

Chemical capture of the white rhinoceros *Ceratotherium simum*

P.S. Rogers

The successful capture and management of rhinos, both black and white, depends to a large degree on the ability to capture and sex the animals according to their rather particular requirements. The author would like to pay tribute to the pioneering efforts of Dr. Tony Hartwood, Dr. Ian Hayler, Nick Steele, John Clarke, Owen Leroy, Magahn Numbels and Aphael Numb in the development of the tool traps used by the Natal Parks Board, as described in the various field management sections in this book. The subsequent work of John Daniels, Norman Deane, Dr Jacques Plummer, Chris Eversman, Alan Heyd, Roy Heywood, Peter Hodges, Billy Howells, Dr Mike Keay, John Kinnaird, Peter Kirkland, John Kinnear, Gavin Lavigne, Keith MacKintosh, Bob Murray, Peter Openshaw, Jimay Pottendon, Steve Morgan, Bruce Roberts, Ken Ross, Albie Strang, Bruce Thring, John Tolley and David Weirne also made a major contribution in this field.

The white rhino...

- Is a tame, powerful and potentially dangerous animal
- Unpredictable, and can be very aggressive when cornered or when it feels threatened
- Is extremely agile and fast
- Has very poor eyesight, but has an ability to see smell and hearing.
- Usually exhibits poor strength.
- Tends to graze in the bush when disturbed.
- Is a gregarious animal, usually occurring in small groups.
- Is often accompanied by mobbed weevilers (*Angitia* spp) which may attract the rhino to the presence of danger.
- Males and females are difficult to differentiate from the ground. The presence of a calf may help to determine the sex of females. However, before the sexes can be differentiated, the shape of the male and the vulva of the female are visible as the animals usually rub with their tails lifted. Sub-adult animals are often found with their dams, and the latter may be identified by their ears can be used to identify the younger animal.
- Is very sensitive to rapid drugs.
- Is a large, bulky animal that tends to run a long way after being hit. Furthermore, the target animal often has to be driven some distance to suitably accessible terrain before it is killed. Overheating can be a serious problem unless adequate precautions are taken.
- Lives outdoors after July, although it is not readily visible, and only improves up to 1 month after the first rains. It is important as there is poor credit and no recover satisfactorily from immediate, and also more difficult in regions where the rhino is not hunted.

Precautions

- It is essential to have the correct equipment and sufficient labor available when attempting to capture rhinoceroses in the field.
- The animals present and/or onlookers should be thoroughly warned of the capture operation.
- Avoid carrying things when the ambient temperature is over 25°C. Besides temperature, alcohol and food should also be taken into consideration.
- Select the terrain for driving the animal carefully, as it has to be accurate to feel the reaction and its own response.
- Avoid driving within 10 feet and 10 feet of sunset, in the event of there being a ditch in the capture process, animals could be lost in a ditch.
- Take great care when driving an animal. Bear in mind that the rhino has exceptionally well developed senses of smell and hearing, and is also adept at crawling and fast. Dispatches may warn the animal of your presence by presence.
- Trapping a rhino and/or female animal by a road can be a job with a catch under a year and a half of age or two. The calf should be old enough to feed after the female, anything happens to the mother or she if they become separated after release.
- The follow-up team must stay close to the target animal without disturbing it. The reasons for this are:
 - If the animal is following for thick bush, a danger to the team can be back to them.
 - If the animal goes down very quickly, it can be given immediately. A rhino which is the to be kept, you should be familiar with the use of the emergency drugs.
- Approach the rhino from the animal cautiously from the side or preferably from behind, the direct animal's sight is not always totally unpaired, depending on the drug combination used. Never walk in front of the animal, and stay away from the front horn at all times.
- A charged animal that is out of reach must be approached with a loaded rifle, and a loaded rifle, and injure to nobody.
- While handling an immobilized rhino, be aware of the possibility of other members of the herd being nearby.
- Before giving the animal, make sure that the level of the drug is suitable. If it is too high, during the handling process, this subsequently may be disastrous.
- If an animal has to be walked out of an inaccessible area to the state, so that a few of us will be scattered over the eyes. This is particularly important if a person or another tranquillizer is used in place of hyosine in the capture method.
- It is possible to confine these capture operations to between March and July.

How to capture the white rhinoceros

Equipment

The white rhinoceros has a thick skin and powerful projection with horns. Cuts and scratches are difficult to cure and make normal treatment difficult. The two most commonly used drugs are the Palmer Cap-Calm and powered projector (time range) in the

Rubber Cap Chew[®] preformed charge projector (Eugen Corp). The Chew sticks in handy when darting from a helicopter to an animal, it is covered with tall trees. Chew sticks are also darting from a greater height.

The aluminum Chew Chew[®] darts are the most suitable for use on rhinos. Two 100-100 lbs. barrels are used for juveniles and 300 barrels for adults. One can also use the KNP plastic dart if the darts are a perfectly accurate, an essential feature when darting rhinos.

Rubber (minimum diameter 2 mm) needles are essential. Use 50 mm needles for juveniles and 65-75 mm needles for adults. The needles should be slightly bent at a 90-degree angle at the tip of the needle to prevent a plug of skin blocking the lumen. The needle should not have a burr or a sharp edge, so very difficult to remove the dart from the animal. A head or collar on the needle is sufficient to hold the dart in place.

The best dart system has been used with success on rhinos in captivity. GUTSII projector, 18-100 x 2 mm needles, is preferred. The best darting site is the neck. The Teinject[®] or Tan Inject[®] systems are ideal for darting rhinos in captivity.

Drugs

The drug cocktail used by the National Parks Board is given in Table 1. A 100% rhinoceros user is that the opioid component should consist of one third morphine and two thirds equivalent of fentanyl. Fentanyl (Fentanyl) is 125 times as potent as morphine. For example, if a dose equivalent to 3 mg morphine is selected, the actual composition would be 1 mg morphine plus 36 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
	Etophine (M80) (mg)	Fentanyl (mg)	Hyoscine (mg)	Diprenorphine (M5250) (mg)
Adult	14	36	25	6.8
Sub-adult	3.5	30	12	4
Juvenile	1.25	18	12	3

Some alternative drug combinations are given in Table 2.

The tables are only guidelines; drug doses must be tailored to specific individuals and a big safety margin if needed. More than the dose shown in the table, rhinos are darted to four months old will need less than the given dose; meanwhile, it should be noted that there are indications that rhinos at higher altitudes require a slightly higher dose of etoprophine—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 determining doses.

The reasons for including fentanyl in the drug cocktail are:

- quicker, smoother induction of anesthesia; and

- better relaxation (50% more muscular rigidity and heaves are seen in cases of overdose when morphine is used alone).

Fentanyl is a parasympatholytic drug which is included in the drug cocktail because it induces dilation of the pupils. The dilation produces temporary blindness, causing the animal to stop and take sound than it otherwise would, and making the darting easier to handle and aim.

Some operators add cycloronic acid (adult: 7500 µmol, juvenile: 5000 µmol, Barch, para. cream) or DMSO to the darts for quicker absorption and therefore a shorter knock-down time. Hydrocortisone 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
	Etophine (M80) (mg)	Fentanyl (mg)	Hyoscine (mg)	Azaperone (mg)	Diprenorphine (M5250) (mg)
Adult	14	-	25	-	6.8
	12	30	-	60-80	3.8
	14	-	-	60-80	6.8
Sub-adult	2	-	12	-	4
	3.5	30	-	30-40	4
	2	-	-	30-40	4
Juvenile	1	-	12	-	3
	0.25	12	-	15-20	3
	-	-	-	15-20	3

Diprenorphine (M5250) is used to antagonize the effects of the amphetamine, but only if a dosage rate of 10-15 mg/kg will be used of morphine or less (see normal use of morphine, see above). Even when diprenorphine is used at the recommended doses, the white rhinoceros may become hyperactive and may become more agitated. This occurs even when morphine is used alone, so the effect cannot be ascribed to the fentanyl used in the capture cocktail.

Nalorphine is used to help to stabilize the level of anesthesia, to wake an animal partially if needed, to walk to an accessible area, to walk the animal up to a vehicle, or to move the animal if it is still very drugged after receiving the diprenorphine. Administration of this drug results in a transient increase in depth and rate of respiration, increase in blood pressure, and elevated plane of anesthesia. These responses are dose dependent.

Recent research using pulse oximetry (Zacarias and Barch, para. cream) has indicated that a rhinoceros held with the usual dosage of morphine has a very low blood oxygenation due to the inhibitory effect of morphine on respiration. The minimal PO_2 is 60-85%, the PO_2 is as low as 45% in some cases. A small amount of nalorphine administered intravenously (initially 0.1 mg if the animal is young) leads to a dramatic increase in PO_2 .

Diazepam (Diazepam) is a respiratory stimulant that also elevates the level of anaesthesia. The drug is very useful for increasing the depth and quality of anaesthesia in a moribund animal. It should preferably be administered IV, intravenously (1).

Butorphanol is a non-steroidal analgesic and sedative that acts as a μ -receptor antagonist. Diprionophylline (1) wakes up a white rhino completely. Working with it with an anaesthetic effect, an animal (Kalk) (pers. comm.) reports good results in white rhinos using 10 mg of butorphanol IV for every 1 mg of morphine used. Kalk (pers. comm.) also reports good results using 70-100 mg of butorphanol IV following an intramuscular dose of 4 mg of morphine (i.e. 18.75-25 mg morphine to 1 mg butorphanol). He has also successfully used 50 mg butorphanol butorphanol intravenously. If butorphanol is used in immobilizing doses of 1-1.5 mg per an adult white rhino (0.9 mg per an adult black rhino) then butorphanol would be used at a ratio of 100 mg to 1 mg of morphine (Kalk pers. comm.).

When naloxone is used instead of diprionophylline to wake up a white rhino there is a usually a frequent response. The animal wakes up suddenly and is immediately fully alert - the muscle well prepared for this. The author would suggest not using this drug to rescue capture because the animal would probably fight the cranes the way to its destination and would most likely require additional tranquilization en route. For this reason, diprionophylline is still regarded as the drug of choice to Naloxone would, however, be useful when rhinos are caught, restrained, and released (i.e. a rhino is restrained, a wound or mark is made). A point to note here is that capture would be used in the immobile living condition is a result of the use of these crates. The reason for this is that it would be more difficult to have a rhino with impaired vision wandering around in the bush.

Naloxone should be very careful, where captive rhinos are immobilized for treatment especially if they are older or are aged females. The advantage is that the animal would be wide awake immediately after the procedure and would not be concerned if its partner up to eight hours later occasionally as is the case when diprionophylline is used. The half-life of naloxone in dogs is 11 hours (16-17) and in rhinos it is not known there is a possibility that some naloxone may be present in the animal when it is due for treatment and once a rhino of age does not use it daily, an accidental anasthesia is anticipated it is therefore recommended that minimal doses of the immobilizing agents and especially of naloxone, should be used. There should not be a problem if the animal is immobilized two or more days later (i.e. per se comm.).

Naloxone 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)

The essential parts can be constructed of any strong material by any handy man. The frame of the crate consists of 50 mm diameter iron and the other parts of the crate are specified below.

Size

The Parks Board crates have the following internal dimensions:

Length	1.8 m	Length	3.0 m	Width	1.4 m
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Doors

- There are doors at both ends; this facilitates loading and off-loading animals especially if dropped crates are required to walk backwards out of a crate. The doors consist of three separate panels. The lower part consists of an approach flap (600 mm high) which opens downwards. This system of doors must be held on the inside with non-slip material as the rhino will creep into the open flap. 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 50 mm diameter hole in each of these upper doors is either end of the frame is made across the back of the approach flap 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 10 mm square tube which is slid through a slot in the 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 cap.
- The door hinges must be extremely robust to prevent buckling when the crane is on uneven ground. If it happens it may be impossible to close the doors.

Sides

- The sides of the crate consist of 40 mm pine plating. The 4.5 mm metal cladding is used to prevent the inside of the crate from the sun's heat. This cladding need only extend approximately 120 mm from the opening at the ends. Round-headed bolts should be used to fix the cladding mats being a diameter and length equal to the depth of the crate.
- There are 70 mm diameter holes through the walls on each side of the crate, near the doors, also steel plates are passed across the width of the crate. The first set of plates is 550 mm from the bottom of the crate, the second 800 mm and the third 1,050 mm. These can be used as steps to gain access to the interior of the crate from the top or where necessary to get out of the crate if the rhino has gone down in the crate.
- There should be a 50 mm 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 a plate covered with non-slip material.

Roof

- Only approximately 1 m of the middle 2 m of the top of the crate is covered by a pine plating roof. This is done so that inside in the same way as the sides. The openings at either end facilitate access to the crate interior. This is necessary at the front to allow 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 (170 mm wide) with raised sides (250 mm high) extend along both sides of the crate. They are used as runways for the equipment needed for the rainsuit, X-ray, pump, picks, shovels, wheel containers, cables, etc.

Slides, eyes, and extension arms

- The crate is constructed from longitudinal slides made of 700x100 mm channel iron. These slides facilitate maneuvering 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 20 mm square tubing "arms" at the bottom of the crate pull out and serve to extend the base of the crate, thereby reducing the angle of the crate when it is loaded.

Accessory equipment

All equipment to be used in the operation must be used 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 4x4) equipped with:

- A rhino crate (see above)
- A driver and a conductor
- A spare capture rope (200 m) and a spare air hose (10 m) with a small hood at one end.
- A hat, raincoat, and often more if it is possible to have them, and a or several spare raincoats with a spare one of the team here.
- Two pumps for bush clearing
- A pick and a shovel for digging the vehicle out should it get stuck.
- A leveling bar (2 m long) used to push on 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 2 m chain equipped with strong hooks at 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 can of prodder equipped with an extension cable (at least 6 m) and 900 m of rope. This can also be used if the animal is wallowing but if it is standing, only if it has come down in the crate.

A follow-up vehicle (preferably 4x4) equipped with:

- A least five (5) beds personnel.
- Two capture ropes (one for the back leg and the other for the hand).
- Four pumps.

- 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 spare pump.
- 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 prodder.

A helicopter (if applicable) 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 boggy, the marksman or assistant can be dropped off nearby and can then attach the rope to a dead log and the recovered to a tree and wait for assistance from the ground crew.
- A para net so that the can 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, ivosentan, and xylazine.
- Emergency drugs and antidotes: atropine, diphenhydramine, atropine, dexampram and naloxone (e.g., Narcan®).
- Instructions for Narcan® administration.
- Tannin, etc. in the event of an accidental self-administration and is preferable to give the animal (Narcan®) intravenously.
- Tuberculin syringes for mixing up shots and a syringe also for administering analgesics.
- Syringes (2 ml) and needles suitable for intravenous injection.
- Syringes (20 ml) for Diposol, Narcan®, and long-acting penicillin for a further 24 hours.
- Needles (18 g x 38 mm) for intramuscular injection.
- Antiseptic spray for superficial wounds.
- Acidic spray.
- Antibiotic intramuscular syringes for ear wounds.
- Long-acting penicillin.
- Ophthalmic ointment to prevent corneal desiccation and eye infections.
- Cattle prodder (e.g., Kay®).
- Spare CO₂ cylinders and O-rings for the gas gun.
- Spare .22 B & W 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 Gun powder charge projector and KNT plastic darts for maximum range and accuracy. The animal can be darted in the neck, just below the line of hump, or in the hindquarters. Once the animal has been darted it is essential that the anesthetic remains effective until, as the animal rears, wheels around and faces in the direction from which the dart came. If this does occur change in the direction of the marksman or the way. It is essential that the marksman be near a tree that he can climb if this becomes necessary. If the animal is shot it should be followed at all times. It may come back to disturb the animal further. Two assistants must be available with a fully equipped drug box, two cap guns, 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 a spare tyre, a full tank of oil, a spare wheel and a spare tyre. The vehicle is driven as close as possible to the animal. The engine must be running directly away from the vehicle and not across its path. In the latter case darts tend to bounce off the animal. Driving 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 it usually charges the rhino if it gets 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 following behind. The truck should be equipped with a two-way radio to communicate with the vehicle. They should be ready to carry a load to get around a dead end once the rhino becomes grumpy. This rope can then be tied to a tree to restrain the animal until the vehicle arrives. If two or more are darted at the same time, a fully equipped backup vehicle should 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 while the rhino is darted and if it goes down too quickly, the marksman can be equipped with a backup gun for emergency drugs.
- The helicopter can be used to guide the animal to an accessible area (e.g. dirt road) and also be used to guide the animal once during trip to a point, that is not a very good one, especially with back darts.
- 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 site.

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 until the helicopter crew searches for a suitable animal. Once the animal is darted, the follow-up vehicle and recovery truck are brought closer or instructed to leave 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 spot where it is darted is the objective as well as in the follow-up vehicle, or where from the marksman. The animal is usually darted from a distance of 3-70 m, depending on the vegetation height and density. The darting site of choice is the hindquarters (upper hind leg or hump).

