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A close-up photograph of an African rhino's head and shoulders, looking directly at the camera. The rhino's skin is thick and wrinkled, and its large horn is prominent. The background shows a blurred savanna landscape with trees and grass.

RHINO MANAGERS HANDBOOK

Concise best practice guidelines for the biological management of the African rhino



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Rhino management is large, complex and evolving topic and there are inevitable differences of views
 and this is natural. The text attempts to capture the range of views where possible. We would like to
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ACRONYMS & ABBREVIATIONS

ARRSG	IUCN/SSC African Rhino Specialist Group
ARRSARCP	African Rhino Range State' African Rhino Conservation Plan
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
EAC	East African Community
ECC	Ecological carrying capacity
ESU	Evolutionary significant unit
HSAH	Homeostatic sex allocation hypothesis
IUCN/SSC	Species Survival Commission of the International Union for the Conservation of Nature
MU	Management Unit
RMG	Rhino Management Group
SADC	Southern African Development Community
TB	Tuberculosis
ToC	Theory of Change (see www.theoryofchange.org)
VHF	Very High Frequency
WWF	World Wide Fund for Nature

DEFINITIONS

Note: all definitions are provided in the context of rhino conservation and overly technical language is avoided. Where possible the same definition is used as found in Emslie et al. (2009) to minimize any misunderstanding.

Biological management	Management focusing on population demography, metapopulation management, social considerations, genetics, habitat management and monitoring.
Boma	A structure designed to hold animals for management purposes.
Conservation purposes	Decisions that aim to further demographic and/or genetic goals to contribute to the long-term survival of the species in their natural habitats throughout their historical range.
Counter poaching	Implemented measures to reduce poaching of rhino on site but also including efforts to investigate, arrest and prosecute after a poaching incident has occurred.
Effective population size	The number of individuals within a population that are actively breeding i.e. excluding sterile, pre-breeding or behaviourally excluded individuals.
Ecological carrying capacity	The maximum number of rhino that can be supported by an area over time, in which the number of births equals the number of mortalities.
Evolutionary Significant Unit	Populations that share a close evolutionary history which is reflected in their genes.
Founder population	The individuals that comprise the initial release of animals when rhino are being reintroduced.

Gene flow	The active or passive transfer of genes between populations.
Harvest rhino	Harvest refers to the capture and translocation of rhino from a population for management purposes.
Management Unit	An identified group of populations that are treated as a metapopulation based on genetics.
Managed metapopulation	A group of populations separated by space with little or no natural dispersal between them and which are managed to compensate for the missing natural movement.
Poaching	Killing of a rhino; usually by shooting, darting, snaring, spearing with poisoned arrows etc. without legal authorization to do so.
Reintroduction	An attempt to establish a population in an area within its historical range, from which it has become locally extinct.
Semi-intensive	Semi-intensive management refers to rhino kept in small (< 10 km ²) areas at compressed densities and spacing, with routine food supplementation and high management intensity, but with a largely natural breeding system, i.e. limited but some human control over which bull mates with a cow.
Translocation	The deliberate and mediated movement of rhinos from one part of their range to another.
Wild rhino	Free-living rhinos with a natural breeding system and limited human intervention within sites 10 km ² or greater and within the historical range of the species.





1 INTRODUCTION

Purpose of these guidelines

In the 1960s and 1970s, pioneering management efforts, including translocation, in Umfolozi Game Reserve in South Africa (now part of the Hluhluwe-iMfolozi Park) resulted in rhino losses whilst techniques were honed. A stage has now been reached where it is possible to move rhino nationally or regionally with a high expectation of success. This is not because rhino management and movement have become easier, rather it is through the improved expertise relating to technology, science and management approaches through consistently building on past lessons as well as substantial improvements in the drugs available for sedation and immobilization.

Rhino conservation requires an appropriate balance between all aspects of management. However, with the renewed poaching pressure experienced since 2008, counter poaching activities and security have occupied the attention of protected area managers. This has resulted in reduced attention being paid to the biological management of rhino populations. These guidelines aim to help recreate some balance by highlighting recent understandings and innovations in the biological management of wild rhino.

In addition, recent developments have resulted in rhino being held in semi-intensive conditions which require enormous skill sets to manage. While there is some overlap with wild rhino management, these guidelines do not cover management under semi-intensive conditions.

While new scientific research informs rhino management, much knowledge is held by people with many years of experience of working in rhino conservation. Elements of this knowledge have been captured in various publications (see Strategies and Complimentary Materials on pages 16 & 17) to assist new rhino managers and guide their decision making. This handbook has been developed as a concise reference document to guide and to stimulate as well as provide references should the reader wish for further information.

Importantly, as rhino conservation and management is a complex, varied, multi-faceted and evolving endeavour, these guidelines should not replace consultation with experienced rhino management practitioners and broad consultation is strongly encouraged.

Target audience

These guidelines are aimed at individuals responsible for the management of wild African rhino in natural landscapes with no supplementary feeding outside of extreme conditions. The guidelines aim to ensure that these individuals are informed about current best practice to guide decision making and to ensure operations incorporate important factors.

More specifically, the guidelines are targeted at:

- Young or new rhino managers;
- Senior staff in formal conservation responsible for oversight of rhino management;
- Government officials responsible for maintaining policies and regulations for rhino conservation;
- Private rhino owners;
- Funders of rhino conservation activities.

Introduction and scope

There are two species of African rhino, white *Ceratotherium simum* and black *Diceros bicornis*. Both species occupy very fragmented and limited components of their historical range and their numbers are substantially reduced in comparison to a pre-colonial baseline. Continental population trends for both species over the past century are generally understood to have differed (Milliken, 1992). Current populations are estimated at ~18 000 white and 5 500 black rhino at the end of 2017 (Emslie *et al.*, 2018).

The modern distribution is restricted largely to relatively secure sites with no natural movement or connectivity between them. Aside from poaching, the isolated and relatively small individual populations, together with increasing habitat loss due to human activity, remain the most serious threats to rhino conservation in Africa.

Poaching and its effects on conservation

Following a brief hiatus, poaching levels began increasing in Zimbabwe in 2002 and in South Africa increased dramatically from 2008 (Emslie, 2016). From a continental baseline of roughly 50 rhino being poached on average per annum between 1990 and 2007, there was a three-fold increase in poaching in 2008. In South Africa, this was the start of an annual increase in recorded poaching during subsequent years to a high of approximately 1 300 rhino of both species lost in 2015 (Figure 1). Subsequently the rate declined to around 1 000 rhino being poached annually at the time of writing.

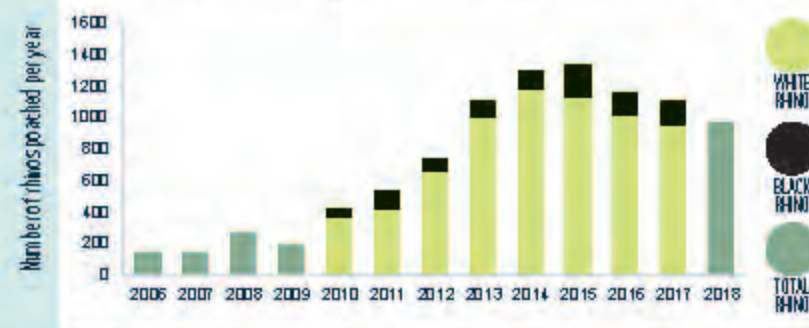


Figure 1: Number of black and white rhino poached in Africa between 2006 and 2018.

The escalation in rhino poaching occurred despite significant resources and attention being directed to securing both species on state and private lands. Security costs have seen a three to tenfold increase for properties with rhino (Knight, 2016). Apart from the increased security expenditure, there have been other undesirable outcomes attributable to the poaching pandemic, including:

- Many smaller private rhino owners, particularly in South Africa, losing all or virtually all, of their rhino as they were unable or reluctant to meet the rising cost of security, or were slow in responding to the growing poaching threat;
- Of those sites that did not lose the majority of their rhino, many decided it was no longer cost effective to maintain rhino on their property and sold them;
- A large percentage of smaller private sites do not plan to re-invest in rhino in the near future;
- In larger private areas as well as most state-managed sites, there has been a significant reallocation of resources to rhino security at the expense of other conservation priorities;
- Increased risks have resulted in a suppressed market demand leading to a reduction in income from sales of live rhinos that formerly contributed in a significant manner to meeting their conservation costs.

The net effect has been one of impaired conservation outcomes, in addition to the loss of rhino.

The increase in poaching has emphasized the need for collaboration amongst African rhino range states. Most range states have national, and in many cases sub-national, plans for their rhino populations (see pages 16 & 23). In addition, the African Rhino Range States' African Rhino Conservation Plan (ARRSARCP; Anon, 2016), was developed and seeks to focus on areas where greater international collaboration could further rhino conservation. A noticeable feature of many management plans is the recognition that security is not in and of itself adequate for effective rhino conservation which requires a significantly larger suite of interventions and activities, here termed focal areas.

Focal areas can relate to issues that are typically beyond the remit of a rhino conservation site manager and can be generically termed "enabling context".

This includes:

- 1) sustainable financing,
- 2) staff capacity and development,
- 3) local social support, and
- 4) broader political support.

There are additional factors over which rhino conservation site managers generally have some, although limited, influence including:

- 5) the socio-economic context of the rhino conservation site and their engagement with neighbouring communities, and
- 6) co-ordination between the site(s) they manage and the range within which they operate.

The ARRSARCP further recognizes, but does not specifically seek to influence, the legislative and policy context influencing rhino conservation in each range state. The two primary components covered by most national plans and the ARRSARCP, over which rhino conservation site managers have control, are:

- 7) the biological management of the rhino population(s), and
- 8) the broad suite of activities that collectively promote rhino security.

With this background, and in an effort to consolidate the lessons learnt, members of WWF-SA, International Rhino Foundation and the Rhino Impact Investment Project (GEF/ZSL, 2016) decided to conduct a sequel to the "SADC Regional Programme for Rhino Conservation" Giant's Castle workshop (Emslie, 2001) in March 2018. The goal of the 2018 workshop was to direct focused discussion and debate at new science and best practice in biological management limited to wild rhino in a protected area context. Functionally this resulted in a workshop dedicated to rhino biology and management, population monitoring and associated technology, genetics and range expansion. The proceedings of the workshop have been released and are available from WWF-SA on request. These guidelines were subsequently developed to present the new learning in a concise manner that is useful to people interested in rhino conservation at a site level.

White Rhino *Ceratotherium simum*

Global population 18,100
*status figure for end 2017 from IUCN AFRGG

CITES Appendix Appendix I, except for the populations of South Africa and Swaziland, which are included in Appendix II for the exclusive purpose of allowing international trade in live animals to appropriate and acceptable destinations and hunting trophies.

IUCN Red List assessment of global population Near threatened

Conservation history Southern white rhinos faced extinction at the turn of the 20th century when only 20 animals were left in Hluhluwe-ikhfolozi Park in KwaZulu-Natal. The population crash was a result of colonial hunting for sport and meat as well as removing rhinos from areas being transformed for agriculture. However, through concerted conservation efforts, the species recovered to their current.



Subspecies The white rhino is a grazer and has two sub-species: the Northern white rhino (*C. s. cottoni*) and the Southern white rhino (*C. s. simum*). There remain only two *C. s. cottoni* globally (both are female) held in a high security facility in Kenya. They require special crisis interventions and are thus not a focus of these guidelines. *C. s. simum* is the most abundant sub-species of rhino in Africa.

Characteristics Height: 1.8m
 Weight: 1,600–2,300kg
 Square muzzle with a longer, lower set head suited to grazing
 Front horn is always longer than the back horn
 Flattened back with a hump near the middle



Life span 40–50 years

Breeding Sexual maturity: females 6–7 years, males 10–12 years
 Gestation: 16 months
 Calving: every 2 to 3 years

Black Rhino *Diceros bicornis*

Global population 5,500
*status figure for end 2017 from IUCN AFRGG

CITES Appendix Appendix I

IUCN Red List assessment of global population Critically Endangered

Conservation history Continental black rhino numbers approached 70,000 or more in the 1960s, but experienced catastrophic poaching in Kenya, Mozambique, Zambia, and Democratic Republic of Congo as well as in central and west Africa in the 1960s and 70s. This was followed by large losses in Zimbabwe in the 1980s resulting in a population crash to ~1,400 in 1990. Black rhino numbers have since more than doubled due to concerted conservation action.



Subspecies The black rhino is a browser and was historically more widely distributed than the white rhino and had at least four sub-species. One of these, *D. b. longipes*, recently went extinct. The three extant sub-species are the eastern (*D. b. michoëi*), the South-central (*D. b. minor*) and the South-western/arid adapted (*D. b. bicornis*) black rhino.

Characteristics Height: 1.6m
 Weight: 800–1,000kg
 Pointed, prehensile muzzle and a higher set, rounded head suited to browsing
 Horns do not always show a clear distinction in length
 Concave back with no hump



Life span 30–40 years

Breeding Sexual maturity: females 4–7 years, males 7–10 years
 Gestation: 15 months
 Calving: every 2 to 3 years

Strategies and complementary material

Existing continental, regional and national level rhino management and associated strategies are provided. National plans have sovereign mandates, efforts to promote the coordination of rhino conservation management and decision making at a continental level were initiated through the development of the ARRSARCP (Anon, 2016). In the rhino conservation sector the terms "strategy" and "plan" are commonly loosely interchanged.

Continental

African Rhino Range States' African Rhino Conservation Plan (Anon, 2016).

Regional

SADC Law Enforcement and Anti-Poaching Strategy (LEAP): 2015 – 2020 (Anon, 2015).

National

- Botswana: Conservation and management strategy for the white rhinoceros *Ceratotherium simum* and the black rhinoceros *Diceros bicornis* in Botswana (Draft: Anon 2011).
- Chad: Draft national black rhino conservation plan (2018-2028).
- eSwatini: Rhino Conservation Plan (undated).
- Kenya: Kenya black rhino action plan (2017 to 2021).
- Malawi: Black rhino conservation and management strategy (2013-18).
- Namibia: Species management plan for white rhino (2012).
National white rhino management strategy (draft at time of writing).
National black rhino management strategy (2018).

- Rwanda: National rhino strategy (2017).
- South Africa: Integrated strategic management approach (2014).
National strategy for the safety and security of rhinoceros in South Africa (2010).
Biodiversity management plan for black rhino – (2011 to 2020).
Biodiversity management plan for white rhino (2015).
- Tanzania: National plan (2018-2023).
- Uganda: National rhino conservation and management strategy (2018-2028).
- Zambia: Rhino conservation plan (2017-2021).
- Zimbabwe: Zimbabwe rhino policy and management framework (2011 to 2016).
Rhino management strategy (2018 to 2022) (draft at time of writing).

Additional management guidelines

[Monitoring African rhino](#) (Adcock & Emslie, 2011).

[Guidelines for implementing SADC rhino conservation strategies](#) (du Toit et al, 2006).

[Translocating black rhino: current techniques for capture, transport, home care, release and post-release monitoring](#) (Morkel & Kennedy-Benson, 2017).

[Guidelines for the in situ reintroduction and translocation of Asian and African rhino](#) (Emslie, 2009).

[Guidelines for reintroductions and conservation translocations](#) (IUCN/SSC, 2013).

Rhino Security Booklet (EWT, 2013).

Kenyan Black Rhino Monitoring Protocols (KWS, 2005).

[Protocol for Immobilization of Black and White Rhinos in Kenya](#) (KWS, 2018)

Roles and Responsibilities

Coordination

National level plans are important for guiding the coordination of rhino management and are likely to take a stronger role in metapopulation management in the future. Regional rhino conservation coordinating bodies such as the SADC RMG and the EAC RMG help facilitate regional rhino management activities, particularly around genetic metapopulation management. With the drafting and ongoing process of gaining range state approval for the ARRSARCP (Anon, 2016), there is potential for additional high level coordination of black and white rhino management across the range states.

These mechanisms target high level coordination and it is equally important that rhino owners and managers engage with local and national agencies responsible for rhino management. Private rhino owners in South Africa may join or affiliate themselves with the Private Rhino Owners Association.

Veterinarians

As rhino management often requires the services of veterinarians, they are key individuals in rhino conservation and have important knowledge and skills. It is important to work with a veterinarian with species specific experience as the two species differ. It is preferable that the veterinarian has experience in the specific landscape where work is being undertaken when possible.

Ownership and permitting

Each country has different legislation and regulations governing the ownership, custodianship, management and movement of rhino. It is essential to comply with these legal requirements.

In some countries, all rhino belong to the state under common or customary law; in other countries there is a mix of state and private ownership. Ownership can also vary between species, with black rhino being state-owned and white rhino being privately-owned.

South Africa created complete private property rights for both species of rhino enabling the development of a domestic market in

rhino. The rights are limited and the sale, movement and handling of rhino is regulated through a permitting system. The regulations are in place to minimize the risks to rhino, as well as to limit, or ideally prevent, the entry of horn into illegal markets.

