

THE FIELD-IMMOBILIZATION AND CAPTURE OF HIPPOPOTAMI (*Hippopotamus amphibius* Linnaeus) IN THEIR AQUATIC ELEMENT

By

U. DE V. PIENAAR, Ph.D.

(Biologist, Kruger National Park, Skukuza)

INTRODUCTION

The earliest reference to the capture of hippopotami by drug-immobilization is that of Buechner, Harthoorn and Lock (1960). Three hippopotami were successfully immobilized by this group, using the muscle relaxant succinylcholine chloride as the immobilizing agent.

It was noted that a safe paralyzing dose of succinylcholine chloride i.e. 0.1 mgm/Kgm only affected the hindquarters of the hippo and the other bodily activities including jaw movements, were left unimpaired.

Harthoorn (1965) provides data from a series of 21 cases of hippo which were darted with succinylcholine chloride in the Queen Elizabeth National Park, Uganda. These were adult animals, ranging in weight from an estimated 2,000 to 3,500 lbs. The majority of these beasts were darted on dry land or in their shallow mud wallows, away from deep water. It was essential to evict the animals from the latter within 5 to 6 minutes, because if they became immobilized in the water, it was usually not feasible to approach them. Harthoorn found that a dose of this muscle relaxant, sufficient to ensure the animal's collapse on land, only slightly impedes it when in its own element, and to approach such beasts in water or mud, could be decidedly dangerous. Even on land, the animal's head, neck and jaws retained near-normal mobility, and, in view of the complete absence of central nervous depression, the immobilized animals were extremely aggressive and could not be handled or approached from the front.

For capturing purposes, succinylcholine chloride is therefore not a suitable drug to use, although hippos can be marked while in this state of temporary paralysis.

The one advantage of the drug is that it is rapidly effective, and immobilization was usually achieved within 10 minutes.

In the case of hippo, the therapeutic index of succinylcholine chloride is low, and it was found that the most effective paralyzing dose for adult animals on dry land ranged from 0.055-0.08 mgm/lb. Doses above 0.08 mgm/lb were not safe, and below 0.05 mgm/lb it was largely ineffective.

In view of the excessive bronchial secretion stimulated in some animals by succinylcholine, atropine was administered with the muscle relaxant by

Harthoorn, at a dosage rate of 5 mgm/100 lbs. It was soon discovered, however, that atropine apparently blocks the sweating reflex of hippo, and this often led to fatal overheating.

Atropine and parasympatholytic drugs such as hyoscine hydrobromide is therefore, in our opinion, best left out of immobilizing mixtures designed for the capture of hippo.

After some initial, rather futile experimenting in the Kruger Park with succinylcholine and gallamine triethiodide (Flaxedil, May & Baker), it was realized that for the successful capture of hippopotami in their aquatic element other drugs, without a primary paralysing or muscle relaxing action, would have to be used.

It was considered essential that the immobilizing drug, in the case of hippo, should have a marked central nervous depressant action because of the beast's inherent aggressive nature, but, on the other hand, complete narcosis would be undesirable, as a hippo in such a state would rapidly drown in deep water.

A number of hippo (5) were eventually captured in the rivers of the Kruger Park and translocated successfully to the Addo National Park, using the neuroleptanalgesic mixture of Morphine (or Themalon), hyoscine hydrobromide and chlorpromazine, which was so effectively employed for the capture of white rhino in Natal (vide Harthoorn, 1962 and 1965; Harthoorn & Player, 1964). The various components of this drug mixture were administered at a dosage rate of 0.5 gms/1,000 lbs in the case of Morphine (1.5 gms Themalon/1,000 lbs), hyoscine hydrobromide 50 mgms/1,000 lbs and chlorpromazine 250 mgms/1,000 lbs.

The results of our efforts in capturing hippo with this drug combination have been reported on in an earlier paper. (Van Niekerk & Pienaar, 1962).

