

Kenya Wildlife Service



Immobilisation and Translocation Protocol for Black Rhinoceros (*Diceros bicornis*) and White Rhinoceros (*Ceratotherium simum*) in Kenya

Kenya Wildlife Service
P. O. Box 40241-00100
Nairobi, Kenya
Telephone: +254 (20) 6000800 or 6002345
Mobile: +254 726610508/9 or 736663421
Fax: +254 (20) 6003792
Website: www.kws.go.ke
Email: vet@kws.go.ke , research@kws.go.ke

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1. INTRODUCTION

This protocol was developed to guide the immobilisation and translocation of black rhinoceros (*Diceros bicornis*) and white rhinoceros (*Ceratotherium simum*) in Kenya in view of increasing needs for veterinary interventions in the two species. Such interventions include diagnosis and treatment of sick and injured animals, fitting of monitoring devices and ear-notches, movement of vulnerable populations, establishment of rhino sanctuaries, translocations to manage social and ecological carrying capacities in established rhino sanctuaries and diversification of genetic pools as well as release of hand-raised rescued animals already rehabilitated for wild release. In particular, translocations of the two species in Kenya are now frequently done because of the need to keep individuals in fenced sanctuaries due poaching threats and for active management of rhino populations for rapid growth.

The protocol is intended to ensure that immobilisation and translocation of rhinos are carried out using 'best practices' by giving recommendations on the practical aspects. It is based on IUCN guidelines for reintroductions and other conservation translocations as well as internationally recognised practices to ensure the welfare and well-being of the animals is of paramount consideration.

The protocol does not represent an inflexible code of conduct and can be modified on prevailing circumstances to ensure the objectives of any intervention are met. The primary target audience are wildlife veterinarians and veterinary para-professionals, ecologists, wildlife managers, security personnel and partners who fund rhino conservation initiatives.

The protocol is to be implemented in the context of prevailing Kenyan laws and policies pertaining to biodiversity conservation and sustainable management of natural resources and veterinary practice, including the Wildlife Conservation and Management Act of 2013, Veterinary Surgeons and Veterinary Para-professional Act 2011, Prevention to Cruelty Act Cap 360, the Veterinary Surgeons and Veterinary Para-Professionals Regulations of 2013 and the Veterinary Surgeons and Veterinary Paraprofessionals (Code of Ethics) Regulations of 2015.

For translocation interventions, the protocol should be read together with the Guidelines for Translocation of Wildlife Species in Kenya (2018). These guidelines amongst other considerations prescribe the translocation approval process, logistical coordination and planning, prerequisite pre-translocation assessments, implementation of the translocation and post-release activities. .

2. BIOLOGY OF THE BLACK AND WHITE RHINOCEROSSES

The following characteristics are relevant and important to note when immobilising, holding and releasing black and white rhinoceroses.

2.1 Black rhino

- It is a browser and the preferred habitat is dense vegetation making immobilisation difficult
- It is strong, aggressive and potentially dangerous when approached on the ground. At full speed, it can attain a speed of 30-40 km/h, consideration which is vital if darting on foot
- When placed in captivity, they are initially very aggressive but calm down quickly within 2-3 days
- When approached, it responds by charging if the approach is too close or by running away depending on temperament of the individual animal
- It has poor eyesight but has very keen senses of hearing and smell
- When confined, it can display aggressive behaviour that lead to self-inflicted injuries, an important consideration during translocation where adoption of appropriate boma designs and tranquillisation are recommended
- It adapts well to feeding on browse in captivity. It is critical to get a black rhino onto Lucerne in bomas as soon as possible to ensure weight gain whilst in bomas
- It is water dependant and must be able to drink at least once every 48 hours and in the wild generally live within about 15km from a water source
- They respond better to immobilization drugs (Opioids) and tranquillizers and may require slightly higher dosage rates than the white rhino
- An adult weight range from 800 to 1400 kg

2.2 White rhino

- It is a grazer, found in relatively open areas, but tends to flee into dense bush when disturbed
- It is a strong and potentially dangerous animal and can be aggressive when disturbed or when it feels threatened
- It is very aggressive and more dangerous in captivity until they calm down. It adapts poorly in bomas
- They may not eat cut grass presented to them whilst in bomas, so natural graze in the boma is ideal but difficult to achieve. It is critical to get white rhino onto Lucerne in bomas as soon as possible to ensure weight gain whilst in bomas. Some animals may have to be released after 7 to 10 days due to non-feeding
- It has poor eyesight, but has keen smell and hearing
- It is gregarious, usually being found in small groups

- It is water dependant
- The species is sensitive to immobilization drugs (Opioids) and may manifest marked physiological side effects. The veterinarian responsible should make himself familiar with the marked physiological side effects from the opioids. It tends to run a long way after darting
- An adult weight ranges between 1600 and 2500 kg

3. PRE-IMMOBILIZATION PREPARATIONS

3.1 General considerations

- Veterinarians should keep abreast of new developments on drugs especially immobilisation drugs combinations and dosages, partial and full reversals, and tranquilisation so as to ensure effective immobilisation and management of the animal under anaesthesia
- Veterinarians and capture teams should be familiar with all aspects of capture techniques so as to ensure safe and effective capture, loading, transportation and release
- Before immobilisation, if at all possible, the protocol should be discussed and demonstrated to veterinarians that have not used it before. This should be done by experienced veterinarians before immobilisation and translocation. This will ensure that that the intricacies of the pharmacology of the drugs is understood fully. This could help ensure the correct usage and any potential risk to staff and rhino during procedures is minimised
- There should be a clear chain of command of who is in charge of the operation. Clear, concise allocation of duties should be given. This can comprise of the following:
 - A veterinarian in charge of the veterinary component, and
 - An operations leader or coordinator to ensure that staff and equipment are properly coordinated during the handling and loading of the animal, whatever the reason for capture
- Other considerations for a successful immobilisation and translocation are:
 - Ensuring all safety aspects are communicated to all personnel so that potential risks are understood
 - A final check of all the equipment present and required should be done at least one month before the exercise
 - Allocation of equipment to those tasked with their use during the capture should be done before the exercise
 - After any capture, there should be a proper debriefing after the operation. During these sessions mistakes/success are discussed and problems are learnt so that captures continuously improve. Constructive criticism after each operation is a healthy way to

demonstrate professional attitude and openness to allow all team members to discuss problems and success

