

Chemical capture of the white rhinoceros

Ceratotherium simum

P.S. Rogers

The successful conservation and management of rhinos, both black and white, depends to a large degree on the ability to capture and care for these animals according to their rather particular requirements. The author would like to pay tribute to the pioneering efforts of Dr. Tony Harthoorn, Dr. Ian Player, Nick Steele, John Clarke, Owen Letley, Maqubu Ntombela and Alpheus Ntuli in the development of the techniques used by the Natal Parks Board, as described in the various rhino management sections in this book. The subsequent work of John Daniels, Norman Deane, Dr Jacques Flamand, Chris Freeman, Alan Heard, Rod Henwood, Peter Hitchins, Billy Howells, Dr. Mike Keep, John Kinloch, Peter Kirtland, John Kymdell, Gavin Livingstone, Keith Meiklejohn, Bob Murray, Peter Openshaw, Jimmy Pattenden, Simon Pillinger, Brian Robins, Ken Rochat, Apie Strauss, Brian Thring, John Tinley and David Weame also made a major contribution in this field.

The white rhino...

- Is an extremely powerful and potentially dangerous animal.
- Is unpredictable, and can be very aggressive when disturbed or when it feels threatened.
- Is extremely agile and fast.
- Has very poor eyesight, but has exceptionally keen smell and hearing.
- Usually inhabits open savannah.
- Tends to flee into dense bush when disturbed.
- Is a gregarious animal, usually occurring in small groups.
- Is often accompanied by red billed oxpeckers *Buphagus erythrorhynchus*, which may alert the animal to the presence of danger.
- Males and females are difficult to differentiate from the ground. The presence of a calf may facilitate the identification of females. From a helicopter the sexes can be differentiated: the sheath of the male and the vulva of the female are visible, as the animals usually run with their tails lifted. Sub-adult animals are often found with their dams, and the relative size and horn length can be used to identify the younger animal.
- Is very sensitive to opioid drugs.
- Is a large, bulky animal that tends to run a long way after darting. Furthermore, the target animal often has to be driven some distance to suitably accessible terrain before being darted. Overheating can be a serious problem unless adequate precautions are taken.
- Loses condition after July, although this is not readily visible, and only improves again a month or more after the first rains. This is important as rhinos in poor condition do not recover satisfactorily from immobilization, and often have difficulty in regaining their feet once the antidote is administered.

Precautions

- It is essential to have the correct equipment and sufficient labour available when immobilizing a white rhinoceros in the field.
- Unessential personnel and/or onlookers should be discouraged from attending the capture operation.
- Avoid darting rhinos when the ambient temperature is over 25°C. Besides temperature, cloud cover and wind should also be taken into consideration.
- Select the terrain for darting the animal carefully, as it has to be accessible to both the recovery and follow-up vehicles.
- Avoid darting within an hour-and-a-half of sunset: in the event of there being a hitch in the capture process, animals could be lost in the dark.
- Take great care when darting on foot. Bear in mind that the rhino has exceptionally well developed senses of smell and hearing, and is also deceptively agile and fast. Oxpeckers may warn the animal of your threatening presence.
- If catching a cow and calf combination, try to avoid catching a cow with a calf under a year-and-a-half of age at foot. The calf should be old enough to look after itself should anything happen to the mother, or should they become separated after release.
- The follow-up team must stay close to the darted animal without disturbing it. The reasons for this are:
 - If the animal is heading for thick bush, a donga or rocky terrain, it can be headed off; and
 - If the animal goes down very quickly, first aid can be given immediately. A member of the follow-up team should be familiar with the use of the emergency drugs.
- Approach the immobilized animal cautiously from the side or, preferably, from behind: the darted animal's sight is not always totally impaired, depending on the drug combination used. Never walk in front of the animal, and stay away from the front horn at all times.
- A drugged animal that is not yet recumbent must be approached and handled with extreme caution, especially in thick bush or scrub. The reason for this is that the animal may easily fall and injure somebody.
- While handling an immobilized rhino, be aware of the possibility of other members of the herd being nearby.
- Before giving the antidote, make sure that the head rope fits snugly – if the rope comes off during the loading process, the consequences may be disastrous.
- If an animal has to be walked out of an inaccessible area to the crate, ensure that a towel is well secured over the eyes. This is particularly important if azaperone or another tranquilizer is used in place of hyoscine in the capture cocktail.
- If possible, confine rhino capture operations to between March and July.

How to capture the white rhinoceros

Equipment

The white rhinoceros has a thick skin, and powerful projectors with robust darts and needles are therefore indicated under normal field conditions. The two most commonly used dart guns are the Palmer Cap-Chur[®] gas-powered projector (close range) and the

Palmer Cap-Chur[®] powder charge projector (longer range). The latter comes in handy when darting from a helicopter in an area that is covered with tall trees, thus necessitating darting from a greater height.

The aluminium Cap-Chur[®] darts are the most suitable for use on rhinos. Two millilitre barrels are used for juveniles and 3 ml barrels for adults. One can also use the KNP plastic darts: these darts are extremely accurate, an essential feature when darting on foot.

Robust (minimum diameter 2 mm) needles are essential. Use 50 mm needles for juveniles and 65–75 mm needles for adults. The needle tip should be slightly bent over towards the central axis of the needle to prevent a plug of skin blocking the lumen. The needle should not have a barb as it is then very difficult to remove the dart from the animal. A bead or collar on the needle is sufficient to hold the dart in place.

