dehorned in 1991, were re-immobilised approximately 12 months after dehorning and horn regrowth measured and form of regrowth documented. A regrowth rate of 6,7 cm/yr (n = 14) for the front horn and 2,9 cm/yr (n = 14) for the back horn were noted. In the majority of rhinos, the shape of horns was roughly cylindrical after 1 year of horn removal. Several of the white rhino had abnormal regrowth characterised by central cavitation, partial cavitation with partial side wall collapse, and undercutting. None of these rhino exhibited ill health associated with horn abnormalities. Twenty eight black rhinos that were dehorned in 1992, were re-immobilised in 1993 for relocation purposes and attachment of telemetry devices. Regrowth (rate and form) was noted to be normal in all these animals except for some evidence of central splitting of the horn, but not into the germinal area. On occasion re-dehorning revealed a crescent shaped area of cavitation inside the horn. None of these showed evidence of moistness or discharge, nor invasion into the germinal area. The higher incidence of regrowth abnormalities seen in white rhinos was due to poor cutting techniques which damaged germinal epithelium. Improvements in cutting technique in 1992/1993 with black and white rhinos resulted in normal horn regrowth. Dehorning as a deterrent to illegal hunting has been successful in the black rhino, with only 19 animals killed during the period 1991-1993. This has been due to markedly improved law-enforcement, use of radio-tracking and dehorning on a regular basis (every 12-18 months). The situation with the loss of > 80 white rhino in Hwange National Park in early 1993 was due to total lack of law enforcement and at least 18 months of horn regrowth. Dehorning is an effective conservation strategy, with little negative health or behaviourial effects on the rhinos but will only succeed if supported by aggressive law-enforcement.

INTRODUCTION

Protection of both black (*Diceros bicornis*) and white (*Ceratotherium simum simum*) rhinoceros in southern Africa since 1986 has consisted of improving law enforcement, increased intelligence gathering, capture and translocation of animals to safer areas to reduce losses due to illegal hunting. In 1989, Namibia instituted a new strategy of dehorning selected populations of black rhinos due to an increase in illegal killing of this species. This technique, coupled with increased law enforcement proved effective in preventing further killing of black rhino in specific areas of the country[7]. In Zimbabwe, despite attempts to prevent illegal killing of both species of rhinos, through improved law enforcement and capture/translocation, loss of rhinos proved to be unsustainable (with protection constrained by lack of adequate finances). A decision was made to carry out an experimental dehorning of white rhinos in Hwange National Park (HNP) in 1991[3], but continued heavy poaching resulted in a decision to dehorn all rhinos throughout Zimbabwe in an attempt to halt the decline[4,8].

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Dehorning has proved to be a controversial management option[4,5,6], with both failures and successes with regard to reduced incentives for illegal poaching. The dehorning operations have allowed considerable data to be accumulated on its deterrent effect, rhino demography, immobilisations, horn size (before and after dehorning), horn regrowth, form of regrowth and veterinary-related problems.

METHODS

Details of immobilisation methods and data collected have been documented[4]. In 1992, in conjunction with dehorning of black rhinos in HNP, the white rhino programme has allowed the collection of considerable data and allowed detailed evaluation of dehorning. During 1992 and 1993 dehorning of both black and white rhino continued in the Parks and Wildlife Estate and private Conservancies, and continues through 1994, combined with a major radio-collaring exercise.

RESULTS AND DISCUSSION

Numbers: During the period 1991-1993, over 478 immobilisations of both black (n = 322) and white (n = 156) rhinoceroses were carried out. Of these, 360 animals were dehorned (white rhino, n = 136; black rhino, n = 224) as part of a management program to reduce the incentive to illegal hunters from Zambia (Table 1).

Research and Monitoring Program: A research and monitoring program was initiated in 1991 prior to starting horn removal on the white rhino in HNP. The aims of this program are:

- to document rates and form of horn regrowth,
- to gather information regarding poaching activity and rhino survival to assist in evaluation of the effectiveness of horn removal in lowering poaching risk,
- to investigate intra- and inter-specific behavioral interactions of dehorned rhino,
- to examine natural variation in horn and body sizes as they relate to dominance and reproductive performance.