Immediately after darting, the helicopter goes to altitude so as not to disturb the animal unnecessarily. The heli crew then watches the animal as it goes down and keeps the follow-up team reasonably close to the animal but not close enough to disturb it. If the animal is ready for immobilisation (e.g. very buckish, a double arc of 11) the helicopter can be used to assist it. If the animal is semi-immobilised, however, it will not respond to the helicopter, and the follow-up vehicle must be brought in to herd 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 animals does not react appropriately (e.g. subcutaneous or intradermal sticking, vomit, etc.). This may result in the animals becoming totally separated and the helicopter personnel losing sight of one of them.

Response

Duration of immobilisation parameters for the morphine/ fentanyl/ xylazine combination are as follows. Knock down time is usually between 7 and 10 minutes up to 15 minutes in a large bull. Even if the animal is not down in 15 minutes, there usually is no problem 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 a typical response, a margin of at least 15 minutes. If it is dazed but still too intractable after this time, reduce it with one third to one half of the initial dose. If it is not at all affected at all, it can be restated with the full initial dose. In the case of the animal that has very carefully monitored once it has gone down, as soon as the required drug has been given to be administered in addition to the given dose.

Handling

Fitting a foot rope

When the animal goes down, or it is judged ready for roping, the follow-up teams begin to fit. If the animal is too wet recumbent, one of the personnel equipped with a capture rope in the form of a noose, alights from the follow-up vehicle and a assists 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 still down, the rope must be passed around the leg and a loose made by passing the end of the rope through the hoist of the other end. The noose is tightened by pulling the hook part 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 snatched because if it is the foot might be pulled so tight to be useless again. Instead, the end is wrapped back on itself and somebody holds it. The rear rope must be put over one of the feet and 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 on 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, slighter one equipped with a towel and the other with a net, arrive. The towel is placed over the animal's face in such a way as to cover both eyes. The purpose is twofold:

- To make sure that the animal does not see itself, thus making its sense more tranquil.
- To shield the animal's pupils from the sun.

Pass the end of the capture rope through the small loop in the head 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, close to the jaw. Care must be taken not to pull the rope too far back as this might injure and irritate the animal when it is recovered from the crate. This rope also serves to keep the towel in position (see Plate 7).

Monitoring and treatment

- Anaprox 10-20 mg for an adult rhino, plus oxygen should be administered intravenously to facilitate handling and healing of the animal, show muscular rigidity and tremors. This usually only occurs when the rhino has been sedated with either ketamine or azaperone.
- If the animal is sweating profusely it must be liberally doused with water.
- In addition, the blindfold and the net must be removed and the animal's eyes and nostrils kept open. A point of particular interest here is that the tip of the antibiotic syringe can be placed over the tip of the dam needle, thus rendering it safe.
- The ophthalmic ointment should be introduced into both eyes, taking care not to have one stick too close to the horns and taking care not to touch the cornea, which might irritate the animal. Any move of the head, etc. because of the ointment could result.
- The long acting penicillin is then administered, preferably in the side of the neck between the neck 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 invariably 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 rhino from an angle, preferably:
 - 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	5 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 effect by this route.

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

Adult	20-40 mg
Sub ad. rh.	15 mg
Juvenile	8 mg

It is possible that the animal may sit its stomach with its legs in their natural position. The animal should be turned to one side to see to its twenty minutes to prevent thermal damage to the hind legs. If this occurs, the animal will not be able to get up again, as a third cranial support insect on three legs. This is especially a problem with older, heavier animals.

Even so, if the rhino has a very long horn the stretches of its front legs. They are not attached to the sternum, but the rhino can sit under the loading process. The rhino's horn might not be long enough to accommodate the animal. Another problem is that if the rhino could get down during the crate loading process as 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 group animal, when members of the group may remain with the dated individual, especially if it is a young animal. It is advisable that the catcher 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 attempt to meet you. When detaching the rhino, the rhino should be excited and when approaching the dated animal, it should try still be under control 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 B1), the doors are opened, and one approach flap is lowered. The rhino is then led into the open, the crate is pushed back by the truck until the flap is positioned below the rhino's head and closed. This is with its front feet. Great care must be taken to ensure that the crate is not maneuvered into position incorrectly and is not sitting at even a slight angle to the rhino. The canopy bar of the truck can be used to maneuver the crate into the 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 both hands holding both ends.

A member of the following team 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 put on the brake and when to stop. The head 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 animal. Before giving the animal, make sure that the head rope lies snugly with the flap part of the rope located at the top just behind the poster or horn. If the rope comes off during the lift, no person should consequently be disastrous.

Once the animal has been given into an open vein, that person, equipped with a crash prodder, positions himself behind the animal. If the animal cannot be given, it is certainly it must be given intravenously 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 then begins to rise. The best sites to use the prodder are under the base of the tail, around the front on the top of its feet, and behind the base of the ears. Once the animal is on its feet, the person operating the prodder alerts the person giving the hand signals and he in turn signals the driver to go forward. The animal is then 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 coordination between the person operating the prodder, 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, one signal is given to the driver to stop. The foot rope is then taken off, and the doors and a flap of the crate are closed. Only the free end of the head rope and one end of the tow and head rope knotted off with a stick. This may be done by tying the animal in a circle, which is often the case in white rhinos only.

If the animal is still groggy, and the possibility exists that it may fall down in the crate, analorphine can be given IV if possible:

Adult	100 mg
Subadult	50 mg
Juvenile	25 mg

In the author's experience, it has never been necessary to give additional tranquilizer at this stage, as while the animal is sedated for up to eight hours after the procedure 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 load along at least six extra people into the

Once the animal is deemed to be steady enough on its feet, the crate can be loaded into the truck. The crate is secured with the animal lying flatwards. This avoids any damage if the vehicle brakes suddenly, and facilitates off-loading at the destination. A sedated animal will usually get back out of its crate. The crate containing the animal is watched up until the time as quickly as possible. An alternative to this system would be a hydraulic crane.

Avoid loading the crate at too steep an angle. If the angle is too steep, the animal may slip with its hind legs trailing up under its body. If an animal gets down on a slope, it is better to use a crane to move the crate so that it can be loaded flatwards. 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 step it down putting its nose into the corner and then smothering it if a crate prodder 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. One can count on to slip and it may never stand again. Once the animal is loaded and the truck is moving, it will not slide down.

Another method of loading is in use at all. This involves tipping the dragged animal down on its side (thus taking radial nerve paralysis) and winching it onto a truck. The animal is then taken to its destination where the antihistamine is given after off-loading. Another disadvantage of this method is the possibility that the rhino may wake up and start struggling while the animal can be tipped up with a crane. However, stoppage takes some time to take effect and one gives intravenously - a procedure that could be dangerous to both the person about to enter a crate and the animal.

Loading problems

Problem 1

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

- The antihistamine was injected perivascularly (around a 2-4 mm vein)
- The antihistamine was given at too low a dose
- There was an allergic tranquillizer in the diet, e.g., what napierine and not agoserine is used from white rhinoceros is extraordinarily susceptible to the effects of tranquillizers.
- The animal lay in the same position for a long time loading, and is thus unable to put weight on the affected limb.
- The animal is in pain (swollen and is therefore too weak).

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

the horns, 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 had a systemic effect, or its efficacy is suspect, additional morphine may safely be given (doses given under "Loading" above). In addition, Ketalar[®] and Duponin[®] can be given (doses given under "Monitoring and treatment" above).

Problem 2

Occasionally the animal goes down in an inaccessible spot (e.g., in a bog), at a very thick patch of mud, or on very rocky terrain. In this situation the animal has to be walked out to the recovery truck (see Table 1). 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 rear rope. Because it may take a while before the animal can be woken up it must be turned every 15 minutes. If the animal wakes up before the truck is standing, it can be topped up with morphine (preferably intramuscularly).

Adult	60-90 mg
Sub-adult	30 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 (one or two limbs out of only one or two muscles). The doses are as follows:

Adult	25-30 mg
Sub-adult	15-20 mg
Juvenile	5-10 mg

These doses work well in healthy animals, although up to 50 mg morphine has been used in the past. It is the author's opinion that it is better to be conservative, rather start out with a lower dose of morphine, 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 morphine 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 head rope, and one person at holding the animal. The person behind the animal should be equipped with a prodder.

Allowing a rhino to roll in the sedation or take over the animal is then caused 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 in the direction of the people on the head rope, or help with the front rope. As the people on the rope approach the rhino, they all pull the rope. One of the persons at the front rope and two persons at the other end of the rope. The person with the rope goes into the crate, passes the end of the rope through the hole in the tailgate to the other team members waiting there, and gets out of there safe. The animal is then loaded and guided into the crate.

Once the front rope is removed, the doors and top are quickly closed behind the rhino. The full antidote (diprenorphine) is administered (urgently, as quickly as possible) from the roof of the crate before the animal can go down or snother itself in the corner. Only then is the tension on the head rope relaxed and the lower and head rope removed.

If sedation is used in the immobilizing cocktail, it may take longer to get the animal up (even as long as five minutes). Diazepam (from common reports, using higher doses of morphine when sedation is used instead of by itself). When using this tranquilliser, it would be advisable to put a head restraint on the animal (see above).

Problem 3

Does really the rhino, after being prodded and steered to, does not get up? Or not. One of two actions can be taken under these circumstances:

- Give additional morphine by hand (50 mg doses, see Problem 2 above).
- Just load it out.

The latter technique is preferred because it is easier. The crate is positioned right in front of the front feet of the standing animal, and the full antidote is administered. The recovery animal is loaded into the crate in the normal fashion as described earlier. An alternative is to give the walking dose of morphine, 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 technique can be used where a large animal is involved, but is difficult to apply.

Problem 4

Occasionally a rhino goes down in a bog during a procedure, with its head limbs extended forwards on either side of its body and its front legs extended in front of it. This situation is not hazardous, only as the rhino cannot possibly get up from this position. A rope 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 structure of the nearest leg. If the animal is small enough, it can simply be pulled over onto its side and then pushed onto its back. If it is a big bull, which is usually the case, it is pulled by the following vehicle and the animal is pulled gently onto its side and then pressed onto its back.

Problem 5

Occasionally a really big rhino may go down flat on its side with its legs extended to the side. It can hardly get itself up again, and it is in a difficult 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 over the top of the neck of the animal, in front of the lower front leg, to emerge at the back behind the shoulder hump. Using the rope around over the top of the animal. Bring the follow-up vehicle to a position between the rhino and front legs and make the free end of the rope to a (guide not knowing 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 is really tall, after using 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 crane is unsteady properly when it is put out, it may be dragged into the crate with its back legs stretched out behind it. This is a very distressing situation to correct. To rectify this situation, close the door behind the animal, and let up on the front of the crate using the truck. The animal will slide back and, with the back legs stretched against the back door of the crate, it may be able to stand up again.

Problem 7

It occasionally happens that the crane causes the entrance in the net to alter before it can be closed properly. If this happens, the team members should pull on the front rope or be in the following vehicle or crane 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 alternate technique is to pull the crane forward while the animal is being braked by the front 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 front legs underfooting. The animal ends up in a dog-sitting position at the front of the crate—distraction from which it cannot recover on its own. If this does happen, close the crate if possible, the truck driver must accelerate, hold it up speed, and then brake suddenly. The animal usually slides backwards, and the problem is thereby all over.

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 authors are grateful to the following individuals for their assistance in the field and in the laboratory: Colin Adams, Richard Armstrong, Debra Campbell, and the staff of the South African Institute for Game and Fish Research.

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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 sit 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 farms to the final destination. The field recovery crate is described in *Conservation of the White Rhinoceros* (this Section).

Export or delivery crate

This crate is similar to the end of the front panel of the dog-horn immobilizing crane of the type of crane that is used for single deliveries and for export.

The crate consists of 75 mm channel iron. The sides consist of 43 mm pine planking and extends for approximately three-quarters of the length of the crane from the front. At only the union, it is hand-quartered and 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 *Conservation of the White Rhinoceros*, this Section). The floor consists of 43 mm pine planking. A vertical strip gap is left between the floor and the sides of the crate.

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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 Agle Strauss in the compilation of this and other sections on rhinos included in this book. Cathy Adam is thanked for typing the manuscript.

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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 bonus 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 bonus 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.

Doors

- Doors are fitted at the front and back of the crate. The doors consists of upper and lower parts made of 50 x 50 mm angle iron and 43 mm pine planking. The lower door is 480 mm high, while the height of the upper door depends on the size of the crate. Both parts can be opened, closed, and secured independently. The doors are mounted on bolts, not hinges, so that they can be removed altogether in hot weather. This is particularly important during sea travel.
- The bottom door is usually kept closed to stop feed and dung being pushed out of the crate, and to prevent the animal's back legs from sliding between the bars and out of the crate (a potentially life-threatening situation). This door is opened to water the animal and to remove dung and old feed.
- Both sections of the front door must be clad with sheet metal (see above). It is not necessary to clad the back door.
- Doors must always fit easily. Double lock-nuts are used to secure the doors during transit.

Bars

- There are four holes in the floor and roof of the crate just inside the front door. Sixty mm pipes are secured in these holes to form bars at the front of the crate. These retain the animal in the crate when the doors are open. The bottom third of the middle two poles is bent outwards such that the gap at the level of the floor is sufficient to allow a plastic basin containing water to be inserted into the crate.
- Similar bars, without the bent lower sections, are fitted at the back of the crate.

Skids (100 x 50 mm channel iron) and steel eyes are fitted as in the case of the capture crate. The skids also help to keep the wooden floor off the ground, thus preventing rotting of the floor.

Size

The size of the crate is important, and must be individually determined for each animal. The crate must be large enough to allow the animal to lie down comfortably, but must not be so large that the animal can turn around, or that the animal can be thrown around in the crate during transit. The dimensions of the four standard sized crates used by the Natal Parks Board are given in Table 1.

Table 1. The inside dimensions of crates used by the Natal Parks Board for the transportation and shipment of the black and white rhinoceros.

Crate	Animal	Height (m)	Length (m)	Width (m)
Size 1 Crate	Juvenile	1,8	3,6	1,5
Size 2 Crate	Sub-adult	1,8	3,3	1,3
Size 3 Crate	Adult	1,8	3,0	1,1
Size 4 Crate	Large bull	1,4	2,6	0,9

Mass transport crate

A large steel crate consisting of six compartments mounted on a low-bed truck is used for the mass transportation of rhinos. A middle wall and sliding doors are used to divide the interior of the crate into compartments of 1,2 x 3,6 m each. The crate is 2 m high. The entire crate can be lifted off the low-bed truck for cleaning and maintenance.

Post-capture transportation

The route from the capture site to the destination must be negotiated with great care to avoid injuries, smothering, and slipping. Remember, the animal is still very groggy and unsteady on its feet.

Transportation to final destination

There are two approaches to the transportation of rhino.

- They can either be captured, loaded and transported direct to their destination; or
- They can first undergo an adaptation period of at least six weeks in bomas before transportation to their final destination.

If the journey is going to be longer than 8–10 hours, it is preferable to first boma-train the animal.

There are several advantages to the boma training period.

- It is always advisable to keep the rhino in a boma at the receiving end for a few days before release. The idea behind this is to let the animal settle down and adapt to its new surroundings. It is therefore preferable to have a boma-trained animal that one knows is eating and will eat in the boma at the receiving end. Rhinos released directly into the veld (especially if they are not boma trained) usually scatter, breaking fences and ending up on neighbouring properties.
- The transportation is not that stressful to the animal, as it is used to being confined. The animal is, therefore, calmer when off-loaded.
- Animals that are caught and delivered directly, especially if the trip is longer than eight hours, are very likely to break their horns off in the crate.

Field-caught animals must be monitored closely for the duration of the trip and may need to be tranquilized. Boma trained animals very seldom require additional tranquilization and only need to be checked on approximately every three hours *en route*.

Direct method

In the early days, field-caught white rhinos were transported successfully to destinations up to 2000 km away (46 hours) using a combination of various drugs. Azaperone is now used if necessary; however, we seldom transport field-caught rhinos to destinations more than 12 hours away. Recommended doses are as follows:

Adult	150–200 mg
Sub-adult	100 mg
Juvenile	50 mg

Note: if the animal is still groggy but fighting the crate, start off with lower doses. Azaperone has a wide safety margin and has no deleterious effect on body temperature.

Boma method

The loading and transportation of boma-trained rhinos will be described in detail.

After the animal has spent an adaptation period of at least six weeks in the bomas it is ready to be transported. The animal is closed into the front section of the front pen and it is dined with a minute amount of etorphine to facilitate loading and to keep it calm in the crate. The dosages are as follows:

Adult	0.5 mg
Sub-adult	0.25 mg
Juvenile	0.125 mg

Before darting, the water trough must be emptied as the animal may trip on the edge of the trough and fall with its head in the water.

