Notes on the Immobilisation of Gemsbok *(Oryx gazella gazella)* in South West Africa using Etorphine Hydrochloride (M-99)

by
H. Ebedes B.V.Sc.
Biologist: S.W.A. Nature Conservation Branch.
Etosha National Park.
Okaukuejo, South West Africa

INTRODUCTION

In earlier times gemsbok were numerous and widely distributed in South West Africa, Shortridge (1934). Human settlement, hunting pressure and repeated droughts forcing the gemsbok to migrate onto farmlands in search of grazing and water, resulted in the gemsbok becoming scarce in certain areas and in unprotected parts of the territory the gemsbok has become completely eliminated.

In the past gemsbok were captured by chasing and roping them from a motor vehicle or horseback or by using dogs to bay them. Because the gemsbok is a nervous and aggressive animal these methods were found to be dangerous and inhumane and heavy mortality often resulted.

A review of the available literature revealed that relatively few gemsbok had been captured successfully with chemical compounds. Ebedes (1962) immobilised a penned gemsbok cow using 17 ml. Cap-Chur-Barb (Palmer Chemical and Equipment Co.) and 7 ml. Trilafon (Schering). The large volume of Cap-Chur-Barb required to immobilise the animal and the long immobilisation and recovery times placed limitations on the routine use of this drug in the field. Bigalke (1965) darted eight gemsbok in the Etosha National Park with 0.75—1.07 milligram per lb. gallamine triethiodide and found that gemsbok had a critical tolerance of the drug. Three animals were successfully immobilised, three showed no reaction and two died. Although these results were not claimed to be conclusive because of the small number of animals darted, Bigalke was of the opinion that "gallamine triethiodide is not a particularly satisfactory immobilising drug for the species". Succinylcholine chloride at a dosage rate of 0.07 milligram per lb. was used to capture a Beisa oryx cow *(Oryx beisa annectens)* in the San Diego Zoo, but she died one minute after she was immobilised. (International Zoo Year Book 1960, Vol. 2). Etorphine hydrochloride was first introduced as a compound for the restraint of wild ungulates by Harthoorn (1965) in 1963 at the Salisbury Symposium on African Mammals. It has since given consistently promising results in various wild ungulate species, Harthoorn (1965) and Pienaar *et. al.*, (1966).

A project was thus initiated by the research section of the South West Africa Nature Conservation Branch to determine the efficacy and safety of etorphine hydrochloride for the capture of gemsbok.

IMMOBILISING DRUGS USED

The chemical compounds used to immobilise various species of wild ungulates have been comprehensively described and reviewed by Harthoorn (1965) and Pienaar *et. al.* (1966). A brief description is however given here.

1. Etorphine hydrochloride (M-99) (Reckitt & Sons Ltd.)

Etorphine hydrochloride (M-99) is an immobilising compound with the following formula:

7,8,-Dihydro-7 α- [1 (R)-hydroxy-1-methylbutyl]-O^6-methyl-6,14-endoethenomorphine. (Synonym: 19-Propylorvinol).

The analgesic properties of this synthetic morphine-like preparation are 5,000—10,000 times greater than that of morphine. A small amount of the drug is necessary to produce narcosis and analgesia. The main advantages of etorphine hydrochloride over other immobilising drugs are the wide safety margin, good tolerance and effective antagonism by antidotes.

Etorphine hydrochloride is soluble in water, but can also be dissolved in either Acetylpromazine or Triflupromazine so that less fluid is needed to fill the projectile syringes. Solutions containing 10 mg. etorphine hydrochloride per ml. were prepared. Etorphine hydrochloride was supplied to us for investigational use by Reckitt and Sons, Dansom Lane, Hull, England.

2. Hyoscine hydrobromide (B.P.)

Hyoscine has an atropine-like effect on the body and also depresses the central nervous system. It was added to the drug mixture because of it's inhibitory effect on salivary and bronchial secretions and it's potentiation of etorphine hydrochloride.

Hyoscine hydrobromide is soluble in water and stock solutions of 100 mg. per ml. were prepared.

3. Tranquillizers

Tranquillizers were used in the drug mixture to potentiate the narcotic effect of etorphine hydrochloride and to sedate the animals after they had been immobilised.

(a) "Acetylpromazine" (Boots Pure Drug Company).

Acepromazine maleate (A.P.) is the 2— acetyl derivative of phenothiazine:

2 acetyl — 10 — (3 dimethylamino — propyl) phenothiazine. A.P. is a central nervous depressant, is rapidly absorbed and is effective at a low dosage rate. The recommended dosage for domestic ungulates is 0.05 mg. per pound body weight. A.P. is commercially available at a concentration of 10 mg./ml. or 20 mg./ml.

(b) "Largactil" (May & Baker, Pty. Ltd.)
Chlorpromazine hydrochloride:

2 — chloro — 10 — (3' — dimethylamino — n — propyl) phenothizine hydrochloride. Largactil is a depressant of the central nervous system. The recommended dosage for domestic ungulates is 0.5—1.0 mg./lb. body weight.

The powder was supplied to us by Maybaker (S.A.) (Pty) Ltd. of Port Elizabeth. The solubility is 1 gram/2.5 ml. water.