The Telinject[®] system has been used with success on rhinos in captivity: GUT50 projector, 38–60 x 2 mm needles, uncollared. The best darting site is the neck. The Telinject[®] or Dan-Inject[®] systems is ideal for darting rhinos in captivity.

Drugs

The drug cocktail used by the Natal Parks Board is given in Table 1. A rule of thumb that is used is that the opioid component should consist of one third etorphine and two thirds equivalent of fentanyl (etorphine being taken as 15x as potent as fentanyl). For example, if a dose equivalent to 3 mg etorphine is selected, the actual composition would be 1 mg etorphine plus 30 mg fentanyl.

Table 1. Drug combinations for the capture of free-living white rhinoceros. Antagonist doses are the minimum that should be used.

	Immobilizing cocktail			Opioid antagonist
	Etorphine (M99) (mg)	Fentanyl (mg)	Hyoscine (mg)	Diprenorphine (M5050) (mg)
Adult	1-2	30	25	6-8
Sub-adult	0.5	20	12	4
Juvenile	0.25	12	12	3

Some alternative drug combinations are given in Table 2.

The tables are only guidelines: drug doses must be tailored to suit the individual animal. A big trophy bull might need more than the dose shown in the table, whereas a calf that is four months old will need less than the juvenile dose mentioned. It should be noted that there are indications that rhinos at higher altitudes require a slightly higher dose of etorphine – approximately 0.5 mg more for an adult animal.

Note: rhinos are extremely sensitive to the effects of opioid drugs, so care must be taken in estimating doses.

The reasons for including fentanyl in the drug cocktail are:

- quicker, smoother induction and knock-down; and

- better relaxation. (Severe muscular rigidity and tremors are sometimes encountered when etorphine is used alone.)

Hyoscine is a parasympatholytic drug which is included in the drug cocktail because it induces dilatation of the pupils. The dilatation produces temporary blindness, causing the animal to stop running sooner than it otherwise would, and making the animal easier to handle and load.

Some operators add hyaluronidase (adult: 7500 i.u., juvenile 5000 i.u., Raath pers. comm.) or DMSO to their darts for quicker absorption and, therefore, a shorter knock-down time. Hyaluronidase has been used with success, but DMSO should be used with caution because of the potential dangers to the operator.

Table 2. Alternative drug combinations for the capture of free-living white rhinoceros. Antagonist doses are the minimum that should be used.

	Immobilizing cocktail				Opioid antagonist
	Etorphine (M99) (mg)	Fentanyl (mg)	Hyoscine (mg)	Azaperone (mg)	Diprenorphin (M5050) (mg)
Adult	3-4	--	25	-	6-8
	1-2	30	-	60-80	6-8
	3-4	-	-	60-80	6-8
Sub-adult	2	-	12	-	4
	0.5	20	-	30-40	4
	2	-	-	30-40	4
Juvenile	1	-	12	-	3
	0.25	12	-	15-20	3
	1	-	-	15-20	3

Diprenorphine (M5050[®]) is used to antagonize the effects of the etorphine and fentanyl at a dosage rate of 2–2.5 mg per milligram of etorphine equivalent (see definition of etorphine equivalent above). Even when diprenorphine is used at the recommended doses, the white rhino remains semi-sedated for up to six hours after reversal. This occurs even when etorphine is used alone, so the effect cannot be ascribed to the hyoscine used in the capture cocktail.

Nalorphine is used either to elevate the level of anaesthesia, to wake the animal partially in order to walk it to an accessible area, to wake the animal up completely, or to revive the animal if it is still very groggy after receiving the diprenorphine. Administration of this drug results in an increase in depth and rate of respiration, increase in blood pressure, and elevated plane of anaesthesia. These responses are dose dependent.

Recent research using pulse oximetry (Kock and Raath, pers. comm.) has indicated that an immobilized white rhino usually has a very low PO₂ (i.e., very low blood oxygenation) due to the inhibitory effect of etorphine on respiration. The normal PO₂ is taken as 80–85%; this can go as low as 45% in some cases. A small amount of nalorphine administered intravenously (obviously only if the animal is down) leads to a dramatic increase in PO₂.

Doxapram (Dopram[®]) is a respiratory stimulant that also elevates the level of anaesthesia. This drug is very useful for increasing the depth and quality of respiration in an immobilized rhino. It should preferably be administered IV, otherwise IM.

Naltrexone is an antidote for etorphine and fentanyl that has a longer-lasting action than diprenorphine. It wakes up a white rhino completely, leaving with it with no hang-over effects at all. Raath (pers. comm.) reports good results in white rhino using 40 mg naltrexone IV for every 1 mg of etorphine used. Kock (pers. comm.) also reports good results using 75–100 mg naltrexone IV following an immobilizing dose of 4 mg etorphine (i.e., 18.75–25 mg naltrexone to 1 mg etorphine). He had previously used 50 mg naltrexone but with inconsistent results. If carfentanil is used (immobilizing doses of 1–1.2 mg for an adult white rhino, 0.9 mg for an adult black rhino), then naltrexone should be used at a ratio of 100 mg to 1 mg carfentanil (Kock, pers. comm.).

When naltrexone is used instead of diprenorphine to wake up a white rhino there is a totally different response. The animal wakes up suddenly and is immediately fully alert – one must be well prepared for this. The author would suggest not using this drug at routine capture because the animal would probably fight the crate all the way to its destination, and would most likely require additional tranquillization *en route*. For this reason, diprenorphine is still recommended for routine capture. Naltrexone would, however, be useful when rhinos are caught, treated, and released (e.g., to remove a snare, treat a wound, or mark the animal). A point to note here is that azaperone would be used in the immobilizing cocktail instead of of hyoscine in these cases. The reason for this is that it would be undesirable to have an animal with impaired vision wandering around in the bush.

