IMMOBILIZING DRUGS USED IN THE CAPTURE OF WILD ANIMALS IN THE KRUGER NATIONAL PARK

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SUMMARY

A discussion on the immobilizing drugs and tranquillizers used in the capture of wild animals in the Kruger and Addo Elephant National Parks is presented. Field trials were conducted with the following drugs: Nicotine salicylate, Scoline (Allan-Hanbury), Flaxedil (May Baker), Sernylan (Parke Davis), Themalon (Burroughs Wellcome), Morphine hydrochloride, Omnopon (Roche), Quiloflex (C. H. Boehringer Sohn), Largactil (May Baker), Trilafon (Scherag), Vetame (Squibbs), Pethidine hydrochloride, Phenergan (May Baker), Hyoscine hydrobromide and an experimental drug Ro5/2807/B–5F (Roche). Dosages for the various drugs successfully applied to different game species are tabulated.

The immobilization of game by means of a projectile syringe containing paralysing or hypnotic drugs, has become a valuable tool in the management and control of wild animals. It enables the scientist to study the migration habits and other peculiarities of game animals, facilitates the translocation of wild animals to areas where they have become extinct, and may be employed as an effective and safe method of elephant control in National Parks. The ultimate perfection of this technique is of importance to both veterinarians and biologists.

Since the publication by Hall *et al.*[10] on the use of paralytic agents in in the capture of White-tailed deer, several workers have been engaged in research on the immobilization of wild game animals. Various drugs were employed on different species of game in an attempt to develop a safe and practical method of capturing wild animals. These drugs varied in their action on the animal from muscle relaxants to tranquillizers, hypnotics, and narcotics. A suitable and reliable drug for all game species has not been found yet — probably as a result of divergent psychosomatic and physiological features in the different species.

Empirically an immobilizing agent for any given species should conform to the following requirements:—

(1) The drug should have a very wide safety margin. This is of great significance where one is confronted with free roaming wild animals, and the correct judging of the animal's bodyweight is difficult.

(2) The latent period prior to the drug taking effect should be as short as possible. A time lapse of 10–20 minutes after the animal has been darted, is often sufficient for the animal to escape in heavily overgrown country.

(3) A reliable and fast-acting antidote should be at hand in cases of severe overdosage or retarded recovery.
(4) In dealing with wild animals, tranquillizing or sedative drugs are essential and it would be of great advantage if a drug incorporated both muscle relaxant and sedative properties.
(5) The drug should be non-irritating to the musculature as intramuscular injection is the only means of parenteral administration with the dart-syringe.
(6) The volume of the drug required for effective immobilization should be as small as possible. Under local conditions in the Kruger National Park, a total volume of 1–5 cc. would be optimal and 10–15 cc. maximal.

During the past two years trials were conducted with various drugs as immobilizing agents on a number of wild animal species in the Kruger and Addo Elephant National Parks. It is our intention in this paper to present a brief résumé of the results achieved, with a discussion of the merits and disadvantages of each drug *per se*. Dosages of the respective drugs, for some African wild animals, are presented in table I.

The method of drug administration was essentially the same as described by us in a previous publication.[20]

To date the following drugs have been subjected to field trials:—

1. *Nicotine salicylate*

Grzimek[9] reports: "The effect of nicotine salicylate is the opposite of that of curare, that is, it stimulates the activity of the nerves. The motor nervous system is strongly stimulated and a total disorganization of the system results. The effect of nicotine appears in two phases: at first there is a temporary strong stimulation of the whole nervous system; this is followed by a general paralysis of the ganglions."

In the Kruger National Park this drug was administered to Impala (*Aepyceros melampus melampus* Lichtenstein), but on account of its danger to the operator and its severe convulsive action on the patient, it was soon discarded and is in our opinion not suitable for this type of work.

2. *Syccinyl choline chloride* ("Scoline" — Allan-Hanbury)

Several workers have used Succinyl choline chloride as an immobilizing agent on a number of animal species. It is a muscle relaxant acting by persistent depolarisation of the motor end plates. There is no specific antidote available for this drug and the safety margin in some animals, viz. Wildebeest (*Gorgon taurinus taurinus* Burchell), Buffalo (*Syncerus caffer caffer* Sparrman) and African elephant (*Loxodonta africana* Blumenbach) is so critical that the drug's application under field conditions becomes unpractical.

