USE OF FOREST STRATA BY THE SUMATRAN ORANG-UTANS: A CONSIDERATION OF FUNCTIONAL ASPECTS

by

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ABSTRACT

Differences in travel height between age-sex classes of the Sumatran orang-utans are determined by locomotory efficiency in relation to body weight. The distribution of travel heights in relation to resting heights suggests also possible influence of predation. Travel height does hardly restrain diet choice, because differences in diet between sexes are not associated with differences in strata utilization with regard to feeding.

INTRODUCTION

Most primates spend a considerable portion of their life moving in search of food. By enlarge, the daily, seasonal and yearly locomotor activities of primates are almost certainly most directly and casually related to the procurement of food (FLEAGLE, 1984). Almost all of the travelling behaviour documented in the field studies seems clearly related to visiting food sources.

One of the primates species that its diet heavily depend on fruits is orang-utan *(Pongo pygmaeus)* (RODMAN, 1973; MACKINNON, 1974; RIJKSEN, 1978; GALDIKAS, 1978; SUGARDJITO, 1986). Orang-utan has been known as the largest creatures in the world that lives almost exclusively arboreal. Adult males weigh up to 84 kg while the adult females average 38 kg (RODMAN, 1984). There are some reports in the literature concerning ecological separation between males and females of this species (RODMAN,1977; GALDIKAS, 1978). This raises the question whether the highly dimorphic male and female are ecologically adapted an a different way. RODMAN (1977) has speculated that the male by exploiting different resources reduces the competition with the weaker females in order to maximize survival of their offspring. The empirical findings of research in wild orang-utans showed that indeed, adult males in Borneo travel on the ground more often than females and differences between sexes in the diet composition is also exist (RODMAN, 1977; GALDIKAS, 1978). The adult males orang-utans in Sumatra (where there are tigers), on the other hand, hardly travel on the ground.

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Concerning differences in the height distribution of forest strata utilization, there are some hypotheses have been proposed. First, diet differences of sexes lead to different use of forest strata. This was implicitly shown in the ecological segregation hypothesis (RODMAN, 1977). Second, the more vulnerable age-sex classes occur higher up in trees in order to avoid predation. This is known as locomotory efficiency hypothesis (SUGARDJITO and van HOOFF, 1986). The question is then, which of these hypotheses fit best in view of the differences in diet and forest strata use and how they relate to each other. Since the differences in body size between age-sex classes is a particularly relevant characteristics in the case of orang-utan, I have chosen to base my study of cost and benefits to individuals on this animals.

STUDY AREA AND METHODS

This research was carried out in the Ketambe area of Sumatra, Indonesia between February 1980 and January 1983 (Fig. 1). Seven habituated individuals were followed as target animals from night nest to the next night nest. They consists of 1 adult male, 3 adult females

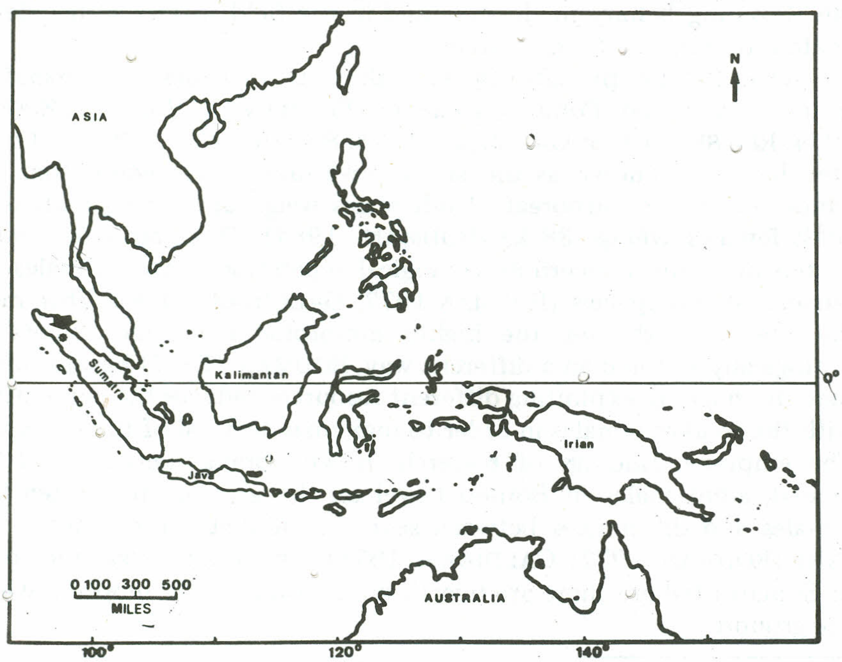

Fig. 1. General location of Ketambe Study Area of the Gunung Leuser National Park, Sumatra.

