

Home range and movement patterns of African Civet *Civettictis civetta* in Wondo Genet, Ethiopia

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Abstract

Radio-telemetry was used to investigate the home range, movements and activity patterns of African Civet *Civettictis civetta* in Wondo Genet, Ethiopia, during November 2006–June 2007. Home-range size was calculated using the minimum convex polygon method (MCP). The home range of a sub-adult female was 0.82 km² (100% MCP) and 0.8 km² (95% MCP). The home range of an adult male was 0.74 km² (100% MCP) and 0.71 km² (95% MCP). For the two animals, average values of 2.8 km/day, 0.24 km², 30%, 3,590 m of travel route/km² and 326 m/h were recorded for daily movement distance, daily movement range, percentage of daily movement range in relation to total home range, intensity of movement and speed of Civets, respectively.

Keywords: activity patterns, intensity of movement, modified habitat, radio-tracking

Domaine vital et patrons de déplacement de la Civette d'Afrique *Civettictis civetta* à Wondo Genet, en Ethiopie

Résumé

Nous avons utilisé la radio-télémetrie pour étudier le domaine vital, les déplacements et les patrons d'activité de la Civette d'Afrique *Civettictis civetta* à Wondo Genet, en Ethiopie, de novembre 2006 à juin 2007. La taille du domaine vital a été calculée en utilisant la méthode du polygone convexe minimum (PCM). Le domaine vital d'une femelle sub-adulte s'élevait à 0,82 km² (100% PCM) et 0,8 km² (95% PCM). Le domaine vital d'un mâle adulte s'élevait à 0,74 km² (100% PCM) et 0,71 km² (95% PCM). Pour les deux animaux, des valeurs moyennes de 2,8 km/jour, 0,24 km², 30%, 3'590 m de route de déplacement/km² et 326 m/h ont été enregistrées pour la distance journalière de déplacement, le domaine journalier de déplacement, le pourcentage du domaine journalier de déplacement par rapport à la taille totale du domaine vital, l'intensité de déplacement et la vitesse des Civettes, respectivement.

Mots clés: habitat modifié, intensité de déplacement, patrons d'activité, radio-pistage

Introduction

The behaviour and ecology of African Civet *Civettictis civetta* are poorly known because of its elusive nature. African Civets are terrestrial, nocturnal and solitary, and are only usually seen in groups of two or more individuals during the breeding season and the post-den mother-young associations (Kingdon 1997, Jennings & Veron 2009). A radio-tracking study in the Bale Mountains National Park, Ethiopia, revealed that the home range of a sub-adult male (body weight 8.75 kg) was 11.1 km², with a core area of 0.4 km² (Admasu *et al.* 2004). This individual preferred to rest during the day in dense bushy vegetation; during the night, it was mainly found in *Hagenia* or juniper *Juniperus* forest, and less frequently in bush, grassland and farmland (Admasu *et al.* 2004). The aim of the present study was to determine the home-range size, movement patterns and activities of African Civets in Wondo Genet, southern Ethiopia.

Study area

Wondo Genet is located in the southeastern escarpment of the Ethiopian Great Rift Valley (7°06–07'N, 38°37'–42'E), approximately 260 km south of Addis Ababa (Fig. 1). The altitude ranges from 1,800 to 2,580 m a.s.l. The average yearly rainfall is 1,210 mm, with a rainy season during March to September, and a relatively dry period from December to February. The

average annual temperature is 20°C. The study area comprised 897 ha of natural and plantation forests, farmland and human settlements (Fig. 2). The remnant forest vegetation is dry Afro-montane and is dominated by *Cordia africana*, *Albizia gummifera*, *Croton macrostachys*, *Ficus*, *Celtis africana* and *Milletia ferruginea* (Yirdaw 2002). Several cash crops are grown in the plantation areas, such as *Saccharum*, *Coffea arabica* and *Catha edulis*. Exotic plant species such as *Grevillea robusta*, *Pinus patula*, *Eucalyptus* and *Cupressus lusitanica* occupy the plantation forest.

Methods

Trapping and collaring

African Civets were captured using locally available leg-hold traps baited with meat and Avocado *Persea americana* fruit. Two to four traps were set up for a month in February 2007, around a single civetry (a communal latrine) around 18h00, and were removed early in the morning before sunset (around 06h00). The traps were checked once every two hours until dawn.