In other species, *viz.* Impala, Zebra, and Uganda Kob[1], where the safety margin is not so critical, succinyl choline chloride can be classed as an effective and relatively safe immobilizing agent.

Its advantages are its relatively short reaction time, i.e. the latent period prior to the drug taking effect, which varies from 6–12 minutes in most animals. The effect of the drug usually lasts for a period of 20–60 minutes and the recovery is rapid and complete. The drug is also virtually non-poisonous when taken per os. In a few instances, where dangerous

and injured elephants had to be destroyed in the Kruger National Park, the drug was effectively and safely adapted as an euthanasiac. Unfortunately Scoline is affected by heat and its potency deteriorates under field conditions, if not kept cool.

3. *Gallamine triethiodide* (Flaxedil — May Baker)

Gallamine triethiodide is a synthetic, curare-like substance, producing paralysis by blocking nervous impulses at the neuro-muscular junctions.

Flaxedil was one of the first drugs used in the immobilization of game. Hall *et al.* reported on the use of Flaxedil to produce paralysis in White-tailed deer in 1953, and it is still to this day one of the most effective drugs for the capture of certain animal species.[10] The fact that Flaxedil and other synthethic curarates have a reliable antidote, renders them preferable to many other preparations.[19] The action of Flaxedil is to a large extent rapidly reversible by Neostigmin and other anti-choline esterase producing agents. In some animals a recurrence of the paralysis after antidote administration, necessitates a supplementary dose of antidote.

Initial experiments with Flaxedil in the Kruger National Park were conducted on the Impala, Wildebeest, Buffalo and Giraffe (*Giraffa camelopardalis* Linnaeus). Eminently satisfactory results were obtained in combination with Atropin (5 mgm/100 lb.)

The time lag between darting and the drug taking effect varied from 9–26 minutes. In the majority of cases the animals recovered within 1½–2 minutes after intra-venous antidote administration.[21] Impala immobilized with Flaxedil, without receiving the antidote, remained paralyzed for a period of 45–72 minutes.

The drug is highly soluble in water and stable under field conditions. A relatively narrow safety margin in some species and rather long reaction time are the two main disadvantages of the drug. The addition of the enzyme hyaluronidase is recommended to induce a shorter latent period prior to the drug taking effect.

As with all paralyzing drugs, regurgitation of the stomach contents may occur in ruminants if they are unable to remain on their briskets.

4. 1-(-1- *Phenyl cyclohexyl*) *piperidine hydrochloride* (*Sernylan — Parke Davis)

According to Graham Chen and co-workers, Sernylan is a drug that acts on the central nervous system[3] either by stimulation or by depression.

In a previous publication[21] we reported on the results obtained with this drug on the following species viz. Giraffe, Impala, Hippopotamus (*Hippopotamus amphibius* Linnaeus), Buffalo and Baboon (*Papio* (*Chaeropithecus*) *ursinus orientalis* Goldblatt). The following characteristics of the drug were mentioned in the report:

"(1) At the dosage rates applied locally Sernylan exhibits little or no tranquillizing effect, but appears to act rather as a depressant of the balance centre in the brain. Some of the animals were only slightly tranquillized . . .". In the Baboon, however, the effect of the drug (combined with Largactil) was that of surgical anaesthesia.

