

The diet of Sri Lankan domesticated elephant (*Elephas maximus maximus*)

W. K. Godagama,* C. Wemmer * and W. D. Ratnasooriya

*Department of Zoology, University of Colombo,
Colombo 03, Sri Lanka, and * Conservation & Research
Center, Smithsonian Institution, USA.*

Received on 98.24.08

Accepted on 98.21.09

Abstract

The aim of this study was to scientifically document the components of the diets usually given to domesticated elephants of Sri Lanka (*Elephas maximus maximus*). The study was conducted between April, 1993 and April, 1994 in 13 of the 24 administrative districts of the country and was based on 140 domesticated elephants. The respective mahouts and/or owners of these elephants were also interviewed. The results show that the elephants are given a standard menu consisting of 3 main items [(kitul logs (*Caryota urens* L.), coconut fronds (*Cocus nucifera* L.) and jak branches (*Artocarpus integrifolia* L.)) and 10 supplementary items [leaves of pota wel (*Pothos scandens* L.), gona (*Ficus callosa* L.), palu (*Minilkara hexandra* Roxb.), nuga (*Ficus bengalensis* L.), na (*Ficus racemosa* L.), attika (*Adathoda vasica* Nees.), budeliya (*Totracera sarmetosa* L.), and erabadu (*Erythrina variegata* F. V. Muell.), leaves and stems of banana (*Musa acuminata* Colla.)]. Two of the main items, namely kitul logs and coconut fronds are given either singly [weight of Kitul (*Caryota urens* L.): 273 ± 5.9 kg./day] or in combination [weight of kitul (*Caryota urens*) 139 ± 2.9 kg/ day and weights of coconut (*Cocus nucifera* L.) 157 ± 2.8 kg/day] with Jak (*Artocarpus integrifolia* L.) branches (48 ± 0.94 kg/day). All the elephants were given fruits [banana (*Musa acuminata* L.), pineapple (*Ananas cosmus* Lindl.), mango (*Mangifera indica* L.), wood apple (*Feronia limonia* L.), papaya (*Carica papaya* L.), water melon (*Citrillus vulgaris* Schrad.), sugar cane (*Saccharum officinale* L.),] and vegetables [bread fruit, jak fruit (*Artocarpus integrifolia* L.), pumpkins (*Cucubita moschata* Duch.)] depending on the availability. Some elephants were also given prepared food items (milk rice, oil cakes, kokis, jaggery). Surprisingly, grass was incorporated in the diet of only 5 (3.57%) animals, all belonging to one owner. Kitul appears to be the most preferred food (80%). Two percent preferred coconut and 18% had no special preference to any item of food. Majority of the mahouts were reluctant to feed their elephants with bamboo (*Bambusa vulgaris* Scharsd.)

and ehatu (*Ficus tsiela* Roxb.). Six percent of the elephants were given alcohol occasionally by their mahouts. Elephants were usually allowed to drink water 3-4 times/day. The quantity of food given to domesticated Sri Lankan elephants is sufficient but quality can be enhanced further without corresponding increase in the maintenance costs.

Key Words: *Elephas maximus maximus*, sri lankan, domesticated elephant, diet, sri lanka.

1. Introduction

Sri Lankan elephants (*Elephas maximus maximus*), a sub species of the Asian elephant (*Elephas maximus*) is an endangered animal included in the appendix I of the Convention of International Trade on Endangered Species of Wild Fauna and Flora (CITES). The survival and propagation of the Sri Lankan elephant would increasingly depend on the improvement of current husbandry practices, health and reproduction of domesticated elephants, as the wild elephant population continue to decline rapidly. In order to do this, information on basic ethnozoology and socio-economic aspects of domesticated elephants are required. But, there is a dearth of such information (Illangakoon, 1993; Kurt, 1975) inspite of domesticated elephants being an integral part of the Sri Lankan society for centuries.

In this study, we examined and report the current diets given to the domesticated elephants in Sri Lanka. Data was gathered from 137 mahouts and 84 owners with respect to 140 elephants in 13 of the 24 administrative districts of the island. This is about 40% of the total domesticated elephant population of Sri Lanka (Jayewardene, 1994) and 22% of the total number of elephant owners (Jayasinghe *et al.* 1970). As yet, no documentation is available regarding the total number of mahouts in Sri Lanka.

