

ETORPHINE (M-99) IMMOBILISATION AND ASSOCIATED BEHAVIOUR OF THE RED HARTEBEEST (*ALCELA PHUS BUSELA PHUS CAAMA*)

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ABSTRACT

Fourteen red hartebeest (*Alcelaphus buselaphus caama*) were immobilised with etorphine hydrochloride (M-99) in combination with azaperone. Dosage rates were kept constant for comparative purposes. An inverse relationship between sympathetic stimulation and eventual immobilisation was demonstrated. Immobilisation time was influenced considerably by the specific site of injection. Hartebeest showed three types of reaction after darting, viz. complete restraint, semi-tranquillisation, and a state where animals required an additional dosage to produce the necessary sedation. Drugged individuals soon became separated from other members of the same species. Typical reactions included the occurrence of exaggerated feeding behaviour and the state of complete indifference to human presence. The unnatural behaviour of semi-tranquillised males occasionally led to aggressiveness on the part of females. Intramuscular injections of cyrenorphine hydrochloride rapidly reversed the narcotic effects of etorphine hydrochloride. Most hartebeest, fully recovered, were observed with their original herds within a day after immobilisation.

INTRODUCTION

A field project, aimed at elucidating various facets of the behaviour and spatial distribution of the red hartebeest was launched in the Willem Pretorius Game Reserve, Orange Free State, in June 1970. Although certain individuals could be distinguished readily on the basis of characteristic horn shape, idiosyncrasy in behaviour or physical abnormalities, it was soon realised that a more reliable method of field identification was necessary.

The employment of photographic equipment enabled Gosling (1966) to recognise individually more than a hundred Coke's hartebeest in the Nairobi National Park by features such as ear nicks and horn shape, length and ridging. By contrast, the wary disposition of red hartebeest in the Willem Pretorius Game Reserve normally excluded the close approach and detailed photography of individual members, so that the use of identification cards proved to be impractical.

After initial netting attempts for marking purposes, attention was finally focussed on drug immobilisation. The recently developed compound, etorphine, was used exclusively as it is highly acclaimed for the capture and handling of large and medium sized African ungulates (Ebedes 1969, 1971; Hanks 1967; Hanks and Dowsett 1969; Harthoorn 1965; Harthoorn and Bligh 1965; Hirst 1966; King 1969; King and Carter 1965; King and Klingel 1965; Pienaar 1967, 1968b; Pienaar et al. 1966a, 1966b; Player 1967; Roth 1967; Short and Spinage 1967; Wallach 1966).

King (1969) and Van Niekerk and Pienaar (1963) mentioned the remarkable difference in drug susceptibility between black rhinoceros (*Diceros bicornis*), blue wildebeest (*Connochaetes taurinus*) and buffalo (*Syncerus caffer*) from east and southern Africa. In this study an attempt was made to indicate the extent of variation in susceptibility, even within a single population of a given locality, by using standardised narcotic mixtures for immobilisation purposes.

MATERIALS AND METHODS

The drugs included in the study were the following: *Etorphine hydrochloride* (Reckitt and Sons, Ltd.), an analgesic better known as M-99, represents the principal constituent of the narcotic mixtures used. Following Pienaar et al. (1966b), working solutions

containing 4 mg/ml of the powdered base were prepared using an organic solvent, dimethylsulphoxide (D.M.S.O.).

Azaperone (Janssen Pharmaceutica) is a major neuroleptic agent displaying a marked potentiating and synergistic effect on the action of M-99. Solutions with a pharmaceutical strength of 10 mg/ml were prepared by dissolving the powdered base and tartaric acid in distilled water. (See Janssen Pharmaceutica brochure (1969) and Pienaar (1968a) for brief description of technique).

Cyprenorphine hydrochloride (Reckitt and Sons, Ltd.), also known by the code-name of M-285, was employed as a highly specific antagonist of etorphine hydrochloride. Aqueous solutions prepared at concentrations of 10 mg/ml successfully counteracted the effects of the analgesic concerned. In all cases the antidote was administered intramuscularly.

Since M-99 and azaperone have such wide therapeutic indexes and safety margins of several hundred per cent, dosage rates are not dependent upon accurate weight estimates. Consequently, no need prevailed to vary the concentration of neuroleptic-analgesic mixtures from one individual to another. Dosage rates were kept constant in order to obtain the necessary data for comparative and statistical purposes. With one exception, all narcotic mixtures consisted of 1 ml (4 mg/ml) etorphine in combination with an equal volume of 10 mg/ml azaperone.

