

Sex Difference in Putty-Nosed Monkey (*Cercopithecus nictitans stampflii*) Locomotor Behavior in the Taï Forest, Côte d'Ivoire

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ABSTRACT: We conducted 15 months field study on one (*Cercopithecus nictitans stampflii*) of the eight guenons species in the Taï National Park. Because this taxa shows a great sexual dimorphic we aimed to test whether there is difference between male and female locomotion behavior. Locomotor behavior of adults was recorded at 5 min time points and the same individual was not sampled within 20 min of itself to ensure sampling independence. On every time point, we recorded the following information: locomotor maintenance activity (travel = long, directed movement usually between distant endpoints, or forage = movement during feeding usually within single or contiguous trees), locomotor mode (walk, run, leap, or climb); forest stratum (ground, shrub layer, understory, lower main canopy and the upper main canopy); support type: (ground, vertical trunk, bough, branch, twig and liana). Our results showed that there is significant difference between male and females during foraging and travelling regarding the frequencies of the locomotor modes used while they revealed that there is no significant difference in term of the concurrency in the different forest layers. Furthermore our results showed a significance difference between male and female during foraging and the medium-sized support (branches) were more used by females than the male while during travelling large-sized support (boughs) and branches are more used by both sexes but at different level.

KEYWORDS: nictitans, male, females, foraging, travelling.

1 INTRODUCTION

Within the Taï forest live eight monkey species among which seven are under a long term field study by the Taï Monkey Project as all well as their positional behavior. However *Cercopithecus nictitans stampflii* is the one that behavior is ignored because of its low distribution in the Taï forest [1], [2]. While this species is common throughout northern Democratic Republic of Congo, Congo, Central African Republic, Cameroon, Gabon, and its behavior has been the subject of several long term studies in Gabon [3], [4]. Among the eight guenon monkey species living in the Taï forest, *Cercopithecus nictitans stampflii* exhibits a high sexual dimorphic. In general the male weighs 1.5 times more than females and that weigh swing

between 5 and 8 kilos for the males and 2.7 and 4.1 for the females [5], [4] (Haltenorth *et al.*, 1985; Gautier-Hion *et al.*, 1999). This difference in body size is a good reason to test the influence of body size within the species locomotion behavior. Indeed, in their influential work on Surinam monkeys. "Reference [6] examined" the relationships between a suite of locomotor and habitat variables. These authors sought answer to fundamental questions such as: (1) is there a general relationship between body size and locomotion? (2) Do locomotor patterns vary predictably with habitat? (3) Is there a functional relationship between body size and support size? Their conclusion served as working hypotheses that could be tested across all primate groups and many previous researchers have investigated at least some of the relationships between locomotion and body size [7], [8], [9], [10], [11], [2].

Size is unquestionably a major influence on locomotion this allows to hypothesis that different-sized primates confronted to the same arboreal architecture will move in different way [11]. One goal of anthropological primatology is to establish predictive relationships among body size, locomotion, and habitat use in extant taxa to make more informed inferences about fossil primate behavior [12], [13], [14]. For several primate groups, these attempts have generally been successful and body size is known to be a reliable predictor of locomotion, support use and canopy preference [6], [15].

Based on that opinion in addition to the great difference in body size of the Putty-nosed (*Cercopithecus nictitans stampflii*) monkey we expect an intraspecific variation on the male versus females in: firstly the locomotion categories frequencies, secondly the locomotion and maintenance activity, and thirdly the support use by both sex classes. Whether this is true even within the same species the locomotion profile could be quite different between male versus female. Therefore, we suspect that the locomotion behavior of the male putty-nosed monkey in the Taï forest would be likely different from those of the females.

This paper aims to highlight the relationships between locomotion, body size and habitat use in a group of a less known Ceropithecoid monkey, *Cercopithecus nictitans stampflii* in the Taï National Park.

2 METHODS

2.1 STUDY SITE

The study was conducted in the Ivory Coast's Taï National Park located between 6° 20' N to 5° 10' N and 4° 20' W to 6° 50' W. The 457,000 ha park is the largest block of continuous, protected forest in West Africa. Vegetation is largely dense evergreen ombrophilous forest of a Guinean type with a continuous canopy of between 25 and 40 m and emergent trees up to 60 m. Average annual rainfall is 1,830 mm and daily temperatures vary between 24 and 28°C. Because of the diversity and the abundance of the primate species hosting by the park, the Taï forest has been identified as high priority for primate conservation.

2.2 DATA COLLECTION

The method used in this study is described as well in previous papers [11], [16], [2]. We studied the positional behavior and habitat use of one group of Stampflii's putty-nosed monkeys from February to September 2002 and from July 2003 to March 2004. At the project's outset, the group contained one adult male, three adult females, two subadults, and two juveniles. No significant changes to the structure of the forest canopy were known to occur between the present study and earlier studies of Taï monkeys.