2. Materials and methods

This study was conducted during April 1996 and April 1994. The study area consisted of 13 of the 24 administrative districts of the island [nine in the wet zone (Galle, Matara, Colombo, Gampala, Kalutara, Ratnapura, Kegalle, Nuwara-Eliya & Kandy three in the intermediatc zone (Matale, Kurunegala and Moneragala) and one in the dry zone (Anuradhapura)]. The sample consisted of 140 domesticated elephants (72 males and 68 females). The sites where the individual elephants were ususally kept (working place, owners' residence, mahouts' residence, temples and dewales) were visited and observations were made on the types and quantities of food items given.

On some occasions, these observations were made when the elephants were brought to participate in peraheras (the Colombo Navam Perahera, the Kelaniya Duruthu Perahera, the Bellanwila Asala Perahera, the Kandy Asala Perahera and the Asala Perahera of the Aluthnuwara Dewalaya). Inquiries were made from the owners (n=82) and the mahouts (n=137) of individual elephants about the lengths of kitul logs (*Caryota urenus* L.), number of coconut (*Cocos nucifera* L.) fronds and jak (*Artocarpus integrifolia* L.) branches with leaves provided per day for their elephants. They were also questioned about other plant types given in small quantities, special food items provided, the preferred food and the types of plants that are not given to their elephants. Information was also gathered about the frequency of drinking of water per day and about the provision of alcohol to the elephants. The gross weights of three main food items provided were estimated in the following manner. Six logs of kitul (*Caryota urenus* L.), six fronds of coconut (*Cocos nucifera* L.) and six branches of jak (*Artocarpus integrifolia* L.) with leaves were randomly selected at the sites of feeding of elephants. Thereafter, six pieces of kitul having a length of 30.8 cm were cut and their weights were determined. Similarly the weights of coconut fronds and jak branches were determined and the mean weights were calculated.

The quantities of each food item were then estimated using the following formula.

Total weight of kitul (kg/day)	= Mean weight of six pieces x length of the kitul logs provided for elephants
Total weight of coconut fronds (kg/day)	= Mean weight of six bunches of coconut fronds x total number of coconut fronds provided for elephants
Total weight of jak branches (kg /day)	= Mean weight of six branches of jak x total number of jak branches provided for el- ephants

The grass bales were individually weighed and the mean weight was computed.

3. Results

The main food items of all 140 elephants in this study were trunks of kitul (*Caryota urenus* L.), fronds of coconut (*Cocos nucifera* L.) and branches of jak (*Artocarpus integrifolia* L.). Normally, according to mahouts and owners, kitul logs and coconut fronds are given in different quantities almost throughout the year either singly or in combination. When there is difficulty in obtaining these two items in sufficient quantities, jak branches are given together with kitul logs and coconut fronds. The mean weight of a kitul trunk (30.8 cm length), a coconut frond, and a bunch of jak leaves and branches were 20.7 and 35 kg, respectively. The estimated amounts of these items were given per day either alone or in combination, are depicted in Table 1.

Table 1: Estimated quantities (kg/day) of the three main food items given to domesticated Sri Lankan elephants (means $\pm$ s.e.m)

Mode of Presentation	Kitul (kg/day) (<i>Caryota urenus</i> L.)	Coconut (kg/day) (<i>Cocos nucifera</i> L.)	Jak (kg/day) (<i>Artocarpus integrifolia</i> L.)
As a single item	273 $\pm$ 5.9 (100-400)	325 $\pm$ 6.0 (140-400)	48 $\pm$ 0.94 (20-75)
In combination with jak (<i>Caryota urenus</i> L.)	139 $\pm$ 2.9 (50-250)	157 $\pm$ 2.8 (75-275)	-

ranges are given in parenthesis

Five out of 140 elephants were regularly fed with 62 $\pm$ 3.4 kg of fresh grass daily (range; 55-75kg) in addition to kitul *Caryota urenus* logs and coconut (*Cocos nucifera* L.) fronds. In addition, depending on the availability, the diet of almost all the elephants were supplemented with other plant species; leaves of pota wel (*Pothos scandens* L.), gonna (*Ficus callosa* Willd), palu (*Minilkara hexandra* Roxb.), nuga (*Ficus benghalensis* L.), na (*Mesua ferrea* L.), attika (*Ficus racemosa* L.) agal adara (*Adhatoda vasica* Nees.), budeliya (*Totracera sarmetosa* L.) and erabadu (*Erythrina variegata* L.), leaves and stems of banana (*Musa acuminata* Lindl.).