(c) "Siquil" (Squibb Laboratories)

Triflupromazine hydrochloride is a tranquillizer five times stronger than chlorpromazine hydrochloride and is virtually non-toxic. Recommended intramuscular dosage for domestic ungulates is 10 mg. per 100 lbs. body weight. It is commercially available at a concentration of 20 mg. per ml.

4. "Sernylan" (Parke Davis)

1 — (— Phenylcyclohexyl) piperidine mono-hydrochloride. Sernylan is a "Neuroleptic" drug and potentiates the action of etorphine hydrochloride and tranquillizers.

Sernylan is commercially available at concentrations of 20 mg./ml. and 100 mg./ml. Pienaar et al (1966) recommend that Sernylan should not be used at a dosage rate of more than 100 mg./500 lbs. body weight when administered in combination with etorphine hydrochloride. There is no antidote for Sernylan.

5. Morphine antagonists

(a) Nalorphine hydrobromide ("Lethidrone" — Burroughs Wellcome and Company).

N — allyl normorphine is a synthetic morphine derivative which reverses or antagonises the narcotic effects of morphine and morphine-like drugs. It is effective by the various parenteral routes but acts most rapidly by intravenous injection. Available as a water soluble powder or a 5 ml. multi-dose solution with a concentration of 20 mg./ml.

(b) Cyprenorphine hydrochloride (M-285)
(Reckitt & Sons)

N — cyclopropylmethyl — 7,8, — dihydro — 7oc - - (1-hydroxy — 1 methylethyl) — 0^6 — methyl - - 6,14 — endoethenormorphine is a highly potent specific etorphine hydrochloride antagonist. The narcotic effect of etorphine hydrochloride is rapidly antagonised by the intravenous or intramuscular injection of cyprenorphine hydrochloride.

Cyprenorphine hydrochloride (M-285) was supplied to us as a water soluble powder for investigational use by Reckitt & Sons, Dansom Lane, Hull, England.

EQUIPMENT

The Palmer Powder-charge Projector (Palmer Chemical and Equipment Co.) and standard Palmer 2 ml. 3 ml. and 4 ml. projectile automatic syringes with barbed needles 1—1½ inches long were used. Because of the low charge of the gunpowder in the preloaded modified shotgun cartridges (c 240 mg.) the range of fire of the darts was inaccurate for distances over 45 yards.

The Van Rooyen crossbow was used on a few occasions, but found impracticable on the windy open plains of Etosha National Park. Gemsbok cows in a herd seldom stood still for a reliable reading to be taken on a range-finder. The crossbow was found unwieldy when fired from a moving motor vehicle. Further trials will however be conducted with the crossbow after more experience has been gained. All syringes, needles and projectile syringe-barrels were sterilised before use.

TECHNIQUES

Four methods of approaching and darting gemsbok were investigated. In open country the last method was found to be the most satisfactory.

1. Penned animals

Due to the keen sense of sight, smell and hearing of the gemsbok great difficulty was experienced in approaching them closely on foot. On one occasion gemsbok were enticed with food and water into a hessian-covered wooden enclosure of approximately 200 square yards area. When a sufficient number were in the enclosure the gate was closed and a few animals injected from close range. This method had disasterous results because the bewildered animals panicked and in their attempts to escape from the enclosure either fractured their necks or fatally gored each other.

2. Darting from a waterhole hide

Animals can easily be darted from close range from hides near a waterhole. The disadvantage of this method is that after the dart has struck, gemsbok, especially the cows, panic and immediately take flight, often running for several miles and getting lost in thick bush. The disturbance factor around the waterhole is considerable and two to three hours may lapse before animals re-approach the water. It is doubtful if more than three gemsbok can be immobilised per day at a waterhole. This method may be the only practical one to use when capturing gemsbok in thick bush or in rocky terrain.

3. Stalking and darting from a motor vehicle

On the open plains of the Etosha National Park gemsbok can sometimes be approached up to 50—60 yards in a slowly moving vehicle. As soon as the vehicle stops however, the animals which are normally nervous are immediately alerted and move away. The marksman has approximately five seconds to aim and fire the dart. Because of the low charge of powder in the cartridges mentioned above, and the unreliable trajectory over 50 yards, many shots were missed. After a herd of gemsbok had been stalked and fired at on two or three occasions, the "flight distance" increased from 60 yards to 130—150 yards. Gemsbok in Etosha National Park soon learnt to associate the capture-vehicle with disturbance and danger and took flight as soon as it approached, but were not unduly upset when other vehicles approached them. In the Namib Desert and on farms bordering the desert, the "flight distance" is usually more than 300 yards.

4. Darting from a moving vehicle

Because the previous three methods proved unsatisfactory for capturing a large number of gemsbok, darting from a moving vehicle was resorted to.

Gemsbok seldom permit a close approach. When found in dense bushy country they could be slowly herded or driven towards an open flat plain suitable for pursuit in a motor vehicle. The technique we used was to select an individual in a herd, drive behind and then along side it and dart it from a distance of 15—30 yards while travelling at speeds of 20—35 miles per hour. The site of darting is important. Placing the dart in the muscles of the forelimb or neck should always be attempted. Darting on or near bones, tendons or abdominally (sometimes unavoidable when operating from a moving vehicle) results in excessively long immobilisation times or ineffective immobilisation. Semi-tranquillization, overexitement and fatigue from running long distances results in stress and muscle-glygogen depletion and fatalities can be expected.