Despite the onerous nature of the regulations, almost half the white rhino in South Africa now belong to the private sector. The percentage of rhino on private land continentally is increasing with many state-owned rhino being conserved on private land under custodianship type agreements. There is also a small but increasing portion of the South African rhino population on land that is under communal ownership – colloquially known as communal rhino – although this is misleading as the rhino are legally owned by Community Property Associations.

Most countries require permits for certain activities involving rhino, including hunting, dehorning, transporting and darting. There are also international permit requirements, such as CITES, when moving rhino between countries. Compliance with the permitting regime contributes to the ability of the state to better regulate activities and to reduce the number of individuals exploiting legal loopholes.

Horn and horn stockpile management

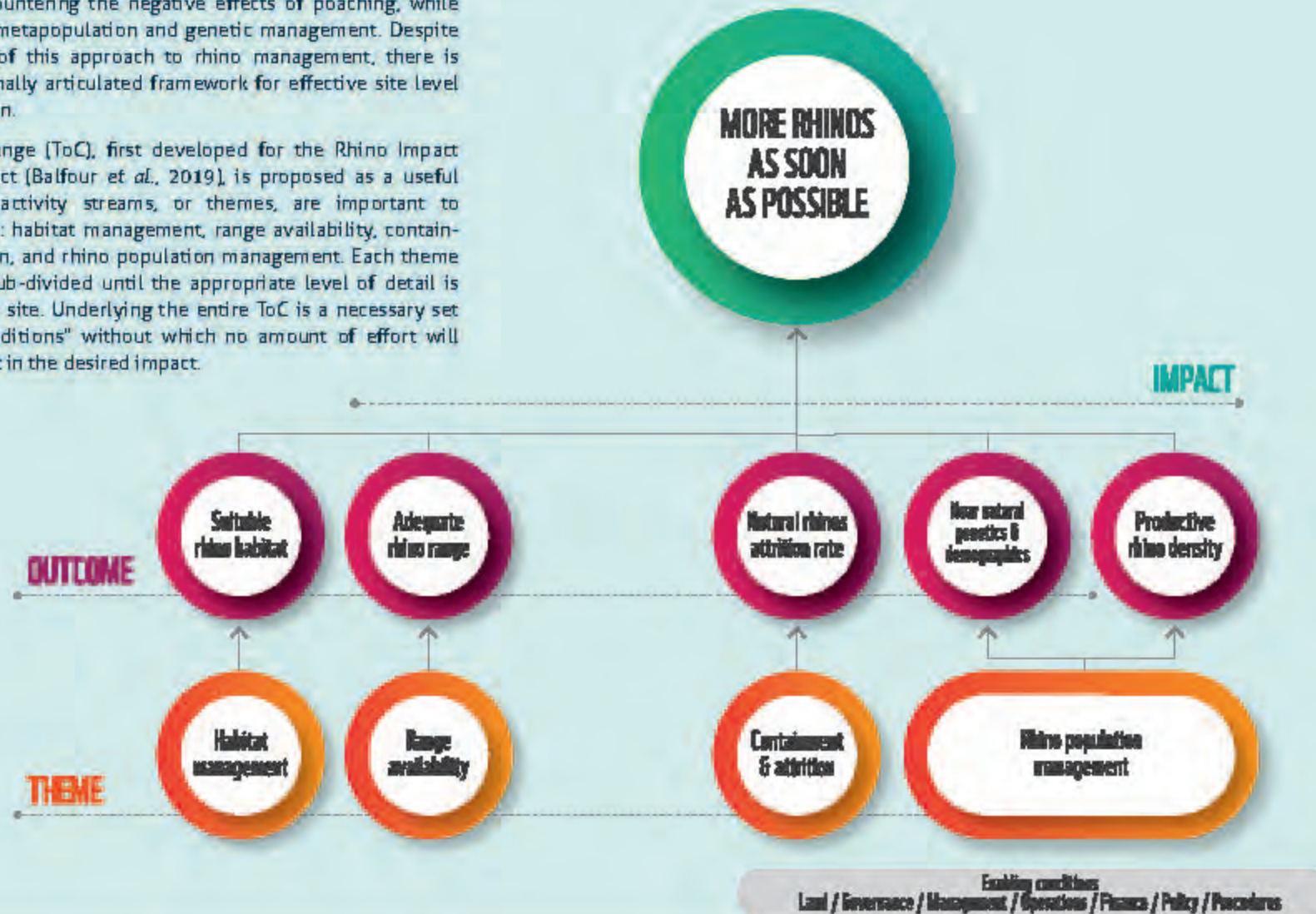
Rhino managers acquire horn through dehorning and natural mortalities. Illegal trade in horn has implications for stockpiled horn. Horns need to be held in facilities, preferably off site and with appropriate levels of security to prevent theft and reduce risk to managers. These off-site safe facilities are generally government stockpiles or commercial safes for hire.

Each country has different legislation and regulations governing the management of horn that comes into the possession of a rhino manager and it is important to comply with these legal requirements. They typically include marking and microchipping horns and registration in government systems. In South Africa, horn stocks are required to be weighed, marked, photographed and have transponders fitted as well as samples being submitted to accredited laboratories.

Theory of Change for rhino management at a site level

The goal broadly expressed in many rhino conservation plans is to increase population numbers with some urgency. Each rhino born contributes to countering the negative effects of poaching, while also benefitting metapopulation and genetic management. Despite the importance of this approach to rhino management, there is currently no formally articulated framework for effective site level rhino conservation.

A Theory of Change (ToC), first developed for the Rhino Impact Investment Project (Balfour *et al.*, 2019), is proposed as a useful approach. Four activity streams, or themes, are important to achieve this goal: habitat management, range availability, containment and attrition, and rhino population management. Each theme can be further sub-divided until the appropriate level of detail is attained for each site. Underlying the entire ToC is a necessary set of "enabling conditions" without which no amount of effort will confidently result in the desired impact.





2 FOCUS AREAS

A. Planning and risk profiling

Planning, profiling risks and decision-making in relation to rhino management in a conservation context requires insight and knowledge of many factors. It requires the consideration of how these factors are likely to vary over time and how they may interact with each other. Any decision should include consideration of how these interactions and variations may affect the risk profile of the decision and whether the net effect results in a risk or benefit.

In order to assist the planning, risk profiling and decision-making processes, this section attempts to serve as an aide memoire to a decision maker. While an attempt has been made for the list to be comprehensive, it cannot be guaranteed and each manager needs to take responsibility to go through the process themselves.

PLANNING

When conserving rhino it is important to develop and work to plans. In general, the more focused the spatial scope of a plan, the more operational it will be, while increasing the scope leads to more strategic plans. Strategic and operational plans are likely to focus on different sets of issues and it is useful to consider both when planning for rhino conservation.

Hierarchy of plans

Planning in a conservation context requires consideration of other plans and how one's own context fits within the hierarchy of plans. New plans should consider existing plans and, where appropriate, integrate or align to them. For example, planning at a national level optimally requires consideration of at least the sub-continental perspective as well as how the plan may impact on sites within a range state (Figure 2).

Points to consider
<<



A hierarchy of plans is not always complete. Attempts to integrate plans across different levels may rely on perspectives gained through engagement with counterparts. Engagement is particularly necessary when planning at higher levels in the hierarchy which requires national and international collaboration.

When planning at an international level, irrespective of the objective of the plan, it is necessary to consider a range of issues including genetics, disease, security, political dynamics and, when moving rhino, logistics and diplomatic protocols. Planning at site level, on the other hand, will focus more on specific details and objectives pertaining to the site as well as ensuring that national level plans are given appropriate consideration.

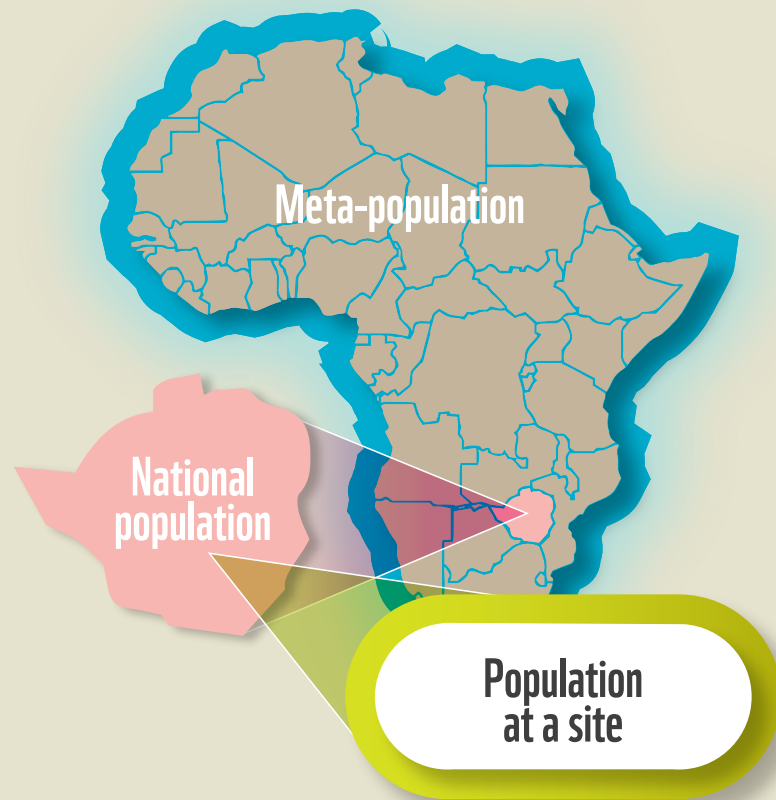


Figure 2: Schematic illustration of the hierarchy of plans from continental to site level

Each plan relating to rhino management is different and decisions need to be made at different scales. Plans differ because each rhino conservation site has its own context, history and set of objectives. There are however common elements that are useful to include in each plan and the most important of these are detailed here. It may be useful to refer to the Theory of Change detailed on page 20 while reading this section. They have been split into conditions that rhino need to thrive (*rhino conditions*) and elements that enable people to manage rhino (*enabling conditions*).

RHINO CONDITIONS

Irrespective of a specific site's conditions and objectives, the important considerations for good rhino management, in a conservation context, are covered by the ToC (Balfour *et al.*, 2019) and are discussed in detail from page 49.

ENABLING CONDITIONS

Enabling conditions include:

- Land;
- Good governance;
- The management team;
- Finance; and
- Operational requirements.

Land

Rhino conservation management is a long-term endeavour that is dependent on the sustained availability of land. It also requires considerable commitment and investment in infrastructure establishment (fencing, roads, accommodation, bomas etc.). For these reasons land tenure and security of access are key considerations when planning to manage rhino. Without security of tenure the risks and costs increase substantially.

Good governance

In broad terms governance is the process of decision-making and the process by which decisions are implemented or not. Guidelines for good governance include formal approaches, such as policies, as well as organizational or management culture. There are eight characteristics of good governance that a management team should consider, namely that governance should be 1) *consensus orientated*, 2) *participatory*, 3) *law abiding*, 4) *effective and efficient*, 5) *accountable*, 6) *transparent*, 7) *responsive* and 8) *inclusive*. How these aspects of good governance are achieved will differ at each site and will depend on the management team and leadership.

Management team

Rhino management requires a range of skills, including law enforcement and security, general protected area management (including operational management of infrastructure, equipment and staff), financial management, and ecological and veterinary expertise. While it is not essential to have separate individuals fulfilling each role, it is necessary to ensure access to expertise when it is required. For example, it may not be necessary to have a full-time wildlife veterinarian on site or a dedicated helicopter, but it should be possible to rapidly mobilize them when required.

Finance

Rhino conservation is costly and without appropriate and sustained finances and strong financial management, rhino conservation is not possible. However, finance is beyond the scope of these guidelines.

Operational requirements

Management should be driven by clear goals and objectives and that day-to-day activities contribute toward these. Operational plans must be aligned to the objectives and realistically budgeted and resourced. It is important that any operational plan is adaptive i.e. that it is regularly reviewed and appropriately adjusted in the light of changes in operating conditions. This adaptive approach underpins effective management and should be strongly built into the site's management approach and operating culture (Roux & Foxcroft, 2011).


RISK IDENTIFICATION

Although it is seldom possible to identify and quantify all risks associated with performing an activity, there are common risks which should be considered in planning processes.

These risks include:

- Security;
- Loss of rhino range;
- Changes in climate;
- Overpopulation;
- Incorrect demographic and genetic structure;
- Disease; and
- Information scarcity.

Security

Poaching presents a very high risk as currently the rate of rhinos lost to poaching exceeds the gains achieved through births in many populations. These guidelines do not cover counter poaching and security but it is useful to know that some management actions can have security consequences and thus play into this risk. These management actions are identified with a  in the guidelines.

Ensuring that a rhino population is adequately contained through well-maintained physical barriers or fencing is important (see page 59). Failure to do so exposes the site to the risk of rhino dispersing out of the population. In the few large ecosystems remaining, size may be considered as a substitute for a barrier fence, but increasingly this option is no longer feasible.

Loss of rhino range

Decisions may be made to use land occupied by rhinos for other purposes such as human settlement or cattle grazing. Infrastructure development, such as roads and railways, can also impact rhino range by fragmenting habitat and increasing risks such as injury or ease of access for poachers. Each country is likely to approach decision making around land use and infrastructure development differently.

Changes in climate

Given changes in climate, site managers will increasingly need to have contingency plans for how these may impact rhino. Climate change models generally predict relatively low changes in average annual rainfall for much rhino range, but an increase in intensity and duration in what are termed “extreme” events e.g. droughts being drier and longer or cold snaps being colder. It may be necessary to make contingency plans for both water provisioning if natural sources dry up and for supplementary fodder if failed rains or frost result in insufficient browse or grazing. An alternative to supplementing fodder could be to reduce the density of competitive species at a site. In natural systems drought induced mortalities can be expected and these may increase if there are no interventions to counter the effects of a fenced landscape. For example, the dry period in 2016 is thought to be responsible for a substantial number of white rhino mortalities in Kruger National Park, South Africa (Ferreira *et al.*, 2019).

Overpopulation

Overpopulation poses two risks for rhino management: total biomass (density) of large mammals exceeds what is ecologically sustainable in the area and the density of rhino on a site has negative impacts on the population.

If the total biomass exceeds what is ecologically sustainable for the area, the net result could be inadequate grazing or browse for rhino, particularly in fenced sites in drought conditions. Good management should prevent overpopulation happening through ensuring appropriate densities for each large mammal species. When it does occur, the biomass of the competing species should be reduced appropriately and with urgency. Failure to do so could result in reduced rhino breeding performance and potentially mortalities. Examples of this phenomenon include impala *Aepyceros melampus* competing with white rhino on short grass areas and nyala *Tragelaphus angasi* or elephant *Loxodonta africana* impacting on black rhino browse availability in savanna thicket and woodlands.

The second element relates to the biomass of the rhino. Rhino population growth is dependent of density (see page 85). High densities of rhino can thus negatively impact growth at a site. Importantly managers should be aware that failure to remove animals may result in the failure to stimulate growth. Managing for growth is an under-recognized, but important, opportunity for contributing to the conservation of rhino.

Incorrect demographic and genetic structure

In a conservation context, a normally structured population implies a normal age class, a sex ratio of close to 50:50 and a reasonable level of genetic heterozygosity in the population (see pages 77 & 78). If a population deviates from these norms there is a risk that it will not have normal behaviour in other respects, including growth rates. Monitoring programmes can be structured to provide the information required to understand the demographics of the population.

Disease

Disease has two elements in relation to rhino management risk. The first is the direct effect of disease on individual rhino, although this is rare (see page 69). For example anthrax is known to have caused rhino fatalities in Etosha National Park in Namibia, Lake Nakuru National Park in Kenya and in Kruger National Park, South Africa. Managing disease risks requires specialist veterinary engagement and intervention.

The second relates to the possibility of state veterinarians placing moratoriums on the movement of rhino due to concerns around disease transmission (e.g. Bovine tuberculosis). A moratorium on movement poses a very serious threat to rhino conservation. Managers need to keep communication open with state veterinarians to remain informed on the status of these risks.

Information scarcity

Managing a rhino population requires good data to inform decision making and assessing goal achievement. Failure to collect this information will result in decisions being made based on partial data or incorrect assumptions and thus risk poor or unexpected outcomes. The development of a monitoring programme is therefore required to avoid this (see page 89). As with many of the other risk areas, monitoring is a specialist function and it is advisable to obtain specialist input into how a monitoring programme should be run and what the key data collection and information needs are for a site.

Useful references

>>



Bothma, 2008. Game ranch management.

du Toit, 1998. [Rhino ranching: Management manual for owners of white rhinos.](#)

du Toit *et al.*, 2006. [Guidelines for implementing SADC rhino conservation strategies.](#)

Ferreira *et al.*, 2019. [Species-specific drought impacts on black and white rhinoceroses.](#)

Roux & Foxcroft, 2011. [The development and application of strategic adaptive management within South African National Parks.](#)





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2 FOCUS AREAS

B. Habitat management

In the context of rhino conservation, habitat management refers to the management of the components of a natural ecosystem that are important to rhino. Functionally not all elements of a rhino's habitat can be managed but understanding which can be is key for effective conservation management. Understanding the impacts of different management interventions and associated risks is equally important. In the case of African rhino, which primarily live in savanna and grasslands, habitat management can include:

- Individual large mammal species;
- Functional trophic groups of large mammals;
- Fire regime;
- Availability and distribution of key resources;
- Control of introduced species that alter the ecology; and
- Compensation for the impacts that rainfall (drought or above average precipitation) has on local ecology and habitat.

