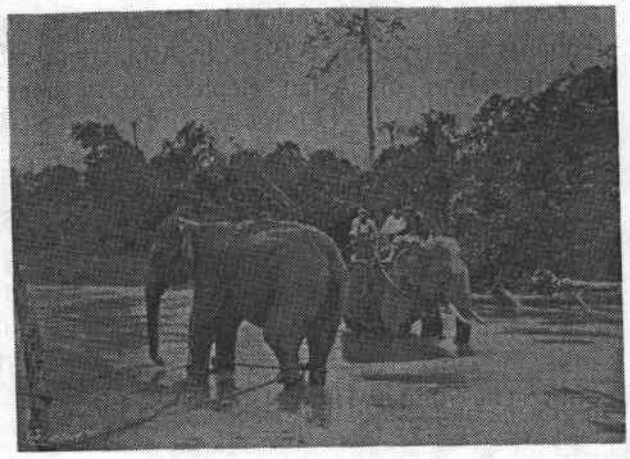

The morning bath.

sa," a sharp iron hook used to guide him. Heavy wooden posts are planted at intervals between the "chelong" and the river, and should he bolt or prove unmanageable, the leg-ropes are immediately made fast to these by the attendants. As soon as the pupil has begun to know the words of command, the services of the tame elephants are dispensed with, and he is taken to the river by the "gembala" assisted by a man on foot, who walks backwards in front of the elephant and helps to guide him with a "kwasa" and a spear.

The work of breaking him in being finished, the elephant is taken to his master's village and there petted and made much of until he becomes quite tame, but he is not expected to do hard work for a year, when he is sent to some distant tin mine to carry rice and provisions to the miners, and bring back his burden of the hard-earned metal to the nearest depot.

Ten years ago a large elephant in Perak would fetch as much as eight hundred or a thousand dollars, but the same beast can now be purchased for five of six hundred, for the advance of civilization has brought with it such improved means of transport that there are comparatively few places where the services of this once useful animal are now necessary.

Immobilization of Free Ranging Asian Elephants (Elephas maximus) in Sri Lanka Using Etorphine Hydrochloride and Acepromazine Maleate

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SUMMARY

Four free ranging adult male elephants were immobilized using a combination of 9.8 — 11.03 mg of etorphine hydrochloride and 40 — 45 mg acepromazine maleate. After capture, wild elephants were shackled and tethered with high tensile steel chain and manila rope before being relocated to an elephant training center in Kurunagala to be domesticated. The use of diprenorphine hydrochloride (12 — 15 mg) as the antidote produces very reliable results. The ability to use a much higher dose of Immobilon, safely will provide an advantage in rapidly tranquilizing large adult males and reducing the induction period which is essential in the capture of free ranging elephants.

INTRODUCTION

The elephant problem in Sri Lanka is quite similar to those animals in Malaysia. The conflict between man and elephants is primarily due to the rapid agricultural development. The most critical situation is the pocketed herds, caught in small traces of left over forest in-between

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villages and agricultural areas. This elephant-man conflict in Sri Lanka is mainly due to shrinking habitats and insufficient forage as a result of increase in human population, land alienation for agriculture and hydro-development projects (Olivier 1978, Santiapillai et. al. 1984). With about 12,460 sq km or 19% of the total forest cover left on the island to maintain about 2000 elephants (Santiapillai et. al. 1984), some of the surplus populations have resorted to utilize areas developed by man. Some of the rogue elephant herds and solitary males had caused serious damages in villages and inflicted significant human mortalities at an estimated rate of 50 villagers/year (Dr. N. Atapattu pers. comm.).

The only solution to mitigate the conflicts between the elephants and human is by translocation. In Malaysia all the problematic herds are translocated into the National Parks. In Sri Lanka one of the recommendation made by the Director of Wildlife Conservation is to capture and domesticate excess animals and also to establish semi-domestic breeding centres. Troublesome elephants with proven crop-raiding records would be the first to be captured and domesticated (De Alwis & Santiapillai, 1991). This elephant capture workshop is conducted in line with one of the objective stated in the "Strategy for Elephant Conservation and management in Sri Lanka" (Rudran, 1988).

Male working elephants are known to be destructive during the annual musth cycle (Scheurmann and Jainudeen 1972). The wild elephants became a nuisance in the last half of the nineteenth century (Olivier 1978).