Naltrexone would be very useful where captive rhinos are immobilized for treatment, especially if this has to be done on a regular basis. The advantage is that the animal would be wide awake immediately after the procedure, and would not wander around its pen for up to eight hours, falling occasionally, as is the case when diprenorphine is used. The half-life of naltrexone in dogs and humans is 6–12 hours (Lance, pers. comm.), so there is a possibility that some naltrexone may be present in the animal when it is due for re-immobilization, particularly if high doses were used. If daily immobilization is anticipated it is therefore recommended that minimal doses of the immobilizing agent, and consequently of naltrexone, should be used. There should not be a problem if the animal is immobilized two or more days later (Lance, pers. comm.).

Naltrexone is not yet registered in South Africa; it has been registered in the USA recently. This is definitely a drug to look out for in the future.

Field recovery or capture crate (see Plate 14)

It is essential that this crate be constructed of very strong materials, for obvious reasons. The frame of the crate consists of 50 mm channel iron, and the other parts of materials as specified below.

Size

The Natal Parks Board crates have the following inside dimensions:

Height	1.8 m	Length	3.6 m	Width	1.3 m
--------	-------	--------	-------	-------	-------

Doors

- There are doors at both ends: this facilitates loading and off-loading (rhinos, especially drugged ones, are reluctant to walk backwards out of a crate). The doors consist of three separate panels. The lower third consists of an approach flap (670 mm high) which opens downwards. This approach flap must be lined on the inside with non-slip material as the rhino walks up this flap into the crate. The upper section consists of two 1.65 m high vertical flaps which meet in the middle. These close on the outside of the approach flap. A 60 mm diameter hole in one of these upright doors at either end of the crate is used to pass the end of the capture rope to people on the outside of the crate. These holes must have smooth edges.
- All the doors are constructed of mild steel plate. Once closed, the upper doors are held in position by a horizontal bar made of 40 x 40 mm square tube which is slid through a slide cover on the outside of the doors from one side to the other. The bar is held in place with a security pin which is passed through both the slide cover and the bar. The security pin is kept in place by a security clip.
- The door hinges must be extremely robust to prevent buckling when the crate is on uneven ground. If this happens, it may be impossible to close the doors.

Sides

- The sides of the crate consist of 43 mm pine planking. Thin (1.5 mm) metal cladding is used to protect the inside of the crate from the rhino's horn. The cladding need only extend approximately 1.2 m from the opening at both ends. Round-headed bolts should be used for the cladding: nails become dislodged and can injure the animal in the crate.
- Three 70 mm diameter holes through the walls on each side of the crate, near the doors, allow steel poles to be passed across the width of the crate. The first set of holes is 550 mm from the bottom of the crate, the second 800 mm, and the third 1050 mm. These can be used as steps to gain access to the interior of the crate from the top to work on the rhino if necessary (e.g., if the rhino has gone down in the crate).
- There should be a small ventilation gap at the bottom of the sides of the crate, between the sides and the floor.

Floor

- The floor of the crate consists of mild steel. The floor must consist of, or be covered with, non-slip material.

Roof

- Only approximately the middle 2 m of the top of the crate is covered by a pine planking roof. This is clad on the inside in the same way as the sides. The openings at either end facilitate access to the crated animal. This is necessary at the front to remove the head rope and towel, and at the back to administer any necessary injections. These gaps also ensure that there is sufficient ventilation (rhinos that have just been captured can be very hot).

Running boards

Running boards (420 mm wide) with raised sides (260 mm high) extend along both sides of the crate. These are used as containers for the equipment needed during rhino capture – pangas, picks, shovels, water containers, cables, etc.

Slides, eyes, and extension arms

- The crate is mounted on two longitudinal slides made of 200x100 mm channel iron. These slides facilitate manoeuvring of the crate while it is on the ground, and also the loading of the crate onto the recovery vehicle.
- Strong metal eyes at the base of the crate are used for the attachment of cables or ropes should it become necessary to pull the crate along the ground.
- Two extendable 75 x 75 mm square tubing 'arms' at the bottom of the crate at either end serve to extend the base of the crate, thereby reducing the angle of the crate when it is loaded.

Accessory equipment

All equipment and vehicles used in the operation must be tested and checked the day before to see that they are in good working order. The equipment used consists of the following.

A rhino recovery truck (preferably 4 x 4) equipped with:

- A rhino crate – see above
- A driver and a conductor.
- A spare capture rope (30 mm woven nylon rope, 10 m long, with a small loop at one end).
- A bow saw – it is often necessary to saw off branches, and occasionally one needs to saw off a section of the front horn.
- Two pangas for bush clearing.
- A pick and a shovel for digging the vehicle out should it get stuck.
- A tommy bar (2 m long) used to position the crate once it is on the ground.
- A 25 litre water container filled with water.
- A spare wheel for the truck as well as one for the follow-up vehicle.
- A 5 m chain equipped with strong hooks on both ends. The chain is used to pull the crate into position before loading it onto the truck.
- A winch or hydraulic hoist, and spare cables for the winch or hoist.
- A two-way radio.
- A cattle prod equipped with an extension handle approximately 600 mm long. This comes in useful if the animal is smothering itself, is standing badly, or has gone down in the crate.