Drug administration and immobilisation were effected by means of dart syringes fitted with NC3 nose plugs and barbed needles. Apart from a single attempt with the Van Rooyen crossbow (Van Niekerk and Pienaar 1962), all darts were fired from a 32 gauge Harrington and Richardson single barrel projector (Cap-Chur Powder Projector), powdered by "Ramset" 0,22 cartridges.

While immobilised, hartebeest were marked individually with a combination of coloured Sterkolite neck bands for subsequent identification at distances of up to 800 m. Various body measurements were taken for future reference.

With the necessary equipment, handlers and organisation, netting of hartebeest herds can be accomplished successfully on the open plains of the Orange Free State. The major drawback of such a method is the possibility of overexcitement and fatigue from running long distances which may result in fatalities through stress disease. In this connection,

Young (1966) reported macroscopic and microscopic lesions of various internal organs after physical exertion by red hartebeest.

For the behavioural project in mind, it was also necessary to mark individuals, preferably males, from different herds and localities within the game reserve, a requirement difficult to meet due to the skewed sex ratio in favour of females and the general occurrence of only one adult male per herd. Furthermore, in contrast to the marked tameness of waterbuck (*Kobus defassa*) following immobilisation as experienced by Hanks (1967), netted hartebeest, particularly females, subsequently became the most alert and wary members of a herd, always initiating flight reactions.

Since most hartebeest occur in rugged terrain, generally preferring grassy slopes interspersed with scattered trees and shrubs, darting from a vehicle was ruled out in the majority of cases. On the plains, where mechanical transport is permitted, flight distances approximated 200 m, probably as a result of the disturbances caused by the annual chasing and capture of hartebeest and other antelope species. As was found in the case of gemsbok (*Oryx gazella*) (Ebedes 1969), hartebeest also quickly learnt to associate the darting vehicle with danger, thereby increasing their flight distances and taking flight as soon as it appeared, even though they were not unduly upset when other vehicles approached. In darkness flight distances decreased considerably, but due to the difficulties encountered in aiming at and tracking stricken animals, darting was not considered feasible at such times.

Due to their keen auditory, olfactory and visual senses, great difficulty was experienced in stalking hartebeest for darting purposes. This was particularly true where the close approach of herds was attempted, as all members quickly become alerted by startled individuals at the periphery. Generally, males have a more placid nature than females, a situation reflected by the fact that females almost invariably take the lead when fleeing from danger while the adult male brings up the rear. In this connection it is perhaps significant to note that the only successful stalking attempts involved two old solitary males and one subadult male.

In practice, it was found easier to approach hartebeest on rainy days than on pleasant days. Two factors which may influence such behaviour, either independently or combined, are suggested. First, dry plant material such as grass, dead leaves and twigs absorbed moisture and tended to give way instead of breaking and cracking upon being trampled on, thereby decreasing the noise level of the approaching person. Secondly, as scent does not carry well on cold, moist air (Darling 1969), the olfactory senses of the animals were probably impaired.

The most successful method of darting, especially in bushy or rocky terrain, eventually proved to be the ambush. This technique involved the slow herding of hartebeest in the direction of the waiting person, and was accomplished by calmly approaching the antelope on foot or by truck at moderate distances so as to prevent panic-stricken flight. In most cases the animals passed within 10-50 m of the darter, being totally unaware of human presence. Such behaviour may seem surprising for antelope which are primarily dependent upon their senses of sight, but movement more than anything else draws attention in the field. As long as the darter's silhouette against the light background of the sky is eliminated, either by sitting

quietly in shady areas or against the dark and broken background of thickets and shrubbery, he mostly goes unnoticed.

A disadvantage of this technique is the detailed knowledge required of home ranges in order to anticipate correctly the direction of flight and the routes most likely to be followed. No more than two individuals could be immobilised successfully on a particular day, but the method nevertheless proved to be the only practical one under the circumstances concerned.

All darting and immobilising were confined to daylight hours for obvious reasons. Even though equal periods of time were spent in tracking hartebeest in the mornings and afternoons, more than twice as many encounters occurred during the morning hours. This can be attributed to the fact that the antelope can be located readily when they are grazing, standing or walking early in the mornings. During the midday hour, on the other hand, they are usually resting and more difficult to observe.