Generally, the smaller an area, the more intensively it needs to be managed.

Ecological systems are complex and it can be difficult to establish a good balance between allowing natural processes to take their own course and intervening.

Management in fenced sites will need to compensate for the impact of fences on the functioning of natural processes and dispersal.

It is not possible to describe generic interventions for habitat management. Interventions will depend on management objectives, site-specific conditions and the history of the site.

In general, best practice tends towards less intervention as more intensive approaches can lead to a cycle of over management.

Where possible, interventions should mimic natural processes.

Lessons Learnt <<



Approaches to take <<



LARGE MAMMALS

In relatively untransformed African ecosystems where rhino are indigenous, the presence of other large mammals is ecologically appropriate. Interactions with other species can have either direct or indirect effects on rhino. These are natural ecological interactions and most management regimes aim to leave them to function naturally. Depending on management objectives, it may be counter-productive not to intervene - particularly in fenced, spatially constrained and fragmented sites. This section aims to provide guidance on appropriate interventions.

Issues to consider

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In a natural system, fluctuations in the large mammal assemblage and density in response to a number of factors should be expected over time. Bothma (2008) provides reasonable density estimates for large mammals that can be moderated depending on site specific conditions and objectives. In general, managing large mammals with ecological objectives will result in lower densities being present at a site than when managing for production or tourism purposes.

Broadly there are four types of interactions that may affect rhino.

DIRECT EFFECTS

Predation

The scarcity of published records and the rapid growth rate in many rhino populations with full complements of large predators suggest low predation rates. However, predation by lions *Panthera leo* or spotted hyena *Crocuta crocuta* on rhino calves can negatively impact population growth, especially in small populations.

There are few records of predation on adult rhino.

It is usually difficult to find rhino calf carcasses in the field and the loss of a calf can easily be missed, unless a sighted young calf is later found to be missing. An unusually long inter-calving interval can also be an indicator of a lost calf, although this is not conclusive. A high level of monitoring is required to detect births and therefore a "lost" calf. Predator densities can be managed in order to increase the probability of calf survival if rhino productivity is the site's objective.



Interspecific social interactions

For example, there were instances of 15 to 30 year old elephant bulls chasing and killing rhino with their tusks in South Africa (Slotow & van Dyk, 2001). These attacks generally happened in newly established populations where there was no dominant bull to suppress the onset of musth in the younger bulls. If such instances are encountered it is recommended that an expert is consulted before taking management action.

INDIRECT EFFECT

Competition

Competition for preferred food sources can have a significant effect on rhino growth rates even by smaller antelope if their densities are sufficiently large (e.g. nyala can severely limit black rhino browse and impala can influence white rhino habitat, particularly during dry times). A method for understanding the competitive interactions between rhino and other large mammals has been developed which converts each herbivore species into a "rhino-equivalent". As a general rule, it is reasonable to ensure that less than 80% of available fodder should be consumed by other species to limit the potential for rhinos to experience competition.



Facilitation

Facilitation leads to greater availability of resources for rhino. For example, elephants can reduce the height of trees that have grown beyond the reach of black rhino or buffalo *Syncerus caffer* and zebra *Equus quagga* can reduce the height of tall bunch grass areas making them more favourable for white rhino.

In both instances these processes are likely to favour enhanced rhino population growth rates at a site. Facilitation is likely to occur at mean densities rather than at very high or very low densities of other large mammal species.



Lessons Learnt >>



Erecting a fence is possibly the single management intervention with the greatest impact on large mammals. Fences prevent natural patterns of dispersal and affect processes such as density regulation and gene flow between large mammals. These disruptions have the potential to generate knock-on effects on the ecology of the site.

Depending on species composition when the fence is erected, the conditions for rhino can be more competitive or facilitative and this has consequences for rhino management.

In systems that are open and adjacent to livestock areas, rhino may experience indirect effects due to the presence of livestock. For example, over grazing by cattle has impacted white rhino in the Save Valley Conservancy, Zimbabwe.

Approaches to take >>



It is important to remember that fencing does have significant ecological consequences and fenced sites need to be managed in order to reduce the negative consequences that may arise. Managing wildlife in general is a very specialized endeavour and expert advice should be sought in this regard.

In sites where competition, interspecific interactions or predation are having an impact, it is necessary to be clear about the site's management objectives. If appropriate, a trade-off between conflicting management objectives may need to be incorporated. These objectives should be stated in site and/or rhino management plans and will guide decisions relating to appropriate interventions. Where there are conflicting objectives, there may be value in developing a matrix in which the objectives are weighed against each other and which provides guidelines to managers, depending on the nature and intensity of the conflicting objectives.

Arsenault & Owen-Smith, 2002. Facilitation versus competition in grazing herbivore assemblages.

Bothma, 2008. Game ranch management.

Mills *et al.*, 2003. [Management of black rhino in the Ngorongoro Crater.](#)

Plotz & Linklater, 2009. [Black rhinoceros \(*Diceros bicornis*\) calf succumbs after lion predation attempt: implications for conservation management.](#)

Slotow & van Dyk, 2001. [Role of delinquent young "orphan" male elephants in high mortality of white rhinoceros in Pilanesberg National Park, South Africa.](#)

Useful references

<<





FIRE

Fire is a natural ecological process in many African ecosystems. Vegetation is adapted to fire, and in some instances may require it. In fragmented landscapes the spread of fire is significantly impaired and many managers burn portions of the vegetation as part of a management programme.

Grass is the primary fuel load that carries fire in savanna and grassland – the primary habitats of rhino. A fire regime is strongly influenced by the rainfall during the preceding two years as this determines the amount of grass available to burn.

Fire can impact rhino both directly and indirectly. As long as there is sufficient heterogeneous space, direct effects, such as rhino being burnt, are rare. Indirect effects are mediated through the interaction and influence of fire on the vegetation.

Terminology

Fire Regime:	The frequency, extent, intensity etc. of fire events
Fuel Load:	The quantity and quality (how green it is and thus how flammable) of vegetation, primarily grass
Topkill:	Reduction of the height of woody plants, which encourages coppicing
Head fire:	A fire that burns with the wind. It tends to be more intense above ground level (1 to 5 m)
Back burn:	A fire that burns against the wind and tends to be most intense close to ground level

Factors affecting fire

A number of factors collectively influence the nature of a fire and its impact on the vegetation as well as the fire's manageability.

- The fire regime of the site
- Rainfall: Especially over the preceding two years as this determines the fuel load
- Season: These determine the fuel load by influencing the quantity of fuel and the quality
- Fuel load
- Weather conditions
 - Wind speed and direction: Head fires and back burns will have different influences on grass and young woody plants.
 - Humidity
 - Temperature
- Terrain: Fire burning upslope is generally hotter above ground level and moves faster than fire burning down slope, which is very hot at ground level.

In general, the more fuel there is, the drier the fuel is and the greater the supply of oxygen, the more intense the fire. For example, fires ignited on cool days, with high relative humidity and low wind are easier to control than those ignited on hot windy days with low relative humidity.

The "fire danger index" (<http://www.weathersa.co.za/home/fireindex>) is useful to know when planning to burn an area. It provides a measure of the fire climate and thus the nature of the fire that is likely to result.

Issues to consider >>



Both species of rhino move in response to fire, mainly to seek new growth that has been stimulated in the post fire period.

White rhino

The fire regime at a site influences the availability and quality of the grass sward and can, over time, influence the composition of grass species present. Other ecological feedback loops can also affect the fire regime. For example, white rhino density can influence a fire event by influencing the fuel load. Fire, in combination with high browsing pressure, can reduce woody plant density to the benefit of white rhino and other grazers.

Black rhino

Fire can influence the availability of browse, particularly in relation to preferred food such as woody plant saplings (e.g. *Vachellia* (previously *Acacia*) spp., *Grewia* spp. and *Dichrostachys cinerea*) in the fire zone of savanna systems. In many instances black rhino also seem to seek out burnt twigs. Certain fires reduce the height of woody plants (commonly called topkill) which encourages coppicing at heights available to black rhino. Thus fire can be used to manage black rhino browse to a certain extent.

Lessons Learnt >>



There are no absolutes when managing fire and controlling its spread can be difficult and costly. As a general guideline it is best to burn less than 50% of a site in any one year and preferably closer to 30 to 35% of the area.

Burning shouldn't be avoided as in the absence of fire the fuel load can simply increase and thus ratchet up the risk in following years.

Fires that burn under high winds, low humidity and a dry fuel load usually exceeding 5 kg/m² present considerably higher risk and should only be ignited if all appropriate control measures are in place. Control measures should be available and it is advisable to consult with your local fire protection agency, or equivalent structure, before igniting a fire.

Fire behavior can change dramatically and rapidly with changes in the wind. Managers should be prepared for this.

Any person planning to burn rangeland must ensure they are familiar with the legal context in which they are operating and their liability for fire that spreads onto neighbouring land. Policies should not prevent burning but they should influence the conditions under which a fire is lit and the precautionary measures taken.

There are no generally applicable guidelines for burning that suit all sites and thus it is not possible to set a "one size fits all" regime. It is probably safest to aim for an average fire regime applicable for the general habitat and rainfall of a site.

Approaches to take <<



Fires in areas that are vulnerable to poaching (e.g. near to fence lines adjacent to public roads) can attract rhinos to these areas and present a clear security risk for a manager. Appropriate action should be taken to reduce this risk.



Archibald *et al.*, 2005. Shaping the landscape – fire-grazer interactions in an African savanna.

For South Africa: [National Veld and Forest Fire Act](#) (Act 101 of 1998).

SANBI, 2014. [Grazing and burning guidelines: Managing grasslands for biodiversity and livestock production.](#)

Trollope & Trollope, undated. [Fire effects and management in African grasslands and savannas.](#)

Van Wilgen, 2009. [The evolution of fire management practices in savanna protected areas in South Africa.](#)

Useful references <<





WATER

Both rhino species need to drink daily, therefore access to sufficient water of appropriate quality is essential. It is of critical importance to ensure there is a reliable and accessible source of fresh water, irrespective of whether rhino are in temporary holdings or wild. Failure to ensure this will rapidly lead to the death of the rhino.



Water supply should be: _____

- Accessible;
- Sustained;
- Meet minimum standards for agricultural livestock.

Issues to consider

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Not all natural water bodies are appropriate for rhino. If the quality of the water does not meet minimum standards (e.g. it is saline or too muddy or is polluted), it will be inadequate for rhino at both an individual and a population level. No water quality guidelines exist specifically for conservation areas but those available for agricultural livestock are valuable to consult as a benchmark for large mammals.

The distribution of water across the landscape affects rhino distribution and movement. Rhino are capable of comfortably walking up to five kilometers to water but may start to fatigue over longer distances – particularly young rhino – which may lead to mortalities. Greater distances may be covered in more arid areas.

Depending on rhino density, water distribution can have ecological feedback loops. Areas closer to water may become more intensely grazed or browsed which in turn can influence other aspects of the local ecology, such as the movement and intensity of fire.

At a site that has the conservation of the natural ecology as a key objective, the density and distribution of water holes requires careful attention. A good rule of thumb is to reflect the pattern of water availability from the larger landscape (e.g. place water close to where rhino would find water if there were no fence in place), but this may not always be possible.

Water holes also influence social behaviour by drawing animals into closer proximity. Depending on the environment and availability of water to wildlife, competition to access waterholes can be intense

and result in physical fighting or increased stress levels. Either of these can limit access to water by rhino, particularly if there are elephant or other large mammals present. Management should monitor this and where appropriate build additional water holes, or take other measures, to reduce conflict.

Rhino are limited in their ability to negotiate obstacles thus the design of a structure or the shape of a natural water source require careful consideration.

Some species, such as elephants and baboons *Papio spp.*, interfere with infrastructure, for this reason pipes and borehole caps should be buried or otherwise protected to ensure a sustained water supply.

Water troughs with steep sides can be death traps for smaller species and care should be taken to avoid this.

It is critically important to ensure water is available and accessible and water quality should be assessed before the introduction of rhinos to an area.

Natural sources (e.g. dam, pans, streams, and rivers) are generally of adequate quality but may not be accessible, particularly in drier times when muddy edges can cause a rhino to become stuck or steep slopes may not be negotiable.

Pumped bore hole water needs to be monitored regularly for both quantity and quality.

Pumping water into a large wallow or dam can be safer than pumping into a small trough as the larger volume will more effectively buffer against a pump failure.

Ensure naturally occurring, accessible and suitable perennial water is available to rhino. If you are not certain, seek expert advice on the matter. If such a supply is not available at a site no rhino should be placed there.

Lessons Learnt <<



Approaches to take <<



If naturally occurring water is not of adequate quality or its distribution in the landscape is limiting, it will be necessary to ensure the artificial supply of water.

Artificial supply can be achieved either by drilling a borehole and pumping or by piping water into natural wallows or troughs. Water supplied artificially needs to be tested for quality and an adequate flow needs to be ensured.

Useful references



Bothma, 2008. Game ranch management. (Chapter 10)

Owen-Smith, 1996. [Ecological guidelines for water points in extensive protected areas.](#)

Department of Water Affairs and Forestry, 1996. [South African water quality guidelines \(2nd Edition\). Volume 5: Agricultural use: Livestock watering.](#)



INVASIVE, ALIEN AND TOXIC PLANT SPECIES

Plant species in an area may have an effect on rhino or their habitat. Managers should be aware of potential risks and management options.

Weedy alien plants can be competitive with indigenous plants, even to the extent that they outcompete indigenous vegetation and completely occupy areas.

Plants can also be toxic and have health implications for rhino.

Issues to consider <<



Low infestations of alien species can remain “undercover” or seem insignificant for a number of years before “exploding” and occupying considerable areas. During monitoring, managers should be on the lookout for young plants as these indicate either an increase in density or signal the spread of the species. Action may be needed to control this process.

Lessons Learnt <<



Regular engagement with relevant agricultural and conservation authorities is key for remaining informed of potential invasive alien species and which should be monitored, and where appropriate, controlled. If an invasive alien species is identified at a site, it is prudent to map and monitor its spread.

It is generally easier and less costly to control an infestation in the early stages, so once the distribution is mapped, a plan for control, or preferably eradication, can be put in place. This plan should incorporate knowledge of the mechanism of spread of the species as this may determine the approach to its long-term control.

Approaches to take <<



While there has been little published data on the effects of alien, invasive or toxic plants on wild rhino, there are several examples from the field that are worth noting. The cases included here come from personal communications with wildlife vets working in Africa alongside the one published study.



1. ***Chromolaena odorata***, is an invasive Central American plant. The spread of the shrub in Hluhluwe-iMfolozi Park, South Africa, resulted in the plant becoming dominant and shrinking the grazing availability for white rhino by up to 20%. It also physically blocked black rhinos' access to browse due to growing so densely that rhino could not penetrate it. Furthermore, it was very flammable and played a role in altering the fire regime of the site.



2. ***Datura stramonium***, originating from Central America, is an invasive annual shrub that is known to be toxic to animals and humans. It may have a toxic effect on black rhino if browsed. Reports of hallucinogenic symptoms in black rhino have come from Hluhluwe-iMfolozi Park in South Africa and Malilangwe Wildlife Reserve in Zimbabwe. *Datura* is also suspected to have caused the deaths of two rhino in Kruger National Park, South Africa, but no diagnosis could be confirmed as the carcasses were too putrified. There were signs that the rhino had browsed on the *Datura* that had sprouted following floods in the area.



3. ***Ipomoea*** is a succulent creeper that can become invasive, and some species may also be alien in the ecosystem. There was a cluster of black rhino deaths in Kenya that were linked to the animals foraging on *Ipomoea*, as it was the dominant emerging pioneer plant following a long dry period. The result was that the rhino experienced severe bloat, colic and death. The vet investigating the deaths stated that when the GI contents were placed in a rubber glove and tied off, the glove enlarged with gas to the size of a football within five minutes.



4. ***Dichapetalum cymosum***, commonly known as gifblaar, is a small shrub found in southern Africa. It is known to be toxic to cattle and is suspected in the deaths of one or two black rhino in Namibia.



5. ***Senecio spp.*** are hepato-toxic to equids and could cause similar symptoms in white rhino if they are allowed to graze in fields where the species grows. However, there no recorded cases.



6. ***Prosopis glandulosa*** is a highly invasive tree species which originates from south-western United States. It has been potentially associated in the death of two black rhino in the Northern Cape of South Africa. Livestock which consume excessive amounts of seedpods are poisoned by neurotoxic alkaloids. The wood contains high levels of the flavanol mesquitol which may have a caustic effect.

Te Beeste *et al.*, 2017. Successful control of the invasive shrub *Chromolaena odorata* in Hluhluwe-iMfolozi Park.

