

## RESEARCH REPORT

## Some Notes on Fig-eating by Arboreal Mammals in Malaysia

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**ABSTRACT.** During a study of avian fig-eating at Kuala Lompat, Malaysia, observations were also made of fig-eating by mammals. Four species of primate, seven species of squirrel, and two species of civet consumed figs. Twenty-six species of *Ficus* were of importance to arboreal mammals. Observations suggest that there were differences in the importance of figs in the diets of sympatric langurs (*Presbytis*) and congeneric squirrels. Dusky langurs *Presbytis obscura* ate carbohydrate-rich ripe figs despite their ruminant-like digestive system and the danger of bloat.

**Key Words:** *Callosciurus*; Diet; *Ficus*; Malaysia; *Presbytis*; *Ratufa*.

## INTRODUCTION

The diets of arboreal mammalian species inhabiting Malaysian rain forest have been recorded in detail for most primates and some species of squirrels (see CHIVERS, 1980; PAYNE, 1979a). Nevertheless, the difficulty of identifying many *Ficus* species has meant that even when figs are known to form an important component of a mammal's diet, it has not always been clear which fig species are important. For example, CURTIN (1980) did not identify any of the 15 or more fig species important in the diet of langurs at Kuala Lompat, whilst CHIVERS was unable to identify all 11 figs important as a fruit source to siamangs (*Hylobates syndactylus*) (CHIVERS 1974; CURTIN & CHIVERS, 1978).

In this paper, the species of *Ficus* important as fruit resources to diurnal arboreal mammals in a Malaysian lowland forest are documented, and some important differences in the diets of some sympatric congeneric mammals identified.

## METHODS

Between March 1984 and October 1986, during a study of avian fig-eating at Kuala Lompat (3°43'N, 102°17'E), Peninsular Malaysia (LAMBERT, 1987, 1989a), observations of fig-eating by mammals were made within a 2-km<sup>2</sup> study plot. Some observations were also made at Taman Negara, Pahang, some 90 km north of Kuala Lompat.

More than 750 hr of systematic observations were made of fruiting *Ficus* crowns. *Ficus* selected for study were those at which at least half the fruiting crown could be observed, either from the ground or from a platform which could be moved to suitable locations in the forest. Periods of observation lasted 3 to 4 hr, and were timed to sample different periods of the day. All mammalian visitors which ate figs were recorded during each observation period. Notes were made on the methods of fruit handling and consumption, and whether figs eaten

were ripe (judged from fig colour). Data were almost exclusively collected during daylight, and mostly at figs known to be of importance to frugivorous birds.

*Ficus* were identified by comparison of specimens of leaves and fruit with herbaria material. These specimens are deposited at the herbaria of the Royal Botanic Gardens, Kew [see LAMBERT, (1989b) for a list of voucher specimen numbers] and University Malaya, Kuala Lumpur. The study site and its mammalian fauna are described in detail by CHIVERS (1980), whilst the figs are described by LAMBERT (1987, 1989a).

## RESULTS

Arboreal mammals were recorded eating the figs of 24 *Ficus* species at Kuala Lompat, and one additional species (*F. virens*, which occurs at Kuala Lompat but was never watched there) at Taman Negara. These *Ficus* species and their fig sizes and colours are listed in Table 1. Table 2 identifies the arboreal mammalian consumers of figs and the figs that they eat from data collected during this study. These lists should not be treated as complete: fig-eating by civets (Viverridae), which are largely nocturnal, and by mammals at non-bird-dispersed figs was undoubtedly under-recorded. Primates tended to avoid fruiting trees under observation if the observer was visible. Hence primates probably feed at more fruiting *Ficus* than they were observed at. In contrast squirrels were not shy and visited trees even if the observer was obvious.

