A STUDY ON THE DEHORNING OF AFRICAN RHINOCEROSES AS A TOOL TO REDUCE THE RISK OF POACHING

environmental affairs

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ENDANGERED WILDLIFE TRUST

Cover picture caption:
Dehorning of White Rhinoceros *Ceratotherium simum* in Hwange National Park during the early 1990s (Photo courtesy: M. Kock).

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ACRONYMS AND GLOSSARY

Acronym / term	Definition
Conservancy	A collaboratively managed wildlife reserve on private or communal land.
DEA	Department of Environmental Affairs
DNPWM	Department of National Parks and Wildlife Management
EWT	Endangered Wildlife Trust
Germinal layer	A vascular, generative layer of epidermis covering the nasal bones from which the horns grow.
IPZ	Intensive Protection Zone
IUCN	International Union for Conservation of Nature and Natural Resources
LRT	Lowveld Rhino Trust
MET	Ministry of Environment and Tourism
NEMBA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
PWMA	Parks and Wildlife Management Authority
SANParks	South African National Parks
SRT	Save the Rhino Trust
TOPS	Threatened or Protected Species Regulations, 2007
TRAFFIC	Wildlife trade monitoring network
WWF	World Wildlife Fund/World Wide Fund for Nature

1 EXECUTIVE SUMMARY

South Africa has experienced a massive surge in rhino poaching during the last three years. In response, the Minister of Water and Environmental Affairs convened a National Rhino Summit, in October 2010 to provide an opportunity for government and the industry to discuss the key interventions relating to rhino poaching, to identify additional initiatives and actions required to address the challenges, to harness further political and broader stakeholder commitment and to launch a strategy to address poaching. Based on the outcomes of the summit, the Department of Environmental Affairs (DEA) commissioned a dehorning impact assessment, to determine whether dehorning is an option in terms of securing rhino populations; a feasibility study to determine the viability of legalising trade in rhino horn in South Africa; and a global market research assessment to enable the Department and stakeholders to make informed decisions relating to key tools that could be used to reduce the threat to rhino populations from poaching.

Rhino dehorning has been used historically as a tool to reduce the threat of poaching in parts of southern Africa, and continues to be employed on a large-scale in Zimbabwe. Dehorning is contentious due to uncertainty regarding the effectiveness of the method at reducing poaching, and due to potential veterinary impacts and adverse effects on the behavioural ecology of rhinos.

This report is the product of the study on rhino dehorning and was conducted on behalf of DEA by the Endangered Wildlife Trust. The aim of the report is to provide clarity on the impacts and efficacy of dehorning and to identify the circumstances under which the intervention is most likely to be effective at reducing poaching. Key findings of the study are summarized below.

Historical and current use of dehorning

- Rhino dehorning was first practiced in Namibia, in Damaraland and part of Etosha National Park, and was undertaken in the country from 1989 until 1995.
- Dehorning would be considered again as an option in Namibia in the event of a significant elevation of poaching threat.
- Zimbabwe followed suit in the early 1990s and after an experimental dehorning phase in Hwange National Park, there was an attempt to dehorn the entire national rhino population.
- Dehorning continues to be undertaken in virtually all rhino areas in Zimbabwe: complete dehorning is attempted for small populations, and strategic horn removals targeting vulnerable individuals are practiced in large populations.
- Dehorning was also practiced on a small-scale in Swaziland in the early 1990s, in Hlane National Park.
- Dehorning was not employed historically in Kenya, but is currently undertaken strategically on a small-scale to reduce the risks of losing vulnerable animals in certain areas.
- Dehorning is not currently practiced in Botswana, Namibia, Tanzania, or Zambia as alternative security measures are preferred under current levels of threat.

- In South Africa, dehorning appears to be practiced to an increasing extent in the private sector, and has been undertaken in provincial parks in Mpumalanga and in Rietvlei Dam Nature Reserve in Gauteng.
- Dehorning is not undertaken in the SANParks estate or in any other provincial reserves.

Insights into the effectiveness of dehorning

Positive indications

- In Namibia between 1989 and the early 1990s, dehorning coupled with rapid improvements in security and funding for anti-poaching was perceived by stakeholders in that country to have contributed significantly to reducing losses to poaching, and not a single dehorned rhino was poached.
- Dehorning in Swaziland during the early 1990s, coupled with efforts to move rhinos to a smaller and more secure sanctuary within Hlane National Park seems to have been effective at reducing poaching of those animals, but may have simply shifted the focus of poachers to other rhino populations in the country.
- In Zimbabwe, the massive dehorning programme, coupled with the translocation of rhinos from vulnerable areas into well protected Intensive Protection Zones (IPZs) and conservancies away from the country's borders is perceived by stakeholders in the country to have contributed to reducing losses of Black Rhinos *Diceros bicornis* to poaching in the early 1990s.
- Rhinos that have been dehorned in recent years in the Zimbabwe Lowveld conservancies (Savé Valley Conservancy, Bubye Valley Conservancy) appear to have 29.1% higher chance of surviving than horned animals (du Toit 2011).
- In Mozambique, dehorning on a private ranch close to Kruger has been effective: no dehorned rhinos have been killed, whereas there were previously significant losses of horned rhinos.
- In Mpumalanga, tentative insights from the dehorning programme in the provincial parks suggest that dehorning has caused a reduction in poaching losses.
- Mpumalanga has 1,071 rhinos (excluding those in Kruger) of which 347 have been dehorned. Mpumalanga province started dehorning in August 2010, though several private owners started well before then. In 2009, 2010 and 2011 (up to the end of August) 6, 17 and 10 rhinos were poached respectively, of which one was dehorned.
- In the Hoedspruit area, following the widespread dehorning of rhinos in mid-2011, information was received by private landowners that a poaching group had decided to focus efforts on other areas where rhinos still retained their horns. However, rhino owners in that area acknowledge that it is too early to assess the efficacy of the dehorning programme.
- Most expert stakeholders surveyed during this study (n=67) thought that dehorning was either an effective means of reducing the poaching risk (39.4%) or effective under specific circumstances (33.3%).

- Most (71.7%) experts felt that dehorning can be an effective means of dissuading poachers from targeting a particular reserve, but 52.6% felt that once a poacher was in a reserve, he would be no less likely to shoot a dehorned rhino if such an animal was encountered, than a horned individual.

Negative indications

- In Hwange National Park, dehorning of White Rhinos in the early 1990s failed to protect them (as the majority of horned and dehorned rhinos were killed by poachers) due to a complete lapse in security for a period of six months 12-18 months after the rhinos were dehorned.
- Reserves that have been dehorned completely in Zimbabwe in recent years have still been severely affected by poaching, due to inadequate security in those reserves. For example, rhino populations occurring in Hwange National Park, Matobo National Park, Matusadona National Park, and Chipinge Safari Area have been almost completely dehorned in the last two years and yet have suffered severe poaching. Similarly, the rhino population of Chiredzi River Conservancy which was completely dehorned (but which had poor security and was heavily settled by subsistence farmers following land 'reform') was virtually eradicated by poachers between 2003 and 2007 (27 rhinos were poached, and the remaining two were translocated to a safer area).
- These experiences clearly demonstrate that dehorning in the absence of effective anti-poaching security for rhinos is ineffective at reducing poaching.
- By contrast, Malilangwe Trust where no dehorning has been done, but where there is excellent security has not lost any rhinos.
- In South Africa, at least five incidents have been recorded of dehorned rhinos being killed by poachers since 2008, including two in September 2011 when this report was being written. In one incident, a horned rhino was wounded by poachers, and then dehorned by management and placed in a boma, where poachers returned to kill the animal despite clearly being able to see that the animal was dehorned (F. Coetzee, pers. comm.).
- These experiences clearly highlight that dehorning in the absence of intensive security is likely to be ineffective, and also stress that horn stumps are still valuable to poachers.

Potential problems associated with dehorning

- Dehorning partially transfers the risk of horn possession from rhinos to the land manager, and also creates administrative burdens and costs through the time and effort needed to acquire permits, transport and store the horns.
- The permitting system for possessing, transporting and storing horn is considered by private rhino owners to be onerous and to impose security risks by providing a conduit for leakage of information on the whereabouts of horns or on planned transportation of horns.
- Immobilizations carry a risk to rhinos, though with improvements to drug combinations and well developed protocols, losses are typically minimal.

- There was significant controversy regarding the potential impacts of immobilizations for dehorning on the reproductive rate, and specifically inter-calving intervals, in Black Rhinos in Zimbabwe during the 1990s. However, the veracity of that research has been widely questioned and more recent data from Zimbabwean Lowveld conservancies suggest that dehorning has no impact on reproductive rates.
- Dehorning can cause damage to the horn base and deformed horn re-growth if the horn is cut too close to the germinal layer. Such problems were recorded during the early days of dehorning in Namibia and Zimbabwe, but are now largely avoided by leaving a sufficient horn-layer covering the vascular tissue. An unfortunate side-effect is that a reasonable quantity of horn remains on the animal after the dehorning process which may attract poachers. Data were collected on estimates of the quantity of horn remaining after dehorning, but the results are not presented due to possible security risks of divulging such information.
- Research from Namibia in the early 1990s suggested that horn size was closely related to dominance in Black Rhinos, suggesting that dehorning could have potentially serious social consequences. However, those research findings were based on small sample sizes (n=3), and since then, data from the Zimbabwe Lowveld Conservancies have emerged which indicate that dehorned rhinos are as likely to retain territories as horned individuals.
- The social and behavioural impacts of dehorning could potentially be more significant in small, fenced populations where rhinos occur at high densities, and particularly if the social structure is unstable due to a high turn-over of individuals within the population which may occur as a result of trophy hunting of animals, and live trade.
- Dehorning has been shown to reduce fighting-related mortalities among Black Rhinos in Zimbabwe.
- Research from Namibia in the early 1990s suggested that dehorning resulted in higher losses of Black Rhino calves to predation. However, those research findings were contentious due to small sample sizes and the possibility that observed trends were due to confounding factors such as intensive competition for food from domestic stock. Furthermore, experiences from Hwange National Park and data from Zimbabwe Lowveld conservancies suggest that the calves of dehorned female Black Rhinos are no more vulnerable to predation than those of horned rhinos.
- In general, dehorning is only likely to be considered under conditions of severe poaching, under which consideration of potential veterinary, behavioural or ecological problems associated with dehorning is likely to be secondary to the imperative of keeping the rhinos alive.
- Further research is urgently required, with cooperation of private rhino owners, to gain empirical data on the efficacy of rhino dehorning as a means of reducing poaching threat, and on potential impacts on social behaviour and reproductive output.
- Similarly, research is required to better understand poacher behaviour and the drivers thereof to identify the extent to which dehorning is likely to act as a meaningful deterrent.

Recommendations pertaining to dehorning

- The decision of whether to dehorn a rhino population or not will depend on a number of factors, including the level of poaching threat, the level of security in place, the availability of funds and the size, location and distribution of the rhino population in question (Figure 1).
- Due to the invasive nature of, and expense associated with dehorning, the intervention should only be considered under conditions of relatively severe poaching threat.
- Dehorning should only be considered where a baseline level of security is in place, otherwise rhinos are highly likely to be poached, regardless of their horn status. An exception to this rule may be where dehorning is used as an emergency interim measure to buy time to improve security, on the implicit understanding that dehorned rhinos are still vulnerable and that such security must be implemented urgently.
- Where there is no realistic expectation of implementing adequate security in a reasonable time frame to protect vulnerable populations, translocating rhinos to more secure locales is preferable to dehorning.
- Where sufficient funds are available for top quality security, dehorning may not be necessary.
- If dehorning is to be undertaken, an attempt should be made to dehorn the entire adult population in small populations (<30-40 individuals), although the practicality of total dehorning will depend on various factors including terrain, habitat and rhino density.
- All dehorning should be done in as short a time as possible to minimize potential behavioural impacts associated with having some individuals horned and others without horns, although such impacts are not necessarily significant.
- In larger reserves/populations, dehorning can be practiced strategically to reduce the vulnerability of highly visible individuals along boundaries, fence lines and roads.
- The ideal frequency of re-dehorning will depend on the level of threat: under conditions of severe threat, rhinos should be re-dehorned every 12-24 months, under conditions of intermediate threat 24-36 months should suffice, and under conditions of low threat, re-dehorning is probably not necessary.
- Dehorning is likely to be most effective if practiced by all, or a significant proportion of the rhino owners / reserves in a given area.
- All dehorning should be accompanied by publicity drives to ensure that poachers are well aware that the reserve in question is 'horn-free', to prevent a lag effect whereby poachers continue to target the area in the belief that the rhinos there are horned.

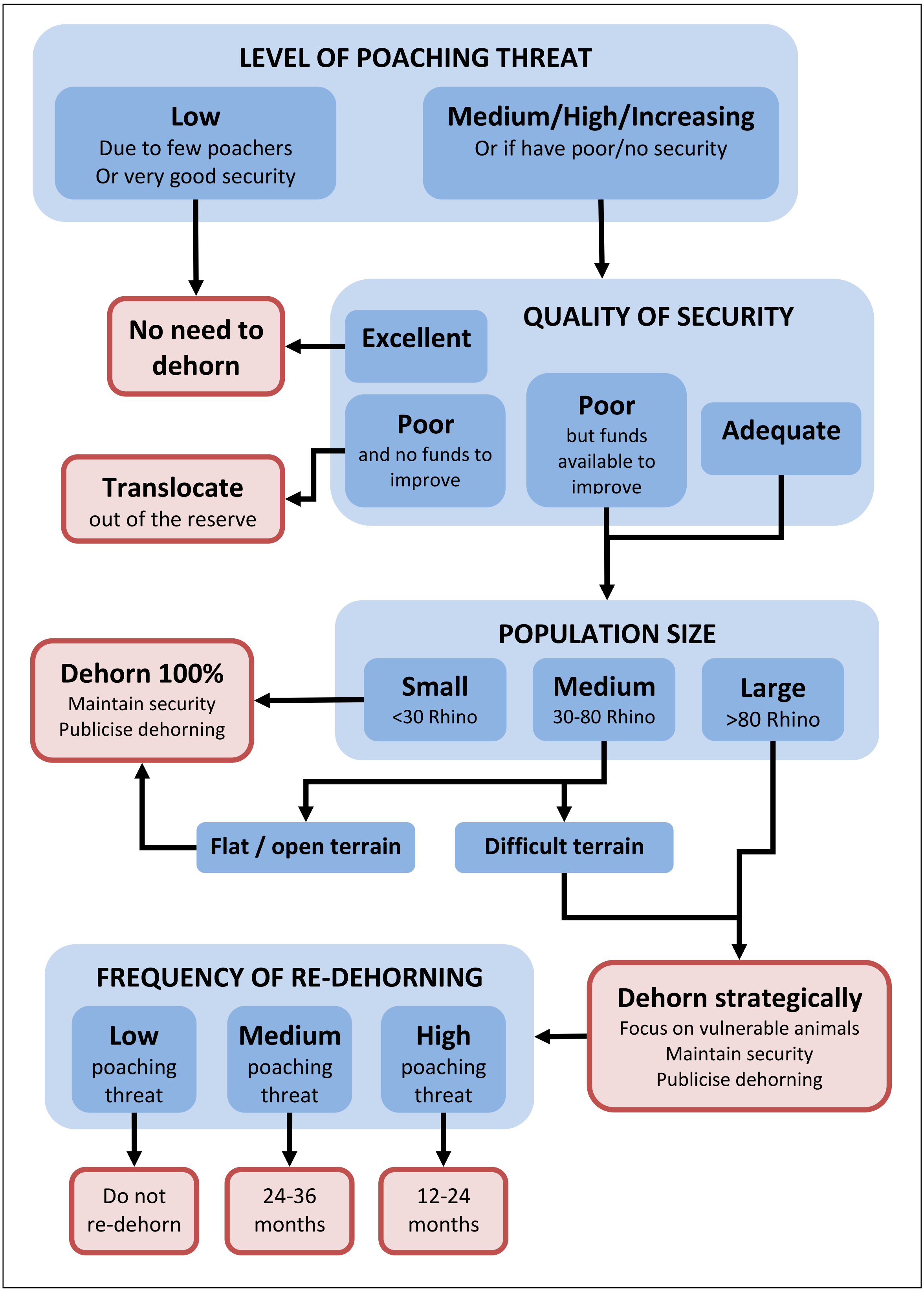

Figure 1: The circumstances regarding when and how dehorning should be used as a tool for reducing the threat from poaching

2 INTRODUCTION

The last few years have been eventful, difficult times for rhino conservation in South Africa. Since 2006, the focus of rhino poaching has shifted to southern Africa from East Africa and the Democratic Republic of Congo, and from 2006-2009, 95% of recorded losses occurred in South Africa and Zimbabwe (Milliken *et al.* 2009). These incidents represent the first significant poaching losses for South Africa since a spike in poaching in 1994 (Figure 2, TRAFFIC in press). Concurrently, abuse of legal trophy hunting through the sale of trophies to Asian nationals was resulting in significant quantities of legal horn entering international trade (as many as 1,061 horns from 531 rhinos during 2006-2008, Milliken *et al.* 2009). In response, hunting restrictions were implemented in 2009 (Gazette No. 32426, Government Notice 756). In addition, there was a fairly substantial internal trade of rhino horn from natural mortalities, privately owned stockpiles and dehorning within the private sector in South Africa, and a subsequent leakage of horns onto international markets (at least 50 horns per annum, Milliken *et al.* 2009; TRAFFIC in press). Recognition of these trends resulted in a moratorium on any trade in rhino horn being implemented in 2009 (Gazette No. 31889, Government Notice 148).