with infants, and 3 adolescents (2 females and 1 male). Various aspects of behaviour and ecological condition in connection with travel height, feeding height, and resting height were recorded. The heights of travel and feeding were recorded every 10 minutes in spot observations and are presented as frequency (cf. GITTINS, 1983 for gibbons). Resting height is measured in terms of the frequency of resting bouts more than five minutes. The description of bout in detail can be found in SUGARDJITO and VAN HOOFF (1986). The food composition was recorded in respects to the time spent feeding on different food items. Food is categorized as leaves, fruits, barks, insects and others. In all cases, non parametric statistical test (SIEGEL, 1956) was used.

RESULTS AND DISCUSSION

The results indicate that the distribution of heights during travel between age-sex classes was significantly different (fig. 2). The adult male occurs more frequently at the lower height whereas the other classes took place higher up in trees.

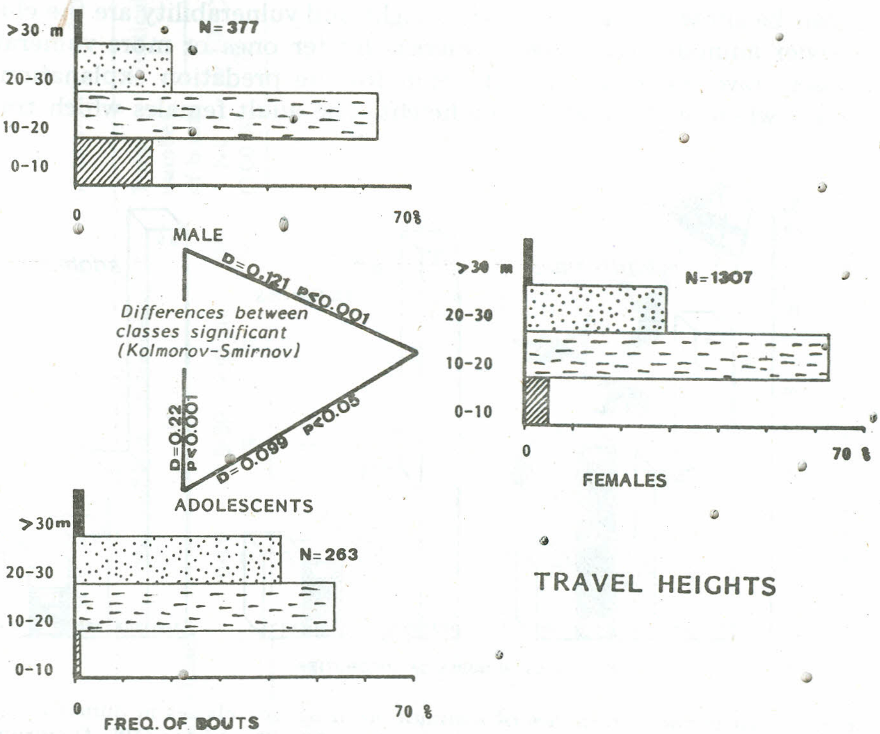

Fig. 2. Comparison among travel heights of age-sex classes of Sumatran orang utans.

Any relationship between locomotion and diet is clearly mediated by the animal's differential use of the available habitat and the distribution of food items within those habitats. Discontinuity in the canopy (gaps between tree) is a major importance to travelling of arboreal animals. It is not distributed uniformly from ground to the tops of emergents. Discontinuity also appears to be least in the main canopy, which contains the crowns of most of the medium trees in the forest. The emergent layer provides negligable opportunity for horizontal travel. The understory, consisting of bendable tree trunk, appears at first glance to exhibit marked horizontal discontinuity. The ground is certainly continuous, and terrestrial travel per se is less laborious (TEMERIN *et al.*, 1984). However, in a habitat such as Sumatra, travel on the ground or low in the canopy is hazardous because of terrestrial mammalian predators (RIJKSEN, 1978; SUGARDJITO, 1982; VAN SCHAIK, 1985).