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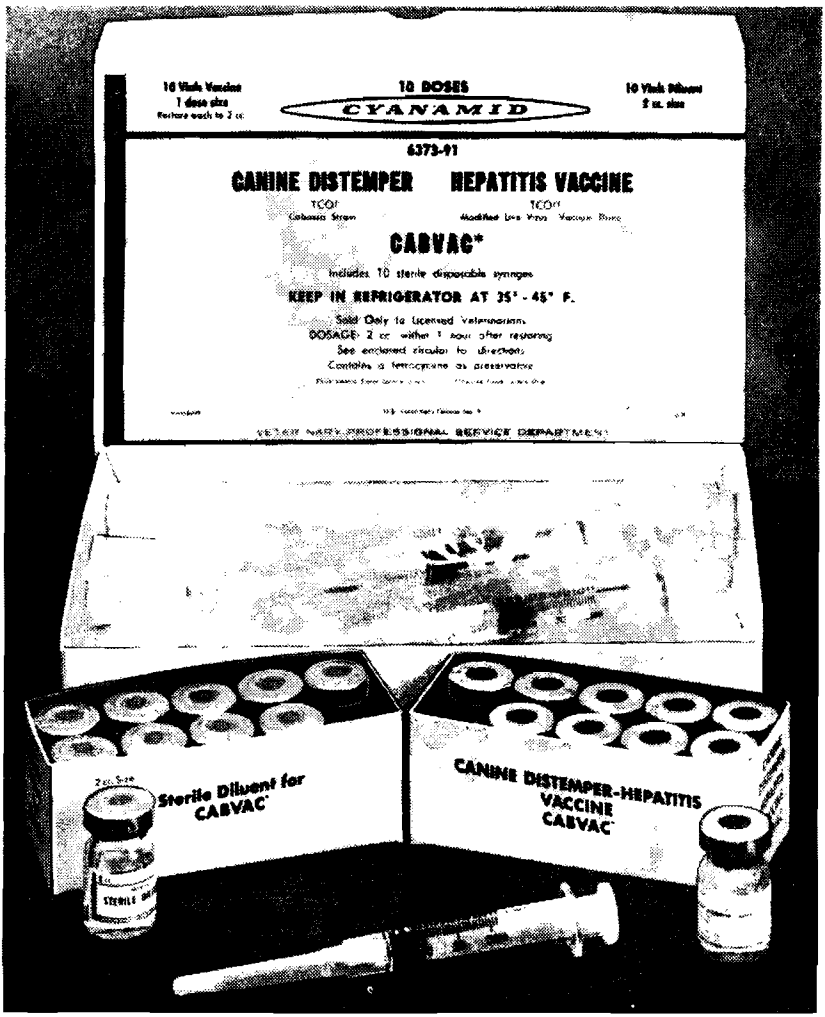

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"(2) The time lag between darting and the drug taking effect was surprisingly short." The animals became ataxic at 7 minutes and went down at 20 minutes.

"(3) There is no detectable depression of respiration, except in cases of severe overdosage. In this respect the drug is superior to muscle relaxants like Succinyl choline chloride and curare-like drugs.

(4) A specific antidote for Sernylan is not available . . .

(5) The most promising results were obtained where Sernylan was combined with a suitable tranquillizer . . .".

The recovery stage is gradual, but characterized by intermittent excitory periods. The duration of the effect of the drug varied from 30 minutes (in Impala) to 13 hours (Baboon). The optimum dosage in the Giraffe caused immobilization for $1\frac{1}{2}$ hours.

5. *Diethyl thiambutene* (Themalon — Burroughs Wellcome)

Harthoorn[13] evolved an immobilizing mixture for the capture of the White (Square lipped) Rhinoceros (*Ceratotherium simum simum* Burchell).

The mixture consists of Themalon or Morphine hydrochloride (a narcotic) as the principal immobilizing agent, with Hyoscine hydrobromide (an amnesiac) and Largactil (or Sernylan) as adjuvants.

The significant advantage of this mixture is its wide margin of safety. The principal drug is also readily antagonized by Nalorphine hydrobromide (Lethidrone).

With this mixture we succeeded in capturing five Hippopotami.[20, 21]

Omnopon (Roche) — (a drug incorporating all the alkaloids of opium) has been used as a substitute for Themalon or Morphine. Themalon, however, remains the drug of choice.

6. 2- (*Gamma-methoxypropyl-aminomethyl*)-1, 4-*benzodioxane hydrochloride* (Quiloflex — C. H. Boehringer Sohn)

Quiloflex is a reflex inhibitor used in human medicine for the symptomatic treatment of spasticity due to pyramidal tract lesions.