Locomotor behavior of adults was recorded at 5 min time points and the same individual was not sampled within 20 min of itself to ensure sampling independence. The sampling interval of 5 min is more conservative than the 3-min interval used in previous positional studies at Taï [17], [11], [18], [16] and, therefore, provides a more rigorous control of temporal autocorrelation. On every time point, we recorded the following information: Locomotor maintenance activity (travel = long, directed movement usually between distant endpoints, or forage = movement during feeding usually within single or contiguous trees), locomotor mode (walk, run, leap, or climb); forest stratum: [ground (stratum 0), shrub layer = between ground and ≤ 5 m (stratum 1), understory = small tree and half grown canopy trees between 6 and 15 m (stratum 2), main canopy divided into lower main canopy between 15 and 23 m (stratum 3), upper main canopy between 24 and 40 m (3), and emergent layer ≥ 40 m (stratum5)]; support type: [ground (support 0), vertical trunk (support 1), bough large su = supports > 10 cm in diameter (support 2), branch = medium-sized supports ≤ 2 cm ≤ 10 cm in diameter (support 3), twig = small, flexible supports < 2 cm in diameter (support 4), and liana (support 5)].

2.3 DATA ANALYSIS

The G-test analysis was performed to compare the frequencies of locomotor modes, support types and forest strata used by the male and females [19].

3 RESULTS

3.1 MAINTENANCE ACTIVITIES OF MALE VERSUS FEMALES

The amount of time male and females engaged in each locomotor activity is shown in Table 1. During foraging regardless of male or females walking is the locomotion mode very often used (respectively, 68.6% and 70%), followed by climbing (respectively, 12.8% and 18.9%), leaping (respectively, 10.5% and 8.3%) and running (respectively, 8.1% and 2.8%). Furthermore during foraging the G test shows that there is no significant difference between male and females in term of locomotion modes used by both male and females ($G = 5.44$; $P > 0,05$). The frequencies of locomotion used by male and female were similar.

During travelling females walked more (67.3%) than the male (53.2%) while the male leaped more (14.4%) than females (9.9%), the male climbed more (23%) than females (16.7%). In addition the male ran more often than the females (respectively, 9.4% and 6.1%).

Furthermore the G test shows a significant difference between the locomotion modes used by the male and females during travelling ($G = 22.59$; $P < 0,001$).

Table 1. Frequency of locomotion profile during overall locomotion, travel and foraging

	Run	Leap	Climb	Walk	N
Forage					
Overall	4.3	8.9	17.2	69.6	303
Female	2.8	8.3	18.9	70	217
Male	8.1	10.5	12.8	68.6	86
Travel					
Overall	14	12	13.3	60.8	301
Female	6.1	9.9	16.7	67.3	162
Male	9.4	14.4	23	53.2	139

3.2 SUPPORT USE BY MALE VERSUS FEMALES

The amount of time male and females used support types is presented in Table 2. During foraging regardless of both male and females branches and boughs are the main supports very often used. However when comparing the frequencies of support used by each sex our results reveals that during foraging females used more branches (47%) than did the male (45.3%) while boughs are more used by the male (31.4%) than females (30.9%). Moreover the male used more twigs (15.1%) than females (7.8%) while females used more the liana (10.6%) than the male (2.4%). The ground and vertical supports are very less used by both male and females. Here also the G test shows that there is a significant difference between male and females regarding to the support used ($G = 11.74$; $P < 0,05$).

During travelling branches and boughs are the preferred supports used by both male and females. However during travelling the male used very often large-sized supports (boughs) than females with 69.1% against 48.8% while the female used more branches (32%) during travelling than the male (21.6%). In addition our results indicate that smaller-sized support (twigs) and liana are less used by both sex and trunks and the ground are use occasionally by both sexes. Moreover, the G test shows a significant difference between the male and females in term of supports used ($G = 14.95$; $P < 0,05$).

Table 2. Frequency of support use during overall locomotion, travel and foraging

	Ground	Vertical	Bough	Branch	Twig	Liana	N
Forage							
Overall	1.7	2.6	31	46.5	9.9	8.3	303
Female	0.9	2.8	30.9	47	7.8	10.6	217
Male	3.5	2.3	31.4	45.3	15.1	2.4	86
Travel							
Overall	0.3	2	27.2	27.2	5.6	6.6	301
Female	0.6	3.1	32.1	32.1	6.8	8.6	162
Male	-	0.7	21.6	21.6	4.3	4.3	139

3.3 FOREST STRATA USE BY MALE VERSUS FEMALES

Regardless of both male and females foraging occurred more often in the upper main canopy layers (respectively, 57% and 56.2%) and lower main canopy layers (respectively, 23.2% and 14.7%) followed by the understory (respectively, 16% and 27.7%). During foraging both sexes were never seen in the shrub layer while the ground was used occasionally (Table 3). The G test shows that there is no significant difference between male and females regarding to forest strata used during foraging ($G = 8.82$; $P > 0,05$).