The restraint and capture of free ranging elephant can be divided into physical (traditional) and chemical methods. The traditional method was used in Assam and Thailand which employed monitor elephants and jute fibre nooses to restraint wild elephants. In Assam, free ranging elephants were captured by driving them into wooden stockade. The animals acquired by this method are the young and subadults which were later trained for domestic use (Ratnam, 1984).

Chemical immobilization had been used on elephants in Africa since 1959. In Asia, chemical immobilization on Asian elephant have been reported previously (Abdul-Aziz, 1987; Gale, 19--; Jainudeen and Khan, 1977; Jainudeen et. al., 1971; Jones, 1975; Mohd-Shariff, 1985; Olivier, 1978, Ratnam, 1984; Sale et. al., 1986). In South-East Asia, this technique had been first experimented on free ranging elephant in Burma in 1966 Gale (19--) and later in Sri Lanka in 1967 (Dr. Nandana Atapattu pers. comm.; The Sunday Times 1991).

This elephant capture operation is under the auspice of the US AID for the environment to assist the Department of Wildlife Conservation in its large scale effort to relocate some of the elephants into protected areas in Sri Lanka.

MATERIALS AND METHODS

Before commencing an elephant work the capture team must first conduct field survey to familiarize with the forest, know the number and the ranging pattern of the elephants in the area. The capture team comprise.of 15 personnel comprising the team leader who was responsible for the running of the whole capture operation, a veterinarian for administering of the drugs and post-capture care, two well trained elephant trackers, two backup riflemen armed with 404 rifles, shot gun and 9 workers who were trained in shackling (steel chain) and tethering (manila rope) techniques. These workers were also responsible for carrying the restraining equipment, food and water for the captured animals.

On the 1st. February 1991 the capture team carried out a reconnaissance survey in the Bogasmewa and the Palattiyawewa area. Bogasmewa area was selected as the first elephant operation area because the elephant damage in that area was very serious. At about 7.30 am the capture team would start moving to the elephant prone area such as agricultural areas which are visited by the animals.

The trackers would look for the fresh elephant track or damaged crops before tracking

the animal. Dosage of Immobilon is estimated based on the front foot diameter (FFD) of the elephant. It is always recommended to use a dose of 4 – 8 mg of etorphine hydrochloride or 1 mg/450 kg for Asian elephants (Fowler 1986). Previous use of a combination of etorphine hydrochloride and acepromazine maleate in Asian elephants never exceeds 3.5 ml. The Immobilon is prepared into the dart as soon as there was a good indication of the animal's presence within 100 – 300 meters. Noise from breaking of branches, ear flapping and squeaking calls were some of the cues indicative of the proximity to the elephants. It was very essential the elephants must not be alerted so that the darter would be able to go close within the shooting distance of about 30 meters. The darter must ensure a clear flight path of the dart. All elephants were immobilized using a long-range Palmer Cap-Chur rifle and 5 ml capacity aluminum syringes barrel with 7.5 cm collared needles (Palmer Chemical and Equipment Co., Inc., USA).

RESULTS

After darting the elephants were observed running for a short distant before the drug took effect. If the darted animal was disturbed the animal would run even further and it would take quite sometime for the capture team to get the immobilized animal. To avoid this incidence the capture team waited at least 5 minutes after darting before pursuing the darted elephants. Within 30 minutes we would be able to get the immobilized animals.

Out of the four animals that were immobilized three were on left lateral recumbency and one on the sternal recumbency. But the latter was pushed over to the lateral recumbency. It is very essential to make sure that the animal is on the lateral recumbency as to avoid respiratory problem. The respiration and the rectal temperature were monitored regularly. Most of the field workers would camp near the captured animals before they were transported to the training center. Huge water drums were half buried in the ground and filled with water were placed near newly captured elephants for drinking and bathing. Water bowser with a pump was used to transport the water to the captured elephants.

For restraining the captured elephants shackling and tethering techniques were used. The first two elephants were restrained by using double front leg shackling technique and double front and hind leg shackling technique respectively. The third and fourth elephants were restrained by tethering using manila ropes on all four legs and secured to nearby trees.