In most cases, hartebeest took flight immediately after having been struck by a dart. So as not to incite further panic, the stricken animal was followed at some distance, either by truck or on foot, or just kept in sight until the effects of the narcotic became apparent or recumbency resulted. Semi-tranquillised animals could be approached readily on foot and taken by the horns while they were wandering around in a bemused state.

RESULTS AND DISCUSSION

Adult or subadult hartebeest were darted intermittently over a two-month period at the end of 1970. Of 22 darting attempts, 17 hits were registered, resulting eventually in the successful capture and marking of 14 individuals – ten males and four females. Details pertaining to the immobilisation attempts are presented in Table 1, while brief discussions and an interpretation of the results obtained are given below.

Darting

Considering all darting attempts, an average distance of 34 m from the target, as measured by pacing immediately after firing, was obtained. If the 17 successful and five unsuccessful shots are considered separately, however, averages of 26 and 64 m are obtained respectively. The high value of the latter gives a good indication of the unreliable trajectory of the projectiles syringes whenever shots of over 50 m are attempted. At such distances, even the maximum cartridge load is inadequate to overcome wind force distortion. High powder charges (heavy and extra heavy) were used in all but three cases in order to maximise efficiency. The employment of extra heavy charges over short ranges was avoided as serious wounds can be inflicted by too deep penetration of the syringe.

Hartebeest being difficult to approach unnoticed, 73 per cent of all darting attempts involved disturbed animals, either walking or trotting away. Such activities indicate that the sympathetic nervous system might have been activated to some extent, thereby releasing epinephrine and norepinephrine. These and morphine-like substances have antagonistic effects on cardiac output, gastric secretion, body temperature, pupil dilatation, metabolism and respiration. (Best and Taylor 1970, Cutting 1969, Goodman and Gilman 1970). Sympathetic stimulation, reflected indirectly by the panicky behaviour of the animals,

TABLE 1. General data on drug immobilisation of hartebeest, Willem Pretorius Game Reserve

No.	Sex	Mode of approach	Distance when darted (m)	Activity when darted	Remarks
1.	Subadult ♂	Ambush	25	Trotting	Recovered well
2.	Adult ♂	Truck	74	Standing	Unsuccessful
3.	Adult ♀	Ambush	30	Walking	Good reaction
4.	Subadult ♀	Ambush	20	Trotting	Recovered well
5.	Adult ♀	Ambush	11	Walking	Good reaction
6a.	Adult ♂	Ambush	30	Trotting	Incomplete tranquillity; darted twice
b.	Adult ♂	Openly on foot	22	Walking	Slightly tranquillised on release
7.	Old solitary ♂	Stalked	18	Lying	Dead when found
8.	Adult ♀ in calf	Ambush	24	Walking	Recovered; not seen subsequently
9a.	Solitary ♂	Ambush	17	Walking	Mild sedation; darted twice
b.	Solitary ♂	Ambush	20	Walking	Marked sedation; slow response to antidote
10.	Adult ♂	Ambush	15	Walking	Good reaction
11.	Adult ♂	Ambush	26	Walking	Unsuccessful
12.	Adult ♂	Ambush	73	Walking	Unsuccessful
13.	Solitary ♂	Truck	39	Grazing	Slow response to antidote
14.	Old solitary ♂	Stalked	46	Grazing	Difficult in handle; recovered well
15.	Subadult ♂	Stalked	30	Standing	Very slow recovery
16.	Adult ♂	Ambush	81	Grazing	Unsuccessful
17.	Adult ♂	Ambush	40	Walking	Recovered well
18.	Adult ♂	Ambush	25	Trotting	Recovered well
19.	Subadult ♂	Ambush	23	Trotting	Very slow recovery
20.	Adult ♂	Ambush	66	Trotting	Unsuccessful

therefore tends to prolong the time lapse from darting to first signs of ataxia (Fig. 1) and immobilisation (Fig. 2). Slightly higher averages for the grazing and trotting categories in Figure 2 are obtained if the two clear bar values are taken into consideration, so that the general pattern of Fig. 1 is approximated more closely.

