The Capture of Plains Zebra *Equus burchelli antiquorum*, H. Smith, 1841, with M-99 (Reckitt) and Tranquillizers in the Etosha National Park.

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CONTENTS

I. INTRODUCTION

The plains zebra *Equus burchelli antiquorum* H. Smith, 1841 is one of the most numerous ungulate species in the Etosha National Park and it's migratory patterns and seasonal movements have never been fully understood. In order to clarify the sometimes confusing migrations a number of zebra were captured with drugs and marked with neckbands so that more definite information could be obtained. At the same time blood samples were collected from the immobilised animals for a study on the blood proteins of equidae by Prof. D. R. Osterhoff of the Faculty of Veterinary Science, Onderstepoort and accurate body measurements of the zebra were taken. The results of the migration study which were made possible by being able to positively identify individually marked animals at various stages of their movements in the Park will be published separately in a later paper.

Before M—99 (Reckitt) became available as an immobilising drug other compounds such as nicotine salicylate, (Grzimek 1961); succinylcholine chloride, (Talbot and Lamprey 1961; van Niekerk 1963; Bigalke 1965); and gallamine triethiodide, (Talbot and Talbot 1962; and Bigalke 1962), were used for capturing free-ranging zebra in East, South and South West Africa. Nicotine alkaloids are highly toxic and dangerous to humans handling the drugs because they can be absorbed directly through the skin. In animals the drug first acts by stimulating the central nervous system often producing convulsions, followed by depression and paralysis. No antidote is available. Using succinylcholine chloride Talbot and Lamprey (loc.cit.) found that although the majority of zebra were excellent subjects for immobilisation, the tolerance of the drug varied among individuals and several deaths were recorded after an apparently safe dose was injected. The zebra were immobilised for periods of 8 to 22 minutes which would have been insufficient time for our requirements. Another serious disadvantage of using succinycholine chloride is that the potency is affected by heat resulting in deterioration of the drug. In subtropical climates such as that of Etosha National Park (Latitude 19° South) this factor would have been an important practical consideration.

Both Bigalke and the Talbots (loc.cit.) found gallamine triethiodide unsuitable for zebra capture because of the critical tolerances. A dosage-rate of 1.3 mg/lb. was found ineffective and 1.4 mg/lb. produced paralysis of the respiratory muscles and subsequent death.

Graham—Jones (1964) working mainly on captive wild animals commented that zebra were extremely difficult animals to sedate and anaesthetise, and found that paralytic/hypnotic/sedative amnesia combinations were less effective in zebra than in other species.

The promising results, wide safety-margin, good tolerance and low toxicity of M—99 (Reckitt) and the rapid reversal of narcosis by morphine anta-

gonists reported by Harthoorn (1965(a)), Harthoorn and Bligh (1965), King and Klingel (1965), Pienaar *et al* (1966) and Ebedes (1969) influenced the writer to use this compound for capturing zebra for the marking project. In this paper the results obtained from capturing fifty zebra with M—99 in combination with other drugs such as acepromazine ("Acetylpromazine", Boots), triflupromazine hydrochloride ("Siquil", Squibb Laboratory), phencyclidine hydrochloride ("Sernylan Parenteral" Parke, Davis and Company) and hyoscine hydrobromide (B.P.) are discussed.

II. DRUGS

1. M — 99 (Reckitt)

M—99 (Reckitt) or Etorphine hydrochloride is a powerful synthetic morphine-like narcotic compound with a wide safety-margin and good tolerance. The narcotic effect can rapidly be reversed by the injection of a morphine antagonist. Small quantities of the compound produce anaesthesia and analgesia in ungulate animals.

M—99 (Reckitt) is available in powder-form and solutions containing 20 milligrams and 10 milligrams per ml. were prepared by us. A supply of M—99 (Reckitt) was given to the writer for investigational use by Reckitt and Sons Ltd., Dansom Lane, Hull, England. Reckitt and Colman (Africa) Ltd., P.O. Box 1097, Cape Town, now control all supplies of M—99 for use on wild animals outside the United States of America.