In order to show how predation may influence on the positional behaviour of the Sumatran orang utans, I also compared travel heights and resting heights for every classes (table 1). From these data it can be shown that both body weight and vulnerability are the clues. Heavier animals travel lower whereas lighter ones or more vulnerable classes travel heigher. An indication for the predation explanation is found when we look at resting height. The adult females which travel

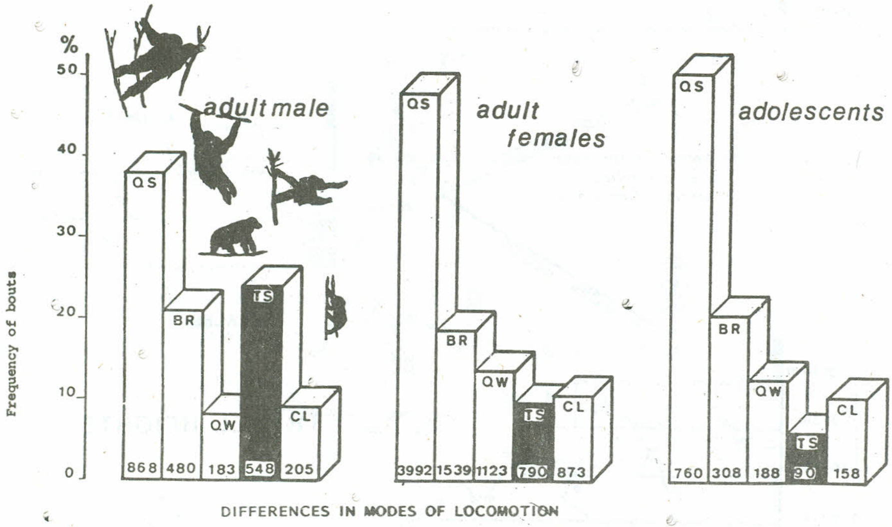

Fig. 3. Differences in modes of locomotion of age-sex classes in Sumatran orang utans. QS: Quadrumanous scramble; BR: Brachiate; QW: Quadrupedal Walk; TS: Tree-sway; CL: Climb. Numbers in each blocks indicate the total number of bouts.

Table 1. Comparison between vertical distribution of travelling and resting of age sex classes in Sumatran orang-utan.

Age-sex classes	Vertical dist. of travelling* (m)				Total number of bouts	Vertical dist. of resting (m)				Total number of bouts	Kolmogorov Smirnov	
	0-10 %	>10-20 %	>20-30 %	>30 %	N1 (100 %)	0-10 %	>10-20 %	>20-30 %	>30 %	N2 (100 %)	D	P
Adult male	16	63	20	1	377	13	57	26	4	176	0.09	ns
Adult females	5	64	30	1	1307	1	44	51	4	260	0.181	<0.001
Adolescents	1	54	44	1	263	0	46	50	4	24	0.086	ns

* Proportion of ten minute spot observations

% Percentages of the total number of bouts.

low, nevertheless go higher for resting. Predator avoidance certainly may involve short term, but high stresses on an animal's locomotion abilities (e.g. RIPLEY, 1979).

When we look at the locomotion types, the adult male shows significantly more frequently use of "tree swaying" than the other age-sex classes (fig. 3). What is more this locomotion type is almost exclusively used below 20 metres by all individuals (fig. 4). It suggests that a pattern of travelling low in the canopy by using a characteristic mode of locomotion such as "tree sway" may be cheeply in locomotion energy expenditure. However, this mode of locomotion is only practicable when the actor are great enough in size and weight. There is also positive correlation between amount of using "tree swaying" and body weight ($r_s = +0.991$; $p < 0.01$; $N = 7$).