According to mahouts, 110 (80%) of the elephants preferred kitul logs (*Caryota urenus* L.) as the favourite food item while three (2%) indicated coconut (*Cocos nucifera* L.) fronds. On the other hand, 24 (18%) of the elephants had no preference to any of the three main food items.

Some mahouts do not feed their elephants with certain plants, such as una (*Bambusa vulgaris* Schard.) and ehatu (*Ficus tsiela* Roxb.). Out of the 137 mahouts, 97 (76%) were of the view that una is a plant that could cause harmful effects when consumed. Out of these, 58 mahouts were averse to feeding their elephants with ehatu for the same reason.

The majority of mahouts and owners did not provide special food items to their elephants regularly. One owner, however, claimed to have given cooked soya beans to his elephants twice a month and another owner reported to have given vitamins (liquid) to his elephant once in every 3 months. Yet another owner gives 4-6 loaves (1 loaf = 500g) of bread to the elephants daily and pea nuts (with husk) once a week.

All elephants were given other fruits and vegetables when ever available or when offered by people in the villages. They were given fruits such as banana (*Musa acuminata* Colla.), pineapple (*Ananas comosus* Lindl.), mango (*Mangifera indica* L.), wood apple (*Feronia limonia* L.), papaya (*Carica papaya* L.), water melon (*Citrillus vulgaris* Schrad.), sugar cane (*Saccharum officinale* L.) etc. However, elephants owned by dewalayas and temples regularly receive these kinds of fruits, which are offered by devotees. Elephants were also given vegetables such as bread fruit, *Artocarpus nobilis* Thw jak fruit (*Artocarpus integrifolia* L.), pumpkins (*Cucubita moschata* Duch.) etc. Some elephants were given milk rice, oil cakes, kokis, and jaggery other sweets on New Years' day and whenever available. They were also given rice in cooked or dry form.

Domestic elephants are normally allowed to drink water 3-4 times a day. Eighty seven mahouts report that their elephants drink water only from wells and watering places and do not drink water while bathing. Fifty other mahouts said that their elephants drink water from anywhere, but do not drink polluted water.

Out of the 140 elephants, only nine (6%) elephants were given alcohol and this was not done on a regular basis.

4. Discussion

Elephants are generalized herbivores (Sukumar, 1989; Eltringham, 1991). The Sri Lankan elephant in the wild feeds on an enormous variety of plant species [73 species, Norris, (1959); 79 species, Nettasinghe, (1973); 88 species, McKay, (1973); and 225 species, Vancuylenberg, (1977)]. However, the bulk of their food (about 50%) consists of grasses (McKay, 1973; Sukumar, 1989). In contrast, the results of