Horn Regrowth: rates and form. Linear rates of horn regrowth were measured for white rhino adults immobilised in 1992, *ca* one year after horn removal (see Table 2 for measurements after dehorning, Table 3 for regrowth measurements). Average regrowth rates for adults did not differ significantly between the sexes for either anterior (males: n = 7, x = 6,8 cm/yr; females: n = 7, x = 7,0 cm/yr) or posterior horns (males: x = 3,4 cm/yr, females: x = 2,5 cm/yr). Rates of regrowth for all adults (n = 14) differed significantly between anterior (x = 6,7 cm/yr) and posterior (x = 2,9 cm/yr) horns. Thus, total horn regrown by white rhino adults averaged 9,6 cm/yr. Berger[1] reported mean rates of regrowth (summed for both horns) for desert black rhinos in Namibia as 8,7 cm/yr and 13,3 cm/yr for adults and juveniles, respectively; no significant differences were detected between the sexes. Although we observed some evidence of rubbing of horn bases one year after horn removal in white rhinos, most horn wear was restricted to the lateral surfaces. Therefore, measured changes in horn length closely reflect rates of horn regrowth. Data are presented for black rhinos (Table 4).

The key measure of interest in horn regrowth is the mass and, hence, monetary value of the horns. Converting measurements into mass values, we found that adult males (n = 38) carried an average mass of 6,24 kg while females (n = 45) supported 5,10 kg before horn removal. Over 90% of the horn was removed from adult males and over 93% from females. Based on regrowth measured in the first year, mean annual mass produced by adults is 0,56 kg and 0,45 kg for males and females, respectively. The shape of horns one year following horn removal was roughly cylindrical. Horn wear has begun to produce a more conical shape to the horns of black rhino 3 to 4 years after dehorning (Berger, pers. comm.). Some white rhino immobilized 10-13 months later exhibited slight abnormality in the shape of regrowth at the base .

Dehorning Tools and Procedure: Retrospective evaluation of horn cutting technique

Normal horn regrowth: Nineteen white rhino were re-immobilised in HNP to measure horn regrowth and evaluate form of regrowth. Normal regrowth was roughly cylindrical but evidence of cracking was seen in several horns. This normal regrowth was related to the correct cutting technique with the chainsaw during dehorning. Evidence of rubbing and shaping of horns was present.

Abnormal regrowth: This was evaluated and defined by developing 4 categories of scoring for regrowth:

Score 1 was normal regrowth.
Score 2 was abnormal regrowth with central cavitation, with outer walls intact, occasionally with a central plug.
Score 3 was partial cavitation with incomplete walls.
Score 4 was undercutting with top of the horn intact.

These abnormalities appeared to be directly related to cutting technique and exposure of the germinal area at the base of the horn. For the development of abnormal horn regrowth scored as 2, the sequence of events are likely as follows: exposure of the germinal area results in infection, introduced either by rubbing or mud. This focus of infection, which cannot drain due to the presence of solid horn on the outside, results in the development of a cavity or failure of horn regrowth centrally.

None of the regrowth abnormalities appeared to have affected the health of the rhino. In fact, in many instances, scar tissue was present with evidence of normal horn underneath. With these abnormalities it appears that normal horn regrowth would be achieved in time, but further monitoring needs to be carried out. Radio-collars were placed on some adult white rhino with abnormal horn regrowth.

The correct cutting technique for dehorning must involve initial cuts *ca* 6cm above the base of the horn. These can be angled or horizontal. The chainsaw blade should then be used to shave the horn to conform as close to the skull as possible. The shaving should be stopped as soon as droplets of blood appear centrally but the area must be solid when pressurised by a finger. Shaving further will result in exposure of the germinal area.

CONCLUSIONS

Mortalities associated with dehorning

With improvements in technique and drug combinations used to chemically immobilise white and black rhinos, based on data collected in Zimbabwe during the period 1991-1993 (> 300 individual rhino immobilisations), the overall mortality rate for a dehorning operation will probably be < 2%. The mortality rate for white rhino immobilisations (associated with prolonged recumbency) will be < 3.5%, and black rhino immobilisations < 1%. It is likely, over time, that the overall mortality rate will approach < 1%, especially for white rhinos.

Cost of dehorning

The cost of a dehorning exercise (with full complement of helicopter and aircraft) appears to have a direct relationship to the density of the rhino population, and the experience of the dehorning team. A low density rhino population will result in an escalation of costs due to difficulties in locating animals (even with ground tracking, fixed-wing support is necessary and judicious use of the helicopter essential). When a helicopter and fixed-wing are used in an operation, costs will tend to escalate. The most cost effective operations will be those carried out entirely on the ground, with only tracker support but time constraints would be a major limiting factor. This type of operation would apply to small, known populations in confined areas. Dehorning cost per animal have varied between US$350-US$1800[4].

