

Obtaining accurate body weights of captive elephants in Sri Lanka

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In the Chinese folktale *Weighing the Elephant*¹, a small Chinese village called 'Beyond the Clouds' is ruled by a cruel and clever emperor. In the village lives a baby elephant named Huan-huan. When the elephant was brought into captivity by the emperor, he neither performs tasks nor responds to commands. This makes the emperor angry and he threatens to banish Huan-huan from the village, sending him into exile. The evil emperor then issues an impossible puzzle: the villagers can save Huan-huan only if they can deduce how much the elephant weighs. The solution eludes even the combined efforts of scholars. A child comes up with an ingenious, and scientifically sound answer.

The elephant is one of the last few species of megaherbivore left in the world. Owen-Smith² defines the term megaherbivore to include any plant-feeding mammal that typically attains an adult body mass in excess of one megagram, i.e. 10⁶ g, 1000 kg or 1 tonne. The largest record for the heaviest terrestrial mammal goes to an African bull elephant (*Loxodonta africana*) shot in Angola in 1955, which weighed an estimated 10,000 kg. Asian elephants (*Elephas maximus*) are smaller than their African cousins. According to Shoshani and Eisenberg³, the mean weight attained by females is reported to be 2720 kg, although a maximum weight of 4160 kg has been claimed, whereas for bulls a maximum weight of 5400 kg has been reported; but, in general, adult bulls tend to weigh about 3600 kg.

Rationale

Body weight of elephants is affected by many factors such as their eating habits, quality of the food, activity levels, body condition, sickness and time of the year. Body weight is also important to determine the correct dosage of prescribed medication, and to administer anesthetic drugs for treatment or chemical immobilization^{4,5}. Too little drug may not give the desired effect and too much might kill it.

Every elephant in captivity must receive a balanced diet and adopt good exercise routines if it is to maintain a

healthy body weight. Therefore, along with nutrition, diet and exercise, the weight must be continually assessed in order to maintain the health of elephants in captivity. Weight change is an important indicator of animal health. Maintaining accurate estimates of body weight of elephants is invaluable for monitoring their health. Routine weighing of elephants in captivity would enable veterinarians to track whether young animals are growing properly. Thus weighing elephants on a regular basis must remain an important part of elephant husbandry. Elephant keepers or mahouts, and veterinarians could then use changes in body weight to monitor physical changes that the elephants experience throughout their life. Obese animals may become lethargic or may be unable to reproduce. Hence, it is necessary to evaluate the animal's weight at regular intervals. Fowler and Mikota⁵ recommend that scales suitable for weighing elephants be mandatory for institutions exhibiting elephants.

Weighing elephants

Weighing large animals offers a set of real challenges and the elephant is one such animal. In Sri Lanka, weighing of elephants has been a tricky business and in most instances, plenty of guesswork was involved in estimating the elephant body weight. However, there are some standard methods available for weighing elephants.

In the past, several measurements such as shoulder height, chest girth or a combination of body length, neck girth and chest girth have been used to calculate the body weight of an elephant⁶. Equations for estimating the body weight of elephants have been derived by many workers⁷⁻⁹. But almost all these methods involve the use of mathematics, and hence is of little use to an elephant manager, mahout or veterinarian.

Another more commonly used method involves weighing large mammals such as elephants or cattle in truck scales or weigh-bridges, which are large scales that are usually mounted permanently on a concrete foundation. The weight of an elephant is obtained by weighing a truck

both when empty and when loaded with an elephant. The problem with this method is that the weigh-bridge is stationary. Hence it is a cumbersome process to transport the elephants to where the weigh-bridge is situated. This is not only difficult but expensive too.

On the other hand, even the mere act of weighing an elephant on a flat electronic scale in the western zoos and circuses is accomplished only if the animal is well-trained. The elephants are trained to step onto a relatively small scale. The weighing platform, though small, appears to be adequate for a well-trained elephant to stand in the centre¹⁰. The problem with such a method is that given the small size of the platform, the elephant despite its training, needs to balance itself rather precariously. This causes the shifting of body weight, making the reading unstable.