- Veterinarians should work in pairs when handling dangerous immobilisation drugs so as to provide first aid in cases of accidental self-injection. Where a second veterinarian is unavailable, there should be a veterinary assistant trained on handling narcotic emergencies in humans
- Capture of animals should be timed to coincide with the cooler hours of the day (ideally below 25°C) to avoid the risk of hyperthermia and other heat related complications, unless it is an extreme emergency

3.2 Immobilization for translocation

- If the immobilization is for translocation purposes, then adequate planning is critical including the long term commitment to protect, monitor and manage the translocated animals
- Planning should take into account the time of the year and the prevailing temperature at the time of capture, the cooler times being preferred. This at both capture and release sites
- Selection of rhino for capture is important. The animals should be in good condition, should not be geriatric and the capture of heavily pregnant animals and calves less than 2 years of age is best avoided. At times, it may be necessary to capture younger calves as long as it is done by an experienced team and managed at release properly. Cows with calves 2 years old will be heavily pregnant so that risk needs to be managed as well
- At the release site, the rhino should be let out when the vegetation is at its best in terms of quantity and quality and good quality water is readily available, such as in the rainy season
- The Guidelines for Translocation of Wildlife Species in Kenya (2018) outline prerequisite pre-translocation assessments that need to be done before any translocation is undertaken. These include good scientific and technical inputs to inform planning; careful consideration of the justification and objectives of the proposed translocation; ecological suitability assessments; source populations including number, sex and age structures; security considerations; land ownership and size; disease risk assessment to ensure translocated animals are not exposed to novel infections or new pathogens are introduced into the recipient area and ensuring conformity with the requirements of applicable environmental management and compliance regulations. The guidelines also outline prerequisite logistical coordination and planning activities, as well as the critical personnel required and their capacities and experiences
- The translocation team should be facilitated with appropriate equipment as summarised in Appendix 1
- The veterinarian responsible should at all times and throughout the operation ensure optimal health and welfare of the rhino being

immobilized. S/he should focus on the physical interventions of the translocation, including loading, transportation and boma management

- Unless unavoidable, darting should be avoided in adverse terrains such as near cliffs and water bodies as well as very thick vegetation that may make recovery from the ground difficult or impossible.

3.3 Immobilization for other interventions

- Immobilizations for other interventions may include treatment of disease or injury, ear- notching and fitting of radio horn-transmitters.
- Just like for immobilization for translocation purposes, the veterinarian responsible should at all times ensure optimal health and welfare of the rhino being immobilized.

3.4 Veterinary considerations

- There is limited published information of diseases in free-ranging rhinos. However, the rhinos belong to the same order with equids (Perissodactyla), and are therefore related in anatomy, physiology, parasites, diseases, nutrition and response to drugs. The larger knowledge in horse veterinary issues can therefore be used to better understand diseases and conditions in rhinos
- Opportunistic pathogens and parasites can occur in free-ranging rhinos during periods of starvation or stressful conditions that can arise during capture and translocations. Thus, 'best practices' outlined in this protocol should be adopted to reduce stress
- Mortalities during translocations can also occur from trauma (during capture, transport, boma holding or after release from territorial fights), which is of critical importance during black rhino translocations. Appropriate measures should therefore be taken to minimize trauma
- There should be a member of the team who should have skills and experience to fit radio horn transmitters and prescribed ear-notch patterns
- For animals to be translocated, the horns should be tipped to blunt them to reduce chances of horns getting stuck in gaps in crates and bomas breaking them off, and also reduce post-release fighting injuries/mortality risks. Such horns should be surrendered to the local conservation area management for safe custody
- The dart should be removed and the wound treated with a topical antibiotic ointment to prevent secondary bacterial infections of the wound which can spread underneath the skin leading to serious complications
- Sometimes because of the stress of capture which can compromise the immune status of the animal, an antibiotic (preferably long acting preparations) should be administered intramuscularly as prophylaxis, the dosage being dependent on the weight of the animal

- A lubricating antibiotic eye ointment may be administered to both eyes to prevent corneal desiccation. Precautions however should be taken and only done when indicated because if sticky, it can attract dust and grass to get stuck in the eyes
- Other interventions (e.g. treatments of infections) and injuries should be administered according to the findings of the veterinarian in-charge
- Samples for DNA profiling should be collected according to established protocols for submission to the Forensic and Genetics Laboratory for inclusion into the Rhino DNA Indexing System. Other samples may be collected for immediate and future studies
- Other veterinary considerations should be followed as outlined in the Guidelines for Translocation of Wildlife Species in Kenya (2018)

4. DARTING PROCEDURES

- Darting of black and white rhinos should be from a helicopter or from the ground (on vehicle or on foot). The latter provided the terrain is suitable and loss of the animal in thick bush is a very low risk. If done from the ground, ample daylight should be available in case the animal is lost
- Radio communication between different teams involved in any capture (air, veterinary, capture, security and ecologists) should be maintained to ensure coordination and success of the operation
- The physical condition of the rhino should be assessed immediately prior to darting and the immobilising dose adjusted accordingly. See Appendix 2 for condition scores of black rhino
- The preferred dart placement areas should be parts of the body with good muscle cover preferably on the rump, hindquarters, neck and shoulder

4.1 Helicopter darting

- Darting should be done by an experienced veterinarian and pilot. This should be the method of choice when darting rhinos, particularly black rhino in difficult terrain
- The helicopter should also have a spotter to identify the target rhino. Once identified, the rhino should be herded towards an open safe area before darting so as to minimise the risks of the rhino going into thick vegetation, difficult terrain such as cliffs and water bodies. The ground support team should be close by before darting commences
- After darting, the helicopter should withdraw and monitor the rhino movement from a distance or another aircraft with a spotter may take over
- The helicopter should initially control the direction of the rhino after darting to prevent it going into difficult terrain and thick vegetation but then leave it when it becomes non-responsive

- Once the animal goes down, the veterinarian should be dropped by the helicopter and the pilot should guide the ground teams to the location of the animal