Initial experiments with Quiloflex in the Kruger National Park were conducted on the Impala. As reported in a previous publication[22] gratifying results were obtained in the case of this species.

In subsequent trials on eight different species, variable reactions were encountered. The small number of animals utilized in these preliminary experiments is far too inadequate to express a definite opinion on the value and versatility of Quiloflex as immobilizing agent in game. Nevertheless, in analyzing the available data, the following salient characteristics may be mentioned.

Quiloflex has a very wide safety margin in the Impala. A dosage range of 2–25 mgm/lb. was effectively applied in this species.

Animals darted with Quiloflex go down on their briskets and remain in that position for a considerable length of time. Should the animal escape after being darted, sufficient time is available to search for it before any assistance is required by the immobilized animal.

In the majority of cases the onset of reaction is fast. Ataxia is usually evident in 2–6 minutes after the animal has been darted. The higher the dosage rate applied, the sooner the animal becomes sufficiently immobilized to be handled. Animals that are only partially immobilized

by this drug resent handling and are prone to serious injuries and complications.

The reaction on the animal varies from ataxia to deep narcosis, depending on the dosage rate applied. The effect lasts from $1\frac{1}{2}$ hours (Baboon) to 6 hours (ruminants). The recovery stage is gradual and the animal is well tranquillized during this period.

The tissue tolerance of Quiloflex in a concentrated solution seems to be good, and the drug is stable under local conditions.

No specific antidote is available yet. Unfavourable side-effects such as bloat and dyspnoea have been observed.

Tranquillizers

Sedatives or tranquillizers are valuable and in some cases indispensable drugs in game immobilization. These drugs are either utilized as essential ingredients of immobilizing mixtures, or play a major rôle in the after care of captured wild animals.

The ideal tranquillizer should sedate the animal to such an extent, that it is divested of all aggressiveness and fear, but retains its consciousness and control over normal body-mechanisms. Significant characteristics are the volume of the dose and the time taken by the drug to produce the requisite state of calmness.

The following tranquillizers were used in game in the Kruger National Park.

1. *Chlorpromazine hydrochloride* (Largactil — May Baker)

This drug was successfully combined with Themalon and Hyoscine hydrobromide in an immobilizing mixture in the capture of White Rhinoceri[12, 13] and Hippopotami.[20, 21]

In combination with Sernylan in the immobilization of Giraffe, Hippopotami and Baboon, the drug was found to be most effective in ôcounter-acting the excitory stage encountered during the recovery period.

The large volume required by big game animals is a limiting factor when the drug is to be administered in combination with other drugs by means of a projectile syringe.

Satisfactory results were obtained with Largactil in ruminants. In the White Rhinoceros a dosage rate of 0.5 mgm/lb. was ineffective to produce tranquillization during transportation.

2. *Perphenazine* (Trilafon — Scherag)

The small volume required by large animals renders this drug suitable as an adjuvant to the principal immobilizing drug.

In the Kruger National Park this drug was combined with Sernylan for the capture of Giraffe and Hippopotami. The onset of reaction (when administered intra-muscularly) is slow.

3. *Trifluprom azine hydrochloride* (Vetame — Squibbs)

Although only a limited number of animals were treated with this drug, excellent results were obtained in the case of Giraffe, Buffalo and Eland.

The drug is available in a high concentration (20 mgm per cc.) and the recommended dosage rate is low (5 mgm/100 lb). It has a rapid onset of reaction.

The drug was used for premedication in buffalo and as an adjuvant to Quiloflex in the immobilization of an eland. Satisfactory results were obtained with Vetame in giraffe during transport.

4. On account of peculiar reactions provoked by some tranquillizers in the horse, the following mixture was administered to zebra: *Pethidine hydrochloride*, *Chlorpromazine hydrochloride*, *Promethazine hydrochloride* and *Hyoscine hydrobromide*.

This cocktail, administered intramuscularly or intravenously, produced effective tranquillization.

5. An experimental drug, Ro5-2807/B-5F (Roche)

This was used as the tranquillizing agent for the translocation of captured oribi (*Ourebia ourebi* Zimmerman), Steenbuck (*Raphicerus campestris zuluensis* Roberts), Grey rhebuck (*Pelea capreolus* Bechstein) and Hippopotami. The majority of captured animals responded very well to this drug.