A follow-up vehicle (preferably 4 x 4) equipped with:

- At least five able-bodied personnel.
- Two capture ropes – one for the back leg and the other for the head.
- Four pangas.

- A towel with which to cover the eyes of the rhino.
- A pick and a shovel.
- A 25 litre water container filled with water.
- A spare wheel and wheel spanner.
- A two-way radio and stopwatch.
- A drug box equipped with all the necessary capture and emergency drugs. This drug box should also contain a cattle prod.

A helicopter equipped with:

- A two-way radio and stopwatch.
- A spare capture rope. The reason for the rope is that if the animal is severely affected and is heading for a donga, the marksman or assistant can be dropped off nearby and can then attach the rope to a hind leg and the other end to a tree and wait for assistance from the ground crew.
- A push rod so that the dart can be removed from the barrel if one decides to go for a different rhino.
- A drug box with all the necessary capture and emergency drugs.

A drug box. In the follow-up vehicle and in the helicopter. A plastic fishing box works well. This should be equipped with the following:

- Capture drugs: etorphine, fentanyl, hyoscine, and azaperone.
- Emergency drugs and antidotes: naloxone, diprenorphine, nalorphine, doxapram and cortisone (e.g., Kortico[®]).
- Instructions for Narcan[®] administration.
- Tourniquet – in the event of accidental self-administration, it is preferable to give the antidote (Narcan[®]) intravenously.
- Tuberculin syringes for making up darts and a separate one for administering antidotes.
- Syringes (3 ml) and needles suitable for intravenous injection.
- Syringes (20 ml) for Dopram[®], Kortico[®], or long-acting penicillin administration.
- Needles (18 g x 38 mm) for intramuscular injection.
- Antibiotic spray for superficial wounds.
- Acaricidal spray.
- Antibiotic intramammary syringes for dart wounds.
- Long-acting penicillin.
- Ophthalmic ointment to prevent corneal desiccation and eye infections.
- Cattle prod, e.g., Kawe[®].
- Spare CO₂ cylinders and O-rings for the gas gun.
- Spare .22 blanks if powder charge gun is used.
- Marking pen to write each drug's name on its syringe.
- A pair of pliers to change CO₂ cylinders and O-rings.

Technique

There are three techniques that may be used for the capture of free-living rhinos.

On foot. Use of this technique can be very hazardous, but is sometimes unavoidable. It is advisable to use the Palmer Cap-Chur[®] powder charge projector and KNP plastic darts for maximum range and accuracy. The animal can be darted in the neck just below the nuchal hump, or in the hindquarters. Once the animal has been darted it is essential that the marksman remains absolutely still, as the animal often wheels around and faces in the direction from which the dart came. It may then either charge in the direction of the marksman or run away. It is essential that the marksman be near a tree that he can climb if this becomes necessary. If the animal runs off it should be followed at a distance, taking care not to disturb the animal further. Two assistants must be available with a fully equipped drug box, two capture ropes, a cloth for the eyes, and a two-way radio. The rest of the capture procedure is the same as that described below.

From a 4 x 4 vehicle. The vehicle should have an open top and a lowered windscreen. Once a rhino is found, the vehicle is driven in as close as possible to the animal. The rhino must be running directly away from the vehicle and not across its path: in the latter case darts tend to bounce off the animal. Darting should be done forwards from the vehicle. The rhino is darted in the hindquarters. Once the rhino is darted, the vehicle should not follow closely as this merely chases the rhino further away. The rhino will tend to seek shelter in thick bush: two members of the capture team should get off and keep track of the animal, with the vehicle lagging behind. The trackers should be equipped with a two-way radio in order to communicate with the vehicle. They should also carry a rope to put around a hind leg once the rhino becomes groggy. This rope can then be tied to a tree to restrain the animal until the vehicle arrives. If two animals are darted at the same time, a fully equipped back-up vehicle must be available in case of separation.

From a helicopter. This method is preferable to darting on foot or from a vehicle for the following reasons.

- The safety aspect.
- One can watch the animal all the time from darting to recumbency. If it goes down too quickly, the marksman can be dropped off immediately to administer emergency drugs.
- The helicopter can be used to guide the animal to an accessible area before darting. It can also be used to guide the animal after darting (up to a point: this is not always possible, especially with black rhinos).
- The helicopter can be used to guide the follow-up vehicle and the recovery truck to the animal quickly and via the shortest route.
- The helicopter can be used to chase away family members and can also hover in the immediate vicinity to make sure that no family members return to the scene.

The helicopter darting technique, as employed by the Natal Parks Board, is described here in detail.

The follow-up vehicle and the recovery truck wait at a pre-arranged site while the helicopter crew searches for a suitable animal. Once the animal is sighted, the follow-up vehicle and the recovery truck are brought closer on instruction from the helicopter crew. If the animal is in rough terrain, it is driven to a more accessible area before darting.

The animal is darted and a stopwatch is started in the helicopter as well as in the follow-up vehicle, on advice from the marksman. The animal is usually darted from a distance of 3–10 m, depending on the vegetation height and density. The darting site of choice is the hindquarters (upper hind leg or rump).

Immediately after darting, the helicopter gains altitude so as not to disturb the animal unnecessarily. The helicopter crew watches the animal all the time and keeps the follow-up team reasonably close to the animal but not close enough to disturb it. If the animal is heading for inaccessible terrain (e.g., very thick bush, a donga, or a cliff) the helicopter can be used to head it off. If the animal is semi-immobilized, however, it will not respond to the helicopter, and the follow-up vehicle must be brought in to head the animal off.