4.2 Foot darting

- This method requires an experienced veterinarian especially when dealing with more than one animal
- Some situations may need a quicker knock-down time and the dose may need to be increased
- A light aircraft (or drone) may be required for monitoring the animal after darting depending on the terrain and vegetation cover to avoid losing the animal after darting. Observers may be placed at strategic high ground points to observe the movement of the rhino where a light aircraft (or drone) is not available
- Approach should be by a limited number of personnel. Stalking skills are required. The animal should be approached against the wind to ensure it doesn't smell the darting team

4.3 Vehicle darting

- The same approaches as for foot darting should apply, including approach against the wind, light aircraft (or drone) and placement of observers at safe vantage points to assist monitor the animal after darting

5. IMMOBILIZATION DRUGS

- The drugs' combinations and dosages depend on the species of rhino as well as the local conditions including terrain, age, sex and health status (body condition) of the animal
- The immobilisation drugs that can be used are one of, or a combination of opioid derivatives Etorphine hydrochloride, Fentanyl, Thiofentanil (A3080/Thianil®) and Butorphanol tartrate. The opioid is mixed with an appropriate short acting sedative or tranquillizer such as Midazolam, Azaperone tartrate, Xylazine hydrochloride, Medetomidine or Detomidine
- To have a quicker knock down for black rhino, Thiofentanil or a 50:50 mix of Thiofentanil and Etorphine is preferred for short procedures in the field (e.g. ear- notching). Thiofentanil is not recommended for white rhino. For translocation, immobilization with Etorphine is preferred
- Butorphanol/Medetomidine mix may be useful in a boma environment or in a severely compromised or young rhino, but is not recommended for the field immobilization of healthy rhinoceros
- Of the above drug combinations, Etorphine combined with Azaperone is by far the most frequently used drug combination for free-ranging rhinos with

good results. The alpha₂ agonist drugs (Xylazine, Medetomidine and Detomidine) although having an antidote unlike Azaperone, have many side effects including respiratory and cardiovascular depression and are to be used with caution and not in compromised animals

- Whereas some general guidelines on dosages are provided in Table 1, the final decision on which drugs to use, their dosages and combinations should be made by the veterinarian responsible for the operation depending on prevailing circumstances including the health status of the animal, the terrain (use of higher dosages so as to achieve fast immobilization in difficult terrains) and excitation status of the animal
- The type of dart and projector (rifle) used will be decided according to the preference of the veterinarian responsible for the operation
- The veterinarian in-charge should be responsible for preparation of darts. Veterinarians should work in pairs and in the absence of a second veterinarian, there should be a veterinary assistant trained to handle opioids' emergencies in humans
- Details of the animal including the age, sex, and body condition should be provided to the veterinarian in advance to enable determination of appropriate drug dosages

Table 1: Recommended dosages for immobilization of the free ranging black and white rhinos

Rhino Species/Age	Opioid (Etorphine Hcl)	Tranquillizer (Azaperone)
Black rhino		
Adult (> 5 years)	4.0 to 5 mg	40-60mg
Sub-adults (3 -4 years)	3 to 3.5 mg	30-40 mg
Juveniles (1 to 2 years)	1 to 2 mg	20-30mg
White rhino		
Adult	3.5 to 4.5 mg	20-40 mg
Sub-adult	2-3.5 mg	20 -40 mg
Juveniles	1 to2 mg	10-20 mg
Calves	0.5-1 mg	5-10 mg

- Modern approach to rhino capture recommends reduction of Azaperone and then add in crate if needed. For non-translocation immobilisations (e.g. treatment, ear notching, etc.) where the animal is woken up immediately, less Azaperone can be used
- Hyalase (2,500- 5,000 IU) is added for both white rhino and black rhino if ground and helicopter darting but not when darting rhinos in bomas as quicker knockdown without exertion can enhance the side effects of the immobilisation drugs. However, Hyalase might exacerbate the opioid side

effects in white rhino and since they respond better to herding by the helicopter, it may be omitted in the white rhino

- Relocating animals <18 months without their dams can have negative survival statistics, and should be considered carefully and done when required for rescue or survival risk at source
- Confined, hand-raised, young, old, sick and compromised animals should be handled with caution as they are prone to respiratory depression and side effects of capture drugs. They require lower drug dosages compared to free ranging healthy animal in optimum body condition. It may be challenging when having to “rescue” rhino in drought situations. Just 1 mg Etorphine may be sufficient for an adult in very poor condition
- Sometimes, some animals may remain standing and semi-narcotized. In such circumstances, Midazolam (a Benzodiazepine sedative) at 5-10 mg intramuscularly or intravenously, or 100 mg ketamine intravenously (for adults) may be administered to make the animal recumbent
- While capturing white rhinos, the veterinarian responsible should make himself familiar with the marked physiological side effects from the opioid derivative of etorphine hydrochloride. The respiratory depression and muscle tremors are pronounced and the partial antagonist Butorphanol MUST be administered as soon as the animal becomes recumbent

6. HANDLING AN IMMOBILISED RHINO

- Once an animal goes down, the following should be done immediately:
 - Apply blindfold. Ear plugs may also be applied
 - A pulse oximeter may be used to monitor the oxygenation of the blood
- In white rhino, Butorphanol at 10-20x the mg dose of etorphine (e.g. 4mg etorphine then give 40-80mg Butorphanol when you get to the rhino) MUST routinely be administered as soon as the animal becomes recumbent. If using lower doses of Butorphanol, the white rhino may become increasingly hypoxic during long procedures. If Butorphanol is not available, Diprenorphine (1/20 – 1/10) of full reversal can be used instead
- In black rhino, Butorphanol is not recommended and is only indicated to counter the respiratory depression induced by Etorphine for very compromised animals and definitely not routinely. A dosage of 5-10mg is sufficient
- A rhino should be placed in sternal recumbency initially, ensuring that the limbs are suitably positioned to ensure adequate blood flow to all extremities. Sternal recumbency is best for respiration, while lateral recumbency is best for limb perfusion. It is thus advisable to roll the animal into lateral recumbency for short periods to alleviate the pressure on the legs if the animal is to remain immobilized for an extended period of time