this study show that, irrespective of the season and the location, domesticated Sri Lankan elephants are given a fairly fixed menu consisting of three main items kitul (*Caryota urens* L.) logs, coconut (*Cocos nucifera* L.) fronds and jak (*Artocarpus integrifolia* L.) branches with leaves] and ten supplementary items. A notable feature is that only 3.6% of the domesticated elephants in Sri Lanka are regularly fed with grasses (these elephants were owned by a single person) and none with bamboo. Bamboo is a very important component of the diet of Asian wild elephants (Sukumar, 1989) and they have a relatively constant protein value throughout the year (Eltringham, 1991). Surprisingly, the three main components of the diet of domesticated elephants are totally absent in the diet of the wild elephants. However, even with this unnatural diet, domesticated elephants possess an overall body condition index of 6.95 (Godagama *et al.*, 1998) indicating that they are in good health. Nevertheless, this artificial diet may be a major contributing factor for the impaired fertility observed with domestic elephants; as yet, captive breeding of elephants is successful only at Pinnawela elephant orphanage where animals are allowed to graze freely for several hours daily (Ratnasooriya *et al.*, 1991a; Ratnasooriya *et al.*, 1992b). Further, grasses are a main component of the diet of domesticated elephants in Burma and Nepal (Evans, 1910; Ferrier, 1947; Dhungel *et al.* 1990). In Burma (Ferrier, 1947; Gale, 1974) and in India (Krishnamurthy, 1992; Krishnamurthy and Wemmer, 1996) domesticated elephants are allowed to graze free in jungles at night. Further, grasses are abundant in many parts of the country and has low levels of chemical defences (Sukumar, 1989). Thus, it would be desirable to encourage owners of domesticated elephants of Sri Lanka to use grass regularly, as a part of elephant fodder. Rice hay, which is also available in plenty in Sri Lanka, is yet another item, that could be incorporated into the diet of domesticated elephants. Albeit, hay may not be palatable to elephants as fresh grasses and also nutritionally inferior (Sukumar, 1989). However, zoo elephants in developed countries are fed diets with grass hay along with pelleted feed. Such a practice would not only reduce the demand for kitul (*Caryota urens* L.) and coconut (*Cocos nucifera* L.) but also cut down the annual maintenance cost for fodder. Currently annual maintenance cost for fodder for domesticated elephants is Rs. 32, 164 (Godagama, 1996)

Some aspects of the diet of domesticated elephants has been reported by Illangakoon (1993). According to this study majority of elephants (68%) were fed continuously on a mixed diet of kitul (*Caryota urens* L.) coconut (*Cocos nucifera* L.) and jak (*Artocarpus integrifolia* L.) branches with no other variations, while the rest were fed solely with kitul (*Caryota urens* L.).

If elephants are fed with a very strict food combination as indicated by Illagakoon (1993), then, it is likely they would suffer from a number of nutritive and vitamin deficiencies and would be in poor health. Yet, the overall health status of domesticated Sri Lankan elephants is good (Godagama *et al.*; 1998 Kurt (1995) states that domesticated Sri Lankan elephants eat only leaves and trunk of jak trees, coconut and civet palms. This cannot be accepted. However, in Myanmar, the diet of domesticated elephants is supplemented with a mixture of cereals and grains (Gale, 1974). In Nepal, at Royal Chitwon National Park, adult elephants are given rice, brown sugar and salt (Dhungel *et al.*, 1990). Domestic elephants in India are given rice, millet, chaff, copra, salt, sugarcane, wheat flour made into a native cake (chappathi) or aromatic spice ball (masala) depending on the season, health and musth (Evans, 1910; Kurt, 1990). Kurt (1995), states that in India elephants are also fed with chicken and goat-head broth. In contrast, this study shows that in Sri Lanka, the diet of domesticated elephants are not supplemented regularly with prepared food as in other countries: only one owner claims to give cooked soya beans and bread, and few, especially, in temples and dewalayas are given milk rice, bread, oil cakes, kokis, toffees and other sweets. It may be desirable to instruct mahouts and owners to supplement the diet in a regular basis with prepared food as in other countries. In this regard, it is of interest to note that elephants in the Pinnawela elephant orphanage and the National Zoological gardens of Sri Lanka are supplied daily with prepared food mixture containing maize meal, rice bran, powdered gingely and minerals with trace elements (Ratnasooriya *et al.*, 1991; Ratnasooriya *et al.*, 1992b). In addition, baby elephants are given powdered milk and 500g rice with honey.

Elephants consume a great deal of food (Sukumar, 1989; Eltringham, 1991). As individuals, elephants are the largest consumers of plants among the terrestrial animals (Eltringham, 1991). However, they eat less food in relation to their body weight than other animals do (Eltringham, 1991). This study, for the first time, reports the estimated amounts of major components of the diet given to Sri Lankan domesticated elephants. However, there is no general agreement on the quantity of food that should be given to elephants: 6-8 % of its body weight/day (Eltringham, 1991); 2-2.5% of its body weight/day (Abeyratne, 1986); 1.5-2 % of its body weight (Laws *et al.*, 1975); 59 kg of fodder for every foot of height (Weinman, 1951); 75-150 kg/day (Dhungel *et al.* 1990); 135-300 kg/day (Guy, 1975); and 315 kg/day (Ferrier, 1947). At the National Zoological gardens of Sri Lanka, the mean food intake of male elephants and female elephants are reported to be 89 and 70 kg/day, respectively (Ratnasooriya *et al.*, 1994). Considering that the average male