**Table 1.** Species, dimensions, and colours of ripe figs eaten by arboreal mammals at Kuala Lompat.

<i>Ficus</i> species	Fruit dimension (mm)	Ripe fig colour
1. <i>caulocarpa</i> MIQ.	5.4 × 5.9	Pink/pale yellow
2. <i>sumatrana</i> MIQ.	5.7 × 7.6	Dull pink/ochre
3. <i>virens</i> AIT [v. <i>glabella</i> (BL.) CORNER]	7.0 × 7.7	Greenish/ochre
4. <i>obscura</i> BL. [v. <i>borneensis</i> (MIQ.) CORNER]	7.1 × 7.8	Red/deep red
5. <i>binnendykii</i> MIQ.	8.5 × 7.8	Pink/purple
6. <i>benjamina</i> L.	8.9 × 7.6	Pink/purple
7. <i>delosyce</i> CORNER	10.1 × 11.0	Pink/yellow-green
8. <i>pisocarpa</i> BL.	11.6 × 12.3	Yellow-orange
9. <i>sagittata</i> VAHL.	12.0 × 12.0	Red/deep red
10. <i>kerkhovenii</i> VAL.	13.3 × 11.9	Orange-red/red
11. <i>pellucido-punctata</i> GRIFF	17.7 × 11.6	Purple
12. <i>parietalis</i> BL.	14.8 × 15.4	Red
13. <i>sundaica</i> BL. (type 2a) <sup>1)</sup>	14.4 × 16.7	Red/deep red
14. <i>stricta</i> MIQ.	15.8 × 15.7	Red
15. <i>consociata</i> BL. (v. <i>murtoni</i> KING.)	14.3 × 17.8	Red/deep red
16. <i>trichocarpa</i> BL.	15.5 × 17.5	Deep red
17. <i>crassiramea</i> MIQ.	20.0 × 17.5	Red/deep red
18. <i>sundaica</i> BL. (type 2b) <sup>1)</sup>	19.6 × 18.3	Red/deep red
19. <i>bracteata</i> WALL. ex KING	18.5 × 21.5	Red
20. <i>annulata</i> BL.	28.7 × 22.2	Brownish
21. <i>cucurbitina</i> KING	30.9 × 20.3	Deep red/black
22. <i>dubia</i> WALL. ex KING	28.6 × 27.6	Deep red/purple
23. <i>stupenda</i> MIQ.	32.4 × 27.4	Red/deep red
24. <i>drupacea</i> THUNB	36.4 × 27.7	Deep red/purple
25. <i>subcordata</i> BL.	45.5 × 34.8	Red
26. <i>aurantiacea</i> GRIFF <sup>2)</sup>	69.5 × 68.4	Black

1) Three taxa of *Ficus sunaica* BL. were recognised. These are described in LAMBERT (1987); 2) identified as food source in other studies (see text).

**Table 2.** Figs consumed by arboreal mammals of Kuala Lompat. Each entry indicates the number of fruiting crowns visited: total number of each species of fig watched is given at the top of each column.

No. of fruitings observed: Mammalian species	Fig species <sup>1)</sup>																								
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
Primates:																									
<i>Hylobates lar</i>					1	1			1	1			1		2					2		4		1	
<i>H. syndactylus</i>					1				1	1					1					1		1		1	
<i>Presbytis obscura</i>		1					1					1									3	1		1	
<i>Macaca fascicularis</i>	1		×				2	2		2		1	1	1	2				1	2		1	1	1	1
Civets:																									
<i>Arctitis binturong</i>																	1		1			1		1	1
<i>Paguma larvata</i>																			1						
Squirrels:																									
<i>Callosciurus notatus</i>	1				2	1	3	1	1	3	1	2					2			2		4		1	1
<i>C. prevostii</i>	2	1	×	3	1		3	1	2	2	1	1	1	1	2	1	1	1	1	4	1	6	1	2	2
<i>C. nigrovittatus</i>	1	1	×	1	2	1			1										1	1	×	2			
<i>Ratufa bicolor</i>	1	1							1	1	1	1	1	1	1		1			3	1	1	1	2	2
<i>Sundasciurus tenuis</i>					1					1	1	1	1	1	1					1					
<i>S. lowii</i>					×	1	1																		
<i>Sundasciurus</i> spp.																									
<i>Petaurista petaurista</i>	1																					1		1	1

Fig-eating observations made in lowland forest elsewhere in Malaysia are indicated by a × mark.  
1) Numbers refer to those used in Table 1; 2) record refers to a nocturnal observation.

Terrestrial mammals at Kuala Lompat also ate fallen figs, but since observations concentrated on the canopy the only pertinent observations were of *Sus scrofa* eating the fallen figs of *F. drupacea*; *Tupaia glis* those of *Ficus obscura*; and of *Lariscus insignis* eating those of *Ficus bracteata*.

Few observations of civets eating figs were made, with the exception of binturong (*Arctitis binturong*). Binturong, although mostly active at night, were observed eating figs during the day on several occasions at Kuala Lompat. Between short periods of feeding, binturong slept on large horizontal branches in the fruiting fig, or in the canopy directly above. As a consequence, the faeces of binturong, which were full of intact fig seeds, were mostly deposited within the fig crown, or on the ground below it.

Primates usually ate figs at the same stage of ripeness as birds. Gibbons *Hylobates* spp., long-tailed macaques *Macaca fascicularis*, and dusky langurs *Presbytis obscura* all ate near-ripe and fully ripe figs, although the last two species also ate unripe figs. On one occasion dusky langurs were seen selecting the darkest, and therefore ripest, figs of *F. cucurbitina*. Many fig seeds were found in the faeces of siamang and lar gibbons after bouts of fig-eating: these were viable, germinating on damp filter paper within a few days. Faeces of other primates were not examined.

Diurnal squirrels were very important consumers of figs. The three *Callosciurus* species (Table 2) and *Ratufa bicolor* ate large quantities of figs, being active in *Ficus* crowns for a period before fig ripening until the crop was fully ripe and almost depleted. Squirrels invariably ate only the pulp of figs, dropping fruit cores, containing the seeds, below the fruiting crown.

Squirrels of several species could often be observed feeding together in a single fruiting fig. Often three, and sometimes as many as four or five *C. prevostii* were observed at one time in a single fruiting crown. Two *R. bicolor* sometimes fed in fruiting *Ficus* crowns simultaneously, and once three. The maximum number of individuals of other species observed simultaneously in the same crown was two.