Often, especially in the case of a cow and calf combination, two animals may be darted at the same time. In this situation the cow is darted first and then the calf. The cow and calf usually stay together but may drift apart shortly before becoming recumbent or being roped. A problem could arise if one of the darts does not function properly (e.g., subcutaneous dart, dart striking bone, etc.). This may result in the animals becoming totally separated and the helicopter personnel losing sight of one of them.

Response

Downtime or tractable time parameters for the etorphine/fentanyl/tylosine combination are as follows. Knock-down time is usually between 7 and 10 minutes (up to 15 minutes in a big bull). Even if the animal is not down in this time, it can usually be roped and is quite manageable. A rhino that becomes recumbent in less than six minutes is regarded as a potential emergency, and all efforts should be made to attend to the animal as quickly as possible.

In cases where the animal does not show any immediate response, monitor it for at least 15 minutes. If it is drugged but still not tractable after this time, redart it with one third to one half of the initial dose. If it is not all affected at all, it can be redarted with the full initial dose. In either case, the animal should be very carefully monitored once it has gone down, as some of the original drug may by then have been absorbed in addition to the extra dose.

Handling

Fitting a foot rope

When the animal goes down, or is judged ready for roping, the follow-up team is brought in. If the animal is not yet recumbent, one of the personnel, equipped with a capture rope in the form of a noose, alights from the follow-up vehicle and sneaks up behind the animal. The noose is put in front of one of the hind legs and the animal steps into it. If the animal is stationary, the rope must be passed around the leg and a noose made by passing the end of the rope through the loop at the other end. The noose is tightened between the hock joint and the foot, and the free end of the rope is then tied to the follow-up vehicle or to a nearby tree. This end is not knotted because if it is, the knot might be pulled too tight to be undone again. Instead, the end is wound back on itself and somebody holds it. The foot rope must be put on even if the animal is recumbent because the animal may get up again and try to move off.

If the animal is lying down, make sure it is lying in its natural resting posture. Occasionally the front legs remain extended in front of the animal. This does not present a problem, however, and does not hinder the loading process.

Fitting a blindfold and head rope

Once the foot rope is secured, two other members of the follow-up team alight – one equipped with a towel and the other with a capture rope. The towel is put over the animal's head in such a way as to cover both eyes. The purpose is twofold.

- To make sure that the animal cannot see at all, thus making it even more manageable.
- To shield the dilated pupils from the sun.

Pass the end of the capture rope through the small loop at the end to make a noose. This noose is passed over the horns and over the towel, and is pulled tight and secured behind the posterior horn and just behind the angle of the lower jaw. The knot should be at the back of the posterior horn, not below the jaw. Care must be taken not to put the rope too far back as it may tighten and throttle the animal when it is manoeuvred into the crate. This rope also serves to keep the towel in position (see Plate 7).

Monitoring and treatment

- Azaperone (± 20 mg for an adult; Raath, pers. comm.) should be administered intravenously to facilitate handling and loading if the animal shows muscular rigidity and tremors. This usually only occurs when etorphine has been used alone, without fentanyl or azaperone.
- If the animal is sweating profusely, it must be liberally doused with water.
- The dart must be removed and the intramammary antibiotic injected into the wound. A point of practical interest here is that the cap of the antibiotic syringe can be placed over the tip of the dart needle, thus rendering it safe.
- The ophthalmic ointment should be introduced into both eyes, taking care not to have one's face too close to the horns and taking care not to touch the cornea with the tube: the animal may move its head, and laceration of the cornea could result.
- The long-acting penicillin is then administered, preferably in the side of the neck below the nuchal hump:

Adult	20 ml
Sub-adult	15 ml
Juvenile	10 ml
- Care must be taken to aspirate before injecting to make sure that the needle is not in a blood vessel – an intravenous injection of a penicillin suspension inevitably proves to be fatal.
- While all this is going on, a responsible member of the team must be delegated to monitor the respiration and venous pressure of the recumbent animal continually.
 - The venous pressure is monitored by inspecting the veins on the back of the ears. If they are flat or not easily visible, the venous pressure is lower than what it should be. In these cases, nalorphine should be administered:

Adult	10–15 mg
Sub-adult	5 mg
Juvenile	3 mg

This should be given intravenously. Injection of nalorphine leads to an almost immediate increase in the venous pressure. If a vein cannot be found, nalorphine can be given intramuscularly, but it obviously has a slower onset by this route.

- In the Kruger National Park, 10–15 mg of nalorphine is administered immediately, depending on the depth of anaesthesia (Raath, pers. comm.). In Zimbabwe, 10 mg is given immediately, and possibly up to a total of 20 mg, depending on the PO_2 . This leads to an improvement of approximately 25% in the PO_2 within five minutes (Kock, pers. comm.).
- The respiratory rate is usually in the region of 7–15 breaths per minute. If it drops below this, and/or becomes shallow, doxapram (Dopram[®]) should may be given intravenously:

Adult	20 ml
Sub-adult	10 ml
Juvenile	5 ml

Injection of doxapram leads to an almost immediate increase in the depth of respiration, a slight increase in the respiratory rate, as well as a lighter level of anaesthesia.

- If the animal has run a very long way, and/or is very stressed, cortisone (e.g., Kortico[®]) can be administered:

Adult	30–40 ml
Sub-adult	15 ml
Juvenile	8 ml

It is preferable that the animal lie on its sternum, with its legs in their natural position. The animal should be turned from side to side every twenty minutes to prevent neuromuscular damage to the hind legs. If this occurs, the animal will never be able to get up again, as a rhino cannot support itself on three legs. This is especially a problem with older, heavier animals.