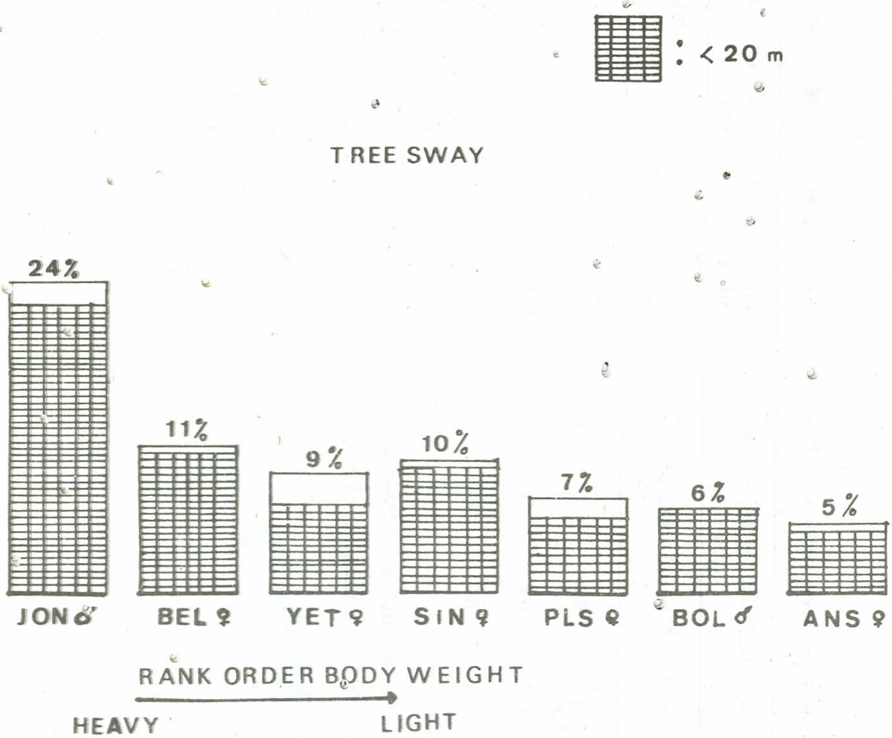

Fig. 4. Correlation between amount of tree-sway and body weight in Sumatran orang utans ($r_s = +0.991$; $p < 0.01$; $N = 7$).

The question is whether the preference of the heavier animal in particular the adult male for moving in this way and at this height is indeed a matter of locomotor efficiency or whether other factors cause this difference. For instance a difference in feeding preference. In order to answer this question I have to look at the diet composition and the heights at which the diet components are harvested.

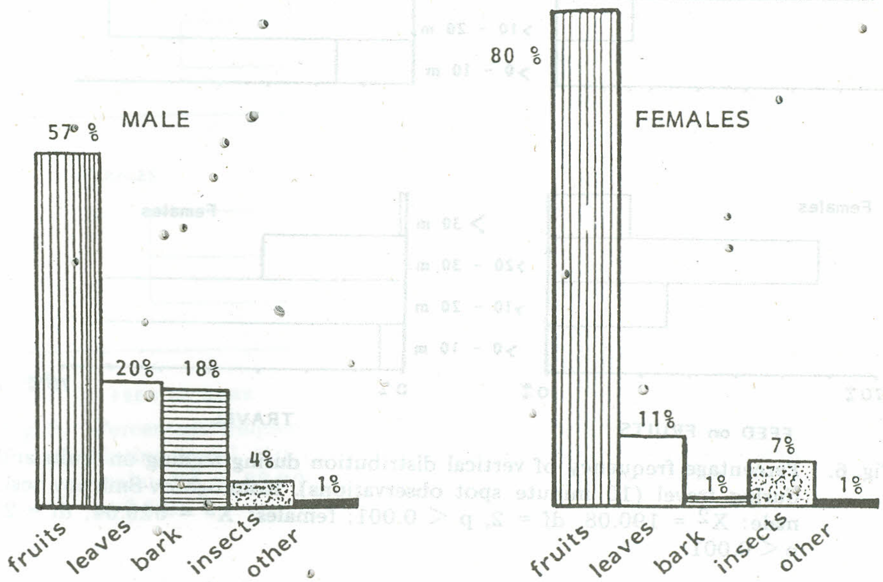

Fig. 5. Proportion of time spent feeding on different food items for two different sexes. Fruits (H = 19.17; df = 3; $p < 0.001$); Bark (H = 50.21; df = 3; $p < 0.001$). Proportion are of a total of 26,390 minutes (females) and 8,264 minutes (male) of feeding by subjects described in the caption to figure 5.

The result reveals that the adult females were found not to differ in the time they spent in feeding on different food items such as fruits and bark. The adult male, however, differed significantly from the adult females in that he spent less time feeding on fruits and more time feeding on bark (fig. 5). In other words, there is a dietetic differences between the sexes. Both RODMAN (1977) and GALDIKAS & TELEKI (1981) have also reported that there is significant difference between males and females of Bornean orang utan in the use of forest strata and it associates with differences in diet between sexes.

