Scent-marking by the African Civet *Civettictis civetta* in the Menagesha–Suba State Forest, Ethiopia

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Abstract

Scent-marking by African Civet *Civettictis civetta* was investigated in the Menagesha–Suba State Forest, Ethiopia, during August 2005–March 2006. A total of 77 scent-marked environmental sign-posts were located in a 300 ha area of natural forest, anthropogenic forest plantations and human settlement areas. Sign-posts such as tree stems, shrubs, herbs, grass, rocks, fences and wooden and metallic poles were scent-marked. The secretion had a species-specific odour, and was whitish yellow in colour when fresh, changing to brownish black after a couple of weeks. A large proportion of scent-markings was at 31–39 cm above ground. Most sign-posts were repeatedly marked. The frequency of marking was higher during the dry season. It seems possible to collect a good part of the secretion from the marked sites without affecting African Civets in their natural habitats, and hence to formulate methods to collect this natural renewable resource on a sustainable basis for the welfare of the local communities.

Keywords: civet musk, communication, perineal gland secretion, seasonality, sustainable harvest

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በኢትዮጵያ በሚገኙ የአፍሪካ ጥርኝ ዘር የጥርኝ ውጤታቸውን በአካባቢው ቁሳቁሶች ላይ እንዴት እንደሚቀቡ በመናገሻ ሱባ ደን ከነሐሴ እስከ መጋቢት 1998 ባለው ጊዜ 300 ሄክታር በሚያጠቃልል በተፈጥሮ ደን በተተከለ ደንና በመንደር አካባቢ መረጃ ተሰብስቧል። ጥርኙ በአካባቢ በሚገኘው ቁሳቁስ ማለትም በዛፍ ግንድ ጭራሮ ሣር ድንጋይ አጥርና የእንጨትና የብረት ምሰሶች ላይ ተቀብቶ ተገኝቷል። ጥርኙ ለየት ያለ ሽታና አዲስ ቅብ ሲሆን ነጣና ቢጫማ ቀለም እየቆየ ሲሄድ ደግሞ ወደ ቡኒ ጥቁር ቀለም ይቀየራል ጥርኝ የተቀባበት እንጨት እርዝማኔው ከመሬት 39 ሳንቲሜትር አይበልጥም ብዙውን ጊዜ ተመሳሳይ ቦታ ተደጋግሞ ሲቀባ ታይቷል የቅባቱም መጠን በበጋ ጊዜ ይጨምራል በተፈጥሮ በሚገኙ ቁሳቁሶች ላይ እንስሳቱ ሳይረበሹ የጥርኝን ውጤት በየጊዜው መሰብሰብ ይቻላል። ስለዚህም ይሕንን በተፈጥሮ የሚገኘውንና ምርቱ ቀጣይነት ያለውን ጥርኝ ዘላቂ በሆነ መንገድ አሰባስቦ የአካባቢው ነዋሪ በሚገባ እንዲጠቀምበት ዘዴ መፈለግ አለበት።

Introduction

The African Civet *Civettictis civetta* (Schreber, 1776) is well known for its perineal gland secretion, a waxy substance known as 'civet' or 'civet musk' that is used commercially as a basic ingredient in perfume industry as a fixative. The 'civet' is characterised by a pleasant odour when diluted, which is responsible for its extensive use in perfumery (Dannenfeldt 1985, cited in Ray 1995). Some mammals have highly efficient olfactory systems, enabling them to perceive signals even in low concentration (Kingdon 1977). Until the end of 1980s, African Civets were kept in large numbers in captivity for collection of 'civet' in Ethiopia and Zanzibar, which constituted major export sources into the international market (Ray 1995). Recently, synthetic musk has been developed, but has not fully replaced the natural 'civet'; most is exported from Ethiopia (Ray 1995). As the demand for civet musk in the perfume industry is growing, production can enhance the economic development of the local communities involved in African Civet farming (EWCO 1999).

Both sexes of African Civet possess perineal glands (slightly larger in males than in females), the secretion of which is used for scent-marking through pressing and rubbing the perineal glandular region against environmental sign-posts such as tree-bases, shrubs, herbs and stones (see Sreedevi 2001). Civets defaecate in special dung piles called 'civetries'. Civetries are normally less than 0.5 m² in area, and are located at territorial boundaries, serving as contact zone between neighbours (Nowak 1999).

'Civet' is used in traditional medicinal practices in Ethiopia, especially for ailments such as headaches, skin discoloration and skin infections, by topical application. In addition to these, a small amount of the musk is taken with coffee as a traditional treatment for cancer (Jemal Mohammed 1999, Yilma Delelegn 2000, Bultuma Qenno & Bekele Tsegaye 2004). Similarly, some of the indigenous communities in India use the perineal gland secretion of the Small Indian Civet *Viverricula indica* in tribal medicine (Sreedevi 2001), particularly to treat respiratory ailments and skin infections (Balakrishnan & Sreedevi 2007a), in addition to its constant use in Ayurveda drugs, a traditional Indian system of medicine (Balakrishnan 2000). It is also used in traditional incense stick preparations, for flavouring tobacco and as an aphrodisiac (Xavier 1994).