- An intravenous catheter can be placed in an ear vein for quick access in case of an emergency
- Airways should be confirmed to be patent, that the animal is breathing and that there is sufficient circulation as evidenced by colour of blood and mucous membranes and capillary refill time
- The administration of oxygen per bifurcated nose tube @ 10L/min should be standard practice. Oxygen cylinder and appropriate accessories should therefore be provided to the veterinary team
- The heart rate, respiration rate and pulse rate should be monitored regularly (at least every 5 minutes) using appropriate accessories. The guiding ranges are as follows:
 - Respiration: - 6-10 deep breaths per minute. If the number of breaths are below 3/minute, emergency drugs should be considered to be administered. This should include additional Butorphanol and Doxapram
 - Body temperature: - 36.5°C up to 38.5°C for black rhino and up to 37.2°C for white rhino. The inevitable running by a rhino after darting and the possibly high ambient temperature will have raised the rhino's temperature. Young animals tend to have a slightly higher temperature than adults after running a similar time. Ensure the rhino is kept cool and, if possible, in the shade. A shade screen may be useful in open country. Overheated animals should be cooled with copious amounts of water all over the body while providing adequate air movement in windless conditions. Animals with temperature above 39°C that fails to go down with appropriate management should be revived to avoid complications associated with hyperthermia.
- Anaesthetic emergencies will occur even in the most well prepared cases and ideal conditions. This calls for prompt action to deal with the cause. Immobilized black and white rhinos constantly demand attention of the veterinarian until they are loaded and safely released.

7. LOADING, REVERSAL OF ANESTHESIA AND TRANQUILISATION

7.1 Loading of rhinos

- Processing and loading into the crate requires an experienced capture team with appropriate equipment. The crate is placed in front of the sternally recumbent rhino. A strong non-abrasive cotton rope with a knot is tied behind the posterior horn. The rope is threaded through a hole at the back of the crate where a sufficient number of people are placed to pull the animal gently into the crate once it wakes up. At least three quarters of the head is placed inside the crate during processing for loading. Sufficient

number of people are also placed on either side of the rhino and at the back to guide it into the crate when it stands up after reversal of anaesthesia

- The translocation team should be availed with appropriate recovery, loading and transportation systems. These should include but not limited to hydraulic lifting cranes, crates, trucks and four-wheel vehicles. Saws and axes (chain saw ideal) should be at hand in case access for trucks in wooded areas is a problem or if a rhino goes down in thick bush
- Once the animal is in the crate, the blind fold and ear plugs are removed. Observation should be made to ensure the animal is not pressing its nostrils onto the crate blocking the nostrils.

7.2 Recovery in difficult terrains

- Where terrain is inaccessible, partial reversal techniques can be used to enable walking animals into crates for loading may be considered
- Animals to be walked are blind folded and tailor-made ear plugs or cotton wool placed into the ears. A strong rope with a knot is tied behind the posterior horn (head rope) and another on one of the hind legs (braking rope). At least 4 people are placed on each rope, at least 2 on each shoulder, one person to the side to control the team and at least two people walking in front clearing obstacles
- For the black rhino, partial reversal is achieved with incremental doses of 5 mg of Butorphanol given at least 10 minutes before each increment. Black rhinos are extremely sensitive to the partial antidote and even 10 mg Butorphanol can result in an “explosive” wake up. The veterinarian responsible should thus administer and monitor the animal very carefully
- For the white rhino, Butorphanol at 10-15mg/mg Etorphine works well. However, if enough Butorphanol was used in the immobilization mixture, white rhino can often be induced to stand by prodding, without additional antagonist. If unsuccessful, small doses of Diprenorphine (1/10 of the full reversal dose of Diprenorphine) works better than using Butorphanol especially in large adult white rhino. Diprenorphine hydrochloride can also be used to walk the rhino into the crate should it go down in inaccessible areas by recovery equipment. Administer up to 1/10 of full reversal dose of Diprenorphine
- After each injection of the antidotes, wait a few minutes and check the rhino’s response to a prodder or water on the ears. If there is no response, another dose is given. Once the animal stands, it is guided by the head rope and people on the sides. If it goes too fast, the brake rope is used to slow it down
- Diprenorphine is injected once the animal is loaded into the crate. For the white rhino, a full reversal dose is given. For the black rhino, a total dose of 10mg Butorphanol and between 0.8 and 2mg Diprenorphine is sufficient

- Powerful helicopters can also be used to airlift animals from inaccessible areas to areas where they can be loaded
- It is however recommended that darting in adverse terrains should be avoided at all times to avoid situations where animals cannot be recovered from the ground. The Guidelines for Translocation of Wildlife Species in Kenya (2018) recommend that planning and timing for any translocations should be done when conditions are favourable at both donor and recipient areas so to avoid eventualities where recovery should be difficult or impossible to undertake from the ground

7.3 Reversal of anaesthesia

Reversal of anaesthesia depends on whether the animal is to be released immediately into the field (after treatment, ear-notching, etc.) or it is for translocation.

7.3.1 Black rhinos for field release

- If the black rhino is to be released into the field, then full reversal can be obtained by giving 10-15 mg Naltrexone per mg of Etorphine used. Half should be given intramuscularly, and the other half intravenously. The IM administration is intended to take care of re-narcotization (Naltrexone has a half-life of 48 hours) by allowing a slower release from the IM injection and also avoids an explosive wake-up
- Diprenorphine for field reversal may lead to later re-narcotization and therefore is not the drug of choice. However, reversal can be achieved by using at least 2-2.5 mg of Diprenorphine for every milligram of Etorphine used if there is no Naltrexone
- Potential disturbances such as vehicles and people should be removed before reversal

7.3.2 Black rhinos for translocation

- For animals to be translocated, the objective of the reversal process is to wake the animal up so that it walks into the transportation crate but is still sedated enough so that it cannot injure itself in the new confinement.
- Small doses of Diprenorphine can be given to obtain a state of tranquillization from the partial agonist effects of the drug. Recommended doses for reversal are 10mg Butorphanol and between 0.8 and 2 mg Diprenorphine depending on the initial etorphine dose. If a 4-4.5 mg dose M99 has been used, then the higher dose of 2mg Diprenorphine is administered.
- Animals to be translocated can also be injected with small doses of Etorphine and Azaperone prior to release into a boma so that a near

immobilized state is achieved. Should the animal become immobilized after release, IM Diprenorphine should be administered to reverse this state.

