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Immobilization and Translocation of the White (Square-Lipped) Rhinoceros

J. D. Wallach, B.S., D.V.M.

THE PROBLEM of conserving the white (square-lipped) rhinoceros, *Ceratotherium simum simum,* is one that has been encountered before by conservationists in dealing with other species. The total population of the southern variety of white rhinoceroses was reduced in 1961 to 650 in a 129,000-acre area.[1] In 1965, there was a total of 912 white rhinoceroses in an area little larger than 118,000 acres,[7] despite the translocation of more than 250 of these animals. Thus, a relative over-population occurred in a species on the brink of extinction. It became necessary to develop methods of capture and translocation of rhinoceroses in a short time to prevent overgrazing of their last sanctuary and to re-establish breeding populations in other suitable areas. Consequently, a project was undertaken to translocate rhinoceroses from Umfolozi Game Reserve, Zululand, to Kyle Dam Game Reserve, Rhodesia.

The original forms of capture and immobilization of large game animals for zoological gardens—translocation, tagging, and treatment—have long been a test of the mental and physical agility of the persons involved. Until the middle 1950's, most captures of this nature were accomplished by trapping, netting, looping, or just plain "bulldogging." Now, with the advent of the projectile syringe, routine immobilization and examination of large game animals has become possible.

The original system of rhinoceros capture with drugs was developed by a research worker from Kenya who used morphine, diethylthiambutene hydrochloride, or phencyclidine as immobilizing agents.[1,2] it was obvious at that time that the methods could be improved if drugs in smaller quantities could be used. The relatively large amounts required (10 to 15 cc.; up to 4 Gm. of dry drug) rendered the projectiles cumbersome and inaccurate at longer ranges, and the immobilization time was exceedingly long, allowing the inoculated rhinoceros to travel a considerable distance before going down. With the incorporation of the oripavine derivative M.99,* the volume was reduced from 15 to 1 cc. and the immobilization time cut from 30 to 10 minutes.

The projectiles** are filled with a combination of 3 drugs. The main component

From the St. Louis Zoological Garden, St. Louis, Mo.

*M.99, Reckitt and Sons Ltd., Hull, England.

**Projectile syringes, 1 cc., Palmer Chemical and Equipment Co., Atlanta, Ga.

is the oripavine derivative M.99, chemically described as 6, 14 endoethano-7α (-2-hydroxy-2-pentyl)-tetrahydro-oripavine. It is a chromatographically pure white powder with a melting point of 266 to 267 C.[6] It can be absorbed through mucous membranes as a powder or through the intact skin as a solution; there is evidence of addiction in experimental animals.[6] Compound M.99 will precipitate in the microcrevices of glass[6]; however, it has proved stable at pH 4. The environmental temperature and scopolamine hydrobromide affect the solubility of M.99.[6] Scopolamine probably reduces its solubility by common ion effect, but this reduction is easily prevented by addition of acetyl promazine maleate to the M.99 stock solution before adding scopolamine.[6] The adduct of M.99 itself has an activity equivalent to that of morphine; by changing it to the corresponding phenol it can have activities 6 to 10,000 times that of morphine.[2,5] In our experience with 54 rhinoceroses (28 males, 26 females), the dose of M.99 ranged from 0.5 to 8.0 mg., depending on estimated body weight, ranging from 180 to 5,500 lb. (81 to 2,475 kg.).

The 2nd ingredient of the combination is acetyl promazine maleate,* a phenothiazine-derived tranquilizer with central depressant, anticonvulsant, antispasmodic, and analgesic activities. Acetyl promazine is effective in small quantities when administered intramuscularly. Depending on body weight, doses ranged from 1.5 to 12.0 mg.

The 3rd ingredient is scopolamine hydrobromide.[2] Its effects are equivalent to those of atropine in preventing cardiac and respiratory arrest[2]; in addition, it asserts a central depressant effect, thus extending the activity of the other drugs in the combination.[2] The effect on the pupils lasts up to 36 hours so that care should be taken to avoid retinal burns by covering the eyes of an immobilized animal with a vitamin A and D ophthalmic ointment.** Depending on body weight, doses ranged from 25 to 100 mg.

Originally, rhinoceroses were chased and inoculated from an open vehicle (land rover).[2] This procedure, however, proved costly in vehicles and created a disturbance in the reserve. Now, rhinoceroses are stalked on foot, and the drug combination is administered intramuscularly with a projectile syringe fired from a CO_2-powered rifle.* After the projectile has made contact, the rhinoceros will often stand and become immobilized without moving more than a few steps, if it is unaware of the hunter's presence. If the rhinoceros knows of the hunter's presence before the projectile makes contact, it will usually gallop a considerable distance before going down. In the latter case, the rhinoceros is followed by Zulu game guards, mounted on horses, who direct the hunters to the immobilized animal by 2-way radio.

In 9 instances, rhinoceroses had to be inoculated a 2nd time for various reasons, including subcutaneous entrance of the needle and underestimation of weight. The additional dose was decreased by approximately half or less, depending upon the state of immobilization. One of 54 rhinoceroses inoculated by this method died 1½ hours after immobilization. (Necropsy revealed subdural hemorrhage in the cranial cavity and thecal canal.)

The 1st reaction in the rhinoceros takes place in 3 to 5 minutes and is signaled by a straightening of the tail from the usual upward curled position. Following the tail droop comes a classical "goose-step," an exaggerated lifting and placing of the forelimbs. Shortly thereafter, the rhinoceros slows to a walk or stops completely. The immobilized rhinoceros will then settle to its sternum or fall to its side.

