Activity cycle and space utilization in captive *Dendrohyrax arboreus*

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The activity cycle of a captive group of *Dendrohyrax arboreus* comprising an adult male, an adult female and two juveniles showed them to be more active during the daylight hours than nocturnally. Activities of the siblings were closely synchronized, but showed no close relationship to the mother's cycle. The animals spent most of their time on the upper level of their enclosure. The data support the view that *D. arboreus* is arboreal and solitary in its natural habitat. The nocturnal habits of some wild *D. arboreus* populations may represent a shift in activity pattern in response to hunting pressure by man.
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Die aktiwiteitsiklus van 'n groep *Dendrohyrax arboreus* in gevangenskap, bestaande uit 'n volwasse mannetjie, 'n volwasse wyfie en twee jongelinge het getoon dat hulle meer aktief is gedurende die dag as in die nag. Aktiwiteite van die twee jongelinge van dieselfde werpsel het nou ooreengestem, maar het geen noue verband met die moeder se siklus getoon nie. Die diere het die meeste van hul tyd op die boonste vlak van hul hok verwyl. Die data ondersteun die sienswyse dat *D. arboreus* boomlewend en enkel in sy natuurlike omgewing voorkom. Die naglewende gewoontes van sommige wilde *D. arboreus*-bevolkings mag dui op 'n verskuiwing in hul aktiwiteitspatroon as 'n reaksie op die jagtingsdruk deur die mens.
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In studies of the three genera in the Family *Procaviidae* (Order *Hyracoidae*), *Procavia* and *Heterohyrax* are well represented, but no sustained observations have yet been published on *Dendrohyrax*. The available information describes this genus as arboreal, nocturnal and solitary, in contrast to the other two genera (Hahn 1934; Sale 1960; Walker 1968). Only a few exceptions to this rule are mentioned in the literature such as *D. arboreus ruwenzorii* and *D. validus* (Hahn 1934, 1959; Rahm 1957, 1963; Kingdon 1971; Seibt, Hoeck & Wickler 1977) which are said occasionally to live a diurnal existence among rocks. Fitzsimmons, quoted by Hahn (1959) saw *D. arboreus* moving about from 16h00 onward.

Most available information on this genus deals with *D. dorsalis* of West Africa and *D. validus* found in Tanzania, the islands along the East African coast and the southern part of the Kenya coast (Seibt *et al.* 1977).

The present paper reports on the activity patterns and interactions of a captive group of *Dendrohyrax arboreus*. A captive colony was studied because of the difficulties of working with a small (mass up to 3 kg) arboreal mammal that often lives in dense forest.

Materials and Methods

An adult female was captured in December 1978 in the attic of a dwelling house in Nairobi, Kenya. She gave birth to a male and a female in June 1979. An adult male, captured in the same locality, was added to the group in December 1979. The study was conducted in an enclosure on the Athi Plains 20 km south-east of Nairobi.

On the basis of the colour of the dorsal spot, dentition, number of mammae, penis structure and capture locality, the animals were classified as *D. arboreus stuhlmanni*, Matschie 1892 (Hahn 1959; Sale 1960; Bothma 1971; Kingdon 1971; Hoeck 1978).

The hyrax were housed in a wiremesh enclosure shown in Figure 1 with natural flooring covered with leaf litter and a wiremesh roof over which branches were spread for shade. Area B was separated from Area A by a wiremesh partition with a gate that was only closed when necessary, such as the time the newly captured male was introduced to the group. Shelters were of two kinds: 'H' square wooden boxes with dimensions of 35 × 45 × 18 cm and 'S' hollowed out logs 15 cm across and 45 cm long, positioned horizontally; both kinds were placed at heights of 1 – 2 m, some suspended from the ceiling. Running boards were placed along the walls at a height of 1,5 m and a number of poles and branches connected the shelters, boards and food platforms to each other and the