The next question is whether this difference in diet is responsible for the differences in travel height. I found no indications for this. Feeding on fruits which form the major diet component of both male and females occurs higher up in the trees than the normal travel height (fig. 6). This suggests that the main food types of orang utan (fruits) are located in a certain height. Although adult male travels low he climbs up to reach a fruit-bearing trees.

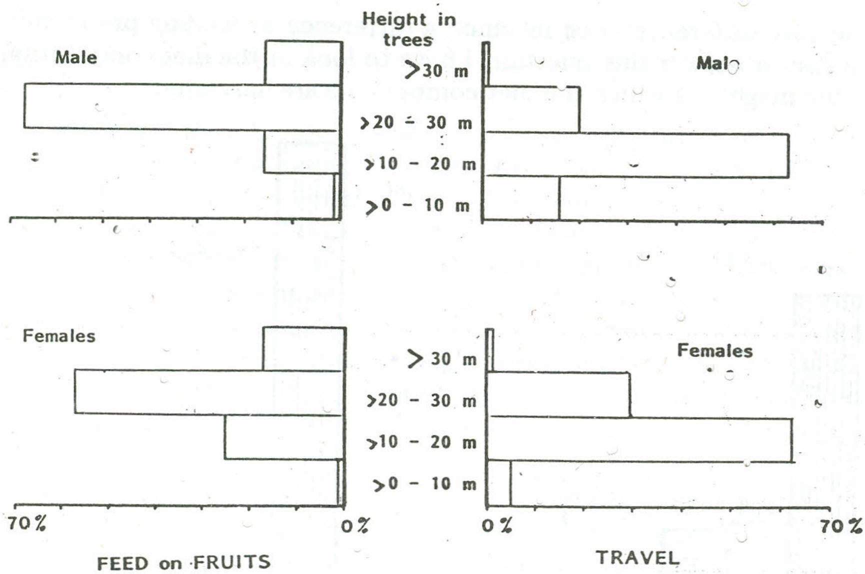

Fig. 6. Percentage frequency of vertical distribution during feeding on fruits and during travel (10 minute spot observations). Kolmogorov-Smirnov test, male: $X^2 = 190.08$, df = 2, $p < 0.001$; females: $X^2 = 529.64$, df = 2, $p < 0.001$.

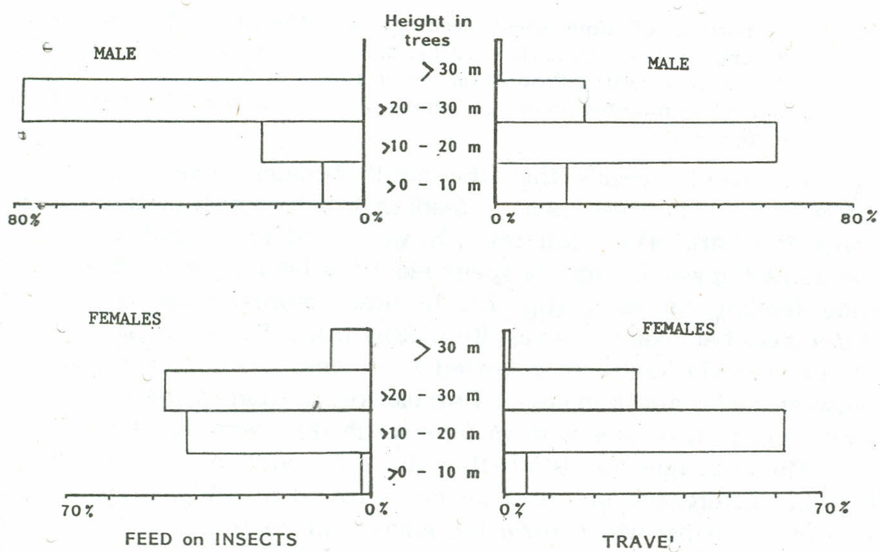

Fig. 7. Percentage frequency of vertival distribution during feeding on insects and during travel (10 minute spot observations). Kolmogorov-Smirnov test; male: $X^2 = 29.17$, df = 2, $p < 0.001$; females: $X^2 = 59.43$, df = 2, $p < 0.001$.