The majority of rhino poaching losses in South Africa have been recorded in Kruger National Park (hereafter, Kruger), followed by Limpopo, Kwa Zulu Natal and North West provinces (Figure 2). Of the 274 rhinos poached in South Africa in 2011 (January through the end of August), 94.2% were White Rhinos and the majority were killed on land managed by South African National Parks (SANParks) (Figure 3). During 2005-2010, most rhino poaching occurred in Kruger (TRAFFIC in press). However, the army was deployed in Kruger in early 2011 to address the poaching threat there, resulting in a partial shifting of the poaching threat to provincial reserves and the private sector (F. Coetzee, pers. comm.). Losses of rhinos in 2011 (January through the end of August) represent 1.4% and 0.8% of national White and Black Rhino populations respectively, and the population of Black Rhinos in South Africa continues to increase. According to data from SANParks, the White Rhino population declined slightly during 2009-2010 (Figure 4).However, that 'decline' was probably due to the introduction of different census techniques in Kruger during that time and in fact, the population is still believed to be increasing (M. Knight, IUCN African Rhino Specialist Group, pers. comm. November 2011).

Zimbabwe has also been affected by large-scale poaching since 2000. Severe poaching commenced earlier in Zimbabwe (during 2000-2005) than South Africa, after a period of several years with few losses (Milledge 2007). Zimbabwe has incurred proportionally worse losses than South Africa (21.2% of the population in 2008 [156 rhinos], 6.7% in 2009 [48 rhinos] and 7.6% in 2010 [52]), causing the combined rhino population to decline (from 734 in 2008, to 720 in 2009 and 684 in 2010) (J. Matipano, pers. comm., Du Toit 2011). Elsewhere in southern Africa, rhino poaching has been less severe in recent years, and only four individuals have been lost in Swaziland, Namibia and Botswana combined during the last five years (M. Reilly, Big Game Parks, pers. comm.; P. Du Preez, MET, pers. comm.; M. Ives, Botswana Rhino Management Committee, pers. comm.).

In terms of absolute numbers of rhinos lost, South Africa is easily the country that has been worst affected by poaching during the last three years. In response, to the upsurge in rhino poaching in South Africa, the Minister of Water and Environmental Affairs convened a National Rhino Summit in October 2010 to provide an opportunity for government and the industry to discuss the key interventions relating to rhino poaching, to identify additional initiatives and actions required to address the challenges, to harness further political and broader stakeholder commitment and to launch a strategy to address poaching.

Based on the outcomes of the summit, the Department of Environmental Affairs (DEA) commissioned a dehorning impact assessment, to determine whether dehorning is an option in terms of securing rhino populations; a feasibility study to determine the viability of legalising trade in rhino horn in South Africa; and a global market research assessment to enable the Department and stakeholders to make informed decisions relating to key tools that could be used to reduced the threat to rhino populations from poaching.

Rhino horn consists mostly of keratin, calcium and melanin and grows continuously (Trendler 2011). The horn includes cells which contain nuclear DNA, allowing the identification of individuals and matching of horns and carcasses through DNA-analysis (Harper et al. 2011). Rhino horns occasionally break off during normal behaviour and can be removed with a saw without adverse physical effects to the animal, so long as the horn is not cut too close to the germinal layer. Dehorning as a tool to reduce the risk of rhinos being poached for their horns involves the removal of the majority of the front and rear horns of rhinos while the animals are under anaesthesia (Atkinson 1996). The practice of dehorning is contentious and several authors have questioned the potential biological and behavioural impacts and there are doubts concerning the effectiveness of the method (Berger *et al.* 1993; Alibhai *et al.* 2001; Trendler 2011). The diversity of opinions on the efficacy and acceptability of dehorning were apparent during a workshop convened by the Endangered Wildlife Trust (EWT) on the topic in March 2011 (Daly *et al.* 2011).

This report represents the output of a study into the feasibility of dehorning as an anti-poaching tool and provides a collation of available knowledge on the potentials and impacts of dehorning as a tool for reducing poaching.

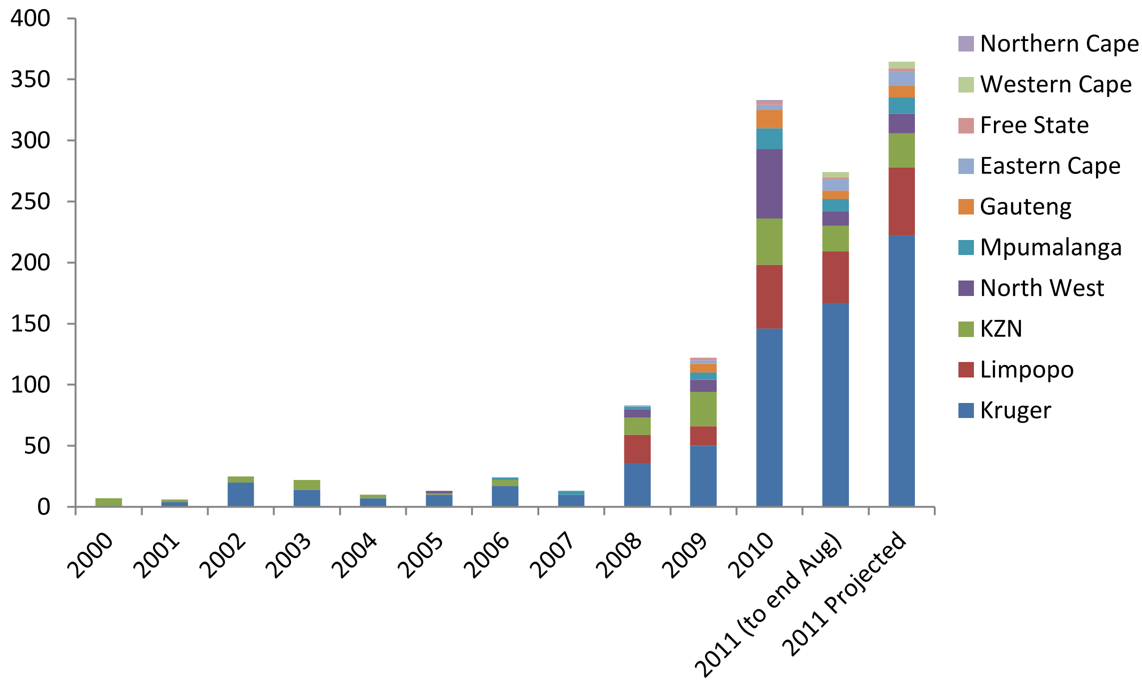

Figure 2: Trends in rhino poaching by province in South Africa (data for 2011 are for January-August) (Source: SANParks)

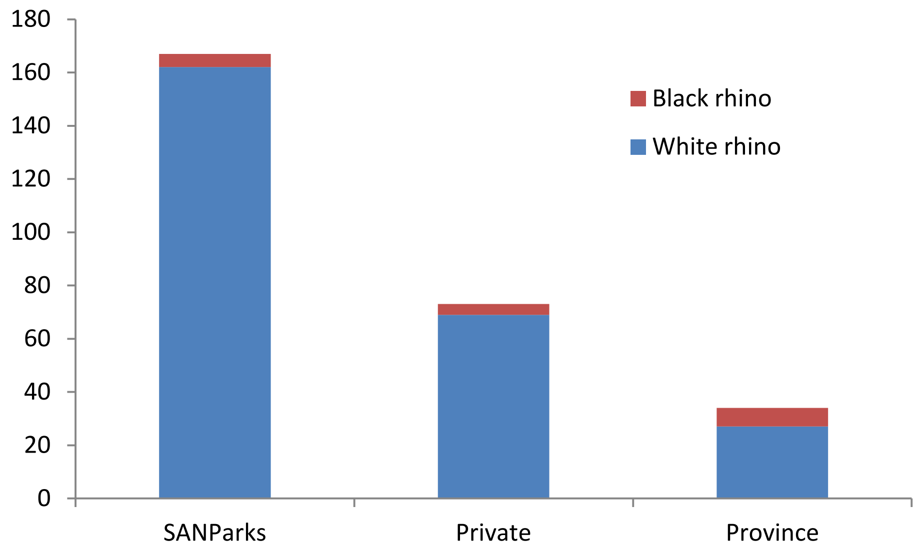

Figure 3: Proportional losses of Black and White Rhinos (Source: SANParks)

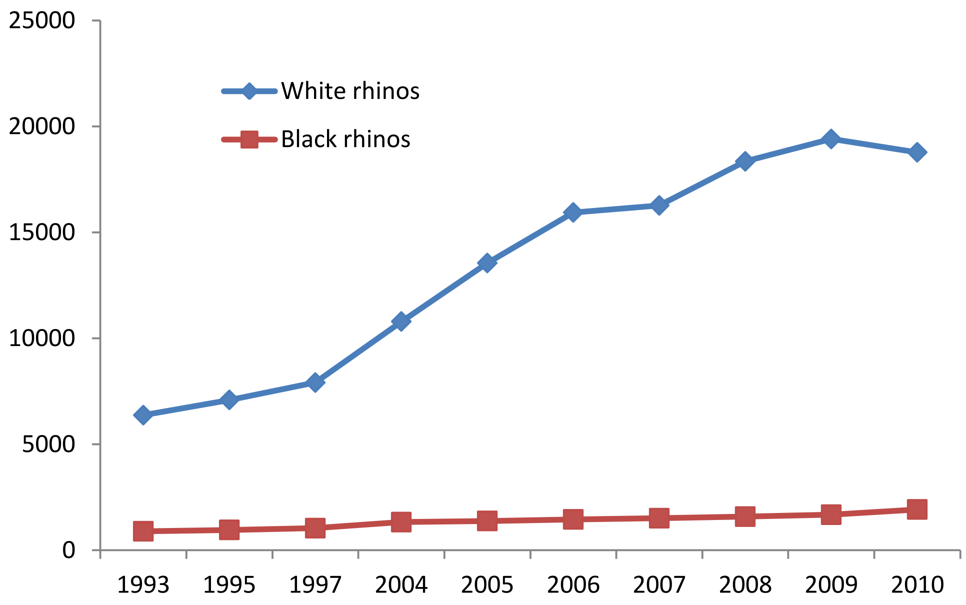

Figure 4: Rhino population trends in South Africa (Source: SANParks)

3 METHODS

Available information on dehorning was collated from the literature and via telephonic and in-person surveys of experts and rhino stakeholders. A total of 67 respondents were interviewed from South Africa, Botswana, Kenya, Namibia, Swaziland, Zambia and Zimbabwe, including national and provincial government workers, private rhino owners, non-governmental organization staff, veterinarians, game capture professionals, wildlife rehabilitation centre staff, tourism operators, and rhino biologists. Information from interviews is included throughout the report. Information was requested on an anonymous basis and so reference is not always made to the respondent(s) who provided certain pieces of information included in the report. Respondents were categorized as: Rhino owners/tourism operators (n=20); government officials (n=16); veterinarians and game capture teams (n=11); and NGO representatives and experts (n=20).

4 REASONS FOR THE RECENT SPIKE IN RHINO POACHING

The reasons for the spike in poaching are poorly understood, though demand in Vietnam for rhino horn may have been stoked by claims that the substance can cure medical conditions such as cancer (Milliken *et al.* 2009). In addition, the poaching spike appears to have coincided with restrictions on the trophy hunting of rhinos by Asian nationals and the moratorium on the local trade in rhino horn, though whether there was a causative relationship is not certain (Milliken *et al.* 2009). The most common explanations for the poaching spike among survey respondents were due to the recent demand for horn in Vietnam and due to the high prices of horn (Table 1).

Table 1: Possible explanations for the recent spike in rhino poaching in South Africa

Explanations	**% of respondents**
The recent demand for horn in Vietnam	43.3%
High horn price	43.3%
Increased disposable income among Asian communities who buy horn	33.3%
Increased demand for horn in China	26.7%
The moratorium on local horn trade and subsequent drying up of 'legal' supplies of horn	20.0%
Horn supplies from trophy hunting by Asians and illicit horn sales by private rhino owners stoked demand	13.3%

5 HISTORIC AND CURRENT USE OF DEHORNING AS A TOOL FOR REDUCING POACHING

5.1 NAMIBIA

5.1.1 Historic use of dehorning

Namibia was the first country to use dehorning as a tool to protect rhinos from poaching, commencing in 1989. After significant losses of rhinos during the 1970s, rhino poaching in Namibia slowed by 1983 (Lindeque 1990). During the remainder of the 1980s, Namibia suffered relatively low losses of rhinos to poaching (only 64 Black Rhinos and a handful of White Rhinos were lost during that decade, Martin 1994). However, in the latter part of the 1980s, poaching spiked. For example, in 1989, 16 desert adapted rhinos were killed in Damaraland (Leader-Williams 1993). Political changes in Namibia led to the withdrawal of the military and police from northern parts of the country, coinciding with a sudden increase in rhino poaching (Lindeque 1990).

The decision was taken to use dehorning of rhinos as an interim measure by the Ministry of the Environment and Tourism (MET) to mobilize greater resources and effort to address the poaching threat, starting in Damaraland. Several factors assisted in the decision to dehorn rhinos in that area, including (Geldenhuys 1994):

- The vast, wild nature and unprotected nature of northern Kunene, which is inhabited by pastoralists and nomadic farmers, many of whom were armed following the war, made protecting rhinos very difficult.
- There was a lack of sufficient personnel and funds to protect rhinos in the vast unprotected landscape.
- The openness of the terrain made it likely that poachers would be able to tell that rhinos had no horns before shooting them.
- It was possible to dehorn all animals, and thus avoid disadvantaging certain individuals within the population.
- Predators were rare in the region, and so the risk of elevated calf losses was low.
- The vegetation strata meant that rhinos were unlikely to need their horns for accessing food.
- It was felt that reintroducing rhinos into that extreme environment would be very difficult (because, *inter alia*, the animals would have to be taught to find water) and so achieving effective *in situ* conservation was considered paramount.

Rhinos were dehorned initially in Damaraland, and then in the 400 km^2 fenced-off Karas section of south western Etosha. Some rhinos were also dehorned in Waterberg Plateau National Park and on a private farm close to Okahanja. Dehorning was focused on the most vulnerable areas of Damaraland, and was strategic, leaving some individuals with horns, particularly in core areas of the rhino range. In the Karas section of Etosha, an effort was made to dehorn the entire population rhinos of sub-adult age (approximately 4 years) and older (25-30 individuals).