The four animals tranquilized were adult males aged between 12 to 40 years old. Aging is based on the dorsal ear folds and physique. They vary in FFD from 35.5 – 48.3 cm and height of withers from 2.44 – 3.05 meters. The darts were fired from a distance between 1 – 30 meters (Table 1). The observation on the rectal temperature, heart rate and respiration are given in Table 2. Elephant No. 4 has the lowest heart and respiration rates. The dosages ranged from 4.0 to 4.5 ml Immobilon (9.8 – 11.03 mg etorphine hydrochloride and 40 – 45 mg acepromazine) (Table 3). All the animals showed temporal secretions 24 hours after immobilization, similar to musth.

DISCUSSION

The present study indicated that doses of 9.8 – 11.03 mg of etorphine hydrochloride and 40 – 45 mg of acepromazine maleate were safely used in free ranging adult male elephants. This amount was higher than previously reported doses of 5 – 8 mg etorphine hydrochloride administered in domesticated and aggressive working elephants (Jainudeen, 1970; Jainudeen et al, 1971). Similarly, free ranging Asian elephants were tranquilized with 4.3 – 8.6 mg in India (Sale et al, 1986), 3.5 – 5.5 mg in Sri Lanka (Jones, 1975) and 2.7 – 8.0 mg in Malaysia (Jainudeen and Khan, 1977).

A major problem with tranquilization of free ranging Asian elephants is mortality asso-

Table 1 : Firing distance, flight distance and search time of immobilized elephants in Sri Lanka

Elephant	Firing[1] Distance	Distance[2] travelled (km)	Recumbency
1	1 m	.5	Left lateral
2	20 m	1	Left lateral
3	25 m	.3	Sternal and leaning against a tree and pushed to right lateral
4	30	1	Right lateral

[1] distant of darter to animal
[2] distance travelled by elephant post-tranquilization

Table 2 : Morphological and physiological parameters of Asian elephants in Sri Lanka immobilization with etorphine HCl-acepromazine maleate

Elephant	FFD (cm)	Height (cm)	Physiological parameters		
			Rectal temperature °F	Pulse rate /min	Respiration rate /min
1	45.7	274	94.4	84	10
2	48.3	297	96.8	84	8
3	35.5	213	97.8	64	6
4	43.2	274	98.0	85	9

ciated with abnormal posture during induction. This problem is further complicated when the animal is underdosed and subsequently allowed to travel a longer distance before being immobilised. In many instances, the animal is dead upon sighting, suffocation being a common cause. In India, a low dose of 4 mg etorphine hidrochloride in free ranging Indian elephants resulted in a long induction period and incomplete immobilization (Sale et al, 1986). Previous work indicated that free ranging elephants requires a higher dose proportion than demosticated ones (Jainudeen et al, 1971).

The darting distance varies from 1 – 30 m, with all the darts propelled by a red (high speed) 0.22 blank (Palmer Chemical & Equipment Co., Inc.). No apparent damage to the skin and subcutis on the hindquarters was observed when the animal was darted from a distance of 1 m. This is due to the thickness of the skin on the body that varies from 1.9 – 3.2 cm, the thickest being over the hind limbs and hindquarters (Fowler, 1986). The epidermis consists of stratified squamous epithelium and is very thick consisting of many layers of cells (Mariappa, 1986). In young elephants, damage to the skin and sub-

Table 3. Immobilization of Asian elephant in Sri Lanka with etorphine HCl-acepromazine maleate

Elephant	Wt[1]	Reaction time (mins)			Drug dosage (ml)		Remarks
		Induc[2]	Down[3]	Recov[4]	Imm[5]	Rev[6]	
1	3500	22	43	4	4.5	5.0	Animal was Kicking still apparent by both hind legs when it was moderately sensitive to auditory stimulus. Tranquilization was very pronounced after 5 minutes. After intravenous Diprenorphine, the animal showed signs of recovery in 2 minutes and was standing within the next 4 minutes.
2	4000	35	34	3	4.0	4.5	Animal was on lateral recumbency but kicking was still apparent by hind and forelimbs and the animal was markedly sensitive to auditory stimulus. Marked sedation was only obvious in 7 minutes.
3	2000	25	31	4	4.0	4.0	
4	3700	20	60	4	4.0	4.0	Animal revived after 60 minutes.