- With field to field translocations, the rhino can safely be immobilized again using a full dose of Etorphine 4-5 hours after the initial immobilization. The reversal then needs to be undertaken by full naltrexone dose IM after all equipment have been removed.

7.3.3 White rhinos for field release

- For non-translocation interventions, Naltrexone at 20 x etorphine dose (half IV and half IM) should be used for a complete antagonism of Etorphine.
- Diprenorphine alone does not sufficiently reverse etorphine in white rhinos as they are highly sensitive to the agonistic effect of the mixed agonist/antagonist Diprenorphine

7.3.4 White rhinos for translocation

- For translocation, the full reversal of Diprenorphine can safely be given. The agonistic effects are marked and will keep the rhino sedated for approximately 4 hours.
- White rhinos sometimes manifest re-narcotization and Naltrexone at 20mg/mg etorphine must be administered IM at release just before opening the crate, to avoid this phenomenon

7.4 Tranquillization

- Transport of black and white rhino must be conducted under heavy sedation, particularly black rhino as they can really harm themselves in the crates if not adequately sedated
- Animals to be translocated should be injected with short and long acting tranquillizers depending on the length of the transportation, and for boma adaptation to reduce stress and prevent self-inflicted injuries. This should be done prior to administration of the opioid reversal agent
- For the black rhino, this can be achieved using alone or in combination, Azaperone, midazolam and Zuclopenthixol acetate (Clopixol Acuphase). The use of Perphenazine enanthate (Trilafon LA) in black rhino should be the discretion of the veterinarian responsible depending on length of time of transportation and boma holding period.
- For white rhino, tranquillization can be achieved by using Azaperone and Zuclopenthixol acetate (Clopixol Acuphase).
- A guideline of tranquillizers' dosage rates is provided in Table 2 below.

Table 2: Dosages for tranquilizers used in black and white rhinos

No.	Drug	Black rhino	White Rhino	Length of activity
1.	Azaperone	100-200mg adult, 50mg sub- adult, 25 mg Juvenile	60 – 120 mg adult, 40 - 60mg sub-adult, 20mg juvenile	2-4 hours. Can be repeated every 4-6 hours if used alone
2.	Midazolam	20 – 30mg	20-40mg	1-2 hours duration but individual variation
3.	Zuclopenthixol acetate (Clopixol Acuphase)	100-250 mg Adult, 80-120 mg sub-adult , 40 -80mg juvenile	100 - 150mg for adults, 50 – 100 sub- adults, 20-50mg juveniles	Takes effect in 1 hour and lasts 3 days
4.	Perphenazine (Trilafon LA)	100-200mg Adult, 100-150 mg sub-adult , 50 -100mg juvenile		Takes effects after 4-5hours and lasts up to 7 days

8. POST-CAPTURE IDENTIFICATION

- Each rhino should be ear notched to make them individually identifiable. The notches should be noted and entered into a database.
- Rhinos for translocation should fitted with horn transmitters and transponders for purposes of post-release monitoring. The translocation team should comprise a person experienced to fit the transmitter. The transmitter hole should be drilled on the side of the horn at least 7 cm from the horn base
- The Rhino Program should verify that the horn transmitter and transponders are functional before they are inserted. The rhino program should also provide the ear-notch patterns for identification of the rhino.

9. RHINO CRATES

- Specially made crates for each species should be available. The size should be dependent on the species and age
- The crates should be strong enough so as to contain the animals. They can be either constructed of metal or wood with angle-line iron bars reinforcements and have strong steel doors. If a metal crate is used, the inside where the head can hit should be rubberized so that the rubber absorbs much of blows and sound.
- The crate should allow the rhino to stand up and lie down comfortably. However, it shouldn't be too long as the animal might tend to rush forwards and sustain injuries on the nostrils, horns and lips or wide enough to allow it to turn in the crate.

- Guidelines for crate inside dimensions for adult animals is as follows:
 - Black rhino: 3-3.2m long, 1.2m wide, and 1.8-2m high.
 - White rhino: 3.6m long, 1.3-1.4 m wide, 1.8 - 2m high
- The crates should have good footing which can be a heavy-duty woven rubber mat well bolted down with a flat bar. There should be provision for drainage at the back of the crate.
- For black rhino the front third of the crate must be closed with only a hatch (which can be securely closed) as they travel best when there is no light or holes that they attempt to get out of the crate. There needs to be ventilation slits at the back and side hatch doors (which can be securely closed) for access to injection at near the front third of the crate.
- White rhino crates can be roomier with more air ventilation slots higher on the crate but ideally the front third must have a hatch door that can be closed securely but opened so ventilation can be encouraged during hot days.
- Both white and black rhino crates need to have an enclosed front third with a hatch door that can securely close or be latched down if opened for ventilation. The middle third must be a solid roof and the back third can be open for good ventilation

10. TRANSPORTATION

- During transportation, the animals should be inspected regularly, every 2 - 3 hours or whenever the driver feels changes in the truck's behaviour. If a remote camera system can be put in place, then it will help with the monitoring of rhino. This is very helpful for black rhino where damage due to trauma can be picked up quickly and intervention can be instituted immediately
- Animals should be checked for head pressing on the crate that might block the nostrils. This can arise if the animal is not fully revived. In cases of excessive head pressing, the following interventions can be done:
 - Black rhino: Administer Butorphanol or 1 mg Diprenorphine
 - White rhino: About 2mg Naltrexone
- An animal manifesting excessive head pressing should be able to stand up after this intervention. However, head pressing should be distinguished from actively pushing using hind legs or simply leaning before intervention is done
- A veterinarian must escort the animal to undertake required interventions during transportation, including giving additional tranquillizers if required
- The veterinarian should not wait until the animal is totally alert as it might injure itself. Instead, s/he should anticipate the animal's tranquillization needs and intervene as necessary

- If Zuclopenthixol acetate (Clopixol Acuphase) is administered at loading (takes effect after 1 hour and lasts up to 3 days), additional sedation is not usually required for Boma to field translocation. For field to field translocations, Midazolam or Azaperone (Midazolam however preferred over Azaperone) can be administered when necessary.
- Unnecessary stops should be avoided during transportation
- Overnight transportation can be planned where feasible to off load at first light even if it means slowing down to meet the schedule instead of stopping and waiting for the sun to come up. Night releases can be done but release site should be selected carefully if hard release
- For other considerations during transport, reference should be made to the Guidelines for Translocation of Wildlife Species in Kenya (2018).

