

## SHORT COMMUNICATION

## Nocturnal Primates of Kibale Forest: Effects of Selective Logging on Prosimian Densities

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**ABSTRACT.** To evaluate the potential impact of logging on nocturnal primates, densities of *Galago demidovii*, *G. inustus*, and *Perodictus potto* were determined in two areas of the Kibale Forest Reserve, Uganda. One of these areas had been logged at a moderate level in the late 1960's, while the second area was relatively undisturbed. The density of the nocturnal primates was lower in the logged area than in the neighboring unlogged area. For the most frequently sighted nocturnal primate, *G. demidovii*, sightings were spatially clustered both within a year and between years, suggesting that clumped resources and/or social factors were influencing space use.

**Key Words:** *Galago*; *Potto*; Logging; Conservation.

## INTRODUCTION

Tropical forests, and the animals they support, are threatened by accelerating rates of forest conversion. Since a small proportion of the plants and animals in tropical forests are protected by the establishment of parks and game reserves, the survival of many species may depend on the habitat value of disturbed forests. Thus, conservation efforts should include assessment of the value of disturbed forest for the maintenance of populations.

Although, there are a number of studies which address the impact of selective logging practises on diurnal primates (WILSON & WILSON, 1975; WILSON & JOHNS, 1982; HARCOURT, 1980; SKORUPA, 1986, 1988; JOHNS, 1986a, b; JOHNS & SKORUPA, 1987), information on population responses of nocturnal primates to such disturbances is scarce. One notable exception is JOHNS (1986b) who reports pre- and post-logging densities for a *Nycticebus coucang* population. For this population, reported densities were higher 3–4 yrs subsequent to logging, but had decreased by a factor of five, 5–6 yrs post-logging. Assessment of the response of nocturnal primates to selective logging practises is important to evaluate, particularly given the suggested preference by many species for secondary forest (WILSON & WILSON, 1975; CHARLES-DOMINIQUE & BEARDER, 1979; WOLFHEIM, 1983). For instance, CHARLES-DOMINIQUE (1977) found that *Galago demidovii* was attracted to secondary growth areas near roadsides (average density = 50–80/km<sup>2</sup>; density along the roadside = 117/km<sup>2</sup>). This might result, at least partially, from their reliance on fruit of early pioneering trees, such as *Musanga cecropioides*. However, it is possible that while small areas of secondary growth, such as roadsides or tree falls, might be preferred habitats, areas of extensive secondary growth might not support higher densities. This could occur if more pristine areas were required at certain times (e.g. during periods when fruit is not available in the secondary areas) or for specific resources (e.g. sleeping sites).

The objective of this study is to provide information on the abundance of the nocturnal primates in two areas in the Kibale Forest Reserve, Uganda which have experienced different histories of logging. Three species of nocturnal prosimians are in Kibale: *Galago demidovii*, *G. inustus*, and *Perodictus potto* (NASH et al., 1989).

## METHODS

The Kibale Forest Reserve, located in western Uganda ( $0^{\circ}13' - 0^{\circ}41' \text{ N}$ ;  $30^{\circ}19' - 30^{\circ}32' \text{ E}$ ), is a moist, evergreen forest, transitional between lowland rain forest and montane forest (WING & BUSS, 1970; STRUHSAKER, 1975; SKORUPA, 1988). About 60% of Kibale is characterized by tall forest with the canopy generally 25–30 m high (BUTYNSKI, 1990), although some trees may exceed 55 m. The remainder of the reserve is comprised of a mosaic of swamp, grassland, plantations of pine, thicket, and colonizing forest (WING & BUSS, 1970; BUTYNSKI, 1990).

A transect was established in each of two forestry compartments that differed in their logging history. The first transect was 1530 m in length and was situated in the K-30 forestry compartment which represents relatively undisturbed forest. A few trees (3–4 stems/ $\text{km}^2$ ) have been removed from this area by pitsawyers, but this has had a relatively small impact on the forest as a whole (SKORUPA, 1988). The second transect was 1700 m long and started in the K-14 forestry compartment and continued into the K-15 compartment. The K-15 forestry compartment was selectively harvested in 1968 and 1969 at 21  $\text{m}^3/\text{ha}$  (approximately 7.4 stems/ha), while in the K-14 compartment the harvest averaged 14  $\text{m}^3/\text{ha}$  (SKORUPA, 1988).