In contrast, during travelling male and females used more often the lower main canopy (respectively 67.6% and 64.8%), followed by the understory (respectively, 18.7% and 26.6%) and the upper main canopy (respectively, 13.7% and 8%). No observation was made during travelling on the underground. However, the G test shows that there is no significant difference between male and females in term forest strata used ($G = 5.59$; $P > 0,05$).

Table 3. Frequency of strata use during overall locomotion, travel and foraging

	0	2	3	4	5	N
Forage						
Overall	1.7	24.4	56.4	17.2	0.3	303
Female	0.9	27.7	56.2	14.7	0.5	217
Male	3.5	16.3	57	23.2	-	86
Travel						
Overall	0.3	22.9	66.1	10.6	-	301
Female	0.6	26.3	64.8	8	-	162
Male	-	18.7	67.6	13.7	-	139

0: ground; 1 (shrub layer): $0\text{ m} < \text{stratum} \leq 5\text{ m}$; 2 (understory): $5\text{ m} < \text{stratum} \leq 15\text{ m}$; 3 (lower main canopy): $15\text{ m} < \text{stratum} \leq 23\text{ m}$; 4 (upper main canopy): $23 < \text{stratum} \leq 40\text{ m}$; 5 (emergence): $\text{stratum} > 40\text{ m}$; (-): no observation; N: number of observation

4 DISCUSSION

During travelling male and females Putty-nosed monkey, *Cercopithecus nictitans stampflii* showed different ways in the use of the different locomotor profile. Indeed, the male leaped and run more often than did the females while the latest walked and climbed more than the formers. However during foraging, no difference between both sexes was observed in the frequencies of the locomotion modes used by that species. This difference in the locomotion of the male and females could be attributed to the great difference in the body size. Previous researches showed that primates locomotion behavior is very influenced by the body size and different body-sized primates could exhibit difference in locomotion behavior [20], [21], [22], [6], [23], [15], [2].

Furthermore, its known that the more body size increase the more often that species would leap while in contrast smallest body-sized species would tend to climb more [6], [9]. However our results with the Stampflii's putty-nosed monkey in the Taï Forest seem to fail to respect that theory during the foraging. In opposite, during travelling our results corroborated this opinion. Indeed, the greater body-size male *Cercopithecus nictitans stampflii*, leaped more than the females while the latest climbed more than the male.

Regarding the use of the forest layers, several answers have given to explain the occurrence of monkeys at different strata of the forest. That behavior seems to be an anti-predatory strategy to escape the predators within the same habit [23], [25] or to avoid interspecific competition for food [3], [26]. In addition to these reasons gradually the presence of the monkeys at the different forest layers is explained by the abundance of certain type of support. Indeed, previous studies showed that because the high availability of larger support in the main canopy, then greater body-sized monkeys should be found within that forest stratum [11]. However, with *Cercopithecus nictitans stampflii* that show a great sexual dimorphic between male and females, both sexes are found similar at the different forest layers during foraging and travelling.

Frugivory mammals as well as leaves and flowers consumers face difficulties to access these items which are generally located on flexible branches and this situation reduces the access to fruits to great body-size animals [27]. Then we expected *C. nictitans* females to use much often smaller and median supports than male. However, whether our results revealed that during foraging, females used more median supports than male in contrast during that activity the twigs are more often used by male than did the females.

Whether it's true that the guenons of the Tai Forest exhibit an interspecific competition for food, this completion is rarely found within the same species. However the male *C. nictitans* very often constitute a barrier for females and other sub classes during feeding on fruit trees and this could explain the difference in support use during foraging.

During travelling even though male used more boughs than the females while the latest use more branches than the male during that activity both sexes preferred big-sized supports during travelling because offered a better body stability during travelling. Monkeys are able to choose larger, more stable support to keep the balance and the center of gravity of the body at the top of these supports.

5 CONCLUSION

Finally with regard to the locomotor modes and the supports use, *Cercopithecus nictitans stampflii* showed sex difference in their behavior. Indeed during foraging although walking and climbing are the locomotor modes more used by both male and females, females walked and climbed more than male while the male leaped and ran more often than did females. Again during travelling females walked more than the male while the male leaped and climbed more frequently than the females. Furthermore during foraging females used more often branches than did male while during travelling the male used very often large-sized (boughs) than females. However no significant difference was seen in the strata used by both sex.

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