All rhinos that were dehorned in Namibia were also ear-notched (i.e. had small sections of ear removed to leave a pattern unique to each individual, enabling recognition of individual animals). The dehorning process was accompanied by a major media campaign designed to inform poachers that all rhinos had been dehorned and that all of their horns had been removed. Rhinos were re-dehorned in the Karas section of Etosha between 3-5 years after the initial dehorning exercise. Estimates of the numbers of rhinos dehorned varied among respondents interviewed (n=9), from 20-40 individuals in total. Dehorning was conducted for the last time in 1995 (du Preez 2011).

Dehorning in Namibia created significant controversy, centred around the effectiveness of the method, the ethics of removing horns from live animals and the potential impacts on calf survival (Berger & Cunningham 1994, 1996, 1998; Cunningham & Berger 1994). However, research that suggested that dehorning was responsible for reduced survival due to elevated predation was widely questioned, due to the low sample sizes and potential for confounding factors to explain observed patterns (such as intensive competition for food with domestic stock) (Lindeque 1990; Lindeque & Erb 1995; Loutit *et al.* 1994).

Not a single dehorned rhino was poached, and the poaching largely ceased after the dehorning exercise. Fewer than 10 rhinos were poached in Namibia in the two decades following the poaching spike in 1989-1991 (du Preez 2011). However, during the period that rhinos were being dehorned, a number of other interventions were pursued, which make it difficult to assess with certainty the extent to which dehorning was responsible for the cessation of rhino poaching. Other interventions included (du Preez 2011):

- A marked increase in anti-poaching effort.
- Establishment of specialized anti-poaching units.
- Implementation of training programmes for staff.
- Enlistment of experts to assist with law enforcement.
- Involvement of the Protected Resources Unit of the police in rhino poaching investigations.
- Capture of the poaching syndicates that had been killing rhinos.
- An increase in the penalties for rhino poaching.
- Provision of major funding support for rhino conservation by Save the Rhino Trust and WWF.
- Initiation of community-based natural resource management programmes which resulted in greatly elevated community buy-in for conservation efforts.

Of the eight Namibian respondents surveyed, six felt that the dehorning of rhinos helped to reduce poaching, and the remainder was unsure. There was some evidence that poachers entered rhino areas with the intention of poaching only to move on and look elsewhere on hearing that the rhinos had been dehorned (Morkel & Geldenhuys 1993).

5.1.2 *Current use of dehorning*

Namibia has not experienced the major poaching losses that have occurred in South Africa and Zimbabwe in recent years, and Black Rhino numbers have increased significantly since the poaching epidemic of the early 1990s (Brodie *et al.* 2011). In 2011 at the time of writing, for example, Namibia had lost only two rhinos to poaching. Consequently, dehorning is not currently undertaken or under consideration for use in Namibia. However, the practice has been retained as a potential option in the event of a major increase in poaching, and would be considered as a last resort (P. du Preez, MET rhino coordinator, pers. comm.).

5.2 ZIMBABWE

5.2.1 *Historic use of dehorning*

Zimbabwe suffered a major spike in poaching during the late 1980s and early 1990s, largely as a result of incursions by cross-border poachers. In response to the severe and sustained poaching, the Parks and Wildlife Management Authority (PWMA, formerly the Department of National Parks and Wild Life Management, DNPWM) established four Intensive Protection Zones (IPZs) within the National Parks Estate (Sinamatela [in Hwange NP], Matusadona NP, Matobo NP and Chipinge Safari Area) in which security was intensified. Rhinos were then translocated to the IPZs from the remainder of the park's estate where adequate protection was difficult to achieve. Rhinos were also translocated from the Zambezi Valley to the relatively more secure privately owned conservancies in the Midlands and Lowveld, located further from international borders.

Raoul du Toit and Mike Kock travelled to Namibia in January 1991 to observe the dehorning process underway there at the time. On their return, they recommended to the director of DNPWM that dehorning be implemented in Zimbabwe. During the three months in which the dehorning proposal was being considered, 30 black rhinos were poached in Matusadona National Park (Kock & Atkinson 1993). In the face of such unsustainable losses, and given severe fiscal constraints, dehorning was considered the only option available to stem losses. The proposal was accepted to provide breathing space while more sophisticated, long term mechanisms to reduce the poaching threat could be implemented (Atkinson 1996). The first dehorning was done in 1991 on an experimental basis on white rhinos in Hwange NP to enable techniques to be perfected prior to implementation on the more endangered black rhinos (Pinchin 1993). At the same time, a monitoring programme was implemented to identify potential impacts of dehorning (Rachlow 1993). A system was developed to notch the feet of rhinos to prevent trackers wasting time searching for rhinos that had already been dehorned, when searching for rhinos to dehorn (Kock & Atkinson 1993, Plate 1).

Continued poaching (notably in the Zambezi Valley) resulted in a national decree being issued that all vulnerable populations in Zimbabwe be dehorned (Rachlow 1993). The first black rhinos were dehorned in Matusadona National Park, and then the dehorning programme was implemented widely in Chizarira National Park, Chirisa Safari Area, Sengwa Research Area, Lower Zambezi, Hwange National Park, Matobo National Park and some private Lowveld conservancies (Kock & Atkinson 1993). In the areas where rhinos were dehorned, pamphlets were distributed among local communities to raise awareness of the fact that horns had been removed from the rhinos. All rhinos translocated to IPZs and conservancies after commencement of the dehorning programme were dehorned.

During the dehorning programme, it became apparent that the population estimate of 2,000 rhinos for Zimbabwe was a gross overestimate, and that as few as 440 individuals remained, despite 'operation stronghold' (a shoot-to-kill campaign against rhino poachers) which resulted in 150 poachers being killed (Kock & Atkinson 1993). At least 1,000 rhinos were killed by poachers in Zimbabwe during 1984-1992 (Kock & Atkinson 1993).

Plate 1: Spoor of a rhino following notching of the feet (used to enable trackers to determine whether an individual had already been dehorned when finding rhinos for dehorning) (Photo: Mike Kock)

The dehorning programme in Hwange NP was not successful due to the circumstances that followed the operation which resulted in failure to protect the population from poaching. In Hwange NP, a population of 100 or so white rhinos (90% of which were dehorned) was reduced to 5-6 individuals (Kock & Atkinson 1994; J. Rachlow pers. comm.). The failure to protect the rhino population in Hwange was ascribed to several factors:

- Twelve to 18 months after the dehorning programme, a freeze was placed on DNPWM activities within the park due to 'budgetary constraints' and so the team that had conducted the dehorning programme and anti-poaching teams were prevented from entering the areas in which the rhinos had been dehorned for several months. Consequently, security (which was supposed to have been elevated greatly) was cut back leaving the rhinos virtually unprotected for several months.
- There was a change in park warden during the dehorning programme and thus loss of experienced leadership.
- The dehorning process was incomplete and some of the rhinos retained horns, making the area attractive to poachers.
- The dehorned rhinos that were poached had at least 18 months of re-growth on their horns.

- After tracking dehorned rhinos in the vast area in which they occurred, poachers are believed to have killed those individuals so as to avoid having to track them again.

The key lesson from the Hwange failure was that dehorning in the absence of security is not effective (J. Rachlow, pers. comm.). After the initial failures in Hwange, the dehorning programme appears to have achieved success in other areas (affecting primarily black rhinos). In the Matobo NP, security was much better than in Hwange NP and the small size made protecting rhinos much easier. Consequently, losses of rhinos to poaching were low after the dehorning programme (J. Rachlow pers. comm.). Similarly, none of the rhinos translocated into Lowveld conservancies (and dehorned in the process) were poached during 1993-2000 (R. du Toit, pers. comm.).

All nine Zimbabwean respondents indicated that they thought that the dehorning conducted in the early 1990s was effective at reducing poaching, and a number of factors suggest that dehorning was effective (Kock & Atkinson 1994):

- Reduced numbers of rhinos killed per poaching incursion. The number of rhinos killed per poaching incursion in the main camp region of Hwange fell from 2.0 in 1992 to 0.5 in 1995 despite a tripling of the number of incursions.
- Reduced numbers of incursions in some parks. There were no incursions into Matusadona NP for eight months following dehorning.
- Reduced losses of dehorned relative to horned rhinos. Eleven dehorned black rhinos were killed in Zimbabwe (up to March 21 1993), compared to losses of 52 horned rhinos in a four month period during September 1991 and January 1992.
- Evidence of poachers having ignored dehorned rhinos. In Matobo NP and Hwange NP, there was evidence of poachers having approached dehorned rhinos on several occasions and leaving them without shooting (Kock & Atkinson 1993; B. O' Hara pers. comm.).
- Evidence of horn stumps being considered to be of lesser value than intact horns by poachers. A stump that was taken from a poached dehorned rhino was buried by a poacher (rather than exported) as it was presumably considered not to be worth the risk of transporting (B. O'Hara, pers. comm.). In several cases in Hwange where dehorned rhinos were poached, the poachers did not bother to remove the horn stump.
- Evidence of reduced quantities of horn being exported after the dehorning programme.

However, respondents did highlight a number of caveats. These included the fact that there are no empirical data concerning the efficacy of the dehorning programme in the 1990s, and while there was a notable reduction in poaching, other factors, such as the translocation of rhinos from vulnerable to more secure areas, likely also contributed significantly.

Atkinson (1999) estimated that during 1991-1994, 586 immobilizations were done in Zimbabwe (including 179 white rhinos and 407 black rhinos) and that approximately 400 rhinos were dehorned, comprising ~90.9% of the population of 440 individuals. Kock &

Atkinson (1994) provided a slightly lower estimate of the number of rhinos dehorned: 136 white rhinos and 224 black rhinos (~81.8% of the combined population).

As with Namibia, dehorning in Zimbabwe was controversial. Research from Hwange NP suggested that widespread immobilization associated with dehorning was resulting in an increase in the inter-calving interval (Alibhai *et al.* 2001). Though the veracity of those research findings was widely questioned (D. Cumming pers. comm.), DNPWM abandoned the dehorning programme under pressure from animal welfare groups (Atkinson 1996).

5.2.2 Current use of dehorning

Poaching in Zimbabwe occurred at extremely low levels during 1995-2002. In 2003, however, there were major poaching losses as gangs hit a number of rhino areas sequentially: starting in Matusadona (where most of the extant population of rhinos was killed), moving to Sinamatela IPZ (where 36 rhinos were killed), and moving to Midlands Conservancy and then Bubiana Conservancy (N. Anderson pers. comm.). Dehorning re-commenced 2002 (practiced by the Lowveld Rhino Trust and the NGO AWARE, with permission of PWMA) coupled with a programme to move rhinos out of portions of the Lowveld conservancies that had been settled by subsistence farmers during the land reform programme.

The current approach to dehorning is somewhat variable, reflecting the opinions of the different stakeholder groups involved and the variable circumstances in which rhinos are conserved. In areas with small populations, an attempt has been made to dehorn all rhinos, including in: Matobo and Matusadona National Parks, Chipinge IPZ, Sinamatela IPZ, and Midlands Conservancy. In the large Lowveld conservancies (Bubye and Savé Valley) with large rhino populations, rhinos are dehorned strategically and opportunistically (Plate 2). Rhinos in vulnerable areas of those conservancies are dehorned, and other individuals are dehorned in the process of ear notching procedures. An average of 62 rhinos has been dehorned in the Lowveld conservancies per year during the last three years, amounting to 10-12% of the population in such areas (du Toit 2011). A further 76 rhinos were dehorned in the PWMA estate in 2010 (49.0% of the population, L. Marabini pers. comm.). With the exception of Malilangwe, which has exceptional high-intensity security, partial or complete dehorning has been conducted in every area containing rhinos in Zimbabwe within the last 24 months.

Available data on the effectiveness of current dehorning efforts in Zimbabwe are scarce. However, several anecdotes point to the importance of security, and ineffectiveness of dehorning as a standalone strategy:

- The reserve which has arguably the best anti-poaching security in Zimbabwe, Malilangwe Trust, has experienced extremely low losses of rhinos (0.3% of the population per year) despite not dehorning (Du Toit 2011).
- By contrast, rhino losses were 10 times greater in three poorly protected populations (Chipinge Safari Area, Matobo National Park and Hwange National Park) despite the fact that a mean of 41% of those populations were dehorned at the time the poaching occurred (Du Toit 2011)
- The rhino population of Chiredzi River Conservancy, which had poor security and was heavily settled by subsistence farmers following land 'reform' (Lindsey *et al.* 2011) was completely dehorned but was virtually eradicated by poachers (27 of 29 animals were lost during 2007-2010 and the remainder was subsequently translocated to more secure areas) (N. Anderson pers. comm.).

- In 2011, the majority of rhinos poached in Zimbabwe had been dehorned within the last 12-18 months, with particularly high proportional losses in areas where most or all rhinos have been dehorned.
- In Savé Valley Conservancy, six rhinos that were poached during January – August 2011 had all been dehorned within 19 months (and one rhino was killed within 24 hours of being dehorned, and another within five days of dehorning, Plate 3).

Plate 2: Black rhino being dehorned in Savé Valley Conservancy (Photo: Chap Masterson)

Plate 3: This black rhino was dehorned by the Lowveld Rhino Trust in Savé Valley Conservancy. Within 24 hours the rhino was shot multiple times by poachers who hacked the horn stumps off. Miraculously the rhino survived for several days with horrendous wounds. Attempts to provide veterinary care to the animal failed and after a few days it was euthanized. Photos: Chap Masterson.

Despite these failures, 100% of Zimbabwean respondents considered dehorning to be an effective intervention at reducing poaching during current conditions (albeit with numerous caveats). In line with these opinions, data from the Lowveld conservancies indicate that the mortality rate is indeed lower among dehorned than non dehorned rhinos (Table 2, χ^2=3.5, *d.f.*=1, *p*=0.0578), Lowveld Rhino Trust, unpublished data).

Table 2: Relative losses of horned versus dehorned rhinos to poaching in the Zimbabwe Lowveld Conservancies (du Toit 2011; Lowveld Rhino Trust, unpublished data)

	2007	2008	2009	2010
Number of horned rhinos	322	269	269	303
Number of dehorned rhinos	72	105	72	57
Horned rhinos lost to poaching	24	51	62	13
Dehorned rhinos lost to poaching	3	19	3	3
% of horned rhinos poached	7.5%	18.9%	23.0%	4.3%
% of dehorned rhinos poached	4.2%	18.1%	4.2%	5.3%

Raoul du Toit of the Lowveld Rhino trust concludes that "dehorning can be effective in reducing poaching of rhinos unless the risk to poachers of being detected is so low that it is still worth the poachers while obtaining horn stubs".

5.3 SWAZILAND

5.3.1 Historic use of dehorning

Swaziland endured severe rhino poaching during 1988-1992, when >80% of the nation's rhinos were killed (http://www.biggameparks.org/conserv_grime.html). In response, 12-15 White Rhinos were dehorned in Hlane Royal National Park. The dehorning was part of a combined operation, which included the arming of rangers with automatic weapons and the movement of dehorned rhinos into a fenced IPZ (http://www.biggameparks.org/conserv_grime.html; M. Reilly, pers. comm.). Two incidents were recorded where poachers' spoor was recorded approaching rhinos and then leaving the animals without shooting, presumably having noted that they had been dehorned (M. Reilly pers. comm.). The dehorning was thus considered to have been an effective measure for protecting the animals that had been dehorned, though there was a suspicion that the intervention served to transfer the threat to non-dehorned rhinos (M. Reilly pers. comm.).

5.3.2 Current use of dehorning

Since the Swaziland 'rhino wars' of 1988-1992, Swaziland has lost only two rhinos (M. Reilly, pers. comm., September 2011). Dehorning is not currently practiced in Swaziland, but would be considered in the event of an extreme poaching threat.

5.4 KENYA

Dehorning is not widely practiced as an anti-poaching measure in Kenya though the idea is being discussed on a national level (e.g. a meeting was recently held in Laikipia by the National Association of Private Rhino Sanctuaries to discuss the issue). Several northern White Rhinos which are being conserved on a Laikipia ranch are routinely dehorned due to their exceptional conservation value. In addition, several vulnerable animals (perhaps 25-30 individuals) have been dehorned on private land and in the parks estate (B. Okita, Kenya Wildlife Service, pers. comm.). A hand-raised tame southern White Rhino was recently dehorned on a Kenyan ranch and subsequently killed by poachers who took the horn stump.