It was found that the first signs of the drugs taking effect could be noticed, in these cases, some 30 minutes after darting. Animals could not be handled however, until about 1½ hours had elapsed, and this was a serious drawback. Furthermore, it would appear that, in contrast to most other herbivores, morphine and related drugs are not well tolerated by hippo. Several cases of spontaneous cardiac collapse were experienced, and a contributory factor here could be the heavy infestation with *Schistosoma hippopotami* suffered by the majority of hippos in our rivers. These parasites cause, amongst others, quite extensive lesions in the circulatory system of the heart of the infected animals, and the affected organs of such beasts often appear to succumb suddenly to the cardiac stress imposed by the drugs in question.

A further serious disadvantage of the neuroleptanalgesic mixtures, in the case of hippo which have been darted in water, is the fact that once the animal is sufficiently restrained to allow its capture, it is usually unable to remain buoyant, and drowns rapidly unless it can be hastily hauled into shallow water. This is very often not possible, in cases where the affected beasts are floundering in deep water amongst the rest of the herd, as a net cannot be used under such circumstances.

Neuroleptic narcosis of hippo with drugs of the Oripavine series (M-99 or M-183), which are rapidly effective, would be particularly useful in the case of such animals on dry land, but would again not be suitable for capturing these beasts in an aquatic medium, because of the dangerously helpless state which they induce.

To date, the only drug which has been effectively employed in the Kruger Park for the capture of hippo in the rivers, without incapacitating the darted animals to the extent of endangering their lives in deep water, is phencyclidine (Sernylan*).

The central nervous depressant action of Sernylan, when administered in combination with a suitable ataractic such as chlorpromazine or acetylpromazine maleate, is such that the beast is able to remain buoyant in deep water for a considerable period. This usually allows ample time for securing it by means of a net or lasso and hauling it to safety. The drug mixture of Sernylan and tranquilliser is also rapidly effective (usually within 10-15 minutes), and the affected animals are sufficiently tractable to allow their handling with the proper precaution.

The difficulty of securing a drugged animal when it is surrounded by aggressive, unaffected animals in a deep hippo pool remains a major problem, however, despite the advantages of Sernylan over other drug combinations in such situations. (Van Niekerk & Pienaar, 1963).

It is the purpose of this paper to report on a new technique, developed in the Kruger Park, whereby hippo may be immobilized and captured in water, with a minimum hazard of losing the animals through drowning.

METHODS AND RESULTS

During the winter months of 1966 the water in the Olifants River in the Kruger Park was very low because of the prevailing drought. The some 800 hippo inhabiting this river were concentrated in large aggregations in the few remaining pools which afforded sufficient shelter, and conditions were ideal for experimenting with capturing techniques in the water.

Instead of darting the hippo from the riverbank or the edge of the pool, as was the custom in the past, it was considered advantageous to execute this part of the operation from the roof of a road grader which we intended using for retrieving the drugged animals from the water. (Figs. (ii) and (vii)).

It was found that as soon as the grader entered the water, the herd would move about in a restless manner, but being very inquisitive animals, they would rear up from the water to obtain a better view of the strange apparition intruding upon their domain. In doing so, the selected animals afforded ample opportunity for the marksman with the crossbow, sitting on top of the grader's cab, to score a hit in some vulnerable spot. (Fig. (iii)).

The Van Rooyen crossbow** was used to propel the drug-darts and we usually employed darts of 3 cc.-5 cc. capacity (depending on the volume of the immobilizing mixture), fitted with needles at least 3 inches long. Where

* 1-(1-Phenyl cyclo-hexyl) piperidine hydrochloride (Parke, Davis).

**Manufactured by G. L. van Rooyen of "Southfields", P.O. Greytown, Natal, South Africa.

possible, it was attempted to dart the animals on the side of the neck, as the skin is not so thick here and the dart would strike at less of an angle than on the back. (Figs. (iii) and (iv)). It was found that with needles of less than 3 inches long, the tip often did not penetrate down to muscle if the animal was hit at an acute angle on the back, and the drug would then be delivered intradermally, or into the subcutaneous adipose tissue, with futile effect.