11. RELEASE APPROACHES

- The use of drugs before release (hard or soft) including opioids to partially narcotize rhinos and use of tranquillizers to reduce stress, injuries and mortalities have been described under the Sections 7.3 and 7.4 on reversal of anaesthesia and tranquillization, respectively. This method also reduces distances animals travel upon release
- The selection of the appropriate release approach is critical. This can either be hard release, soft release (field to boma), boma to field or boma to boma.
- The method selected should be determined by preference and a multitude of factors, such as those based on the physical condition of the rhinos, the distance the animals are to be moved, if source and recipient areas have similar or very different habitats as well as available resources. For instance, if to be moved very long distances, holding them at the source site for training to reduce stress and make them calm for ease transportation is an advantage. At the release site, such animals can be hard released (boma to field) or further held in bomas at the release site (boma to boma). Alternatively, a field to boma approach can also be used for animals being moved long distances.
- For black rhino, a soft release from bomas is generally preferred. The rationale for a soft release is that if the rhinos are held for a period in release bomas, any veterinary issues arising during their translocation can be detected and if possible dealt with, the rhinos can adjust to the local browse and disease conditions (e.g. trypanosomiasis) if they have been moved from different habitats, their condition can be built up over some weeks after an initial decline due to the stress of capture and translocation, and they can generally “settle-in” to a new area. Being very geographically orientated, black rhinos tend to become accustomed to features of the site that they are held at and if released very quietly with minimum post-release

disturbance after several weeks of well-managed confinement in spacious, quiet, well-shaded pens, they can be expected to explore the surrounds in a relatively tranquil state and to generally remain in that vicinity rather than “bomb-shelling”. It is an important matter in the historical record of Tsavo East that the early re-introductions of 20 rhinos in 1993-1994, including two that had been hand-reared as orphans, were done through soft releases from pens that had been carefully sited in areas of relatively optimum habitat. Having been sourced from upland areas (Nairobi N.P. and Solio) it was deemed prudent to hold these rhinos in pens in Tsavo East for one month on average, in order that they could adapt to local browse and to the disease challenge of trypanosomiasis (borne by tsetse flies), which they had not faced in the upland areas.

- For all hard releases of black rhino from a crate into the wild, a controlled release is recommended. This entails knocking the black rhino down in good habitat near water using a full etorphine dose is administered in the crate and, once it is sufficiently drowsy and a foot rope fitted to a hind foot, the crate doors are opened and the rhino allowed to walk out into a long rope held by a number of people at either end of the rope. The rhino is then tripped up or falls from the anaesthesia. While it is down, all the vehicles and personnel (except for the vet) can be taken away, final procedures carried out and, when all is quiet, the antidote (IM naltrexone) given and the vet walks away quietly. This method is particularly useful if there is no possibility of suitable bomas being available, and if ecological and nutritional conditions at source and recipient areas are similar because it is most efficient, cost effective and has the lowest risks. The white rhinos especially does not adapt well to bomas and artificial feeding. This release method is associated with the least amount of post release complications. Best that releases are done during good environmental conditions so that water and feed are amply available to ensure post release adaptation success is maximised
- For other considerations, reference should be made to Guidelines for Translocation of Wildlife Species in Kenya (2018).

12. HOLDING FACILITIES (BOMAS) AND MANAGEMENT

12.1 Boma siting and design

- Careful selection of the boma site is necessary. For bomas from which rhinos are going to be released directly into the field and which will only be used once or a few times at the most, bomas should be sited:
 - Centrally in the release area to minimize contact with fences immediately after release
 - Away from fences

- Close to good quality water source
- Away from hazards (e.g. cliffs, etc.)
- Area of good habitat for the species concerned
- Away from human disturbance
- An area with natural shade (e.g. from large trees). If no natural shade is available, then artificial shade must be provided
- For bomas that are going to be used frequently over many years, mostly for removing rhinos from an area, other factors that will be important to consider will be:
 - Easy access and close to roads
 - Good supply of good quality water
 - Good supply of browse nearby for feeding
- The following are factors to consider while constructing bomas:
 - Good drainage
 - Good substrate - not be too dusty nor too slippery if it gets wet (might have to truck in sand or gravel)
 - Attention to prevailing wind - upwind from close human habitation and downwind from water for release
 - Cold - cold can be much more lethal than heat. Bomas should not be constructed in very low lying areas. Bomas should be positioned to keep out cold winds
 - Heat - position the bomas where there is some air movement and, if possible, where trees can provide shade. Artificial shade is required in any boma and should be enough to ensure that there is adequate shade at any time of the day
 - Sun- angle of the sun can be an important consideration in hot and cold area.
- The bomas should meet the animal's spatial requirements. Each compartment should be at least 8x8m but the bigger the better. Note that very large bomas are potentially problematic in newly caught black rhino as they can build up speed and try and break out of them. There should be at least two boma compartments side by side to facilitate cleaning by alternately moving an animal to one side
- Boma construction materials can either be wood or metal plates. The best bomas are made with vertical pole partitions. This allows for good ventilation and are less hard than metal plates. They should be very sturdy with poles firmly fixed and concreted in place and connected with strong supporting frames. A rhino will initially test the limits of its enclosure by pushing and bashing the walls and doors. If it finds a weakness, it will focus its efforts on that particular spot. Regular prophylactic maintenance is required to ensure that bomas remain sturdy and cannot be broken by rhinos. They will find the weak point and work on loose poles etc. until they break.