Although injection sites involved various parts of the body, including the abdomen, flank, rump, shoulder, thigh and thorax, the majority of darts penetrated in the rump region. A diagrammatic representation of all the sites referred to in the text and table is given in Fig. 3. Since individual dosage rates were

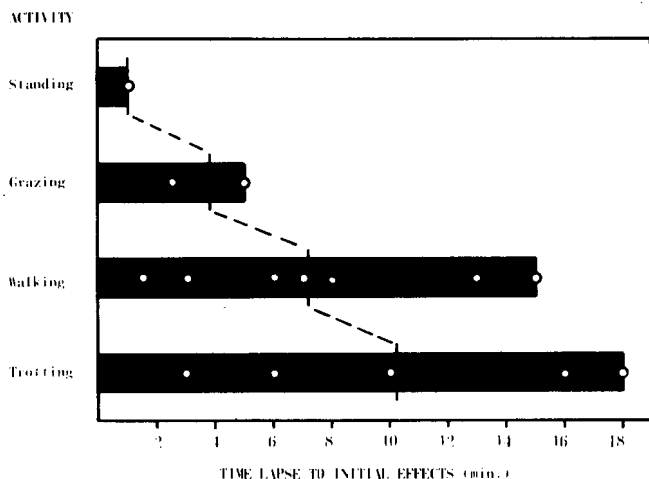


Fig. 1. Bar chart showing relationship between activity when darted and first signs of ataxia. Vertical lines indicate averages or single values.

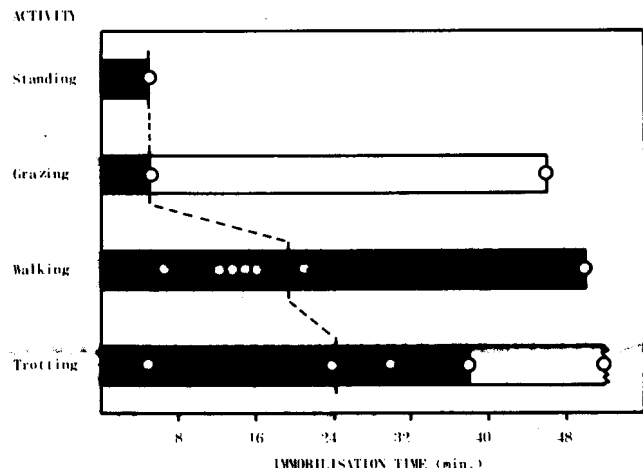


Fig. 2. Bar chart showing relationship between activity when darted and immobilisation time. Closed clear bar represents subsequent discovery of immobilised individual, while broken clear bar represents incomplete immobilisation. Vertical lines indicate averages or single values. (Clear bar data not included in calculations).

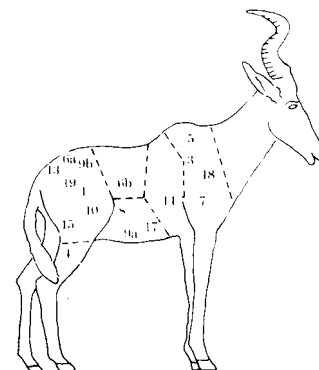


Fig. 3. Diagram of hartebeest showing darting sites. Numbers refer to those of Table 1.

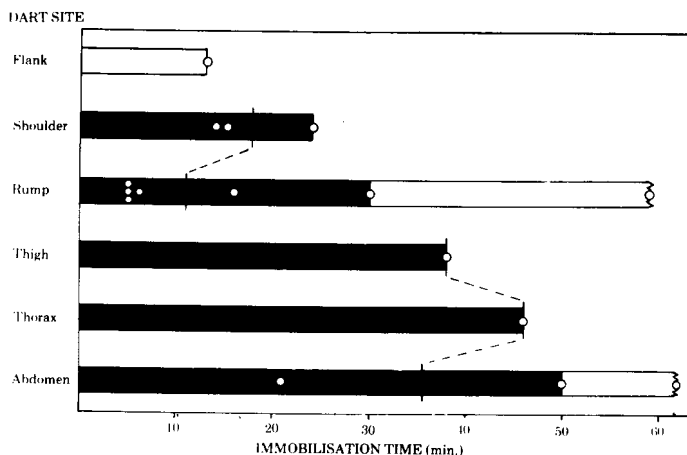


Fig. 4. Bar chart showing relationship between darting sites and immobilisation time. Closed clear bar represents subsequent darting of heavily tranquillised individual, while broken clear bars represent incomplete immobilisation. Vertical lines indicate averages or single values. (Clear bar data not included in calculations).

