# CHEMICAL IMMOBILIZATION OF AFRICAN ELEPHANT IN LOWLAND FOREST, SOUTHWESTERN CAMEROON

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## ABSTRACT

The chemical immobilization of free ranging African elephant *(Loxodonta africana cylcotis)* in the lowland forest of southwestern Cameroon was undertaken as part of a long term investigation of elephant ecology. Such capture and tagging (with satellite/VHF transmitter units) of African forest elephant had not been accomplished prior to this work. Dense vegetation, diverse topography and severe climatic conditions caused the darting and post-darting location of the subject animal to be difficult and hazardous to both man and elephant. Innovation of methodology and strategy brought about six immobilisations. Etorphine and carfentanil (with their antagonists diprenorphine and naltrexone) were employed as immobilizing agents. Various delivery systems and technological aids were field tested. The lessons learned by this project may be useful to anyone wishing to undertake large mammal chemical immobilization under similar dense forest conditions.

## RESUME

L'immobilisation chimique de l'éléphant d'Afiique *(Loxodonta africana cyclotis)* en liberté dans les forêts de basse altitude au sud ouest du Cameroun avait été menée après une série d'investigations sur l'écologie de l'éléphant. Aucune action de capture et de marquage (par satellite/VHF avec émetteur) de l'éléphant de forêt n'avait été entreprise avant ce travail d'investigation. La densité de la végétation et la diversité topographique ainsi que les conditions climatiques difficiles, causent des difflcultés pour viser et retrouver les animaux atteints. Ce qui est également hasardeux à la fois pour l'homme et l'éléphant. L'innovation de ha méthodologie et de la stratégie a permis environ six immobilisations. L'etorphine et Ia carfentanil (associés à leur neutralisant diprenorphine et naltrexone) ont été utiuisés comme agents immobilisants. Des systèmes et technologie diverses bénéfiques ont été testés sur le terrain. Les leçons tirées de ce projet sont utiles pour toute personae qui envisage l'immobilisation chimique des grands mammiféres dans les mêmes conditions en forêts denses.

## INTRODUCTION

The chemical capture of free-ranging African elephants, *Loxodonta africana africana,* in open and semi-wooded habitats has been well documented and protocol has been developed to the point where such procedures are carried out quite routinely in eastern and southern Africa (Pienaar *et al.,* 1966; Woodford *et al.,* 1972; Alford *et al.,* 1974; Ebedes, 1975; Schmidt in Fowler, 1986; Kock *et al.,* in Fowler, 1993). However, such an operation in dense equatorial forest with completely unhabituated forest elephants, *Loxodontus africanus cyclotis,* had not been attempted prior to this study. Low visibility, high variability of terrain, dense vegetation, and lack of points of consistent elephant activity in the area created unique problems that needed to be addressed. With the objective of fitting the elephants with Satellite/VHF transmitter collars ('Telonics, Mesa, Arizona, U.S.A.) to gather elephant movement information, capture attempts were made intermittently from December1990 to April 1993 in the region of Korup National Park and Banyang Mbo Forest Reserve, South West Province, Cameroon. Initial setbacks due to various factors brought about innovation of methodologies and equipment, resulting in six immobilisations. In this paper we examine the specific difficulties encountered in conducting chemical immobilization of elephant in dense forest conditions and discuss how these issues may be managed in order to reduce risk and increase capture success rate.

## METHODS

### Capture team

The capture team was usually composed of: a shooter (the veterinarian in nine of 12 shot attempts), a veterinarian, a chief tracker, a local guide, one or two project biologists and two assistant tracker/porters. A veterinarian was not present for procedure III. Two different chief trackers were employed, the second being more skilled and experienced (attempts nine to 12).

### Delivery system

Cap-chur darts (usually 3cc) (Palmer Chemical and Equipment Company, Inc., Douglasville, GA, 30133, USA) were fitted with Palmer elephant needles. They were projected either by a crossbow (Barnett International, Inc., Odessa FL, 33556, USA) equipped with a laser-dot sight (Aimpoint, Herndon, VA, 22070, USA) or a .22 cartridge fired dart rifle (Model No. 1820 No.308N, Pneudart, Inc., Wrlliamsport, PA, 17703, USA). A $CO_2$ powered projector with 3cc syringes (Telinject, Romerburg, Germany, model Vario 4 V) was used in procedure IV The ducts of all needles were covered by a silicone "cap" to prevent leakage, as the loaded darts were carried and subsequently shaken during the days/weeks of attempted immobilization.