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REFERENCES

1. BUECHNER, H. K., HARTHOORN, A. M. & LOCK, J. A., (1960): Immobilizing Uganda Kob with Succinyl choline chloride. *Canadian Jnl. of Comp. Med.*, **24**, 11.
2. BUECHNER, H. K., HARTHOORN, A. M. & LOCK, J. A., (1960): The immobilization of African animals in the field with special reference to their transfer to other areas. *Proc. Zool. Soc.*, London, **135**, Part 2, 261.
3. BUECHNER, H. K., HARTHOORN, A. M. & LOCK, J. A., (1960): Recent advances in field immobilization of large mammals with drugs. *Trans. 25th North American Wild Life Conference.*
4. BUECHNER, H. K., HARTHOORN, A. M. & LOCK, J. A., (1960): The immobilization of wild animals as an aid to management and control. *Oryx. V*, No. 6.
5. BUECHNER, H. K., HARTHOORN, A. M. & LOCK, J. A., (1960): Control of African Wild animals. *Nature.*, **185**, 47.
6. CARTER, N., (1961): Progress in drugging technique. *Wild Life*, **2**, 9.
7. COWAN, McT. I., WOOD, A. J. & NORDAN, H. C., (1962): Studies in the tranquillization and immobilization of deer (Odocoileus). *Canadian Jnl. of Comp. Med. and Vet. Sci.*, **26**, 57-61.
8. CRAIGHEAD, JOHN J. et al., (1960): Trapping, immobilization and color-marking of Grizzly bears. *Trans. of the 25th North Amer. Wild Life and Natural Resources Conf.*, March, 1960, p. 347-63.
9. GRZIMEK, M. and B., (1960): A study of the game of the Serengeti plains. *Zeitschrift für Saugetierkunde.*, **25**.

DOSAGES OF DRUGS USED IN SUCCESSFUL IMMOBILIZATION AND TRANQUILLIZATION OF DIFFERENT GAME SPECIES (MGM/LB)

TABLE 1

Species	Scoline	Flaxedil	Sernylan	Themalon	Morphine	Omnopon	Quiloflex	Largactil	Trilafon	Vetame	Ro5-2807/B-5F	Hyoscine	Pethidene	Phenergan	Prostigmin	Atropin	Mixtures
Impala...	0.16	0.9–1.2	0.215	—	—	—	2.0–25.0	0.5–1.0	—	—	—	—	—	—	0.01	0.05	1. Flaxedil & Atropin 2. Sernylan & Largactil
Wildebeest*	0.035	0.9–1.0	0.18	—	—	—	—	0.5–1.0	—	—	—	—	—	—	0.01	0.05	1. Sernylan & Largactil 2. Flaxedil & Atropin
Buffalo...	—	0.9–1.0	0.15	—	—	—	3.0–5.0	—	0.06	0.05	—	—	—	—	0.01	0.05	1. Quiloflex & Vetame 2. Flaxedil & Atropin
Giraffe*..	—	1.0–1.2	0.15–0.18	—	—	1.0	2.5–3.0	0.5	0.06	0.05	—	0.05	—	—	0.01	0.05	1. Flaxedil & Atropin 2. Sernylan & Largactil or Trilafon 3. Omnopon, Largactil & Hyoscine
Eland*...	—	—	—	—	—	—	2.5	—	—	0.03	—	—	—	—	—	—	Quiloflex & Vetame
Blesbuck*	—	—	—	—	—	—	17.0	—	—	—	—	—	—	—	—	—	
Zebra....	0.1	—	—	—	—	—	—	0.2	—	—	—	0.05	0.4	0.2	—	—	Largactil, Pethidine, Phenergan & Hyoscine combined
Zebra....	0.1	—	—	—	—	—	—	0.2	—	—	—	0.05	0.4	0.2	—	—	Largactil, Pethidine, Phenergan & Hyoscine combined
Springbok*	—	—	—	—	—	—	15.0	—	—	—	—	—	—	—	—	—	
Baboon..	—	—	2.5	—	—	—	12.5	1.0	—	—	—	—	—	—	—	—	Sernylan & Largactil
Hippopotamus	0.05	—	0.125–0.16	—	0.5	0.5–1.0	—	0.25–0.4	0.06	—	—	0.05	—	—	—	—	1. Sernylan & Largactil or Trilafon 2. Morphine, Largactil & Hyoscine
White Rhinoceros*	—	—	—	1.5	—	—	—	0.25	—	—	—	0.05	—	—	—	—	Themalon, Hyoscine & Largactil
Oribi.....	—	—	—	—	—	—	—	—	—	—	0.6–0.8	—	—	—	—	—	
Steenbuck	—	—	—	—	—	—	—	—	—	—	1.1–1.4	—	—	—	—	—	
Grey rhebuck	—	—	—	—	—	—	—	—	—	—	1.1–1.4	—	—	—	—	—	