kept constant, the different time values obtained for immobilisation could be used for comparative purposes. As illustrated by the varying lengths of the solid bars in Fig. 4, immobilisation time is influenced considerably by the specific site of injection. Two groups of average values can also be distinguished. The higher group consists of animals injected in the abdomen, a category of which the average value increases noticeably if the clear bar datum is included in the calculation, or near skeletal structures such as are found in the thigh and thorax regions. Animals darted in the rump or shoulder constitute the lower group. Such regions provide ample surface area for deep intramuscular penetration of the needle, leading to effective drug absorption and rapid immobilisation. If the broken clear bar value of the rump category is taken into consideration, an average is obtained almost identical with that of the shoulder region. The single injection in the flank has not been considered part of the low group of average values as it represents the administration of an additional dosage to an individual already under marked sedation.

Due to the somewhat unreliable trajectory of the projectile syringes, and the difficulties encountered in darting moving targets, shots were often missed, resulting occasionally in the loss of expensive equipment. Although barbed needles were used exclusively, scraping from bushes and removal by mouth of firmly fixed darts were also witnessed. Altogether eight syringes were lost while five were recovered partly damaged. Four of the latter involved shots on or near bony structures such as the tibia, ribs and scapula, whereas the fifth accidentally struck a rock.

Reaction

Although the effects of the narcotic mixture differed slightly from individual to individual, certain features of the reaction were shared by most hartebeest. On feeling the dart strike, the victim immediately rushed off at great speed. Herd members likewise panicked and started bolting. In a single instance a solitary male did not flee on impact of the dart, but merely walked away slowly, pausing twice in order to urinate and defecate. While fleeing more or less in a specific direction, the stricken animal soon tended to dissociate itself from its companions. In part, this is due to the general slow-

down of reactions and movements on the part of the victim caused by the commencement of drug action. The only occasion where separation from other individuals did not take place until the moment of capture, involved a female in calf who was followed closely by a one- and a two-year old calf over a distance of 3 km.

The first obvious signs of ataxia were generally noticed within seven minutes after darting. A graphical representation of the relationship between the occurrence of the initial effects and eventual immobilisation is given in Fig. 5. After slowing

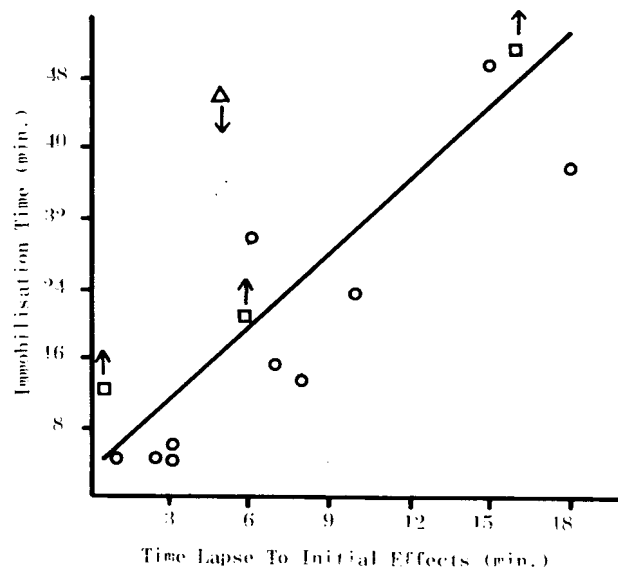


Fig. 5. Regression of immobilisation time on time lapse before ataxia ($r = 0.88$, $p < 0.01$). Triangle refers to subsequent discovery of immobilised individual, while squares indicate incomplete tranquillity.

down gradually from a gallop to a slow trot or a fast walk, the stricken animal typically advances by giving short brisk steps and lifting the forelegs high off the ground in hackney fashion. At the same time, the head is held high with the mouth often opened wide. The sense of equilibrium is apparently impaired, a condition which manifests itself by the walking in circles. At deeper levels of narcosis the head is lowered and the hind legs become unsteady, resulting in frequent stumbling. Before collapsing or coming to a standstill, however the animal may still wander about aimlessly for some time, or even sprint a few metres if disturbed. In Fig. 6 the estimated