2. Hyoscine Hydrobromide (B.P.) (Burroughs Wellcome & Co.)

Hyoscine hydrobromide or scopolamine has an atropine-like action, depresses the central nervous system, produces general sedation with morphine and morphine analogues and is a powerful mydratic (Krantz and Carr, 1951).

Hyoscine hydrobromide is mainly used in immobilising mixtures because of it's potentiating effect on tranquillizers and narcotic drugs (Harthoorn 1965, (a). It also causes mydriasis which may hasten the capture of the animal because of it's inability to see properly.

Hyoscine hydrobromide is obtainable in powder form and multidose solutions of 100 milligrams per ml. were prepared.

3. "Sernylan" (Parke, Davis and Company)

Sernylan or phencyclidine hydrochloride is a neuroleptic drug with anaesthetic properties. Sernylan is rapidly absorbed and potentiates narcotics and anaesthetics, (Harthoorn 1965 (a)). It is a useful drug for immobilising carnivorous mammals (Ebedes, 1968).

Multi-dose solutions of Sernylan 100 milligrams per ml. were obtained from the manufacturers, Parke, Davis and Company, Isando, Transvaal.

4. "Acetylpromazine" (Boots Pure Drug Company)

Acetylpromazine or Acepromazine maleate, a phenothiazine derivative, is a rapidly-absorbed, fast-acting and potent tranquillizer. It's action is potentiated by narcotics (Pienaar, 1966). Multi-dose solutions of 10 milligrams per ml. and 20 milligrams per ml. were purchased from Messrs. A. S. Ruffel and Co., P.O. Box 2905, Windhoek.

5. "Siquil" (Squibb Laboratories)

Siquil or triflupromazine hydrochloride is a potent phenothiazine derivative with 3 to 5 times the activity of chlorpromazine. Siquil prolongs and intensifies the action of many central nervous system depressants including narcotics. Multi-dose solutions of 20 milligram per ml. were obtained from the manufacturers, Squibb Laboratories, Isando, Transvaal.

III. ANTIDOTES (MORPHINE ANTAGONISTS)

One of the main advantages of using M—99 to capture wild ugulates is that the narcotic effect can rapidly be reversed or counteracted by morphine antagonists. The captured narcotised animal can therefore be revived and released immediately after capture. Three morphine antagonists are presently available; one of them Diprenorphine hydrochloride or R & S 5050—M HC1 (Reckitt and Sons) has only recently been released for investigational use.

Although the exact mode of action of morphine antagonists is not known it is possible that they compete with morphine and similar drugs for occupation of the receptor sites in the brain. (Bentley, 1964).

1. "Lethidrone" (Nalorphine Hydrobromide) (Burroughs Wellcome and Company).

Lethidrone (B.W. & Co.) is N-allylnormorphine hydrobromide and is a specific morphine antagonist. It is available as a water-soluble powder or in multi-dose solutions of 20 milligrams per ml. from the manufacturers.

2. M — 285 (Reckitt) or Cyprenorphine Hydrochloride (Reckitt).

M—285 (Reckitt is a specific M—99 (Reckitt) antagonist and produces a rapid and complete reversal of the immobilisation effects produced by M—99. It's potency is up to 35 times greater than

nalorphine hydrobromide. The recommended dosage-ratio of M—285 to M—99 is 2.5:1.

Supplies of M—285 in powder form were made available to the writer for investigational use by Reckitt & Sons, Dansom Lane, Hull, England, but is now available from the South African Company, Reckitt and Colman (Africa)Ltd., P.O. Box 1097, Cape Town.