While at the trap, each Civet was anaesthetised intramuscularly with ketamine HCl (0.7 ml/kg body weight; see Jennings *et al.* 2006), using a hand-held 10 ml syringe. The sex was identified and the age approximately determined based on body size. A radio collar was attached around the neck

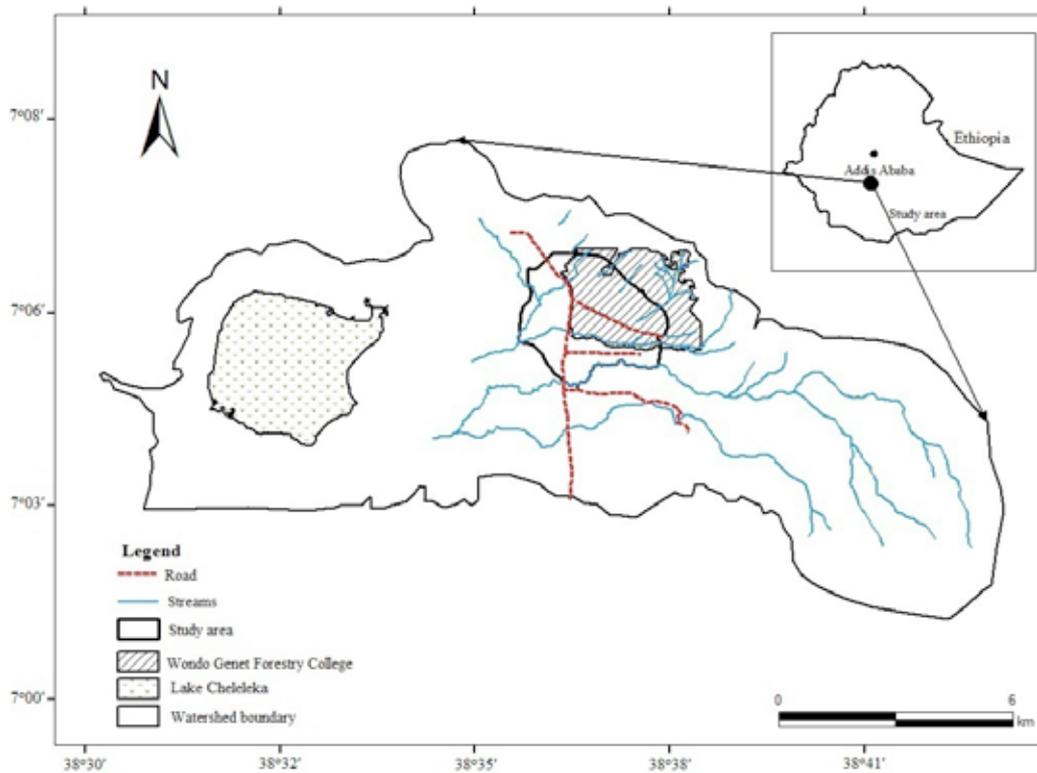


Fig. 1. Wondo Genet watershed area, Ethiopia, showing the area in which African Civets *Civettictis civetta* were studied.