Effectiveness as an Anti-Poaching Measure and Law Enforcement

Early in the dehorning program only eight dehorned white rhino were killed by poachers (known deaths) in the first 22 months. The number of incursions into HNP tripled in 1992, but the number of rhinos killed dropped from 2.0 to 0.5 per incursion. There were no incursions in 8 months in Matusadona National Park, following dehorning. Nineteen dehorned black rhinos are known to have died from poacher's bullets throughout the country up to the end of 1993, with two dying from other causes, in the space of 18 months. Contrast this with the 52 horned rhino that died between September 1991 and January 1992 (a 4-month period), throughout Zimbabwe, and an estimated loss rate of > 100 per year.

There are several important facts and observations that have become apparent with the Zimbabwe dehorning program:

1. Dehorning must be accompanied by an aggressive law-enforcement programme,
2. Behaviourial effects appear to be minimal, and in contrast to a recent report[2] several calves that were < 2 months old at the dehorning of their mothers have survived beyond 12 months in a predator-rich area. Dehorned black rhino have bred successfully and given birth, with one calf alive 4 months after birth.
3. Dehorning, if carried out by professionally trained individuals, has little effect on health, and the mortality rate should be less than 1%.
4. The deterrent effect of dehorning has taken at least 12 months to show signs of effect. There is evidence that Zambian poachers are still being paid (*ca* 50,000 kwachas) for horn stubs, but with the development of Intensive Protection Zones (IPZs) and Conservancies in Zimbabwe (several far from the northern border), the incentive to hunt is less, especially when the distances to reach certain rhino areas are considerable, returns are relatively small and chances of being killed or apprehended greater. For example, the IPZs in Zimbabwe are approaching manpower levels of one scout per rhino, with incentives and increased coverage.

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Table 1: Black (*Diceros bicornis*) and white rhinoceros (*Ceratotherium simum*) immobilised for dehorning, relocation and radio-collaring in Zimbabwe, 1991-1993. Numbers immobilised, dehorned, mortalities from unknown causes and those due to illegal hunting following dehorning.

	Immobilised	Dehorned	Mortalities[a]	Mortalities[b]	Mortalities[c]
White rhino	156	136	2	70[d]	6
Black rhino	322	224	7	19[e]	1

[a] Mortalities from unknown causes, could be due to natural mortality, trauma, or undetermined.
[b] Mortalities known to be due to illegal hunting following dehorning.
[c] Mortalities directly related to immobilizations.
[d] Loss of white rhino from illegal hunting that occurred during a 4 month period in early 1993 in Hwange National Park.
[e] This figure represents killing of dehorned black rhinos throughout the Parks and Wild Life Estate, from early 1992 until January 1994.

Table 2: White rhino (*Ceratotherium simum*) horn measurement data, before and after dehorning, collected from Hwange National Park, Zimbabwe 1991.

Measurement	Number	Mean	SE	Min	Max
Front horn length (cm)	68	47	2,8	3	97
Cut front[a] horn (cm)	41	4.5	0,29	1	9
Rear horn length (cm)	66	15	1	1	36
Cut rear[a] horn (cm)	40	3,6	0,22	1	6

[a] Measurement from skin to cut surface (side).

Table 3: White rhino (*Ceratotherium simum*) horn regrowth data, measured *ca* 1 year after dehorning from Hwange National Park, Zimbabwe 1992.

Age/sex	number	Front horn (cm/yr)	number	Rear horn (cm/yr)
Adults	14	6,7	14	2,9
Male	7	6,8	7	3,4
Female	7	7,0	7	2,5

Table 4: Black rhino (*Diceros bicornis*) horn measurement data, before and after dehorning, collected from the Sinamatella/Deka Safari Area, Hwange National Park, Zimbabwe 1992.

Measurement	Number	Mean	SE	Min	Max
Front horn length (cm)	58	37	1,9	2	61
Circumference (cm)	48	50	1,5	20	66
Cut front* horn (cm)	51	5,04	0,19	3	8
Rear horn length (cm)	57	18	1,06	1	39
Circumference horn (cm)	46	46	1,6	10	58
Cut rear* horn (cm)	51	3,4	0,13	1,5	5

* Measurement from skin to cut surface (side).