The immobilizing mixture used in the successful capture of the 6 hippopotami during the last week in September, was a combination of Sernylan and Acetylpromazine maleate. The drugs were administered at a dosage rate varying from about 0.16 mgm/lb to 0.25 mgm/lb in the case of the Sernylan and 0.05 to 0.11 mgm/lb in the case of the Acetylpromazine. (See Table 1).

For obvious reasons young animals ranging in body weight from \pm 550-1,800 lbs were selected for capture.

The first signs of the drugs taking effect were usually noted about 10 minutes after darting. Sernylan apparently causes some relaxation of the eye musculature, resulting in varying degrees of exophthalmus. (See Fig. (vii)). This "pop-eyed" effect was the first to be noted, but soon afterwards the animal showed signs of ataxia and began swimming slowly around in circles, the while emitting plaintive little grunts every now and then. Should it have stumbled into shallower water, it would sometimes stagger about drunkenly or squat down with the head reared high and the mouth partially agape (Fig. (iv)). The facial expression is fixed in dumb, drugged stupor and the animal can then be safely approached and captured.

This was accomplished by driving straight into the pool with the grader (the river having a firm bottom), and throwing a noose around the head and neck of the affected animal by means of a pole lasso (Fig. (iii)). The head of the animal would then be lifted out of the water and lashed to the side of the grader, whereupon the grader would reverse back onto dry land, towing the immobilized beast behind it. Once on dry land, the hippo would be properly secured with ropes, rolled onto a hand carrying net of some 8' square (made out of stout manilla rope) and lifted into its crate. (Fig. (viii)). To be on hand, the latter was tied onto a trailer, which was in tow behind the grader. Prior to crating, the dart was removed, the wound disinfected and each animal received some 12,000,000 i.u. of a long-acting penicillin preparation such as "Triplopen" (Glaxo-Allenbury's). Sometimes additional doses of tranquilliser had to be administered to facilitate crating and to prevent the animal from injuring itself in the crate while in transit.

While working with the captured animal on land, the latter would often protest and bellow furiously. This on many occasions provoked the bereaved hippo cows or the herd bull to charge the capture team in an attempt to rescue the captive calf. (See Fig. (v)). In such instances the engine of the grader was "revved" and the resulting din effectively drowned the noisy complaints of the captured animal.

In some cases, it was possible to chase the rest of the herd out of a pool with the grader after a darted calf showed signs of ataxia. (See Fig. (iii)).

Fig. (i) — Grader, with all equipment in position, moving into hippo pool for darting.

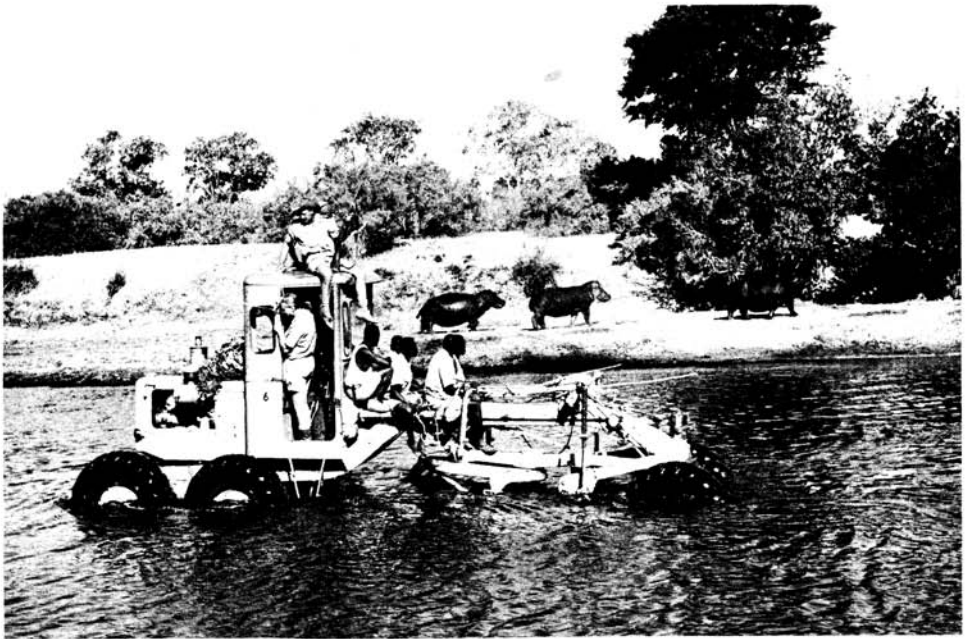


Fig. (ii) — Marksman aiming at hippo in the water from the top of the grader's cab.