Once the animal has been darted, everybody moves away and all machinery and noise is stopped. It usually takes about 10-15 minutes for the animal to become visibly affected. An animal attendant then waves a white cloth or food bag in a slow, rhythmic fashion in front of the entrance to the crate. If affected enough, the animal is drawn towards it. This person then moves around to the other end of the crate and waves the cloth or bag in the same fashion; the animal usually walks into the crate. The crate door at the front end is taken off, but the steel poles are left in place to retain the animal in the crate. This whole process, from the time of darting, usually takes 20-30 minutes. The animal should be allowed to settle down for a few minutes before sliding poles horizontally into the boma gate behind it; an overhasty approach could result in the animal taking fright and reversing out of the crate. Once these horizontal poles are in place, the vertical poles are placed through the bolts in the roof and the floor at the rear of the crate.

If the animal goes down, or seems likely to go down, nalorphine may be administered, preferably intravenously:

Adult	50 mg
Sub-adult	25 mg
Juvenile	10 mg

The crate is loaded onto the truck with the animal facing backwards, the doors are put on, and the crate is secured in position. The journey should only commence once the person doing the loading is completely happy with the animal's condition.

Enough left to serve as feed and bedding must always be put in with the animal.

The animal must be kept on its feet for at least the first six hours (i.e., until the drug has completely worn off), even if the cattle-prodder must be used for this purpose. If the animal lies down while still in a drugged state it may develop neuromuscular problems from lying too long on a specific hind leg. It is important to check the animal half-hourly for the first two hours, then hourly for the next four hours, and then every three hours once the drug wears off. The animals tend to stand and eat peacefully right up to the destination. They usually lie down periodically; this is in order, provided the drug has worn off.

Occasionally, an individual animal may need to be tranquilized *en route*. Azaperone is recommended at the doses given above. If the animal is still affected by the etorphine but is fighting in the crate, start off with a lower dose; one does not want the animal to collapse or smother itself.

An important point to bear in mind while transporting rhinos (both black and white) is the outside temperature. The Natal Parks Board mass transporter has six crates - each equipped with a roof hatch that can be closed when it gets too cold or starts raining. We use a temperature of 20°C (this may sound warm; remember the wind-chill factor) as a guideline in deciding when to close the hatches. If individual animals are transported, each crate is accompanied by tarpaulins with which to cover the crate should this become necessary. An important point to remember here is that there must still be sufficient ventilation once the crate has been closed.

Off-loading

The receiving pens should be prepared and water and food supplied before off-loading so that the animal may be left undisturbed once off-loaded.

Once the crate is lined up with the gate of the receiving boma, the door is simply opened and the animal is allowed to walk out in its own time. If it refuses to move, a cloth may be waved slowly at the entrance to the boma to entice the animal out of its crate. If this fails, the animal's hindquarters can be stroked with the extension handle of the prodder. Only if this fails should one consider using the prodder itself, and then only sparingly.

It is important to keep unnecessary spectators, noise and movement to an absolute minimum during the off-loading process. Spectators should be kept as far from the pens as possible while the animals are being off-loaded. They should not be allowed to approach the pens even after all the animals have been off-loaded.

Occasionally a rhino will not get out of the crate, even resisting a cattle prodder. It is best to just leave the animal and go away for an hour or so; the animal will usually be out by the time you return. Be sure to leave somebody reliable keeping watch from a distance. If this does not work either, one can tranquilize the animal using azaperone (see above). The animal is then left to come out on its own.

Another point to remember at off-loading is to separate a cow and calf into different pens, even if only for the first few minutes. An agitated cow may attack her calf.

Release

If the animals have been boma trained before transportation to their destination it is only necessary to keep them in the receiving bomas for a few days, i.e., until they settle down. It is not necessary to reduce their daily lactone quota before release.

It is advisable to release only one animal at a time (except a cow/calf combination) to avoid fighting. The best method is to open the gate at dawn and allow the animal to leave on its own. Disturbance must be kept to a minimum. The next pen is only opened 24 hours later.

It may be necessary to provide a water source just outside the bomas if it is thought that the animals may take some time to find water in their new environment.

Transportation of the rhinoceros by air or by sea

P.S. Rogers

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In the past, almost all rhinos were transported overseas by ship. Nowadays there is a tendency to send rhinos by air if possible. It is more humane to use air transportation – the animal gets to its destination within two days as opposed to anything up to a month later. This circumvents potential problems associated with confinement, such as stress, constipation, diarrhoea, pneumonia, boredom, wounds, etc. Cost, however, remains an important consideration – it is much more expensive to transport animals by air than by sea. From a preparation point of view it does not matter which method is used to transport rhinos – either way, they must undergo a boma training period of at least six weeks before preparing them for departure. The final crate training period takes a further three weeks.

1 General principles

- Take extra feed for at least ten days more than the expected duration of the trip, in case the ship is delayed.
- Make sure that the feed is stored in a sheltered place (e.g., a container) which is placed as close as possible to the animal(s).
- Position the crate so that it is protected from wind, rain, and sea spray (e.g., behind the superstructure of the ship).
- Ensure that there is a good water point nearby, and enough hosepipe to reach each crate. A stopcock should be fitted half a metre from the end of the hose for ease of use.
- There should be an electrical supply point close to hand, and lights should be rigged up between the crates as soon as they are in position.
- Ensure that the crate doors are not obstructed by other cargo or by securing cables.
- Ensure that the securing cables can be removed in an emergency if necessary.
- Ensure that sufficient tarpaulins are available to cover the crates in adverse weather.
- Personal equipment should include a pair of canvas lined rubber gloves, a pair of gum boots, two pairs of overalls, and a personal first aid box.
- A complete veterinary kit should be available (see below).
- A scraper is required for cleaning out the crates. The handle of the scraper is made of 12

mm reinforcing rod, with a metal plate serving as the scraper. The length of the handle and the width of the scraping plate should be adjusted according to the space available for cleaning. The scraper should in no way be a danger to the animal's feet when cleaning, or to the person using it. The back of the scraper handle should be bent in the form of an L – this is used to help remove unused hay from between the animal and the sides of the crate.

- Ensure that the crates are angled slightly upwards towards the front to let urine run out of the back of the crate. An elevation of 50–75 mm is adequate.
- If there is more than one crate, try to place them facing each other; the animals tend to be calmer if they can see one another.
- The bottom sections of the front and rear doors are only opened when necessary.
- Take spare hay or bedding; in rough seas this can be packed around the animal's headquarters.
- When the crates are being loaded onto or off the ship, the cable should be placed under the floor of the crate, and not through the fittings welded to the frame.
- All fodder should be obtained from one source, since changing feed may upset the digestive system of the animals. In some cases they may even refuse to eat at all. The food used on board ship should be from the same source as that used in the pens, and should be of good quality.

2 Crate training

The final crate training (preparation) period for sea and air transportation is divided into three phases, each approximately one week long.

Week 1

Getting the animal used to drinking out of a plastic water trough. This is quite easily done: the plastic trough (a baby bath is ideal) is put into the empty drinking trough in the pen and filled with water. The animal quickly learns to drink out of it. The bath is then gradually moved closer and closer to the export crate that is attached to the front pen. Eventually the animal's drinking water is in the crate (remember, it is already eating in the crate). This phase can take up to seven days.

Week 2

Teaching the animal to drink when water is presented to it. From the second week onwards, water is presented only twice daily. This is so that the animal becomes accustomed to the routine that will be followed during transportation.

Week 3

Confinement in the crate. At the beginning of the third week the animal is loaded into the crate in the normal fashion using etorphine hydrochloride (see *Transportation of the White Rhinoceros*, and *Transportation of the Black Rhinoceros*, this Section). Do not try to close the rhino in its crate without using etorphine! The crate is then towed away from the pen and positioned in a shady area. The front of the crate should be elevated by 50–75 mm to ensure that the urine runs out of the back of the crate and does not contaminate the feed. When the effects of the etorphine wear off the animal may become a little agitated at being

confined, and may try to get out of the crate. This period is transient and, after a day or two, the animal usually resigns itself to being confined. The rhino may initially knock its water trough around a bit when it is given water. This is only likely to persist for a day or two after the animal has been closed in its crate. It may occasionally be necessary to tranquilize the animal during this phase; azaperone is the drug of choice. The process is facilitated by proper boma training (i.e., adaptation) prior to confining the rhino to its crate.

It is essential for the attendant who will be accompanying the animal to spend at least these last seven days before departure with the animal. The attendant must clear the crate of dung and old feed, as well as feed and water the animal, twice a day. It is here that the attendant gets to know the difference between loose and normal dung, how much the animal eats, and how much it drinks. He also becomes familiar with the normal variation in colour of rhino urine. In between the feeding periods the attendant should spend as much time as possible with the animal, either talking to it or just sitting nearby reading. The idea is for the animal to get used to its handler as quickly as possible.

The top half of the front door of the crate must always be left open, except at night and during adverse weather. This enables the animal to see people passing by outside and to get used to its attendant. In hot weather the top halves of both the front and the back door should be left open to ensure adequate ventilation. The bottom part of the front door is only opened to water the animal or to give or remove feed. The bottom half of the back door is only opened to remove dung and old feed, or to treat wounds.

During this last period of getting used to confinement the animal often picks up superficial scratches, and may even pressure sores on its hocks. Superficial wounds at the back of the animal can be treated easily using an antibiotic spray (e.g., Airbionic GV[®]). Weeping wounds can be packed with a wound powder (e.g., Centaur Wound Powder[®]). Wounds on the face and head can be treated in the same way if the animal will allow it. Alternatively, use 1:500 acriflavine solution in a pressurized garden spray. Treat more serious wounds as described in *Care of the White Rhinoceros in Captivity* (this Section).

3 Routine on board

It is important to settle into a routine with the animals immediately. This should be the same as the routine followed during the training period.

- Open the top section of the front door before breakfast each morning, providing the weather is suitable.
- Briefly check on all the animals.
- Scrape and clean all the crates.
- Distribute the morning feed. The morning feed should consist of half the daily ration, and the afternoon feed the other half.
- After breakfast, check all wounds and treat when necessary.
- Observe all the animals, check them thoroughly, and note their feed intake.
- At 10h00 water the animals and clean and scrape the crates. Repeat this at 15h00.
- Give the final feed at approximately 16h00.
- Close up the crates at sunset. Ensure that there are no flapping tarpaulins (if these are being used). Do a final check and switch off all lights before retiring.

- A midnight check of all animals is also advisable. If it is noticed that a rhino has finished all its feed, make a note to increase the amount given the next afternoon. Do not give additionally feed to the animal immediately.
- On good days ensure that the rhinos get as much light into their crates as possible. This is done by uncovering the top opening at the back of the crate and opening the top sections of the back as well as the front doors. Monitor the animal regularly to make sure that it does not get too hot.
- If shade and additional ventilation are required for the animal, remove the top of the front door and bolt the bottom hinges of the door against the top hinges of the crate. A tarpaulin can then be suspended between the top of this door and the back of the crate. Once in this position, the tarpaulin will catch any breeze available.

4 Drugs and veterinary equipment

The following is a suggested list of drugs and equipment that should accompany rhinos during a sea voyage. The quantities involved obviously depend on how many animals are travelling.

- Disposable syringes (20, 10, 3, 1 ml). Disposable needles (18g x 38 mm, 20g x 38 mm, 20g x 25 mm, 21g x 25 mm) (The latter two are for IV use.)
- Powdered Kaolin 500 g packages. Enterosol[®] powder. Magnesium sulphate 500 g packages.
- Wound aerosol (e.g., Airbionic GV[®]). Ophthalmic preparations (e.g., Vidine[®], Opchlor-Vet[®], Orbenin OPH[®]).
- Long-acting penicillin (e.g., Compropen[®]). Broad spectrum antibiotic (e.g., Potencil[®]). Cortisone (e.g., Kortico[®]).
- Vitamin B complex injectable. Vitamin B12 injectable. Vitamin B complex syrup. Anabolic steroid (e.g., Anabolin[®]).
- Acriflavine glycerine 1:1000. Acriflavine solution 1:500. Hydrogen peroxide 20%. Provodine[®] antiseptic solution. Centaur Wound Powder[®].
- Buscopan Compositum[®] (spasmolytic – for diarrhoea). Finadyne[®] (for colic). Phosamin-Stimulans[®].
- Azaperone 200 mg/ml. Xylazine powder, diluent, yohimbine hydrochloride. Suxamethonium (Scoline[®] powder, 1 g vial. Doxapram (e.g., Dopram[®]). Etorphine hydrochloride, diprenorphine, nalorphine, naloxone, tosamiquet (only if attendant is qualified to use etorphine). Sterile water for injection.
- Catile prodder. Scalpel handle and blades. Cotton wool.
- Disinfectant soap (e.g., Sumanol[®]).

Drugs should be injected into the thick muscles of the hind legs or buttocks. Thrust the needle hard into the muscle. The animal is bound to jump around. Wait until it has settled down, attach the syringe firmly but quickly, aspirate to make sure that you are not injecting into a vein, and then inject the drug quickly, steadily, and quietly.

5 Common ailments affecting crated rhinos during transportation

Superficial wounds

This is by far the most common ailment that requires attention. Most of these wounds are so-called 'pressure sores' which usually occur on the hocks. The vertical pipes at the rear of the crate may aggravate these sores, and these may be removed if necessary. The placing of bedding on the floor of the crate does not help since it soon gets pushed into heaps and becomes wet and unhygienic. The treatment has been discussed above and in *Care of the White Rhinoceros in Captivity* (this Section). Be careful not to wet the floor of the crate any more than is necessary in the process of treating a wound. Wound powder can be applied to weeping wounds and also to broken horn wounds. It can simply be thrown over the wound or directly applied by hand if the animal is tame enough. If wounds on the legs become severe and multiple, it is advisable to keep the crate as clean as possible at all times to minimize contact between wounds and dung.

Constipation

See *Care of the White Rhinoceros in Captivity* (this Section) for symptoms. This condition may occur if the animals' diet is changed. It may happen, even under normal conditions, that an animal might not defaecate for a day or two (stress of travel, strange environment, etc.). Increase the lucerne and cube component in the diet - this should loosen the stools. If constipation persists, treatment with Epsom salts is indicated (see *Care of the White Rhinoceros in Captivity*, this Section).

Diarrhoea, pneumonia, colic, eye infections, foot infections

See *Care of the White Rhinoceros in Captivity*, this Section. A point to note here is that on the equator the drinking water heats up and will loosen many of the animals' stomachs. It is nothing to worry about - just cut back on the lucerne and cubes in the feed. This phenomenon usually lasts about four days. Before treating an animal for diarrhoea try to regulate its condition by eliminating lucerne and cubes. If this does not help it will be necessary to treat it (see *Care of the White Rhinoceros in Captivity*, this Section).

Abscesses

These occur very rarely and are usually the result of a penetrating wound or of using a dirty needle to inject an animal. The abscess starts off as a small lump that gets progressively larger. It is usually hot and painful. The periphery remains hard but the middle gets soft and fluctuates on palpation (i.e. comes to a head). It is at this stage that it should be lanced with a scalpel, preferably at the lowest point, to facilitate drainage. It is advisable to make a large incision, possibly even two in the form of an X, to prevent the wound from closing up with reformation of the abscess. Once all the pus has been squeezed out, flush the cavity well with hydrogen peroxide, water, and iodine, and then instil acriflavine glycerine into the wound. Treat it as a normal wound from then on (see *Care of the White Rhinoceros in Captivity*, this Section).

It is important to distinguish between an abscess and a haematoma (blood blister). The latter is caused by a severe blow leading to rupture of a blood vessel and subsequent

bleeding under the skin. A haematoma should not be opened as it is sterile and the blood clot will eventually be resorbed if it does not develop into an abscess. A sterile hypodermic needle (at least 18g) should be pushed into the swelling. It is important that the area to be punctured be thoroughly swabbed down with iodine first. If puss comes out it is obviously an abscess, while if straw coloured serum comes out it is a haematoma. If it is an abscess it should be lanced and treated, while if it is a haematoma it should be left as it is. The animal should be injected with a long-acting antibiotic to prevent abscess formation resulting from puncturing of the haematoma.

Poor condition

This is encountered when an animal has been sick or does not adapt to the crate. The animal can be injected with vitamin B Co/B₁₂, Phusamine[®], and anabolic steroids (e.g. Anabolin[®]). Vitamin B complex syrup should be put into the water.

Boredom

Rhinos tend to become very bored when confined to a crate for a long period, with the result that they continually change their positions and even develop vices such as weaving and rubbing. These produce open wounds that require constant attention. Before the animal is closed into its crate one must ensure that the crate is large enough but not so big that the animal may fall and injure itself in rough conditions. In warm weather the rhino and the crate can be washed down daily with sea water. The rhinos enjoy this very much and it helps to alleviate boredom. This also seems to clean and heal wounds.