*Only one animal has been treated by the authors with the following drugs:
(1) Wildebeest — Sernylan & Largactil.
(2) Giraffe — Omnopon, Hyoscine & Largactil.
(3) Eland — Quiloflex.
(4) Blesbuck — Quiloflex.
(5) Springbok — Quiloflex.
(6) White Rhinoceros — Themalon, Hyoscine & Largactil.

10. HALL, T. C., TAFT, E. B., BAKER, W. H. & AUB, J. C., (1953): Use of Flaxedil to produce paralysis in deer. *Jnl. Wild Life Mngmt.*, **17.**
11. HARTHOORN, A. M., (1962): The use of a Neuro-muscular blocking agent on domestic cattle. *Vet. Rec.*, **74,** 13.
12. HARTHOORN, A. M., (1962): The capture and relocation of the White (Square lipped) Rhinoceros, *Ceratotherium simum simum. The Lammergeyer*, **2,** 2.
13. HARTHOORN, A. M., (1962): Capture of the White (Square lipped) Rhinoceros, *Ceratotherium simum simum* (Burchell) with the use of drug immobilization technique. *Can. Jnl. of Comp. Med. and Vet. Sci.*, **26,** 9.
14. HEUSCHELE, WERNER P., (1961): Immobilization of captive wild animals. *Vet. Med.*, **56** (8).
15. PIENAAR, U. DE V. & VAN NIEKERK, J. W., (1963a): The capture and translocation of three species of wild ungulates in the Eastern Transvaal with special reference to Ro5–2807/B–5F (Roche) as a tranquillizer in game animals. *Koedoe*, **6,** 83–90.
16. PIENAAR, U. DE V. & VAN NIEKERK, J. W., (1963b): Elephant control in National Parks. A new approach. *Oryx*, **VII,** No. 1, 35–38.
17. TALBOT, L. A. & LAMPREY, H. F., (1961): Immobilization of free-ranging East African Ungulates with Succinyl choline chloride. *Jnl. Wild Life Mngmt.*, **25,** No. 3.
18. TALBOT, L. M., (1961): Field immobilization of some East African wild animals and cattle. *East. Afr. Agr. & For. Jnl.*, **26,** No. 2, 92–102.
19. TALBOT, L. M. & TALBOT, M. H., (1962): Flaxedil and other drugs in field immobilization and translocation of large mammals in East Africa. *J. Mammal.*, **43,** No. **1,** 76–88.
20. VAN NIEKERK, J. W. & PIENAAR, U. DE V., (1962): Adaptation of the immobilizing technique to the capture, marking and translocation of game animals in the Kruger National Park. *Koedoe*, **5,** 137–143.
21. VAN NIEKERK, J. W. & PIENAAR, U. DE V., (1963a): A report on some immobilizing drugs used in the capture of wild animals in the Kruger National Park. *Koedoe*, **6,** 126–133.
22. VAN NIEKERK, J. W., PIENAAR, U. DE V. and FAIRALL, N., (1963b): A preliminary note on the use of Quiloflex (Benzodioxane hydrochloride) in the immobilization of game. *Koedoe*, **6,** 109–114.

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