Fig. (iii) — Hippo herd being evicted from their pool by harassing them with the grader. Note pole lassos and immobilized calf (with dart in neck) at upper left.



Fig. (iv) — Drug-immobilized hippo in shallow water. Note characteristic facial expression and dart in shoulder.

Fig. (v) — Adult hippo charging grader after calf has been captured.

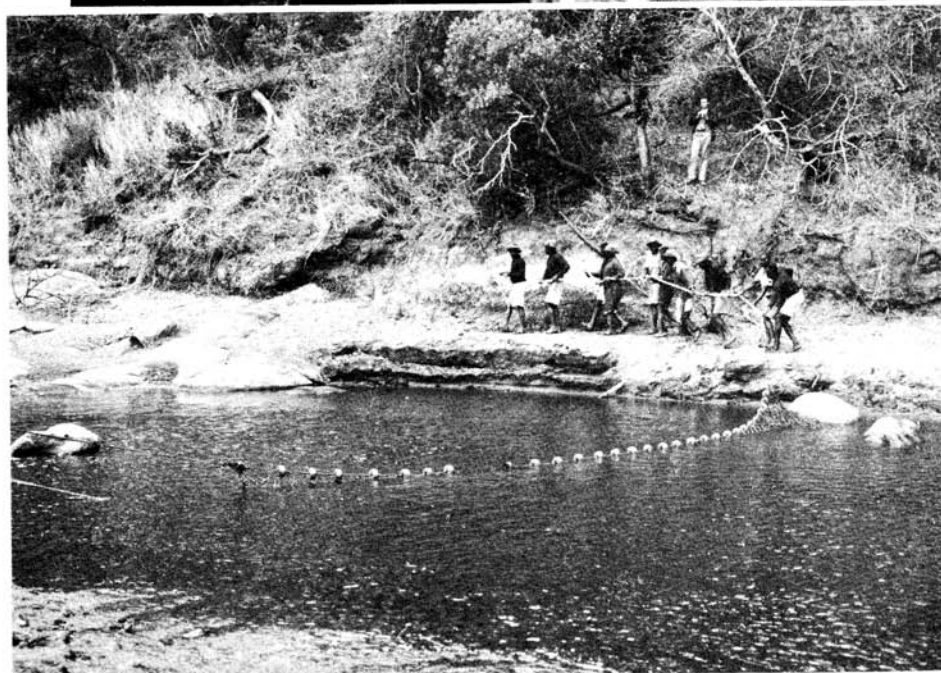


Fig. (vi) — Partially immobilized hippo (submerged in pool) being surrounded by net.

Fig. (vii) — Young male hippopotamus retrieved from river after Sernylan immobilization. Note exophthalmus caused by drug.



Fig. (viii) — Young hippopotamus secured by means of net after Sernylan immobilization, being made ready for crating.