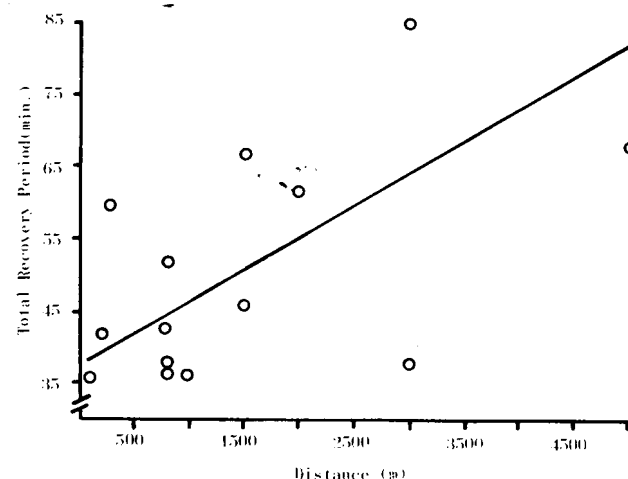


Fig. 6. Regression of total recovery period on estimated distance covered from darting to immobilisation ($r = 0.07$; $p > 0.05$).

distance covered from darting to immobilisation (approximately 1 km on the average) is related to total recovery period.

While in a trance-like state, the unnatural behaviour of drugged males occasionally lead to an attack by female companions who are normally completely dominated by adult males. Elephants, in contrast, may assist each other in similar situations (Pienaar 1967). Among birds, members of the same species are attracted to drugged individuals which behave in such an abnormal manner (Kok 1971, Murton et al. 1963).

Based on their reaction to the narcotic mixtures, hartebeest can roughly be divided into three groups. The categories include those individuals (6a and 9a) which were incompletely anaesthetised and required an additional dose to produce the necessary sedation, those which stayed on their feet and never went down of their own accord (1,4,6b,8,17 and 18), and those which collapsed gently and lay in sternal recumbency in a state of complete restraint (3, 5, 9b, 10, 13-15, 19, including also number 7). Individuals of the latter group remained on their briskets with the head held erect or with the chin propped up against the ground. Eyes remained open all the time except in the case of two heavily sedated males whose stomachs could also be heard rumbling periodically. Signs of slightly increased salivary flow and depressed respiration were occasionally exhibited. Furthermore, in almost all cases a rather sweet smell prevailed the air in the proximity of the animal's head, but its origin, drug action, gland secretion or some other property, could not be ascertained.

Hartebeest included in the second category kept moving continuously or grazed any form of vegetation available. As shown in Fig. 7, their voracious appetites caused plant material to be eaten and swallowed by the mouthful. Apparently such feeding behaviour is a common response in ungulates (Pienaar 1968a, 1968b; Lynch 1971), even continuing while lying down (Fig. 8), and is induced primarily by the presence of the neuroleptic, azaperone, in the narcotic mixture.

Having lost all reactions of fear, probably as a result of the senses of smell, sight and hearing being dulled, and being inquisitive, semi-tranquilised individuals typically approached human beings. A similar phenomenon has been recorded for blesbok



Fig. 7. Heavily sedated young male hartebeest feeding on a mouthful of plant material.



Fig. 8. Sternal recumbency of completely immobilised adult male hartebeest. Feeding reaction persisting even though lying on sandy patch almost devoid of any vegetation. Collar fitted 17 minutes after darting.

(*Damaliscus dorcas*) (Lynch 1971), giraffe (*Giraffa camelopardalis*) (Hirst 1966) and other ungulates, particularly blue wildebeest (Pienaar 1968a). Drugged animals being attracted to human presence, capture by grabbing the horns was readily accomplished. However, at least two people were necessary to restrain the animals, as they struggled violently on being handled. Like giraffe (Hirst 1966), drugged hartebeest always moved forward when confronted by humans or inanimate objects such as bushes and small trees. One female got herself entangled among dead branches of a sweet-thorn (*Acacia karroo*) and could be handled right away.

Recovery

On the average, 40 minutes elapsed from the time of darting to the intramuscular injection of the antidote. A few minutes after administration of the antidote, the animal usually regained its feet fully conscious with no evidence of any soporific effects. Generally speaking, delayed antidote administration resulted in rapid recovery and vice versa (Figure 9).