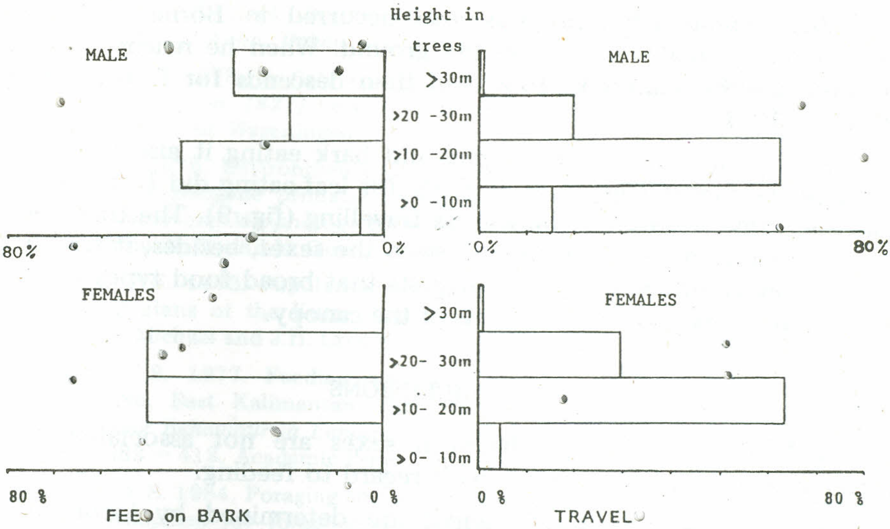

Fig. 8. Percentage frequency of vertical distributions during feeding on bark and during travel (10 minute spot observations). Kolmogorov-Smirnov test; male: $X^2 = 37.79$; df = 2, $p < 0.001$; females: $X^2 = 10.24$, df = 2, $p < 0.01$.

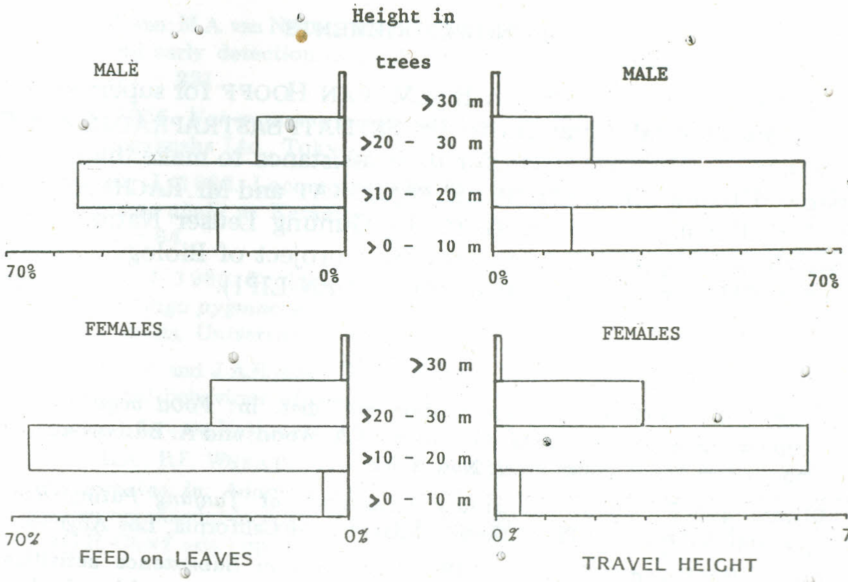

Fig. 9. Percentage frequency of vertical distributions during feeding on leaves and during travel (10 minute spot observations). Kolmogorov-Smirnov test; male: $X^2 = 4.34$, df = 2, ns.; females: $X^2 = 0.66$, df = 2, ns.

The similar situation was also occurred in Borneo when an adult male normally travels on the ground. When he reaches a fruit-bearing tree he climbs to food and then descends for further travel (CANT, 1987).

In the case of insect foraging and bark eating it also found the same phenomenon (figs. 7 & 8). Only for leaf-eating did I find that it had the same height distribution as travelling (fig. 9). The time spent on leaf-eating, however, differ between the sexes; besides, it is only a minor diet component. It also suggests that broad food types such as leaves tend to be found at all levels of the canopy.

CONCLUSIONS

1. Differences in diet between sexes are not associated with differences in strata utilization with regard to feeding.

2. Differences in travel height are determined by locomotory efficiency in relation to body weight.

3. Distribution of travel heights in relation to resting heights, suggests also a possible influence of predation.

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