### Drugs and other medicine

Etorphine hydrochloride ("Immobilon LA", C-Vet, Suffolk, UK) was administered at dosages ranging between 4.9 and 6.125mg per animal in procedures II-VI. These dosages were based on field observations and known weights of zoo animals. Carfentanil (Wildnil, Wildlife Laboratories, Inc., Fort Collins, CO 80524, USA) was used in procedure I. Azaperone ("Stresnil", Janssen, Paris, France) was added to the etorphine in 4 and 7cc darts in procedures V and VI respectively.

The reversal agent employed in each etorphine procedure was diprenorphine ("Revivon", C-Vet), a dose being administered through i.v. route and an additional half dose s.c. or i.m. The antagonist naltrexone hydrochloride (ICN Biochemicals, Inc. Cleveland, OH, 44128, USA) was administered i.v. in the carfentanil procedures. Any injury was treated using an antibiotic/anti-inflammatory ointment ("Cortamycetine", Distrivet, Paris, France). The same medicine oran antibiotic ointment (Parke-Davis/ WarnerLambert Co. Morris Plains, NJ, 07950, USA) was used on the eyes to reduce irritation due to drying or foreign matter. Cortamycetine or Penicillin Mastitis Treatment cream (Aveco, Co., Inc., 800 5th St N.W. Fort Dodge, IO, 50501) was applied to the needle wound to help prevent infection. If the respiratory rate became lower than 5 breaths/min, Doxapram ("Dopram V", A.H. Robbins Co., Richmond, VA, 23220, USA) was injected i.v.

### Measurements/samples

Precise anatomical measurements were taken and blood, skin biopsy (for genetic analyses), external parasites (ticks, mites, etc), and ivory (cut from tip of tusk with a hacksaw blade) samples were collected to contribute to baseline forest elephant studies. A weight estimate was made for each elephant and compared with shoulder height: body weight correlation made in past studies of captive savanna elephants (Woodford *et al.*, 1972).

### Darting strategies

To gain darting opportunities elephant paths and hunting trails were walked with the team pausing periodically to listen for elephant activity or fresh spoor was followed until meeting elephants. Silence was maintained, quiet and accurate communication being facilitated by hand signals and hand-held radios. A lighter was used to indicate wind direction, which greatly influenced the approach. For darting the team separated into two groups, the shooter and chief tracker moving ahead for the approach and darting.

### Locating the subject post-darting

Two technological aids were applied in attempt to facilitate locating the subject animal post-darting. A transmitter dart (Wildlife Materials, Inc., Route 1, Box 427A, Carbondale, IL, 62901) and tracker line (Gametracker, Flushing, MI, 48433) served as indicators of the animals' initial direction of flight. The VHF transmitter unit facilitated the location of the elephant in procedure IV, when she was re-tagged due to the satellite unit's battery failure nine months after initial tagging (the VHF unit continued to function properly).

Post-reversal, the elephant was followed for l00-200m to observe its condition as it moved away. It was then monitored via the VHF unit for one to two hours. Further efforts were made to VHF track the elephant from nearby points of elevation during the days following capture.

## RESULTS

A total of 87 days in the field were spent in capture attempt in and around Korup National Park and the Banyang-Mbo Forest Reserve. Sixty-three days over the period of July 1990 - October1992 produced eight darting attempts resulting in two immobilisations (Table 1 attempts one

to eight). Twenty-four field days during January -April 1993 produced four darting attempts that resulted in four immobilisations (Table 1 attempts 9-12).

The outcomes of the twelve darting attempts in relation to the delivery system and tracking aids employed are shown in Table 1. Seven shots resulted in successful injection of the drug, six of which resulted in immobilization of the subject The mean shooting distance was 11m (3-25m). Mean time to find the elephant post-darting was 33.5 minutes with a range of 13-63 minutes. When used (seven of 12 shot attempts), the tracking siring broke after 30-70m. The transmitter barrel, along with the entire dart, fell out in attempts nine and 12.

Of the six elephants immobilized two were found dead (procedures VI and I). In procedures 11-V elephant respiration was four to ten breaths per minute, heart rate of 38-60 beats per minute, temperature around 36-37$^{O}$ C, and mean duration of immobilisation was 75 ± 2 min with a range of 51.5-98 minutes.

In procedure III there was no observed change in the elephant's position eight minutes after iv administration of the antagonist, therefore a second i.m. injection was given. Ten seconds after the second i.m. injection there was movement of the tail and the elephant was standing after two minutes.

## DISCUSSION

The immobilization of free-ranging elephants in open terrain has been well documented and dosage protocol for etorphine established (Pienaar *et al.*, 1966; Alford *et al.*, 1974; Ebedes, 1975; Haigh *et al.*, 1979; Schmidt in Fowler, 1986). Those circumstances and environmental factors are completely different than those encountered while conducting similar immobilization of entirely unhabituated elephants living in dense lowland forest The mechanical complexities of immobilizing elephants in such an environment were addressed in this study. Over the course of many efforts various personnel sought to correct the problems through innovation in both methodology and equipment.

