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## 4 The Drug Immobilization of Large Wild Herbivores other than the Antelopes

1973

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This chapter deals with the chemical restraint of the principal African herbivores other than the antelopes, in the following order: elephant, white or square-lipped rhinoceros, black or hook-lipped rhinoceros, hippopotamus, buffalo, giraffe, zebra and warthog.

The description of chemical restraint and handling of animals is indicated in the text as follows:

- a) Animal and generic name.
- b) Body weight and usual habitat.
- c) General information e.g. social organization.
- d) Darting - areas of the body - special problems.
- e) Syringe - type and needles.
- f) Activating mechanism of syringe.
- g) Projector - long range powder-charged gun, pistol, crossbow, etc.
- h) Drugs.
- i) Reaction.
- j) Method of handling.
- k) After-care.

Dosage rates in the text are given as total doses for adult animals, unless otherwise stated. More exact information may be found at the end of the chapter (Table 1).

1. a) Elephant, *Loxodonta africana*.
- b) The body weight of the elephant varies widely, and is not easily estimated. Reports on elephant capture give body weights ranging from 1 800 kg (4 000 lb) to 6 800 kg (15 000 lb) with a fore-foot circumference of 121,9 cm (4') to 189,15 cm (5' 1½") for

elephants in the Kruger National Park<sup>11</sup>. Addo elephants have a forefoot circumference of about 120 cm (4 ft) in adult bulls, ranging from 110 to 130 cm<sup>22</sup>.

Elephants prefer bush to tall grass habitat, especially where they are hunted. It is therefore not feasible to dart them from a motor vehicle. Following may be difficult and must sometimes be carried out on foot.

c) Bull elephants may be found alone or in small groups, which are fairly easy to approach, while cow and calf herds have proved more difficult. At times they will protect an immobilized herd member so that it cannot be approached, or, at any rate only after a long period of time incurring a risk of death. At least on one occasion a four-year-old calf was assisted to its feet and then borne off by elders of the herd (own records).

d) The shoulder of the elephant or the hindquarters below the tail are the most effective locations for placing the syringe. The upper parts which slope downwards are rich in subcutaneous fascia and this hinders rapid absorption; the skin of that part of the body being extremely thick. When aiming at the shoulder the ear may well intercept the flying syringe, which has even less chance if the trunk, well within reach, knocks it out.

e) The size of the syringe used for elephants is necessarily larger than that used for lesser animals; the former must contain a greater dose of immobilizing compound and at the

same time balance the needle of greater length, which is required to penetrate the skin. The dose for a large elephant is about 8 mg etorphine hydrochloride to which 40-50 mg acepromazine may be added. If the latter is at a concentration of 100 mg per ml and the etorphine at 5 mg per ml, it necessitates a 3 ml syringe, or a 4 ml syringe if the acepromazine has been dissolved in water at 20 mg per ml.

Needle lengths range from 6 to 8 cm. They are reinforced by the addition of a welded steel spine, though this may be unnecessary when small syringes are used. Reinforcing for the first centimetre, or so, at the base by a section of needle steel precludes snapping off on impact, and provides firmer anchorage. The hole in the nose-piece must be smaller than the needle bore to prevent the needle being driven back into the syringe on impact, which would interfere with emptying of the syringe. For adequate seating of the needle, the nosepiece should be at least 12 mm long.

Needles of 3 mm outside diameter are adequate. Five millimetre needles have been used, but appear to cause excessive pain and have no special advantage.

The barb should be very securely welded onto the lower third of the needle.

A bead of welding placed on the inner end of the needle bevel is effective in preventing the syringe from being plugged with skin. A series of holes bored into the needle and complete closure of the anterior needle end appear wholly unnecessary.

f) The activating mechanism of the explosive-cap type (Palmer Chem. Co. Inc.) is recommended as the syringe is often removed immediately after impact. In addition, the force of the injection of a cap-activated syringe is likely to be useful in elephant where tissues are strong and the depth of subcutaneous fascia is extensive.

g) A powder-charge projector or crossbow

is essential if elephants are to be injected from a safe distance. In thick bush it has frequently proved necessary to resort to a carbon-dioxide powered projector, owing to the extremely short field of fire, but this is not recommended.