The present investigation was to study the behaviour of the African Civet with special reference to the scent-marking in the Menagesha–Suba State Forest, Oromia region, Ethiopia.

Study Area and Methods

The Menagesha–Suba Man-made and Natural Forest Conservation and Development Centre is located 45 km west of Addis Ababa. The centre extends along the range of the north-western and south-western escarpments of Wachacha Mountain, within 08°54′–09°04′N, 38°30′–39′E (Fig. 1). The forest area is part of the central plateau comprising natural forests of about 2,500 ha and a plantation area of 3,350 ha. The natural forest is undifferentiated Afromontane forest, mainly *Juniperus–Podocarpus–Olea*.

The annual rainfall is around 1,500 mm with the major pre-

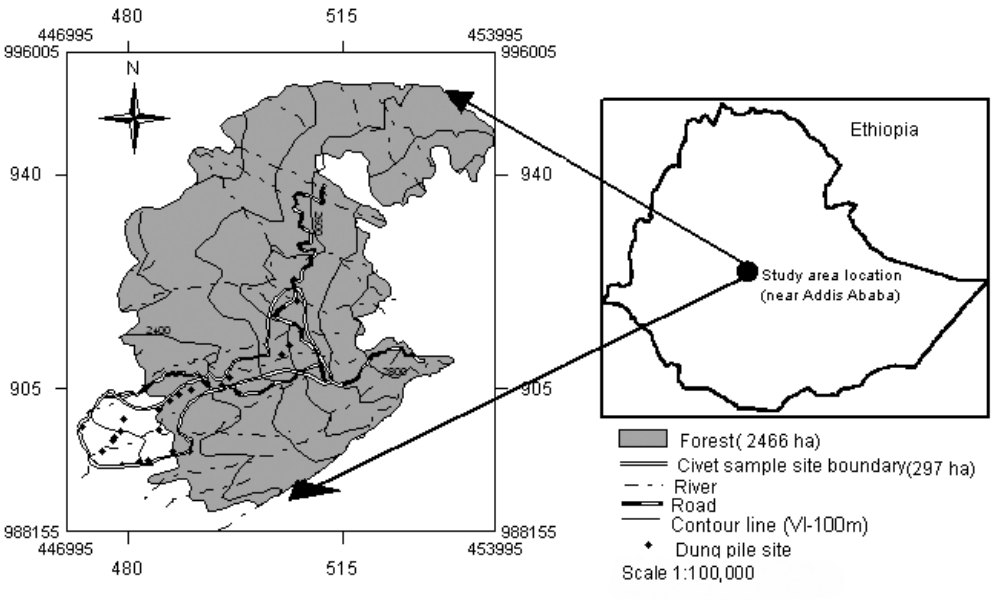

Fig. 1. Map of the Menagesha–Suba State Forest in Ethiopia and the sites of the present investigation.

cipitation during June–September. However, this area may get rain in any month. The mean temperature is 16°C with a maximum of 22.5°C and minimum of 9.5°C. In the forest, the average temperature is 11°C in the upper parts. Frost is common on the mountain outside the forest. The hottest months are May and June, while the coldest months are December and January.

The vegetation of the area was characterised by Elisabeth (1970). The natural forest is dominated by the African Pencil-cedar (African Juniper) *Juniperus procera*, with an open canopy. The biggest trees are over 50 m tall with a single trunk having diameter up to 2 m at breast height. Other big trees are African Podo *Podocarpus falcatus* and Red Stinkwood or Ironwood *Prunus africana*. Big trees of these species are few in number, but many seedlings and saplings are found in the lower parts of the forest, particularly in the plantation area. Young trees of *Hagenia abyssinica* with its soft leaves and hanging bunches of small red flowers are found around the state forest office, and in the higher altitudinal areas. The smaller trees of the main forest include *Olea europaea* subsp. *cuspidata*, *Allophylus abyssinicus*, *Euphorbia ampliphylla*, *Teclea nobilis*, *Nuxia congesta*, *Bersama abyssinica*, *Measa lanceolata*, *Myrsine africana*, *Rhus ruspolii*, *Rubus apetalus*, *Calpurina aurea*, *Carissa spinarum* and *Dovyalis abyssinica.* There are also many shrubs. Two giant herbs of the forest, *Lobelia gibberoa* and *Solanecio gigas* are found on the steep slopes of the valley. In March and April, the forest floor becomes carpeted with balls of red flowers of *Scadoxus multiflorus*.

At higher altitude, where the soil is thin, the *Juniperus* trees are short, mixed with several other small trees and bushes. Some of the more common species are *Erica arborea*, *Rosa abyssinica*, *Hypericum revolutum*, the endemic *Jasminum stans*, and the small trees *Myrsine melanophloeos*, *Ilex mitis* and *Maytenus gracilipes.* The herbs include *Helichrysum* spp. The closely grazed turf is mixed with *Trifolium* spp., *Thymus* spp. and other small herbs. Forest plantations at various altitudes consist mainly of *Juniperus procera*, *Cupressus lusitanica*, *Pinus patula*, *Pinus radiata* and *Eucalyptus* spp.