3. R & S 5050 — M (Reckitt) or Diprenorphine Hydrochloride (Reckitt)

R & S 5050 — M is a new M—99 antagonist developed by Reckitt and Sons. The recommended dosage-ratio of R & S 5050 — M to M—99 is 1:1, however the drug is still in the initial investigational stages and has not been extensively evaluated (J. Visser, 1968, pers. comm.). R & S 550 — M was supplied to the writer for investigational use by Reckitt and Colman (Africa) Ltd., P.O. Box 1097, Cape Town.

IV. METHODS

The apparatus used mainly for darting the zebra was the Palmer Powder Charge Cap-Chur Gun with standard Palmer 1 ml., 2 ml. and 3 ml. volume projectile darts fitted with 1" and 1½" length barbed needles (Palmer Chemical & Equipment Co.). Occasionally the Palmer Short Range Projectile (gas operated) was used when the zebra could be approached from a close range. The darts were sterilised before use and were only used once because the projectory and flight of darts used for more than one darting was found to be erratic and unreliable.

Two methods were used for approaching and darting the zebra:

(i) Darting from a moving Land Rover. On the open shortgrass plains west of the Etosha Salina this was the only practical method of approaching and darting the zebra particularly during the rainy season. The zebra were pursued at speeds of 20 to 35 miles per hour and darted from a distance of 5 to 25 yards.

(ii) Stalking in a Land Rover. On the Andoni Plain north of Namutoni Rest Camp and at waterholes, zebra were stalked in a Land Rover as they approached the water and were darted from a distance which varied from 35 to 60 yards.

All relevant information pertaining to the drugs and dosages used, dart sites, distance, down-times, reaction after immobilisation, rectal temperature, heart-rate, respiration-rate, external temperature and humidity, body-measurements, marking materials and techniques, additional therapy etc., were recorded on standardised departmental immobilisation forms.

(a) Weight.

The weights of all the zebra were based on estimations.

(b) Age.

Ageing was based on Klingel's ageing criteria of zebra (Klingel, 1965). After a visit to the Etosha National Park in 1965, Klingel (pers. comm.) established that there were no significant differences in the dental wear of East African and South West African plains zebra.

(c) Dart site.

Whenever possible it was attempted to dart the animals in a thick muscular area such as the shoulder or hindquarter (hip) so that the drugs could be absorbed rapidly in areas of good vascularity. However, because of the occasional erratic flight of the darts, bumpy conditions when firing from a moving motor-vehicle, the influence of strong winds deflecting the darts and misjudgement of distance, zebra were sometimes darted in the thorax and other areas as noted in the Tables.

(d) Down-time or immobilisation time.

The time-lapse from the moment the dart hit the animal until it became recumbent was determined on a stopwatch. Immobilised zebra usually assumed a position of lateral recumbency.

(e) Recovery Time.

The recovery time is the time recorded from the moment the antagonist was injected until the animal showed signs of recovery and regained it's feet. By injecting the antagonist intravenously, reversal of narcosis and recovery was often dramatic and rapid (Plate 1). Because the neckband used for marking the zebra sometimes hindered the injection of the antagonist into the jugular vein, the superficial ear veins were found suitable. In a few cases the injection needle accidentally slipped out of the thin ear vein and a portion of the antagonist was injected subcutaneously resulting in longer recovery times. Intramuscular injection of the antagonist resulted in a less dramatic, smoother and more gradual recovery. No antagonist was injected into zebra N1, TABLE 1, because he was not fully immobilised. The amount of antagonist injected into zebra GW1, TABLE 3 was not recorded on the immobilisation data form.
To counteract possible stress factors and infections which could have resulted from the capture, the zebra were routinely injected with antibiotics, corticosteroid preparations and vitamins, particularly Vitamins A.D. and E and the majority were innoculated against anthrax with 1 ml. Onderstepoort Anthrax Spore Vaccine.

V. RESULTS

The results obtained from immobilising 50 plains zebra in the Etosha National Park are summarised in TABLES 1, 2, 3 and 4.

Plate 1. Recovery of marked zebra after injection of antagonist R & S 5050-M (Reckitt). Photo R. Borland.