After the animal has been successfully darted the vehicle is slowed and the animal kept in sight with binoculars or followed in the vehicle from a distance of 150—200 yards until it starts reacting to the narcotic.

We found the most suitable vehicle for this work to be the Land Rover Short Wheel Base with the cab and the side windows removed and windscreen folded down or removed, or the Land Rover Stationwagon with the left side window removed. When operating from an open Land Rover it is adviseable for the team to wear safety belts, protective goggles and crash helmets.

Over fairly rough terrain good results can be obtained wtih practice, especially if there is understanding and good communication between the driver and the marksman. The animal must be darted within a mile from the commencement of the pursuit or the pursuit must be abandoned, because mortality from heart failure or muscle paralysis may result. These conditions are not due to the immobilising drugs, but may be precipitated by them. Gemsbok chased for long distances even without the injection of immobilising drugs can also die of heart-failure.

After the gemsbok is recumbent, it is approached on foot and the horns lassooed. The horns are held and the ends of a 3 foot length of thick rubber hosepipe are firmly fitted over each horn and the eyes blind-folded as a safety precaution. Eye ointment is applied over the cornea of the eyes to prevent drying. (Terra-Cortril eye/ear ointment, Pfizer.)

While a semi-tranquillised gemsbok circles around in a bemused state, it can easily be lassooed and cast.

The disadvantages of above method are:

(a) Frequent misses by the inexperienced and unpracticed markman resulting in wastage of drugs and darts.

(b) Incorrect placing of the projectile syringe resulting in long immobilisation times of ineffective immobilisation.

(c) Damage to the vehicle in rough terrain.

RESULTS AND DISCUSSION

The results obtained from darting sixty-four gemsbok using various drug combinations are given in Tables 1, 2, 3, 4, and 5. Table 6 is a summary of the data from Tables 1 to 5. Table 7 is a summary of the recovery times.

WEIGHTS

The weights of gemsbok were based on estimations. When members of the capture team disagreed on the weights , the average was taken.

DART OR INJECTION SITES

The various injection sites referred to in the tables are illustrated in Figure 1.

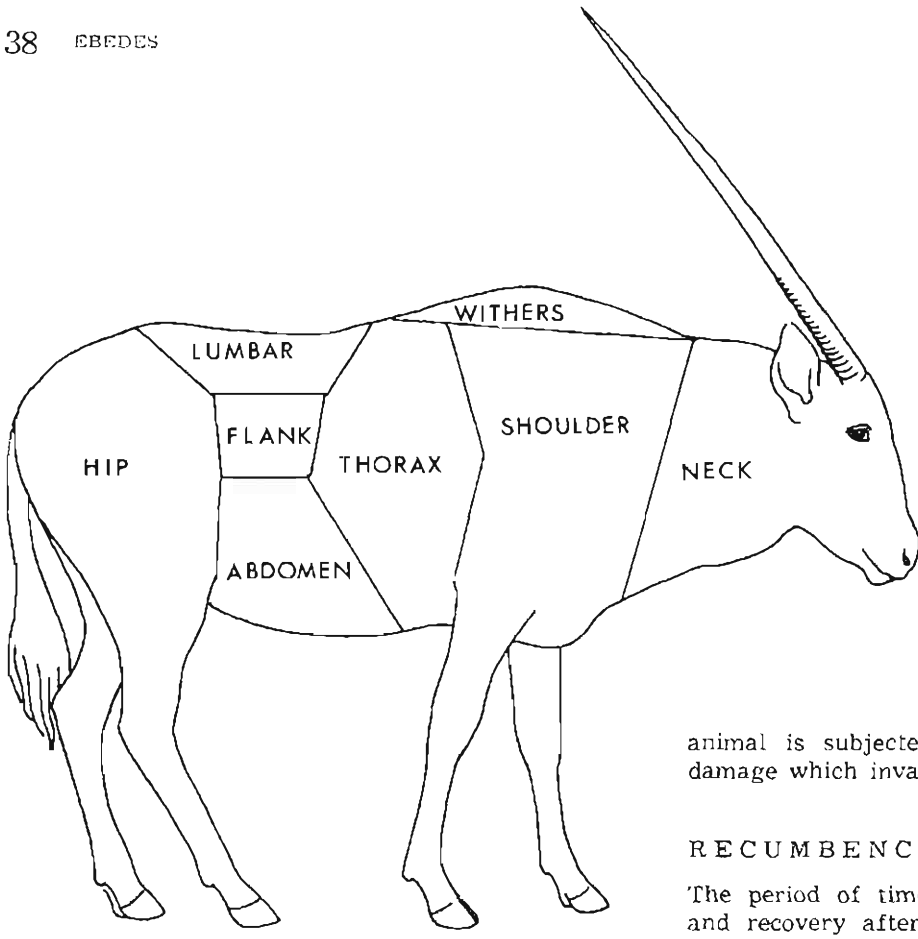

Figure 1. Diagram of Gemsbok showing Darting Sites.