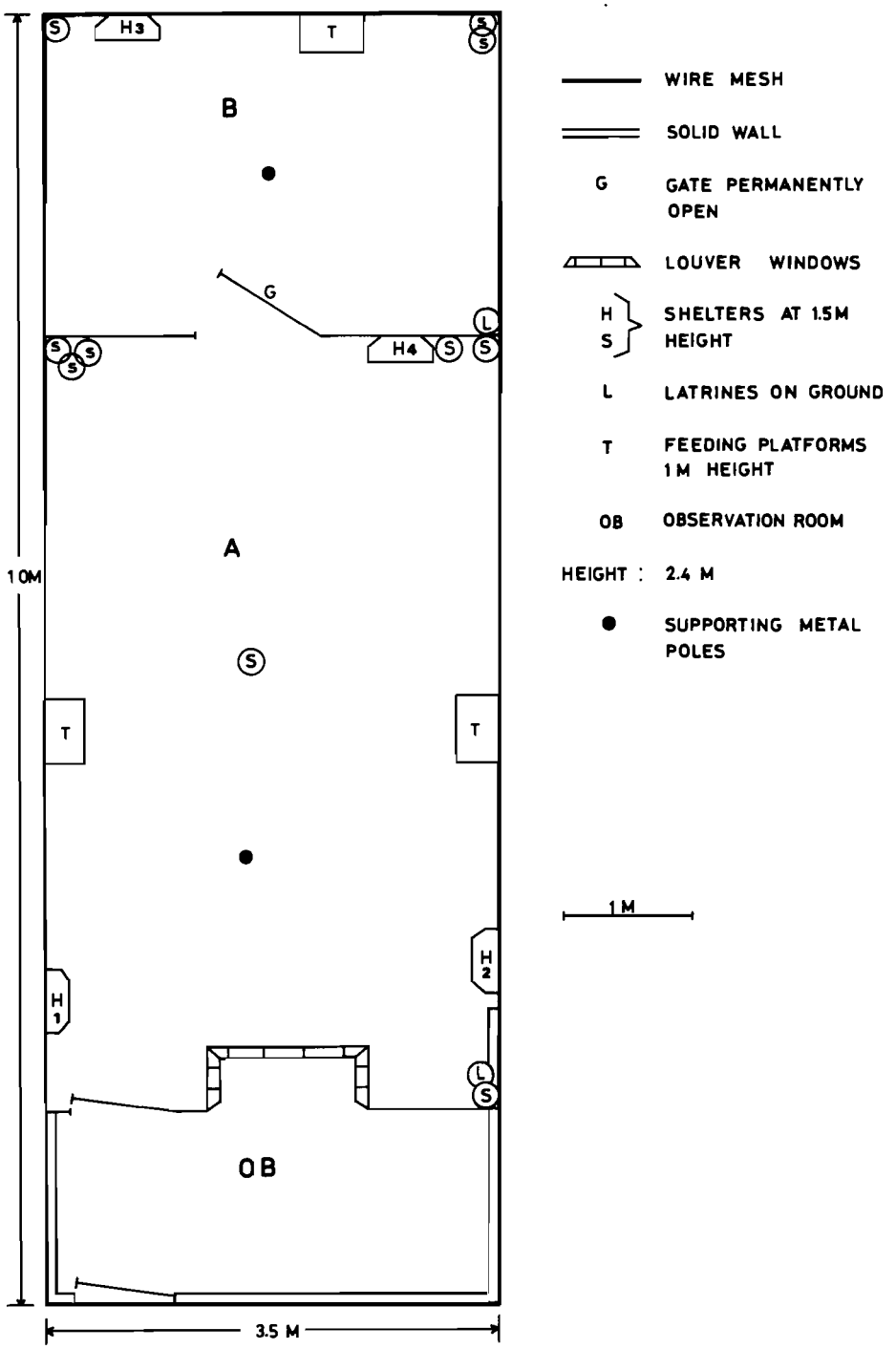

Figure 1 Plan of *Dendrohyrax* enclosure.

ground (not shown on Figure 1).