During the elephant survey carried out by the Smithsonian Institution in Sri Lanka in 1967, a total of 42 elephants were weighed on the weigh-bridge at the Railway Station in Kandy⁷, and some 30 years later, a team from the University of Veterinary Medicine of Vienna, Austria was able to weigh 22 elephants on the same weigh-bridge⁶. A far simpler and more accurate approach would be to take the scale to where the elephants are kept in captivity and weigh them with all four feet firmly placed on the scale.

Modified scale

The design of a modified scale was the brainchild of the principal author, who felt the need not only to weigh elephants accurately, but also make the process more cost-effective. The idea was communicated to Asano Lanka (Pvt) Ltd, a company that specializes in the manufacture and sale of precision electronic scales in Sri Lanka. Traditional electronic scales used for weighing large objects (including animals) came as one piece of equipment. But our priority was to design an electronic scale that can be transported anywhere in the island on the back of a pick-up truck to accurately weigh elephants in captivity. This was accomplished by designing the weighing

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platform in two parts hinged to each other so that the entire equipment could be folded and transported in a truck.

The total length of the weighing platform is 2415 mm, and that of a single platform is 1200 mm. The gap between the two sections is 15 mm. The platform is 1000 mm wide and 60 mm high. There

are four handles to fold and unfold the two sections. The platform is operated by eight load cells located at the four corners of each section. There are eight adjustable feet to ensure both platforms are in level with each other. The weight is displayed in digital form in the weight controller which operates on both AC

mains (220–240 V) as well as on a rechargeable battery. Once the battery is fully charged, the controller could be taken to any remote area and operated with its battery power alone for about 100 h. The scale was calibrated by the manufacturer using 500 kg standard weights up to 6000 kg and hence it is extremely sensitive and has a weighing capacity that extends from 2 to 10,000 kg.

The scale, being 240 kg in weight, itself is rather heavy and would require at least four men to carry. Hence a method was devised to enable just one person to load it onto the tub of the truck, unload it at the site, weigh the elephants, and reload the scale back into the truck. In order to achieve this goal, two A-frames were made which are joined by a cross beam from which a winch is attached so that the scale could be hauled up, after which the truck is driven forwards, leaving the scale hanging in mid air. Once the scale is lowered gently to level ground, it is ready to weigh the elephants with the help of their mahouts (see Figures 1 and 2). Once the weighing is over, the scale is winched up and the truck is reversed so that the scale can then be lowered and the A-frames dismantled, ready for transport. The entire operation takes 20 min to set up, but once the scale is in position, weighing an elephant takes only a couple of minutes.