Turpie *et al.* 2008. [The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa.](#)

Useful references





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2 FOCUS AREAS

C. Range for population expansion

The history of African rhino contains a narrative of population decline and a substantial reduction in distribution and occupied range (see pages 14 & 15). With conservation successes resulting in increases in numbers of both black and white rhino, there came the need for identifying new range for rhino to expand into.

Acquiring and managing new range, enabled ongoing growth of rhino populations as well as initiating the repopulation of their historical ranges. However, the landscapes were no longer open in a way that rhino could disperse naturally. Populations were, and remain, largely restricted to relatively small and fragmented sites with a few exceptions, such as the Kunene region of northern Namibia, the Zambezi Valley, the Selous Game Reserve in Tanzania and arguably in areas of Tsavo (East and West) National Park in Kenya. As natural dispersal is limited, translocation (covered from page 101) is required to move animals to new range.

Important considerations for rhino range expansion include:

- Indigenous range;
- Habitat suitability;
- Potential density of a site;
- Tenure of land and rhino ownership.

INDIGENOUS RANGE

The term “indigenous range” is a descriptive term for where rhino occurred historically and the environmental conditions in and to which they evolved and adapted. Indigenous range can extend over large areas and thus environmental conditions can vary greatly across it. Variation in environmental conditions, combined with higher levels of local as opposed to regional gene flow, has led to local adaptation and what are referred to as evolutionary significant units (also known as sub-species, see page 82).

Issues to consider
<<





Other species in these environments are adapted to the presence of rhino and interact with them ecologically. If these interactions are disrupted there may be knock-on consequences for the overall ecology of an area.

For these reasons, range expansion should take place within the species' indigenous range as this is where there is likely to be the strongest congruency between the rhino's genetic adaptations and the ecological conditions.

This does not mean that rhino are unable to survive outside their indigenous range; as evidenced by African rhino populations thriving in other continents. However, it is not good conservation practice to place them in such sites. *Ex situ* placement of rhino is better used for crisis interventions, such as placing of Northern white rhino on Ol Pejeta in Kenya, after population numbers had become critically low.

There is reasonable knowledge of what constituted the natural distribution of black and white rhino in pre-colonial times (see pages 14 & 15) and this can be used to circumscribe the extent of their natural range for current conservation purposes. It is useful to note that indigenous range for the two rhino species overlaps in some areas of southern Africa but not widely across the continent.

Rhino managers should actively limit rhino range expansion initiatives to sites within the indigenous range of the species and the ESUs. Site selection is best achieved through consultation with experts who are informed with the latest scientific research.

HABITAT SUITABILITY

This section contains overlap with the habitat management section (see pages 33 - 47). The presence of adequate suitable grazing for white rhino and adequate suitable and accessible browse for black rhino are essential features of their habitat, as is the availability of water.

Habitat suitability is determined by various factors including:

- Size of habitat;
- Vegetation structure;
- Species composition and density (both vegetation and other herbivores);
- Water availability;
- Soil fertility;
- Mix, configuration and accessibility of habitat patches;
- Slope of the terrain; and
- The site's management history.

Examples:

- 1) *Vachellia* (previously *Acacia*) dominated savanna is potentially very good black rhino habitat, but the density of black rhino that such a site can support will vary depending on the actual mix of species present, as well as the density, height and recruitment patterns of the trees, as this dictates the availability of browse.
- 2) Abandoned crop fields are commonly colonized by woody plants of the same species within a similar age cohort. While they are young they will be accessible to black rhino, however as they age they may grow beyond the reach of a rhino and thus make the habitat unsuitable.

Lessons Learnt >>



Within each species' indigenous range, sites fall along a continuum from optimal to poor habitat. Any translocation needs to ensure that a full habitat assessment of the potential reintroduction site is conducted by suitably qualified experts before translocating rhino.

Rhino are moved for many reasons. There is a risk that the proposed destination is selected for reasons unrelated to conservation goals and is questionable if it falls outside of the indigenous range of the species. Pressures of this type can best be countered through the development, and ratification, of appropriately designed metapopulation plans, both within and between range states. Once such plans are in place, any proposed translocation outside of the indigenous range can be reflected against the metapopulation plan in an attempt to influence proceedings towards a positive conservation outcome.

Issues to consider >>



Habitat suitability can fluctuate over time and space in response to fire, rainfall, other herbivores and successional patterns and trends of vegetation.

Frost:

Both species are able to tolerate a limited amount of frost but this lowers the quality of available food resources. It is better if there are less than 5 to 7 frost days per year at a site and if the distribution of the frost is limited to low lying areas in such a way that not all rhino browse and grazing has been exposed.

Supplemental fodder:

Supplemental winter browse or grazing may be required and is dependent on the size of the area and the density of rhinos and other species at the site.

Fire:

The use of fire and its extent and heterogeneity can be an issue. Particularly for white rhino if the grass sward is uniformly burned, when there is a risk of the entire resource base being lost.

Soil depth:

Deeper soils tend to be more resilient to drying out during droughts.

Slope:

Impacts on the accessibility of areas within the site.

Toxic plants:

Presence could negatively impact herbivores.

Approaches to take >>



It remains a truism that rhino management involves “art as well as science” and that experience is very valuable for guiding decisions around habitat and likely ecological densities of rhinos at a site when re-establishing a population. It is advisable to ensure that experienced ecologists and managers are consulted when considering habitat suitability.

POTENTIAL DENSITY

It is important to consider potential rhino densities when assessing new sites for range expansion. The inherent quality of a landscape will influence how many rhinos a site can support.

Each habitat will have a different potential density for each species of rhino. The proportional contribution, and potentially the configuration, of each habitat in a landscape will influence the total potential density of a site.

Although an assessment of potential density can take place at any time of year, it is important to reference any assessment against the period which is most limiting for rhinos. Commonly this is towards the end of the dry season when grass resources are depleted and dry for white rhino and there has been a drying out and loss of browse leaf for black rhino.

There is an additional loss of available graze or browse in areas subjected to periods of frost for more than a couple of days. Depending on severity, frost can result in 20 to 30% reduction in potential rhino density.

In good habitat, white rhino can thrive at densities approaching 3.0/km² or more, although it is more common for them to occur at half that density. Black rhino are commonly found at densities between 0.01 to 0.5/km², with densities of 0.1/km² being common. Densities of around 1.0/km² in more fertile areas have been recorded.

Seeking the advice of people experienced in rhino ecology and management is essential when evaluating potential density.

There are methods of objectively evaluating potential rhino density of a site by comparing its vegetation, soil, geology and climate features against a set of reference sites for which approximate densities have been established through long-term monitoring. The densities of other herbivores also need to be assessed. These detailed carrying capacity assessments can be time consuming and thus costly.

Issues to consider <<



Lessons Learnt <<



Approaches to take >> All but the larger sites (>750 km²) should undertake an assessment of potential density of rhino prior to planning a reintroduction. It is recommended to start a new founder population at between 30% to 50% of the estimated density at ECC and to allow the population to grow. Apart from reducing risk of density-related mortalities, this approach allows for monitoring to accumulate sufficient data to understand the site's habitat potential in order to guide management decisions.



TENURE OF LAND AND OWNERSHIP OF RHINO

It may not be possible, and it will certainly be more challenging, to effectively manage a rhino population if the legal status of occupying and managing the land is disputed, or if the ownership and conditions of management of rhino are not clearly established. Rhino conservation can take place on land under state, provincial, municipal, communal or private ownership or a partnership involving any combination of these.

Issues to consider >>



Management can be undertaken by owners, employees or contracted third parties but, as with any enterprise, it is necessary to adopt a due diligence approach. This ensures that the legal aspects of land tenure and any agreements relating to the use of the land and the ownership and management of rhino are sound.

Approaches to, and conditions of, land ownership vary in different countries. In some countries private land ownership is strongly entrenched, whereas in others there is a mix of communal and private land tenure alongside state ownership. The specifics at a site can have a profound effect on the approach of managers, the governance structures they work under and the nature of the decisions they take.

Rhino ownership also varies between countries with implications for management. In some countries, rhino are owned by the state and are largely managed on state or communal land. Rhinos on private land may be managed under a custodianship agreement, or similar arrangement, with restrictions on activities that can be undertaken without state authorization.



In South Africa, legislation allows rhino to be privately owned; and owners have clear private property rights and decision making freedom when considering management interventions. There are some restrictions on management decisions and there are regulations requiring permits in relation to hunting, translocation, dehorning and other activities.

Lessons Learnt >>



It is important to have a clear understanding of the legal status of land tenure and rhino ownership, particularly where other parties and partners are involved. This makes the decision making processes and management actions easier to understand.

Under custodianship agreements in South Africa, while the adult rhino remains the property of the original owner, it is common to include a protocol determining how any progeny should be allocated between the original owner and the site custodian. These can be complex, but it is important that they are in place and tested to ensure that they cover all eventualities.

In other countries where rhinos and their progeny remain the property of the state, there are fewer incentives for private owners and communities to conserve rhinos under a custodianship basis.

In order to implement these agreements and protocols it is very important to be able to identify each rhino and to be able to track the calves that are born. This requires that an appropriate monitoring programme is in place (see page 89).

Approaches to take >>



It is important to ensure appropriate legal advice when engaging in all legal contracting relating to the site, its management and the ownership of rhino. Such agreements should ensure that there is adequate detail covering ownership, responsibilities and decision making in relation to the progeny while at the same time attempting to keep the legal aspects simple.

A sample protocol for progeny sharing as used by the [WWF-SA Black Rhino Range Expansion Project](#) is presented on the next page. The details should be adjusted to match the specific circumstances in each custodianship agreement.

PROTOCOL

1. Individuals that make up the founder population remain the property of the donor until they die or for a maximum of 25 years at which point they become the property of the recipient site.
2. The progeny of the founder population are shared equally between the donor and the recipient site.
3. The donor will determine when management removals of their rhino are to be undertaken.

PRINCIPLES

- a. All progeny must be ear notched and rendered individually identifiable before leaving their mothers (normally 2-4 yr old).
- b. Progeny should not be removed before they turn 5, unless special circumstances for their release are in place.
- c. Ownership will be conferred when each calf enters the 5 yr age class, not at birth or some stage between birth and 5 years.
- d. The opportunity for ownership of progeny will alternate and be shared equally with respect to sex ratio. Ownership will be conferred as follows:
 - The first male and first female calf turning 5 years will be conferred to the recipient site.
 - The second male and second female calf turning 5 years will be conferred on the donor.
 - Ownership of all subsequent calves will alternate in the manner described above.
- e. In the event that a calf loses its mother and is orphaned, the calf will be cared for by the recipient site which will retain ownership of that calf. In such an instance, the following conditions pertain:
 - The risk and costs associated with the management and care of the rhino are to be carried by the recipient site.
 - No replacement rhino will be considered should the orphan not survive.
 - The rhino will form part of the recipient site's existing progeny allocation.
- f. A record of ownership of all animals at the recipient site will be maintained on the site's Black Rhino Database, which will be updated at the end of each calendar year.
- g. Progeny may be temporarily kept on the recipient site, at risk, and by agreement.
- h. Once ownership is conferred, a rhino that dies will not be replaced, no matter the cause.
- i. Calves born to female progeny which have had ownership conferred on them automatically become the property of the owner of that female.
- j. Progeny may be disposed of at the party's own discretion.



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2 FOCUS AREAS

D. Containment

Contemporary management of rhino has a strong focus on contained populations as the majority of rhino populations in Africa are on fenced sites. For this reason, consideration of fencing is important and includes factors such as its structure, strength, maintenance needs, etc.

In addition bomas may be required to contain rhino for short periods for veterinary purposes or during translocation at either the donor site, the recipient site or both. Even though they are usually only used for a short period, bomas come at a significant cost and it is important that they are appropriately designed and constructed.

BARRIERS TO MOVEMENT

The reason for fencing or creating a barrier, such as the Kenyan stone wall, is fundamentally to prevent rhino from leaving a site. The design of a fence needs to meet that criterion as well as being a durable permanent structure. The design will also, in part, depend on the other species on the site. For example, if elephant are present the fence will likely be designed to contain elephant (Scholes & Mennell, 2007), but if rhino are the largest animals then the fence will only need to be adequate to contain rhino and thus designed to a different standard.

Other functions of movement barriers include reducing conflict between wildlife and humans, demarcating site boundaries and controlling the spread of disease between domesticated and wild animals.

There are a multitude of different fence designs, fencing materials, and fence construction techniques. A fence is usually a long-term asset that requires both capital outlay as well as ongoing maintenance costs. It is worth conducting a cost-benefit analysis on various options before committing to a specific design. Short-term electric fencing for specific purposes, such as managing population supplementation, is less costly.

Points to consider
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Fencing needs to be effectively maintained and regularly inspected. Many sites have daily perimeter patrols to check for breaches in security. These patrols can be used to inspect the fence and undertake small maintenance activities as necessary, such as removing fallen tree branches or repairing minor holes. Importantly these inspections allow for the rapid detection of possible breakouts of rhino and thus limit delays in the responses of the management team.

The presence of burrowing animals, river or drainage line crossings and the slope and nature of the substrate (e.g. sand or rock) will impact the structure and cost of the fence.

Fence line monitoring and maintenance requires access. The final routing of the fence should take this into consideration.

Lessons Learnt >>



Most contemporary protected area fencing makes use of electrified strands. Electrified fences are optimally functional if rhino are familiar with them. There may be value in including a number of electric strands on fencing in bomas to familiarize rhino with the wires and the associated sensation, which in turn hopefully leads to later avoidance. This approach is not well tested and if attempted, needs to be closely monitored and if necessary, the electrical current should be switched off. This technique may work better for white rhino than black rhino.

The life of a fence is substantially reduced if it is exposed to fire. Effective fire breaks should be maintained on either side of the fence. Spraying herbicide or cutting/removing the grass can work well for this purpose as can grading a vehicle track. However, these actions may increase the risk of erosion and this needs to be monitored and addressed if necessary.



A vehicle track has the added advantage in that it can be used for counter-poaching activities.

Early perimeter fencing included a steel rope cable at a height of approximately 0.5 - 0.6 m above ground level as rhino are not able to step over this and was generally up to 2.4 m high with Bonnox fencing. Contemporary fencing relies a lot more on electrification and can be as low as 0.75 m, which allows greater movement by other species.

The approach taken will depend heavily on the specific circumstances and requirements.

Bothma, J. du P. 2008. Game ranch management.

Scholes & Mennell, 2008. [Elephant management: a scientific assessment for South Africa.](#)

Approaches to take <<



Useful references <<



BOMA DESIGN

Bomas are structures used to temporarily contain rhino in controlled conditions and are not suitable for permanent housing. Primarily bomas are used for veterinary or husbandry reasons or during translocation. They can also be used in the short term for a specific purpose such as rhino awaiting transportation or an auction. It also can contribute towards any veterinary quarantine period that may be necessary prior to moving the rhinos.

Boma design has developed during the past two decades and can vary considerably depending on the envisaged purpose. Boma design depends on individual opinion, but there are some fundamental features that most rhino managers agree on.

Definitions: _____

Boma: the infrastructure for housing and managing rhino.

Pen: an enclosure within a boma in which a rhino is held. Pens are usually connected by passages, have watering facilities and access control for moving rhino and enabling cleaning.

Points to consider >>



Because of their intended use and cost, boma placement, design and size are important considerations. The number of rhino to be held in the boma will be a key factor in design and construction. The species of rhino is also important, as adult white rhino are larger and on average double the weight of adult black rhino.

Boma design can be modified based on the intended use, but it is strongly recommended that an experienced boma manager is consulted regarding the design to minimize unintended consequences and maximize beneficial design features.

A boma can be built to house one or more rhino. Pens within a boma typically accommodate one rhino but can be used for more. This arrangement is particularly useful in the case of more than one juvenile without an adult or a cow-calf combination.

Approaches to take >>



- Away from boundary fencing and main roads to
 - Limit human proximity and disturbance,
 - Reduce vulnerability from a security perspective, and
 - Better serve the function as a release area if rhino are to be released directly from the boma.
- Close to good roads and should be easy for staff to access.

Boma Design:

- Allow for easy isolation of rhino, either in a pen or a passage;
- Allow for easy movement of rhino between pens as well as ease of loading and unloading;
- A ramp may be necessary if trucks used do not have hydraulic cranes to load or unload. It should lead into the passage leading into the pens. If there is a crane, the crate can be placed at the main entrance to each pen;
- Allow for easy access to the rhino for darting by a veterinarian while they are in a pen for treatment. This can be achieved through gaps in the poles around the pens, by means of an overhead walkway, or by narrow platforms built against sections of the outer side of the outer wall;
- Access to pens or passages shouldn't be blocked by structural elements such as water troughs;

- Boma orientation and shelter placement within pens should be considered in the design phase.