5.5 OTHER COUNTRIES

Dehorning is not currently practiced in Tanzania, Zambia or in the Botswana parks estate. While some dehorning may be occurring on private game ranches in Botswana, there have been no requests for permission to dehorn rhinos at the Botswana Rhino Management Committee (M. Ives, pers. comm.). Several rhinos have been dehorned on a private ranch in Mozambique adjacent to Kruger. The individual who dehorned those rhinos indicated that the intervention has been a success: no dehorned rhinos have been killed, whereas there were previously significant losses of horned rhinos.

5.6 SOUTH AFRICA

5.6.1 History of dehorning

South Africa was not exposed to the poaching pressure experienced by other southern African countries during the 1980s and 1990s. Consequently, dehorning was not used as an anti-poaching deterrent until recently.

5.6.2 Current use of dehorning

During the mid 2000s, an unknown number of private rhino owners were dehorning rhinos specifically to acquire horn to trade within South Africa. In some cases, landowners were convinced by veterinarians of the threat to their rhinos from poaching, and offered free or cheap dehorning services in exchange for the horns (anonymous survey respondent, pers. comm.). Following the moratorium on local trade in rhino horn in 2009, the practice of dehorning specifically to acquire horn to sell appears to have declined significantly in prevalence (though data on numbers are not available). However, with the dramatic increase in rhino poaching since 2008 (Figure 2), the prevalence of dehorning as an anti-poaching tool has increased on private land.

While no data are available on the prevalence of dehorning, discussion with stakeholders suggests the practice appears to be most common in North West (home to 6.3% of the country's white rhinos, Castley & Hall-Martin 2005), Limpopo (which holds 50.8% of South Africa's white rhinos), and Mpumalanga (which holds 15.8% of the white rhino population). However, dehorning is occurring to some extent in all provinces. The prevalence of dehorning appears to be lowest in the Free State and Northern Cape.

On state land dehorning is currently only practiced on a number of the provincial parks in Mpumalanga and on Rietvlei Dam Nature Reserve in Gauteng, and has not been pursued as an option on SANParks land or in other provincial parks. In Mpumalanga, the decision was taken to dehorn after a severe bout of poaching in which 12 rhinos (42% of the population) in one reserve was destroyed by poachers.

Estimates of the prevalence of dehorning among private rhino owners vary between 5 and >50% (there are 329 private reserves with White Rhinos [2005 data], and 18 to 26 with Black Rhinos [2007 data], TRAFFIC in press 2009). It seems likely that the percentage of rhino owners who dehorn is lower than the percentage of individual rhinos on private land that are dehorned, as one particularly large-scale, multi-site rhino owner dehorns all of his rhinos as an anti-poaching deterrent and stockpiles the horns. In the Hoedspruit - Gravelotte area of Limpopo Province, from mid-2011 there has been an ongoing, coordinated effort among multiple landowners to dehorn their rhinos and publicize the area as a rhino-horn free zone.

To date, no data exist on the prevalence or effectiveness of dehorning in South Africa, partly because the practice is a relatively new phenomenon in the country. At least five dehorned rhinos have been lost to poaching in South Africa during 2008 to October 2011 (F. Coetzee, pers. comm.). However, information on the total number of rhinos that have been dehorned is extremely difficult to obtain, making assessment of the effectiveness of the intervention challenging. Some landowners are believed by a proportion of survey respondents to have dehorned illegally to sell horn, and such individuals are unlikely to speak openly about the practice. A carefully designed study is required to monitor the effectiveness of dehorning over time involving landowners willing to share data on rhino population sizes, poaching losses, dehorning prevalence and security interventions (see the section below on required research).

Early indications from Mpumalanga suggest that dehorning may be having a positive impact. Mpumalanga has 1,071 rhinos (excluding those in Kruger) of which 347 have been dehorned. Mpumalanga province started dehorning in August 2010, though several private owners started well before then. In 2009, 2010 and 2011 (up to the end of August) 6, 17 and 10 rhinos were poached respectively, of which one was dehorned. The dehorned rhino was believed to have been killed by an inexperienced poacher who was unaware of the dehorning programme. A group of poachers that had been targeting one particular reserve appeared to move on after the dehorning programme was initiated.

In Hoedspruit, following the dehorning of rhinos in mid-2011, information was received by private landowners that a poaching group had decided to focus efforts on other areas where rhinos still retained their horns. However, rhino owners in that area acknowledge that it is too early to assess the efficacy of the dehorning programme.

Several respondents indicated that rhino security tactics on private land vary widely, from security systems with high densities of well trained and armed scouts, very high frequency (VHF) transmitters (used for radio telemetry), micro chipping of rhinos (used for individual recognition of rhino carcasses and/or their horns), aerial surveillance, intelligence systems, daily monitoring of rhinos, daily boundary patrols, and community-outreach programmes to scenarios where absentee landowners have little or no security specific to rhinos. Such weak security appears to be less common in KwaZulu-Natal, where ranchers have a long tradition of anti-poaching security due to the long-standing threat from bushmeat poaching.

6 LEGAL CONSIDERATIONS PERTAINING TO DEHORNING IN SOUTH AFRICA

A restricted activity involving a specimen of a listed threatened or protected species may not be undertaken without a permit issued in terms of Chapter 7 of the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004). The Threatened or Protected Species (TOPS) regulations further regulate the aforementioned permit system. The TOPS regulations were Published in Government Gazette No 29657 Notice No R152 on 23 February 2007 and subsequently amended on several occasions. Both Black and White Rhino are listed in terms of Section 56(1) of the National Environmental Management Biodiversity Act, 2004 and permits are required to authorise the carrying out of restricted activities involving these species. Picking parts of, cutting or chopping off parts of threatened or protected species (and thus dehorning of rhinos) constitutes a restricted activity. The Department of Environmental Affairs considers dehorning as an acceptable interim security measure subject to the requirements of the law, but dehorning is not currently exercised as a security intervention in national parks (Meintjes 2011).

Horn obtained from dehorned rhinos must be photographed, measured, micro chipped and details of the horns submitted to nature conservation authorities. Trade in rhino horns and derivatives is prohibited in terms of a national moratorium which was published in Gazette No. 31899 (Government Notice 148). A number of permits are required for a private landowner to dehorn rhinos:

- Standing permits may be issued to the owners of game farms who register their game farms, and may make provision for restricted activities such as possession of the rhinos to be conducted on an ongoing basis.
- Ordinary permits are required for dehorning if it is the owner that will be doing the dehorning.
- Ordinary permits are required for dehorning if a veterinarian will be carrying out the dehorning and darting the animal.
- An **ordinary** permit is required for the restricted activities of destruction of horns, if the owner of the horns intends to destroy the horns.
- A possession permit is required for possession of rhino horns resulting from dehorning, for which the owner would be required to submit information on horn measurements such as the circumference at the base, the length, weight and micro-chip number
- If the horns are to be stored in a different province from where they were removed, an ordinary permit is required for the conveyance of the horns. In addition, both provincial export and import permits may be needed. In some cases, integrated permits may be issued for the transportation or possession of horns

7 THE DEHORNING PROCESS

7.1 RHINO CAPTURE

The techniques for capturing and immobilizing rhinos are well documented (e.g. Mackenzie 1993; Kock *et al.* 2006; Morkel & Kennedy-Benson 2007) and will not be repeated here. The method of darting rhinos for the purposes of immobilizing them for dehorning depends on the circumstances. More often than not, rhinos are darted from helicopters due to their manoeuvrability, due to the fact that rhinos can be herded away from dangerous obstacles, and because helicopters reduce the likelihood of rhinos being lost after darting. To cut costs in large free-ranging populations, fixed-wing spotter planes and ground-based tracker teams are often used to find rhinos prior to use of the helicopter. In Namibia and Zimbabwe, trackers were/are used to seek rhino spoor to cut down on flying time (Kock & Atkinson 1993; Morkel & Geldenhuys 1993). In some cases, particularly on smaller private properties, rhinos (most commonly White Rhinos) can be darted from the ground.

7.2 DEHORNING TECHNIQUES

During early efforts to dehorn rhinos, the recommended procedure was to cut until a few drops of blood were observed (Kock & Atkinson 1994a). However, the method has since be refined, as cutting too close to the germinal layer can result in infections and deformed horn re-growth (Plate 4 to Plate 7). The basic procedure for current dehorning is as follows (taken from Morkel & Kennedy-Benson 2007 and from feedback from survey respondents):

- With a felt tip pen, mark the front horn 7 cm from the base, and 5 cm from the base for the back horn (note: the survey respondents with personal experience of dehorning [n=33] suggested cutting mean distance of 8.8 ± 0.8 cm from the horn base for the front horn (range 4-20 cm) and 5 ± 0 cm for the back horn).
- Using a chainsaw or cross-cut wood saw, cut the horn off horizontally. The advantage of a chainsaw is that the dehorning can be done rapidly, thus reducing the down-time and risk to the animal.
- If using a chainsaw, ensure that the chain on the chainsaw is not fitted too loosely, and have two spare blades at hand.
- Don't cut the horn too low (e.g. lower than 7 cm from the base on the anterior horn) and ensure that a reasonable cap of horn is left over the germinal layer for protection (1.5 – 2 cm).
- Make sure the rhino's eyes are well-covered to prevent damage from the heat of the chainsaw's exhaust (Plate 8).
- Ensure the exhaust does not blow into the rhino's nostrils.
- Block the rhino's ears to prevent damage from the noise of the saw.
- Hoof clippers should be used to trim off the extra horn and round off the stump (Plate 9).
- Smooth the stump with a coarse rasp and apply Stockholm tar to prevent rapid drying and cracking of the moist horn base (which can lead to infection) (Plate 10).

- Approximately 350 grams of flakes are produced when dehorning a White Rhino with a chain / oscillating saw. These should be collected and stored with the horn.

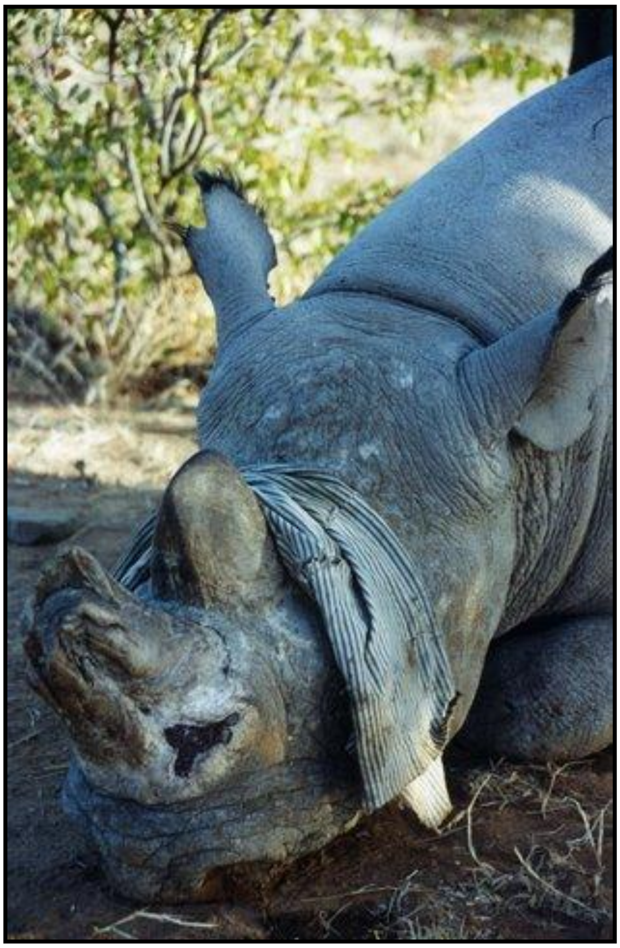

Plate 4: **Deformed horn re-growth in a black rhino dehorned in Namibia (Photo: Hartmut Winterbach)**

Plate 5: Pus emanating from a cavity in a black rhino horn in Namibia. This rhino had been dehorned several years previously, at which time the germinal layer of the horn had been damaged resulting in a long term infection (photo and explanation, H. Winterbach).

Plate 6: Deformed horn re-growth in a white rhino dehorned in South Africa (picture credit W. Boing).

Plate 7: Stumps removed from rhinos that were dehorned several years previously in Namibia, showing the hollow form of horns that re-grew following dehorning that involved cutting too close to the germinal layer.

Plate 8: Black rhino being dehorned in Savé Valley Conservancy: note the material used to cover the eyes and cords attached to ear plugs to prevent damage from the heat and noise of the chain saw respectively (Photo: C. Masterson)

Plate 9: **Trimming the edges of the horn to reduce the amount of horn remaining on the animal and to reduce the risk of the horn stump cracking (Photo: Mike Kock).**

Plate 10: **Stockholm tar is pasted on the horn stumps after dehorning to prevent rapid drying out and splitting of the moist horn base (Photo: Mike Kock).**

8 PRACTICAL CONSIDERATIONS ASSOCIATED WITH DEHORNING

8.1 ECONOMIC CONSIDERATIONS

Dehorning is a costly exercise due to the effort of finding the animals, and the costs associated with the immobilization process. Actual costs of a dehorning operation will depend on a number of factors, including (Kock & Atkinson 1993; EWT 2011): rhino population density (which has a strong inverse relationship on the length of time taken to find the rhinos); the size of the area; the vegetation and terrain; the degree of habituation of the rhinos; whether rhinos will have to be darted from a helicopter, or if they can be darted from the ground; the degree of remoteness of the area and extent of road penetration (which will affect the ferrying costs for aircraft and the veterinary team); and, whether the reserve in question has in-house veterinary capacity and equipment. In Zimbabwe, for example, the costs of dehorning in the early 1990s ranged from US$500 (R1,380 using exchange rates from that time) in Hwange National Park (where the rhinos occurred at higher densities in smaller areas, with relatively easy terrain) to US$5,000 (R13,800) per animal in Matusadona National Park (where the rhinos were widely dispersed across large areas) in the early 1990s (M. Atkinson pers. comm.). In Namibia, dehorning was estimated to cost US$1,400 [R3,864]/rhino (Cunningham & Berger 1994) to US$1,500 [R4,140]/rhino (Morkel & Geldenhuys (1993).

Published estimates of the current cost of dehorning vary from: R5,000 (US$620 per rhino (estimated for Kruger National Park) and R8,000 (US$1,000) per rhino (estimated for private land) (EWT 2011; Trendler 2011). Estimates presented in Trendler (2011) suggest that a once-off dehorning of Kruger National Park's rhino population (which stands between 9,000-12,000 individuals) would cost R47-70 million (US$5.8-8.8 million). During surveys, respondents estimated that dehorning costs R7,785 (US$973) ± 640 per rhino. However, costs may be as low as R1,000-2,000 (US$125-250) if the rhinos can be darted from the ground (which is sometimes possible in small reserves, particularly with White Rhinos), or as high as R20,000 (US$1,600) in difficult terrain and where populations are dispersed. A breakdown of the current costs of dehorning in Zimbabwe is provided in Table 3.

Thirty-percent (30.2%) of the 67 respondents indicated they felt that dehorning is a financially viable intervention, while 26.4% thought that it might be, depending on various caveats. Forty-two percent (42.1%) felt that dehorning is a practical option, while 31.6% thought it might be, again depending on certain caveats. The most common caveats were that dehorning is only practical and affordable in small populations and in small areas, and that it is not practical or affordable in larger areas (Table 4). Rhino owners typically considered rhino dehorning to be a practical 'doable' option, but not a financially viable one, due to the costs involved (Table 4).