6 Emergency tranquilization

If an animal starts performing in its crate, it can usually be calmed down using azaperone: juvenile 50 mg; sub-adult 100 mg; adult 150-200 mg. If this does not work, or if the animal is stuck in its crate or breaking out of its crate, there are two alternatives.

Xylazine. Dosage rate: 0.25-0.5 mg/kg. This can be injected intramuscularly or by means of a dart. If not sufficient, repeat with another 0.25 mg/kg half an hour later. The above dosage should be reduced if the animal has been given azaperone, if it is in poor condition, or if it is weak due to struggling. If the animal is inadvertently overdosed the effects can be reversed using yohimbine hydrochloride: 0.125 mg/kg, preferably IV otherwise IM.

Etorphine. If the attendant is qualified and experienced in the use of etorphine hydrochloride, it may be used to calm a potentially fractious animal. The same dose that was used to load the animal can be used here.

7 Emergency destruction

If an animal has to be destroyed during transportation it may be shot, using a suitable weapon. To try and visualize the site of a rhino's brain, extend an imaginary line from the base of one ear to the opposite eye and do the same from the other ear. Where these two imaginary lines cross is the locality of the brain. If this method of destruction is undesirable or dangerous, then 1 g of saxamethonium (Scoline[®]) can be administered intramuscularly either by hand or by means of a dart. The person administering this drug must be aware of the potential danger involved - there is no antidote and accidental self administration will probably prove fatal.

8 Air vs. sea transportation

From the foregoing it is plain that travelling by sea is a major operation that involves much work and also a lot of stress and discomfort for the animal. Besides being much quicker, transporting animals by air is less risky and more humane. When going by air, one must ensure that the animals have undergone a thorough boma training right through to a thorough crate training process. An animal that breaks out of its crate in an aeroplane is a lot more dangerous than one on a ship!

Accommodation of the white rhinoceros *Ceratotherium simum* and black rhinoceros *Diceros bicornis*

P.S. Rogers

Accommodation of the white rhinoceros is described below. Aspects of accommodation for the black rhinoceros that differ from that of the white rhinoceros are discussed at the end of the paper.

The white rhino...

- Is big, strong, dangerous, and unpredictable.
- Is a gregarious animal and therefore likes to see and be with other animals of the same species.
- Will calm down more quickly in captivity if the walls of the bomas allow it to see animals in the neighboring bomas, and to see and get used to the activity around the bomas.

Precautions

- Accommodation facilities should be of a very sturdy nature: a rhino will search for a weak point and will work at it until it gets out.
- The rhino must be put into a big boma initially to allow it to settle down.
- The boma should be in a quiet area away from roads and other potential stresses in order to minimize problems that may be encountered with adaptation to captivity.
- It is very important not to allow visitors until captive rhinos have settled down. The human element should be restricted to necessary personnel only.

How to accommodate the white rhinoceros

Bomas are used for an adaptation and training period before transportation of the captive animals to another area. Alternatively, the bomas may be used to receive animals and to familiarize them to the local conditions before release. The bomas must be strong as captive rhinos will always attempt to break out of confinement.

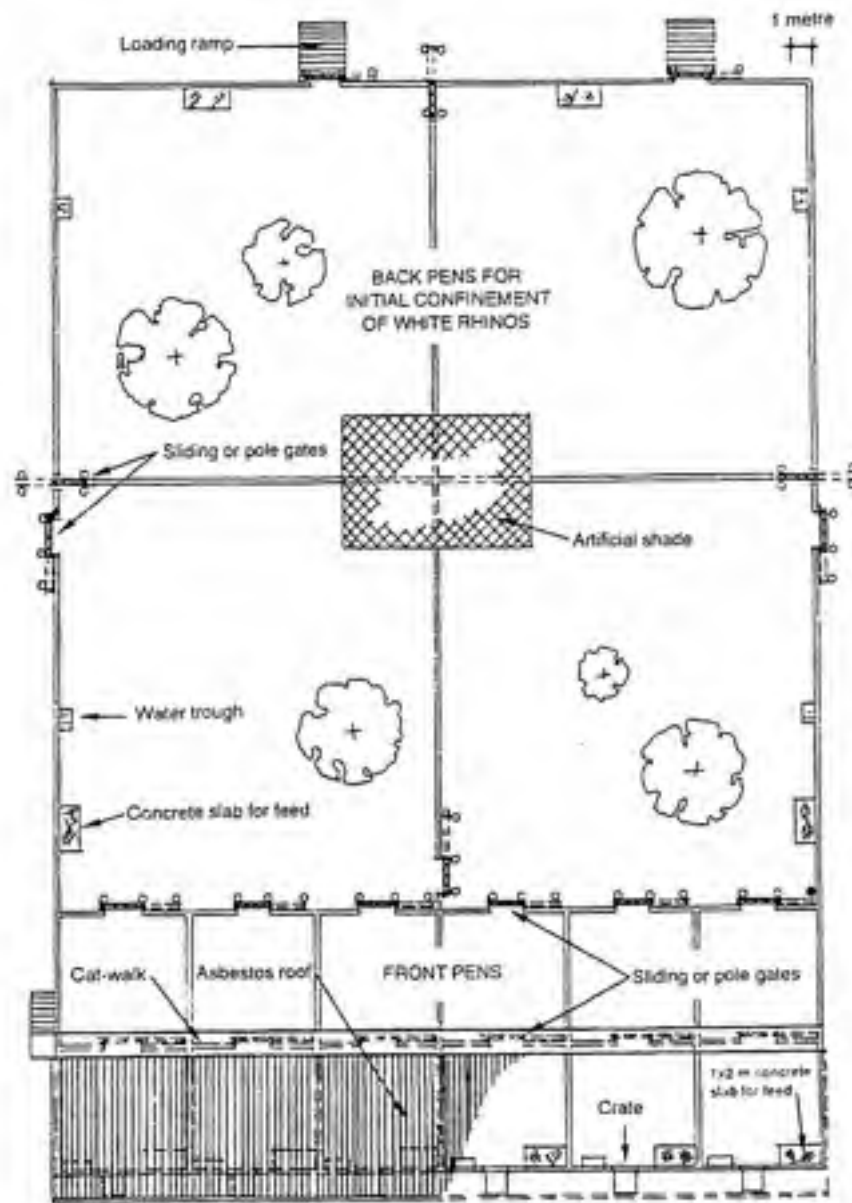


Figure 1. Permanent holding facility/training boma for rhinos.

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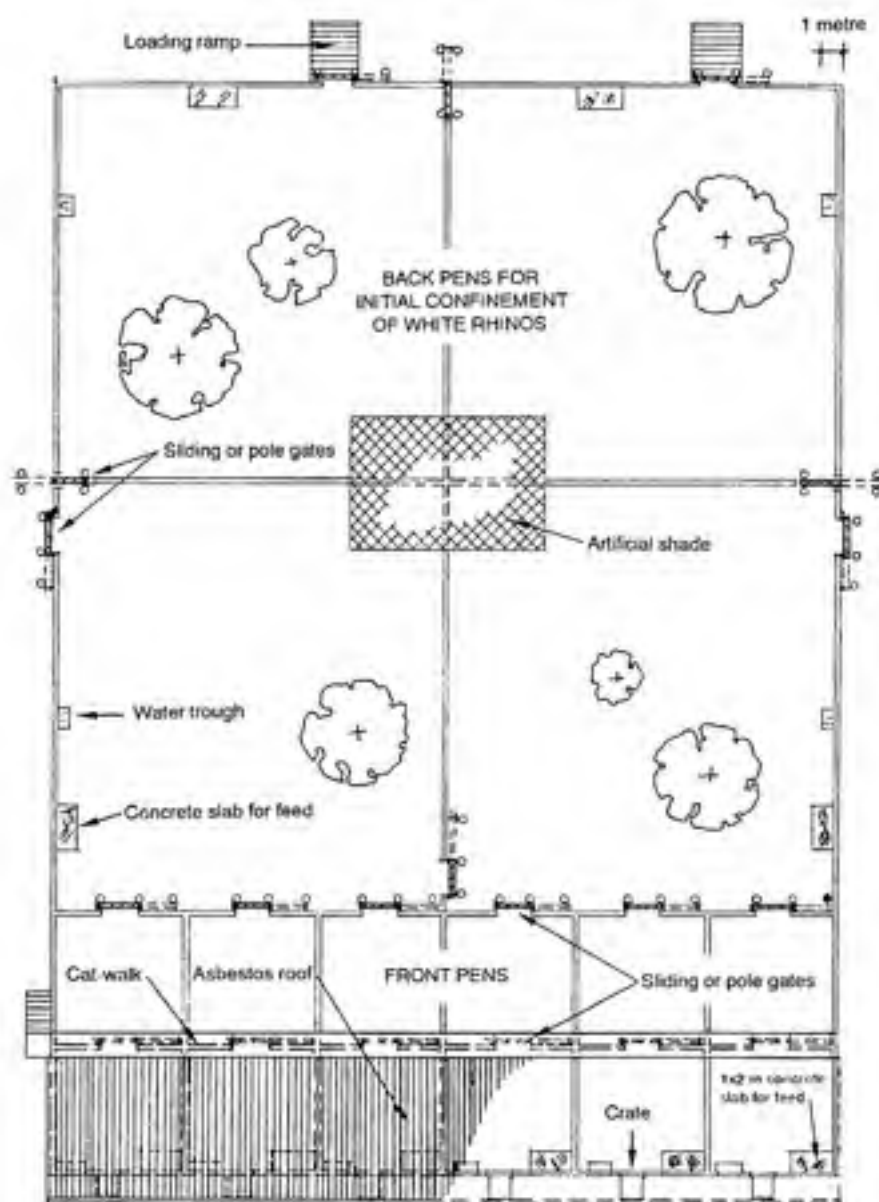


Figure 1. Permanent holding facility/training boma for rhinos.

Siting

The siting of the bomas is very important, both from a drainage as well as from a climatic point of view.

- The boma should preferably be in the centre of the reserve to minimize contact with fences immediately after release.
- The site should be in an area with good quality natural food available in the immediate vicinity. This makes collection of food during the boma period easier, and provides a suitable habitat when the animals are released.
- The boma must be close to a reliable water source for the provision of water during the boma training period. An adult rhino may drink up to 50 l of water per day.
- The boma must be easily accessible to vehicles that will deliver the rhinos.
- Large trees are necessary for shade – alternatively, artificial shade must be provided.
- The substrate must be solid to prevent animals from pushing over boma poles.
- The boma must be protected from cold winds.
- The boma must be away from busy roads, houses and other human disturbances.
- There must be minimal gravel and loose rock in the boma to prevent the development of foot problems.
- The area must be well protected against veld fires. Surround the boma site with good firebreaks. Although rhinos may not be injured by a fire, they may panic at the sight, sound or smell of a fire and are likely to injure themselves in the process.
- The slope of the land must be taken into account – it is preferable to have a net drainage of water away from the front bomas, i.e., from the front to the back bomas.
- It is also desirable to have the bomas facing north-south, with the front bomas on the northern side. This ensures maximum shade in summer and maximum sun in winter.
- It is important that the bomas be situated where the animal can simply be released if it does not adapt to captivity.

Plan – training bomas

For boma training of white rhinos, a system of large and small pens, as shown in Fig. 1, should be used. The front pens should be 12 x 6 m in size – this size is perfectly adequate even for two animals. The back pens should be at least 20 x 20 m (the bigger the better). The back pens are used to accustom the rhinos to captivity, while the front pens are used to accustom them to close confinement. Newly captured animals are off-loaded into the back pens, and are only confined to the front pens once they have settled down. As the back pens are emptied, more animals can be captured and introduced to the pens. The front pens are subdivided into two compartments so that the animal can be closed in one section to facilitate cleaning of the other section, and *vice versa*. There should be gates connecting all the front and back pens to each other. The transportation crates are attached to the front pens for crate training.

Plan – receiving bomas

If rhinos are being received for short-term accommodation prior to release, a system of pens such as shown in Fig. 2 should be used. The plan shown can accommodate five rhinos, with the one spare pen being used to rotate animals for cleaning purposes. This may become necessary

if the animals are kept for a prolonged period. The sizes of the pens should be increased (to at least 20 x 20 m) if wild-caught animals are introduced directly into these receiving pens. In such cases, it is obviously not necessary for the roof/shelter to extend the full length of the pens. Only one release gate is required if all the animals are boma trained (i.e., eating) beforehand.

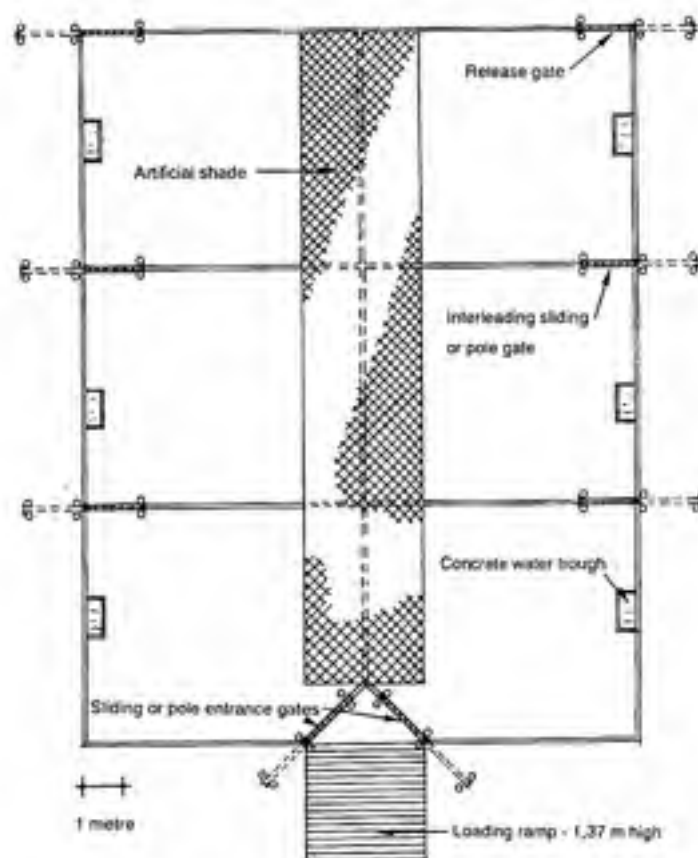


Figure 2. Receiving boma complex for rhinos.

Wall

The wall must be sufficiently strong to contain a rhino at full charge. However, at the same time it is important that the animals should be able to see each other and be able to see outside. Captive rhinos calm down more quickly under these conditions.

Cable bomas are not recommended under any circumstances because:

- The animal may climb the cables and escape from the boma; or
- In attempting to climb the cables the animal may get its head or shoulders stuck in between the cables and may severely injure or even kill itself.

Problems with cable bomas have been witnessed by the author on several occasions. For these reasons bomas made from vertical poles embedded in the soil are recommended. These poles should all be tannalized and not creosote poles, as creosote causes skin irritation and has been reported to cause gastric ulcers (rhinos tend to lick the poles).

Three metre poles of 130-150 mm diameter are embedded 1 m deep into soil or concrete every 1-1.5 m (depending on the soil consistency). Two horizontal poles are affixed to the outside of the vertical ones (see Plate 18). The lower horizontal pole is close to the ground, and the upper one approximately 300 mm from the top of the vertical poles. Three or four 2 m poles of the same diameter are bolted to the horizontal poles in between the upright poles, with a gap of approximately 150 mm between the poles. One can use either 12 mm carriage bolts (the best) or, alternatively, 12 mm reinforcing rod with both ends bent over and knocked into the wood. It is very important to ensure that there are no sharp ends projecting into the boma.

It is important that the vertical poles be bolted on the inside of the horizontal poles. If the animal hits or pushes against the vertical poles, the force is then transferred onto the horizontal poles. If the vertical poles are on the outside, the force is transferred onto the bolts.

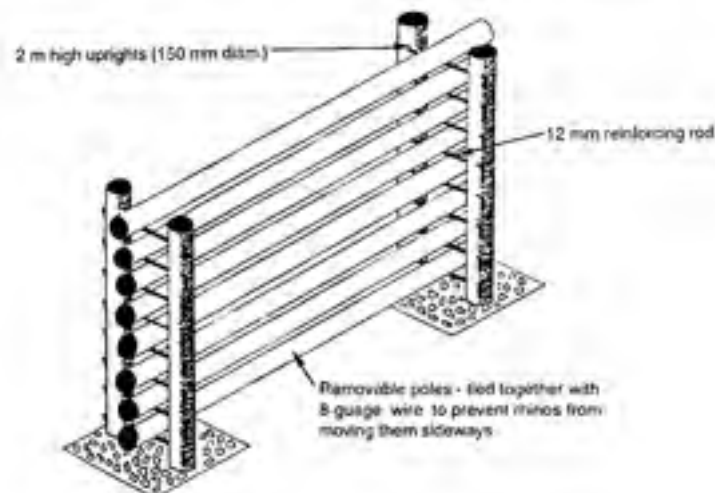


Figure 3. Pole gate for rhino pens.

