J. Sci. Univ. Kelaniya **1** (2003) : 15-21

ROOST SELECTION OF THE SHORT-NOSED FRUIT BAT, *Cynopterus* spp. IN SRI LANKA

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ABSTRACT

A total of 160 day roosts of short nosed fruit bats (*Cynopterus* sp.) were examined during a 3 year study in Sri Lanka. Day roosts were found in five species of trees; Talipot palm (*Corypha umbraculifera*), Coconut (*Cocos nucifera*), Banana (*Musa* sp.), Habarala (*Alocasia* sp.) and Kitul (*Caryota urens*). All the day roosts found in this study can be categorized in to three groups, viz, tents, foliage roosts and seed string roosts. Majority (92%) of day roosts were in the form of tents, all of which were found in the talipot palm. Foliage roosts (7%) were found in three species of plants (*C. nucifera, Musa* sp., *Alocasia* sp.) while two (1%) of the roosts were found in Kitul palm, inside the seed strings. Our observations indicate that the tents are constructed by male bats and serve as the primary roosts of the *Cynopterus*.

Key words: *Cynopterus*, Chiroptera, day roosts, tents, *Corypha umbraculifera*

INTRODUCTION

Bats form one of the most successful orders of mammals in Sri Lanka (Bates & Harrison, 1997). With 30 species, they account for over 1/3 of the mammalian species in the island (Phillips, 1980; Bates & Harrison, 1997). Both suborders of the order Chiroptera are well represented in the island with 4 species of megachiropterans and 26 species of microchiropterans. All living megachiropterans belong to a single familiy, Pteropodidae. This family is represented by 4 species in Sri Lanka, the common flying foxes (*Pteropus giganteus*), dog faced bats (*Rousettus leschenaulti*) and short nosed fruit bats (*Cynopterus* spp.).

Short nosed fruit bats are a widely distributed megachiropteran throughout India, Malaysia, China, Philippine, Indonesia, Timor and Sri Lanka (Brosset, 1962; Goodwin, 1979; Phillips, 1980; Balasingh *et al.*, 1995, Bates & Harrison 1997). Although it is claimed that there are two species in this genus in Sri Lanka, taxonomic status of the *Cynopterus* species complex was a subject of controversy and confusion. However, recent studies with multivariate morphometrics and mitochondrial DNA sequence

analysis confirmed the existence of two species of short nosed fruit bats, *Cynopterus brachyotis* and *Cynopterus sphinx* although differentiating the two by external features is difficult (Mapatuna *et al.*, 2002).

Short nosed fruit bats have been described as one of the commonest plant-visiting bats in the old world tropics. They are known to entertain a wide dietary spectrum with nectar, fruits, leaves and flowers/pollen (Elangovan *et al.*, 2000). In addition, compared to other megachiropterans, they exhibit a wide variation of roosting habits which includes various types of tents, dried leaves in palm trees, dead palm fronds, tree cavities, in recesses beneath the barks of some trees, aerial roots in *Ficus* trees and some times even in buildings (Balasingh *et al.*, 1995, Elangovan *et al.* 1999, Elangovan *et al.*, 2000).

With this remarkable flexibility in diet and roost selection, short nosed fruit bats may thrive not only in forests, but even more in disturbed areas. On one hand, the short nosed fruit bats can play a very important role in pollination, seed dispersal and tropical reforestation. On the other hand, large populations of fruit bats in areas where fruit plants are cultivated in commercial scales, they can cause colossal damage to the fruit industry and act as a fruit pest to many commercially important fruit plants. Thus, it is vitally important to examine the ecology, biology and population status of fruit bats in the genus *Cynopterus* as very little is known on the biology and ecology of them in Sri Lanka. Therefore, a long term study program on fruit eating bats to evaluate their current status, distribution, population parameters and roosting habits was initiated. This paper describes roost selection of *Cynopterus* species complex in Sri Lanka.

MATERIALS AND METHODS

The study was conducted from September 1995 to December 2000, in all six climatic regions of Sri Lanka (Low and Mid country Wet Zone, Dry Zone, Low and Mid country Intermediate Zone, Montane Wet Zone, Montane Intermidiate Zone and Arid Zone). During the investigations, the island was divided into 10x10 km grids and observations were made in arbitrarily selected grids to include all provinces except the North and the East. Since *Cynopterus* is known to roost in large leafed trees in India (Balasingh *et al.*, 1995), potential roosting sites (usually palm trees and other large leafed trees) were examined to locate viable roosting sites. Once a roost was detected in a tree, the species of the tree, leaf shape and pattern, and the location of the bat colony were recorded. The number of bats in a roost was determined by individual counting. Bats were observed with naked eye (at short distances: approximately 5–6 m) and some of observations were aided with binoculars. Where necessary, tents were illuminated with a beam of red light. To facilitate identification, roosting bats were captured using either mist or hand nets. Whenever feasible, whole population was captured by encircling the roosts with mist nets. If the entrances of the roosts (usually tents) were smaller enough to be encircled by a hand net (with a diameter of 75 cm), then hand nets were used. Bats were handled with extreme care to minimize the stress to captured individuals and all captured bats were released at the site of capture. Identification of bats was mainly based on external morphological characters (Bates & Harrison, 1997; Mapatuna *et al.*, 2002). Since *C. sphinx* and *C. brachyotis* are rather

difficult to differentiae in the field by external morphology, identification was restricted to generic level.