8.2 HORN RE-GROWTH AND OPTIMAL FREQUENCY OF RE-DEHORNING

Black Rhinos are estimated to carry a mean of 2.65 kg of horn material (from a representative sample of a population, including both sexes and various ages, Pienaar 1991). Male and female White Rhinos in Zimbabwe were estimated to have carried a mean of 6.24 and 5.10 kg of horn respectively prior to dehorning (Kock & Atkinson 1993). Dehorning is estimated to result in the removal of 90% and 93% of the mass of horns in male and female White Rhinos respectively (Kock & Atkinson 1993). The rate of re-growth of horns after dehorning is similar for both Black and White Rhinos (

Table 5).

Authors	Anterior horn re-growth/year	Posterior horn re-growth /year	Cumulative annual horn mass re-growth	Ideal frequency of re-dehorning
	Black Rhinos			
Morkel & Geldenhuys (1993)	8 cm	5 cm	No data	12-24 months
Cunningham & Berger (1994)	6 cm (8.9 in s.adults)	2.7 cm (4.4 in s.adults)	No data	No data
Trendler (2011)	No data	No data	No data	18-24 months
Rachlow *et al.* (1993)			0.54 kg - adult 0.33 kg - juv	
	White Rhinos			
Rachlow & Berger (1997)	6.7 cm	2.9 cm	M - 1.30 kg F – 0.65 kg	14-17 months (depending on sex/age)
Kock & Atkinson 1993	M - 6.8 cm F – 7.0 cm	M – 3.4 cm F – 2.5 cm	M- 0.56 kg F – 0.48 kg	No data No data
Atkinson 1996	-	-	-	18-24 months

Table 3: A breakdown of costs associated with dehorning in large Zimbabwean conservancies (3,000-3,500 km^2) (from a dehorning exercise in June 2011, when rhinos were dehorned at a rate of 35 in 8 days, C. Masterson, pers. comm.)

Item	ZAR	USD
Helicopter time - approximately an hour per rhino (depending on the remoteness of the location, rhino population density and size, etc)	R22 – R3,400 R44 – R4,250	R22- $425 R44 - $584
Spotter planes - ~0.4/hr used per rhino	R800/hour	$100/hour
Three vehicles (100 km per rhino per vehicle including ferry costs)	R455/rhino/vehicle	$57/rhino/vehicle
Veterinary expertise	R3500-R6500/day	$437-813/day
Microchips	R100 each	$12.5 each
Immobilizing drugs – range presented applies for both Black and White Rhinos (depending on the age and size of the animal and degree of price mark-up by the veterinarian)	R1,000-R1,500	$125-188
Approximately 12 trackers (for finding rhinos in large, wild areas)	R80-160/person /day	$10-20 per person per day
Staff costs other than a vet per rhino – including 12 trackers and 5 labourers	R2,000/ month/person	$250/month/person
A ground manager to coordinate monitoring of rhinos and logistics	R32,000/month	$4,000/month

Table 4: Respondents' answers when asked if dehorning is a financial viable or practical conservation intervention

	Yes	No	Depends
Is dehorning financially viable? (All respondents)	30.2%	43.4%	26.4%
Vets/capture teams	33.3%	22.2%	44.4%
Rhino owners/reserve managers	33.3%	50.0%	16.7%
NGOs/experts	26.7%	40.0%	33.3%
Government officials	23.0%	46.2%	30.8%
Is dehorning a practical intervention? (All respondents)	42.1%	26.3%	31.6%
Rhino owners/reserve managers	61.1%	27.8%	11.1%
Vets/capture teams	42.9%	14.2%	42.9%
NGOs/experts	35.3%	23.5%	41.2%
Government officials	28.6%	35.7%	35.7%

Caveats/explanations	% of respondents providing caveat
Only practical/affordable in small populations/areas	42.2%
Not in large, free ranging populations	31.0%
Dehorning is not viable as sale of horn is prohibited	19.6%
Not viable due to the costs of storing horns	15.2%
If done in combination with other operations	14.3%
Money would be better spent on other interventions	13.6%
Not viable without donor support	11.1%

Table 5: Estimates of annual re-growth of the anterior and posterior horns and horn mass, and the optimal frequency of dehorning

Authors	Anterior horn re-growth/year	Posterior horn re-growth /year	Cumulative annual horn mass re-growth	Ideal frequency of re-dehorning
	Black Rhinos			
Morkel & Geldenhuys (1993)	8 cm	5 cm	No data	12-24 months
Cunningham & Berger (1994)	6 cm (8.9 in s.adults)	2.7 cm (4.4 in s.adults)	No data	No data
Trendler (2011)	No data	No data	No data	18-24 months
Rachlow *et al.* (1993)			0.54 kg - adult 0.33 kg - juv	
	White Rhinos			
Rachlow & Berger (1997)	6.7 cm	2.9 cm	M - 1.30 kg F – 0.65 kg	14-17 months (depending on sex/age)
Kock & Atkinson 1993	M - 6.8 cm F – 7.0 cm	M – 3.4 cm F – 2.5 cm	M- 0.56 kg F – 0.48 kg	No data No data
Atkinson 1996	-	-	-	18-24 months

The re-growth of dehorned rhinos appears to be slightly faster than horn growth in non-dehorned rhinos, suggesting that the dehorning process may stimulate slightly faster horn growth (Rachlow & Berger 1997). Male White Rhinos re-grow horn mass at a rate which is almost twice that of females (Rachlow & Berger 1997). Female White Rhinos reach a peak in horn regeneration at 8 years, whereas mass of horn regenerated by males approaches an asymptote slowly at >30 years of age (Rachlow & Berger 1997).

In Namibia during the early 1990s, rhinos were re-dehorned 3-5 years after the initial dehorning (P. du Preez., pers. comm.), and in Zimbabwe rhinos were re-dehorned after 2-3 years (M. Kock, pers. comm.). One of the suggested reasons for the failure of the Hwange National Park dehorning was that the rhinos carried at least 18 months of re-growth when they were poached (Kock & Atkinson 1996).

When asked how frequently rhinos should be dehorned, the median response was 24 months (mean 26.6 ± 2.2, minimum 12 months, maximum 60 months, n=43). Respondents indicated that the ideal frequency of re-dehorning would depend on how much horn would tempt a poacher (22.6%), the level of poaching threat (21.2%); the age of the rhinos that were dehorned (16.1%), the price of horn (and the value of horn stumps, 15.7%), and how fast the horns grow (13.3%). The available budget would also represent a key factor to consider when deciding when to re-dehorn. In cases where dehorning is done as an interim measure to provide time to bolster anti-poaching capacity, re-dehorning may not be necessary when the elevated security is in place. In cases where ongoing threat from poachers is significant, re-dehorning at a rate of every 12-24 months may be necessary, whereas under scenarios of lower threat, intervals of 24-36 months may suffice.

8.3 OPTIMAL POPULATION COVERAGE FOR DEHORNING

If dehorning is adopted as an intervention, a key question is what proportion of the population to dehorn. Milner-Gulland *et al.* (1999) suggested that the ideal strategy for managing a small rhino population would be to dehorn as many of the rhinos as possible each year as the budget allows regardless of population size, and that dehorning only half of the population per year, or only dehorning every other year is not an adequate deterrent to poachers.

Total dehorning was attempted in the Karas section of Etosha National Park during the 1990s, was practiced in all Zimbabwean rhino areas during the 1990s, is currently undertaken in the smaller rhino populations in Zimbabwe, was recently undertaken on provincial land in Mpumalanga, and is practiced on a number of private ranches in South Africa. Strategic, partial dehorning (i.e. dehorning of a proportion of rhino populations) is currently practiced in the Zimbabwean Lowveld conservancies (which are large – 3,000-3,500 km^2) and was practiced in Damaraland in Namibia during the early 1990s.

When asked what percentage of the population it would be necessary to dehorn for dehorning to effectively deter poachers, 75.9% of respondents provided an estimate, of which 90% suggested that 100% of rhino populations should be dehorned. Twenty-eight percent (27.9%) stressed that the ideal proportion of populations to dehorn depends on the level of threat, 23.3% indicated that it depends on the population size, and 11.6% suggested that the percentage necessary depends on the level of security.

In practice, the approach to dehorning is likely to be limited by the available budget, the size and density of the population, the nature of the terrain, and the level of threat. In small areas and small populations (i.e. 30 or fewer), total dehorning should ideally be practiced. In larger populations, if budgetary or practical constraints prevent total population coverage, dehorning could be employed strategically to target vulnerable individuals within populations, such as those along fence lines or roads. Strategic dehorning around the edge of large rhino populations may help to convey the impression that the population is dehorned, and could encourage poachers to move deeper into protected areas, and thus increase their risks of being apprehended. *Ad hoc* dehorning is practiced in some large populations whereby rhinos are dehorned when they are immobilized for other purposes (such as ear notching). Such an approach, if combined with strategic dehorning, could gradually decrease the proportion of horned rhinos in a population, and would be cost-effective, but could potentially confer social disadvantages to dehorned individuals in the population relative to animals with horns (such as during territorial/dominance disputes) (Trendler 2011).

8.4 POTENTIAL IMPACTS OF DEHORNING ON THE TOURISM VALUE OF RHINOS

As members of the 'Big Five', rhinos are a key species for tourism. The majority of respondents (63.9%) felt that dehorning affects the tourism value of rhinos adversely, while 11.5% thought it might, depending on how well tourists could be convinced of the conservation value of de-horning (

Table 6).

Table 6: Respondents' opinions regarding the impact of dehorning on the tourism value of rhinos

	Yes	No	Depends
Does dehorning affect the tourism value of rhinos?	63.9%	24.6%	11.5%
Rhino owners/reserve managers	73.6%	21.1%	5.3%
Vets/capture teams	66.7%	22.2%	11.1%
Government officials	35.7%	35.7%	28.6%
NGOs/experts	23.5%	29.4%	47.1%

Sixty-seven percent (67.3%) felt that rhinos' horns were a key reason for the appeal of the species to tourists. However, 59.6% of respondents felt that tourists would understand if the rationale behind the intervention was explained to them. When rhinos were dehorned in Hwange National Park, there were numerous complaints from international tourists who objected to the process, possibly due to some of the negative publicity that was generated about the dehorning process in the country at the time (M. Atkinson pers. comm.). Nonetheless, there was a belief among some respondents that dehorning could actually benefit tourism operations by demonstrating that reserve owners were actively trying to prevent poaching. In the Hoedspruit area, landowners hope that dehorning may enable the area to be marketed as a safe haven for rhinos (V. Barkas pers. comm.).

8.5 POTENTIAL IMPACTS OF DEHORNING ON THE LIVE-SALE VALUE OF RHINOS

Sixty-five percent (65.4%) of respondents felt that dehorning would affect the live sale value of rhinos adversely, 17.3% said it would not, while 17.3% suggested it might, depending on various factors including the reasons for buying, the country of sale, whether rhinos are sold on catalogue or from a boma. Of those that said it would adversely affect live sales, 59.1% explained that dehorning would reduce the value of rhinos to people who buy them to hunt, 24.4% felt that rhinos are sold on the basis of the size of their horns (due to their value for trophy hunting or for potential or actual [illegal] trade in horn), 11.1% indicated that some buyers purchase rhinos to acquire horn speculatively in case a legal trade opens up. Some rhino traders are known to purchase rhinos and then dehorn them to sell them on for a reduced price. One respondent estimated that horned rhinos were purchased and re-sold after dehorning for ~25-30% less than the initial purchase price. A minority (6.7%) of respondents felt that dehorning could affect the live sale price positively as buyers may feel that their investment would be safer and would not have to pay themselves for the animals to be dehorned.

The live sale price of White Rhinoceros dipped in 2009 and this coincided with the moratorium on local trade in rhino horn, and the introduction of restrictions on rhino trophy hunting), and then rose again in 2010 (Figure 5). One respondent explained the recent price increase in terms of recognition among buyers of the continued market for selling rhino hunts to Asian nationals and loopholes which allow the hunting regulations to be circumvented.

Figure 5: Trends in the live sale price of White Rhinoceros (data provided by F. Cloete, North West University)

8.6 SECURITY ISSUES ASSOCIATED WITH THE STORAGE OF HORNS FROM DEHORNING

When rhinos are (or have been) dehorned in Zimbabwe, Namibia and Kenya, the horns are sent to a central government stockpile. Private landowners in South Africa store their horns in a variety of locations, typically in vaults located off the property, due to the security risks. In most cases, private rhino owners appear to store horn in bank vaults, though some respondents indicated that banks are sometimes unwilling to handle horns, in which case private security companies have been used. Respondents typically felt that the ideal place to store horns from dehorning would be in a bank (55.6%) or off the property (55.6%). Several (34.6%) respondents suggested the need for establishment of an official, centralized facility for storing horns.

Dehorning (partially) transfers the risk associated with possessing horns from rhinos to the manager of the land. The severity of this risk is emphasized by the fact that at least 38 thefts involving horn had occurred by mid-2009, several of which were armed robberies (TRAFFIC in press). In addition to the security risks associated with possession and transporting horn, there are time and costs associated with applying for the necessary permits to own and transport horn, to organize and pay for storage and to transport the horns. Estimates for the costs associated with the storage of rhino horn from respondents varied from R180 to R12,000 per annum. The high-estimate was for a storage area the size of a school boy trunk, with a private security company.

There was a perception among some respondents that the legal requirements for horns to be registered, and for permits to be acquired for ownership and transport of the horns creates a major security risk. Two respondents relayed separate stories of an armed robbery following the registering process, due to an alleged leak of information on the whereabouts of horn or on planned movements, following registration with provincial nature conservation authorities. Conversely, some provincial nature conservation respondents were concerned about how horn stockpiles can be effectively monitored when horns are exported from the province of origin to another. One respondent suggested that some rhino owners who dehorn are continuing to sell the horns illegally.

9 POTENTIAL PROBLEMS ASSOCIATED WITH DEHORNING

9.1 POTENTIAL VETERINARY PROBLEMS

9.1.1 Risks associated with the immobilization of rhinos

Any immobilizations of wildlife carry an associated risk. During the 1960s, Roth & Child (1968) estimated that rhino mortality under anaesthetic was around 9%. Using these estimates, Milner-Gulland *et al.* (1992) suggested that dehorning was not likely to be sustainable in the long term. The same authors estimated that rhino mortality from poaching and dehorning combined must not exceed 3.7% per annum, otherwise rhino populations will decline (Milner-Gulland 1992). In the late 1980s, rhinos that were captured and translocated had a 14% indirect mortality rate, post-capture (Kock *et al.* 1993). During the early stages of the dehorning programme in Zimbabwe in the early 1990s, White Rhino immobilizations had a 7% mortality rate (from 34 rhinos, Kock & Atkinson 1993). However, improvements in the drug combinations and capture techniques resulted in zero mortalities being recorded during immobilization of 37 White Rhinos in 1991 (Kock & Atkinson 1993). Only one Black Rhino died during immobilization for dehorning in Zimbabwe, resulting in a mortality rate of 0.6% (Kock & Atkinson 1993). Similarly, in Namibia, no mortalities were recorded from immobilization associated with dehorning (30-40 rhinos, Morkel & Geldenhuys 1993).

Ninety percent (89.7%) of respondents felt that immobilizing rhinos for the purpose of dehorning does not involve a significant risk of death or serious injury for the animals involved, of which 100% cited the low mortality rates associated with modern-day immobilizations, 17.6% indicated that the risks are significant if the animal being immobilized has an underlying illness, 15.7% stressed that the risks are low because the immobilization period for dehorning is short, and 9.8% suggested that the risks depend partly on the terrain.

The risks from short immobilizations *in situ* for the purposes of dehorning clearly carry a markedly lower risk than that posed by the process of translocation, where rhinos are exposed to longer periods of stress, are transported for long distances, released into unfamiliar environments among unknown and potentially hostile neighbours. During 2001-2006, the mortality rate from translocations of Black Rhinos was 6.5% (Emslie 2009). By contrast, the Lowveld Rhino Trust, recorded a mortality rate of 0.26% during the course of 381 immobilizations without translocation (N. Anderson, pers. comm.). Eight respondents recounted having immobilized hundreds (and in two cases thousands) of rhinos with minimal or zero losses.