Occasionally the rhino has a very long horn that stretches out in front of it. This is most often encountered in old females. The long horn can hinder the loading process because the crate might not be long enough to accommodate the animal. Another problem is that if the rhino does go down during the crate loading process its horn might get stuck, thus preventing it from getting up again. Yet another problem is that the horn might break off at the base: the animal leans against the front of the crate and, because the horn is so long, there is much leverage on the base of the horn. It is advisable to shorten the front horns of such animals to alleviate potential problems. A bow saw is used for this purpose.

Because the white rhino is a gregarious animal, other members of the group may remain with the darted individual, especially if it is a young animal. It is advisable that the helicopter be used to chase away other members of the herd when the follow-up team arrives. Even then, extreme care must be taken because animals belonging to the group may return to investigate. When darting on foot, even greater caution should be exercised when approaching the darted animal, as there may still be other animals in the immediate vicinity.

The rest of the follow-up crew clear a site in front of the rhino's head where the crate can be off-loaded. If there is an obstacle in the way, the rhino's position can be changed by pulling on the head rope.

Loading

The crate is off-loaded in front of the rhino (see Plate 8), the doors are opened, and the approach flap is lowered. The rhino's head is then lifted up and the crate is pushed back by the truck until the flap is positioned below the rhino's head and almost flush with its front feet. Great care must be taken to ensure that the crate is manoeuvred into position correctly and is not sitting at even a slight angle to the rhino. The tommy bar or the truck can be used to manoeuvre the crate into its final position. The free end of the head rope is then passed through the hole in the door at the front of the crate and tied to the bumper of the recovery truck. Again, this rope is not knotted, but is wound back on itself with somebody holding onto it.

A member of the follow-up team then positions himself slightly to the side of the entrance to the crate where the driver of the truck can see him in his side mirror. This person will be responsible for signalling to the driver when to pull on the rope and when to stop. The free end of the foot rope is then loosened from the vehicle or tree, but the rope is not taken off the foot.

Two or three team members are positioned on either side of the rhino, just behind its head. When the slack on the head rope has been taken up by the truck, it is time to give the antidote. Before giving the antidote, make sure that the head rope fits snugly, with the slip knot of the rope located at the top just behind the posterior horn: if the rope comes off during the loading process the consequences may be disastrous.

Once the antidote has been given (into an ear vein) that person, equipped with a cattle prod, positions himself behind the animal. If the antidote cannot be given intravenously it must be given intramuscularly in the neck: one may then have to wait for up to 10 minutes before the animal is able to get up.

The first sign that the animal is waking up is the increase in its respiratory rate as well as an increase in the depth of each breath. This takes 1–2 minutes following intravenous injection. The animal can then be prodded to rouse it. The best sites to use the prod are under the base of the tail, around the anus, on the top of the feet, and behind the base of the ears. Once the animal is on its feet, the person operating the prod alerts the person giving the hand signals and he in turn signals to the driver to go forward. The animal is thus guided and pulled into the truck.

One must bear in mind that this loading process usually takes place very quickly: there is therefore a need for good co-ordination between the person operating the prod, the person giving the hand signals, and the truck driver.

Make sure that the animal is standing properly before pulling it into the crate, otherwise it may fall down with its hind legs extended behind it. Once it is in the crate, the signal is given to the driver to stop. The foot rope is then taken off, and the doors and the flap of the crate are closed. Only then is the free end of the head rope undone and the towel and head rope hooked off with a stick. This may be done by hand if the animal is docile, which is often the case (white rhino only).

If the animal is still groggy, and the possibility exists that it may lie down in the crate, nalorphine can be given (IV if possible):

Adult	100 mg
Sub-adult	50 mg
Juvenile	25 mg

In the author's experience, it has never been necessary to give additional tranquillizer at this stage, as a white rhino is usually sedated for up to eight hours after the antidote has been given.

An alternative to pulling the animal in with the truck is to pull it in manually. The disadvantage is that one then has to take along at least six extra people to help.

Once the animal is deemed to be steady enough on its feet, the crate can be loaded onto the truck. The crate is loaded with the animal facing backwards. This avoids horn damage if the vehicle brakes suddenly, and facilitates off-loading at the destination: a sedated animal will usually not back out of a crate. The crate containing the animal is winched up onto the lorry as quickly as possible. An alternative to this system would be a hydraulic hoist.

Avoid loading the crate at too steep an angle. If the angle is too steep, the animal may slip with its hind legs ending up under its body. If an animal goes down on a slope, it is therefore better to manoeuvre the crate so that it can be loaded downhill. By doing this, one can avoid the problem of loading at too steep an angle. The loading procedure should be carried out as quickly as possible to avoid smothering and slipping.

Once the rhino is in the crate, keep it on its feet and stop it from pushing its nose into the corner and thus smothering itself. A cattle prod equipped with an extension handle is very useful for this purpose. Once the crate is securely in place on the truck the animal is inspected again to see that all is in order before the truck moves off.

Avoid pouring water on the animal once it is in the crate: this can cause it to slip and it may never stand up again. Once the animal is loaded and the truck is moving, it will quickly cool down.

Another method of loading is to use a sled. This involves strapping the drugged animal down on its side (thus risking radial nerve paralysis) and winching it onto a truck. The animal is then taken to its destination where the antidote is given after off-loading. Another disadvantage of this method is the possibility that the rhino may wake up and start struggling *en route*. The animal can be 'topped up' with etorphine. However, etorphine takes some time to take effect unless given intravenously – a procedure that could be dangerous to both the person administering it and to the animal.