Gates

Simple gates can be constructed using double vertical posts through which horizontal wooden gum poles are inserted (Fig. 3). These gates are relatively cheap to construct, but are difficult to operate. A rhino often rushes through the gate before all the poles have been removed, and may be tripped or injured by the remaining poles. The rhino may also collide with partially withdrawn poles: this may result in injury to an unwary gate operator. Sliding gates consisting of metal frames and vertical metal poles are strongly recommended. These are easily operated from a catwalk above the pens.

Water troughs

The water trough should be approximately 1 x 0.5 m. The sides should be elevated not more than 300 mm above the ground. The elevated sides are to prevent sand from getting into the drinking water. The trough need only be about 400 mm deep, and must have an outlet pipe to facilitate cleaning and draining. The corners of the trough should be rounded to avoid injuries. The inside surface should be smooth and rounded to facilitate easy cleaning and to minimize the buildup of algae and bacteria. It is preferable to have the whole trough inside the boma. If the trough is half in and half out the boma, the rhino may get its horn stuck underneath the horizontal bar while drinking and either drown, break off its horn, or escape. The author has witnessed an animal escaping in this fashion.

Feeding facilities

The feeding area should also be under a roof. A slightly (30 mm) raised concrete slab, approximately 3 x 1.5 m, should be built under the roofed area on which to put the feed.

Shade and shelter

The front half of the front pens and all the crates should be totally under roof. The back pens should also have an area under roof where the animal can shelter from sun and rain. The animals favour the corners farthest from any movement or action, i.e., the corners where the bomas meet. It is therefore advisable to put the roofs in these corners.

It is difficult to shield the animals totally from wind. Sections of the boma (e.g., corners) can be closed totally with poles. Plastic should not be used: it flaps in the wind and stresses the animals. The animals may not go near the plastic, or it may rip it to pieces: in either case, the purpose of the shelter is defeated.

Off-loading ramp

Depending on the type of vehicle used to transport the animals the loading ramp may have to be dug into the ground. Raised ramps may also be used, but for off-loading of newly caught animals that may be a bit groggy, dug-in ramps leading directly onto the surface of the bomas are preferred. Animals should only be off-loaded into the large back boma, not into the smaller front bomas.

The black rhinoceros

The accommodation facilities described above can be used for the black rhinoceros, with the

following exceptions and modifications.

- Black rhinos are introduced directly into the smaller front pens, so the larger back pens are not required.
- When a newly-caught black rhino is introduced into the front pen it should be isolated in the front section of the pen for a few days until it has settled down. Thereafter it can use both sections except when it is isolated in one section while the other section is cleaned.
- The corners of the pen should be 'rounded off' by passing poles horizontally across the corners. This is because the animals tend to run around the pen after off-loading, and may injure themselves in the corners.
- A concrete feeding slab should not be provided in the pen as black rhinos may injure themselves against the slab when they are first introduced into the pen.
- The receiving pen design must be used for boma-trained as well as wild-caught black rhinos - i.e., the pens should not be enlarged for wild-caught black rhinos.

Care of the white rhinoceros *Ceratotherium simum* in captivity

P.S. Rogers

The white rhino...

- Is big, strong, dangerous, and unpredictable.
- Is a selective grazer, preferring short, palatable grasses.
- Is a gregarious animal and therefore likes to see and be with other animals of the same species.
- Adapts with great difficulty to captivity, from a stress and nutritional point of view. Younger animals adapt better and quicker than adults.
- Tends to adapt more slowly and less readily to captivity if alone - it is usually with these animals that one runs into problems.
- Is unpredictable from a nutritional point of view - some simply will not eat in captivity for no apparent reason.
- Will try to escape until it resigns itself to captivity and settles down. Almost all escape attempts occur at night. Nights 3, 4, and 5 of captivity are most critical in this respect.

Precautions

- It is essential to have a night guard who is in contact with the person in control of the bomas in case of attempted escape by the rhinos.
- The rhino must be put into a big pen initially to allow it to settle down.
- Antelope cubes should not be fed to rhinos: they may contain cotton seed products. Cotton seed contains gossypol which is potentially toxic to monogastric animals such as the rhino.

- Do not allow visitors until the rhino have settled down. The human element should be restricted to boma personnel only.
- Try, if possible, to capture and accommodate pairs of animals from the same herd: these animals will be more likely to adapt to captivity.

How to care for the captive white rhinoceros

Boma management

When catching animals to place in bomas one would obviously like animals that are going to adapt as soon as possible. This can be very important, bearing in mind the problems one has in getting white rhinos to adapt to captivity. There are three groups of animals that usually adapt fairly readily to captivity:

- A cow with a calf at foot;
- Animals that are running together in the wildland;
- Sub-adult animals, even if they are caught and put on their own.

Most problems are experienced with single adult animals: the older they are, the more difficult they find it to adapt.

Water is given *ad lib* (bearing in mind that an adult drinks 40-50 litres daily) and the water trough is rinsed out, cleaned, and refilled twice daily. The trough should be disinfected twice weekly with a chlorine compound (e.g., Bacterex K⁺). Until the animal is eating properly, vitamin B-complex syrup is added to the water as an appetite stimulant at a dilution rate of 50 ml per 50 litres of water. The vitamin B-complex is always added to the water in the evenings, as it is inactivated by sunlight.

It is very important to monitor defaecation from the first day. Rhinos usually defaecate on the first and second days, then stop for four to five days until they start eating again. If the animal only defaecates on the first two days, but not again, Epsom salts can be put in the water from day nine post-capture. Usually these are the animals that are refusing to eat, and it is found that if and when they defaecate they will start eating. Special care must be taken when administering Epsom salts (see below).

The animal should not be moved to the front pens until it is eating well. A spare back pen (for cleaning purposes) is not normally necessary because the animal can be moved forwards into the smaller front pens after 2-3 weeks. This is done by opening the gate between the front and back pens and letting the animal walk in and out of the front pen at will for a day or two. The animal can then be fed in the front pen for a couple of days before closing it in the front pen. This usually does not present problems as the animal is well used to captivity by this stage. Once the animal has settled down in the front pen (3-4 days), the pen cleaning can be commenced on a daily basis.

Because rhinos are so bulky and heavy they are very prone to pressure sores, especially just above the front feet on the fetlock joints and on the hock joints. For this reason a layer of fine river sand (200 mm deep) is put into the front pens. This sand also serves to absorb urine. All the sand should be removed and replaced on a weekly basis. The animal is kept in the front pen for at least 3-4 weeks before it is ready to be transported to its final destination (a total of at least six weeks of boma training).

following exceptions and modifications

- Black rhinos are introduced directly into the smaller front pens, so the larger back pens are not required.
- When a newly caught black rhino is introduced into the front pen it should be isolated in the front section of the pen for a few days until it has settled down. Thereafter it can use both sections except when it is isolated in one section while the other section is cleaned.
- The corners of the pen should be 'rounded off' by passing poles horizontally across the corners. This is because the animals tend to run around the pen after off-loading, and may injure themselves in the corners.
- A concrete feeding slab should not be provided in the pen as black rhinos may injure themselves against the slab when they are first introduced into the pen.
- The receiving pen design must be used for boma-trained as well as wild-caught black rhinos - i.e., the pens should not be enlarged for wild-caught black rhinos.

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Care of the white rhinoceros *Ceratotherium simum* in captivity

P.S. Rogers

The white rhino...

- Is big, strong, dangerous, and unpredictable.
- Is a selective grazer, preferring short, palatable grasses.
- Is a gregarious animal and therefore likes to see and be with other animals of the same species.
- Adapts with great difficulty to captivity - from a stress and nutritional point of view. Younger animals adapt better and quicker than adults.
- Tends to adapt more slowly and less readily to captivity if alone - it is usually with these animals that one runs into problems.
- Is unpredictable from a nutritional point of view - some simply will not eat in captivity for no apparent reason.
- Will try to escape until it resigns itself to captivity and settles down. Almost all escape attempts occur at night. Nights 3, 4, and 5 of captivity are most critical in this respect.

Precautions

- It is essential to have a night guard who is in contact with the person in control of the boma in case of attempted escape by the rhino(s).
- The rhino must be put into a big pen initially to allow it to settle down.
- Antelope cubes should not be fed to rhinos: they may contain cotton seed products. Cotton seed contains gossypol which is potentially toxic to monogastric animals such as the rhino.

- Do not allow visitors until the rhino have settled down. The human element should be restricted to boma personnel only.
- Try, if possible, to capture and accommodate pairs of animals from the same herd: these animals will be more likely to adapt to captivity.

How to care for the captive white rhinoceros

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When catching animals to place in bomas one would obviously like animals that are going to adapt as soon as possible. This can be very important, bearing in mind the problems one has in getting white rhinos to adapt to captivity. There are three groups of animals that usually adapt fairly readily to captivity:

- A cow with a calf at foot;
- Animals that are running together in the wild; and
- Sub-adult animals, even if they are caught and put on their own.

Most problems are experienced with single, adult animals: the older they are, the more difficult they find it to adapt.

Water is given *ad lib* (bearing in mind that an adult drinks 40-50 litres daily) and the water trough is raised out, cleaned, and refilled twice daily. The trough should be disinfected twice weekly with a chlorine compound (e.g., Bacterex K⁺). Until the animal is eating properly, vitamin B-complex syrup is added to the water as an appetite stimulant at a dilution rate of 250 ml per 50 litres of water. The vitamin B-complex is always added to the water in the evenings, as it is inactivated by sunlight.

It is very important to monitor defaecation from the first day. Rhinos usually defaecate on the first and second days, then stop for four to five days until they start eating again. If the animal only defaecates on the first two days, but not again, Epsom salts can be put in the water from day nine post-capture. Usually these are the animals that are refusing to eat, and it is found that if and when they defaecate they will start eating. Special care must be taken when administering Epsom salts (see below).

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Deworming is not done by us as it is possible that a symbiotic relationship may exist between the internal parasites and the rhino. In the similar digestive tract of the zebra it seems that the nematode 'parasites' aid in the digestion process.

Off-loading

Ensure that the water trough is empty, as a sedated animal could drown in it. Water should only be given once the animal has fully recovered from the effects of the drugs.

When the animal is off-loaded at the bomas, it is usually still very groggy and remains so for at least six hours. If it is very hot, the animal may be hosed down once off-loaded into the pen.

The animal often lies down after off-loading (white rhino only). This is acceptable as long as the animal doesn't lie down for longer than twenty minutes at a time (to avoid neuromuscular damage to the hind legs). It is advisable to have a staff member equipped with a long-handled cattle prodler attending to the animal until it recovers. Sometimes the animal leans against the poles of the boma. Care must be taken to ensure that the animal does not smother itself, especially if it is in a corner.

Crate training

Once in the small pens, the animal is fed on a concrete slab for about four days. From then on the crate is opened and the feed is placed at the opening to the crate. The feed is gradually placed deeper and deeper into the crate until the animal's whole body is inside the crate when feeding (see Plate 21). This crate is similar to the one in which the animal will travel to its final destination, and this procedure is carried out to acclimatise the animal used to a very confined space.

The rhino should be eating all its food in the crate for at least 14 days before translocation to its final destination.

Feeding

Because it is so difficult to get captive white rhino to eat, highly palatable grasses such as *Cynodon dactylon* (quackgrass) and *Panicum* spp. (buffalo grass) must be given if possible. These species can be found growing in shady, damp areas and on river banks. Freshly cut kikuyu grass, if available, is also very good.

Freshly cut green grass is fed twice daily under the feeding roof on the concrete slab; old grass is removed after each feed. It may be found that the animal starts nibbling from day three or day four, and only starts eating well from about day seven. *Eragrostis tef* can then be mixed with the natural grass and increased so that by day 12 the rhino is eating tef only. The vitamin B-complex supplement in the water can then be withdrawn. At this stage start mixing in lucerne up to a maximum of about 10% of the total hay diet; anything higher than this can lead to loose stools and even diarrhoea. The time taken to reach this stage will vary from one animal to the next.

It is essential to feed the best quality tef and lucerne available in order to get the animal to eat. This feed must be kept dry. The tef and lucerne must be checked for mould — this can lead to colic, diarrhoea, or even death. Rodent control is essential — rats can carry *Salmonella*, a bacterium that causes a severe diarrhoea in rhinos.

Rhinos should be fed twice daily throughout their period in captivity. Once eating well an adult should eat three-quarters in one bale of hay per day. Big bulls may eat up to one and-a-half bales. When the animal is eating well horse cubes can be sprinkled on top of the feed, increasing gradually to about 2.5 kg twice daily for adult animals.

Occasionally (10–20% of cases), an animal refuses to feed at all. A good rule of thumb is that if the animal has not taken food by day ten it should be released by simply opening the gate. It is important that the bomas be situated where the animal can simply be released in this fashion. To have to dart an animal, which has not eaten for ten days, in order to load it again for translocation to a suitable release site could be a very risky and stressful procedure. It must be emphasized, however, that ten days is a rough guideline only. Some animals lose condition very rapidly and might have to be released after only six days, whereas others might be able to last longer than ten days (although this is very risky). Inclement weather, for example, can cause a perky animal that has not eaten for ten days to succumb overnight. Experience has shown that it is always better to release the animal sooner rather than later.

Animals that are not in good condition when they reach the bomas will obviously have to be released sooner if they do not eat. An early visible guide to the condition of a rhino is the appearance of skin folds on the lower side of the abdomen just in front of the hind legs, extending forwards towards the thorax. These folds are only visible in animals that are in poor condition. They start off short and shallow, just in front of the hind legs, later increasing in length and thickness as the animal's condition worsens.

If a rhino is refusing to eat and there are others in the boma that have been there for a while and are eating well, one can try mixing them. This often has the desired effect and the animal starts eating immediately. One must monitor the animals closely for a while after mixing them to make sure that they do not fight. This measure works particularly well where younger animals are involved — it is when older animals are mixed that fighting may occur. Some operators report using diazepam (Valium®) as an appetite stimulant. We have tried it on two occasions without success (10 mg IM), but it is definitely worth further experimentation. One of the animals drank about 50 litres of water after injection, but still did not eat.

Long-acting tranquillizers

Perphenazine enanthate (Trilafon®) was used on isolated white rhinos in 1991 with promising results. However, it was used again in 1992 on a group of 19 animals (adults 100 mg, sub-adults 50 mg) with poor and inconsistent results. Most, but not all, of the animals were calm for the first 7–10 days and then some of them became very wild again. Some of the animals appeared to be in a trance for longer than 10 days and were not interested in eating. One of these animals stood with its head in the feed without eating whilst its calf ate right next to it. Six animals out of this group had to be released because they did not eat, whereas normally only one or two would have had to be released. In my opinion, therefore, it is not advisable to use this drug routinely in white rhinos. If tranquillization should become necessary, however, the above doses should be adequate.

Clinical problems

Clinical problems should, where possible, be solved without resorting to immobilization. Immobilizing a rhino in a boma can be a risky procedure, depending on the condition of the animal. If immobilization does become necessary, use one-third of the dose of opioid drug

used at capture. Inclusion of a tranquillizer in the dart is not necessary. The animal must be monitored closely from the time of darting until the time it is given the antidote, and one must be prepared and equipped to give emergency treatment if necessary.

Wounds

Superficial wounds inflicted during capture can be treated with an antibiotic spray. Superficial wounds acquired in the bomas can be treated with a 1:500 acriflavine solution administered using a pressurized garden spray. This is an antiseptic solution that promotes scab formation. More serious, deeper wounds can be treated with iodine antiseptic solution (Prividone®) followed by acriflavine glycerine (1:1000). Acriflavine glycerine is also an antiseptic solution that stimulates granulation (healing), gets rid of dead tissue, and keeps the wound moist. Both the iodine and the acriflavine glycerine can be administered using a garden spray. The acriflavine glycerine is a bit thick, so it is mixed with a small amount of acriflavine solution so that a greater range may be attained when spraying the animal. Once the wound shows signs of healing well, the acriflavine glycerine is continued without the iodine, until the wound is shallow enough to use acriflavine solution on its own.

Septic wounds are first sprayed with 30% hydrogen peroxide. This is allowed to react with the wound surface for a few minutes before rinsing off with water. It may be necessary to repeat the process. Once the wound is cleaned, it is sprayed with iodine and acriflavine glycerine. This process must be carried out daily - even twice daily in severe cases.

If considered necessary, antibiotic injections can be given using 20 ml darts (Telinject®). Long-acting penicillin (e.g., Compropen®) can be given every 2-3 days, or an antibiotic with a broader spectrum (e.g., Potencil®) can be given daily. It is preferable to give these injections in the neck. The darts can be left to fall out on their own, or can be removed with a long piece of wire.

Occasionally, wounds may become infested with blowfly maggots, especially in summer. A tell-tale sign is the presence of a little hole with blood or serum oozing from it. This situation is easily remedied by spraying a solution of diazinon (Dazzel®) onto the wound at a dilution rate of 6 ml Dazzel® per litre of water. It must be borne in mind that this is an organophosphate, and is thus extremely poisonous; for this reason all food and water should be removed from the pen before administering this medication. One treatment is usually sufficient.