and female domesticated Sri Lankan elephants weigh 2902 kg and 2507 kg (Kurt, unpublished observations), respectively, this study shows that the quantities of food given are within the range of other workers and thus believed to be the required range. This view is further supported by the fact that the overall body condition of the Sri Lankan domesticated elephant is 6.95 (Godagama *et al.* 1998).

Food preferences of the domesticated elephants for the three main food items were investigated in this study. According to the mahouts, kitul logs (*Caryota urenus* L.) are the most preferred food (80% of 137). Two percent indicated that their elephants preferred coconut fronds (*Cocos nucifera* L.). The rest (18%) was of the view that their elephants do not show a clear preference to any of the three main components of the diet. Illangakoon (1993) has attempted to study food preferences of domesticated Sri Lankan elephants. In agreement with our data Illangakoon (1993) has also found that majority of the domesticated elephants preferred kitul but there appears to be a flaw in the presentation of data which prevents further comparisons to be made. Most of the mahouts (76%) believed that bamboo (*Bambusa vulgaris* Schrad.) and leaves of ehathu (*Ficus tsiela* Roxb.) are generally harmful to elephants under normal conditions. Rhizomes of bamboo (*Bambusa vulgaris* Schrad.) and leaves of ehathu (*Ficus tsiela* Roxb.) possess sedative action when tested in rats using the hole-board technique (Ratnasooriya & Tillekeratne., 1991; Ratnasooriya *et al.*, 1992b) and this could be one reason why mahouts are reluctant to include these two items in the diets of domesticated elephants. However, other *Ficus* species, such as gonna (*Ficus callosa* Willd.), nuge (*Ficus benghalensis* Linn), attika (*Ficus racemosa* Linn) included in the diet depending on their availability.

Yet another interesting and novel point that emerged from this study was that 9 of the 140 domesticated elephants were given alcohol. Several mahouts stated that the elephants are friends and companions and therefore they share liquor with them. Sukumar (1986) states that elephants are fond of alcoholic liquor. He also cites anecdotal evidence of elephants raiding the illicit brewers in Indian forests. In the wild, elephants may get alcohol by consuming over-ripe and slightly fermenting fruits (Guy, 1975).

An attempt was also made in this study to ascertain the frequency of drinking by the domesticated elephants. It appears that they are allowed to drink 3-4 times a day. However, this frequency would change depending on the season and the work they are called upon to do.

In conclusion, this study shows that the Sri Lankan domesticated elephants are fed on a fixed diet. The quantity of food given is sufficient but the quality can be further improved without a concomitant increase in costs.

Further, physical status and health conditions should be taken into account by both mahouts and owners in providing diet to the domestic Sri Lankan elephants.

5. Acknowledgements :

This work was supported by the Conservation and Research center, Smithsonian Institute, U. S.A. and USAID (Grant number DHR-5600-G-00-0062-00)

Reprint requests: Professor W. D. Ratnasooriya,
Department of Zoology,
University of Colombo,
Colombo 03,
Sri Lanka.

6. References

- Abeyratne, A.S. (1986). Feeding elephants in the correct way. Daily News, 19th September. Colombo, Sri Lanka.
- Dhungel, S. Brawner, C. and Yodder, J. (1990). Elephant training and management in Nepal. Tiger Paper, 17, 1-6.
- Eltringham, S.K. (1991). The illustrated encyclopedia of elephants. Salamander Books Ltd., London, U.K.
- Evans, G.H. (1910). Elephants and their diseases: A treatise on elephants. Government Printing and Stay Union of Burma, Rangoon, Burma.
- Ferrier, A. J. (1947). The Care and management of elephants in Burma. Government Printing Office, Rangoon, Burma.
- Gale, V. (1974). Burmese timber elephant. Trade Corporation, Rangoon, Burma.
- Godagama, W. K. (1996). An ethnozoological study of domesticated elephants in Sri Lanka. M. Phil. Thesis. University of Colombo, Colombo, Sri Lanka.
- Godagama W. K., Wemmer, C. and Ratnasooriya, W.D. (1998). The body condition of Sri Lankan domesticated elephants (*Elephas maximus maximus*) Cey. J. Sci., (Bio. Sci.V), 26, 1-6
- Guy, P.R. (1975). The daily food intake of the African elephant, *Loxodonta africana* Blumenbach, in Rhodesia. *Arnoldia rhodesia*, 7, 1-8.