h) The only feasible drug for medium to large elephant is etorphine hydrochloride (M99, Reckitt). This is conveniently dissolved in acid-buffered water at a strength of 5 mg per ml or in more concentrated form in dimethyl sulphoxide (D.M.S.O.). The usual dose for baby elephant ( $\pm 500$  kg) is 1 mg and for adults 5-8 mg, together with acepromazine<sup>13, 14, 22</sup>. Acepromazine maleate (Acetylpromazine, Boots) is added for its ataractic effect, and to aid stabilisation of etorphine (qv.). Small ( $\pm 500$  kg) animals may be given 5-7 mg and adults 40-60 mg acepromazine. Atropine or hyoscine is not used owing to the large quantities which would be required and the potential toxic effects of hyoscine on elephant<sup>16</sup>. This species, can in fact, be immobilized adequately without either tranquilizer, atropine or hyoscine. For resuscitation it is necessary to use the M-series of competitive antagonists, such as cyprenorphine (M285, Reckitt). The elephant frequently shows no response to nalorphine. The antidote should be given intravenously into the ear or leg vein of a standing animal. Intramuscular injection is useful only when the subject is already showing signs of becoming ambulant. The usual dose of cyprenorphine for elephant is about 6-8 mg (500 kg animals) or 50-60 mg (adult animals)<sup>13, 16, 22</sup>.

i) The first reaction to successful immobilization is the slowing of pace within a few hundred metres concurrent with relaxation of the penis and increased rate of ear flapping. Locomotory paralysis, during which some trunk control is retained, sets in from 5-30 minutes after the first injection.

The reaction of the elephant to antidote ad-

ministered intravenously tends to be slower than that of other animals, although one has been known to rise 15 seconds after termination of the injection (own records). The recovery time in a series of elephant varied from 2 to 17 min., most animals reacting in 2-6 min.<sup>16</sup>. High environmental temperature appears to have a detrimental effect and may delay recovery.

After rising, most elephants move off at a rapid walk, although one in particular is recorded as having made determined efforts to destroy property left lying around.

j) Elephants should, for obvious reasons, be handled with special caution. Previously, before the advent of a reliable antidote, low dosage rates of etorphine were used and the elephants handled while on their feet. This practice has been discontinued to minimise the danger of accidents.

k) Elephants should be left in sternal recumbency for no longer than 20 minutes, preferable not more than for 15 minutes. The animal should be pulled over, using a vehicle and a rope on the tusk which is passed over the head. The position of the hind legs must always be ascertained before traction commences. Smaller elephant may be rocked until they fall over.

Immobilization should be avoided during the hotter parts of the day, but when animals do lie in the sun they should be carefully protected by copious water lavage. Work should always be completed as quickly as possible. The administration of small amounts of antidote, to render the subject more viable soon after recumbency, is not practicable in the elephant which cannot manually be controlled as can other animals, such as the rhinoceros.

2. a) Rhinoceros (white or square-lipped), *Ceratotherium simum*.

b) The white or square-lipped adult female rhinoceros weighs approximately 1 500

to 1 800 kg (3 300-3 960 lb) and the adult male up to 2 500 kg (5 500 lb). Their preferred habitat is open, short-grass bushland.

c) This species is commonly found in groups of 8 to 10; solitary animals or pairs are also encountered. Aggression is rare and there appears to be little risk in approaching on foot, although a case of a horse being tossed by an injected rhinoceros has been recorded<sup>18</sup>.

d) In the rhinoceros the body area suitable for injection is extensive and includes the shoulder, most of the hump and neck and the lower part of the hindquarters; the rib-cage, saddle and croup should be avoided. Syringes fired into the rear end are less likely to be brushed off as the animal moves through bush and also act as markers. On the other hand, immobilization is likely to be speedier when a shoulder shot is used.

e) Similar syringe criteria apply for rhinoceros as for elephant. However, the gas-powered gun may be used, especially if darting is carried out from a following motor vehicle: here the needles need be less robust than when the powder-charge gun is used. A minimum of trauma should always be inflicted since abscesses are otherwise likely to result. The choice of needle should be made with the utmost care; it must be sharp and free of burrs. Abscesses occur less frequently when smaller, less concentrated quantities of solution are used.