Food was offered on three platforms (T) at the level of the running boards. It was freely available and consisted of a diet of items listed in Appendix 1. When green fodder became dry it was thrown on the ground to form leaf litter.

Vertically placed hollow logs at ground level (L) served as communal latrines. Two ceiling lights with 25-W bulbs, covered with red paper to reduce glare, were automatically switched on at dusk and off at dawn. A minimum-maximum thermometer hung from the ceiling in the centre of cage A.

For the determination of space utilization the cage was divided into three levels: Upper, including the running boards, tables and shelters; Medium, including the poles and branches and Lower, including the ground itself and the latrines.

The location of this study, the Athi Plains, was somewhat drier and hotter than the locality the animals came from or where the nearest known wild population lives in the suburb of Langata (Table 1).

Observations were of two kinds:

(i) Scans at 5-min intervals noting each individual's position, activity and interaction with any other;

(ii) Scans at 1-min intervals noting positions and activities as above.

Both were considered simultaneous samples as defined by Altmann (1974) owing to the small size of the group.

The observation area (OB on Figure 1) was connected to the enclosure by a door and louvered windows which were open during observation periods. Fast action sequences were dictated into a taperecorder. Positions were recorded on prepared checksheets.

Table 1 Comparative meteorological data from this study (the Athi Plains enclosure), J. Kenyatta Airport (2,5 km from study location) and area of nearest wild population

	Yearly rainfall in 1980 mm	Monthly mean max. temp. C°
Athi Plains enclosure	no record	29,7
J. Kenyatta Airport	798,1	25,9
Dagoretti Corner Met. Station (1 km from capture site and 3 km from Langata)	1 053,2	24,1

Observations were initially spread over the whole 24-h period, whereas emphasis was later shifted to daylight hours as there was minimal activity between 19h00 and 06h00. At this latitude, 1°17'S, sunrise varies between 06h12 and 06h43 and sunset between 18h22 and 18h52.

Results

Behaviour patterns — definitions

Eight categories of behaviour patterns were recognized:

(i) Resting; lying in various positions within or without shelters with underside in contact with substrate.
(ii) Standing; daylight showing between underside and substrate. Alert position.
(iii) Locomotion; walking, hopping, running, climbing or ambling along.
(iv) Grooming; scratching with grooming claw of hindfoot or combing fur with scalloped incisors with upward sweeping motion of head.
(v) Feeding; eating food offered on tables or growing on ground, foraging in leaf litter, occasional ingestion of soil, suckling.
(vi) Playing: (a) solitary — pawing of objects, climbing up central pole and gliding down, swinging on branches (b) social — play-chasing.
(vii) Non-play interactions: (a) friendly — nose-to-nose contact, nuzzling (touching another's body with muzzle), (b) aggressive — turning face towards another with open mouth, nipping, muzzle sparring, lunging and chasing, the latter two with or without vocalization.
(viii) Other: not visible, on latrine, mother suckling infants.

Two to seven were considered 'active' and one and eight 'inactive' the latter as it meant mostly 'not visible' when hiding deep in the shelters.

Activity patterns

The activity patterns were significantly different in the daytime from similar patterns at night, with the animals being much more active during the daylight hours ($\chi^2 = 271,6$; df = 2; $p < 0,001$) (Table 2).

The animals were inactive 69,9% of the time during daylight (06h00 – 19h00) and 94,6% of the time during the hours of darkness (19h00 – 06h00).

Activity did not seem to bear a close relationship to temperature, which showed a smooth ascending curve to a peak between 12h00 and 15h00 while there are several activity peaks and troughs during this period among both the adults and the juveniles (Figure 2).

The individual activity patterns reflected the social relationships within the group. Activity patterns of the siblings were almost totally synchronized and the young were the only animals that had any play behaviour. There was little evidence of social interactions among the adults or between adults and young (Figure 2). Maternal care or interaction with the young was confined to suckling and approaching in response to distress calls. No grooming, carrying or playing with the young was noted.