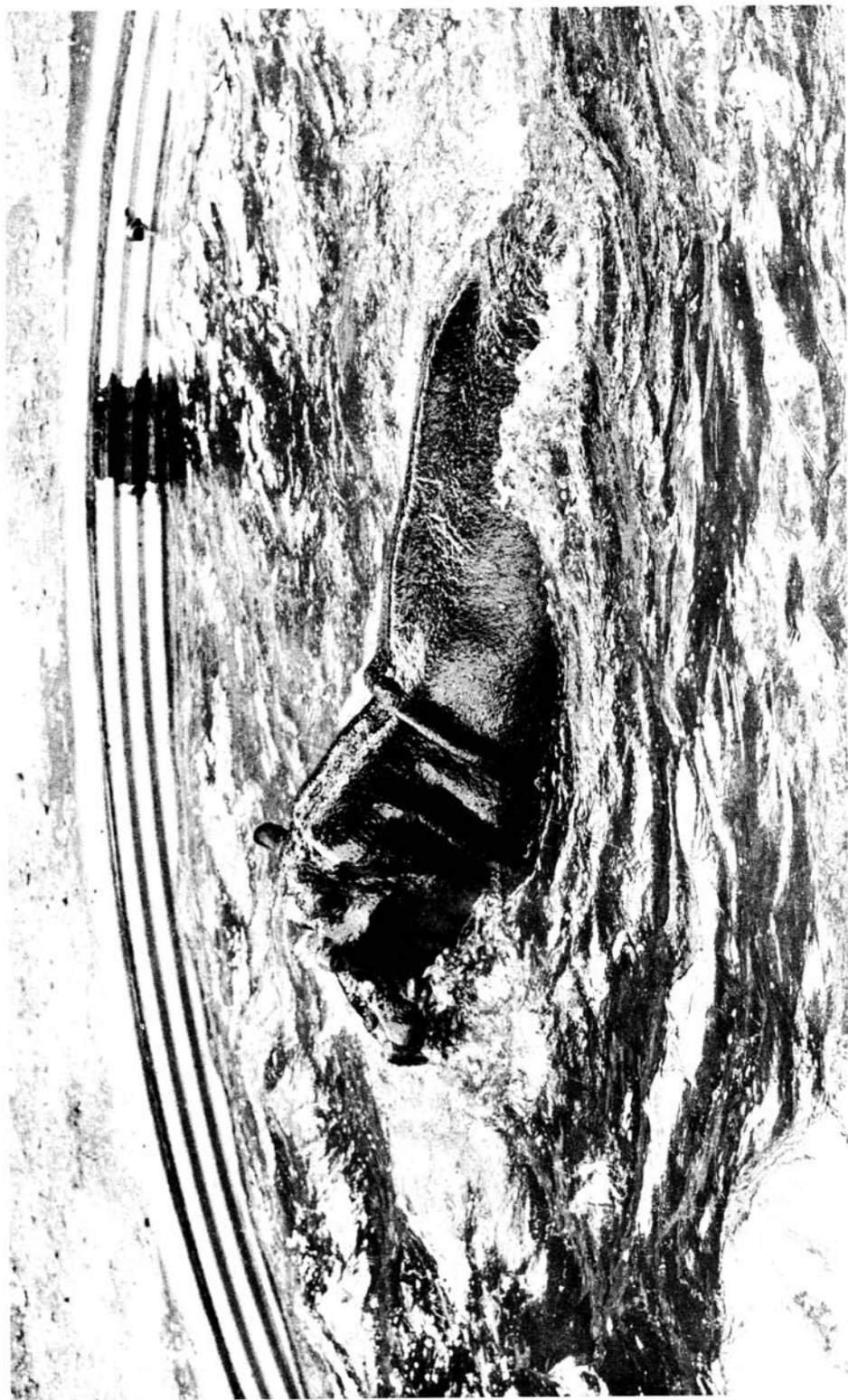


Fig. (ix) — Hippopotamus wallowing in artificial pool, after release in the boma.

Another essential piece of equipment i.e. a net of about 6-8 feet deep and 50 yards long with 6-8" mesh (constructed out of $\frac{1}{4}$ " flax rope), was now brought in operation. (Fig. (vi)). It was then a relatively simple procedure to haul the partially-immobilized animal out onto dry land.

It was found that the grader could operate effectively in water up to about 3 ft. deep, and one could conceivably use a large tractor with equal effect under such conditions. In deeper water of rivers and lakes an amphibious vehicle such as an army "Duck" or motorised raft, could be used instead of the grader; the main purpose being to secure the immobilized beast as soon as possible, without fear of getting involved with the rest of the herd.

Captured hippopotami in crates were kept cool on hot days by dousing them with water at intervals during the journey, but these animals usually cause very little trouble in transit, and all our recent captives dozed peacefully all the way from the Olifants River to Skukuza (a distance of about 100 miles). After having recovered completely, they were released in a specially-constructed boma which was provided with a pool of sufficient depth to allow the animals to submerge completely. (Fig. (ix)).