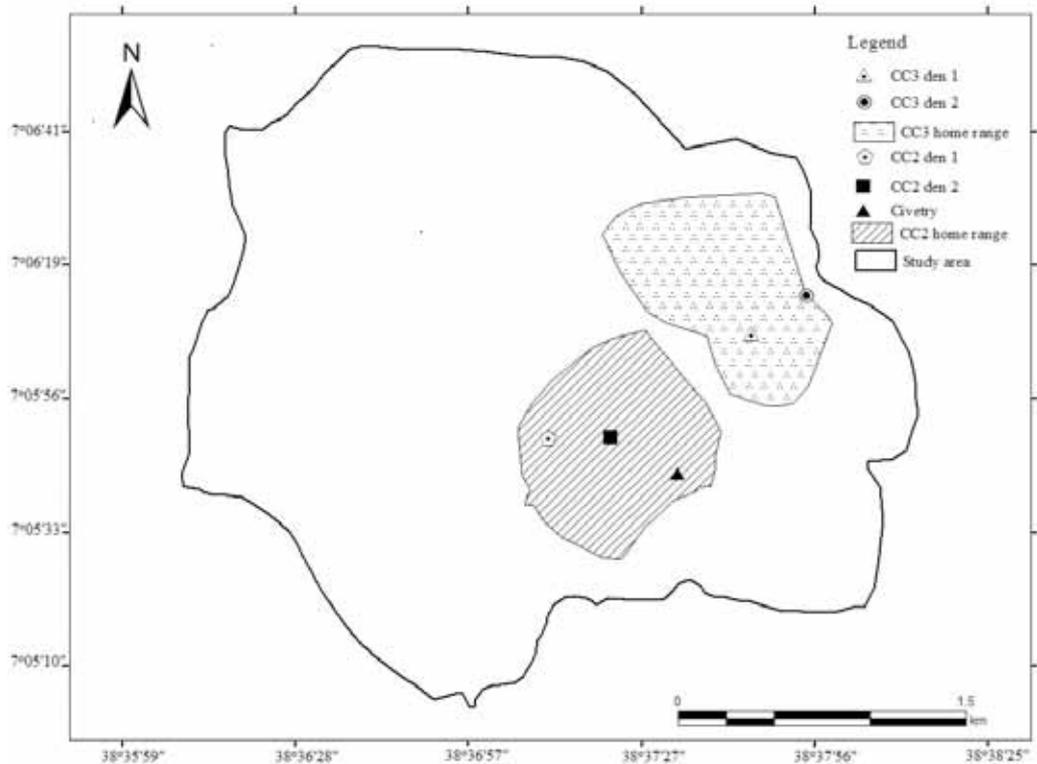


Fig. 2. Home range of the radio-collared sub-adult female (CC2) and adult male (CC3) African Civets *Civettictis civetta* in Wondo Genet, Ethiopia.

(MOD-225, Telonics, Mesa, Arizona, USA). The overall weight of the collar with transmitter was 160 g, which was less than 5% of the total body weight of the Civet. Each Civet was released in the same area where it was trapped.

Radio-tracking and data analysis

Each collared Civet was radio-tracked using a hand-held 3-element Yagi antenna (RA-14, Biotrack, UK) and a receiver (TR4, Telonics, Mesa, Arizona, USA). Radio-collared animals were

followed on foot and locations were recorded using a GPS unit (Garmin 12, etrex, 1200E, Kansas, USA). Locations were obtained by triangulation from three successive bearings. A maximum of five minutes between successive bearings was used in order to minimise location errors from the animal's movement (see Jennings *et al.* 2006). Location fixes were imported into ArcGis 9.1 for home-range analysis and home-range sizes were calculated using the minimum convex polygon method (MCP), with 100% and 95% of all fixes. The radio-collars lacked activity sensors, so activity (as opposed to rest) was inferred from the important variations in radio-signal intensity, distance and direction. Whenever possible our diagnosis was confirmed by approaching the target Civet to a distance of 30–40 m, without disturbing it, and determining its state visually by means of a night-vision scope.

To record movement patterns, each animal was followed over a continuous period of 6–10 hours during the night. Between locations, 40–45 minute intervals were maintained. A distance of at least 30–100 m from the focal animal was maintained to avoid disturbance (see Colón 2002). Ten tracking sessions were carried out for each Civet; the two animals were tracked on different days. Data were analysed to provide the following parameters (Schmidt *et al.* 2003): (1) Daily movement distance (DMD): the sum of straight-line distances between consecutive locations; (2) Daily movement range (DMR): the area encompassing the daily movement route; (3) Daily movement range as a percentage of total home range (DMR% = DMR/THR, where THR is total home range of the Civet during the entire study period; (4) Intensity of movements (IM): length of the route the Civets moved per 1 km² of their total home range per day calculated as DMD/THR (IM indicates whether the daily routes were concentrated or loosely distributed); and (5) Speed of travel (distance moved per hour). In addition, daytime resting sites were located three times per day: at around 10h00, 14h00 and 18h00.

Results

Home range size and use

Two African Civets were captured and radio-collared: a sub-adult female and an adult male (Table 1). Data were collected within February–June 2007 for the female, and within March–April 2007 for the male. A total of 252 location fixes (203 for the sub-adult female and 49 for the adult male) were recorded. The home range of the sub-adult female was 0.82 km² (100% MCP) and 0.8 km² (95% MCP). The home range of the adult male was 0.74 km² (100% MCP) and 0.71 km² (95% MCP). There was no overlap between the ranges of the two tagged Civets (Fig. 2). The home range of the sub-adult female was concentrated around the human settlement and sugarcane

Table 1. Details of the two African Civets *Civettictis civetta* radio-collared in Wondo Genet, Ethiopia.

Age	Sex	Weight (kg)	Capture site	Capture time	Capture date
Sub-adult	F	8.7	EF	04h49	9 February 2007
Adult	M	14	NF	23h50	27 February 2007

EF = *Eucalyptus* forest, NF = Natural forest

Table 2. Movement parameters of the two African Civets *Civettictis civetta* radio-collared in Wondo Genet, Ethiopia.