The elephants in the study area usually fled as soon as they sensed human presence, this may have been attributed to high poaching levels (Elkan, pers. obs.). 'This behavior compounded the difficulty of darting and a quiet approach from downwind was crucial. Because of the quickly changing drafts found in the forest a rapid but cautious approach may also facilitate obtaining a good shooting opportunity. Dense vegetation reduces the range from which one is able to shoot (mean of 11m in this study). The chief tracker played an important role in guiding the shooter towards the subject elephant under these circumstances. The second tracker employed in this study (who had been recently active in elephant poaching- skills fresh and fear limited) made the close approach required safer and more efficient than with the earlier tracker.

It is impossible to predict the aftermath of darling a wild elephant and the least sound or scent can indicate to the elephant the location of the shooter at close range, therefore increasing the danger of being charged. The Pneudart gun was efficient in delivering the dart to the target but was noisy and produced a gun powder odor. Both the noise and smell of the gun contributed to elephant stress and directed charges. In one case an aggressive elephant kept the tracker and veterinarian/shooter hidden behind a tree for over five minutes. Although the choice of delivery system depended largely on the preference of the shooter, the crossbow delivery system was introduced to reduce risk.

The advantages of the crossbow were that is was quiet and without the smell of gunpowder. Its power aided in forcing the dart through vegetation. The laser-dot sight mounted on the crossbow was a reliable indicator of whether the shot was clear in low light conditions of the forest when the elephant was less than twenty meters away. However, in case of darting in lighted "open" areas, secondary forest and at longer range the laser-dot would have been difficult to see without a standard sight The crossbow's main drawback was that it was more cumbersome to carry in vegetation than the dart gun.

The Telinject system was quiet, ligh tto carry and predictive of correct function through its manometer and transparent dart. The telinject's thin needle and lightweight dart resulted in a less subject-disturbing injection than the heavier Cap-chur darts with Palmer elephant needles. Drawbacks to this system were that the dart was easily sent off course upon contact with vegetation and that tracker string cannot be attached to the dart without hindering its flight

Locating the elephant after the shot was the greatest difficulty of the capture operation. 'Technological aids produced various degrees of success. The Gametracker string was found to be a good indicator of the subject's initial flight direction but usually broke or stopped where the dart fell out The string hindered the flight of the dart at distances greater than 15m. and when shooting through narrow openings in vegetation. As with the line, the transmitter-dart assembly was attached to the syringe dart and fell out when it did.

***Table 1. Elephant** darting attempts in lowland forest using various delivery techniques and tracking aids **(1990-93).***

| At No. | Delivery System | Range (in) | Tracking Aids | Locating Time | Outcome |
|---|---|---|---|---|---|
| 1. | .22 Pneudart Rifle/ Cap-chur dart | ? | transmitter | n.a. dart | 2 guns used (1 for drug, 1 for transmitter) Drug dart hit vegetation. |
| 2. | .22 Pneu. Rifle/ Cap-chur dart | ? | trans. dart | n.a. | 2 guns used (1 for drug, 1 for transmitter) Uncertain if drug dart hit subject |
| 3. | Crossbow/ Cap-chur dart | 3 | tracking | 31 min string | Dart hit subject String broke after 50m Subadult male elephant found dead Procedure I. |
| 4. | Crossbow/ Cap-chur dart | ? | string | n.a. | Dart hit vegetation. |
| 5. | 22 Pneu. Rifle/ Cap-chur dart | 6 | _____ | n.a. | Dart hit subject. Trackers unable to locate elephant. |
| 6.. | .22 Pneu. Rifle/ Cap-chur dart | 25 | string | 63 min | String broke after 70m. Adult female elephant tagged. Procedure II. |
| 7. | .22 Pneu. Rifle/ Cap-chur dart | 10 | string | n.a. | .22 charge misfired. |
| 8. | .22 Pneu. Rifle/ Cap-chur dart | 25 | string | n.a. | Dart hit subject String broke after 30m. Trackers unable to locate elephant |
| 9. | Crossbow/ Cap-chur dart | 12 | trans. dart string | 36 min | String broke after 50m. Trans. dart fell out after 70m. Adult female elephant tagged Procedure III. |
| 10. | Telinject Rifle/ Telinject dart | 15 | VHF tag | 26 min | VHF tag facilitated location of subject post darting. Adult female elephant re-tagged. Procedure IV. |
| 11. | Crossbow/ Cap-chur dart | 10 | string | 13 min | String broke after 5m. Adult male elephant tagged. Procedure V. |
| 12. | Crossbow/ Cap-chur dart | 7 | trans. dart | 32 min | Trans. dart fell out after 50m. Adult male elephant found dead in sternal recumbency. Procedure VI. |