The activity pattern of the adult male showed a marked difference from that of the female. The male had more frequent bouts of activity when the female was resting.

Table 2 Activity patterns of *Dendrohyrax arboreus* during the 24-h period. The activity is divided into daylight hours (06h00 – 19h00) and nocturnal hours (19h00 – 06h00)

Type of activity	No. of observ. (5-min scans)	Per cent of total
Between 06h00 and 19h00		
Inactive	9 538	69,9
Stand, locomote, groom	2 053	15,0
Feed	1 568	11,5
Interact, play	88	0,7
Other	392	2,9
Total	13 639	100,0
Between 19h00 and 06h00		
Inactive	802	94,6
Stand, locomote, groom	29	3,4
Feed	6	0,7
Total	847	98,7

Space utilization

Significantly more of the time (86,1%) was spent by all the animals on the upper level than on the ground or on the medium level ($\chi^2 = 4511$; df = 2; $p < 0,001$) (Table 3). The animals used the ground primarily during foraging.

Table 3 Utilization of height levels by *Dendrohyrax arboreus* within the observation enclosure. Number of observations is based on 1-min scans during the period 8 July 1979 and 20 December 1979

Levels	No. of observ. (1-min scans)	Per cent of total
Upper (2 m above ground)	9 255	86,1
Medium (1,5 m above ground)	400	3,7
Lower (0 m above ground)	1 096	10,2
Total	10 751	100,0

Discussion

Quantitative data show these *Dendrohyrax* to be diurnal. This is unlikely to be a captive artifact since the activity patterns did not change with time in captivity. Casual observations in th wild, e.g. in a Nairobi suburb, on a farm on the slopes of Mt Kenya and in the Masai Mara Game Reserve, suggest that *D. arboreus*, at least in the above localities, is active by day. All these are areas where hunting pressure from humans would