RESULTS

During the study period a total of 160 day roosts were recorded in all climatic zones. All roosts were exclusively found on trees. The day roosts were found in six different species of plants (Table 1). The tree roosts located were categorized into the following three types.

i. Tents: Tents differ from all other roosts in that they are constructed by bats. We assume that the tents are constructed by bats as single animals were observed on several occasions (approximately 15 times) in partially constructed tents. On two occasions these tent making bats were identified as males. Altogether a total of 147 tents (92% of *Cynopterus* roosts) were found during the study period (Table 1). All of these tents were constructed on the Talipot palm, *Corypha umbraculifera* (Fig. 1-a). During the tent construction, the inner margins of the mature palm leaves were bitten off in a characteristic way so that the distal parts of the leaves bend downwards forming a sort of a tent (Fig. 1-b). The bats roosted inside this tent, and were visible, only if observed directly underneath the tent. Each tent had one or few (2-3) openings which may serve as entrances and exits to the roost. The number of tents in a palmyrah tree varied between a single tent to as much as ten tents. Tents were recorded in all climatic zones except in montane wet zone and arid zone.

ii. Foliage roosts: A total of 11 day roosts (7%) were found within the foliage of large-leafed trees (Figs. 1- c, d & e). These foliage roosts were found in three species of plants, i.e., banana (*Musa sp*: *N=3*), coconut (*Cocos nucifera: N=6*) and habarala leaves (*Alocasia sp*: *N=2*). None of these roosts were altered roosts and bats were simply roosting under surface of the leaves. These were found in all zones except in the arid zone.

iii. Roosts in seed strings: On two occasions bats were found to roost within the seed strings of the Kitul palm, *Caryota urens* (Fig. 1-f). The opening at the distal end of the seed cluster served as the entrance to the roost. Both roosts were located in the low and mid country intermediate zone.

Colony size (number of individuals per roost) of *Cynopterus* was comparatively small. Out of 160 roosts, in 140 (87.5%) the colony size consisted of less than 15 individuals. The largest colony observed during this study consisted of 35 individuals.

Table 1. Type of trees, roost location, roost type and the number of roosts found in each type of tree species

Tree species	Roost Location	Roost type	# of roosts
Talipot palm (*Corypha umbraculifera*)	Leaves	Tent	147 (92%)
Coconut (*Cocos nucifera*)	Dead Leaves	Foliage	6 (4%)
Banana (*Musa* sp.)	Dead leaves	Foliage	3 (2%)
Habarala (*Alocasia* sp.)	Dead leaves	Foliage	2 (1%)
Kitul (*Caryota urens*)	Seed strings	Seed strings	2 (1%)
Total			160

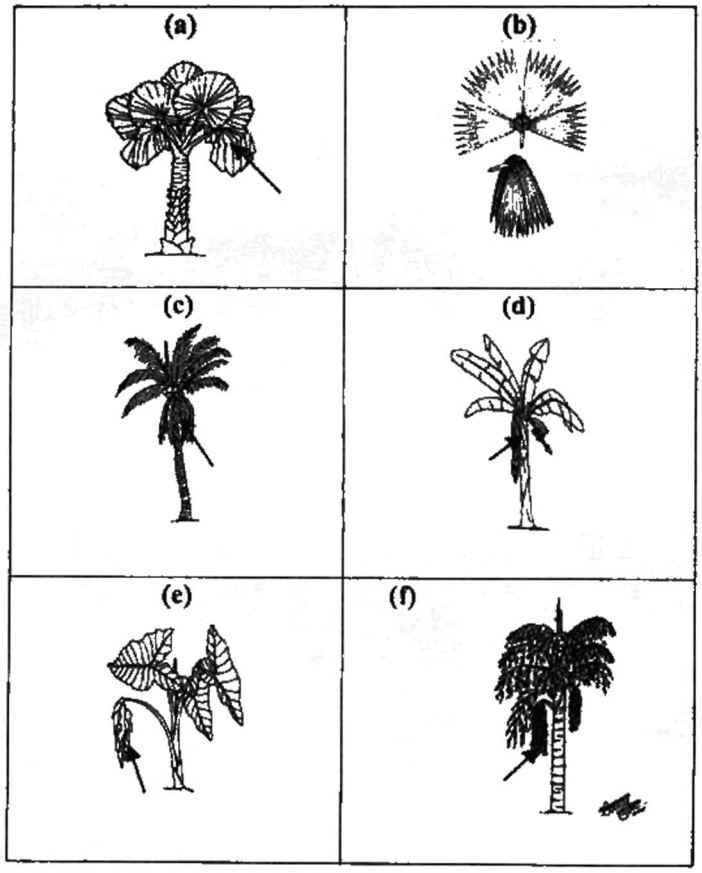

Figure1: Day roosts of *Cynopterus* (a) Talipot palm. (c) Coconut palm, (d) Banana, (e) *Alocasia* sp. and (f). kitul palm. In all figures the arrows indicate the location of the roost. (b) shows diagrammatic view of a tent constructed by *Cynopterus*. The upper figure shows the tooth marks of leaf during tent construction and lower figure shows the normal view of a completed tent.