Transects were sampled every September or October during three consecutive years (1990, 1991, and 1992). Observations started at 7:00 pm (shortly after sunset) and ended at approximately 9:00 pm. Logged and unlogged transects were sampled on alternate nights with one transect being walked on a particular night. To prevent systematic biases, the end of the transect in which sampling was initiated was alternated between samples of the same transect. In general, transects were walked every second night throughout a 28-day period to distribute the sampling effort throughout the lunar cycle and to increase the level of consistency between years. Forty-three transects were sampled in total (logged=20; unlogged=23).

A headlamp and hand flashlights were used to spot the eyeshine of the primates. Prosimian species, height of the animal in the tree, direct distance from the observer to the animal, perpendicular distance from the animal to the transect line, and the meter along the transect were recorded for each sighting. Finally, the tree was marked to facilitate measurement (Diameter at Breast Height, DBH) and species identification when marked trees were revisited during the daylight hours.

Both *Galago* species tended to move quickly when sighted, precluding the possibility of differentiating the two species on occasion. Thus, densities are presented for all *Galago* species combined.

The strip width of the transect was determined in two ways: first as the average observer to animal distance, and second as the average perpendicular distance from the transect to the animal (NATIONAL RESEARCH COUNCIL, 1981). We report the densities calculated using perpendicular distance. Since animals were often sighted well ahead of the observers near the transect line, the observer to animal distance produced an inflated estimate of the area sampled. The strip width calculated using perpendicular distance averaged 87% less than

that derived from using animal to observer. Thus, density was calculated as the total number of animals sighted divided by the transect length and the average perpendicular distance for that taxon on that transect.

## RESULTS AND DISCUSSION

The transects were sampled on 43 nights over three 1-month periods producing a total transect length of 70 km. Forty-nine prosimians were observed (*Galago* sp.  $n=42$ , *P. potto*  $n=6$ ). *P. potto* occurred at 17.7 individuals/km<sup>2</sup> in the unlogged forest, but at a density of only 1.8 individuals/km<sup>2</sup> in the logged area. Galagos were found at higher densities than *P. potto*, but were also more common in the unlogged forest (79.5 individuals/km<sup>2</sup>) than in the area of forest that had been logged (50.4 individuals/km<sup>2</sup>).

SKORUPA (1988) documented a similar decline in the density between the unlogged forestry compartment and the logged areas of Kibale Forest for most of the diurnal primates (e.g. *Cercocebus albigena* K-30–0.69 groups/km<sup>2</sup>, K-15–0.19 groups/km<sup>2</sup>; *C. ascanius*: K-30–3.88 groups/km<sup>2</sup>, K-15–1.37 groups/km<sup>2</sup>). The only exception to this trend is *Colobus guereza* which occurred at a higher density in K-15 than K-30 (K-15–5.90 groups/km<sup>2</sup>, K-30–0.76 groups/km<sup>2</sup>).

There was no relationship between the use of particular tree species and their availability in the environment, either in unlogged ( $r=0.229$ ,  $p=0.362$ ) or logged areas ( $r=0.258$ ,  $p=0.301$ ), suggesting that selection of tree species was not random (Table 1). In addition, the size of the trees used by the galagos was larger than what was available in the habitat (only trees >10 cm DBH were considered available; unlogged, use=52 cm, available=35 cm; logged, use=43 cm, available=32 cm) (Table 1).

**Table 1.** The trees selected by *Galago* spp. in the Kibale Forest Reserve, Uganda in comparison with the average size and abundance of the tree species in the habitat.

Tree species	Use: No. DBH				Availability: density DBH			
	Unlogged		Logged		Unlogged		Logged	
<i>Celtis durandii</i>	8	51	4	36	45.29	32	25.56	28
<i>Fagara angolensis</i>	0	–	6	51	0.88	16	0.56	14
<i>Albizia grandibracteata</i>	3	11	0	–	4.41	17	1.11	26
<i>Mimusops bagshawei</i>	3	133	0	–	2.35	75	–	–
<i>Neoboutonia macrocalyx</i>	0	–	3	51	2.65	22	12.22	27
<i>Diospyros abyssinica</i>	0	–	2	31	45.88	27	46.11	27
<i>Pygeum africanum</i>	2	49	0	–	–	–	1.11	28
<i>Chrysophyllum</i> sp.	2	30	0	–	2.05	47	1.11	12
<i>Ficus exasperata</i>	2	21	0	–	3.82	44	1.11	36
<i>Teclea nobilis</i>	1	42	0	–	20.00	16	3.33	15
<i>Polyscias fulva</i>	1	57	0	–	0.88	21	–	–
<i>Fagaropsis angolensis</i>	1	83	0	–	2.35	35	5.00	13
<i>Celtis africana</i>	1	56	0	–	6.76	47	11.67	22
<i>Markhamia platycalyx</i>	0	–	1	24	49.12	26	33.33	24
<i>Funtumia latifolia</i>	1	35	0	–	33.24	25	22.78	18
<i>Parinari excelsa</i>	0	–	1	95	2.06	101	1.11	33
<i>Olea welwitschii</i>	0	–	1	16	3.24	50	1.67	71