Since rhinoceros skin is apt to cause blockage of the needle bore, the end of the needle should be partially closed by a bead of metal (see 1 (e) above).

f) The preferred activating mechanism is one of the slow-acting type; either a modification of the acid-carbonate variety, such as the one developed by Van Rooyen (Kruger National Park) or that as described by Hart-hoorn<sup>4</sup>, or else the various compressed air mechanisms produced by manufacturers such as Paxarms Ltd.

g) Any of several types of projector may be used, depending on whether darting is performed on foot or from a following vehicle.

h) Etorphine (M99) was the drug of choice for most of the 1 400 rhinoceros captured in Zululand. Some adult bulls were immobilized with only 1 mg. More usually doses ranged from 1 mg for calves weighing about 1 000 kg or less, to 2 mg for adults and sub-adults. The dosage range has been found to vary widely when computed from 0.25 to 3 micrograms per kg, injected in combination with acepromazine (0.5-4.5 mg) and hyoscine hydrobromide (25-100 mg).

Competitive antidotes vary in relation to the body weight of the recipient animal rather than to the dose of the immobilizing compound initially administered.

The dosage rate of nalorphine fluctuates widely since it is biologically graduated and injected until a certain response is obtained. On the whole this varies between 200 and 400 mg. As most of the rhinoceros captured in Zululand were crated, only small doses of antidote were needed, resulting in almost immediate (30 seconds) improvement in the respiration and signs of awakening. Additional tranquillizer, such as diazepam, was often administered at this point.

i) The square-lipped rhinoceros becomes extremely tractable under the influence of morphine-like compounds which take effect in 6-20 minutes after administration. During that time the darted animal may travel from 300 metres to about 5 kilometres and may fight if confronted by a solid obstacle in its path. The addition of tranquillizer will prevent this tendency and induce the immobilized rhinoceros to lie down. The response to the intravenous injection of antidote is usually rapid.

j) Semi-immobilized rhino are apt to get into difficulties when in rough terrain or in water. An important aspect of handling is to remain with the darted animal so that first

aid, in the form of small injections of antidote, can be applied when necessary.

They are most easily followed on horseback, two horsemen being quite adequate. After immobilization it is vital to establish sternal recumbency and monitor respiratory rate and rhythm.

k) The after-care of captive rhinoceros is very important. Careful attention to lacerations and needle punctures should be given along standard veterinary procedures. It is necessary to induce feeding at an early date, music having, on occasion, been found to have a calming effect<sup>18</sup>.

3. a) Rhinoceros (black or hook-lipped), *Diceros bicornis*.

b) The body weight of the black rhinoceros varies from 370 kg (800 lb) to 1 260 kg (2 770 lb)<sup>9</sup>.

The habitat consists of dense acacia bush, montaine bush-forest and semi-desert scrub. In protected areas the black rhinoceros can be seen in open grassland where it is easier to approach.

c) The black rhinoceros is usually encountered singly. Bull groups are rarely observed. Black rhino are more easily approached when feeding, or when asleep in the open on a ridge. In bush they tend to move down wind before resting and can only be approached with the greatest difficulty.

d) The capture of black rhinoceros has been found easier and less costly when helicopters are used, saving a great deal of wear and tear of vehicles. They can be injected successfully using a powder-charged projector<sup>2, 9</sup> and more sporadically, from vehicles, using gas-powered projectors. The neck and shoulders are preferred as sites for injection, but good results have also been obtained from areas along the back, that is, if the syringe is fired directly downwards from the air.

e) Six centimetre needles are used, as for

white rhinoceros; the procedure indicated for elephant needles is, however, to be followed here also. The hide, especially along the back, is so tough that it may cause the end of the syringe to expand, creating a leak or shedding of the nose piece; alternatively, the syringe may flip over to break the needle at the base or cause it to be jerked from its socket. Needles should therefore be strongly embedded into the nose piece.

f) The criteria for the activating mechanism of the syringe is as for white rhinoceros (q.v.).

g) The type of projector varies in relation to whether the animal is injected on foot, from a motor vehicle, or from a helicopter. A powder-charged projector used from the latter is the most practicable way of capturing black rhinoceros.

h) The black rhinoceros tends, more than the white, to become excited by morphine-like compounds, necessitating greater attention to the tranquillizers in the immobilizing dose. A most effective mixture consists of Etorphine, Acetylpromazine and Azaperone or Etorphine and Azaperone. Fentanyl and Azaperone have also been used successfully. Recommended dosage rates are the following: Etorphine 1.5-2 mg, Acetylpromazine 20-28 mg and Azaperone 250 to 400 mg.