However, immobilizations do confer risks that need to be borne in consideration. Key steps that can be taken to reduce the risk include: avoiding immobilizing in hot ambient temperatures, using a helicopter to prevent loss of sight of the animal after darting and to enable the animal to be herded away from dangerous obstacles, avoiding darting animals in steep terrain or close to cliffs/gullies, ensuring that the correct drugs and equipment are used, and using an experienced capture team and wildlife veterinarian. The more frequently rhinos are immobilized, the greater the risk. Twenty-three percent (22.5%) of respondents felt that immobilizing rhinos in the frequency necessary for re-dehorning would likely be risky for the rhinos involved.

9.1.2 *Risk of increased inter-calving interval due to immobilizations for dehorning*

Immobilization has potential to affect the inter-calving interval in rhinos through one of three mechanisms - delayed conception, abortion or post-natal calf loss (Alibhai *et al.* 2001).
Alleged increased inter-calving intervals were a key source of contention surrounding the rhino dehorning (and general rhino management) in Hwange NP in Zimbabwe during the early 1990s (Alibhai *et al.* 2001). Ultimately, the dehorning programme in Zimbabwe was temporarily abandoned due to pressure from animal welfare groups using these purported effects as justification. However, Alibhai et al.'s (2001) research findings were widely questioned because they were derived during a period when the black rhino population was increasing at a rate of 9-10% per annum (which is one of the highest growth rates sustained in African rhino populations) and due to flaws in their experimental design and statistical analyses (du Toit 2001; Atkinson *et al.* 2002). The IUCN African Rhino Specialist Group convened a working group to assess the claims that immobilization disrupted rhino reproduction, and concluded that the data presented by Alibhai *et al.* (1999) did not support their assertions (du Toit 2001). The risk of post-natal calf loss due to immobilization (which is most likely to be caused by separation of cow-calf pairs) can be minimized by following a simple set of steps (Box 1).

There is little reliable published information on the impact of immobilizations on the rate of abortion in rhinos, though intuitively, one would expect the risk to increase with increasing frequency of immobilization (W. Linklater, pers. comm.). Detecting rhino pregnancy loss due to immobilization is difficult because it is logistically challenging in the field to determine whether cows are pregnant [although robust techniques that can be applied in the field are becoming available (e.g. MacDonald *et al.* 2008)], and it is impossible to detect early pregnancies (i.e., the first trimester) reliably.

Although they are not directly comparable, empirical studies on the impact of repeated immobilizations on reproduction in other large mammal species can provide insights into the risks faced when capturing rhinos. In a long-term study on African buffalo *Syncerus caffer* in Kruger, buffalo were repeatedly immobilized to fit radio-collars and test for bovine TB (Oosthuizen 2005). Immobilization protocols used on these buffalo were similar to those used on rhino during de-horning operations; drug combinations were etorphine hydrochloride and azaperone, while animals were usually down for short periods (15-50 mins). Results indicated that multiple repeated immobilizations of buffalo did not decrease the calving rate. Similarly, a study of captive White-tailed Deer *Odocoileus virginianus* found that multiple immobilizations of pregnant females using xylazine hydrochloride and ketamine hydrochloride had no effect on fawn survival when compared to females not immobilized (DelGiudice *et al.* 1986). Detrimental effects of anaesthesia have been recorded, however, as demonstrated in a study on pregnant Horse mares *Equus ferus* treated for colic (Chenier & Whitehead 2009). Mares treated surgically using anaesthesia were 3.5 times more likely to fail to deliver a live foal than mares treated medically and not anaesthetized, while the longer the duration of anaesthesia, the higher the risk of a negative pregnancy outcome.

In the case of rhinos, while the possibility of an elevated risk of abortion from immobilization is a potential concern associated with dehorning, adult females are more valuable than foetuses from a population perspective and keeping them alive is a priority. Therefore, if dehorning results in the loss of some pregnancies but reduces the loss of an equivalent number of breeding females, there would be a net population benefit from the intervention. Furthermore, data from the Zimbabwean Lowveld conservancies suggests that dehorning has no impact on the inter-calving interval. According to Du Toit (2011): 'the average inter-calving interval for a sample of 23 dehorned black rhino cows in Lowveld conservancies was 2.6 years, compared to an average of 2.8 years for horned rhinos within 85 black rhino populations that have been monitored by the Rhino Management Group), and population growth rates have consistently been over 7 % per annum''.

Box 1: Steps for minimizing separation of calves and mothers during rhino immobilizations

Several simple steps can be taken when immobilizing cow-calf pairs to minimize the risk of separation (Morkel & Geldenhuys 1993; M. Kock pers. comm., Plate 11). These precautions ensured that not a single calf was lost in Zimbabwe during the dehorning exercise in the early 1990s (M. Kock pers. comm.).

- Immobilizations of mother-calf combinations were only ever done from a helicopter, as it is important to have full control and be able to respond rapidly.
- Cow / calf combinations where the calf was younger than 2-3 months old were not immobilized until several months later.
- The mother was immobilized first, and the calf was only darted when the mother went down.
- Stockholm tar was not painted on the stumps of the cows with calves in case the strong smell of the tar caused the mother to fail to recognize her calf or vice versa.
- After dehorning, all vehicles and personnel were removed from the area prior to providing the antidote, as it was found that without disturbance mothers and calves came together without problems.
- The calf was given the reversal drugs 10-20 seconds before the mother, so that the calf would wake up first (if the mother is woken up first, she may run off and leave the calf behind).

9.1.3 Risk of immobilization causing skewed birth sex ratios

Research on the translocation of rhinos from the wild into captivity has highlighted that exposure of rhinos to stressors for extended periods can influence birth sex ratios due to differential rates of mortalities of male and female foetuses at various stages of pregnancy (Linklater 2007). These stressors include the immobilization and capture process, crating, transport, handling, release and acclimation to a new environment and new diets (Linklater 2007). Multiple sex-allocation mechanisms may affect rhinos during the translocation process: female embryos are vulnerable to maternal stress before implantation, whereas male embryos are more vulnerable to maternal stress with placentation (Linklater 2007). However, immobilizations for dehorning are likely to involve many fewer stressors than translocations, and are unlikely to have significant impacts on birth sex ratios (W. Linklater, pers. comm.):

- Research on rhinos in bomas suggests that distress (where stress accumulates to the point where negative biological impacts are conferred) did not commence until animals had been in captivity for 5-15 days, so the once off stress associated with immobilizing a rhino for a period of 20-40 minutes for dehorning is unlikely to have the same effect on birth sex ratios.
- Even if there was an impact on birth sex ratios from immobilization for dehorning, it would be more likely to result in a female bias than male bias as

male foetuses are more vulnerable over a longer portion of pregnancy (i.e., 5 to 16 months).

- Even if there was an impact on birth sex ratios, there are (poorly understood) natural mechanisms to compensate for gender skews within populations.

Plate 11: Rhino calf being returned to its mother by chopper after being separated during immobilization for dehorning in Zimbabwe (photo: Mike Kock).

9.1.4 Risk of damage to the horn base and deformed horn re-growth

If dehorning is done incorrectly, and horns are cut too close to the germinal layer, the process can cause infections, maggot infestations, cavitations in the horn and deformed re-growth (Trendler 2011, Plate 4 to Plate 7). Such problems were recorded on occasion during the early days of dehorning in both Namibia and Zimbabwe. In one case in Namibia, when a rhino was re-dehorned several years after the initial dehorning, the horns were observed to have cavities that were full of pus, due to an ongoing infection caused by cutting the horn too close to the germinal layer (Plate 5, H. Winterbach, pers. comm.). Such problems arise when exposure of the germinal layer causes infection, induced by either rubbing or mud, creating a focal point for infection which cannot drain due to the presence of solid horn on the outside (Kock & Atkinson 1994a). In Zimbabwe, several of the White Rhinos that were dehorned were observed with abnormal re-growth, characterized by central cavitations, partial side wall collapse and undercutting, though none of those rhinos exhibited indications of associated ill-health (Kock & Atkinson 1993).

Damage to the horn base and deformed horn re-growth were subsequently largely prevented through improvements in the cutting technique, such that a larger layer of horn is left over the germinal layer, reducing the likelihood of it being nicked or damaged by heat from the chainsaw (Kock & Atkinson 1993). An unfortunate side effect is that a relatively substantial quantity of horn remains after dehorning. Even when rhinos are dehorned correctly, the dehorning process affects re-growth, either by stimulating a slightly faster rate of horn growth (Rachlow *et al.* 1993) or resulting in a more stumpy horn shape following re-growth (Berger *et al.* 1993; R. Taylor, L. Marabini, pers. comm.).

9.2 BEHAVIOURAL AND ECOLOGICAL IMPLICATIONS OF DEHORNING

The evolutionary significance of horns in rhinos is not entirely clear, and may include mate choice or anti-predator defence (Berger & Cunningham 1994). It is known, however, that rhinos use their horns for a variety of behavioural functions, including (Trendler 2011):

- Defending territories
- Defending calves from other rhinos
- Maternal care, guiding calves
- Defending rhino calves from predators
- Foraging behaviour: digging for water, breaking branches, reaching branches, removing bark.

Removal of horns through dehorning may thus confer consequences for the affected individuals. In Zimbabwe, a study was established in Hwange National Park specifically to assess the biological impacts of dehorning on White Rhinos. However, that study was severely compromised by the fact that virtually the entire population was eradicated by poaching (J. Rachlow, pers. comm.). Consequently, available data on the impacts of dehorning on rhino biology and ecology are limited.

9.2.1 Potential social and behavioural implications

Male rhinos use their horns during disputes over territory or dominance and so removal of the horn may undermine the ability of a particular bull to retain territory or status. Consequently, dehorning may enable some bulls to gain access to more mating opportunities than would otherwise have been the case. Dominance relationships are particularly important among Black Rhinos, which have the highest rate of fatal fighting in any mammal (Berger 1994). The majority of literature on the potential social impacts of dehorning has focused on Black Rhinos, with little discussion of possible impacts on White Rhinos.

In Namibia, intra-sexual dominance in male (but not female) Black Rhinos is related to horn size, and horn size differences of >10 cm confer dominance advantages (Berger & Cunningham 1998). The same authors reported that in 65% of 128 male : male Black Rhino interactions, males with larger horns dominated (after controlling for age, Berger & Cunningham 1998). However, Berger & Cunningham (1998) found that female Black Rhinos tended to dominate males, regardless of differences in horn sizes: suggesting that dehorning may have little impact in terms of undermining the ability of females to defend themselves and their calves against bulls. Trendler (2011) reported incidents of dehorned bulls being killed by horned cows and lesser bulls. These findings suggest that if dehorning is to be practiced, it would be advisable to dehorn all adults in a population, and to minimize the period of time between the dehorning of each individual in the population, to minimize interference in dominance relationships.

By contrast, other authors have noted minimal social impacts in Black Rhinos resulting from dehorning. There is evidence from Zimbabwe that dehorned Black Rhinos are effective at retaining their home ranges, and that previously dominant individuals are able to continue to dominate horned individuals after dehorning (Kock & Atkinson 1993). Data from the Zimbabwean Lowveld indicated that the mean distance of 30 dehorned bulls from the dehorning site (3.64 km, n=30) was not greater than the mean distance between subsequent sightings of horned individuals (4.68 km, n=31), suggesting that dehorning did not cause Black Rhino bulls to be displaced from their home ranges (which are typically around 10 km^2, Du Toit 2011; N. Anderson pers. comm.). In Namibia, Lindeque (1990) reported an anecdote of a Black Rhino bull retaining dominance status following a natural break-off of its horn in Etosha National Park.

While dehorning may impose negative social impacts on rhinos in some contexts, the possibility exists that removal of the horn may reduce the frequency of fatal fights among Black Rhino bulls (Cunningham & Berger 1994). Kock & Atkinson (1993) suggest that dehorning may reduce fight-related mortality by 30-40%, and Du Toit (2011), using data from Zimbabwe Lowveld conservancies indicated that dehorning reduces such mortality by 23.9% (though the difference was not statistically significant due to small number of combat mortalities ($\chi 2$=0.14, *d.f.*=1, p=0.711) (Table 7).

Table 7: Relative losses of horned versus dehorned rhinos to fighting in the Zimbabwe Lowveld Conservancies (Lowveld Rhino Trust, unpublished data)

	2007	**2008**	**2009**	**2010**
Number of horned rhinos	322	269	269	303
Number of dehorned rhinos	72	105	72	57
Horned rhinos lost to fighting	5	4	1	0
Dehorned rhinos lost to fighting	0	1	1	0
% of horned rhinos killed in fights	1.6%	1.5%	0%	0%
% of dehorned rhinos killed in fights	0%	1.0%	1.4%	0%

Intuitively, one might expect the social impacts of dehorning to be greater in the higher density populations occurring in smaller fenced areas in South Africa (du Toit 2011). The social impacts of dehorning in the South African context may be further compounded by high turnovers of individuals within populations due to translocations and trophy hunting, as combat-related mortalities are higher among interactions between unfamiliar animals (Berger 1994).

Among survey respondents, 33.3% felt that dehorning would have an effect on social interactions among rhinos, 44.4% felt dehorning would have no impact and the remainder were not sure or felt that the answer depends on various factors (Table 8).

Table 8: Respondents' attitudes towards the likely behavioural and social impacts of dehorning

	Yes	No	Don't know/ depends
Does affect social interactions between rhinos?	33.3%	44.5%	22.2%
Government officials	46.7%	33.3%	20.0%
NGOs/experts	33.3%	38.9%	27.8%
Rhino owners/reserve managers	30.0%	50.0%	20.0%
Vets/capture teams	25.0%	50.0%	25.0%
	% providing explanations		
Dehorned rhinos would be at a disadvantage	30.0%		
No effects have been observed	23.0%		
Dehorning would affect dominance relationships	23.0%		
Impacts depend on the proportion of rhinos in a population that is dehorned	19.7%		
Would undermine ability of females with calves to ward off males	18.3%		
Rhinos must have horns for a reason	13.3%		
Dehorning can reduce serious injuries/deaths from fighting	13.1%		
Dehorning could elevate breeding opportunities for inferior bulls	5.0%		
Depends on population density	3.4%		

9.2.2 Implications for anti-predator defence

Black Rhino calves are affected by predation by Lions *Panthera leo* and Spotted hyaenas *Crocuta crocuta* (Kruuk 1972; Goddard 1967; Elliot 1987; Sillero-Zubiri & Gottelli 1991). In Hwange National Park in Zimbabwe, 10.1% of White Rhinos observed showed damage to ears or tails indicative of predator attacks (Kock & Atkinson 1993). The potential impact of horn removal on the ability of rhinos to defend their calves has been a major source of contention surrounding dehorning (Berger & Cunningham 1993). Research from Namibia, suggested that dehorning increases the risk of predation of Black Rhino calves (Berger *et al.* 1993; Berger 1994):

- Infant mortality of dehorned Black Rhinos (*n*=3) was 100% when those populations were sympatric with Spotted Hyaenas, whereas calf survival was 100% for horned rhinos living with Spotted Hyaenas and occasional Lions and for hornless mothers living in predator-free areas.
- The length of horns of female Black Rhinos whose young were maimed by predators were shorter than mothers that did not lose young.

Cunningham & Berger (1994) went as far as to say that 'it appears that dehorning cannot help to save Black Rhinos unless other measures, such as killing or removing predators are taken'. However, these research findings were widely criticized by virtue of the small sample sizes of the data presented and due to potentially confounding variables (Lindeque & Erb 1995; Loutit *et al.* 1994). Lindeque (1990) went further to suggest that the only occasions known in Namibia where predators have killed rhino calves have been where the mother died from other causes, and that the area in Etosha National Park with the highest density of Spotted Hyaenas also had the highest recruitment rate of Black Rhinos. Black Rhinos occasionally hide their young, which represents a key period of vulnerability which is unlikely to be affected by dehorning (Lindeque 1990).

Berger & Cunningham (1996) defended their work by suggesting that management decisions based on empirically-derived data might be better than those based on no data at all. However, during telephonic correspondence, the lead author (J. Berger) emphasized the caveat that predator losses of Black Rhinos observed in their study site occurred during a severe drought when most alternative prey had left the area, and that predation of rhino calves in areas with abundant antelopes is less likely (J. Berger pers. comm.).