- Walls should be between 2.20 m and 2.40 m high, taking care to ensure that there are no places lower than this as an adult black rhino can get its legs over a wall/door of approximately 190 cm.
- Once released into the boma, black rhinos can sometimes be aggressive to each other. The gaps should not allow the horns to fit through. It is important to cut off the tip of the anterior horn to prevent self-inflicted injuries/horn breaking off. White rhinos calm more quickly if the walls of the boma allow animals to see those in neighbouring bomas, and see and get used to the activity around the bomas.
- Doors should be 1.5m wide and strong so as to contain the animals. When initially confined, the rhino test the walls and especially the doors, probably because they move, are noisy and are usually lower than the boma walls. There must not be a gap under the door, as the rhino can get its horn under it and lift the door off or break its horn off. The locking mechanisms must be reliable as rhino can force a door open and either escape or get into an adjacent pen. Doors should preferably be sliding doors allow for the most safe and practical movement of rhino between pens and also for release
- Sliding doors are either all steel (plate on a pipe or square tube frame) or wooden with a steel frame. To prevent injury to the rhino and damage to the door, both wooden and steel doors should be covered with conveyor belting. Conveyor belting also makes the door quieter if it is hit or pushed. The sliding door moves on an overhead steel beam (best if it moves on bearings). The door is supported below by a beam or pipe and when closed should slot into a gap inside the boma. Sliding doors must always open to the outside of the boma. There should be little or no gap between the door and the supporting beam. Too much of a gap and the rhino will force its horn in there and either break off its horn or the door. It must also be impossible for the rhino to lift the door (put a spacer between the door and the supporting beam). The height of the sliding door (or other boma door) must not be too dissimilar to the boma wall height or the black rhino will try to climb over it. It is also important that it moves easily and there is minimal movement and noise if a rhino hits it from the side. Good handles should be welded to the doors on the outside. Handles and/or a door stop should be placed carefully to prevent the door operator hand from being crushed should the rhino push the door while it is being opened. There must be a very stout locking mechanism to keep the door closed and it is also good if there is a mechanism to hold it when opened.
- If there are shade trees, no roof is necessary. If a roof is required, this should be of insulating material. Where corrugated iron sheets are used to screen against rain and sunlight, it should be placed at a sufficient height from the ground to allow for ventilation and reduce heat and noise. The roof should be about 280 cm or more from the ground. A roof that is too low inhibits ventilation and is easily broken by a black rhino standing up on its hind legs

against the wall. The roof should be angled so that rainwater flows away from the boma. If this can't be done, then gutters should be used to take water away. There should be no single poles supporting the roof in the middle of the boma.

12.2 Management of rhinos in bomas

- Black rhino adapt more easily to boma living than white rhino. Generally, after introduction to bomas, both species of rhino lose condition and then pick up again once they start eating satisfactorily. It can take up to six weeks for white rhino to gain good condition again.
- Before rhinos are placed in bomas, the bomas should be ready with clean water and food so as to minimise disturbance for the first hours of captivity. Should re-narcotisation be considered a likelihood, then only a shouldow amount of water should be provided to prevent drowning.
- The doors of the crate should cover any gaps between the crate and the boma entrance during release into bomas
- Rhinos are often let out of the crate backwards into a boma. They should be allowed to do this in an unhurried way and with no obstacles; certainly the use of prodders and noise should be minimal, if at all. One can urge them out with a gentle tap with a stick on the hindquarters or water over the head or into the ears. Unless not possible to release backwards, release can be done from the front for both white and black rhino
- Bomas should be kept clean and well maintained. Noise and disturbance should be kept to a minimum.
- Adequate and appropriate feed and clean fresh water and sufficient salt should be provided to maintain animals' health condition. Feeds should not be provided on the ground, as the rhino will ingest dirt/sand which may cause colic. Instead, a shouldow hollow concreted slab should be provided. For the white rhino, water troughs design should need to ensure they can drink because their skulls and lip structures can prevent them from accessing conventional trough designs.
- There should be at least one person with appropriate training and experience in animal health/husbandry to oversee and coordinate feeding and cleaning of the bomas during the holding period.
- A veterinarian should be present for the first few days after capture and release into the boma. He/she should make regular visits thereafter, but should always be within reach to attend to any emergencies when called upon.
- The people at the bomas must have the right equipment including a prodder, torch, radio or phone, ropes and the other essential tools to handle any emergency.
- Armed rangers should be stationed at the boma to provide security.

12.3 Holding period in boma

- The length of time in boma has no specific recommendations but will be determined by a variety of factors including prevailing conditions during boma holding, but the longer the holding period, the better.
- For white rhino, holding period can be up to six weeks. They drop off in condition for the first two weeks and take another four weeks to pick up. Should white rhino not eat cut grass, they should be released after 7 to 10 days, either where they were captured or, if safe to do so, in their new release area. However, this will require to be assessed on a case by case basis so that rhinos are released before serious complications develop. A scoring system needs to be instituted that allows holistic monitoring to take place. Parameters to assess include behaviour, food and water intake and faeces.
- Because black rhino adapt more readily to bomas, the holding period can be two to four weeks depending on physical condition and behaviour
- To manage stress during the holding period, long acting tranquillizers can be used on unsettled individuals (Table 2).
- Trypanosomiasis is an important disease to consider, particularly in the case of animals being moved from the highlands to the lowlands of Kenya. For this reason, it is important to monitor their condition and only release once the rhinos are in good condition and thus able to withstand a trypanosome challenge
- For other considerations, reference should be made to Guidelines for Translocation of Wildlife Species in Kenya (2018).

12.4 Release from bomas

- Black rhino should be released one at a time, starting with young animals, then older females and, lastly, older males. Cows with calves should be released together. This gives the young and the females' time to settle before the big bulls move in to establish themselves.
- It is best to release rhino in the early evening as it is getting dark. Being nocturnal, rhino see well at night and are more confident and more relaxed. Released in the early evening they have the whole first night to wander around and get used to the area before day comes. Some preferred food like Lucerne or browse may be placed outside the boma to draw the animal out and away from the boma. It is important to draw the rhino away from the boma because if it comes back to the other pens from the outside, the other rhinos in the boma will take umbrage at having a rhino approach them from an unknown side and get agitated, which may make the released rhino get excited that it charges off. In the afternoon before release, they must be watered and fed as usual.