IMMOBILISATION TIMES

The time interval that lapsed between injection of the drugs and recumbency is referred to as the immobilisation time and was determined by means of a stopwatch. In some cases gemsbok were not immobilised within 20—30 minutes, but wandered around in a semi-tranquillized bemused state. These animals were lassooed with a rope and cast. A "c" in front of the immobilisation time in the tables refers to the time lapse before the lassooed animal was cast and recumbent on the ground.

If no signs of sedation or narcosis were observed within 45 minutes, the immobilisation was regarded as ineffective.

Figure 2 illustrates graphically the relationship between the injection site and immobilisation time. The data in Figure 2 is compiled from Table 5 because the dosage rates were kept constant and are of statistical value. Of the twelve animals darted in the muscles of the forequarter and neck, seven were immobilised in under ten minutes and the remaining five in under fifteen minutes. Gemsbok E58 was injected accidentally behind the ear near the atlas vertebra and was immobilised in the remarkably short time of 48 seconds.

The data in Figure 2 shows that the site of injection plays an important role in producing rapid immobilization of gemsbok because the drugs are absorbed more effectively. With prolonged immobilisation times great distances are covered and the animal is subjected to stress factors and tissue damage which invariably result in mortality.

RECUMBENCY TIME

The period of time elapsing between recumbency and recovery after injection of the antagonist is not recorded but varied from 30 minutes to one hour thirty minutes. Most of the gemsbok immobilised, were eartagged, branded, painted or in some cases marked with coloured plastic neckbands. Some of the gemsbok were crated and translocated before the antagonist was injected.

RECOVERY TIME

This was recorded from the moment the antagonist was injected until the animal was alert and attempted to rise to it's feet. The antagonist was usually slowly injected intravenously via one of the superficial ear veins or the jugular vein.

Occasionally a recovered animal was reluctant to rise. Clapping of hands, shouting or a sharp smack on the buttocks usually brought it onto it's feet.

TEMPERATURE

The rectal temperature was taken soon after the gemsbok were recumbent. High temperatures corresponded with long immobilisation times probably because of increased muscular action and exertion.

BEHAVIOUR AFTER DARTING

The reaction of gemsbok to the immobilising drugs invariably was as follows:

1. The pace slows from a gallop to a slow trot to a fast walk.

2. During the fast walk with short brisk steps and feet raised high, known as "hackney gait", the

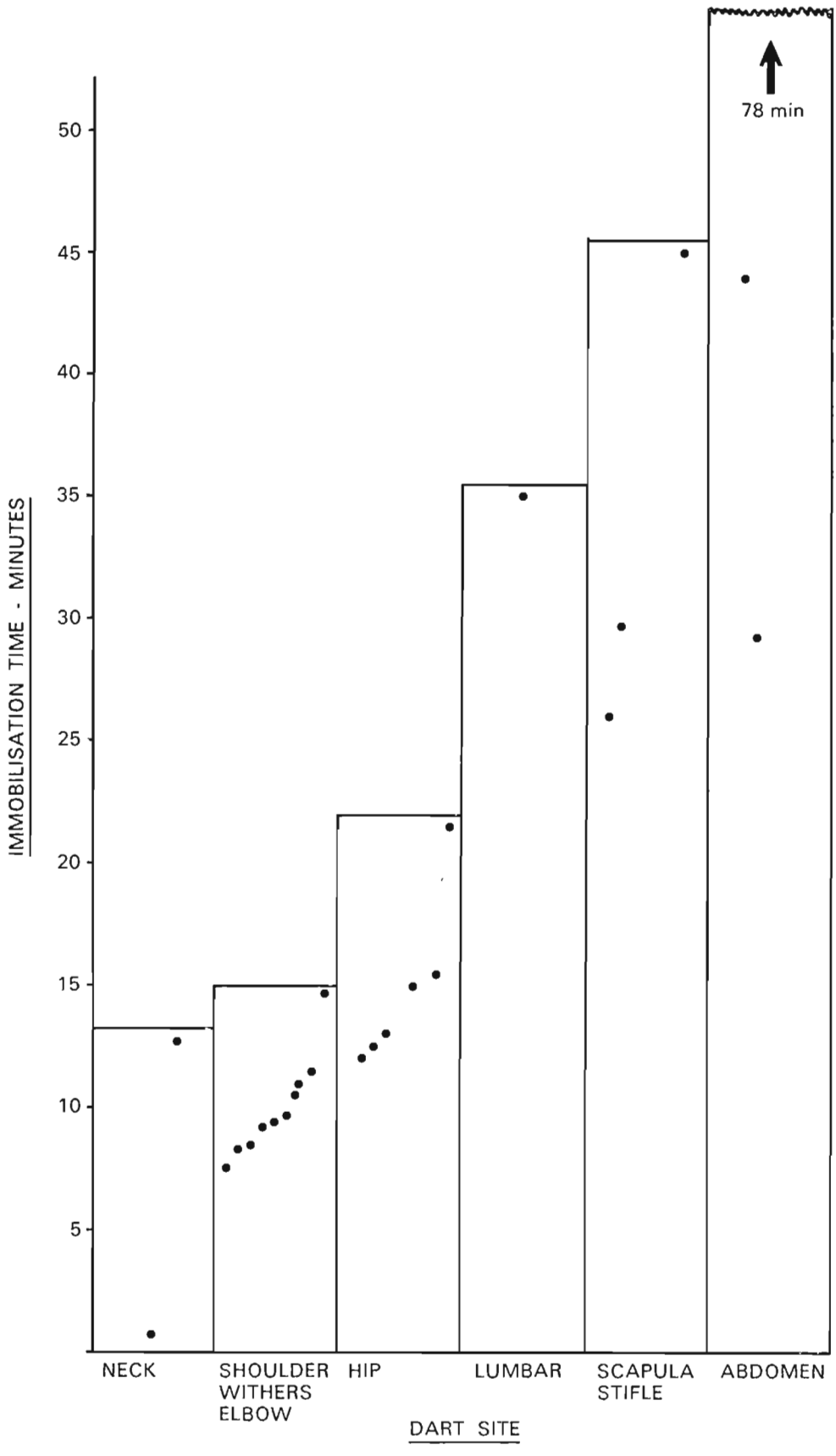

Figure 2. Relationship between Darting Sites and Immobilisation Time
(refer to Table 5).

animal usually starts circling. Concurrent with the circling the head is lowered, the eyes held wide open, the ears forward, and the tail stiffly down.

3. The circles at first wide, become smaller and the animal shows ataxia and frequent stumbling.

4. An effect resembling the Straub-Hermann reaction of mice is shown shortly before the animal falls to the ground.

5. The majority of the animals lie on their sternums with the chin resting on the ground.

6. A large number of immobilised gemsbok gnash their teeth.

7. Mydriasis is always present and the animal frequently blinks it's eyes indicating photophobia. The eyes are usually dull.

8. Curiosity and fearlessness of humans is shown in most animals prior to recumbency. Gemsbok taking a long time to react to the immobilising drugs would approach the darting vehicle and stand next to it for several minutes.

9. The senses of smell and sight are dulled, but hearing remains good. For this reason unnecessary loud noises must always be avoided.

10. Antibiotics, vitamins A, D and E and corticosteriod preparations were always injected intramuscularly to prevent possible stress and infection.

BEHAVIOUR AFTER ADMINISTRATION OF ANTAGONISTS

Immobilised gemsbok responded dramatically to the intravenous injection of either nalorphine hydrobromide or cyprenorphine hydrochloride.

Reactions occurred in the following order:

1. The ears went back and started twitching. Head was raised and the eyes brightened.

2. The animal was usually fully conscious within two minutes and attempted to rise to it's feet.

3. A characteristic "snort-purring" noise was often made as the animal regained consciousness.

4. When upright the muscles twitched for a few minutes and the animal slowly walked or ran away.

5. Occasionally a gemsbok showed a peroneal paresis, but this never lasted for more than 10 minutes.

6. Bulls were sometimes oblivious to human presence for periods of 20 to 30 minutes before walking or running away.

7. Cows were frequently found with their original herds within twenty-four hours after immobilisation.

8. A few animals bloated most probably as a result of the hyoscine inhibiting the eructation reflex. An intramuscular injection of 1 to 2 mg. per 100 lbs. bodyweight of neostigmine methylsulphate ("Prostigmin": Roche Products) brought about eructation and relief.

MORTALITY

Mortality after immobilisation resulted when gemsbok were chased for long distances before they were darted or ran too far as a result or prolonged or delayed immobilisation times. The three animals immobilised in Table 4 were pursued for more than three miles before they were darted. Two of them died three days later after showing symptoms of generalised locomotor paralysis and the third one died of congestive heart-failure. Post mortem examination indicated degeneration of the skeletal muscles and myohaemoglobinuria. Histopathological examination showed advanced Zenker's necrosis of skeletal muscle, congestion of the myocard, degeneration and congestion of the kidney, and oedema and congestion of the lung, Basson (1966) (Veterinary Research Institute. Personal communication). A fifth gemsbok of the same sex and weight as the forementioned, was chased for approximately five miles, but was not darted because it ran into a fence. It died 40 minutes later after it was disentangled from the wires. Post mortem examination revealed severe congestion of all the organs and some degree of haemorrhage in various tissues; these were probably due to shock or acute cardiac failure, Basson (Personal communication).

Gemsbok E.5 had a posterior paralysis and was destroyed for humanitarian reasons after 48 hours. Post mortem examination showed a myohaemoglobinuria and myocardial degeneration. E.52 was destroyed after injuring her spine while trying to escape from a holding pen. E.53 was accidentally darted in the abdomen and ran for approximately 6.5 miles before she could be lassooed and cast. Because of the delayed absorbtion of the immobilising drugs the immobilisation time was 78 minutes. Post mortem examination immediately after death revealed the following: generalised congestion of the internal organs and skeletal muscles, sub- endo and subepicardial haemorrhages, myocardial degeneration and oedema, emphysema and congestion of the lungs. These lesions are similar to those described by Young (1966) in red hartebeeste *(Alcelaphus buselaphus)*, which died a few days after they had been caught mechanically; and the muscular dystrophy described by Jarrett *et. al.* (1964), and Murray (1967) in Hunter's antelope *(Damaliscus hunteri)*.