Parameters*	Sub-adult female	Adult male
DMD (km)	3.22±0.27 (2.29–4.24)	2.4±0.55 (1.33–3.15)
DMR (km ²)	0.31±0.04 (0.2–0.42)	0.17±0.04 (0.1–0.23)
DMR%	38.3±4.4 (24.4–51.2)	23.0±5.2 (13.5–31.1)
IM (m/km ²)	3,928±326 (2,797–5,175)	3,247±744 (1,795–4,255)
Speed (m/h)	345±28 (447–235)	307±82 (166–450)

*DMD = daily movement distance, DMR = daily movement range, DMR% = daily movement range as a percentage of the total home range, IM = intensity of movement. Tabled values are mean ± SE (range). Both animals were tracked for 10 nights.

farm, whereas that of the adult male was centred around the headquarters and student dormitory area.

Movement patterns

Table 2 presents the movement patterns of each collared Civet. The average daily distance moved was 2.8 km (range: 1.3–4.3 km). The sub-adult female's mean daily area coverage was 0.31 km², that of the adult male only 0.17 km². The daily movement as a percentage of the (total) home ranges averaged 30%, larger in the sub-adult female than in the male. High intensity of movement was observed in both individuals, with an average of 3,590 m of travel route/km². The average speed was 326 m/h (range: 167–450 m/h).

Activity patterns

There was no continuous monitoring of Civet activity between 06h00 and 18h30. Civets were active throughout the night from about 19h00 (after sunset), with the highest activity period during 20h30–06h00 (before sunrise). There was neither sign of resting in the middle of the night nor of any return to the den site during the night (Fig. 3). Nocturnal activity ceased around 06h00.

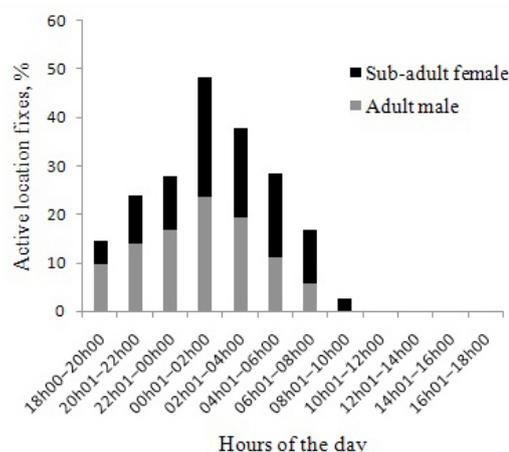


Fig. 3. The percentage of active telemetry fixes of adult male (grey) and sub-adult female (black) African Civets *Civettictis civetta* in Wondo Genet, Ethiopia, by 2-hour intervals throughout the day.



Fig. 4. Denning site for the sub-adult female African Civet *Civettictis civetta* within a thorny bush, Wondo Genet, Ethiopia.

Den sites

The male used two den sites before its disappearance from the study area; both were in natural forest. The distance between the two sites was 230 m, and the dens were entered through cracks of rocks. The pattern of use of the two dens was not clear. There were also two den sites for the sub-adult female, in dense bushy vegetation near human settlement (Fig. 4). The first den was abandoned in April 2007, when the female moved to a second one about 250 m from the first. Both individuals mostly visited their civetry during the morning, around 05h00–06h00.

Discussion

A wide range of home-range sizes has been recorded for other ground-dwelling civet species, such as Malay Civet *Viverra zibellina*, a South-east Asian forest species (Macdonald & Wise 1979, Colón 2002, Jennings *et al.* 2006, 2010), and a difference in habitat productivity and food availability was suggested as the probable reason (Jennings *et al.* 2006). The home ranges of the sub-adult female and the adult male African Civets in this study were considerably smaller than that of a sub-adult male in the Bale Mountains, Ethiopia (Admasu *et al.* 2004). Anthropogenic food resources may reduce home-range size and movements of carnivores (Quinn & Whisson 2005), and human-modified habitats may also have enhanced abundance of prey such as rodents and insects. Admasu *et al.* (2004) suggested that the small core area of the Civet in their study was probably influenced by the food resources in the Bale Mountains National Park headquarters and the adjacent town. Thus, the diversity of habitat types in Wondo Genet, including extensive overlap with people, may have provided rich food resources for these Civets, allowing their small home ranges there.

The sub-adult female used its range in a more intensive way than the adult male. Diet analysis in the same study area revealed that the younger Civet preferred to feed on protein-rich food sources than on plant foods; the male fed mostly on plant sources (AB own data).

The present study showed that two African Civets in synanthropic Wondo Genet were active during the night from about 19h00 to 06h00. Other species of civets also show noc-

turnal activity (Macdonald & Wise 1979, Rabinowitz 1991, Grassman 1998). The later emergence of the sub-adult female than the adult male (Fig. 3) near the human settlement might be caused by the presence of humans in the area during dusk. Cattle-grazing was observed in the study area until 19h30 on some days, and the collared Civets left their den just after the cattle and people had left the area.

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