- There should be absolutely no disturbance, lights, cameras, vehicles, drums, or other equipment close to the boma. The number of people should be as few as possible to minimise disturbance.
- When everything is quiet, carefully open the door between the pens and quietly back off preferably behind the boma to observe the rhino leave the boma. The animal might take some time before it leaves the boma.
- Should the animal refuse to leave the boma, close the doors and try again the next evening. The animal should not be chased (forced) to leave the boma. It must leave at its own pace.
- Often a rhino will walk out of a boma and then return and possibly even do this a number of times, so water and food should be left for the following days or weeks.
- Once the rhino has left the boma, give it a while to wander off before making any movements for it might still be in the vicinity. When walking away, do it quietly away. If it is necessary to drive away from the boma, do so slowly and carefully.
- Once all the animals are released, the bomas can be left open with water until the rhinos are settled. If there is an animal that is of particular concern, e.g. a sub-adult in poor condition, food can also be left in the boma until you are certain the rhino is relaxed and eating.

13. POST RELEASE MONITORING

- There should be a dedicated monitoring team who can assess the animals after release, not only to assess distribution and condition. For black rhino in the first 2 weeks, it is best to triangulate rather than have visuals, but after that animals should be seen at least once a week to check for condition and wounds. An introduction is not complete until the animals have successfully established their home ranges
- Black rhino usually have established their new home ranges after about 2 months. Monitoring information can be used to direct security operations.
- It is thus important that there should be in place a post-release monitoring strategy of all or a sample of the individuals translocated for a sufficient period of time in order to assess the outcome of the translocation.
- The monitoring should include studies on the ecological and behavioural aspects, long-term adaptation, collection and investigation of mortalities, interventions (veterinary aid and supplemental feeding amongst other interventions), amongst other studies. Monitoring also assists with security.
- All translocated rhinos should be fitted with horn implant or leg transmitter collars and transponders to aid in the post-release monitoring. Horn transmitters work better, but the horn size may not allow their fitment.

- For the first few days after release, the rhino should be given a chance to settle down with minimal disturbance. It is not usually necessary to actually see the animal for the first few days unless a problem is suspected, though triangulation is useful to determine locality.
- It is necessary to check fences to see that the rhino has not broken out, as newly released rhino often lie close to the fences.
- After about four days, it is a good idea to track the animal to visually check on its condition and see that it is eating and appears alert. Thereafter, continue monitoring and try to see the rhino every few days.

14. PLANNING FOR SECURITY

14.1 Manpower densities and competence of personnel

- It is essential that adequate and competent staff are recruited/appointed to manage an area with rare and endangered species (e.g. rhino). Recommended field ranger/scout densities for free-range and Intensive Protected Zones (IPZ) management systems should range between one field ranger/scout for every 10-20 Km²

14.2 Boundary Integrity

- There needs to be adequate enclosure (fences in most cases) and in big open systems there needs to be an area that is under management control at all times to manage dispersing animals that become vulnerable outside the intensely managed area.

14.3 Equipment

- Adequate and appropriate equipment, including vehicles and weapons need to be readily available for effective law enforcement at an operational level.

14.4 Proactive and reactive protocols

- Well-articulated standard operating procedures need to be in place to ensure effective operational plans, including post-incident reaction plans.

14.5 Patrol strategies

- There needs to be a host of different patrol strategies that include day and night operations, observation points, listening watches, aerial surveillance, hot pursuit operations, access control, etc.

14.6 Intelligence capacity

- There needs to be effective intelligence gathering and analysis and all levels to ensure law enforcement operations are intel-driven.

14.7 Monitoring strategy

- Consistent long-term monitoring strategies and analysis should be in place to ensure effective security effort and biological management (performance) of rare and endangered species (e.g. rhino).

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16. APENDICES

Appendix 1: Checklist of equipment and materials

Veterinary

- Appropriate dart rifle and darting accessories
- Immobilisation drugs (Narcotics and sedatives) and antagonists, human antidote (Naloxone), tranquilisers, respiratory stimulants (Doxapram), antibiotics, eye ointments
- Wound treatment materials – hydrogen peroxide, lugol's iodine, sufficient clean water, topical antibacterials,
- Surgical instruments including for ear-notching
- Blind folds and ear plugs/cotton wool
- Pole syringe
- Sample collection kits
- Consumables- hypodermic needles and syringes, gloves, swabs,
- Physiological monitoring equipment – stethoscope, thermometer, pulse oximeter, watches
- Immobilisation forms and pens
- Water containers/jerricans and sufficient water to cool the animal
- Oxygen cylinders and accessories
- At least 2 veterinarians, 1 veterinary assistant and 1 laboratory technician

Capture, loading and transport equipment

- At least 2 non-abrasive soft cotton ropes of more than 10 meters long or the more durable soft nylon ropes
- Electrical cattle prod and new batteries
- Enough crates for specific rhino species and age
- Crates' repair items
- Hydraulic lifting cranes for loading
- Tie down ropes, straps, clamps or chains
- Two way radios (ground to ground, and ground to air)
- Transport trucks
- Four-wheel drive vehicles
- Chain saws, hand saws, pangas and axes
- Torches
- Firearms and ammunition for security during transport
- Phones for communication during transport
- At least 6 capture rangers to assist in processing and loading
- Sufficient drivers. Long distances transport to have at least 2 drivers to avoid fatigue

Air support

- Helicopter for darting (preferably small manoeuvrable one)

- Safety harnesses for the darting vet
- Light aircraft with ground to air communication (or drone)
- Rhino slings if rhinos are to be rescued in inaccessible areas using powerful helicopters

Ground support

- Follow up vehicles to deliver equipment

Post release monitoring

- Ear notching tools or scissors, forceps and scalpel blades
- Ear notch patterns, preferable with pictures of notches
- Transponders and applicators, and recording form to record transponder numbers inserted to each rhino
- Horn transmitters with hand and electric drills and sealing compounds usually dental acrylic powder and liquid catalyst, and form to record transmitter details, spare batteries and a portable generator
- Digital camera especially to record notch patterns

Appendix 2: Black rhino body scoring sheet

BLACK RHINO CONDITION SCORE CHART



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