Structure:

- The structure must be sufficiently strong to withstand the behaviour of a newly captured rhino;
- The height of the walls are commonly 2.2 to 2.4m as rhino can walk their front legs up the wall and reach a height approaching 2 m;
- The main structural element is usually upright cross-braced gum poles of approximately 110 mm diameter;
- A stronger, larger pole is required at 2 m intervals;
- Cross-braces (poles or rails) should be placed at the top and bottom of the wall rather than in between as rhinos can then use them to climb up with their front legs and get themselves into dangerous positions;
- Spacing between poles should be limited to between 0 and 50 mm so a rhino cannot insert its horn between poles;
- The bottom of the poles should abut on the ground to prevent a rhino placing its horn underneath it;
- The ends of all securing wires and cables must be bent to the outside of the pen to avoid injuries to rhinos. Similarly, no length of bolt or similar object should protrude into the pen;
- Steel pipes have been used but wooden poles are preferred as they are less hard on the rhino physically, they are less noisy and they get less hot. Steel pipes may be used in the short term for mobile bomas, but are not advised for fixed bomas, even if they are well covered with conveyor belting to reduce noise and injury to the rhinos;
- Wooden poles need to be treated as they rot or are eaten by termites. Creosote should not be used as it is toxic to black rhinos.

Pens

- Each pen to be roughly 10 to 15 m wide and 20 to 30 m long;
- Smaller pens can be built but are more limited in use, and rhinos are less likely to settle in smaller confined spaces.

Sliding Doors

- 1.5 to 2 m wide;
- Same height as boma walls;
- Hung on firmly attached upper wheels. Lower wheels should be avoided as they can jam with the general muck around a boma;
- Lower edges should be constrained by a solid guide or other mechanism to prevent sideways movement if pressured by a rhino;
- Doors must be able to be operated easily and from a place of safety;
- In some instances pole doors can be used;
- It is better to have more doors to allow for flexibility of rhino movement in the boma.

Ground

- Good drainage is essential to prevent the area from becoming muddy and difficult to manage as well as being potentially unhealthy to a rhino.

Water

- Each pen requires a reliable source of water;
- Troughs should be built using bricks and reinforced concrete to ensure adequate strength;
- The shape and positioning of the trough should allow easy access;
- It should not be raised more than 0.5 m above ground level;
- A trough should be able to contain at least 100 liters;
- Ideally troughs should replenish water once a rhino has drunk;
- Ideally positioned along one of the edges or in a corner of a pen and be easily accessible to enable regular cleaning;
- If free-standing troughs are used, they must be securely fixed in place to ensure they cannot be moved by rhinos;
- A trough half-in, half-out of pen, under a section of the wall, with its bottom sloping to the outside allows easy cleaning as muck can be scooped out easily.

- There should be no free lying pipes or mechanisms that can be accessed and damaged by a rhino in the pen.

Forage

- Feed areas should allow for easy placement of food and daily cleaning in a manner that does not endanger staff;
- Feed can be provided on the ground or on a large piece of heavy-duty flat conveyor belt on the ground which allows for daily cleaning.

Shelter

- Natural shade from a tree is the best option as this allows a rhino to feel more "at home";
- If not possible, artificial shelter such as a corrugated iron roof over a section (approximately one quarter) of each pen must be provided for shade, shelter from wind and protection from hail;
- The roof should be at least 3 m above ground level and it should be angled to provide optimal shade and channel rain water out of the pen;
- At least one wall of a pen should have a facility to enable windproof material to be put in place to stop cold winds if necessary;
- Depending on the area and winter temperatures it might be good practice to provide heating.

Morkel & Kennedy-Benson, 2016. [Translocating black rhino: Current techniques for capture, transport, boma care, release and post release monitoring.](#)

Useful references



Boma Design





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2 FOCUS AREAS

E. Veterinary Considerations

As with all species, not all individuals are healthy and some may die at an early age of natural causes. While it is normal to try to minimize these mortalities, it is also useful to consider that they are not always a sign of a problem and, as part of bigger natural ecosystem processes, may in fact be beneficial to the population in the longer term.

Veterinary attention is rarely required for rhinos in the wild and then usually only to treat anthropogenically generated injuries, such as gunshot wounds, vehicle accidents and facial wounds following rough horn removal.

Rhino generally have a strong immune system and are able to fight off secondary wound infections successfully. Because of this they respond well to veterinary treatment.

DISEASE

Both species are fairly resistant to disease, though they may become infected by a number of agents, sometimes with no apparent symptoms.

A list of the diseases that have been found in rhino is presented (Table 1) with notes on the vectors, likely hosts and symptoms that can be expected in rhinos.

Points to consider

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Table 1: Diseases that have been found in rhino, their means of transmission and likely hosts. The list is not comprehensive but does identify diseases that have been encountered.

Causal Agent & Name	Vector	Host(s)	Symptoms observed & other notes
Viruses			
Middelburg Virus (MIDV)	Mosquitos	Livestock, horses and humans	Neurological signs and fever. Rhinos infected with SINV or MIDV, singly or co-infected, display neurological symptoms such as weakness and progressive paralysis with death occurring within 24 hours of recumbency.
Sindbis (SINV)			
Wesselsbron			
West Nile			
Shunivirus			
Equine Encephalosis Virus (EEV)	Direct aerosol	Zebra, Rhino	Rapid respiration, nervous symptoms, abortion.
Rabies			
Bacteria			
Tetanus <i>Clostridium tetani</i>	Spores enter through wounds		Muscular tetany.
<i>Clostridium</i>			A vaccine (Rhinovax) was developed to deal with an outbreak in a semi-intensive white rhino establishment.
Anthrax <i>Bacillus anthracis</i>			Paralysis. One should avoid releasing rhinos in an area where anthrax is common.
<i>Salmonellosis</i>			Gastroenteritis, septicaemia (can be fatal). <i>S. typhimurium</i> was isolated in white rhino cow with diarrhoea, held in captivity in Zululand.
<i>Streptococcus</i>			Poor body condition, pharyngitis, oesophagitis

Causal Agent & Name	Vector	Host(s)	Symptoms observed & other notes
Tuberculosis <i>Mycobacterium bovis</i> or <i>M. tuberculosis</i>		Diverse, including both livestock and wild animals, but in wild areas of South Africa, predominantly buffalo	Chronic infection that can lead to fatal disease but this is rare. Rhino can carry the bacteria for months or years before showing clinical symptoms that include poor body condition, weight loss, nasal discharge, coughing, sneezing, diarrhea, lethargy, lack of appetite, and terminal dyspnoea or tachypnoea. At necropsy, granulomas in the lungs. Very few cases have been recorded in the wild.
Secondary infections			
Trypanosomiasis	Tsetse fly	Buffalo, zebra, warthog, elephant, hippopotamus, rhinoceros & antelope	Symptoms are rarely seen in wildlife, despite carrying the parasites. Lethargy, abortions, anaemia, leukopaenia, thrombocytopaenia. Releasing in tsetse-infested areas is possible but monitoring of rhinos is necessary.
Blood Parasites			
Piroplasms <i>Theileria</i> and <i>Babesia</i>	Ticks		<i>Babesia bicornis</i> has resulted in black rhino mortalities, particularly in stressed individuals, e.g. during droughts.
Parasites			
Ticks		All	Rhinos can carry many tick species and vet authorities often require acaricide treatment prior to transport to a new area.

Causal Agent & Name	Vector	Host(s)	Symptoms observed & other notes
Filariosis <i>Stephanofilaria dinniki</i>	Transmitted by flies		Typical bilaterally symmetrical skin lesions have only been described in black rhino in Kenya, South Africa and Zimbabwe, but cases have been reported in white rhinos in Kenya.
Toxins			
Cyanobacterial intoxication (blue-green algae)			Rapid death. Generalized haemorrhages, hepatic lesions, pulmonary oedema observed on autopsy.
Salt poisoning			Cases were reported in 2018 in black rhino in Kenya, where only highly saline water was available to translocated rhinos. This increased the stress levels in individual animals and ultimately lead to the loss of a number of rhino.
Various plant species			see pages 46-47

Individual rhino that are naïve to a disease agent may be at risk when introduced into an infected area. Equally, infected rhino translocated to an infection-free area can put the naïve animals at the release site at risk.

Stresses experienced by rhino during immobilization, capture, holding in captivity and translocation or simply dehorning, may have immunosuppressive effects, thereby increasing the susceptibility to infections to which rhino are normally resistant, such as trypanosomiasis and babesiosis.

Lessons Learnt >>



Managers of free-ranging rhino are unlikely to be concerned with disease at the level of the individual animal. Rhinos typically do not exhibit visual clinical symptoms that could be picked up during routine monitoring and many are only identified at autopsy. Disease

risks to individual rhino are minimal in translocations although the presence of anthrax, trypanosomiasis and toxic plants should be considered.

The disease with the greatest management implications is tuberculosis (TB). Although rhino are capable of contracting TB and even dying from it, they are generally considered to be at low risk due to an inherent resistance. They are also generally considered to be low risk as agents for TB transmission. TB is an important disease in the cattle industry and considerable effort goes into containing or eradicating it. For this reason, rhino living in a declared TB area by state veterinary authorities, may be refused a permit to be moved out of the area. This clearly has significant implications for rhino movements as well as for the management of rhino metapopulations.

An example of this are the recent restrictions imposed on the movement of both species of rhino out of Kruger National Park, South Africa, by the veterinary authorities. A plan is being developed that may allow rhino to be transported out of Kruger, which includes the development of a reliable blood test for TB in rhino. There are other knowledge gaps such as how TB is transmitted to and from rhinos, the rate of this transmission and the rate of progression from infection to a diseased state. Reliable diagnostic tools and further research are needed to limit TB impact on future conservation efforts.

Because disease and disease risk can have significant implications for rhino conservation, particularly when translocation is involved, these issues should be considered at an early stage of the planning. Veterinary involvement should begin as early as possible. This should include establishing the presence of novel toxic plants at the release sites as rhino may naïvely eat them to their detriment.

Approaches to take <<



Miller *et al.*, 2017. [Tuberculosis in rhinoceros: an under-recognized threat?](#)

Fischer-Tenhagen *et al.*, 2000. [Serosurvey for selected infectious disease agents in free-ranging black and white rhinoceros in Africa.](#)

Useful references <<



VETERINARY COMPLICATIONS

When rhino management requires the intervention of a veterinarian, it is always possible that complications arise. An example of this occurs when rhino are captured and exposed to elevated stress by running more than normal and, at times, in the heat of the day. While the majority of rhino in these instances will be fine, a small percentage of individuals may experience complications that are detrimental or can lead to death.

Points to consider

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These instances are difficult to predict and may not be avoidable. Stress commonly underlies veterinary complications and can cause the manifestation of conditions that have been dormant. It is therefore important to attempt to keep stress levels to a minimum while handling rhino.





2 FOCUS AREAS

F. Biological management

Biological management refers to managing attributes of a free-ranging population to promote its biological sustainability.

Biological management has three aspects:

- Demographics;
- Conservation genetics;
- Population growth.

Underpinning all decisions and interventions of biological management is the requirement of good monitoring of the population (covered from page 89).

DEMOGRAPHICS

Sustainable long-term rhino conservation best practice should aim for a naturally structured age and sex distribution in a population. The Homeostatic Sex Allocation Hypothesis (HSAH; Fisher, 1958) predicts that in natural populations of rhino, calves will more likely be of the rarer sex in a population. There is some evidence that this is the case (Linklater *et al.*, 2017) although this is disputed by others. A consequence is that natural populations tend towards a 50:50 sex ratio. If the sex ratio is significantly skewed through management, the HSAH predicts that there will be compensation in the birth sex ratio that would shift the population back to a 50:50 ratio. The time line for compensation of this nature could be over a few generations.

Natural birth sex ratios of rhino: 53% female, 47% male

Normal population structure: 50 to 65% female, 35 to 50% male

Normal age structure: 50 to 65% adults aged 7 and above and slightly more juveniles than sub-adults

Points to consider >>



From a management perspective, there is likely to be an ongoing trade-off between the benefits gained by skewing the sex ratio in favour of females to achieve growth and the cost of managing the resultant “excess” males as well as the potential risk of an increase in male calves. Unless there is a suitable way to manage the male calves, this approach is not recommended.

Stochastic effects and greater fluctuations in the population structure are likely to be present in populations of less than 200 rhino.

Lessons Learnt >>



The only time that there seems to be a real benefit to introducing a slight skew in favour of cows is when a new founder population is being established. This will support a higher growth rate from an earlier stage, which serves to counter the reduced birth rate that commonly accompanies translocation. Reduced fighting among males can be an added advantage.

There is no evidence to support manipulating the age and sex structures of populations in order to promote the growth rate of the population in the long term.

Young male rhinos experience a higher mortality rate.

Approaches to take >> It is recommended that managers aim for normally structured age and sex ratios in rhino populations.



CONSERVATION GENETICS

During the last three decades conservationists have recognized the importance of genetics for conservation management and decision making. Genetic issues are of particular concern for small populations in fenced areas, reintroduction initiatives and metapopulation management.

Terminology

Evolutionary significant unit	Populations that share a close evolutionary history which is reflected in their genes.
Gene flow	The active or passive transfer of genes between populations.
Genetic diversity	A measure of the amount of variation present in the gene pool of a population and is often established by measuring the level of heterozygosity, i.e. the amount of genetic variability.
Genetic drift	Variation in the relative frequency of different alleles in a small population, owing to the chance disappearance of particular alleles as individuals die or do not reproduce. This effect is more marked in smaller isolated population.
Heterozygous	Genes come in pairs, called alleles, and each pair is located in a specific position (or locus) on a chromosome. If the two alleles are different from one another, they are heterozygous.
Heterozygosity	A measure of genetic variability referring to the fraction of individuals that are heterozygous for a particular gene locus.
Inbreeding depression	Reduced genetic fitness of an individual due to breeding of closely related individuals.
Management unit	An identified group of populations that are treated as a metapopulation based on genetics.
Outbreeding depression	Reduced genetic fitness of an individual due to breeding of distantly related individuals. Reduced fitness can be due to the offspring not being well adapted to the parental habitat or through physiological incompatibility. It is more rare than inbreeding depression.

Points to consider

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POPULATIONS

Both species of rhino have been through substantial population declines during relatively short time scales exposing them to the risk of losing genetic diversity. High genetic diversity, meaning more variation is present in a population, should result in the population being better able to withstand changing conditions. Natural levels of genetic diversity vary between species but there is no baseline with which to compare the current genetic variation to historic levels.

From the data that we have on current populations, heterozygosity measures indicate that despite their overall lower numbers, *D.b.michaeli* has the highest genetic diversity of black rhino sub-species, followed by *D.b.minor* of Zambezi origin. *D.b. minor* populations with mixed Zambezi /KwaZulu-Natal genepools are the next most diverse followed by *D.b. bicornis* populations. *D.b. minor* populations of KwaZulu-Natal origin appear to have the lowest genetic diversity of the black rhino species. Compared to the black rhino populations, the Southern white rhino populations have the least genetic diversity.

Small populations

More than half the current rhino populations in Africa have fewer than 100 individuals and are considered small by geneticists. Small populations are at greater risk of adverse effects of genetic drift and as a result, they may benefit from more intensive genetic management. Such management may include individual-level genetic profiling of each animal in the population in order to guide management decisions.

Genetic profiling can assist in determining paternity in calves and relatedness between individuals. This information can enable the identification of individuals that should be removed from the population, e.g. if a bull is at risk of mating with his daughter. It can also indicate the dominance hierarchy in the mating system where, for example, a single male is siring the majority of calves. This knowledge can be used, alongside other population data, to guide appropriate management interventions.

Large populations

Large populations, on the other hand, require less, if any, genetic management. In these populations, the level of genetic diversity and demographic data, such as the proportion of breeding adults, may be more informative than individual genetic details. Genetic data from large populations can, however, be useful to calculate population heterozygosity and contribute to understanding genetic differences between populations. Individual genetic profiles would not be used to select rhino for translocations from large populations.

Metapopulations

A key consideration in metapopulation management is the need to compensate for gene flow impeded due to a fragmented landscape. Metapopulations should aim to preserve evolutionary processes and the natural network of genetic connections between populations. This approach is a change from earlier thinking, which had a more static view of distinct populations, and seeks to mimic the processes that maintain adaptive diversity and evolutionary potential in populations. The general rule when artificially ensuring gene flow into a population is to aim for a minimum of one new founder per population per generation which in the case of African rhino is ~ 14 years.

Other considerations include the selection of unrelated animals for founder populations insofar as this is possible. Genetically depauperate populations (those with particularly low diversity) should be reinforced with new individuals where possible.



EVOLUTIONARY SIGNIFICANT UNITS /SUB-SPECIES

Thinking has moved from the concept of sub-species to the development of Evolutionary Significant Units (ESUs) and, nested within them, genetic Management Units (MUs). The ESUs and MUs are based on genetic considerations rather than on traditional morphology, however some overlaps occur. In general, individuals can be moved between populations within MUs, but there need to be good reasons for moving individuals between ESUs.