DISCUSSION AND CONCLUSIONS

Although drugs such as succinylcholine chloride, and mixtures such as M-99 or M-183 with acetylpromazine, chlorpromazine, trifluopromazine or fluanisone could be used with equal effect in the case of hippo on dry land, and the latter combination has obvious advantages where there is no danger of drowning the darted animal, the technique outlined above is, in our opinion, the safest and most efficient method of capturing these animals in water.

Sernylan is well tolerated by hippo and the therapeutic index is wider than that of succinylcholine chloride. At the same time, it is fast-acting, and although its action cannot be reversed (cases of slight overdosage can be treated symptomatically), the prolonged somnolent state induced has no adverse effect in hippo.

The administration i.m. of 100-200 mgm hydrocortisone (such as "Vecor-tenol" Ciba) appears to reduce the period of Sernylan depression.

For the benefit of other workers in this field, a table is provided (Table 2) which summarizes our present knowledge of drugs suitable for the capture of hippopotami on land as well as in the water.

SUMMARY

Drugs used for the immobilization and capture of hippo were effective but often dependant on the animals being on dry land. Fatalities through drowning were common once the animals resorted to the cover afforded by their natural element.

A method is described whereby hippos may be captured with reasonable safety and minimal loss, using a combination of the drugs Sernylan and a suitable tranquilliser as immobilizing agents, and a road grader to facilitate the rapid retrieval of the drugged beast.

A table of dosages is provided, listing all drugs suitable for the capture of hippopotami on land or in water.

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TABLE 1.
RESULTS OF SERNYLAN-ACETYLPROMAZINE MIXTURE ON SIX YOUNG HIPPOPOTAMI DARTED IN WATER.

Locality: Olifants River, Kruger National Park.

Date	Sex of animal	Estimated body weight (lbs)	Sernylan (Total) initial dose in (mgm)	Additional Sernylan (mgm)	Time after initial dose	Acetylpromazine (Total initial dose in mgm)	Additional Acetyl-promazine (mgm)	Time after initial dose	Animal ataxic after darting Time in min.	Animal captured after darting Time in min.	REMARKS
26th Sept. 1966	♂	±1500 lbs	200 mgm	—	—	75 mgm	70 mgm	±40 min.	± 12 min.	± 30 min. (Animal lassoed)	Animal not completely immobilized and thrashed about quite a bit after capture. Additional Ac. prom. effectively tranquilised animal and it dozed throughout journey.
26th Sept. 1966	♂	±500 lbs	150 mgm	—	—	50 mgm	—	—	± 10 min.	± 20 min. (Animal lassoed)	Dose apparently too high and animal was rescued from deep water just in time. Recovered well.
27th Sept. 1966	♂	±700 lbs	150 mgm	—	—	75 mgm	—	—	± 15 min.	± 30 min. (Animal lassoed)	Textbook reaction. Animal strong when captured but very tractable.
28th Sept. 1966	♂	±800 lbs	150 mgm	—	—	75 mgm	—	—	± 16 min.	± 35 min. (Animal lassoed)	Good reaction. Animal strong when crated and able to lift its head. Well sedated.
29th Sept. 1966	♀	±1400 lbs	150 mgm	150 mgm	10 min.	75 mgm	75 mgm 80 mgm mgm	10 min. 40 min. min.	± 20 min. after 2nd dart	± 35 min. (Animal netted)	Good reaction. Animal crated with some difficulty. Additional Ac.prom. caused animal to sleep for 6 hours.
30th Sept. 1966	♀	±1800 lbs	200 mgm	150 mgm	25 min.	80 mgm	75 mgm 80 mgm mgm	25 min. 45 min.	± 7 min. after 2nd dart	± 40 min. (Animal netted)	Good reaction. Animal strong and somewhat aggressive when hauled onto land. Additional Ac. prom. induced tranquil state.

TABLE 2.
IMMOBILIZING DRUG-MIXTURES FOR THE CAPTURE OF HIPPOPOTAMI ON LAND AND IN WATER.