Nalorphine hydrobromide is effective as antidote, injected intravenously and or intramuscularly in doses of 150-250 mg, depending on the estimated weight of each individual animal.

i) The black rhinoceros, when darted, will usually react by running. Only in game reserves, when out in the open, have they remained standing or feeding (own records). They will usually move fast through rugged terrain which makes following extremely hazardous. As black rhinoceros tend to inhabit tsetse infested areas, horses are usually not available for following. As with the white rhinoceros, they tend to drown easily when

entering water in a semi-immobilized state. Partially immobilized individuals are also apt to stumble and fall when going steeply downhill.

Once the antidote is administered recovery is rapid, often within one minute of injection. Aggression may be shown at this point, endangering field staff and vehicles.

j) The black rhinoceros is difficult to handle and is likely to light its crate. Denney<sup>2</sup> found crating of rhinoceros under Azaperone tranquillization quite feasible, although King<sup>19</sup> preferred to tie them onto their sides on a sledge. If the journey to the pens is prolonged, there is a substantial advantage in the crating method, which seems entirely satisfactory if adequate tranquillization is practised.

k) After-care is particularly important in black rhinoceros which tend to be infected with trypanosomes and die of acute trypanosomiasis several days after capture unless treated. Berenyl (Bayer), although not classed as a prophylactic, appears to prevent the stress-induced formation of this disease.

The black rhinoceros usually feeds within a day after capture and must be supplied with its natural diet to which increasing amounts of lucerne may be added. Careful attention should be paid to adequate feeding and elimination of parasites, diseases and deficiencies.

Note that rhinoceros are inclined to fight in captivity and will try to break down the walls between their enclosures to attack each other. Black rhinoceros tame down readily if the walls of their enclosures are solid.

4. a) Hippopotamus, *Hippopotamus amphibius*.

b) The body weight of the hippopotamus is only sporadically known. Pienaar<sup>12</sup> gives weights ranging from 1 360 kg (3 000 lb) to 2 050 kg (4 500 lb). Males weighing 1 460 kg (3 237 lb) were recorded by Mann (ms.) and 1 900 kg (4 000 lb) by Lamprey (ms.)

1.5 mg, in combination with 5-10 mg hyoscine hydrobromide and 20 mg Acetylpromazine (or Fluanisone)<sup>15</sup>. Pienaar<sup>4</sup> also recommends a mixture of 10-15 mg Fentanyl and 50 mg Azaperone for the capture of adult warthog.

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Table 1 Suggested dosages of the major drugs used for the capture of large herbivores, excluding the antelope

Name	Average Weights (kg)	Fentanyl (total dose in mg)*	Etorphine* (total dose in mg)	Animals immobilized	Mortality (as stated)	References
Elephant	500† 750† 5 000**	— Not recomd. —	1,0 5,5 7,5	87—	4,—	5, 7, 14, 16, 22
Rhinoceros (white)	800† 2 000**	10 40	1 2	142†	1,—	5, 8, 14, 18
Rhinoceros (black)	950	30	1,5-2	79—	0,—	2, 5, 9, 10
Giraffe	400† 800**	— 20-30	1,5 3,5	106†	13,—	5, 7, 14, 17, 20
Hippopotamus	400† 950**	— 60-80	3 5	26—	1,—	12, 14
Buffalo	400† 950**	— 40-60	3-4 4-6	25†	0,—	1, 5, 14, 20
Zebra	130† 350**	Not recomd.	1 2-3	280†	2,—	3, 5, 7, 10, 14, 23
Warthog	65-90**	10-15	1-1,5 3,50	—	—	14, 15

\* Fluanisone, Azaperone or Acetylpromazine or some other suitable tranquillizer and/or hyoscine added (see text).

\*\* Adult animals.

† Young animals.

— Information not supplied.

*Editor E. Young*  
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# THE CAPTURE AND CARE OF WILD ANIMALS

*The work of eighteen Veterinary,  
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pp [1-13], 1-224

Human & Rousseau Cape Town and Pretoria

1973