In TABLE 1 there is a lot of scatter because experience was being gained by the writer in drug-dosages, drug-combinations and darting techniques.

In TABLE 2 the dosage of M—99 and Acetylpromazine was kept constant, hyoscine hydrobromide was excluded from the drug-mixture and zebra of approximately the same weight and age-group were selected for immobilisation.

In TABLE 3 the Acetylpromazine in the drug-mixture was replaced with another tranquillizer — triflupromazine ("Siquil", Squibb Laboratories) at the same dosage rate viz. 20 milligrams per animal.

In TABLE 4 the dosage of M—99 was increased by 0.50 milligram (or 1 microgram per lb. bodyweight) and Acetylpromazine and hyoscine hydrobromide were again included in the drug-mixture to determine if the down-time or immobilisation time could be lowered. The new M—99 antagonist R & S 5050 — M was used instead of Lethidrone and M—285 to evaluate it's efficacy.

In TABLE 5 the grouped data from TABLES 2, 3 and 4 are summarised.

All the zebra were immobilised satisfactorily and could be marked and measured without additional restraint.

The rectal temperatures of the immobilised zebra were taken shortly after they were recumbent. There was little difference in the average rectal temperatures of the zebra immobilised with combinations of M—99 plus acetylpromazine and M—99 plus triflupromazine. A rise of 1°F was observed in the average temperatures of zebra immobilised with a higher dosage of M—99 plus acetylpromazine and hyoscine hydrobromide. The external environmental temperature and humidity was measured with a whirling hygrometer at each immobilisation. The average external temperature was 84.4°F, lowest temperature 77°F and highest 94°F. High rectal temperatures were usually recorded when the immobilisation time exceeded 10 minutes. The higher rectal temperatures could not be correlated to high external temperatures or to the effects of the tranquillizers, but probably resulted from the increased muscular activity caused by the animal running a longer distance before becoming immobilised.

The normal pulse and respiration-rates of resting zebra are not known to the writer. Average pulse-rates and respiration-rates recorded from 24 zebra shortly after they were recumbent were 82 per minute and 20 per minute respectively. Gibbons, (1966) gives the normal resting pulse-rate for mature horses as 28—40 per minute and the normal resting respiratory-rate for mature horses as 8—16

Table 1. Results of zebra capture with M-99, Hyoscine hydrobromide, Acetylpromazine and Sernylan.

No.	Code No.	Area	Sex	Age years	Est. weight lbs.	Dart site	M-99 mg.	Hyoscine mg.	Acetylpromazine mg.	Sernylan mg.	Down-time	Temp. °F.	Antagonist mg.	Recovery time
1	N1	Andoni	M	4	550	Hip	1.5	25	15	—	30 min.	—	—	—
2	N2	Andoni	M	1	320	Hip	1.5	25	15	—	3 min. 30 secs.	—	L 100 I.M.	16 min.
3	N3	Andoni	F	3/4	250	Shoulder	1.5	25	15	—	3 min. 41 secs.	—	L 50 I.V.	3 min.
4	N4	Andoni	F	3	350	Hip	1.5	25	15	—	Approx. 5 min.	—	L 50 I.V.	44 secs.
5	GV1	Grootvlakte	M	10	750	Hip	2.5	25	10	—	33 min. 22 secs.	104	L 60 I.M.	2 min. 30 secs.
6	GV.2	Grootvlakte	F	3	400	Hip	2.5	25	10	—	25 min.	107	L 100 I.M.	6 min. 30 secs.
7	GV.3	Grootvlakte	F	3	375	Hip	2.5	25	10	—	8 min. 33 secs.	103	L 80 I.M.	6 min. 10 secs.
8	GV.4	Grootvlakte	F	?	450	Thorax*	2.5	25	15			104.2		
						Hip	2.5	25	15		5 min. 30 secs.		L 100 I.M.	12 min. 53 secs.
9	GV.5	Grootvlakte	F	4	475	Flank	2.5	25	15		20 min.	107	L 70 I.M.	30 secs.
10	A2	Adamax	F	3	400	Hip	2.5	12½	12		10 min.	—	L 100 I.M.	6 min.
11	A3	Adamax	M	5	550	Hip	2.5	12½	10		12 min.	106	L 100 I.M.	6 min.
12	GV.6	Grootvlakte	F	4	475	Shoulder	2.25	—	5	15	24 min.	—	L 50 I.V.	6 min. 20 secs.
13	L1	Leeubron	F	3	350	Shoulder	2.5	—	5	10	10½ min.	—	L 60 I.V.	15 secs.
14	GV.8	Grootvlakte	F	2	350	Hip	2.5	—	5	10	7½ min.	—	L 80 I.V.	18 secs.
15	GV.9	Grootvlakte	F	5	550	Hip	2.5	—	5	10	10 min.	—	L 60 I.V.	19 secs.
16	L2	Leeubron	F	2	360	Shoulder	2.5	—	5	10	10½ min.	—	M 10 I.V.	1 min. 2 secs.
17	A4	Adamax	M	2	350	Hip	2.25	—	10	—	19 min.	—	M 10 I.V.	5 secs.
18	GV.10	Grootvlakte	M	8	680	Hip	3	—	10	—	7½ min.	—	M 12 I.V.	45 secs.
19	A5	Adamax	M	7	650	Hip	2.25	—	—	—	30 min.	106.4	L 120 I.V.	5 secs.