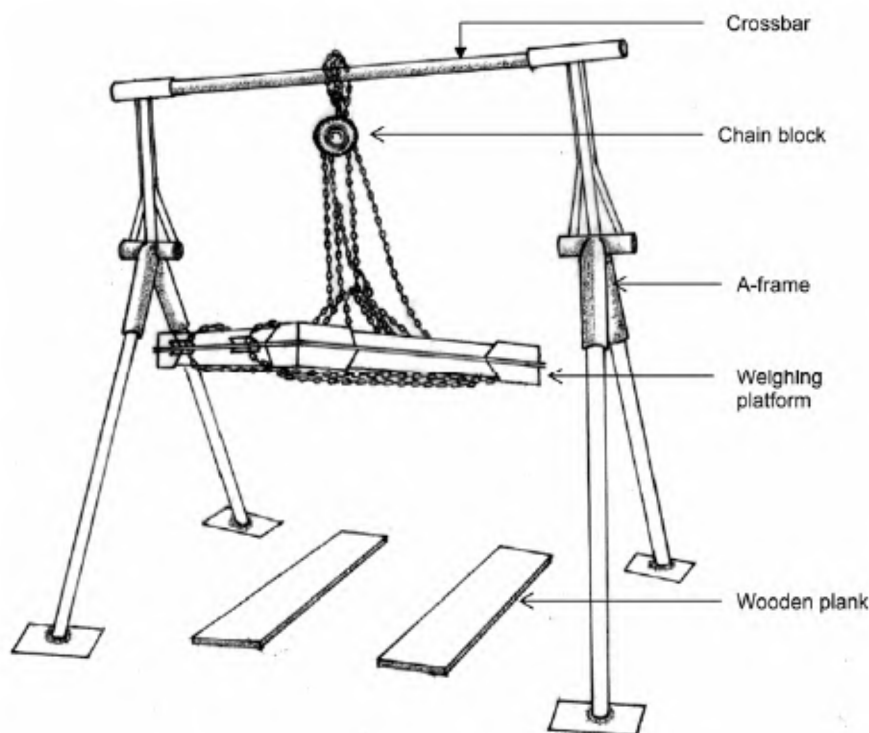


Figure 1. Diagram of a scale being winched using 1 tonne chain block from the crossbar supported by two A-frames prior to weighing of elephants.

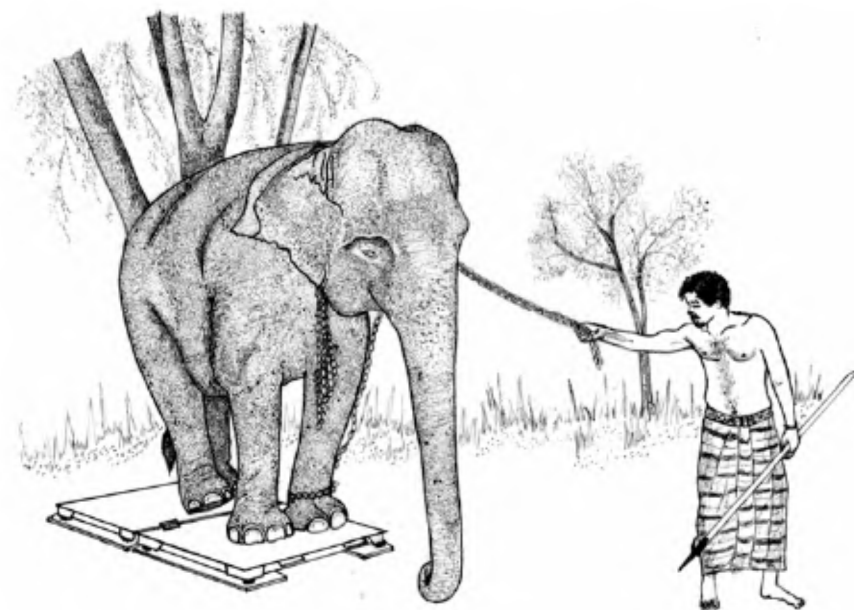


Figure 2. Drawing showing an elephant being taken off the scale by its mahout after weighing.

Results

The first attempt to weigh elephants accurately using this modified scale was made on 10 March 2010 at the premises of the Sacred Temple of the Tooth in Kandy, Sri Lanka, where six elephants (nos 1–6) were weighed (Table 1). The entire operation took only 25 min.

In the small sample of elephants that were weighed, it appears that the body weight of adult bull elephants in capti-

Table 1. Size class and body weight of elephants in captivity in Sri Lanka

Number	Size class	Body weight (kg)
1	Juvenile male	1000
2	Juvenile male	1018
3	Adult tusker	3000
4	Adult tusker	4120
5	Adult male	3136
6	Adult male	3720

vity ranges from 3000 to 4120 kg (average 3494 kg).

Discussion

This method offers an alternative to the estimation of weights and the flexibility of taking the scale to the elephants. It is also extremely accurate, and cost-effective at the rate of US 10 cents per km for transportation of the scale by a truck. We hope to continue using a programme of training elephants to stand on the scale and be weighed, through positive reinforcement, by rewarding the animals once they obey a command and move to the area where the scale is kept. It is our plan to weigh all the elephants in captivity in Sri Lanka at regular intervals so that the information could then be shared with elephant owners, managers, veterinarians, conservationists and mahouts. We would also estimate as accurately as possible the shoulder height of the animals, age (based on tooth eruption) and note their body condition. This would also enable us to estimate roughly the body weight of elephants in the wild as well. Having reliable estimates of body weight of elephants in the wild would greatly mini-

mize accidental deaths of animals when they are darted for capture or for treatment by veterinarians.

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