The transmitter-dart was of help in attempt 12 as an indicator of the initial direction of flight of the subject Through the combination of these tracking aids (string and transmitter) the task of finding the elephants was facilitated. Although the two aids functioned worse than expected in each case, which might be considered technical failure, they proved useful in directional indication of the subject post-darting. The partial technical function of the tracking aids was thought to have contributed significantly to the locating of the elephant.

The inability of the team to locate the subject elephants post-darting in attempts five, eight and perhaps two may be attributed to partial injection of the drug and or quality of the trackers. The darts recovered in attempts two, five, and eight had discharged their contents. Partial injections can considerably affect the animal's response, the induction period being very long and the animal remaining nervous, moving and potentially dangerous during that time (Planton and Michaux, 1993). *Woodford et al.* (1972) found in elephant that subcutaneous and partial injection probably occurred in seven of fifty-three cases, mechanical failure of the dart being the cause in fourteen. This is supported by the mechanical failures, which Planton (1987) reported in one out of ten cases. Another possible factor may have been leakage. Leakage was observed at the collar wields of the needle on several occasions when the darts had been pre-loaded and carried while stalking (as was mostly the case). The chief tracker for attempts two, five and eight was not as skilled as his later replacement. The morale of the trackers was very important to their desire to find the elephant after darting. It was found that a cautious yet rapid tracking regime with the presence of the shooter up front with the trackers provided significant encouragement

The observations made at the end of procedure III are typical of what happens to animals of any species that receive a relative overdose. The response to the reversal agent is not as rapid as expected and, if left alone and quiet, they remain lying down for along time. The second i.m. injection of antagonist acted as a mechanical stimulus that woke the elephant. Hand clapping can have the same effect, however, in such cases an additional dose of antagonist helps to prevent further renarcotisation.

The necropsy following procedure I indicated that the probable cause of death was "respiratory compromise resulting from anesthesia and non-dependent lung pathology" (Karesh, 1991). The elephant in procedure VI was judged to have died from "anoxia and congestion of the vena cava with probable cardiac congestion"(Haigh, 1993). This was most likely a direct result of the elephant having fallen in sternal recumbency. During procedures II-V the elephants were found in lateral recumbency. The danger that the elephant may fall in sternal recumbency and die before it is found and can be assisted is encountered in all types of habitat (Pienaar *et al.,* 1966; Schmidt, 1986). The difficult terrain compounds this possibility and vegetation found in equatorial forest regions. In procedure VI the elephant ran in a near straight line for 700-l000m after being darted. It was estimated that the team arrived five to seven minutes too late. The pursuit after darting had been conducted efficiently and rapidly.

In dense forest habitat the increased chance of an elephant going down in sternal recumbency makes it vital to locate the animal as quickly as possible in order to correct its position. The position of the elephant in procedure IV, resting on a small tree was impossible to ameliorate and probably hindered the elephant's respiration. This underlines the fact that in such habitat/topography physical interference is a real possibility and sometimes impossible to avoid. Although it is seldom to be fired, Planton (1993) recommends that a dart filled with reversal agent be ready in the dart projector as soon as the drug injection is likely to have been completed. If the animal is in difficulty and cannot be handled for any reason the drug can be antagonized from a distance.

By attempting to locate the elephant quickly there is a compromise of human safety. Rapid tracking of the elephant greatly increases the danger of coming too close to the subject animal and or its group members. Low visibility, thick vegetation, and changing terrain magnify the difficulty of tracking both rapidly and safely. Under these adverse conditions there is significant risk of human injury (or death) as a result of elephant attack or flight.

A short induction period would limit the distance of the post darting travel and therefore help make location of the elephant faster. Studies undertaking capture under similar conditions should consider use of Hyaluronidase (Wyeth Laboratories Inc., Philadelphia, PA, 19101) in solution with the immobilizing agent (Morton *et al.,* 1991). It was not used in this study because it is unstable and the infrequency of darting opportunities dictated the carrying of loaded darts over the course of many days in most cases.

The protocol established through this project has shown that successful chemical immobilization of elephant in dense lowland forest habitat certainly is possible. Danger to man and elephant can be reduced, but not eliminated, through the proper team, equipment, and strategies. The risk of the elephant falling in sternal recumbency and respiratory failure before the team can reach the elephant may be unavoidable.

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