* Darted twice.
L = "Lethidrone" (B.W. & Co.)
M = M-285 (Reckitts.)

Table 2. Results of zebra capture with M-99 and Acetylpromazine.

No.	Code	Area	Sex	Aage years	Est. body weight lbs.	Dart site	M-99 mg.	Acetylpromazine mg.	Down-time	Temp. °F.	Pulse per min.	Resp. per min.	M-285 mg.	Recovery time
1	Y1	Andoni	M	6	700	Shoulder	2.5	20	9 min.	101.2	—	—	8 I.V.	3 min. 25 secs.
2	Y2	Andoni	F	5	600	Shoulder	2.5	20	9 min. 30 secs.	103	90	17	5 I.V.	4 min. 30 secs.
3	Y3	Andoni	F	5	630	Shoulder	2.5	20	7 min. 30 secs.	101.5	90	11	5 I.V.	4 min. 30 secs.
4	Y4	Andoni	F	5	630	Shoulder	2.5	20	6 min. 30 secs.	102	—	—	5 I.V.	39 secs.
5	Y5	Andoni	F	5	630	Shoulder	2.5	20	8 min. 23 secs.	103.5	86	14	10 I.V.	1 min. 33 secs.
6	Y6	Andoni	F	5	650	Thorax	2.5	20	27 min.	103	90	24	10 I.V.	32 secs.
7	W1	Andoni	F	5	600	Neck	2.5	20	2 min. 49 secs.	102	70	16	10 I.V.	4 min. 30 secs.
8	W2	Andoni	F	5	600	Thorax	2.5	20	11 min. 25 secs.	105	86	16	10 I.V.	31 secs.
9	W3	Andoni	F	6	650	Jaw	2.5	20	6 min. 43 secs.	101	90	16	10 I.V.	1 min. 25 secs.
10	W5	Springbok-fontein	F	5	650	Sternum	2.5	20	16 min. 15 secs.	103	—	—	10 I.V.	2 min. 54 secs.
11	W6	Springbok-fontein	F	4	550	Cardiac region	2.5	20	2 min. 25 secs.	101.5	—	—	*L 80 I.V.	48 secs.
Average					626		4 micro-gram per lb.	32 micro-gram per lb.	9 min. 46 secs.	102.4	86	16	13.3 mico-gram per lb.	2 min. 18 secs.

* = Lethidrone (B.W. & Co.)