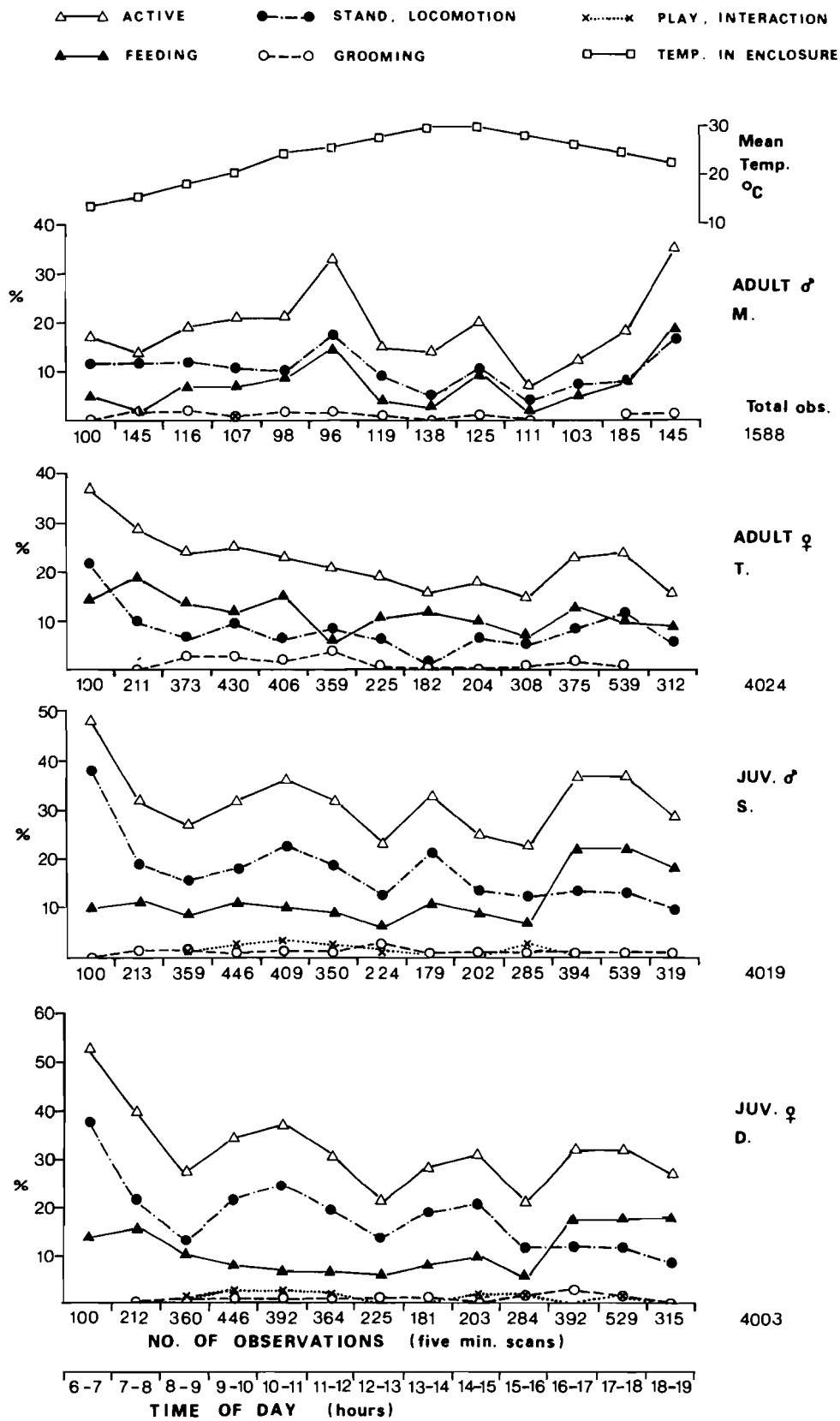

Figure 2 Individual activity patterns during daylight hours.

be slight, i.e., European-owned farms, suburban areas and Game Reserves. In many other regions *Dendrohyrax* species are hunted both for their palatable flesh and their soft fur (Rahm 1963; Kundaeli 1976b) and such pressure from human exploitation may have caused these animals to shift their activity to a nocturnal time period. According to Hahn (1959) *Procavia* and *Heterohyrax* may become nocturnal when harassed by man.

This suggestion is supported by the fact that two *D. arboreus* received for exhibit in the Brookfield Zoological Gardens, Chicago, showed an initial period of diurnal activity while in quarantine, but turned nocturnal after being put on exhibit and exposed to crowds during daytime (J.A. Davies, pers. comm.). There are other instances in the literature where mammals change from diurnal to nocturnal habits either seasonally or under hunting pressure (Hoogerwerf 1970 quoted by Ralls,

Barasch & Minkowski 1975; Nel 1979). *Dendrohyrax* seems to be similarly flexible in adapting its activity patterns to variable conditions.

While the present evidence does not support statements in the literature on *Dendrohyrax*'s nocturnal habits (Hahn 1934; Sale 1960; Walker 1968) it does confirm suggestions that *Dendrohyrax* spends most of its time above ground (Rahm 1957; Hahn 1959; Kingdon 1971), and the limited amount of interactions between adults lends support to the theory that in the wild this species is solitary with only one adult or an adult female and her young occupying a single shelter (Kundaeli 1976a).

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Appendix 1 List of food items offered

Carrot (*Daucus carota*)
Dry dates (*Phoenix dactilifera*)
Groundnuts (*Arachis hypogea*)
Mango (*Mangifera indica*)
Paw-paw (*Carica papaya*)
Apple (*Malus domestica*)
Fresh leaves of the following plants:
- Native shrubs and trees:
  - *Rhus natalensis* and *R. vulgaris*
  - *Acacia* spp.
- Exotic plants:
  - Geranium (*Geraniaceae*)
  - Sweet potato (*Ipomea batatas*)
  - Morning glory (*Ipomea* sp.)