After complete immobilization has taken place, respiratory rate and rectal temperature are determined. From 4 to 8 deep respirations per minute was optimum at the correct level of immobilization in our experience, with a rectal temperature of 85 to 95 F. (29 to 35 C.). There is usually tachycardia.[4] Heart rates up to 120 per minute without ill effect were observed. Rhinoceroses that had been given large overdoses were given 50 to 100 mg. nalorphine

*Acetylopromazine Veterinary, Boots Pure Drug Co., Nottingham, England.

**Moruguent Ophthalmic Ointment, S. E. Massengill Co., Bristol, Tenn.

*Cap-chur gun, Palmer Chemical and Equipment Co., Atlanta, Ga.

hydrobromide,* intravenously, in an auricular vein. In cases of respiratory arrest, this amount stimulated respiration in less than 30 seconds.

Body measurements of the immobilized rhinoceros are then taken, after which it is placed in a crate. Crating is accomplished by administering nalorphine hydrobromide at the rate of 250 mg. i.v. and 250 mg. i.m. The rhinoceros will get to its feet and walk into the crate guided only by a head rope.

Nalorphine itself is prepared from morphine; it will antagonize the effects of most compounds having activity similar to morphine.[2] The effective dose is determined by the size of the animal rather than by the amount of M.99 given previously. A zebra will require the same amount of M.99 as will a 2,000-lb. (900-kg.) rhinoceros, but the zebra will require 50 mg. of nalorphine and the rhinoceros 500 mg. This phenomenon reflects the selectivity of M.99 for the central nervous system and demonstrates that M.99 is not affected by simple dilution but that nalorphine is.[2]

The crate containing the rhinoceros is then lifted by a winch onto the bed of a truck, with the rhinoceros facing the rear of the vehicle to lessen the chance of the anterior horn being broken off if sudden stops are made.

The crates are then delivered to the rhinoceros "boma," an enclosure where the rhinoceros is trained to eat and drink while confined in its crate. This training is necessary to facilitate shipment in cases where the rhinoceros would be traveling for more than 1 day, since effects of the original immobilizing dose wear off in 6 to 8 hours.[3] Crate training takes a minimum of 8 weeks for the white rhinoceros.[3] The black rhinoceros (*Diceros bicornis*) takes only 3 days to adjust to eating from a person's hands, despite its more aggressive nature in the bush. Although crate training is certainly necessary for ocean voyages, it seriously hampered the translocation of numbers of rhinoceroses in the short time available to prevent the decimation of the Umfolozi Game Reserve and the dying out of the species.

During February and March, 1966, we successfully translocated 2 white rhinoceroses directly from the Umfolozi bush to Kyle Dam Game Reserve, Rhodesia. The journey of nearly 1,000 miles took 28 hours for 1 of the rhinoceroses and 26 hours for the other. Previously, expeditions of this nature were not attempted, owing to lack of experience in tranquilizing animals over a long period of time after administration of the original immobilizing drugs.

During the course of the journey, chlorpromazine hydrochloride* was administered as needed in doses of 250 mg. i.m. The 1st rhinoceros, a male, weighed 2,500 lb. (1,125 kg.). It was given an initial dose of 250 mg. of chlorpromazine approximately 2½ hours after capture. An additional 500 mg. was given: 250 mg. 8½ hours after leaving and 250 mg. 9 hours later.

The 2nd rhinoceros, a female weighing 4,000 lb. (1,800 kg.), was given an initial dose of 500 mg. of chlorpromazine. She required 4 additional doses of chlorpromazine of 250 mg. each. Half way in the trip, this rhinoceros lost her anterior horn while dozing on her feet and supporting herself by leaning on the horn.

Upon arrival at Kyle Dam, the rhinoceroses were kept under observation in bomas for several days before release to determine possible adverse effects from the prolonged tranquilization. Both rhinoceroses were released without incident.

The development of a successful and safe method of rapid translocation has now made possible large-scale operations in which the number of rhinoceroses translocated per day is limited only by the number of vehicles available. We can now foresee the rapid reduction of the excess population of white rhinoceroses in Umfolozi and the re-establishment of breeding herds elsewhere in Africa.

*Lethidrone, Burroughs Wellcome and Co., London, England.

*Largactil, May and Baker Ltd., Dagenham, England.

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Blood Pressure of Feral Giraffes Studied by Radio Telemetry

Considerable hypertension must be created in order to propel blood to the giraffe brain, 2 meters or more above heart level. The cerebral vessels must be protected from increased pressure, when the animal's head is lowered, as for drinking.

Recently in Kenya, East Africa, blood pressures of 2 wild giraffes were recorded by radio telemetry. Upon capture, the center of the neck, about 40 cm. below the jaw, was infiltrated with 2% procaine. A 15-cm. vertical incision exposed the trachea and carotid arteries. A 10-cm. section of the right carotid artery was clamped off. A small blood-pressure transducer in the form of a stainless-steel wafer was inserted into a 1-cm. longitudinal opening. Recording was done on the animals when lying down, grazing, and galloping. Then after recapture, the incision was opened and the transducer removed.

The heart rate of both giraffes lying flat on the ground was 90 beats per minute. The carotid artery blood pressure rose to about 280 mm. Hg. When they raised their heads, heart rate dropped to less than 60 beats. When they got up, blood pressure was 190/120 mm. Hg and heart rate 150 beats per minute. During walking, the carotid blood pressure varied from 140/90 and 180/120 mm. Hg; when standing quietly, carotid blood pressure was 150/105 to 170/110 mm. Hg. Accordingly, cerebral perfusion pressure varied from 280/160 in the recumbent animal to 110/60 mm. Hg in the standing animal.—*Science, 152, (April 15, 1966): 384.*