Table 3. Results of zebra capture with M-99 and Siquil.

No.	Code No.	Area	Est. weight lbs.	Sex	Age years	Dart site	M-99 mg.	Siquil mg.	Down-time	Temp. °F.	Pulse per min.	Resp. per min.	Antagonist mg.	Recovery time
1	NTV.	Ombika	630	F	6½	Hip	2.5	20	8 min. 25 secs.	100	66	18	7.5 M285 I.V.	1 min. 8 secs.
2	GW. 1	Gobaub	580	M	5	Neck	2.5	20	6 min.	101.8	68	26	*	10 min.
3	GW. 2	Gobaub	560	F	6½	Shoulder	2.5	20	18 min.	103.4	92	22	L 60 I.V.	30 secs.
4	GW. 3	Gobaub	400	F	3½	Shoulder	2.5	20	20 min.	107.2	106	36	L 60 I.V.	2 min. 30 secs.
5	GW. 4	Gobaub	580	F	5	Hip	2.5	20	15 min.	101.4	64	26	L 60 I.V.	35 secs.
6	GW. 5	Gobaub	600	M	6	Hip	2.5	20	6 min.	101.2	42	16	L 60 I.V.	50 secs.
7	OY. 3	Ock/font.	600	F	5	Shoulder	2.5	20	4 min.	—	—	—	L 80 I.M.	3 min. 30 secs.
8	OY. 4	Ock/font.	700	F	7	Shoulder	2.5	20	12 min.	—	—	—	L 80 I.M.	4 min. 20 secs.
9	OY. 5	Ock/font.	450	F	3½	Thorax	2.5	20	11 min.	—	—	—	L 50 I.V.	1 min. 15 secs.
10	OG. 1	Ock/font.	400	F	3½	Shoulder	2.5	20	8 min. 12 secs.	101.4	80	24	L 80 I.V.	36 secs.
Average:			550				4.5 mi-crogr. per lbs.	36 mi-crogr. per lbs.	10 min. 51 secs.	102.3 °F.	74	24	120 microgr./ lbs.	1 min. 40 secs.

L = "Lethidrone" (B.W. & Co.)
* Dosage of antagonist not recorded

Table 4. Results of zebra capture with M-99, Acetylpromazine and Hyoscine hydrobromide, and the antagonism of M-99 with R & S 5050-M (Reckitt). Area: Grootvlakte, Etosha National Park.

No.	Est. weight lbs.	Sex	Est. age years	Dart site	M-99 mg.	Hyoscine mg.	Acetylpromazine mg.	Down-time	Temp. °F.	Pulse per min.	Resp. per min.	R & S 5050-M mg. I.V.	Recovery time
R 1	640	F	8	Thorax	3	15	20	12 min. 46 secs	105	94	16	5	1 min. 18 secs.
R 2	550	F	6	Thorax	3	15	20	13 min. 34 secs.	104	96	14	4	25 secs.
R 3	550	F	5	Shoulder	3	15	20	3 min. 30 secs.	102	84	30	3	1 min. 50 secs.
R 4	580	F	5	Shoulder	3	15	20	8 min. 26 secs.	104.4	80	18	3	1 min. 52 secs.
R 5	580	F	4½	Neck	3	15	20	7 min. 14 secs.	100.6	96	20	6	2 min. 36 secs.
R 6	600	F	7	Shoulder	3	15	20	9 min. 28 secs.	102.6	72	16	6	1 min. 50 secs.
R 7	640	F	10	Neck	3	15	20	3 min. 28 secs.	101.9	84	16	6	1 min. 45 secs.
R 8	720	M	14	Shoulder	3	10	10	16 mins.	104	86	20	6	4 min.. 58 secs.
R 9	500	F	4	Shoulder	3	10	10	10 min. 29 secs.	104.6	86	20	4.5	52 secs.
R10	610	F	7	Shoulder	3	10	10	10 min. 37 secs.	105.8	90	20	6	1 min. 32 secs.
Average: 597					3 microgr. per lbs.	22.5 microgr. per lbs.	28.3 microgr. per lbs.	9 min. 33 secs.	103.5	87	19	8.25 microgr. per lbs.	1 min. 54 secs.