Illangakoon, A. D. (1993). A preliminary study of the captive elephants in Sri Lanka. *Gajah*, **11**, 29-42.

Jayasinghe, T. B. and Jainudeen, M.R. (1970). A census of the tame elephant population in Ceylon with reference to location and distribution. *Cey. J. Sci.* **8**, 63-68.

Jayewardene, J. (1994). The elephants in Sri Lanka, Mortlake Press Ltd., Colombo, Sri Lanka.

Krishnamurthy, V. (1992). Recommendations for improving the management of captive elephants in Waykambas National Park, Hampung, Sumatra, Iadonesia. *Gajah*, **9**, 4-13.

Krishnamurthy, V. and Wemmer, C. (1996). Timber elephant management in the Madras Presidency of India (1844-1947) In: *Internal Symposium on the conservation of the Asian elephants*. Daniel, J. C. and Choudary, D.K.L.(Eds.). Bombay History Society, Bombay, India.

Kurt, F. (1995). The preservation of Asian elephants in human care A Comparison between the different keeping systems in South Asia and Europe, *Animal Res. Dev.* **41**, 38-60.

Laws, R.M., Parker, I. S. C. and Johnstone, R.C.B. (1975). Elephants and their habitats. Clarendon Press, Cambridge, U.K.

Mckay, G.M. (1973). Behaviour and ecology of the Asian elephant in South Eastern Ceylon. *Smithsonian Contribution Zool.*, **125**, 1-113.

Nettasinghe, A.P.W. (1975). The interrelationship of livestock and elephants at Thamankaduwa farm with special reference to feeding and environment. M. V.Sc. Thesis, University of Ceylon, Peradeniya University, Sri Lanka.

Norris, C.E. (1959). Preliminary report on the Ceylon elephant feeding survey. Times of Cey Ltd, Colombo, Sri Lanka.

Ratnasooriya, W.D. and Tillekeratne, L.M.V. (1991). Effect of *Bambusa vulgaris* crude extract on the exploratory behaviour of male rats. *Med. Sci. Res.*, **19**, 253-254.

Ratnasooriya, W.D. Fernando, S. B. U. and Manatunga, A. M.V.R. (1991). Serum testosterone levels of Sri Lankan elephant (*Elphas maximus maximus*) in captivity. *Med. Sci. Res.* **19**, 623-624.

Ratnasooriya, W.D., Fernando, S. B. U. and Manatunga, A. M. V. R. (1992a). Serum testosterone levels of Sri Lankan female elephants (*Elephas maximus maximus*). *Med. Sci. Res.*, **20**,79-80.

Ratnasooriya, W.D., Premakumara, G. A.S. and Tillekeratne, L. M. V. (1992b). Exploratory behaviour of male rats treated with crude extract of *Ficus tsiela* leaves. *Med. Sci. Res.*, **20**,233-234.

Ratnasooriya W.D., Molligoda, P.S., Molligoda, W.H.M., Fernando, S.B.U. and Premakumara, G. A.S. (1994). Absence of synchronization either in defaecation or urination of the Sri Lankan elephant (*Elephas maximus maximus*) in captivity. *Cey. J.Sci.*, **23**,47-51.

Sukumar, R. (1989). The Asian elephant: ecology and management. Cambridge University press, Cambridge, U.K.

Vancuylenberg, B.W.B. (1977). Feeding behaviour of elephants of the South Eastern Sri Lanka in relation to conservation. *Biol. Conserv.* **12**, 33-54.

Weinman, A.W. (1951). Elephants and their ways. *Loris*, **6**, 296-301.