Loading problems

Problem 1

Very occasionally a rhino may refuse to stand, or is unable to stand, after the antidote has been given. The reason could be one of the following.

- The antidote was injected perivascularly (around, and not into, the vein).
- The antidote has expired, or not enough was given.
- There was too much tranquillizer in the dart, e.g., when azaperone and not hyoscine is used (the white rhinoceros is extremely susceptible to the effects of azaperone).
- The animal lay in the same position for too long before loading, and is thus not able to put weight on the affected back leg.
- The animal is in poor condition and is, therefore, too weak.

If the problem is one of the first two, additional antidote can be given. If it is one of

the latter two, the prognosis is poor. If the animal has been struggling to get up, it is advisable to let it recover before trying again. If there is some doubt as to whether the antidote has been given correctly, or its efficacy is suspect, additional nalorphine may safely be given (doses given under 'Loading' above). In addition, Kortico[®] and Dopram[®] can be given (doses given under 'Monitoring and treatment' above).

Problem 2

Occasionally the animal goes down in an inaccessible spot (e.g., a donga, a very thick patch of bush, or a very rocky area). In this situation the animal has to be walked out to the recovery truck (see Plate 7). While the truck is being guided in, the animal is given all the necessary treatments, and the follow-up team prepares a path along which to walk the rhino. The animal is prepared for the walking out procedure in exactly the same way as it would be for a normal loading: towel over the eyes and a head as well as a foot rope. Because it may take a while before the animal can be woken up it must be turned every twenty minutes. If the animal wakes up before the truck is ready it can be topped up with etorphine, preferably intramuscularly:

Adult	0.5–0.75 mg
Sub-adult	0.25 mg
Juvenile	0.125 mg

Once everything is ready the animal can be woken. Because the rhino must still be manageable after getting up, it is only woken partially using small amounts of nalorphine intravenously. The doses are as follows:

Adult	25–35 mg
Sub-adult	15–20 mg
Juvenile	5–10 mg

These doses work well in healthy animals, although up to 50 mg nalorphine has been used in the past. It is the author's opinion that it is better to be conservative: rather start off with a lower dose of nalorphine, as more can always be given later. If too much is given, you may have a wide-awake, uncontrollable animal on your hands!

Before the nalorphine is administered the personnel are carefully positioned. The ideal situation is to have six people on the head rope, two on either side of the animal, one holding on to the foot rope, and one positioned behind the animal. The person behind the animal should be equipped with a prodder.

Allowing a minute or two for the nalorphine to take effect, the animal is then roused by prodding it. It is then pulled forward by the people on the head rope and steered by those on the sides.

The person with the prodder keeps the animal moving by prodding it – only when necessary. If the animal is moving too fast some of the people on the head rope can help with the foot rope. As the people on the rope approach the crate they all (with the exception of the person at the front) let go and run around to the other end of the crate. The person with the rope runs into the crate, passes the end of the rope through the hole in the far door to the other team members waiting there, and gets out of the crate. The animal is then hauled and guided into the crate.

Once the foot rope is removed, the doors and ramp are quickly closed behind the animal. The full antidote (diprenorphine) is administered intravenously as quickly as possible from the roof of the crate before the animal can go down or smother itself in the corner. Only then is the tension on the head rope relieved and the towel and head rope removed.

If azaperone is used in the immobilizing cocktail, it may take longer to get the animal up – even as long as five minutes. Burroughs (pers. comm.) reports using higher doses of nalorphine when azaperone is used instead of hyoscine. When using this tranquilizer, it would be advisable to be patient and not inadvertently give too much nalorphine.

Problem 3

Occasionally the rhino, after being roped and attended to, does not go down at all. One of two actions can be taken under these circumstances.

- Give it additional etorphine by hand (see doses under Problem 2 above).
- Just load it as it is.

The latter technique is preferred because it saves time. The crate is positioned right in front of the front feet of the standing animal, and the full antidote is administered. The recovering animal is loaded into the crate in the normal fashion as described earlier. An alternative is to give the walking dose of nalorphine, wait for it to take effect, and then pull the animal into the crate. The full antidote can then be given from the roof of the crate. This alternative can be used where a large bull is involved that is still fairly lively.

Problem 4

Occasionally a rhino goes down in a dog-sitting position, with its hind limbs extended forwards on either side of its body and its front legs extended in front of it. This situation must be remedied immediately as the animal cannot possibly get up from this position. A noose is placed high up on one of the front legs. The free end of the rope is passed under the neck, in front of the opposite leg, and over the top of the neck behind the hump in the direction of the noosed leg. If the animal is small enough, it can simply be pulled over onto its side and then pushed onto its brisket. If it is a big bull (which it usually is!) the rope is tied to the follow-up vehicle and the animal is pulled gently onto its side and then pushed onto its brisket.

Problem 5

Occasionally a really big rhino may go down flat on its side with its legs extended and rigid. It can be very difficult to right an animal in this position because of the enormous weight and the rigidity of the legs.

Using one of the capture ropes, slip the loop over the top front leg, as high up as possible. Take the free end of the rope underneath the neck of the animal, in front of the lower front leg, to emerge at the back behind the nuchal hump. Bring the rope around over the top of the animal. Bring the follow-up vehicle to a position between the front and hind legs and tie the free end of the rope to it (again not knotting it). By pulling gently and slowly on the rope, the animal can be righted, making sure that the legs bend as the animal is pulled up. If the animal tends to fall over after releasing the rope, it can be propped up by team members or even the spare wheel of the vehicle. The rhino can then be loaded in the normal fashion.