The details of black rhino ESUs and MUs are in the process of being established scientifically and there remains some uncertainty around specific details. Recent analyses of genetic structure within black rhino suggests the existence of four ESUs. They are Chari Victoria (CV), East African (EA) and Central Eastern (CE), which correspond geographically to *D.b. michaeli*, and the Southern (S) ESU. The CV, EA and CE ESUs are thought to have recently had secondary genetic contact (i.e. limited gene flow between them) and it has been recommended that they should be managed together as a single Eastern African black rhino MU. The Southern ESU can be divided into South Western and South Eastern MUs which correspond to the current *D.b. bicornis* and *D.b. minor* subspecies classifications respectively. The South Eastern MU can be further subdivided into populations of Zambezi and KwaZulu-Natal origin.

Two ESUs have been identified for white rhino, the Northern and the Southern ESU, which match the existing subspecies classification. With the dire status of the Northern white rhino there is functionally only one white rhino MU that rhino managers need to consider.

As far as possible, management decisions should take the metapopulation into consideration, with a focus on maintaining or improving the natural network of genetic connections between populations rather than securing isolated populations.

Generally, if the current separation between populations is due to anthropogenic reasons (e.g. poaching and fragmentation), attempts should be made to reconnect the populations and enable gene mixing. If separations are largely natural (e.g. due to a topographical barrier) the genetic variability in the populations may be worth preserving.

All else being equal, faster-growing rhino populations are less vulnerable to the adverse effects of genetic drift than slow growing populations. Managing rhino populations for growth thus has dual potential benefits of countering poaching losses and reducing adverse effects of genetic drift.

Although reduced gene pools are not desired, there is little evidence to suggest that the current levels of genetic diversity are having a negative effect on rhino population performance. The asymmetry that has been detected in black rhino skulls in Hluhluwe-iMfolozi Park may be a consequence of low heterozygosity within that population.

From a management perspective, it is beneficial to collect and submit samples of any rhino that is immobilised/handled to an accredited laboratory and to enter the details of those samples on a database. In South Africa this is a legal requirement and samples are submitted to the national database through the Department of Environment, Forestry and Fisheries. The resulting rhino genetic profiles can contribute to forensic investigations (e.g. by matching the DNA of seized horns with that from known rhino or crime scenes) as well as for conservation genetic work. Managers should ensure that they receive and archive the DNA profile certificates generated by the laboratory for each rhino.

The collection of samples for genetic work requires adherence to strict methods and it is important that the person responsible is appropriately trained and uses the correct equipment as DNA can degrade and poor-quality samples can reduce the legitimacy of results.

Field observations of paternity can be subject to error and should not be used in lieu of genetic testing. It is also true that genetic analysis can be simplified and improved by using information on known relationships, especially for white rhinos that have low genetic variation.

Approaches to take >>



With the advent of more affordable, and in some cases commercially available, DNA testing it is increasingly important for sites, particularly ones with small populations, to DNA profile their rhinos. This information allows managers to understand the genetic make-up of their population and make informed decisions with regards to gene flow (removals/introductions) as well as their population's genetic contribution to the greater rhino metapopulation. Data from forensic DNA samples, which has become common place in many populations, can be used to examine relatedness of individuals and to guide management decisions.

Useful references >>



Hedrick & Miller, 1992. [Conservation genetics: techniques and fundamentals.](#)

Harper, *et al.*, 2018. [Robust forensic matching of confiscated horns to individual poache African rhinoceros.](#)

Moodley *et al.*, 2017. [Extinctions, genetic erosion and conservation options for the black rhinoceros \(*Diceros bicornis*\).](#)

POPULATION GROWTH

It is well established that rhino population growth is dependent on population density. Rhino populations left to increase without any density management will reach ecological carrying capacity (ECC), where there is no longer any growth. Therefore, if the management objective is growing a rhino population as quickly as possible, then it needs to be managed at a density that will enable growth.

At lower densities there is sufficient fodder available and rhino cows are able to rapidly regain condition after calving. This enables them to carry their next calf sooner than they would otherwise under dietary stress. At higher densities there is less fodder per rhino and there is strong evidence that rhino population growth declines. This density dependent growth reduction is due to an increase in the age at first calving and the inter-calving intervals of a cow as well as calf mortality rates increasing at higher densities with the net result being a lower population growth rate.

Although density-dependent growth responses are accepted for rhino populations, it is not possible to independently identify at what density these responses will occur. It is thus necessary to establish the density through careful monitoring to collect the required data to inform decision making and adaptive management.

There is growing evidence, particularly from monitoring of sites in South Africa and Kenya, that black rhino population growth is responsive to density management and that it is a sound approach to use when attempting to stimulate growth. There is no equivalent dataset for white rhino but expert opinion is that density management is a useful tool for promoting white rhino growth as well.

Early attempts to manage density sought to estimate the ECC and to manage towards a target of 75% of ECC remaining at the site. Any animal above that was removed and contributed to a recipient or founder population. This approach, while conceptually simple, was difficult in practice as there is no objective method to easily estimate ECC and subjective estimates varied considerably. Furthermore, ECC may naturally vary over time depending on rainfall, fire and the presence and density of other species.

Points to consider <<



The current approach, for all but very small populations, bypasses the need to estimate ECC. It relies on the theory that if a population is over 50% of ECC, it will grow at the rate at which it is harvested as long as the rate is below the intrinsic growth rate for the species (~9%), i.e. the population will grow with an underlying growth rate equal to the average percentage offtake. This approach is known as “set-percentage harvesting”. For example, a rhino population of 140 and an ECC of 200 will, if harvested at 5% per annum, grow at 5% per annum.

Lessons Learnt >>



There is commonly a lag time before black rhino recolonize areas in the donor site from which individuals were removed, introducing a delay in the density-dependent response at the donor site.

Removal of rhino should be implemented with consideration of social biology so that harvesting is least disruptive to the animals remaining in the donor population, while having positive outcomes for the new or supplemented population.

Approaches to take >>



The population size fluctuates for the first few years, before stabilizing at a level that can sustain that level of removal, as long as habitat conditions do not change significantly. If habitat changes occur, rhino growth rates and numbers will adjust to match the new habitat productivity level. Removals should be responsive to changes in ECC over time.

Set percentage harvesting works best in larger populations and may be difficult to implement effectively in populations of fewer than 25 rhinos.

Very importantly, poaching counts as a removal and management removals need to be adjusted down to account for poaching losses. Thus if seeking a 5% underlying growth rate and 2% of the population was poached during the last year, only 3% should be removed by management.





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2 FOCUS AREAS

G. Monitoring

Monitoring enables managers to understand rhino populations and trends, which in turn informs management decisions. For rhino populations of fewer than 350 to 400 individuals, it is generally accepted that individual monitoring, as opposed to statistical sample surveying approaches, is best practice. Methods such as intensive helicopter block counts or line transect distance sampling can be used to estimate numbers in larger populations. These guidelines only deal with individual identification techniques as the majority of sites have small populations.

The primary function of a rhino monitoring team is to collect data on the population through direct observation. Indirect observation through spoor or dung can be useful but is not generally adequate to record as a sighting, although this does depend on the context.

Individual monitoring requires that each rhino is uniquely identifiable, enabling the collection of a set of data specific to that individual. Ideally a rhino should be identifiable by a person with binoculars from a distance of up to 100 m. Individual monitoring has significant advantages as one can assess additional parameters such as individual health or breeding performance of performance of females, which is not possible in larger non-ID-based sample surveys.

Data Management

Each site should have its own set of master records which details specific information for each identified rhino. Rhino monitoring data should be kept in two files, the Master File and the Monitoring File. These files can be electronic or paper-based or a combination of both. Back-up files should be kept of all records; these should be made on a regular basis and stored in a separate location.

The Master File for an individual rhino should include basic information, including:

- Ear notch pattern (drawing and photograph taken at time of notching);
- Date of notching;
- Any changes to notching pattern over time (e.g. if the ear gets torn);
- Photograph of notching pattern taken at the time of notching;
- Microchip number/s, microchip location and date of insertion;
- Telemetry details if fitted with transmitter;
- Unique physical features (horn shape, missing tail/ears etc.);
- Date of birth (as close as possible);
- Sex of individual;
- Location of birth;
- Maternity;
- Date and details of genetic samples taken;
- Breeding performance including age at first calving and inter-calving intervals;
- Translocation history including date of arrival at current site; and
- Date of death.

Not all of these data will be available and for some data there may be some uncertainty which should be recorded, e.g. record if the date of birth is known accurately to within a week, a month, six months or longer.

The Monitoring File includes data that are repeatedly collected over time, including:

- Date and GPS coordinates of each sighting;
- Date of calving for each cow;
- Date when a calf was noted to be lost or missing;
- Other rhino that were associated with the observed individual;
- Body condition; and
- Injuries or treatments.

Good guides in this regard are Adcock and Emslie 's (2003) guides to monitoring African rhino.

Example of a Master File

Area:


BLACK RHINO IDENTIKIT BOTSWANA

Status:

Alive

Dead

Removed



Date First Known:

Name:

Code #:

Origin:

Date of Birth

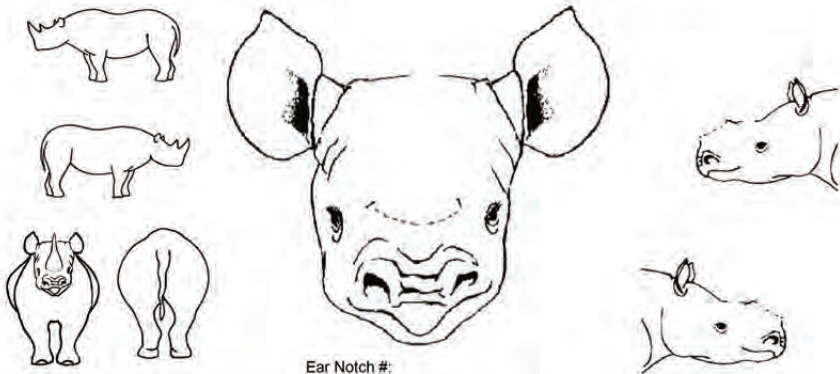
Conf.

Sex

Current Age Class: A B C D E F

Date of Independence from Mother:

Date Notched:



Ear Notch #:

Notes (e.g. on Main Range Patterns, Associations, Major Events and Movements):

Mother: _____ Father: _____

Transponders:

Position:	Number

Introduction details

Place of Birth: _____

Introduced from: _____

Date of Release: _____ Time Boma'd: _____

Notes: _____

Death Details:

Date found: _____ Time Since Death: _____

Cause of Death: _____

Removal Details:

Date Captured: _____ Destination: _____

Calf Details:

Birthdate	Conf.	Sex	First Seen	Calf ID	Survived?

MICROCHIPS

Microchips are typically inserted subcutaneously on the neck as well as in both horns. Microchips cannot be read remotely and verification can only occur when a rhino has died or has been immobilised or captured. Microchips can be used to link seized horns to known carcasses, and thus be useful for investigation and prosecution purposes. However, poachers and traffickers know about them and often look to disable or remove them. They are also useful for managing and auditing horn stockpiles. Microchips can also be useful for identifying a carcass following a natural mortality if the rhino's ears have been eaten by hyenas. Microchips grow out of horns and move subcutaneously in the body, so these need to be checked and replaced at appropriate opportunities.

EAR NOTCHING

Ear notching systems have a slightly uncoordinated history in Africa and there are at least four different systems being implemented between South Africa, Kenya, Zimbabwe and Namibia. Different systems have been devised in which the pattern of ear notching and the ear (left or right) on which notches are cut represents a number. This number becomes the unique identifier for that rhino. Prior to notching, it is necessary to crosscheck against the master records and to select a pattern/number that it is not already in use. Complications can arise when rhino are moved between populations and a specific notching pattern is duplicated on the new property.

Notches are usually triangular but can also be semi-circular or square. They are usually made at predefined positions on the outer edge of a rhino's ears with notches in the right ear representing the tens and hundreds while the notches in the left ear represent smaller numbers. In some systems there can be single or double notches in lower section of the ear. A hole can be punched in the center of the ear but these may get filled with mud or tear, and therefore should be avoided. Notches on the inside of the ear are also best avoided as these are harder to identify during monitoring.

Ear notching can only be conducted on an immobilized rhino. Thus the procedure requires a veterinarian on site for the darting. The ear is generally notched using a notching tool, similar to that used on cattle, or a scalpel. Once the notches are made it is best to use forceps to stem the bleeding and apply topical antibiotic.

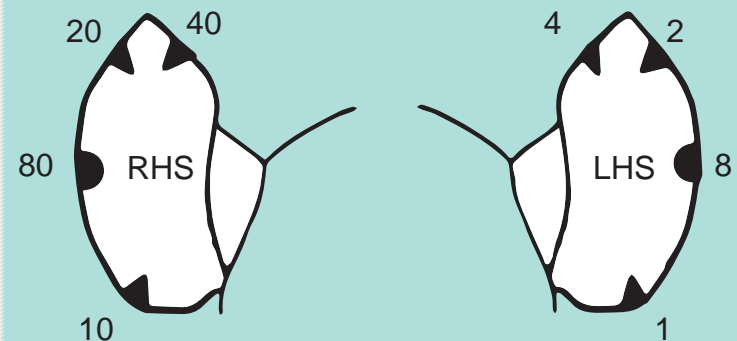
It is important to photograph both the rhino's ears in a full face picture so there is a clear record of the original notching pattern. A plain, light-coloured backing behind the ears should be used to ensure the notched pattern is easy to see. At the same time it is recommended that any other unique features of the individual rhino are photographed for identification.

While many prefer to use names, it is essential that an associated unique ID number is recorded on the master data sheet. Ideally, all animals should be ear-notched before becoming independent of their mothers so their maternity is confirmed. Neither name nor ID number should be reused once an animal dies, as this could result in confusion in a database.

In some identification systems the sex of the rhino is used as a part of the unique identification. This approach is not recommended as it is difficult to sex the rhino during monitoring. This results in monitoring records being lost as the animal is not identified. Locality alone should not be used to identify a rhino as they do move, resulting in them becoming "unknown" due to a lack of a unique identifier.

Unique IDs

One of the various ear notching systems that are in use is shown below. Different notch shapes are not necessary, they are used here for illustrative purposes. The system illustrated is capable of indicating 135 unique rhino (i.e. there are 9 options on the left hand ear [1 to 9] and 15 on the right hand ear [0 to 15]). This is generally sufficient to cover a population of 150 rhino as there will likely be un-notched calves and individuals that are identifiable by other features.



AGEING OF RHINO

Different systems are used for ageing rhinos. Whilst there may be value in using a uniform system for describing the age of a rhino, experience shows this is not always pragmatic or useful and that certain systems make more sense in some regions.

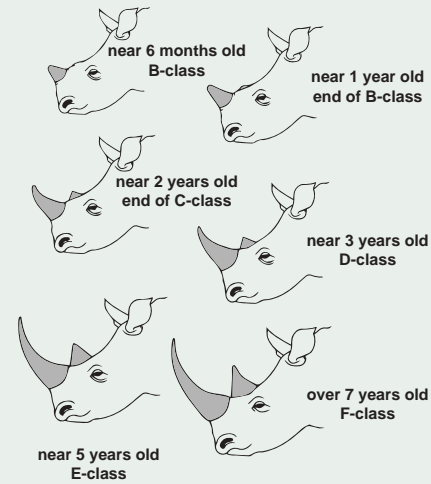
An aging system that corresponds with key growth or maturation phases of a rhino is beneficial. If you can estimate the birthdate of known individuals then you can track their actual age over time.

The South African system shown on next page uses six age categories. The first four age categories (A-D) describe different aged calves, the fifth category (E) is a sub-adult and the sixth category (F) is an adult.

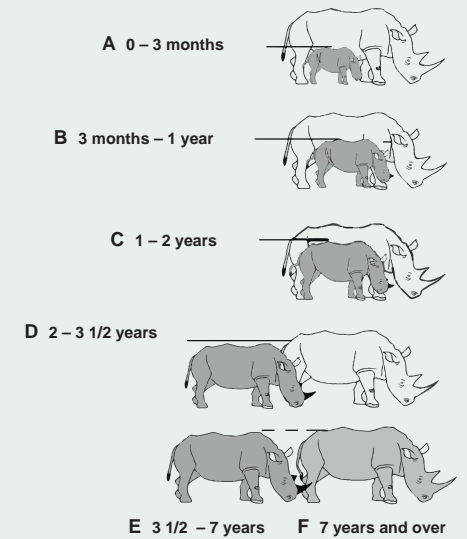


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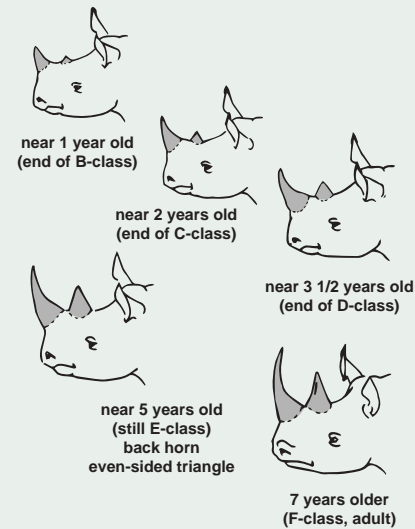
Approximate Appearance of Horns in White Rhino From 6 months to Adult



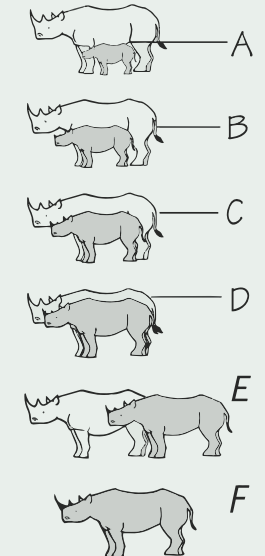
White Rhino Age Classes



Black Rhino Age Classes



Approximate Appearance of Horns in Black Rhino From 1 year Old Until Adult



MONITORING TECHNOLOGY

Technology for monitoring rhinos is going through a phase of rapid development. For decades, VHF transmitters have been the most reliable and common technology. Over the past decade, new technologies have entered the workplace, increasing the options for rhino managers. Testing processes are ongoing and there is ongoing debate about most technologies.