Tree density was determined from 26 vegetation transects (200 × 10 m) that were established along randomly selected trails within three strata (logged forest,  $n=9$ ; valley bottom,  $n=3$ ; pristine habitat,  $n=14$ ). Each tree greater than 10 cm DBH within 5 m of each side of the trail was individually marked with a number aluminum tag, measured, and identified.

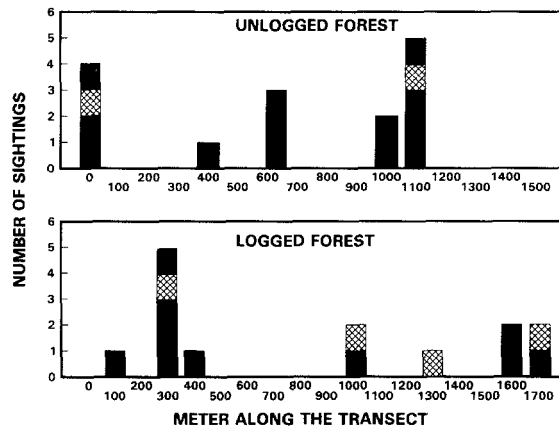


Fig. 1. The distribution of *Galago demidovii* along transects through logged and unlogged forest in Kibale Forest Reserve, Uganda over a three-year period. The number expressed is the number of sightings in each 100-m block of the transect. Solid black: 1990; hatched: 1991; shaded: 1992.

For the most frequently sighted prosimian, *G. demidovii*, sightings were spatially clustered both within a year and between years (Fig. 1). This may reflect habitat preference for patchy resources (e.g. treefalls, CHARLES-DOMINIQUE, 1977) and/or social factors influencing space use. The tree species in which the animals were observed (Table 1) often occur at a high density and do not exhibit a clumped distribution at least on the scale of *Galago* use (CHAPMAN & WRANGHAM, unpubl. data). Social factors may contribute to the observed pattern of space use, but it is intriguing to consider how this would lead to consistent patterns of habitat use between years and why “no-man” zones exist between areas of concentrated use.

*P. potto* were never seen in the peripheral branches of a tree, they were either using the central branches or they were seen in vine tangles. In contrast, when *G. inustus* were first seen, they were typically in the peripheral branches of the tree (85.7% of sightings) and were first observed on central supports only once (14.3%). *G. demidovii* were observed on peripheral branches on 52.4% of the sightings, while central supports and vine tangles represented only 28.6% and 19.0% of the sightings, respectively. Considering that vine tangles are rare relative to peripheral branches and central supports, it seems probable that vine tangles are selected as locomotory supports or as feeding locations.

Based on the analysis of 19 stomach contents from *P. potto* in Uganda, KINGDON (1974) suggests that their major food is resins. However, he also reported insects as representing 30% of the stomach contents. CHARLES-DOMINIQUE (1974) found that animal food constituted 20% of the stomach contents of pottos from Gabon. An analysis of 40 stomachs from *G. demidovii* in Uganda indicated insects as constituting 78% of the diet (18% resin, 4% fruit and seeds; KINGDON, 1974). Sweep net samples done in the first year of our survey indicated a very similar biomass of insects in the logged (8.13 g) and unlogged (9.05 g) forests. Similarly, NUMMELIN (1989) found no significant differences in the number of insects collected in sweep net samples ( $n=800$ ) of logged and unlogged areas in the Kibale Forest. This suggests that although both *G. demidovii* and *P. potto* eat large quantities of insects, prosimian densities in Kibale are limited by other food sources, such as fruits or

resins. If further investigation supports this idea, it may be possible to determine which fruit and resin resources are important to these animals and modify selective logging practises to reduce the destruction of certain tree species.

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