Problem 6

If the rhino is not standing properly when it is pulled, it may be dragged into the crate with its back legs stretched out behind it. This is a very difficult situation to correct. To rectify this situation, close the door behind the animal and lift up the front of the crate using the truck. The animal will slide back and, with the back legs braced against the back door of the crate, it may be able to stand up again.

Problem 7

It occasionally happens that the rhino misses the entrance to the crate after being roused, and goes past it. If this happens, the team members should pull on the foot rope or tie it to the follow-up vehicle or a tree to brake the animal. The animal is then prodded on the nose which causes it to reverse, whereupon it can be pulled into the crate.

An alternative method is to pull the crate forward while the animal is being braked by the foot rope. The animal can then be guided into the crate. This method is, however, more time consuming.

Problem 8

If the crate is loaded at too steep an angle, the animal may slip forwards with its hind legs under its body. The animal ends up in a dog-sitting position at the front of the crate – a situation from which it cannot recover on its own. If this does happen, once the crate is loaded, the truck driver must accelerate, build up speed, and then brake suddenly. The animal usually slides backwards, and the problem is thereby alleviated.

Do not

- Never take chances with rhinos: they are unpredictable.
- Never dart a rhino less than one-and-a-half hours before sunset.
- Never walk in front of an immobilized rhino, and stay away from the front horn at all times.

Acknowledgements

The author acknowledges the assistance of Apie Strauss in the compilation of this and other sections on rhino included in this book. Cathy Adam is thanked for typing the manuscript.

Bibliography

- Flamand, J.R.B., Rochat, K. & Keep, M.E. 1984. An instruction guide to the most commonly and successfully used methods in rhino capture, handling, transport and release. In: *The Wilderness Guardian*, T. Corfield (Ed). Nairobi Space Publishing, Nairobi.
- Harthorn, A.M. 1962. Capture of white (square-lipped) rhinoceros, *Ceratotherium simum simum* (Burchell), with the use of the drug immobilization technique. *Can. J. Comp. Med.* 26:203–208.
- Harthorn, A.M. 1962. The capture and relocation of the white (square-lipped) rhinoceros, *Ceratotherium simum simum*. *Lammergeyer* 2:1–9.
- Harthorn, A.M. 1973. The drug immobilization of large wild herbivores other than the antelope. In: E. Young (ed.), *The Capture and Care of Wild Animals*, pp 51–61. Human & Rousseau, Cape Town.

Keep, M.E. 1971. Etorphine hydrochloride antagonists used in the capture of the white rhinoceros *Ceratotherium simum simum*. *Lammergeyer* 13:60–68.

Keep, M.E. 1972. The use of "Rompun" (VA 1470) Bayer on the white rhinoceros. *Lammergeyer* 17:31–35.

Keep, M.E. 1973. The use of etorphine hydrochloride (M-99-Rockitt), fentanyl (Janssen) and hyoscine hydrobromide combination for field capture of white rhinoceros. *Lammergeyer* 19:28–30.

Heard, D.J., Olsen, J.H. & Stover, J.S. 1992. Cardiopulmonary changes associated with chemical immobilization and recumbency in a white rhinoceros (*Ceratotherium simum*). *J. Zoo Wildl. Med.* 23:197–200.

Rochat, K. & Steele, N.A. 1968. Operation Rhodesian Rhino. *Lammergeyer* 8:15–24.

Personal communications: Dr R.E.J. Burroughs, Du Toit Game Services, Box 29421, Sunnyside, 0132 RSA; Dr M.D. Kock, Department of National Parks and Wildlife Management, P.O. Box 8365, Causeway, Harare, Zimbabwe; B. Lance, Wildlife Pharmaceuticals Inc., 1401 Duff Drive, Sweet 600, Fort Collins, CO80524, Colorado, USA; Dr J.P. Raath, Kruger National Park, P. Bag X402, Skukuza, 1350 RSA.

Transportation of the white rhinoceros *Ceratotherium simum*

P.S. Rogers

Precautions

- Ensure that adequately robust crates are used, and that facilities at the receiving end are suitable for accommodating rhinos.
- Ensure that rhinos do not lie down in the crate for at least the first six hours.

How to transport the white rhinoceros

All rhinos are crated and transported individually – even cows and calves.

Crate design

Two types of crates are used, one for the capture operation and one for transportation from the boma to the final destination. The field recovery crate is described in *Chemical Capture of the White Rhinoceros*, this Section.

Export or delivery crate

This crate is attached to the end of the front pen at the boma for crate training, and is the type of crate that is used for single deliveries and for export.

The frame consists of 75 mm channel iron. The roof consists of 43 mm pine planking and extends for approximately three-quarters of the length of the crate from the front (i.e., only the animal's hindquarters are exposed). The sides consist of pine planking. The inside of the sides and roof are clad with steel as in the case of the capture crate (see *Chemical Capture of the White Rhinoceros*, this Section). The floor consists of 43 mm pine planking. A ventilation gap is left between the floor and the sides of the crate.

The Capture and Care Manual

Capture, Care, Accommodation and Transportation of Wild African Animals

**The work of twenty-six wildlife
specialists**

Edited by Andrew A. McKenzie B.V.Sc., Ph.D.

Foreword by Ian Player D.M.S.



Wildlife Decision Support Services and



The South African Veterinary Foundation.

Pretoria, 1993.

i-xxvii, 1-729