Dehorning appeared to have little impact on the survival of Black Rhino calves in the Sinamatela IPZ, an area with high densities of Spotted Hyaenas and Lions, and the survival rate of calves whose mothers were dehorned was 70-100% (Atkinson & Kock 1999). In Sinamatela, dehorned rhinos were observed successfully defending calves from predators (Atkinson 1996). Similarly, data from the Zimbabwean Lowveld conservancies (which have substantial populations of Lions and Spotted Hyaenas), suggest that dehorning has zero impact on calf survival (Table 9, du Toit 2011).

Table 9: Relative mortalities of horned versus dehorned rhinos through fighting in the Zimbabwe Lowveld Conservancies (du Toit 2011; Lowveld Rhino Trust, unpublished data)

	2007	2008	2009	2010
Number of horned rhinos	322	269	269	303
Number of dehorned rhinos	72	105	72	57
Horned rhinos lost to fighting	0	0	1	2
Dehorned rhinos lost to fighting	0	0	0	0
% of horned rhino calves killed by predators	0%	0%	0.4%	0.7%
% of dehorned rhino calves killed by predators	0%	0%	0%	0%

A minority of respondents interviewed considered dehorning to have a significant impact on the ability of rhinos to protect calves from predators (Table 10). Several respondents felt that rhinos are capable of deterring predators without horns, while others stressed that many areas in which rhinos are conserved in South Africa lack large predators (Table 10).

Table 10: Respondents' attitudes towards the potential impact of dehorning on rhino calf predation risk

	Yes	No	Don't know/ depends
Does dehorning affect the ability of rhinos to protect calves from predators?	35.6%	47.5%	16.9%
Government officials	42.9%	42.9%	14.2%
NGOs/experts	33.3%	50.0%	16.7%
Vets/capture teams	33.3%	55.6%	11.1%
Rhino owners/reserve managers	31.6%	42.1%	26.3%

	% providing explanations
Dehorning may be problematic in areas with high predator densities	31.5%
Rhinos without horns can still deter predators	29.8%
Rhinos without horns can not deter predators	26.8%
Predation can occur, regardless of the horn status	16.7%
Predators are absent in most rhino areas in South Africa	16.4%
Dehorning must have some effect on anti-predator defence	11.1%

10 RECOMMENDATIONS FOR THE FUTURE USE OF DEHORNING AS A TOOL TO PREVENT POACHING

10.1 IS DEHORNING AN EFFECTIVE TOOL FOR RHINO CONSERVATION?

Poaching pressure on a particular population is likely to be a function of the following equation (du Toit 2011):

$$\textbf{Poaching pressure} = \frac{\textbf{Reward to poacher (from the illegal sale of horn)}}{\textbf{Risk to poacher of being arrested x Effort required to poach}}$$

Poaching pressure is thus likely to be reduced by either reducing the reward to the poachers through dehorning, or increasing the risk and difficulty associated with poaching by investing in anti-poaching security. The ideal scenario would be to invest heavily in both dehorning and security. However, when budgets are limiting, decisions are required as to which side of the equation to prioritize investments in. Using a modelling approach, Milner-Gulland (1999) suggested that 'the strategy of not dehorning, but relying instead on law enforcement, is far inferior to dehorning'. They go on to say 'that the superiority of security over dehorning depends on the efficiency with which spending on security by managers is translated into reductions in profits for the poachers' (Milner-Gulland 1999). However, since Milner-Gulland's (1999) analysis, the price of rhino horn has increased markedly, making it more likely that poachers would kill rhinos for horn stubs. In such circumstances, Milner-Gulland (1999) predicted that it is probably necessary to both dehorn and invest heavily in security. In addition, expenditure on, and efficacy of anti-poaching security in South Africa is likely to be much higher than that recorded in Zambia, and on which Milner-Gulland's (1999) assumptions regarding the effectiveness of security were based. Consequently, a repeat of Milner-Gulland's (1999) model with parameter values based on the South African situation under current horn pricing would likely result in recommendations lending greater importance to security relative to dehorning.

10.2 HISTORICAL AND CURRENT INSIGHTS INTO THE EFFECTIVENESS OF DEHORNING

The available literature, coupled with feedback from expert respondents provides some insights into the effectiveness of dehorning as a tool for reducing poaching. However, few rigorous data on the relative survivorship of horned versus dehorned rhinos are available from past dehorning efforts, and assessing the effectiveness of the method is difficult due to the concurrent additional interventions (such as translocations and elevated anti-poaching security) that occurred. Similarly, limited current data are available on the prevalence or effectiveness of dehorning. The private sector is secretive regarding information on rhinos, and so obtaining the data necessary to accurately assess the effectiveness of dehorning is difficult. The private sector is nervous about releasing information on population sizes, for security reasons and in some cases, land owners may be unwilling to disclose the details of dehorning because in some cases the practice has been done illegally. Illegal dehorning is believed to be practiced both to generate horns for illegal sale and in some cases, to avoid having to inform nature conservation authorities given the risks associated with information leakage pertaining to the whereabouts of horns, and the delays associated with applying for and receiving permits. In addition, dehorning as a security measure is a relatively new phenomenon in South Africa and it will take time for clear patterns regarding the relative survival rates of horned versus dehorned animals to emerge.

Notwithstanding the lack of empirical data, historical and current experiences provide insights into the effectiveness of dehorning:

- In Namibia between 1989 and the early 1990s, dehorning coupled with rapid improvements in security is perceived by stakeholders in that country to have contributed to reducing losses to poaching.
- In Zimbabwe, during the early 1990s, a massive dehorning programme, coupled with the translocation of rhinos from vulnerable areas into well protected IPZs and conservancies away from the country's borders is perceived by stakeholders in the country to have contributed to reducing losses to poaching. In addition, rhinos that have been dehorned in recent years in the Zimbabwe Lowveld conservancies appear to have 29.1% higher chance of surviving than horned animals (du Toit 2011).
- Dehorning in Swaziland during the early 1990s, coupled with efforts to move rhinos to a smaller and more secure sanctuary within Hlane National Park seem to have been effective at reducing poaching of those animals, but may have simply shifted the focus of poachers to other rhino populations in the country.
- In Mpumalanga, tentative insights from the dehorning programme in the provincial parks suggest that the intervention has caused a reduction in poaching losses.
- However, in Hwange National Park, dehorning in 1991 was unsuccessful primarily due to a virtually complete lapse in security for six months 12-18 months after the rhinos were dehorned.
- Similarly, several populations in Zimbabwe that have been almost completely dehorned in the last 2-3 years (Hwange National Park, Matobo National Park, Matusadona National Park, Chipinge Safari Area, Sinamatela) have suffered severe poaching, due to the lack of security in those areas.
- The rhino population of Chiredzi River Conservancy which was completely dehorned (which had poor security and was heavily settled by subsistence farmers following land 'reform') was virtually eradicated by poachers (during 2003-2007), whereas Malilangwe Trust (where no dehorning was done, but where there is excellent security) has not lost any rhinos.
- In South Africa, several incidents have been recorded of dehorned rhinos being killed by poachers in the last two years (including two in September 2011 when this report was being written). In one incident, a horned rhino was wounded by poachers, and then dehorned by management and placed in a boma, where poachers returned to kill the animal despite clearly being able to see that the animal was dehorned (F. Coetzee, pers. comm.).

These experiences clearly highlight that dehorning in the absence of security is likely to be ineffective, and also stress that horn stumps are still valuable to poachers. This fact is likely to be even more true now than during the 1990s, due to the massive increase in horn prices and thus of the value of horn stumps. The current price of horn is approximately seven times greater than recorded in the early 1990s, highlighting that poorly protected dehorned rhinos would be at extreme risk of being poached. The suggestion that horn stubs are likely to be valued by poachers is supported by the finding that the lengths of horns confiscated from poachers (n=61) did not differ from those occurring in a live population of Black Rhinos (n=71), suggesting that poachers are unselective (Berger *et al.* 1993).

10.3 RESPONDENTS' OPINIONS ON DEHORNING

Most respondents thought that dehorning was effective (39.4%) or effective under some circumstances (33.3%) (Table 11). Respondents who felt that dehorning is effective considered dehorning to result in reduced losses to poaching, to be effective if accompanied by rhino security, to be effective in small areas or with small populations, and to be a key crisis management tool (Table 11). Respondents who felt that dehorning was not effective, most commonly explained that: dehorned rhinos are still attractive to poachers due to the horn remaining in the stub; and that other security is still needed; that dehorned rhino are still killed by poachers.

Table 11: Perspectives on the effectiveness of dehorning as a tool for reducing rhino poaching

	Yes	Depends/ partially	Don't know	No
Is dehorning an effective intervention for reducing rhino poaching?	39.4%	33.3%	3.0%	24.3%
Vets/capture teams	75.0%	0%	0%	25.0%
Rhino owners/reserve managers	50.0%	0%	0%	50.0%
NGOs/experts	45.0%	35.0%	5.0%	15.0%
Government officials	31.2%	31.2%	6.4%	31.2%

Reasons why dehorning is effective or partially effective	**% providing explanations**
Dehorning can help to reduce poaching	96.1%
Dehorning is not a standalone solution and security is needed	57.7%
Dehorning is effective in small areas / with small populations	26.9%
Dehorning is a crisis management tool	26.9%
Dehorning makes poaching less profitable	26.9%
Dehorning increases the risk : reward ratio	23.1%
Dehorning can buy time while other measures are implemented	15.4%
Dehorning shifts the threat from one area to another	15.4%

Reasons why dehorning is ineffective	**% providing explanations**
Rhinos are still attractive to poachers due to the horn stub	93.3%
Dehorning is not a standalone solution and security is needed	62.5%
Rhinos still get killed by poachers even after dehorning	50.0%
Poachers kill dehorned rhinos vindictively	31.2%
Dehorning simply shifts the threat from one area to another	25.0%
Dehorning is a message of defeat	12.5%
Dehorning reduces the tourism value of rhinos	12.5%
Dehorning means that poachers will have to kill more rhinos to acquire horn	6.3%

10.3.1 Would reserves that have dehorned rhinos be less likely to be targets for poachers?

Three quarters of respondents felt that a particular reserve would be less likely to be targeted if the rhinos there were dehorned (Table 12). However, typical caveats provided by respondents were that dehorning would only be effective if there were other reserves where rhinos still had horns, that dehorning would only be effective if poachers knew that dehorning had been done and if security was effective, otherwise poaching for the horn stub would still be worthwhile (Table 12). If dehorning is undertaken and not publicized, poachers may kill several rhinos before realizing that the population has been dehorned (particularly in thick bush where observing horns is difficult). Such effects could lead to a lag time whereby poaching losses continue for a period after dehorning (unless a major effort is made to publicize the dehorning).

Table 12: Respondents' answer to 'Would poachers be less likely to target a particular reserve if the rhinos there were dehorned?'

	Yes	Don't know/ depends	No
Would a particular reserve be less likely to be targeted if the rhinos there were dehorned?	71.7%	19.6%	8.7%
NGOs/experts	84.6%	15.4%	0%
Vets/capture teams	77.8%	11.1%	11.1%
Rhino owners/reserve managers	75.0%	25.0%	0%
Government officials	55.6%	22.2%	22.2%

Explanations / caveats	% providing explanations
So long as there were other reserves where rhinos have horns	36.1%
Poachers would look elsewhere due to the reduced rewards	19.4%
If poachers know that the rhinos there are dehorned	16.7%
If security is good	16.7%
Dehorning would have a deterring effect in the short term	5.6%
If all else is equal	2.8%

10.3.2 Does dehorning simply shift the poaching risk from one area to another?

Respondents were asked whether they agreed with a common criticism dehorning: that all it does is shift the threat of poaching from one area to another. More than three-quarters (80.0%) of respondents answered in the affirmative, and provided the following explanations/caveats: dehorning makes reserves that have not dehorned more vulnerable (57.9%); the shift effect would not be problematic if rhinos were dehorned everywhere (44.0%); effective security causes a similar shift of the threat (31.6%); and, dehorning should be a coordinated national strategy if it is to be implemented (13.6%).

10.3.3 Would the average poacher be any less likely to shoot a dehorned rhino?

When asked if they thought the 'average' poacher would be any less likely to shoot a dehorned rhino that he encountered in the bush than a horned individual, the majority of respondents answered in the negative, or was not sure (Table 13). Consequently, dehorning is seen by rhino experts as a means of preventing reserves from being targeted, but is generally perceived as ineffective at preventing poaching once poachers have entered a particular reserve.

Table 13: Respondents' answer to 'If the average poacher came across a dehorned rhino in the bush, do you think he would be any less likely to shoot that individual than a horned animal? '

	Yes	Don't know/ depends	No
If the average poacher came across a dehorned rhino in the bush, do you think he would be any less likely to shoot that individual than a horned animal?	17.6%	29.8%	52.6%
Government officials	27.3%	9.1%	63.6%
NGOs/experts	26.3%	47.4%	26.3%
Vets/capture teams	8.5%	36.0%	55.5%
Rhino owners/reserve managers	11.1%	16.7%	72.2%

Explanations / caveats	% providing explanations
If he has got that far, he would shoot it	37.7%
The horn stub still has value	36.4%
It depends if there were other, un-dehorned rhinos to go for there	25.5%
Depends on the level of security	18.2%
The noise of the shot would create risk for him	18.2%
He would shoot so he doesn't have to track the same animal	15.7%
Depends on the type of poacher	12.7%
Poachers shoot first and look at the horns later	11.1%

10.3.4 The marketability of horn stumps versus intact horns

Dehorning serves to reduce the quantity of horn available to poachers, and thus reduce the reward. However, the deterrent effect would be greatly elevated if dehorning also reduced the quality of remaining horn, as would be the case if horn stumps were less saleable than intact horns. Such an impact would be expected where horns are sold for use as *jambiya* handles in Yemen, where long lengths of horn are required. However, recent research indicates that Yemen is no longer a key destination for rhino horn (Vigne & Martin 2008; Milliken *et al.* 2009). The inferior aesthetic quality of a horn stub could reduce the price per unit weight obtainable from some buyers (unless horn is purchased for re-sale as powder). Furthermore, if there was mistrust at any point in the marketing chain, buyers may be more reluctant to buy horn stubs than intact horns. Such mistrust is a distinct possibility given that rhino horn markets are replete with fake horn (Milliken *et al.* 2009). In cases where trade channels exist between partners with no history of deception, however, horn stubs would likely have greater acceptance among buyers. Most (69.2%) respondents felt that rhino horn stumps would be worth less than the equivalent weight in an intact horn, though there was a great deal of uncertainty expressed during discussion on the topic.

11 RECOMMENDATIONS FOR DEHORNING

11.1 WHETHER TO DEHORN AT ALL?

The key steps taken to decide whether to dehorn, what proportion of the population to dehorn and if and when to re-dehorn are outlined in Figure 1. The first question when considering dehorning is whether the intervention should be used at all. The answer to this question will depend on a number of factors:

11.1.1 Level of poaching threat

Dehorning is an expensive, invasive intervention which carries risks associated with the immobilization process, and confers potential (though unproven) behavioural and social impacts and the possibilities of reduced calf survivorship in areas with high densities of Spotted Hyaenas and Lions. Consequently, dehorning should only be considered in areas and during times of severe poaching threat.

11.1.2 Availability of funding

The decision as to whether to dehorn will also be affected by the availability of resources. Where sufficient resources are available to hire top quality security personnel and to maintain a very high standard and intensity of security (such as that in place at Malilangwe Trust in Zimbabwe) dehorning may not be necessary. Dehorning is generally considered under scenarios of lesser funding availability. However, under no circumstances should dehorning be considered as an alternative to anti-poaching security, or as a short-cut, cost-cutting means of protecting rhinos. Ideally, dehorning should only be considered where funds are sufficient to permit a minimum standard of anti-poaching security and rhino monitoring (Appendix 1). Where insufficient funds are available for essential security, dehorning should only be considered as a stop-gap to act as a partial deterrent while resources are mobilized hastily for more rigorous security. However, if an elevation of security is not possible within a reasonable time-frame (of weeks to months, depending on the level of threat), funds would be better spent to translocate the rhinos to a more secure area, as experience clearly shows that unprotected, dehorned rhinos will be killed by poachers.