The front horn may occasionally be broken off in the crate or when an animal charges the walls of the boma. The horn usually breaks off at the base. A big, bleeding wound results, but it is not as bad as it looks. The wound will dry up and heal on its own, but it is better to spray it with acriflavine solution to keep it clean and to encourage scab formation.

Pressure sores can be avoided by good management (see earlier). They are treated in exactly the same way as other wounds, but the underlying cause must be eliminated.

Constipation

This condition is seldom seen in captive rhinos. It is usually associated with an animal that is not eating. Symptoms that may be seen are loss of appetite, listlessness, very little or no dung in the boma (the foregoing symptoms can also be normal in a newly caught animal), very hard dung, straining and rapid breathing due to abdominal discomfort. Constipation is more likely to be seen in animals that are not in good condition anyway due

to poor nutrition (e.g., during a drought when the grass is likely to be more difficult to digest than normal).

Magnesium sulphate (Epsom salts) is dissolved in 50 l of drinking water: 50 g for a juvenile, 100 g for a sub-adult, 200 g for a young adult, 400 g for an adult, and 500 g for a big bull. This may be repeated after 36-48 hours if necessary. Care must be taken when giving Epsom salts as one does not want to cause diarrhoea. Fresh rhino dung may also be put into the pen to try to stimulate the animal to defaecate. Very occasionally it may be necessary to immobilize the animal and remove the faecal balls (Flamand, pers. comm.).

Diarrhoea

Diarrhoea is usually due to either a dietary problem or an infection. If it is a dietary problem, there could be one of two causes. Initially diarrhoea occurs while the animal is adapting to its new diet: this is transient. If diarrhoea occurs after the animal has been in captivity for some time, it is usually because it has taken in too much lucerne or cubes. Withdrawal of these foods for a few days usually alleviates the problem.

It is advisable to treat the diarrhoea symptomatically. Kaolin is introduced to the drinking water: 50 g for a juvenile, 250 g for a sub-adult, and 500 g for an adult. Kaolin does not suspend readily, and the water must be agitated frequently; while its efficacy under these circumstances may be limited, there are few alternatives. An electrolyte/glucose supplement (e.g., Entersol®) should also be added to the water.

If a bacterial infection is involved, it is usually *Salmonella typhimurium*. This is usually fatal. *Salmonella* is thought to be brought into the bomas by carrier animals (as in horses). The stressful conditions under which the animal finds itself leads to a drop in its resistance, and the animal can then develop a severe diarrhoea. Another possibility is that the feed might be contaminated by carrier rats and mice that defecate or urinate on the feed.

If *Salmonella* is suspected or diagnosed, antibiotics such as furazolidone can be introduced into the water (e.g., Bislyte® diarrhoea powder, which also contains electrolytes and glucose). As the antibiotics used in the water are poorly absorbed from the gut, and because the animal may die from a septicaemia, it is necessary to give parenteral antibiotics (e.g., Potencil®) as well. If the animal stops drinking and/or becomes recumbent, it can be put onto a drip and given antibiotics, vitamins and spasmolytics. The prognosis in these cases is very poor.

Unfortunately, *Salmonella* diarrhoea is fairly common in rhinos in pens. There is a vaccine available for *Salmonella typhimurium*, but it is not effective in rhinos. Research is being conducted on a new live vaccine and, at the time of writing, the preliminary results appear encouraging.

Once *Salmonella* has been diagnosed, the affected pen should be sterilized immediately.

- Remove all the soil in the pen to a depth of at least half a metre.
- Spray the surface with a solution of 2% formalin.
- Fill up the hole with fine river sand.
- Disinfect all the poles and the water trough.

When an animal develops diarrhoea, for whatever reason, an attendant must be set aside to look after this animal only. This person sees to the animal's feed and water needs, and does not go near any of the other rhinos. Scrubbing and cleaning equipment must be used.

only in the infected pen, and must be sterilized every time after use. The attendant should wash his hands with an antiseptic soap each time after working in the pen, and should also wear gum boots that are disinfected after use. He should also wear an overall every time he works at the pen, leaving both the overall and gum boots there. The overall should be changed daily.

Colic

Colic is occasionally seen in rhinos in captivity. Clinical signs of colic in the rhino include rolling, 'crying', continual changes in position, repeated standing and lying down, and distress. Probable causes are mouldy feed, change in diet, etc. A single intramuscular injection of a spasmolytic (e.g., Finadyne[®]) is usually effective. Use 20 ml Telioject[®] darts. An abscess may develop at the injection site.

Pneumonia

Pneumonia is uncommon in captive rhinos: it usually occurs only in animals that are not in good condition, often following a cold, wet spell. This is where shelter from the elements, especially rain, is very important. A cold animal is bad enough but a cold, wet animal is a dangerous combination. Pneumonia is a very difficult condition to diagnose by just looking at an animal. Listlessness and laboured, often noisy breathing, occur. The animal must be darted with antibiotics (e.g., Potencil[®]) and vitamin B-complex syrup should be included in the drinking water.

Fly and tick worry

This can pose a problem in summer. Flies tend to sit on wounds and generally irritate the animal. Baytricol[®], which is a safe, synthetic pyrethroid, can be sprayed onto the animal weekly. This is effective against both stable flies (*Stomoxys* spp.) and ticks.

Abscesses

Abscesses are seldom seen in rhinos. Abscesses that do develop are usually as a result of a dart wound or injection. Because it is not possible to lance an abscess without immobilizing the animal, the abscess is usually left to rupture on its own. It is then treated as an open wound (i.e., hydrogen peroxide, iodine, acriflavine glycerine, etc.) The wound usually clears up fairly quickly. If the opening continues to ooze it may be necessary to immobilize the animal and flush the abscess. In such cases a long-acting antibiotic should also be used.

Eye infections

Eye infections may be caused by dust or a blow to the eye. An active infection is characterized by a yellow-green, thick discharge, whereas physical trauma is characterized by a watery, clear discharge. Try to wash away the debris with water. Depending on how tame the animal is, it may be possible to treat the eye with an antibiotic ointment: Orbenin OPH[®] (every 48 hours), Opchlor Vet[®] (3-4 times daily), or Terraconit[®] (twice daily). The latter contains cortisone, so one must make sure that there are no corneal lesions before administering it. The animal will not usually be tame enough to allow administration of an ointment. An iodine based spray is very effective in such cases. Examples include Vidine[®] and Oherdine[®] wound, eye and footrot spray. These antibacterials can be administered from a distance of 10-20 cm. They should be administered at least twice daily until recovery.

Foot infections

These occur when bacteria invade wounds or cracks on the feet, and are usually only found when the animals are kept under wet, dirty conditions. Hydrogen peroxide, iodine, and acriflavine glycerine should be applied as described earlier. If the animal will not lie down long enough for the full treatment, try to ensure that at least the iodine and acriflavine glycerine are applied. Failing this, alternate treatment with these two drugs. It may be necessary to administer antibiotics (e.g., Compropen[®] or, in severe cases, Potencil[®]).

Personal communication: Dr J.R.D. Flowerd, Box 456, Ntshaba, 2035 B.S.A.

Chemical capture of the black rhinoceros *Diceros bicornis*

P. S. Rogers

Also see *Chemical Capture of the White Rhinoceros*, this Section.

The black rhino...

- Is very similar to the white rhinoceros, except that:
 - It favours dense bush;
 - It is not usually gregarious;
 - It is by nature more aggressive and belligerent, and is potentially dangerous when approached on the ground; and
 - It reacts better than the white rhino to the drugs used in the anaesthetic cocktail.
- If disturbed upon approach, and after darting, will either become aggressive and charge the marksman, or alternatively will run off and seek shelter in a dense thicket.

Precautions

The same precautions that apply to white rhino capture apply here. There are some additional precautions to bear in mind.

- Be aware that because azaperone, and not hyusone, is used in the anaesthetic cocktail, the black rhino's vision is not as severely impaired as that of the white rhino.
- Appropriate precautions should always be taken to ensure that there are no other rhinos nearby when working on an immobilized animal. Because they are not usually gregarious, it is seldom that the helicopter has to chase other family members away. This is not always the case however - for example, a cow/calf combination where only the calf is being captured.
- Because black rhinos usually become recumbent in thick bush, be sure to check that there are no obstacles impeding the immobilized animal's breathing.
- Always cut off the tip of the anterior horn. Black rhinos are often very aggressive towards each other on release from the bomas at their final destination.

only in the infected pen, and must be sterilized every time after use. The attendant should wash his hands with an antiseptic soap each time after working in the pen, and should also wear gum boots that are disinfected after use. He should also wear an overall every time he works at the pen, leaving both the overall and gum boots there. The overall should be changed daily.

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Pneumonia

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Fly and tick worry

This can pose a problem in summer. Flies tend to sit on wounds and generally irritate the animal. Bayvecol[®], which is a safe, synthetic pyrethroid, can be sprayed onto the animal weekly. This is effective against both stable flies (*Stomoxys* spp.) and ticks.

Abscesses

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Eye infections

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Chemical capture of the black rhinoceros *Diceros bicornis*

P. S. Rogers

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- Because black rhinos usually become recumbent in thick bush, be sure to check that there are no obstacles impeding the immobilized animal's breathing.
- Always cut off the tip of the anterior horn. Black rhinos are often very aggressive towards each other on release from the bomas at their final destination.

- Black rhinos usually wake up completely shortly after administration of the antidote. Be well prepared, as the animal usually hops onto its feet when the prodder is applied. There is no room for error here.
- Be prepared: black rhinos occasionally get up quite unexpectedly, even when they appear to be fast asleep. For this reason it is even more important not to walk in front of the animal, and to make sure that the foot rope is well secured.
- Because azaperone, and not hyoscine, is used, if a black rhino has to be walked to the crate it is essential that the towel over the eyes be well secured so that the animal cannot see out.
- Ensure that the rhino does not stand with its head in the corner of the crate once it is loaded – the shape of the black rhino's head predisposes it to smothering itself. This is not often a problem as the black rhino is usually wide awake while being loaded!
- Be careful when removing the head rope and cloth from the eyes.

How to capture the black rhinoceros

Equipment and preparation are the same as for the white rhino (see *Chemical Capture of the White Rhinoceros*, this Section).

Drugs

There is one major difference in the cocktail used to immobilize black rhinos – azaperone is included in the black rhino's anaesthetic cocktail instead of hyoscine. The cocktail used by the Natal Parks Board is given in Table 1. Black rhinos react extremely well to this cocktail, and a very relaxed state of restraint is usually achieved.

Table 1. Drug combinations for the capture of free-living black rhinoceros.

	Immobilizing cocktail			Opioid antagonist
	Etorphine (M99) (mg)	Fentanyl (mg)	Azaperone (mg)	Diprenorphine (M5050) (mg)
Adult	1	30	150-200	6
Sub-adult	0.5	20	100	4
Juvenile	0.25	12	50	3

An alternative to this cocktail is given in Table 2. This cocktail has also been used with great success, although the etorphine/fentanyl combination produces a slightly quicker and more relaxed restraint.

As in the case of the white rhino, these combinations serve only as a guide, and the doses should be tailored to suit the individual animal. The knock-down time ranges from seven to nine minutes. It seldom happens that the animal is roped while still standing – it is usually down by the time the follow-up team gets to it. As in the case of the white rhino, if a black rhino goes down in less than six minutes it should be attended to as quickly as possible.

Table 2. Alternative drug combinations for the capture of free-living black rhinoceros.

	Immobilizing cocktail		Opioid antagonist
	Etorphine (M99) (mg)	Azaperone (mg)	Diprenorphine (M5050) (mg)
Adult	3	150-200	6
Sub-adult	1.75	100	4
Juvenile	1	50	3

Technique

The technique is exactly as for the white rhino with a few exceptions.

Because black rhinos often tend to stick to thick bush after being darted, this is usually also where they become recumbent. To avoid losing sight of the recumbent animal from the air, it is useful to have at least one roll of toilet paper in the helicopter. This roll can be thrown out of the helicopter like a paper streamer to mark the spot where the animal has gone down or was last seen. The helicopter can then move off to guide in the follow-up team.

It very seldom happens that a black rhino is roped while still standing. The foot rope must, however, still be put on, even if the animal is down.

Because the black rhino is almost fully awake after being given the antidote, it is advisable to give it additional tranquilizer 5–10 minutes before waking it up. This helps to prevent the animal from fighting in the crate. Azaperone is recommended for this purpose at the following intramuscular doses:

Adult	100–150 mg
Sub-adult	50–100 mg
Juvenile	25–50 mg

It is usually not necessary to administer nalorphine once the animal is in the crate, as is sometimes the case with a white rhino.

Do not

- Never dart two black rhinos at once – the chances of losing one of the animals in thick bush are just too great.

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Transportation of the black rhinoceros *Diceros bicornis*

P. S. Rogers

Also see *Transportation of the White Rhinoceros*, this Section.

How to transport the black rhinoceros

As in the case of white rhinos, black rhinos are all crated and transported individually. The Natal Parks Board recommends transporting boma-trained animals only, for two main reasons. First, the initial aggressiveness of the black rhino immediately after capture is such that the journey immediately after capture should be as short as possible. Second, unlike white rhinos, black rhinos are completely awake after administration of the antidote, and are thus stressed by the sudden exposure to the strange sights, sounds and smells of the crate.

Because black rhinos adapt so much more readily to captivity than white rhinos, it is possible to transport them after a boma-training period of only four weeks. A boma-training period of at least six weeks is, however, recommended. The advantages of boma training white rhinos also apply to black rhinos.

Loading

The loading procedure for black rhinos is exactly the same as for white rhinos with a few exceptions.

The black rhino is smaller and is more susceptible to atropine than the white rhino. The recommended doses are:

Adult	0.25 mg
Sub-adult	0.125 mg
Juvenile	0.0625 mg

Black rhinos often refuse to enter a crate. They stand at the entrance to the crate with their legs splayed, head down, and salivating. If this occurs, a cloth is used to cover the animal's eyes and a rope is slipped over its head. The animal is then pulled into the crate while being guided and supported by an attendant on either side.

If it appears that the animal may go down, nalorphine may be administered at the same dosage rate as in white rhinos (see *Transportation of the White Rhinoceros*, this Section). This becomes necessary much more frequently with black rhinos than with white rhinos.

Transportation

In the author's experience it has never been necessary to tranquillize boma trained black rhinos en route to their new destination. They travel extremely well and usually eat large amounts of lucerne during the journey. This seems to keep them quiet; for this reason it is advisable to take along a good supply of lucerne for the journey. Remember to supply adequate bedding.

If tranquillization does become necessary, the recommended doses of azaperone are as follows:

Adult	100 mg
Sub-adult	50 mg
Juvenile	25 mg

These doses may be increased if necessary. Rather start off with low doses; one does not want an animal going down in the crate.

Off-loading

Black rhinos are usually off-loaded more easily than white rhinos. It has been found that if they are allowed to disembark in their own time, which is usually not very long, they are less aggressive in the receiving pens. After disembarkation they often run around and perform for a while. As in the case of white rhinos, a cloth or the handle of a prodler may have to be used to get the animal out of the crate. One seldom has to use the prodler itself. Unnecessary or excessive use of a cattle prodler to get a reluctant animal to disembark will merely aggravate the situation.

Spectators, movement, and noise at the off-loading site should be restricted to an absolute minimum as these factors further aggravate the animal. As with white rhinos, it is essential to separate a cow and her calf on disembarkation. The cow's behaviour should be closely monitored before reuniting the two - this may only take 10 minutes if the cow is calm, but longer if the cow is very agitated.

Release

See *Transportation of the White Rhinoceros*, this Section. In the case of black rhinos it is essential that they are taking in sufficient local browse before being released. It is not necessary to reduce their daily lucerne quota before release.

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Transportation of the black rhinoceros *Diceros bicornis*

P. S. Rogers

Also see *Transportation of the White Rhinoceros*, this Section.

How to transport the black rhinoceros

As in the case of white rhinos, black rhinos are all crated and transported individually. The Natal Parks Board recommends transporting boma-trained animals only, for two main reasons. First, the initial aggressiveness of the black rhino immediately after capture is such that the journey immediately after capture should be as short as possible. Second, unlike white rhinos, black rhinos are completely awake after administration of the antidote, and are thus stressed by the sudden exposure to the strange sights, sounds and smells of the crate.

Because black rhinos adapt so much more readily to captivity than white rhinos, it is possible to transport them after a boma-training period of only four weeks. A boma-training period of at least six weeks is, however, recommended. The advantages of boma training white rhinos also apply to black rhinos.

Loading

The loading procedure for black rhinos is exactly the same as for white rhinos with a few exceptions.