These lesions have also been seen by us in eland *(Taurotragus oryx)* and giraffe *(Giraffa camelopardalis)* that died after prolonged muscular exertion.

No deaths could be attributed directly to the drugs.

GROUPED DATA

Preliminary analysis of the grouped data of the five Tables show that at a mean dosage rate of 8.41 microgram/lb. etorphine hydrochloride (M-99), 58 microgram/lb. hyoscine hydrobromide and 128 microgram/lb. triflupromazine, 75% of 64 gemsbok were successfully immobilised. 52% were immobilised within 15 minutes. At a dosage rate of 32.8

microgram per lb. cyprenorphine hydrochloride (M-285) by intravenous injection the mean recovery time was less than two minutes.

CONCLUSION

1. Gemsbok can be immobilised effectively, rapidly and safely with etorphine hydrochloride, hyoscine hydrobromide and triflupromazine (Siquil).

2. The immobilising drugs should preferably be injected into the muscles of the shoulder, neck or hindquarter to ensure satisfactory absorbtion of the drugs and rapid immobilisation.

3. When pursued and darted from a moving vehicle gemsbok must not be chased for more than one mile.

4. Provided the animals are not subjected to excessive chasing and prolonged muscular exertion, mortality is of no significance.

5. The narcotic effect of etorphine hydrochloride is rapidly antagonised with the intravenous injection of nalorphine hydrobromide or cyprenorphine hydrochloride.

6. With a dosage rate of 10.25 microgram/lb. etorphine hydrochloride, 52 microgram/lb. hyoscine hydrobromide and 128 microgram/lb. triflupromazine based on estimated bodyweight, 25 out of 30 gemsbok (83%) were successfully immobilised (Table 5).

7. Tentatively the following dosage rate is recommended for the immobilisation of gemsbok in South West Africa: 8 to 10 microgram per lb. etorphine hydrochloride + 50 microgram per lb. hyoscine hydrobromide + 100 to 120 microgram per lb. triflupromazine. The narcotic effect of the etorphine hydrochloride is antagonised by the intravenous injection of 20 to 30 microgram/lb. bodyweight cyprenorphine hydrochloride.

8. Further trials are to be conducted.

SUMMARY

Capturing gemsbok *(Oryx gazella gazella)*. by immobilising them with *Etorphine hydrochloride* (M-99) in combination with other drugs is described and presented as a guide for future workers.

Of sixty-four gemsbok darted 75% were satisfactorily immobilised; 52% were immobilised and captured in less than 15 minutes.

The site of injection of the immobilising drugs is important and has a direct relationship to effective and rapid immobilisation. Animals injected in the abdomen or near skeletal structures took a long time to become immobilised and suffered from stress symptoms which often resulted in mortality. Mortality was low excepting in cases when the animals were chased for long distances or ran long distances because of poor absorbtion of the drugs.

The narcotic effect of etorphine hydrochloride was successfully reversed by the antagonist drugs nalorphine hydrobromide or cyprenorphine hydrochloride (M-285).

A preliminary dosage rate for etorphine hydrochloride, hyoscine hydrobromide and triflupromazine is suggested for the immobilisation of gemsbok in South West Africa.

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TABLE 1.Immobilisation of *Oryx gazella* with 2—2.5 mg. M99, 20—25 mg, hyoscine and 10—50 mg. Acetylpromazine.

No.	Code No.	Sex	Estimated weight lbs.	Dart Site	M99 mg.	Hyoscine mg.	Acetylpromazine mg.	Immobilisation Time	Temp. ° F.	Lethidrone mg. 1. V	Recovery Time
1	—	M	400	Hip	2.5	20	10	—	—	—	—
2	—	M	400	Hip	2.5	20	10	—	—	—	—
3	—	M	420	Flank	2.2	20	10	—	—	—	—
4	E.14	M	500	Hip	2.2	25	50	17 min.	103.2	60	2 min. 30 secs.
5	E.15	M	450	Hip	2 + 1	25	50 + 10	49 min.	105	60	9 min.
6	—	F	400	Hock	2	25	50	—	—	—	—
7	E.16	M	450	Thorax	2	25	50	16 min.	104	75	5 min.
8	E.17	F	400	Thorax	2	25	50	12 min.	106.4	75	3 min. 20 secs.
9	E.18	M	375	Hip	2	25	50	25 min.	104.8	75	4 min.
10	—	F	400	Hip	2	25	50	—	—	—	—
11	E.20	F	450	Shoulder	2	25	35	13 min.	105	50 + 140	2 min. 25 secs.
12	E.22	M	500	Flank	2	25	35	29 min.	109	120	2 min. 20 secs.
Average			428		2.2 5.1 microgram/lb.	24 56 microgram/lb.	38 89 microgram/lb.	23 min.	105.4	73 170 microgram/lb.	4 min. 5 secs

Comment: At this dosage 58% Immobilisation.
Two gemsbok immobilised under 15 minutes.
E.15 was redarted with 1 milligram M99 and 10 milligram A.P. after 30 minutes.