11.2 WHAT PERCENTAGE OF THE POPULATION TO DEHORN?

11.2.1 The size and density of the population

In small, high-density populations, if dehorning is to be used, an attempt should be made to dehorn all individuals within a population to provide maximal deterrent, and to reduce possible negative behavioural impacts associated with disadvantaging dehorned individuals. Total dehorning is generally restricted to populations of below 30-40 individuals, though in some cases, larger populations have been completely dehorned.

In large reserves with large and/or low density populations, the costs of dehorning (and particularly finding animals to dehorn) are likely to preclude total dehorning as an option. Under such circumstances, funding would likely be better spent on alternative security interventions and dehorning should be limited to strategic dehorning of vulnerable sectors of the population, such as rhinos occurring along boundaries and main roads. Such interventions would likely reduce the vulnerability of the dehorned animals and may have some deterrent effect at reducing targeting of the area by poachers. Furthermore, poachers who entered the reserve would have to travel further for horned animals, thus increasing the risks associated with the poaching operation (du Preez 2011). In such areas, additional ad hoc dehorning can be practiced during the course of other management activities (at minimal extra cost) such as ear notching, to increase the overall proportion of rhinos that are dehorned. However, such dehorning is likely to have relatively little deterrent effect, and could theoretically introduce behavioural asymmetries by compromising dehorned individuals.

11.2.2 Terrain, habitat and density of the population

The practicality of achieving complete dehorning will depend on the density of the habitat and on the terrain. A complete dehorning of a relatively small population occurring in a large, hilly reserve with dense vegetation may be prohibitive due to the costs associated with finding all of the animals. Conversely, total dehorning of a relatively large population may be feasible if they occur in a flat, open reserve.

11.3 HOW OFTEN SHOULD RHINOS BE DEHORNED?

The frequency with which rhinos should be re-dehorned depends on the level of ongoing poaching threat (re-dehorning should only be considered given a high level of threat), the level of security in place (if security has been elevated significantly since the initial dehorning, re-dehorning may not be necessary) and on the availability of funds. If repeat dehorning is considered necessary, rhinos should be re-dehorned every 12-24 months under conditions of high poaching intensity and every 24-36 under conditions of relatively lower risk. Ideally, all suitable rhinos (i.e. excluding those with very young calves, or females in late stage pregnancy) should be re-dehorned within a short space of time to minimize possible risks associated with some rhinos retaining horns while others are dehorned.

11.4 OTHER CONSIDERATIONS

Dehorning is most likely to be effective if poachers are very aware that the rhinos there are dehorned. Publicizing the dehorning is thus of key importance and is likely to minimize incidents where poachers enter reserves, or shoot at rhinos because they are unaware that the rhinos there are dehorned. The deterrent effect is likely to be highest if dehorning is practiced on a regional basis, such that most private and/or state reserves in a given area practice dehorning simultaneously and broadcast the fact, to discourage poachers from operating in the area at all.

Following dehorning, the horns should be removed from the property to a secure, off-site location. Knowledge of the details (time, route, destination) of the horn transport should be limited to as few people as possible.

12 RECOMMENDED RESEARCH ON THE IMPACTS OF DEHORNING

12.1 EFFECTIVENESS OF DEHORNING AS A TOOL FOR REDUCING POACHING

To accurately assess the effectiveness of dehorning as an anti-poaching tool, further empirical data are required. A study is required which assesses the factors which predispose rhino populations to poaching. This would require the collection of the following data for all rhino reserves in South Africa (and ideally southern Africa):

- Location of the reserve (country, province)
- Type of reserve (e.g. National Park, provincial reserve, private land)
- Size of the reserve
- Number of rhinos of each species occurring on each reserve each year
- Number of rhinos of each species lost to poaching each year for the last five years
- % of the population lost to poaching
- Proximity of the reserve to national highways, towns and national borders
- Human population density in areas adjacent to each reserve
- Measures of anti-poaching security to create an index of rhino protection for each reserve each year:
- Whether the reserve has a permanent management presence
- Expenditure per annum per km^2 on rhino security
- The density of anti-poaching scouts
- Intensity of rhino monitoring
- Whether rhinos are tagged with transmitters
- Whether aerial surveillance of the rhinos is conducted
- Whether an intelligence network is in place
- Degree of cooperation among local rhino owners
- Whether rhinos are dehorned: the % of the population dehorned; whether the dehorning was publicized; the time since the rhinos were dehorned

These data would undoubtedly provide insights into the factors that predispose rhino populations to losses from poaching, and would shed light into the efficacy of dehorning at reducing losses. Dehorning is a relatively new phenomenon in South Africa and so ideally data collection should continue for a period of at least 3-5 years in future. There are at least 26 private properties with Black Rhinos and 329 with White Rhinos (data from 2005) (TRAFFIC in press), and data would be required from a significant proportion of these properties to allow for meaningful comparison of poaching rates among dehorned versus no dehorned populations. In addition, where possible, data from partially dehorned populations (such as those in the Zimbabwe Lowveld) should be included to provide for paired comparisons of survivorship within populations.

An additional key source of information required to assess the effectiveness of dehorning as a tool for reducing poaching is the perspectives of poachers and purchasers of rhino horn, notwithstanding the obvious difficulty associated with obtaining such data. Such information could potentially be obtained through covert, undercover operations. In addition, captured poachers could be interviewed while they are incarcerated.

Key questions are:

- What factors do poachers consider when deciding which reserves to target?
- What factors do poachers consider when deciding which rhinos to target within a reserve?
- Would dehorning make poachers less likely to target a particular reserve?
- Would poachers be any less likely to shoot dehorned rhinos that horned rhinos?
- Would poachers obtain the same price for a rhino horn stump as for the equivalent proportion of an intact horn?

12.2 Impacts of dehorning on rhino biology

To measure the impacts of dehorning on the reproductive productivity of rhinos, a multi-site study would be required with populations that were: completely dehorned; partially dehorned; and not dehorned. Within and between the sites, variation should be introduced in terms of the frequency of dehorning. Reproduction indices would then be monitored in each study site (taking into account potentially confounding variables), including: pregnancy rates; inter-calving intervals; population growth rates and birth sex ratios. This research would help identify whether dehorning has any influence on the reproductive rate of rhinos, or calf survivorship. This monitoring should include recording of the frequency of mortalities or veterinary complications arising from immobilizations and dehorning.

To identify social impacts of dehorning, similar monitoring to that conducted by du Toit (2011) could be conducted, whereby the mean distance of dehorned individuals from the dehorning site is compared with the mean distance of horned individuals from sites where their presence is initially recorded in the study. Such monitoring (coupled with behavioural observations of interactions among rhinos of varying horn status and controlling for other factors such as age and body size) would highlight whether dehorned rhinos are more likely to be displaced from their territories than horned individuals.

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APPENDICES

APPENDIX A: Key factors in rhino security[1]

The following components are essential for effective anti-poaching security for rhinos:

Undertake a thorough threat analysis of property:

- Evaluate all possible threats (e.g. know the most likely entry and exit points, know the locations of rhinos [see field monitoring below]).
- Prepare response plans for as many eventualities as possible.

Secure the property:

- Electrified fencing that is monitored and maintained.
- Control entry points onto property with guarded boom gates.

Field protection:

- Scouts must be well trained in weapons, anti-poaching tactics and drills.

Scouts must be well equipped, with:

- Ideally with assault rifles (AK47 or equivalent)
- Handheld radios, spare batteries
- Backpacks, water bottles, rations
- Maps, GPS devices, binoculars
- Scouts must be authorised and empowered to aggressively respond to and engage poachers when necessary and have indemnity against legal proceedings in the same way that police do.
- Scouts should be adequately paid and rewarded to maintain motivation (and avoid collusion with poachers). But, the reward system must be sustainable.

Scout density should be:

- Minimum: 1 scout every 20 sq km
- Under conditions of high poaching threat: 1 scout every 10 sq km
- In large reserves: concentrate scouts where rhinos occur
- In large reserves (>200 km^2) there should also be a mobile anti-poaching reaction unit with rapid deployment capabilities – set up in picket camps situated in peripheral high risk areas.
- There should be routine patrols around fences and buffer zones for the early detection of poacher incursions, as well as at sites where poachers will focus attention (e.g. water points, vantage points good for surveillance).

Field monitoring:

- Auxiliary staff well trained in tracking and identifying rhinos (to allow rapid detection of poaching) should be deployed.
- Monitoring of rhinos should proceed with the use of standardised field recording booklets and a density of at least 1 scout per 20 rhinos

[1] Derived from du Toit, Mungwashu & Emslie 2006; Emslie, Amin & Kock 2009; Rhino Management Group 2011

- Monitors should utilize strategic observational points to view rhinos
- An attempt should be made to positively identify every rhino in the population as often as possible
- Rhinos should be ear-notched to facilitate individual identification and to provide accurate and unbiased population estimates of population performance
- Rhinos should be tagged with transponders to aid in identification of individuals that have died
- Radio telemetry (using transmitters in horns) can be used to assist with monitoring [Plate 12]
- DNA analysis of horns should be undertaken to assist with highlighting ownership of horns, and to be able to identify the source of horns in the event of a poaching incident and subsequent seizure of horns.

Intelligence:

- Intelligence and field surveillance lead to early detection of poaching incursions.
- Effective intelligence requires effective community engagement - if relations between protected areas and local communities are good, neighbouring communities often provide intelligence about poachers. If the relationship is bad, communities may assist poachers.
- Intelligence gathered from informers can reduce the number of anti-poaching staff necessary needed to patrol rhino areas, so informers need to be sufficiently rewarded and protected.

Dedicated law enforcement strategy:

- Law enforcement effort should be standardized and documented, including days and time spent on patrol, where those patrols took place, rhino sighting positions, and where poaching activities occurred. This will help determine trends in poaching between areas and over time.
- A functional intelligence network should be developed by fostering a relationship with informers, developing close collaborations with local police and military, and establishing a good relationship with prosecution agency.
- Staff should be trained in scene-of-crime techniques to maximise the chances of identifying poachers and to ensure that evidence gathered is admissible in court for successful prosecution.
- It is critical that poachers who are successfully prosecuted receive harsh sentences, so strong legal representation is required, as is expert testimony indicating that rhinos are scarce and stressing that poaching them is a serious crime.
- Databases on criminals should be made available across borders so that poachers don't get away with multiple convictions while being considered first time offenders.

Cooperation:

- Intelligence and resource sharing between landowners and reserves is critical.

- There should be standardised training of scouts, standardised rewards, standard wages and conditions of service, standard equipment etc among reserves/rhino owners in a given area.
- Incentives for intelligence should be paid on a group basis to avoid the scenario whereby informers play reserves against each other.
- Information sharing with and between wildlife and law enforcement agencies is critical to help counter organised criminal syndicates.

Reduce incentive to poach:

- Reduce the reward by de-horning rhinos (optional, only employ if adequate security is in place, in which case the intervention can help reduce poaching threat).

Plate 12: Fitment of a horn transmitter (photo: C. Masterson)

Appendix B: Respondents interviewed for the rhino dehorning study

Person	Country	Affiliation
Anderson, Natasha	Zimbabwe	Lowveld Rhino Trust
Bakkes, Chris	Namibia	Wilderness Safaris Damaraland Rhino Camp
Barkas, Vincent	South Africa	ProTrack anti-poaching
Berger, Joel	USA	Wildlife Conservation Society/University of Montana
Beytell, Ben	Namibia	Recent head of Ministry of Environment and Tourism
Boing, Werner	South Africa	Free State Nature Conservation
Brooks, Martin	South Africa	IUCN African Rhino Specialist Group
Carlisle, Les	South Africa	And Beyond tourism / Phinda
Coetzee, Faan	South Africa	Former EWT/Limpopo nature conservation
Coetzee, Rynette	South Africa	Endangered Wildlife Trust
Conway, Tony	South Africa	EKZN Wildlife
Cooke, Jeff	South Africa	EKZN Wildlife
Craig, Ian	Kenya	Lewa Conservancy
Cumming, David	Zimbabwe	Ex-chair of the IUCN Rhino and Elephant Group
De Beer, Juan	South Africa	Mpumalanga Parks Board
De Jager, Riaan	South Africa	Limpopo Nature Conservation
Du Preez, Pierre	Namibia	MET Rhino coordinator
Du Toit, Kobus	South Africa	South African Veterinary Foundation
Du Toit, Raoul	Zimbabwe	Lowveld Rhino Trust
Els, Rubin	South Africa	Thaba Tholo
Emslie, Richard	South Africa	IUCN African Rhino Specialist Group
Eustace, Mike	South Africa	Resource economist
Fike, Brad	South Africa	Great Fish River Reserve
Flamand, Jacques	South Africa	EKZNW / WWF Rhino expansion project
Fuller, Mike	South Africa	Karrige Reserve
Gadd, Michelle	USA	USFWS / IUCN African Rhino Specialist Group
Gaymer, Jamie	Kenya	Ol Jogi Ranch
Geldenhuys, Louis	Namibia	MET head of game capture during dehorning era
Gildenhuys, Paul	South Africa	CapeNature
Hofmeyr, Markus	South Africa	SANATIONAL PARKarks
Hume, John	South Africa	Private rhino owner
Hustler, Rusty	South Africa	North West Parks Board
Jones, Pelham	South Africa	WRSA/PROA
Jordan, Patrick	South Africa	Blue Canyon Conservancy
Kock, Mike	Zimbabwe/SA	WCS
Kooy, Hans	South Africa	Thabamanzi Game Capture
Knight, Mike	South Africa	IUCN African Rhino Specialist Group
Lewis, Alex	South Africa	Game Capture Vet
Linklater, Wayne	New Zealand	University of Wellington
Loutit, Rudi	Namibia	Save the Rhino Trust
Map, Ives	Botswana	Botswana Rhino Management Committee
Malan, Jacques	South Africa	Wildlife Ranching South Africa, president
Marabini, Lisa & Keith	Zimbabwe	AWARE
Masterson, Chap	Zimbabwe	Lowveld Rhino Trust / ex game capture unit in South Africa
Matipano, Jeffries	Zimbabwe	Parks and Wildlife Management Authority
Milliken, Tom	Zimbabwe	TRAFFIC East & southern Africa
Morkel, Pete	Namibia/Zim/SA	FZS
Mortensen, Claus	Kenya	Mugie Ranch
O'Brien, John	South Africa	Shamwari Game Reserve
O'Hara, Barney	Zimbabwe	Zimbabwe National Parks during dehorning era
Okita, Benson	Kenya	Kenya Wildlife Service
Rachlow, Janet	USA	University of Idaho

Person	Country	Affiliation
Reilly, Mick	Swaziland	Swaziland Big Game Parks
Roche, Chris	South Africa	Wilderness Safaris
Sayer, Ed	Zambia	Frankfurt Zoological Society
Shaw, Jo	South Africa	Rhino scientific expert
Sholto-Douglas, Angus	South Africa	Kwandwe Reserve
Steenkamp, Stony	South Africa	Gauteng Nature Conservation
Stuart-Hill, Greg	Namibia	WWF-Namibia
Taylor, Russell	Zimbabwe	Former chairman of WWF-SARPO
Tracy, Grant	South Africa	Game capture operator
Trendler, Karen	South Africa	Working Wild
Van Dyk, Gus	South Africa	Tswalu Game Reserve
Van Niekerk, Pieter	South Africa	Northern Cape Nature Conservation
Van Zyl, Jurie	South Africa	Free State Nature Conservation
Vigne, Richard	Kenya	Ol Pejeta Conservancy
Vynevold, Russell	Namibia	MET during dehorning/tourism operator
Weeks, Rodney	South Africa	Amakhala Game Reserve
Winterbach, Hartmut	Namibia	Vet with MET game capture unit during dehorning era

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