Table 5. Grouped data of Tables 2, 3 and 4.

	Weight	M-99	Hyoscine	Tranquillizer	Down-time	Temp. °F.	Antagonist	Recovery time
Table 2	626 lbs.	4 microgram per lbs.	—	A.C.P. 32 microgram per lbs.	9 min. 46 secs.	102.4	M-285 13.3 microgram per lbs.	2 min. 18 secs.
Table 3	550 lbs.	4.5 microgram per lbs.	—	Siquil 36 microgram per lbs.	10 min. 51 secs.	102.3	Lethidrone 120 microgram per lbs.	1 min. 40 secs.
Table 4	597 lbs.	5 microgram per lbs.	22.5 microgram per lbs.	A.C.P. 28.3 microgram per lbs.	9 min. 33 secs.	103.5	R & S 5050-M 8.25 microgram per lbs.	1 min. 54 secs.

per minute. Harthoorn (1965(b)) suggested that M—99 might have a specific effect on the heart of the donkey because in some instances the pulse-rate doubled and even trebled after M—99 was injected intravenously. Although high pulse-rates were recorded in the zebra, the effect on the heart appears to be transient because the zebra were normal in every respect after recovery from the narcosis.

VI. DISCUSSION

Although there is a lot of scatter in TABLE 1, two-thirds of the zebra were immobilised in less than 15 minutes. These animals are split evenly between those receiving hyoscine and those not receiving the drug. Four of the five animals receiving Sernylan were immobilised in less than 15 minutes. The numbers are too few to draw any firm conclusions, but it was felt that because there is no antagonist for Sernylan and because drug-mixtures should be kept as simple as possible it did not merit inclusion in further drug-combinatiins. No conclusions can be drawn from the one zebra, A5, that was immobilised with only 2.25 milligram M—99. However the down-time was 30 minutes and it seemed beneficial to include tranquillizers in future drug-mixtures because of the synergism and potentiation of M—99 reported by various workers.

In TABLE 2 the dosage of M—99 and acetylpromazine was kept constant and zebra of approximately the same weight and age group were selected for darting. Hyoscine was excluded from the mixture and results indicate that there is no justi ication for it's use in the immobilisation of zebra on open plains. In thick bush or overgrown environments hyoscine will be beneficial because the mydriatic effect of the drug will result in more rapid capture as a result of the affected animals being impeded by branches and bushes (Pienaar. per. comm.).

When zebra were immobilised with a slightly increased dosage of M—99, and triflupromazine HC1. was used instead of acetylpromazine (TABLE 3). the difference in average down-times was approximately one minute. This is possibly an indication that the two tranquillizers are similar in action at the dosage-rate of 20 milligrams per animal.

In an attempt to immobilise zebra in a shorter time, the M—99 dosage was increased to 3 milligrams per animal (5.0 microgram per lb.), and hyoscine hydrobromide was again included in the mixture (TABLE 4). No significant decrease in immobilisation time was achieved which once again indicated that hyoscine could be left out of future drug-combinations for zebra. Although the writer realises that the rapidity of immobilisation is dependent on the rate of absorbtion of the drugs and their effect on the central nervous system, he was unable to consistently achieve the rapid immobilisation times of 3 minutes reported by Harthoorn and Bligh (loc. cit). Increased dosage-rates of M—99, from 4 microgram per lb. to 5 microgram per lb. also did not significantly affect the immobilisation-times. The differences in our findings are most probably due to nutritional, physiological and subspecies differences between East African and South West African zebra. Zebra in Etosha National Park probably have an increased tolerance for M—99.