With an increasing range of technology to choose from, with widely varying costs, and with each technology having its own strengths and weaknesses, it is not possible to recommend one solution for all circumstances. It is advisable that expert assistance is sought to a) clearly understand the reason why you want to monitor, and b) establish the most cost-effective method of getting monitoring to meet requirements.

VHF TRANSMITTERS

The VHF transmitter, is a technology that lost some popularity but may be gaining again. There is a need to improve battery power to last longer, but this is difficult to achieve without trading off against some other aspect of data collection.

Horn transmitters:

Conventionally transmitters have been placed in holes drilled into a rhino's horn. In white rhino the anterior horn is generally preferred as it is longer, while in black rhino the transmitter might best be placed in the posterior horn. Horn transmitters are generally more reliable than ankle bracelets, but they do have challenges, such as being dislodged if they are not adequately anchored in the horn. An additional challenge is that horns grow and this limits the life of the transmitter to approximately two years.

Ankle bracelets:

Ankle bracelets have the advantage of being able to accommodate the additional bulk of a satellite-tracking device which is too big to put in a horn. Bracelets commonly last for six months due to damage as a result of their position on a rhino. Ankle bracelets remain contentious and can be almost useless if the rhino is lying down and covering the transmitter. They are best when the animal is active. There is information that they can cause injury, whether placed on a hind or front foot, especially in wetter and muddier areas.

LONG RANGE LOW POWER (LoRa)

During the past decade, there has been an increase in the number of transmitters that operate off low power and have the capability to cover long distances to a network tower. Depending on the surrounding vegetation and topography, these transmitters can transmit over 25 to 70 km. As with VHF transmitters, they operate strictly on the basis of line-of-sight. LoRa transmitters are currently being widely tested and it is too early to say which may be better for any particular circumstance. They require a communications tower to which to transmit, thus requiring costly infrastructure. However, the system is open source thus allowing for great flexibility.

There is a proprietary LoRa system available, Sigfox, that has the advantage of not needing masts to triangulate positions. Instead it obtains GPS fixes. In Sigfox systems, the company manages the base stations and there is a need for an arrangement between the user and the company to ensure that the data are accessible.

Both systems are still under development, but it is worth noting that unlike VHF, a Sigfox or LoRa system can be used to track many assets and patrol deployments through the same infrastructure. This increases their utility beyond monitoring rhino.

CAMERA TRAPS

As passive monitoring tools, camera traps have become increasingly popular. Triggered by motion, they are able to take a photograph of animals moving past them day and night. They have a range of different flashes, including black flash, normal light and infrared. The better units are able to work in low light and have a fast flash refresh rate. Most are waterproof but may need to be mounted in animal-proof housing. Camera traps are very useful for census purposes and can be made optimally effective by good placement, e.g. at water holes or on well-used game paths. Using two cameras, it is possible to get front- and rear- view shots, enabling ear notches and sex identification to be obtained from a single observation.

Camera traps are indiscriminate and can collect too much data, causing memory cards to fill up or waste staff time sorting photos of non-target animals. If cameras are transmitting along a Wi-Fi network or through GSM, it is best to reduce the level of unnecessary information on the system. To counter this, new cameras being released are able to use artificial intelligence technology to "pre-process" images and

only send photos of rhino to the server. This technology is being developed rapidly and is likely to make a significant difference to rhino monitoring. Batteries are commonly a limitation for cameras and need to be replaced frequently.



When effectively deployed, camera traps can also detect poachers. This evidence is not always accepted by magistrates in a court case, but it can assist in investigations. However, if poachers detect the camera, they are likely to destroy it.

MONITORING PATROLS

A common mistake in rhino management is to underestimate the importance and value of monitoring patrols. Monitoring patrols are used to observe, identify and record relevant information about each rhino encountered and can provide essential information to a manager. Monitoring should be done by trained staff as it can be very dangerous. Monitors need to know how to find and observe rhino without disturbing them or disrupting their normal behavior. This requires good tracking skills as well as experience in rhino behaviour. Experience shows that good monitors have a gut feel for or empathy towards rhinos.

Monitors should be trained to record:

- Any carcasses detected;
- Cause of death, where this is possible;
- Presence of any calves or the loss of a calf;
- Rhino injuries or illness; and
- Sex, age and position (e.g. GPS location) of each rhino.

Monitoring effort should evenly cover the whole area occupied by rhinos. The size of the rhino population, together with the terrain and the vegetation type, will determine the amount of effort and thus the number of people required to conduct an effective monitoring programme.

A useful target in a monitoring programme is to obtain and record a minimum of one positive sighting of each rhino in a population each year, although more than this is better and many managers aim to obtain monthly sightings of each rhino.

It is useful to note that some rhino are “trap happy” and seen regularly while others are “camera shy” and seldom seen. Extra effort should be put into achieving a positive clear sighting of each camera shy rhino each year.

Adcock & Emslie, 2003. [Monitoring African rhino trainees guide.](#)

Useful references

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2 FOCUS AREAS

H. Translocation

Translocation involves the capture of the rhino at the donor site, transport and release into the recipient site. However, each of these activities is complex and involves a range of specialist skills as well as high levels of coordination and contingencies in case the initial plan does not work. Preparation is the key to successful rhino translocation. One cannot put too much effort into getting the right information, planning, preparing your equipment and training and briefing the team.

In addition, complexity is introduced through the history of each site and the objective behind each translocation. These factors dictate that many expert based decisions and judgement calls need to be made at the time of implementation – and this relies on experience and skill. There is no perfect formula that should be followed. For this reason, one of the key considerations when planning a translocation is the team of experts assembled to discuss and advise on options before and throughout the entire operation. There are some guidelines that can assist the team approaching and implementing a translocation in the best practice manner.

A key reference to consult on this topic is the IUCN Guidelines for the *in situ* reintroduction and translocation of African and Asian rhinoceros (Emslie *et al.*, 2009).

There are many risks involved in translocating rhinos, but with thorough preparation and planning as well as consultation and engagement with appropriate expertise, the risks can be reduced and the chances of success increased substantially.

There is a wealth of expertise across rhino range states with skilled veterinarians and capture teams accustomed to working in a range of environments. It is strongly advised to consult widely to ensure latest learnings are taken into account.

Any benefits gained by rushing the process are easily outweighed by delays or losses experienced through insufficient planning.

It is worth seeking opportunities for exchange experiences for staff.

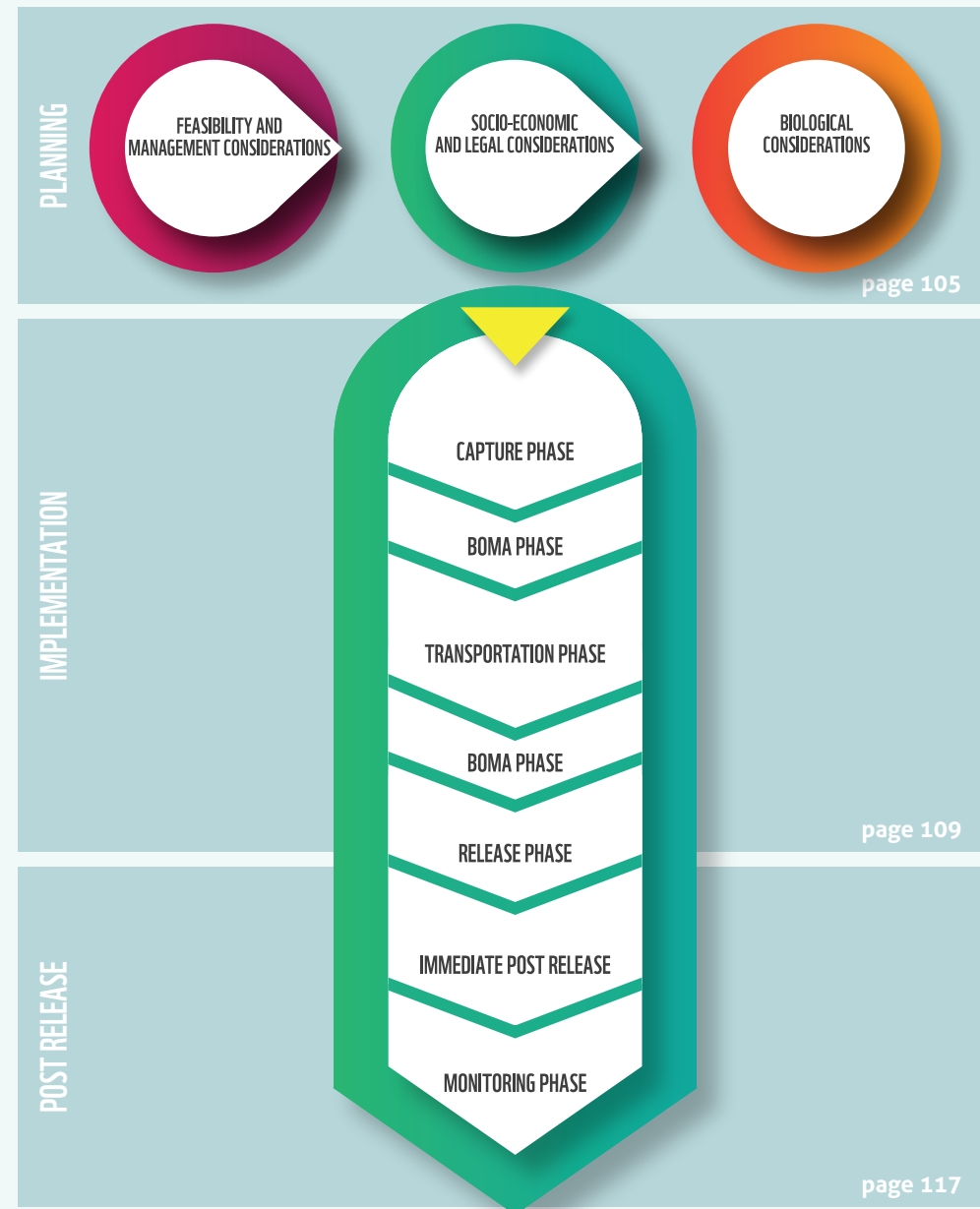
Lessons Learnt <<

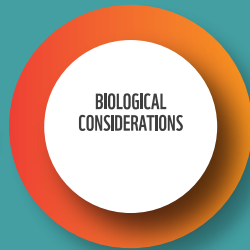


Terminology

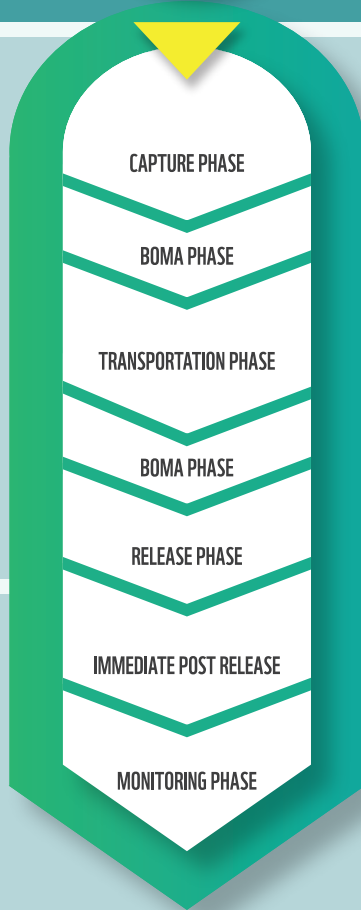
Hard capture	When a rhino is captured at a site and immediately loaded into a crate and transported from the site, i.e. there is no settling period spent in a boma for the rhino to become familiar with captivity, the presence of people and eating artificial fodder or browse.
Hard release	When a rhino is released directly into the field at a new site after being translocated from a donor site. This approach does not allow for a period in which the rhino is held in a boma at the release site to settle and recover from some of the stress and debilitation of translocation and develop a familiarity with its new environment.
Reintroduction	An attempt to establish a population in an area within its historical range, but from which it has become locally extinct.
Soft capture	When a rhino is captured and placed in a boma to settle and become familiar with captivity, the presence of people and artificial fodder or browse before being transported from the site.
Soft release	When a rhino is kept in a boma at a new site after being translocated, allowing for a period in which it can settle and adapt to local browse before being released into the new environment.
Translocation	The deliberate and mediated movement of rhinos from one part of their range to another.

Translocation Process





page 105



page 109



page 117

PLANNING PHASE

Pre-capture **planning phase** of the translocation includes consideration of three sets of information:

- Feasibility and overall project management;
- Socio-economic and legal considerations; and
- Biological considerations.

Any attempt to short cut this process increases the risks to the entire project and the rhinos themselves.

Feasibility & Management Considerations

- Feasibility of translocation

A high level feasibility assessment should be done to identify any potential flaws in the planned translocation.

- Availability and willingness of recipient area/s

The next step is to consider the availability and willingness of the potential area to become a recipient site. Recipient sites should be within the species' indigenous range (see page 49) and should be assessed on their potential density (see page 53).

Thereafter, detailed discussions should be held between stakeholders on:

- Logistical Planning
- Co-ordination
- Staffing
- Budget

A rhino translocation is a costly exercise. Guidelines for budgeting are provided in Emslie *et al.* (2009) but include:

- Preparation of the release site;
- Bomas;
- Helicopters, crates and drugs needed during the translocation;
- Staff, utility and rhino transport vehicles;
- Staff travel and communication costs; and
- Post-release monitoring staff, vehicles and equipment.

- Security

While not covered in these guidelines, the security of the site is an important consideration in light of the current poaching crisis.

Socio-economic and legal considerations

If all these considerations suggest that the project has potential to work, the next phase is to conduct a deeper level of due diligence on the recipient site including:

- Capability
- Financial strength
- Social considerations
- Legal consideration of
 - Tenure of land and ownership of rhino – see page 54
 - Permits required at local, national and international level. They can also be required from different government departments and cover issues such as veterinary, environmental and transport regulations. These processes can take time and it is important that adequate provision is made for them during the planning phase.
 - Quarantine

Biological considerations

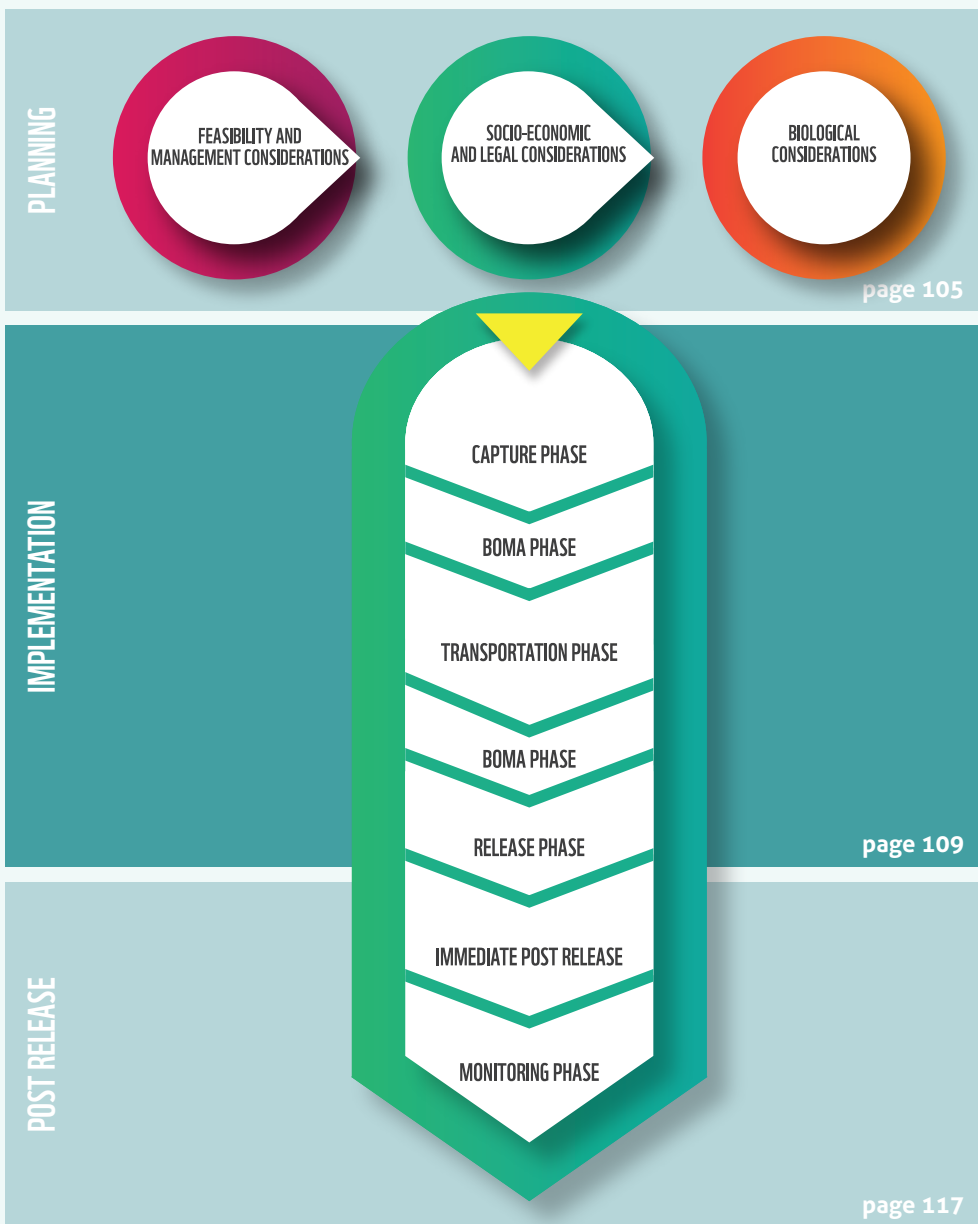
Finally, both donor and recipient sites need to take into account biological considerations of the rhino and the habitat.