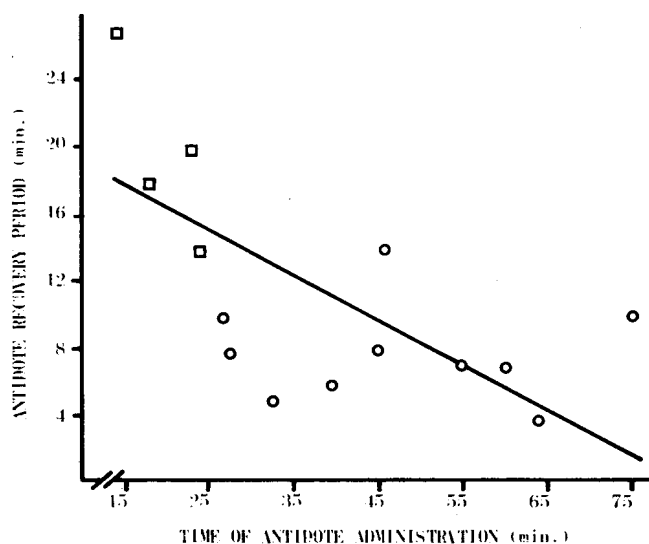


Fig. 9. Regression of antidote recovery period terminated by the regaining of feet on time lapse from darting to antidote administration ($r = 0,77$; $p < 0,01$). Circles represent single antidote injections, while squares represent multiple dosages.

The former tendency is perhaps explicable on the basis of the low etorphine concentration having resulted from continued breakdown through internal metabolic processes. If the antidote is administered too soon after darting, the action of the relatively high concentration of the narcotic mixture is reversed so slowly that the cyprenorphine dosage has to be replenished to enhance recovery. Following the administration of the antagonist, individuals sometimes urinated, while in the male the penis became evaginated from its sheath. Instead of being slightly curved, the tail likewise relaxed until hanging straight down (Figure 10). When upright, two heavily

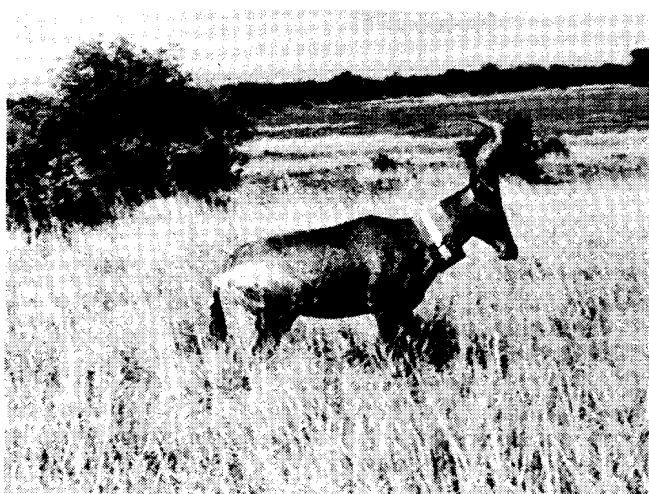


Fig. 10. Young male hartebeest with collar applied, having just received the antagonist. Note slightly elevated position of head and slack hanging tail.

tranquillised animals showed leg tremors and peroneal paresis. Hartebeest occasionally remained placid for a while after receiving the antidote. This state of indifference to human presence resulted in persons being approached or the darting vehicle being followed persistently when driving along slowly. Sudden noise, moving of the arms or a slap of the hand usually provided sufficient stimulus for the animal to turn and walk or trot away.

Apart from solitary males, all hartebeest were noticed with their original herds within a day after immobilisation. One one occasion the return of a marked individual to a bachelor group of three males was actually witnessed. While approaching his former companions, one of the latter rushed forward aggressively, possibly as a visual response to the unfamiliar neckband of the "intruder". Within a metre of his would-be opponent, the aggressor suddenly stopped, obviously taken aback (by the human odour?), and kept moving backwards for a considerable distance while facing the other. On the following day the four males were still together, but the others were observed fighting playfully in turn with the collared subadult. The group eventually broke up.

Mortality of hartebeest attributed directly to immobilising procedures remained insignificant. Only an old solitary male died after having been lost in a densely vegetated gorge at dusk. The animal was found heavily bloated in a lateral position 16 hours after darting.

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