TABLE 2. Immobilisation of *Oryx gazella* with 2.5—4 mg. M99, 25 mg. hyoscine and 500 mg. Largactil.

No.	Code No.	Sex	Estimated weight lbs.	Dart Site	M99 mg.	Hyoscine mg.	Largactil mg.	Immobilisation Time	Temp. ° F.	Lethidrone I. V. mg.	Recovery Time
1	E.29	M	450	Thorax	2.5	25	500	+ 30 min.	107	110	2 min.
2	—	F	450	Sternum	2.5	25	500	—	—	—	—
3	E.25	M	450	Thorax	3	25	500	39 min.	106	150	2 min. 10 secs.
4	E.26	F	450	Sternum	3	25 + 25	500	c 90 min.	106	100	2 min. 25 secs.
5	E.28	M	450	Hip	3	25	500	+ 40 min.	106.5	130	2 min. 30 secs.
6	E.24	F	450	Hip	4	25	500	28 min.	—	120	2 min. 40 secs.
7	E.27	M	450	Stifle	4	25	500	24 min.	107	100	45 secs.
Average			450		3 6.6 microgram/lb.	25 56 microgram/lb.	500 1.1 milligram/lb.	42 min.	106.5	118 262 microgram/lb.	2 min. 5 secs.

\+ = Longer than
c = Caught with rope
Comment: 86% Immobilised
Long immobilisation times
E.26: Excessive salivation — additional hyoscine injected

TABLE 3. Immobilisation of *Oryx gazella* with M99, hyoscine, Sernylan and Siquil.

No.	Code No.	Sex	Estimated weight lbs.	Dart Site	M99 mg.	Hyoscine mg.	Sernylan mg.	Siquil mg.	Immobilisation Time	Temp. ° F.	M 285 mg. I.V.	Recovery Time
1	E.35	M	450	Shoulder	3	20	20	—	c. 30 min.	108.4	15	3 min.
2	E.33	F	420	Abdomen	3	—	50	5	c. 40 min.	108.2	15	1 min. 7 secs.
3	—	M	450	Hip	3	—	50	20	—	—	—	—
4	—	M	475	Stifle	3	10	20	5	—	—	—	—
5	—	F	420	Lumbar	3	20	80	—	—	—	—	—
6	E.40	M	430	Thorax	3	20	80	—	c. 41 min.	107.4	15	1 min. 19 secs.
7	E.37	F	420	Withers	4	20	50	—	11 min.	106	15	1 min. 30 secs.
8	E.31	M	430	Hip	4	20	50	—	12 min. 13 sec.	106.4	15	2 min.
9	E.42	M	450	Hip	4	20	50	—	13 min. 30 sec.	105.4	15	3 min.
10	E.5	F	400	Shoulder	4	25	80	45	8 min.	105	15	3 min.
11	—	F	400	Flank	4	25	100	30	—	—	—	—
Average			430		3.5 8.1 microgram/lb.	20 46.5 microgram/lb.	57 132.5 microgram/lb.	—	22 min. 32 sec.	106.7	15 35 microgram/lb.	2 min. 6 secs.

Comments: c = caught with rope
64% Immobilised
57% Immobilised in under 15 minutes
E.5: Destroyed because of Posterior paralysis

TABLE 4. Immobilisation of young *Oryx gazella* females with 3 mg. M99 + 20 mg. hyoscine + 20 mg. Acetylpromazine.

No.	Code No.	Sex	Estimated weight lbs.	Dart Site	M99 mg.	Hyoscine mg.	Acetylpromazine mg.	Immobilisation Time	Temp. ° F.	M 285 mg.	Recovery Time
1	N1	F	270	Shoulder	3	20	20	7 min.	108	8 I.M.	?
2	N2	F	250	Stifle	3	20	20	13 min.	108	10 I.V.	1 min. 30 secs.
3	N3	F	250	Hip	3	20	20	13 min.	107	10 I.V.	1 min. 30 secs.
4	—	F	230	Abdomen	3	20	20	-	—	—	—
Average			250		3 12 microgram/lb.	20 80 microgram/lb.	20 80 microgram/lb.	11 min.	107.6	9 mg. 36 microgram/lb.	1 min. 30 secs.

Comments: 75% Immobilised
100% Immobilised in under 15 minutes
All these gemsbok died 2 to 3 days later as a result of myoglobinuria and heart failure due to stress from excessive chasing before injection of drugs.

TABLE 5. Immobilisation of *Oryx gazella* with 4 mg. M99, 20 mg. hyoscine and 50 (60) mg. Siquil.