DISCUSSION

Results of the present study clearly show that *Cynopterus* is a widely distributed genus throughout the island and is essentially phytophilous in its roosting habit. During the study period, three types of roosts were identified, all of which were tree-based. One of the major findings of this study was the high preference shown by *Cynopterus* to the talipot palm (*Corypha umbraculifera)* for roosting as 92% of the day roosts were found in talipot palms. All the day roosts found in this palm were in the form of tents, constructed by bats. In India *C. sphinx* was reported to use six different species of plants as day roost which included, the mast tree (*Polyalthia longifolia*), curtain

creeper (*Vernonia scandens*), palmyrah palm (*Borassus flabellifer*), areca palm (*Areca catechu*), banyan tree (*Ficus bengalensis*) and banana (*Musa* sp.) (Balasingh *et al.*, 1995). In our study, *Cynopterus* roosts were located on five species of plants. But *Musa* was the only common plant where *Cynopterus* roosts were found in both countries.

Both in India and Sri Lanka, *Cynopterus* roosts included tents. In India tents were found in two species, in the mast tree, *Polyalthia longifolia* and curtain creeper, *Vernonia scandens*, both of which were "stem tents" (Balasingh *et al.*, 1995). In contrast, in Sri Lanka, all tents (n=147) were found in the talipot palm and these were "leaf tents". Despite this difference found in the tent type (stem vs leaf) and tent architecture, comparable observations made in India and in the present study suggest that geographic differences do not alter roosting pattern of *Cynopterus*.

What are the benefits derived from tent construction? In general, bats select both man made and natural enclosures as roosts, and tents are the only form of roosts build by bats. Among both megachiropterans and microchiropterans, which exceed over 1000 species (Mickleburgh *et al.*, 2002), tents are constructed by 15 species (Balasingh *et al.*, 1995). There are distinct advantages in tent roosting. Compared to other known roosts of *Cynopterus*, tents may provide protection from inclement weather and reduce the risk of predation. The margins of the leaf stem of *Corypha* are lined with small thorns and the leaf surface is very slippery. Therefore, these tents are virtually inaccessible by many predators. The shiny waxy layer of the upper surface of the palm leaves reflect direct sunlight and are not soaked with water during rain. Interior of the roosts are fairly dark and probably provide high humidity during the day light hours. Thus, tents may confer thermoregulatory advantages to the roosting bats (Brooke, 1990).

Further, tent roosting is essentially related to the social organization of the species. Perusal of recent literature show that tents are exclusively formed by species, which form polygynous mating systems (Balasingh *et al.*, 1995 and references therein). In such a system, a male would gain access to critical resources that are important to females and then defend these resources to gain reproductive success. Balasingh *et al.*, (1995) suggest that the construction of tents by male *C. sphinx* and the subsequent recruitment of the females provide one type of resource and represents a form of mate guarding that would lead to the evolution of resource defense polygyny.

Our observations are in agreement with this hypothesis since we observed that in Sri Lanka, tents are occupied by a single adult male and several females. Further, our observations show that the tents are constructed by males. Therefore, *Cynopterus* tents are not only serving as a better refuge for occupying bats, but also play an important role in the social organization and reproduction of the species and could be termed as a critical resource.

Although *Cynopterus* was found to roost in several other types of day roosts, majority of the roosts (92%) were tents. Therefore, we believe that tents are the main type of day roosts of *Cynopterus*. The other roosts may be temporary roosts occupied by male sub adults who are excluded from the tents by the dominant harem males or may be the females who are "looking" for an appropriate tent. However, further observations are necessary to confirm this assumption.

Phillips (1980) reported the construction of a roost by *Cynopterus sphinx brachyotis* by severing the parts of the seed strings of the kitul palm, *Caryota urens*. In

the recent taxonomic evaluation, this sub species has been identified as *C. brachyotis* (Mapatuna *et al.*, 2002). In the present study, two roosts in the seed strings of the kitul palm were located in the high land. According to Phillips (1980) and Mapatuna *et al.*, (2002) *C. brachyotis* is restricted to high lands. Thus, it may be possible that the populations which were observed to occupy kitul plam in this study are those of *C. brachyotis*. It may even be possible that these two species (*C. sphinx* and *C. brachyotis*) have two different types of roost selection, leaf tents in *Corypha umbraculifera* by *C. sphinx* and seed string roots in *Caryota urens* by *C. brachyotis*. In such a situation, this may be one way of resource partitioning when they live in sympatry.

In conclusion our study shows that the roost selection of *Cynopterus* is exclusively phytophilous. Although roosts were found in five different species of trees, *Corypha umbraculifera* is the most preferred tree for roosting.

ACKNOWLEDGEMENTS

We thank Mr. W.L.D.P.T.S. de A. Goonatilake for drawing the *Cynopterus* roosts. This project was funded by NSF research Grant No. RG/95/B/5.

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