All the zebra recovered completely after one of the three morphine antagonists were injected. Three parenteral routes were used, viz. intravenous, intramuscular and accidentally the subcutaneous route. It appears from the results that nalorphine hydrobromide, ("Lethidrone" B.W. & Co.) produced the most rapid recoveries, followed by diprenorphine hydrochloride, (R & S 505 0— M (Reckitt). The recovery with R & S 5050 — M was smoother and with less excitement than when either "Lethidrone" or M—285 were used.

No mortality or detrimental side-effects as a result of the drugs were recorded in any of the zebra and the majority of the marked zebra were seen on subsequent occasions. Marked mares rejoined their families shortly after they had recovered from the immobilisation.

VII. CONCLUSION

1. For all practical purposes highly satisfactory results were obtained when 50 plains zebra in the Etosha National Park were immobilised with average doses of 4 to 5 microgram/lb. M—99 in combination with various other drugs such as hyoscine hydrobromide, phencyclidine hydrochloride, acetylpromazine and triflupromazine hydrochloride.

2. Plains zebra in the Etosha National Park have an increased tolerance for M—99 compared with plains zebra in East Africa.

3. Hyoscine hydrobromide does not appear to be necessary in drug-combinations for immobilising zebra on open grass plains, but may be useful in dense and bushy terrain. The inclusion of hyoscine hydrobromide at an average dosage-rate of 22.5 micrograms per lb. did not significantly decrease the immobilisation time.

4. The average rectal temperature of 28 zebra taken shortly after immobilisation was 102.7°F. The rectal temperatures were not influenced by the immobilising drugs. High rectal temperatures were caused by increased muscular activity when immobilisation times exceeded 10 minutes.

5. The two tranquillizers, acetylpromazine and triflupromazine are effective and safe tranquillizers in drug-combination used for capturing zebra.

6. Three morphine and M—99 antagonists "Lethidrone", M—285 and è & S 5050 — M satisfactorily reversed the narcotic effects of M—99 by intravenous, intramuscular or subcutaneous injection routes. A new M—99 antagonist, Diprenorphine hydrochloride (R & S 5050 — M, Reckitt) was found suitable for antagonising M—99 at a ratio of 1:1 and 1:2.

7. No mortality or detrimental side-effects were observed at the various dosage-rates and drug-combinations.

VIII. SUMMARY

A total of 50 plains zebra were successfully captured with M—99 in combination with tranquillizers such as acetylpromazine, triflupromazine hydrochloride, phencyclidine hydrochloride and/or hyoscine hydrobromide, and marked to facilitate the study of zebra migrations in Etosha National Park, South West Africa. The Palmer Powder Charge Cap-Chur Gun and Palmer Short Range Projector were used to fire 1 ml., 2 ml., and 3 ml. projectile darts containing the drug-mixtures.

The details of the results are presented in five Tables. At average dosage-rates of 4 to 5 microgram per lb. M—99, 28 to 32 microgram per lb. acetylpromazine or 36 microgram per lb. triflupromazine hydrochloride and/or 22.5 microgram huoscine hydrobromide per lb. the zebra were immobilised in average times of 9 to 11 minutes.

The rectal temperature, pulse-rates and respiration-rates of some of the immobilised zebra are recorded.

The benefits of adding hyoscine hydrobromide to drug-combinations for immobilising zebra on open plains is discussed. No significant lowering of immobilisation times was achieved when hyoscine hydrobromide was included in the drug-mixture at average rates of 22.5 microgram per lb. Effective immobilisation was obtained without any additional restraint when M—99 was combined with either acetylpromazine or triflupromazine hydrochloride. Zebra in Etosha appear to have a higher tolerance for M—99 compared with zebra in East Africa.

All the zebra recovered from the immobilisation after parenteral injections of one of three different morphine or M—99 antagonists. None of the animals died or suffered from detrimental side-effects as a result of the capture technique.

A new M—99 antagonist, Diprenorphine hydrochloride (R & S 5050 — M, Reckitt) was used with highly satisfactory results.

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