No.	Code No.	Sex	Estimated weight lbs.	Dart Site	M99 mg.	Hyoscine mg.	Siquil mg.	Immobilisation Time	Temp. ° F.	M285 I.V. mg.	Recovery Time
1	E.4	M	450	Hip	4	20	50	12 min.	108.8	8	2 min.
2	E.19	F	430	Hip	4	25	50	12 min. 30 secs.	110	15	1 min.
3	E.46	F	430	Hip	4	25	50	21 min. 30 secs.	108	15	1 min. 30 secs
4	E.47	F	280	Hip	4	30	50	13 min.	109	Leth 30 M285/2.5	1 min. 30 secs
5	E.48	M	475	Hip	4	30	50	15 min.	108	15	2 min.
6		F	380	Hip	4	20	50	—	—	—	—
7		F	350	Abdomen	4	20	50	—	—	—	—
8	E.49	F	450	Hip	4	30	50	15 min. 30 secs.	108.5	15	1 min. 30 secs
9	E.50	F	320	Shoulder	4	20	50	8 min. 30 secs.	106.4	8	?
10		M	320	Humerus	4	20	50	—	—	-	-
11	E.51	F	450	Stifle	4	20	50	c 45 min.	—	5	?
12	E.52	F	375	Abdomen	4	20	50	c 44 min.	- -	10	?
13	E.53	F	420	Abdomen	4	20	50	78 min.	110.4	5	?
14	E.54	F	350	Shoulder	4	20	50	9 min. 30 secs.	105	8	1 min. 30 secs
15	E.55	F	400	Shoulder	4	20	50	10 min. 30 secs.	106.5	8	3 min. 25 secs.
16	E.56	F	375	Scapula	4	20	50	25 min.	107.5	4	10 min.
17		F	350	Abdomen	4	20	50	—	—	—	-
18	E.57	F	425	Scapula	4	20	50	29 min. 45 secs.	107.2	8	2 min. 25 secs.
19	E.58	F	375	Upper neck	4	20	50	48 secs.	105	8	2 min. 20 secs.
20	E.59	F	320	Withers	4	20	50	8 min. 25 secs.	105.4	10	1 min. 30 secs.
21	E.60	F	380	Shoulder	4	20	50	11 min. 30 secs.	107.2	10	1 min. 30 secs
22	E.64	F	350	Shoulder	4	20	50	7 min. 35 secs.	107.2	12.5	1 min. 30 secs.
23	E.65	F	350	Withers	4	20	50	9 min. 10 secs.	108	12.5	1 min. 30 secs.
24	E.66	F	380	Withers	4	20	50	9 min. 35 secs.	108.6	12.5	1 min. 30 secs.
25	E.67	M	450	Lower neck	4	20	50	12 min. 40 secs.	106.3	12.5	2 min. 20 secs.
26	E.68	F	420	Withers	4	20	50	14 min. 35 secs.	107	10	1 min. 20 secs.
27		F	400	Abdomen	4	20	50	—	—	—	—
28	E.69	F	420	Abdomen	4	20	50	29 min. 20 secs.	107.8	15	1 min. 30 secs.
29	E.44	M	430	Lumbar	4	20	60	c 35 min.	108	15	1 min. 30 secs.
30	E.45	F	420	Elbow	4	20	60	11 min.	107	15	2 min. 30 secs.
Mean:			390		10.25 microgram/lb.	52 microgram/lb.	128 microgram/lb.	19 min. 37 secs.	107.5	27.4 microgram/lb.	2 min. 10 secs.

Comments: c = caught with rope
83% gemsbok immobilised. 64% immobilised under 15 minutes
E.50, E.51 and E.52 translocated 40 miles and released in a holding pen. Small doses of antidote given.
E.52 died as a result of spinal injury sustained while trying to escape from pen.
E.53 died of heart failure due to excessive stress from long immobilisation time.

TABLE 6. Summary of results: Grouped data of Tables 1 to 5.

	No. of Gemsbok darted	Male	Female	Average weight lb. estimated	M-99 microgram per lb.	Hyoscine microgram per lb.	Acetyl-promazine microgram per lb.	Siquil microgram per lb.	Largactil	Sernylan microgram per lb.	No. of Gemsbok immobilised	%	Average immo-bilisation time. Minutes	No. immobilised under 15 minutes	%	Average Temperature °F.
Table 1	12	8	4	428	5.1	56	89	—	—	- -	7	58 %	23	32	29%	105.4
Table 2	7	4	3	450	6.6	56	—	—	1.1 mg/lb	- -	6	86 %	42	—	—	106.5
Table 3	11	6	5	430	8.1	46.5	—	—	—	132.5	7	64 %	22.5	4	57%	106.7
Table 4	4	- -	4	250	12.0	80	80	—	- -	—	3	75 %	11	3	100%	107.6
Table 5	30	5	25	390	10.25	52	- -	128	—	—	25	83.3%	19.5	16	64%	107.5
Mean	64	23	41	390	8.41	58	84.5	128	1.1 mg/lb	132.5	48	75 %	23.6	25	52%	106.7

TABLE 7. Antagonism of etorphine hydrochloride: Recovery time.

	Nalorphine hydrobromide microgram per lb. bodyweight	Cyprenorphine hydrochloride microgram per lb. bodyweight	Average Recovery Time
Table 1	170		4 min. 5 secs.
Table 2	265		2 min. 5 secs.
Table 3		35	2 min. 8 secs.
Table 4		36	1 min. 30 secs.
Table 5		27.4	2 min. 10 secs.

Comments: Average Nalorphine hydrobromide: 217.5 microgram/lb. Recovery time: 3 min. 5 secs.
Average Cyprenorphine hydrochloride: 32.8 microgram/lb. Recovery time: 1 min. 56 secs.