DRUG	Pharmaceutical classification of drug	Dosage Rate mgm./lb.	Total dose of drug in mgm. for different weight classes of hippo					
			500 lbs ± 6 months old	1000 lbs ± 12-18 months old	1500 lbs 18-30 months old	2000 lbs 30-42 months old	Adult cow 2500-3000 lbs	Adult bull 3000-4000 lbs
Phencyclidine ('Sernylan' Parke, Davis)	'Major' neuroleptic and C.N.S. depressant	0.16-0.25 mgm/lb	80-125 mgm	160-250 mgm	240-375 mgm	320-500 mgm	480-750 mgm	640-1000 mgm
Chlorpromazine hydrochloride ('Largactil' May & Baker)	Ataractic (Tranquilliser)	0.25-0.4 mgm/lb	125-200 mgm	250-400 mgm	375-600 mgm	500-800 mgm	750-1000 mgm	1000-1600 mgm
Trifluopromazine ('Siquil' Squibbs)	Ataractic (Tranquilliser)	0.15 mgm/lb	75 mgm	150 mgm	225 mgm	300 mgm	450 mgm	600 mgm
Acetylpromazine maleate (Boots)	Ataractic (Tranquilliser)	0.15 mgm/lb with Sernylan 0.05 mgm/lb. with M-99	75 mgm 25 mgm	150 mgm 50 mgm	225 mgm 75 mgm	300 mgm 100 mgm	450 mgm 150 mgm	600 mgm 200 mgm
Succinylcholine chloride ('Scoline' Glaxo-Allenburys)	Muscle relaxant	0.055-0.08 mgm/lb	27.5-40 mgm	55.0-80 mgm	82.5-120 mgm	110-160 mgm	175 mgm	175-200 mgm
Morphine hydrochloride	Analgesic	0.5 mgm/lb	250 mgm	500 mgm	750 mgm	1000 mgm	1500 mgm	2000 mgm
Diethylthiambutene HCl. ('Themalon' Burroughs-Wellcome)	Analgesic	1.5 mgm/lb	750 mgm	1500 mgm	2250 mgm	3000 mgm	4500 mgm	6000 mgm
*Scopolamine (Hyoscine hydrobromide)	Parasympatholytic	0.05 mgm/lb	25 mgm	50 mgm	75 mgm	100 mgm	150 mgm	200 mgm
Oripavine hydrochloride ('M-99 & M-183' Reckitts)	Major Analgesic	2 µ gm/lb	1 mgm	2 mgm	2.5-3.0 mgm	3.0 mgm	3.0-3.5 mgm	3.5-5.0 mgm
Flaunison (Janssen Pharm.)	'Major' Neuroleptic	0.05 mgm/lb	25 mgm	50 mgm	75 mgm	100 mgm	150 mgm	200 mgm

* Not recommended.

ANTIDOTES	Pharmaceutical classification of antidote	Dosage Rate mgm./lb.	Total dose of antidote in mgm for different weight classes of hippo					
			500 lbs ± 6 months old	1000 lbs ± 12-18 months old	1500 lbs 18-30 months old	2000 lbs 30-42 months old	Adult cows 2500-3000 lbs	Adult bulls 3000-4000 lbs
Nalorphine hydrobromide (‘Lethidrone’, Burroughs-Wellcome)	Morphine antagonist	0.1 mgm./lb	50 mgm	100 mgm	150 mgm	200 mgm	250-300 mgm	400 mgm
Nor-orphavine hydrochloride (‘M-285’, Reckitts)	Oripavine antagonist	4 μgm./lb	2 mgm	4 mgm	6 mgm	8 mgm	10 mgm	15-20 mgm

Drug combination recommended for capture of hippopotami on dry land or in shallow water:

M-183 (or M-99) + Acetylpromazine (or $\frac{1}{2}$ Acetylpromazine + $\frac{1}{3}$ Fluanisone).

Drug combination recommended for capture of hippopotami in deep water:

Sernylan + Acetylpromazine (or Chlorpromazine or Trifluopromazine).