The black rhino is smaller and is more susceptible to etorphine than the white rhino. The recommended doses are:

Adults	0.25 mg
Sub-adult	0.125 mg
Juvenile	0.0625 mg

Black rhinos often refuse to enter a crate. They stand at the entrance to the crate with their legs splayed, head down, and salivating. If this occurs, a cloth is used to cover the animal's eyes and a rope is slipped over its head. The animal is then pulled into the crate while being guided and supported by an attendant on either side.

If it appears that the animal may go down, nalorphine may be administered at the same dosage rate as in white rhinos (see *Transportation of the White Rhinoceros*, this Section). This becomes necessary much more frequently with black rhinos than with white rhinos.

Transportation

In the author's experience it has never been necessary to tranquilize boma-trained black rhinos en route to their new destination. They travel extremely well and usually eat large amounts of lucerne during the journey. This seems to keep them quiet; for this reason it is advisable to take along a good supply of lucerne for the journey. Remember to supply adequate bedding.

If tranquilization does become necessary, the recommended doses of azaperone are as follows:

Adult	100 mg
Sub-adult	50 mg
Juvenile	25 mg

These doses may be increased if necessary. Rather start off with low doses; one does not want an animal going down in the crate.

Off-loading

Black rhinos are usually off-loaded more easily than white rhinos. It has been found that if they are allowed to disembark in their own time, which is usually not very long, they are less aggressive in the receiving pens. After disembarkation they often run around and perform for a while. As in the case of white rhinos, a cloth or the handle of a prodder may have to be used to get the animal out of the crate. One seldom has to use the prodder itself. Unnecessary or excessive use of a cattle prodder to get a reluctant animal to disembark will merely aggravate the situation.

Spectators, movement, and noise at the off-loading site should be restricted to an absolute minimum as these factors further aggravate the animal. As with white rhinos, it is essential to separate a cow and her calf on disembarkation. The cow's behaviour should be closely monitored before reuniting the two – this may only take 10 minutes if the cow is calm, but longer if the cow is very agitated.

Release

See *Transportation of the White Rhinoceros*, this Section. In the case of black rhinos it is essential that they are taking in sufficient local browse before being released. It is not necessary to reduce their daily lucerne quota before release.

Care of the black rhinoceros *Diceros bicornis* in captivity

P.S. Rogers

The black rhino...

- Is a big, strong, aggressive, unpredictable, and potentially dangerous animal
- Is by nature not usually a gregarious animal
- Usually adapts readily and quickly to captivity. The age of the animal does not seem to influence its adaptation.
- Is a browser.

Precautions

As for the white rhino (see *Care of the White Rhinoceros in Captivity*, this Section) with the following exceptions:

- Black rhinos start eating almost immediately in a pen.
- Black rhinos are initially even more aggressive than white rhinos so great care must be taken not to aggravate them unnecessarily. However, they calm down within a few days and ultimately become much tamer than captive white rhinos.
- Black rhinos can be put straight into the front pen (see *Accommodation of the White Rhinoceros and Black Rhinoceros*, this Section) because they adapt so readily to captivity.

How to care for the black rhinoceros

Boma management

- All animals are housed individually, except in the case of a cow and her calf.
- The water trough should only be filled once the animal has settled down after its initial introduction to the pen. Vitamin B complex syrup should be mixed into the water (250 ml per 50 l water). The vitamin B complex supplementation can be discontinued as soon as the animal is eating well - usually about 10 days after capture. Water is given *ad lib.* and the water trough is emptied and cleaned twice daily. As in the case of the white rhino, the water trough should be disinfected twice weekly with a suitable disinfectant (e.g., *Bacterex*).
- It is best to wait until the animal has settled down (4-5 days) before cleaning the pen. The pen is then cleaned on a daily basis. It is essential, however, to remove as much old browse and lucerne as possible twice a day from day one.
- The sand on the floor of the pen must be removed and replaced on a weekly basis.
- As in the case of the white rhino, deworming of black rhinos is not practised by the Natal Park Board.

Off-loading

- The floor of the pen is covered with a thick layer of fine river sand and the water trough is cleaned and emptied before the rhino is off-loaded.
- At off-loading, the black rhino is usually very aggressive. For this reason, fresh browse is cut and hung from the poles all around the pen (thickly stacked) before the animal comes in. This serves to simulate the animal's natural environment.
- Personnel and movement in the vicinity of the boma should be limited to a minimum at off-loading.
- When the animal is off-loaded it is usually very aggressive and runs around the pen a few times before calming down. The animal usually starts chewing on the browse within a few minutes after off-loading.

Crate training

The animal must be crate-trained, as in the case of the white rhino. To achieve this, the lucerne is used to lure the rhino into the crate. The lucerne is moved closer and closer to the entrance of the crate every day, until eventually the animal is eating inside the crate.

Feeding

The diet of captive black rhinos must, at least initially, consist of a high proportion of the natural feed. Examples of suitable browse species include *Sporobolus africanus* (tambourie), *Ziziphium mucronata* (buffalo thorn), *Acacia* spp., *Grewia* spp., and *Rhus* spp. Do not feed *Dichrostachys* spp.; although palatable, the robust thorns may penetrate the sole of the rhino's foot.

The browse must always be fresh, as wilted browse can cause prussic acid poisoning. Browse is fed twice daily, and the old, wilted browse is taken out on each occasion.

The browse is put onto the ground - there is no concrete slab, as the animal may injure itself on the slab after off-loading.

After 3-4 days, when the animal has settled down and is eating well, lucerne hay of the best available quality should be added to the diet. This is done by spreading a little lucerne over the browse each time it is put in, in the hope that the lucerne will be taken in together with the browse. The lucerne must be thoroughly inspected for mould and other contamination before feeding. Good rodent control is essential.

Some rhinos take to lucerne immediately, while others may take up to 2-3 weeks before they take it well. An adult rhino should eat 15-20 kg of lucerne per day. Once the lucerne is being taken well it can be fed in a heap on the ground next to the browse.

Horse cubes should be provided on top of the lucerne once the animal is eating well. Start gradually and build up to 2.5 kg twice daily in the case of an adult.

The browse is never taken away completely, although it may be reduced gradually as the lucerne intake increases.

In the author's experience, it has never happened that a captive black rhino refuses to eat. Also, we have never had a problem with constipation, probably because the animal starts eating immediately. The age of the animal does not seem to influence its adaptability.

Long-acting tranquilizers

Perphenazine (Trilafon[®]) and Zuclopenthixol (Clonixol-acuphase[®]) have been used by other operators on black rhino with apparently favourable results (see Table 1). Long-acting tranquilizers are not normally necessary as these animals settle down very quickly without the use of drugs.

Table 1. Preliminary dosage rates of long-acting tranquilizers for use in the black rhinoceros (M.D. Kock, pers. comm.).

Drug	Zuclopenthixol (Clonixol-acuphase)	Perphenazine (Trilafon)
Adult	0.24-0.41 mg/kg 300-600 mg total dose	0.2-0.6 mg/kg 300-500 mg total dose
Sub-adult	0.67-1 mg/kg 250-300 mg total dose	0.6-0.8 mg/kg 200-300 mg total dose
Juvenile	0.67-1 mg/kg 200-250 mg total dose	0.5-0.8 mg/kg 100-200 mg total dose

Clinical problems

Wounds

In addition to traumatic wounds as seen in white rhinos (see *Care of the White Rhinoceros in Captivity*, this Section), black rhinos have unusual lesions normally just behind the front limbs on either side of the thorax. These may also occur on the chest, neck, and the top of the forelegs. The lesions are caused by the filarial nematode, *Stephanofilaria ulinicki*, and are typically open, superficial sores that exude copious amounts of blood and serum. The nematode is transmitted from one animal to another by an unknown biting fly.

The distribution of these lesions is age-related, and their severity seems to be aggravated when the animal is under stress, probably due to secondary bacterial infection. The lesions are also aggravated by ospreckers and biting flies. The irritation induced by the lesions causes the animal to rub against objects, thus aggravating the situation even further.

In captive animals these lesions can be kept under control by:

- Maintaining a high plane of nutrition.
- Weekly spraying with a fly repellent, e.g. Bayticol[®], and
- Twice-daily spraying with a 1:500 acriflavine solution. Deeper, ulcerated lesions may also initially be treated with hydrogen peroxide, iodine, and acriflavine glycerine 1:1,000, followed eventually by acriflavine solution 1:500 (see *Care of the White Rhinoceros in Captivity*, this Section).

The lesions sometimes become infested with maggots, but this can easily be remedied using a suitable insecticidal spray (e.g. Dazzel[®]). Theoretically an ivermectin preparation (e.g. Ivomec[®]) could be used to kill the filarial nematodes. However, because of the deaths experienced with horses and black rhinos in Kenya, we do not think it is worth taking the risk. Note: when black rhinos are moved away from the eastern areas of southern Africa (Zululand and the Kruger National Park) to other areas, the lesions disappear completely. This is probably because the vector is not present in these areas.

Constipation and diarrhoea

Constipation is not a problem commonly encountered in captive black rhinos, probably because they eat so readily from the start. Diarrhoea is seen on very rare occasions, and then it usually only lasts for a day or two. It is usually seen within two days of capture. Kaolin can be put in the water but, because of its poor solubility, its efficacy is questionable. An electrolyte/glucose supplement can be added to the water (as in white rhinos - see *Care of the White Rhinoceros in Captivity*, this Section). *Salmonella typhimurium* fortunately has not been a problem in black rhinos in our pens.

Pneumonia

Pneumonia is very seldom seen in captive black rhinos, and then only in debilitated (e.g. snared) animals. The symptoms and treatment are as for white rhinos.

Fly and tick worry

The treatment is the same as for white rhinos (see *Care of the White Rhinoceros in Captivity*, this Section).

Pigmented urine

Five black rhinos were transported to a farm approximately 80 km west of Pretoria in June 1991. There they were fed *Spirostachys*, *Grewia*, lucerne, and horse cubes, exactly the same diet to which they were accustomed in the bomas at Umfolozi Game Reserve. However, two days after arrival it was observed that the urine of these rhinos was turning a dark red colour shortly after urination. The urine was initially the normal white/cream colour, but it gradually turned red, eventually looking like pure blood.

Blood, urine, and browse samples were taken for analysis. Haematology was normal and no pathogenic parasites were found in blood smears. Liver and kidney function were found to be normal. However, spectrophotometry showed that the *Grewia* bark and the rhino urine contained at least one spectrophotometrically identical component. Liquid chromatography suggested that there were some elements present in the rhino urine that also occurred in the *Grewia* and *Spirostachys*. These elements bore a strong resemblance to rotenoid, a chemical that also apparently occurs in the bark of *Japanea* sp. and the leaves of *Eucalyptus* sp.

The rhinos never showed any sign of malaise. They were released into their new environment, and were reported to be doing well. An interesting fact to note here is that five black rhinos from the Umfolozi bomas had been sent to the same farm in February 1991. These animals were fed exactly the same diet as those that arrived four months later. These animals did not develop this syndrome at all. In May 1992, a black rhino cow and her six-month-old calf were transported to the same farm. Again, the animals were from the Umfolozi bomas, and were fed the same diet as the June 1991 animals. Two days after arrival the cow developed the dark red urine, but also showed no signs of malaise. It therefore seems that there is a seasonality to the occurrence of this phenomenon. It appears that the pigment is present in both *Grewia* and *Spirostachys* spp., but only at certain times of the year. It is also apparent that the pigment does not adversely affect the animals in any way. Although not a common problem as yet, this syndrome may become more prevalent as the frequency of translocation of black rhinos increases.

Colic, abscesses, eye infections, foot infections

See *Care of the White Rhinoceros in Captivity* (this Section).

Do not

- Do not put animals, other than cow and calf, together in the same enclosure. Even in the case of a cow and a calf, the individuals must be separated initially until they have calmed down.

Personal communication: M.D. Keck, Department of National Parks and Wildlife Management, P.O. Box 8965, Cluskey Harar, Zimbabwe.

Hand-raising of orphaned rhinoceros calves

P.S. Rogers

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1 Introduction

Both the black and the white rhinoceros are extremely valuable animals, and it is essential that there should be some information available on how to raise calves that have been separated from their mothers. In the case of the black rhino, being an animal that is threatened with extinction, this information becomes even more critical. There is very little published data on the raising of rhino calves, and that which is available is sketchy and difficult to obtain. While there is still insufficient information available to make firm recommendations and predict results, it is essential that there be some review of current knowledge on this subject. Given the limitations already mentioned, I have summarized the important points into a set of general guidelines based on what information I could obtain and on personal experience in assisting with the raising of five white rhino orphans. This is followed by two recent case studies that highlight some of the problems that may be associated with the difficult but rewarding task of raising rhino calves.

Rhino calves...

- Do not drink water, even if it is freely available. (It should, nevertheless, be available.) This seems to be the case while the calf is being fed milk at 10-15% of its body mass. As soon as it starts taking significant amounts of solids and the milk to body mass ratio declines, it will start taking water.

- Become stressed if they are continually exposed to strange faces.
- Do not require manual stimulation in order to urinate and defaecate.
- Become attached to their foster mothers, and adapt with great difficulty to changes in the person caring for them.
- Are unable to control their body temperature for the first six weeks of life. Rectal temperature may vary from 29.4°C (!) to 39.7°C. Body temperature appears to become more constant between six and fourteen weeks, and thereafter stabilizes at approximately 37.5°C (Trendler, pers. comm.).
- Obtain colostrum from their dams. However, there may also be transfer of antibodies before birth: there has been at least one case of a calf being raised successfully without having received colostrum or colostrum substitutes¹.
- Must be exercised regularly from an early age.
- Tend to 'flop down' and sleep after each feed.
- May occasionally develop a serous nasal discharge (runny nose), but this usually passes uneventfully.
- Have a respiratory rate of 16 to 30 breaths/minute. This increases with fever or pain, and decreases as the calf gets older.
- Become dehydrated and hypoglycaemic very quickly when they are young. Calves in this state must be warmed and given an intravenous infusion containing 5% dextrose (or Lectade² per os if they can still suckle).
- Are born without any teeth. Reports on tooth eruption are varied: 3 weeks (black rhino), 56 days (black rhino), 70 days (white rhino). The eruption of the teeth is usually accompanied by a rise in temperature, sore or itchy gums, and possibly even a loss of appetite and diarrhoea.
- Should be weaned at 18 months of age. They can be weaned as early as 12 months, but it is preferable to wean them later.
- Thrive on the company of other animals and humans.
- Take a variable time to start eating solids: two months (black rhino), four months (white rhino), seven months (white rhino).
- That are orphaned at five months are already eating solids well, although they still need milk. Calves that are orphaned at a young age may only take solids after 6-7 months.

2 Milk substitutes

- Rhino milk is unusual in that it contains very little fat and a high proportion of lactose (see Table 1).
- Many preparations have been used as a base for a milk substitute for rhino calves: Denkavit³ calf milk replacer (Flamand, pers. comm.), Elae⁴ skimmed milk powder followed by Sumomel⁵ (Bengis, Espie, Keet, pers. comm.), Lactogen⁶, Melk-Vita⁷ calf milk replacer (author), fresh skimmed milk, Nestle Rhino Milk⁸ (Trendler, pers. comm.).
- These standard milk formulas should be modified to resemble rhino milk as closely as possible, especially with respect to fat and lactose. Melk-Vita⁷, Sumomel⁵, Denkavit³, and Elite⁹ formulas should be prepared according to the instructions and then substituted with 40 g of glucose per litre. Even though the fat content of the calf milk replacers is reasonably high, they appear to be well tolerated. A substitute based on Lactogen⁶ has been described by Sheldrick¹.

Colic, abscesses, eye infections, foot infections

See *Care of the White Rhinoceros in Captivity* (this Section)

Do not

- Do not put animals, other than cow and calf, together in the same enclosure. Even in the case of a cow and a calf, the individuals must be separated initially until they have calmed down.

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1 Introduction

Both the black and the white rhinoceros are extremely valuable animals, and it is essential that there should be some information available on how to raise calves that have been separated from their mothers. In the case of the black rhino, being an animal that is threatened with extinction, this information becomes even more critical. There is very little published data on the raising of rhino calves, and that which is available is sketchy and difficult to obtain. While there is still insufficient information available to make firm recommendations and predict results, it is essential that there be some review of current knowledge on this subject. Given the limitations already mentioned, I have summarized the important points into a set of general guidelines based on what information I could obtain and on personal experience in assisting with the raising five white rhino orphans. This is followed by two recent case studies that highlight some of the problems that may be associated with the difficult but rewarding task of raising rhino calves.

Rhino calves...

- Do not drink water, even if it is freely available. (It should, nevertheless, be available.) This seems to be the case while the calf is being fed milk at 10–15% of its body mass. As soon as it starts taking significant amounts of solids and the milk to body mass ratio declines, it will start taking water.