1 estimated weight in kilograms
2 induction period from intramuscular administration of Immobilon to recumbency in minutes
3 period animal kept tranquilized
4 recovery time from intravenous administration of Revivon to standing position
5 Immobilon (etorphine HCl and acepromazine maleate)
6 Revivon (diprenorphine HCl)

cutis was severe when darted from a close range (Kamaruddin Mohd-Noor, pers comm).

Temporal secretions was observed between 12 – 24 hours post immobilization. This phenomenon was not present or reported in previous tranquilization (Jainudeen and Khan, 1977; Jones, ; Sale et al, 1986). Previous report indicated that the secretions from the temporal glands is associated with the liver (Deraniyagala, 1955). The entero-hepatic cycling of etorphine may have an effect on the liver function and cause a subsequent temporal secretions. However, a significant rise in testosterone levels in the peripheral circulation occurs during musth (Jainudeen et al, 1971).

The mean recovery time of 3.75 minutes (range 3 – 4 minutes) after intravenous administration of diprenorphine was lower than 6.3 minutes (range 4 – 9 minutes) by Sale et al (1986) 5 minutes (range 2 – 7 minutes) by Jainudeen and Khan (1977) and 2 – 7 minutes by Jones (1975). All four animals were unapproachable after remobilization. Although entero-hepatic cycling may occur resulting in excitement and "walking", it was never observed in all the animals. However, this is in contrast to the free ranging elephants tranquilized by Jones (1975) which experienced a 4 – 6 hours of sedation after remobilization with diprenorphine hydrochloride.

The induction period ranging from 20 – 30 minutes was similar to the eleven cases (15 – 45 minutes) by Jainudeen and Khan (1977) and six cases (15 – 35 minutes) by Sale et al (1986).

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Genetics of Asian Elaphants

Blood samples were collected from the Sri Lankan and Indian subspecies of the tamed Asian elephants, and genetic variations within and between them were screened by starch and polyacrylamidegel electrophoretic examinations. Number of genetic loci screened was 33. The experimental results showed that the genetic variabilities within subspecies were low like as observed in other non-domesticated large mammalian species, and that the genetic divergence between the two subspecies was about on the same level as observed between two subspecies of the Japanese macaques. At the Tetrazolium oxidase (To) locus a complete allelic substitution was observed between the Sri Lankan and Indian subspecies of Asian elephants.

(Source: Genetic variabilities within and between Sri Lankan and Indian subspecies of the tamed Asian elephants, *Elephas maximus.* by Takayoshi Shotake, Ken Nozawa, Mewa Singh, H.W.Cyril and Hilary Crusz. Report of the Society for Researches on Native Livestock. No:11, 215-221 (1986).

WORKSHOPS and PROJECTS

1. *THAILAND:* The Royal Forest Department (RFD) in association with the Regional Office (Asia/Pacific) of the Food and Agriculture Organization (FAO) in Bangkok, Thailand plans to hold a workshop entitled, ELEPHANT MANAGEMENT IN THAILAND in October 1991. Particulars could be obtained from the Workshop organizer, Dr Schwann Tunhikorn at the Royal Forest Department, Paholyothin Road, Bangkok 10900, Thailand, Fax: 662-579 8611. Voice Phone: 662-579 1565.

2. *SABAH:* Dr John Sale (UN Technical Adviser, Sabah Wildlife Department) plans to introduce the technique of estimating elephant numbers in Sabah using the indirect method that had been successfully used in India by Ms Shanthini Dawson. Sabah, as Dr Sale points out, has the largest population of elephants on Borneo and there is some evidence that it constitutes a distinct race from other populations of the species. The Sabah population is small (several hundred) and, being subject to serious habitat loss due to logging of the rainforest and its clearance fot large scale agriculture, is highly endangered. Only one (recently gazetted) protected area, Tabin Wildlife Reserve, contains a significant number of elephants. Damage to crops is fairly widespread and frequent. A species management plan for elephant will shortly be prepared with the assistance from UNDP project now providing technical aid to the Sabah Wildlife Department. It will consider all possible management options, including further protected areas, erection of barriers such as electric fencing and translocation of pocketed groups.

In the light of the above, it is clearly of immediate importance to obtain a more accurate estimate of elephant numbers and understanding of their seasonal distribution than that presently available — which due to the great difficulty of sighting the animals in dense rain forest is somewhat sketchy. The estimation of numbers