## DISCUSSION

The list of figs eaten by primates at Kuala Lompat is probably almost complete, although to it should be added *Ficus aurantiacea* (and presumably the very similar-fruited *F. punctata* THUNB.). The large (ca. 70 mm diameter) fruits of *F. aurantiacea* are depicted as one of the fruits eaten by *Hylobates* species by GITTINS and RAEMAEKERS (1980). CHIVERS (1974) and GITTINS and RAEMAEKERS (1980) list *F. annulata* as a fruit eaten by siamang (*Hylobates syndactylus*) in Malaysia, but the species they illustrate as *F. annulata* is in fact *F. cucurbitina*. Only long-tailed macaques were seen to eat figs of *F. annulata* in this study.

It is of interest to note that the figs of importance to birds at Kuala Lompat (see LAMBERT, 1989a) were all also important to primates with the exception of *F. heteropleura* BL. However, two figs used by primates, *F. aurantiacea* and *F. annulata*, were not important for birds.

Although dusky langurs were regularly observed eating figs, banded langur (*P. melalophos*) was never seen eating them. This suggests an important difference in diet: either banded langurs avoid figs, or they eat them at a very unripe stage (when no observations were made). However, there are conflicting reports concerning fig-eating by langurs from other studies at Kuala Lompat.

Banded and dusky langurs were both reported to feed on figs by CURTIN (1976): indeed,

dusky langurs consumed figs all year, and ripe figs were an important food source (CURTIN, 1980). In contrast, BENNETT (1983), who also studied banded langurs at Kuala Lompat, did not observe them eating figs and G. HARDY (pers. comm.) also failed to record langurs eating figs: his study animal was dusky langur. During CURTIN's (1980) study banded langur was found to be more dependent on fruit with 48% of their diet being fruits, in contrast to 32% for dusky leaf monkey. During BENNETT's (1983) study, fruit comprised between 9% and 23.2% of the diet of banded leaf monkeys. G. HARDY (pers. comm.) found that 25% of the diet of dusky langurs was fruit. These differences suggest that perhaps there was an abundance of fruit during the period of CURTIN's study, or a shortage of other preferred food items, and that langurs are able to modify their diet accordingly.

Whatever the reasons for these contradictory reports, it is of interest that dusky langurs do occasionally eat ripe figs, since they contain very high levels of polysaccharides (VELLAYAN, 1981). Langurs have sacculated stomachs in which cellulysis and fermentation occur, and the consumption of carbohydrate can lead to a condition comparable to that of bloat in cattle, in which the stomach becomes acutely distended (HUNGATE et al., 1959; BAUCHOP, 1978). Bloat and hyper-acidity have caused fatalities among captive colobines (COLLINS & ROBERTS, 1976; DAVIES et al., 1983). BENNETT (1983) suggested that banded leaf monkeys avoided consuming fleshy fruits in order to avoid bloat.

The importance of figs to squirrels has been well documented (PAYNE, 1979a, 1980). At some fruiting figs squirrels eat more than 25% of the fruit removed by frugivores (LAMBERT, 1989b). Nevertheless, not all squirrels eat figs: whilst *Ratufa bicolor* consumed at least ten species of fig, its congener, *R. affinis*, was never observed eating figs even though the population of the latter species at Kuala Lompat is reported to be about twice that of *R. bicolor* (PAYNE, 1979b, 1980). This suggests that the different incidence of fig-eating by these similar species reflects an important difference in diet. PAYNE (1980) also found this difference in diet at Kuala Lompat: *R. affinis* ate figs on ca. 1% of feeding observations, whilst in contrast 10% of feeding observations of *R. bicolor* were of fig eating. PAYNE (1980) did not record fig pulp in the diet of *Sundasciurus tenuis* during his study, but in this study *S. tenuis* was recorded eating figs of six species.

Since visits by squirrels did not appear to be influenced by the presence of an observer, the differences in the number of fruiting crowns in which they were observed eating figs probably reflect real differences in diet. Of the *Callosciurus* species, *C. prevostii* ate figs at 68.5% of the 54 fruiting *Ficus* crowns watched at Kuala Lompat, whilst *C. notatus* ate figs at 42.6% and *C. nigrovittatus* at only 18.5%. At Kuala Lompat, PAYNE (1979b) estimated that the densities of these three species were in the region of 34, 416, and 10 per km<sup>2</sup>, respectively. These data taken together suggest that figs must be more important in the diet of *C. prevostii* than in that of *C. notatus*. The fact that *C. prevostii* often congregated at fruiting figs augments this suggestion: more than two individuals of other *Callosciurus* species were never present.

Although squirrels eat large quantities of figs they are probably not important as fig seed dispersal agents. Usually only the pulp is consumed, whilst the fig core, containing the seeds, is discarded below the parent tree. Even when seeds are consumed they may be digested. R. CORLETT (pers. comm.) recovered no seeds from the faeces of *Callosciurus notatus* fed with figs of *Ficus grossularioides* BURM. F. in Singapore. Primates, in particular gibbons, are more likely to be dispersers of fig seeds since they pass the small seeds of figs intact.

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