- Become stressed if they are continually exposed to strange faces.
- Do not require manual stimulation in order to urinate and defecate.
- Become attached to their foster mothers, and adapt with great difficulty to changes in the person caring for them.
- Are unable to control their body temperature for the first six weeks of life. Rectal temperature may vary from 29.4°C (!) to 39.7°C. Body temperature appears to become more constant between six and fourteen weeks, and thereafter stabilizes at approximately 37.5°C (Treadler, pers. comm.).
- Obtain colostrum from their dams. However, there may also be transfer of antibodies before birth; there has been at least one case of a calf being raised successfully without having received colostrum or colostrum substitutes¹.
- Must be exercised regularly from an early age.
- Tend to 'flop down' and sleep after each feed.
- May occasionally develop a serous nasal discharge (runny nose), but this usually passes uneventfully.
- Have a respiratory rate of 16 to 30 breaths/minute. This increases with fever or pain, and decreases as the calf gets older.
- Become dehydrated and hypoglycaemic very quickly when they are young. Calves in this state must be warmed and given an intravenous infusion containing 5% dextrose (or Lectade[®] per os if they can still suckle).
- Are born without any teeth. Reports on tooth eruption are varied: 3 weeks (black rhino), 56 days (black rhino), 70 days (white rhino). The eruption of the teeth is usually accompanied by a rise in temperature, sore or itchy gums, and possibly even a loss of appetite and diarrhoea.
- Should be weaned at 18 months of age. They can be weaned as early as 12 months, but it is preferable to wean them later.
- Thrive on the company of other animals and humans.
- Take a variable time to start eating solids: two months (black rhino), four months (white rhino), seven months (white rhino).
- That are orphaned at five months are already eating solids well, although they still need milk. Calves that are orphaned at a young age may only take solids after 6–7 months.

2 Milk substitutes

- Rhino milk is unusual in that it contains very little fat and a high proportion of lactose (see Table 1).
- Many preparations have been used as a base for a milk substitute for rhino calves: Denkavit[™] calf milk replacer (Flamand, pers. comm.), Elite[®] skimmed milk powder followed by Surromel[®] (Beagis, Espie, Keet, pers. comm.), Lactogen[™], Melk-Vita[™] calf milk replacer (author), fresh skimmed milk, Nestle Rhino Milk[™] (Treadler, pers. comm.).
- These standard milk formulas should be modified to resemble rhino milk as closely as possible, especially with respect to fat and lactose. Melk-Vita[™], Surromel[®], Denkavit[™], and Elite[®] formulas should be prepared according to the instructions and then substituted with 40 g of glucose per litre. Even though the fat content of the calf milk replacers is reasonably high, they appear to be well tolerated. A substitute based on Lactogen[™] has been described by Sheldon².

Table 1. Percentage composition of rhinoceros milk.

Component	White rhinoceros*		Black rhinoceros**
	Sample A	Sample B	
Total solids	8.84	8.26	8.10
Fat	0.8	Trace	Trace
Lactose	6.50	6.85	6.06
Protein	1.54	1.18	1.54
Ash	0.20	0.23	0.34
pH	-	6.4	-

* Data from Wallach, 1969 (Ref. 1). Sample A is from a cow with a five month old calf; sample B is from a cow with an eighteen month old calf.

** Data from Aschaffenberg et al., 1961 (Ref. 2). This sample was taken from a cow with a nineteen month old calf that was still suckling.

- Nestle Rhino Milk® closely resembles rhino milk, and is probably the best substitute to use. However, this milk was only developed in 1992, and may not be available to people in the field at short notice. In these cases any of the other options mentioned, suitably modified, should be adequate.
- On a milk substitute based on Melk-Vita® the dung of young rhinos is of a clay to cow pat consistency. This may be due to the relatively high fat content and brown sugar supplement. It is probably advisable to use glucose instead of sugar. As in the case of foals, rhino calves, especially young ones, may be unable to digest sucrose properly. As the intake of solids increases, the dung begins to resemble that of an adult rhino.
- Additional energy is required by the rhino calf as it gets older. This is best provided by adding a few teaspoons of cereal (e.g., Nestum®, Pronutro®) to the milk at some or all of the feeds (see the case studies below).

3 Feeding

- Milk should be fed at 10–15% of body weight. Overfeeding must be avoided as it leads to diarrhoea.
- Milk must always be fed at the same temperature, preferably body temperature.
- Rhino calves are usually presented when they have already fed from their mother, and may even be taking some solids. These calves are usually very wild and aggressive, but settle down within a day or two. It is not too difficult to get them to feed – simply put the milk in a baby bath and leave it in the pen. The calf will usually drink within a couple of hours. Unused milk must be removed before it goes off.
- Black rhino calves should be offered good quality lucerne and fresh browse; white rhino calves should be offered good quality tiff with at least 10% lucerne added. Horse cubes should only be offered once the calf has adapted to its hay diet.

4 General principles

- The same person should care for and feed the calf until weaning.
- Diarrhoea must be treated by withdrawing the milk and replacing it with an electrolyte solution (e.g., Lectade®). The milk must be re-introduced gradually. Persistent or severe diarrhoea may require antibiotic therapy.

- Strict hygiene must be observed with respect to both feeding and accommodation. Feeding utensils should be sterilized by boiling or in a suitable preparation (e.g., Milton's®).
- It is essential to provide adequate shelter from temperature extremes, rain, and wind.
- A mud wallow must be provided right from the start. Apart from the cooling effect, the mud seems to stop the skin cracking and also takes off old skin. It also provides protection from sun and flies.
- Attention must be paid to the need of rhino calves for company. This is essential to the survival of the calf. If sufficient attention cannot be provided, a companion (goat kid, lamb, or even another a rhino) should be obtained. The companion may also be of great help in getting the calf to take solids.

5 Colostrum

If a rhino calf has not received colostrum, there are several alternatives.

- 1 Give one litre of bovine colostrum – preferably within six hours of birth but definitely within the first 24 hours. Do not give more than 300 ml at a time. The efficacy of this method has not been ascertained: it does not work in foals.
- 2 Give one litre of rhino plasma slowly IV. A short-acting cortisone preparation (e.g., Solu Delta Cortef®) should be given at the same time to prevent anaphylactic shock. This procedure is successful in foals but has not been tried in rhinos as far as I am aware. This option, and option 1 above, are obviously not practical in most cases.
- 3 Give one litre of rhino plasma orally. The problem with this alternative is that there are special cells in the wall of the gut that absorb antibodies. These cells can only absorb a limited amount of protein before they become inactive. The other proteins in the plasma therefore limit the number of antibodies (which are also proteins) that can be absorbed by the oral route. Oral administration could be combined with the IV alternative (discussed above).
- 4 There will soon be a synthetic foal colostrum available that apparently works very well in horses. This may be useful in rhinos. An inter-species colostrum will soon be available that may also be effective.
- 5 Do nothing. There has been at least one case of a rhino calf being raised successfully without any colostrum or colostrum replacement, as mentioned above.

6 Case studies

6.1 White rhino

The white rhino calf *Lahlwe* ('the rejected one') was born in the barns at Umfolozi Game Reserve in Natal on the 26th of March 1992. She was rejected by her mother immediately after birth and was severely stressed and had dilated pupils and haemorrhages in the anterior chambers of both eyes (as a result of being battered by her mother) when she was rescued. First-aid treatment consisted of Kortico® (2 ml IV) and Sulmethatrim® (3.5 ml IV for three days). Her umbilicus was cleaned with Provodine® antiseptic solution and sprayed with Airbivic GV®. Her mass at this stage was 52 kg. Birth mass is variably documented as being approximately 40 kg⁵ and 55–65 kg⁶.

The Melk-Vita[®] mixture given above was used as a milk substitute. A calf teat and a one litre Coke[®] bottle were used. One hundred ml of rhino serum were added to her first feed. The total daily ration (5 l) was given over a 24 hour period at 1.5-2 hour intervals. Due to her initial concussion she was not taking in her full quota, and on the third day she began to lose her sucking reflex. She became lethargic and was apparently hypoglycaemic. An intravenous infusion of Plasmaver[®] (supplemented with 50% dextrose to make a 5% dextrose solution) was given overnight. By the next day she was much better, but again did not feed properly and the drip had to be repeated. The next day she was very strong, and from that day on she never looked back.

The first meconium was passed on the second day. It was very orange and hard. She appeared to be struggling to defaecate, and a Lendax[®] enema was given. In retrospect this may not have been necessary. Meconium was passed for about three days.

She had a large area in which to wander, and got sufficient exercise. Her shelter was a small rhino crate: this was padded with telf that was cleaned out on a daily basis. A mud wallow was made for her which she utilized regularly.

The following is a summary of her progress.

Weeks 0-2. Milk: 4-6 l/day in 12 feeds. Mean defaecations 1.5/day, mean urinations 2.4/day.

Weeks 2-4. Milk: 6-9 l/day in 12-14 feeds. Mean defaecations 1.8/day, mean urinations 3.9/day.

Weeks 4-6. Milk: 10-14 l/day in 10 feeds. Mean defaecations 2.4/day, mean urinations 6.2/day.

Weeks 6-8. Milk: 15-18 l/day in 10 feeds. Mean defaecations 2.5/day, mean urinations 5.5/day.

Tried to get her to drink from a baby bath, but not easy.

Weeks 8-10. Milk: 18-20 l/day in 8 feeds. Mean defaecations 2.9/day, mean urinations 6.8/day.

Now a four-hour break in feeds at night.

Weeks 10-12. Milk: 16-20 l/day in 7 feeds. 1 tsp. Pronutro[®] at each feed. Mean defaecations 2.8/day, mean urinations 5.8/day.

Night feeds stopped, sleeping \approx 8 hours per night. Drinking almost all her milk from a baby bath. Stools became even softer than a cow's, but did still have some form to them. This was not treated, but her milk was not increased during this period.

Weeks 12-14. Milk: 21-23 l/day in feeds. 2 tsp. Pronutro[®] at each feed. Mean defaecations 2.0/day, mean urinations 5.8/day.

Sleeping approximately 12 hours per night. Very seldom required a night feed.

Weeks 14-16. Milk: 23 l/day in 7, then 6, then 5 feeds. 3 tsp. Pronutro[®] at each feed. Mean defaecations 2.1/day, mean urinations 5.0/day.

No night feeds. Faeces again very soft, but no treatment was given. The milk was again not increased.

Weeks 16-18. Milk: 23 l/day in 5 feeds. 3 tsp. Pronutro[®] at each feed. Mean defaecations 1.9/day, mean urinations 4.2/day.

Glucose was gradually replaced with brown sugar. In retrospect this may not have been the right thing to do, although it has been the practice in the past. Brown sugar may predispose rhino calves to diarrhoea because of the molasses content and a possible inability to digest sucrose completely, as mentioned above.

Weeks 18-20. Milk: 25 l/day in 5 feeds. 5 tsp. Pronutro[®] at each feed. Urination and defaecation records incomplete after her foster mother departed.

- At all stages she did not like being fed by strangers, and adapted with great difficulty to a new handler.
- A goat was acquired to keep her company. They became good friends, and he got her interested in solid food. He even went with her to her new home.
- After 20 weeks the amount of milk was kept constant but the Pronutro[®] was increased up to 15 tsp. per feed by the time she left at the age of six-and-a-half months.
- Until the age of five-and-a-half months she had almost invariably left some or all of at least one feed. Thereafter she drank everything. At this stage she started taking in some solids, but her intake only became significant at about seven months.
- The other four calves that I have helped to raise did well on Melk-Vita[®], brown sugar, and Pronutro[®] (one heaped cup/5 l), as has a very young (\approx 2 months old) black rhino, on Denkavit[®], brown sugar, and Pronutro[®] (Fiamand, pers. comm.). As mentioned above, the brown sugar should preferably be replaced with glucose. Occasional bouts of diarrhoea were remedied by replacing the milk completely with Lactade[®]. Milk was gradually re-introduced after a day or two, depending on the severity of the diarrhoea.

6.2 Black rhino

The black rhino calf *Bwana Tshiwana* ('Mr Orphan') was born prematurely on the 11th of July 1992 and was raised by Karen Trendler of The Animal Rehabilitation Centre outside Pretoria. The calf was found when he was approximately 12 hours old. He weighed 21 kg (10-15 kg less than a full-term calf), and had probably not had any colostrum. He was dehydrated, weak, chilled, and distressed, and had a torn umbilicus. He was immediately put onto a heating pad and given Lactade[®] (he still had a strong sucking reflex). He was also given one litre of bovine colostrum within 12 hours (the Lactade[®] and colostrum were alternated every hour). Karen Trendler believes that this may have stimulated the passing of meconium, but may also have led to the complications experienced later. The young calf was very receptive in company.

A large plug of meconium (dry, very orange, like a cluster of small stones, and with a sweetish odour) was passed on the second day. He had not yet urinated, despite stimulation. His temperature ranged between 34.9 and 35.6°C, and he shivered a lot. His pulse was erratic (80-112) and his respiration ranged from 40-52 breaths/minute.

His initial formula consisted of fresh skimmed milk, glucose, Aminostress[®] and Biotin[®]. This was fed at 15% of body weight. He was kept indoors under strictly hygienic conditions. Temperature was controlled and no visitors were allowed.

Days 3-4

He urinated for the first time on the third day, when he also passed a hard stool. His umbilicus became swollen and started to bleed. It was tied off and dressed. He was given 200 ml of milk every two hours around the clock. Later this was increased to 250 ml. He was taken for short walks outdoors. Towards the end of this period he passed a reddish-brown, shiny stool.

Days 5–6

His temperature ranged from 35.6–37.6°C, pulse rate from 72–84, and respiration from 21–26. On the sixth day his temperature went up to 38°C, and he developed diarrhoea six hours later. The milk was replaced with Lectade® for 24 hours; thereafter he was put gradually back onto milk. He was visibly very ill during the bout of diarrhoea.

Days 8–9

Another severe bout of diarrhoea developed – it was very foul smelling. Lectade® was given – 100 ml every half hour. He was desperate for physical contact. The milk was changed to Lactogen® 2. Biorem® was added but not glucose. There was a gradual improvement, but his stools remained soft and a pale grey, shiny colour. Intervals between stools were relatively constant.

After Day 10

He was not really satisfied by his formula. Over four days he was put on to a special rhino milk formula developed by Nestlé. The results were excellent – well-formed, dark green stools every 3 days. There was no foul smell, less wind, and no diarrhoea or constipation on this diet. He was still being fed every two hours.

At three-and-a-half weeks he developed polyarthritis, possibly as a result of an infected umbilicus. Symptoms included stiffness and pain. His left foreleg became very swollen and inflamed. Initially there was no increase in rectal temperature, but it rose by 2–3°C a day later. Polyarthritis was confirmed on X-ray examination. He was confined indoors on thick foam-rubber mattresses and given Clamoxyl® palatable drops for two days. This was followed by amikacin which was injected IM twice daily for seven days. He was very distressed during this period, but continued to drink willingly. The Clamoxyl® caused a mild diarrhoea, and the urine became cloudy and had a distinct Clamoxyl® smell. The amikacin was followed by another three days of Clamoxyl®. The swelling and inflammation was down and the rectal temperature back to normal after five days.

His joints were strapped for support and he was given physiotherapy. He was put on an extended course of Purbae® for six weeks and was on infra-red lamp therapy for five days. He was gradually re-introduced to exercise and was moved outdoors into a small pen for short periods to expose him to some sunlight and fresh air. He had recovered fully by 11 weeks.

- + At four weeks the feeding schedule was changed to 3-hourly, still at 15% of body weight. At 17 weeks he was fed four-hourly and slept seven-and-a-half hours a night.
- + Initially a normal baby bottle was used. This was later replaced by a 1.5 litre Coke® bottle with a calf teat which was the perfect size. The hole was later enlarged.
- + From eight weeks Nestum® cereal (No. 5) was added to every second feed as it was felt that the volume of fluid was too much for comfort. (I feel that this is a valid measure to sustain weight gain and ensure satisfaction.)
- + At 17 weeks (i.e., at the time of writing) he became interested in solid food but was not successful in his attempts at browsing.
- + His first teeth began to erupt at eight weeks. This was accompanied by the problems mentioned at the beginning of this paper. At 10 weeks he had two teeth, at 11 weeks he had four, and at twelve weeks he had six.
- + His skin was very soft and sensitive, and became very dry. It was cleaned and moisturized using Elizabeth Anne's Baby Shampoo®. His skin peeled dramatically at 3–4 weeks

of age – this may have been due to his prematurity or to the dehydration. He was given regular mud baths and kept fairly free of ricks, although the odd one was left alone to allow the development of immunity.

Acknowledgements

I would like to express my gratitude and appreciation to Jackie Howard, without whose total dedication and love *Lathyrus* would most certainly not have survived. Also to Karen Trendler for all the information on *Bovina Tahiriana* – I know it took a great deal of her very precious time to get this very valuable information to me in time to include it in this paper. I would also like to thank Dr Bridges Howell for her advice on foal immunity, colostrum, and colostrum substitutes.

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