- Baseline monitoring at donor site (see page 89)
- Identifying rhino to move and harvest strategy
- Genetic considerations (see page 78)
- Veterinary matters (see page 69)
- Habitat at recipient site (see pages 33 and 51)

Translocation Team

A good translocation team requires more than simply assembling people with the right technical skills. Non-technical human skills can, and often do, play a significant role in the success or failure of a rhino translocation exercise. For this reason:

- It's important that individuals involved in a translocation and its planning, especially those in leadership positions, have a natural empathy for animals and are prepared "to go the extra mile" when caring for them.
- The individuals involved must have the cognitive ability to do the job, they must be adequately trained and up-to-date in their knowledge and they need to have a strong work ethic.
- Translocating rhino can be dangerous (wild animals, aircraft, potent drugs, firearms, fast moving vehicles etc.) and it's essential that all involved have excellent situational awareness and respond appropriately.
- Being able to work as part of a team, to communicate and to collaborate effectively is essential.
- The person in charge needs to be a strong and capable leader, and they must give subordinates the freedom to speak freely and raise their concerns about issues.
- There are significant advantages to a daily thorough debriefing of team members, so that possible solutions to any problems encountered are discussed, although this is not always possible.
- Human memories can be unreliable and check lists are very important, as long as they are used intelligently and with good judgement.
- Good written records need to be kept and should be drafted as soon as possible to avoid memory loss.
- The technical staff must be sufficiently empowered and have power to make operational decisions, including halting an operation or changing the specific details.



IMPLEMENTATION PHASE

The **implementation phase** includes the physical act of capturing the rhino, possibly keeping them in bomas at the donor and/or the recipient sites, transportation, and finally their release at the new site. These activities require considerable experience and expertise to run effectively. Best practice translocations aim to minimize stress and injury to the rhino and minimize the risk of mortality.

It is difficult to overstate the importance of experience when engaging in all stages of the implementation phase. Experience is required at all levels to enable the operation to run smoothly, from the person leading the process to the assistant on the ground, from the helicopter pilot to the truck driver.

A variety of different translocation methodologies have been developed and there may be differing views as to which to follow - multiple opinions may be needed to be considered to select the best method for a particular operation.

There are differences in the typical behaviour and response of black and white rhino to capture, translocation and release and appropriate experience should guide decision making.

Once methodologies have been considered, the team must develop, communicate and follow a clear plan for the translocation and ensure experienced individuals are involved at all levels to enable the operation to run smoothly.

All equipment, from the helicopter used to dart a rhino to the bolts and straps that secure a crate onto the back of a truck, needs to be in good working condition.

It is very important to recognize that things can change at any stage of the translocation and it may be necessary to improvise. It is vital to have contingency plans if a portion of the capture fails (e.g. if a truck breaks down) or if a rhino injures itself. This requires that all role players understand the plan and their roles and responsibilities.

Approaches to take <<



Capture

The understanding of what is important when capturing rhino, as well as options available for managing the process and the techniques used, is developing all the time. There are existing guidelines that should be consulted, with the most comprehensive being Morkel and Kennedy-Benson (2016) and Emslie *et al.*, (2009).

There are a number of highly experienced wildlife veterinarians in Africa who can assist in a translocation and it is important that their services are used.

The Malilangwe Course in Chemical and Physical Restraint of African Wildlife is recommended as a way to obtain a strong grounding of theoretical and practical experience, as well as hands-on training. This information can be accessed at <http://wildlifecaptureafrica.com/>.

Points to consider

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Extra measures need to be taken when translocating individuals that are outside the ideal age of rhinos for translocation.

Capture of rhinos is generally better undertaken early in the cool dry season. This is less stressful for the rhino as they are at less risk of overheating. Additionally, it is easier to work with large vehicles in the field when the ground is dry. The disadvantage of the dry season is that the rhino have often lost some condition and thus it is not optimal for them. It can also be difficult to access suitable boma forage in the dry season.

Lessons Learnt >>



Chain of command:

There needs to be a clear chain of command that is pre-determined and followed during a capture and translocation operation. A single experienced person, who is respected, able to exercise good practical judgement in the field and has authority, should be put in charge of the capture operation. An additional key role player is the veterinarian, who has final say regarding animal welfare issues.

There needs to be an effective communication system to ensure everyone knows what is expected of them at all times as well as to be continuously informed of any changes that occur.

Efficiency:

Although it is not recommended to attempt to rush a capture, it is important to attempt to keep the time taken to a minimum throughout the process. Smooth and efficient processes make for better translocations. Having selected an individual for removal, it may be convenient to place a telemetry unit on the rhino in advance of the capture to speed up the locating and capture of the individual making for a more efficient operation with less stress on the animal.

Stress:

Capture is stressful to the animal and every effort should be made to reduce this. Experience suggests that the less stressed the rhino, the more likely it is to settle and adapt to its new habitat, and the less likely it is for a capture-related mortality to occur. While a certain amount of stress is unavoidable, most reduction in stress is achieved through the use of established techniques as well as through good planning to ensure as few unnecessary delays as possible.



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Transportation

Moving rhino between donor and recipient sites commonly requires rhino to be placed in a crate on the back of a suitable vehicle. If distances are very short (less than a few kilometers), rhino can be walked across. Rhino can be moved on a sled in a lateral position for short distances.

If the equipment is available and able to handle the weight of rhino, rhinos can be slung beneath a helicopter by their ankles for a maximum of 20 minutes. This technique is very useful for removing rhino from areas with poor road infrastructure to waiting trucks on established roads. It reduces the stress rhino may experience on poor roads in a crate while partially sedated. This is a costly option.

Rhino are vulnerable to hurting themselves when in their transport crates and can strain muscles, dislodge their horns or inflict injury to their facial bones and tissue (Morkel, 2016). They are also vulnerable to heat stress and more so to cold, which is often encountered through wind chill when rhinos are transported at night. Regular checks during transportation should be conducted by an experienced person, who can then take appropriate action.

Over the years, crates of different sizes have been built for different functions, such as field recovery or long distance travel. It is important to assess the needs of each operation and to ensure that appropriate crates are available. Advice from experienced capture operatives is useful in this regard. Crates need to provide firm footing and be sized appropriately to reduce the risk of injury to the rhino. Crates need to have rubberized padding, such as conveyor belting, in areas where a rhino can bash and injure its head. For longer distances, rhinos need a crate within which they are able to lie down or stand in comfort.

If possible, rhino should be accompanied by a suitably experienced veterinarian who is in close contact with the driver.

A good driver can make a difference to the rhino's stress and potential for injury. Drivers should be trained in transporting live animals particularly as pertains to speed management, braking and turning. There should be a backup driver at all time, particularly on long trips.

To reduce the risk of head injuries or horn breakage, rhinos should be transported facing backwards. Rhino should be partially dehorned prior to crating to reduce the possibility of traumatic horn loss.

Boma phase/s

During soft captures and releases, rhino may be kept in bomas for a period of time at either the donor or release site or both. Bomas are ideal for enabling a calm release of rhino and can assist in familiarization with new food plant species. However, they are expensive and add three to four weeks onto the translocation time.

If unfamiliar rhinos are released onto a site with each other (i.e. they were captured at separate locations and brought together for the purposes of the translocation), the use of a boma can be effective for familiarizing rhinos with each other.

The design and siting of the bomas can contribute to a successful release (see page 61), as can the skill and effort of the boma handlers responsible for looking after the rhinos, rebuilding their condition and calming them. If these boma factors are not all in place, there may be benefits to an earlier boma release date. Judgement will need to be exercised as to the value of bomas or other approaches to releasing rhino.



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Points to consider

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Lessons Learnt >>



Release

As with the capture and transport of rhino, there are no golden rules determining best practice when releasing rhino at a new site. There are likely to be a variety of views as to how to manage each release and the specific circumstances of the site and the translocation can influence which approach might work best.

Points to consider

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If there are limited water points, it will be important to ensure rhino have located the water before exploring the greater landscape.

A rhino released in a stressed state may run for a number of kilometres. This behavior could result in it breaking out of the release site, exposing itself to danger, or missing water points. Sedative drugs can be administered to rhinos to assist in achieving a less stressed release.

From a monitoring perspective a rhino should not be released without properly recorded ear notches and microchips inserted.

Lessons Learnt >>



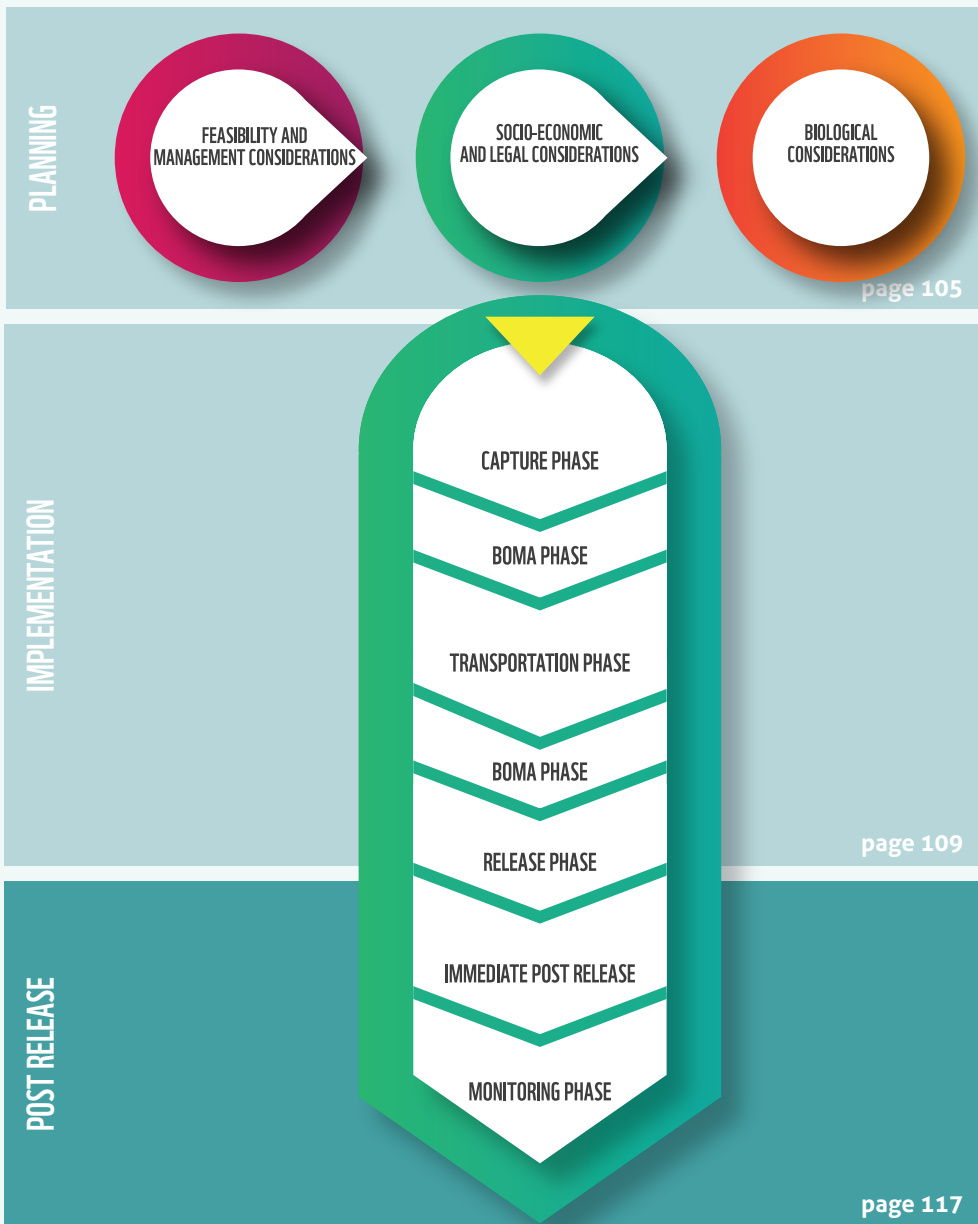
If the rhinos being released were caught from the same donor site, hard releases of all individuals can be relatively stress free.

All non-essential staff as well as vehicles and other equipment, such as crates, should be removed from the area prior to a rhino being released to avoid noise, panic and potential injury to the rhino.

One of the most important risk factors for a release is during the process of supplementing a population where there are other rhinos of the same species, with established territories, at the site. This phenomenon is of higher risk to bulls than cows and moreso for black rhino than white rhino which are less inclined to enter into aggressive behavior.

Physical separation of the newly released rhinos from the resident animals is a useful tool, especially if introductions are to be staggered over a number of years. It is important that the fencing used for separation is removed once the rhinos have established territories.





POST RELEASE & MONITORING

The post-release phase is important in the short term (six to 12 months) to ensure the rhino settle and adapt to their new environment. It is an important period for management to monitor the population and the movement of individuals in such a manner that problems are picked up sooner rather than later. Usually this means attempting to sight each animal daily for the first three months or more. It is important, particularly in the first two weeks, that monitors are sufficiently skilled to obtain information without disturbing the animals. This early monitoring is also important as the knowledge gained will feed into, and underpin, a sustainable monitoring programme. This information can also inform future translocation initiatives.

Long-term monitoring is covered extensively from page 89.

Rhino adapt more quickly to habitat and vegetation that is similar to what they experienced at the source site. Close monitoring is essential until they settle into the release site.

Points to consider
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Note: : many of the references are available at www.rhinosourcecenter.com Anyone can register and use the facility. You are encouraged to support it as well.

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WWF SA:

WWF is one of the world's largest and most experienced independent conservation organisations, with over 6 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

WWF Green Trust:

The WWF Nedbank Green Trust, founded in 1990 by Nedbank and the World Wide Fund for Nature (WWF-SA), funds innovative projects that have the potential to contribute to solving some of South Africa's greatest societal and environmental challenges. Our slogan, 'igniting new ways for people and nature to thrive', is our key reason for existence and we have, over the years, sought new paths, points of connection and solutions to ensure that people and planet prosper. Our impact is achieved through working with partners and communities who champion the custodianship of our natural resources and directing their energy and efforts to key levers of change for South Africa's future. From the beginning the Green Trust recognised that the future prosperity of South Africa depends on the coming together of governments, businesses, organisations and all people, and so has worked to create and cement these interconnected relationships. The WWF Nedbank Green Trust achieves its impact through a very clearly defined strategy, which allows us to direct scarce resources and projects to key focus areas in order to make a difference.

Rhino Impact Investment Project:

RII is an initiative of United for Wildlife (UfW), an unprecedented partnership between seven of the world's leading wildlife charities and The Royal Foundation of The Duke and Duchess of Cambridge. Implementation of RII was led by the Zoological Society of London (ZSL) and the Project was funded by the Global Environment Facility (GEF), the UK Government through the IWT Challenge Fund, UfW and ZSL. The United Nations Development Programme served as the operational arm of the GEF to implement and execute the Project and all associated activities consistent with both the GEF mandate and national sustainable development plans. Conservation Capital is the appointed RII Finance Manager and Conservation Alpha is the appointed RII Performance Manager.

International Rhino Foundation:

The International Rhino Foundation's vision is a world where rhinos thrive in the wild. Our mission is to ensure the survival of rhinos through strategic partnerships, targeted protection, and scientifically sound interventions. For nearly 30 years, IRF has worked to protect all five rhino species in both Africa and Asia.



Rhino Impact Investment Project
Developing innovative funding mechanisms for conservation