Methods

Menagesha–Suba State Forest was selected as the study area after a preliminary study carried out in February 2005 using indirect and direct methods (see Sutherland 1996). As stated by Estes (1991) and Kingdon (1997), African Civets have civetries, where they defaecate. According to Randall (1979) and Hutchings & White (2000), African Civets scent-mark their territories and objects around civetries and movement routes.

Civetries and scent-marked environmental sign-posts were searched and located in a 300 ha intensive study area. The observed civetries were numbered from 1 to 34. Each site was visited on alternate days. Direct observations at civetries were made during night using a night-vision scope. Each site was visited daily at least for 15 days per month. Detailed observations were made during August, September and October (2005) (wet season) and November and December (2005) and January and March (2006) (dry season). The objects that were scent-marked, the nature of marking, path of marking and the colour change of the musk were recorded. Data collection also included the girth and height of the objects at which scent marks were laid. In case of plants, the species were identified. The glandular secretion was removed from some of the sign-posts to examine whether the Civets scent-mark such sites again or abandon such sign-posts.

Results

Scent markings were recorded mainly around civetries, forest tracks and roads, and around human settlements. They were located in several places on sign-posts such as tree stems (Fig. 2), shrubs, herbs, grass, stones (rocks), fences (Fig. 3) and on wooden and metallic poles. They preferred to mark on smooth-surfaced vertically standing objects (Table 1). Scent marking on environmental sign-posts was more concentrated on road-sides especially around the Suba village. Thorny stems were not scent-marked in the present study area; however, *Juniperus procera* was frequently marked. Most objects were scent-marked repeatedly, a few only occasionally. Fresh markings were whitish in colour, changing to brownish black in a couple of weeks. They were butter-like in the beginning, but became stiffer in texture. The glandular secretion collected from the scent-marked sites had a species-specific odour detectable by the human nose.

The girth of plants at the marking height ranged from 0.1 to 98 cm with the mean of 70 cm (Table 1). The height from the ground at which scent-markings were seen ranged from 26 to 42

Fig. 2. Perineal gland secretion of African Civet at the base of a Pinus patula *tree in the study area. Note the thick and rough nature of the bark on which the animal has scent-marked.*

Fig. 3. Scent-marking site on a fencing stump with smooth surface in human settlement area in Suba village. The secretion adhered on the surface of the sign-post is shown with a pointer.

cm with a mean of 35 cm. A large proportion of scent-markings was at 31–39 cm high. Scent-markings were observed more in areas near human settlements and around civetries. During the dry season, scent-marking sites were observed frequently on several plants around the dung piles as well as in village areas and roadsides. More fresh scent-markings were observed during the dry season than during the wet season (Table 2), with a significant seasonal difference ($\chi^2 = 8.12$, df = 1, $P < 0.10$). Scent-marking sites in the forest area also seemed more during the dry than the wet season.

Civets were observed to re-mark the sites from where the glandular secretion was removed. It was not established whether removing the civet musk stimulated an increase in the frequency of scent-marking (re-marking). No obvious difference was observed in the frequency of marking sites from where the secretion was removed and from where it was not, but this was not tested specifically.

Discussion

African Civets are known to scent-mark environmental sign-posts along established routes with perineal gland secretions (Kingdon 1977). Trees and shrubs that bear fruits eaten by Civets are frequently scent-marked. Grasses, dry logs and rocks are also used as sign-posts for scent-marking by African and Small Indian Civets (Randall 1979, Hutchings & White 2000, Sreedevi 2001). Scents are often overlaid by others passing through the same way, indicating that the scent may provide olfactory information such as

Table 1. Details of plant species and other environmental sign-posts that African Civets used for scent marking in the Menagesha–Suba State Forest and nearby areas (N – number of observations).

Scent-marked plants/objects	*N*	Percentage	Height (cm) of marking	Girth (cm) at the height of marking
Acacia abyssinica	3	3.9	41, 31, 32	97, 43, 60
Acacia decurrens	2	2.6	33, 39	11, 26
Brucea antidysentrica	3	3.9	39, 32, 30	6, 7, 4
Carissa spinarum	3	3.9	31, 34, 37	7, 3, 5
Casuarina cunninghamiana	7	3.9	40, 39, 27, 31, 38, 41, 37	63, 85, 98, 21, 10, 66, 93
Cupressus lusitanica	9	11.7	39, 41, 37, 31, 30, 40, 37, 33, 35	17, 37, 20, 90, 87, 76, 63, 85, 77
Eucalyptus spp.	6	7.8	28, 39, 33, 36, 40, 38	38, 70, 83, 15, 11, 14
Juniperus procera	11	14.3	40, 37, 38, 42, 41, 35, 34, 35, 38, 40, 39	94, 82, 40, 59, 67, 71, 88, 69, 56, 80, 81
Maytenus spp.	2	2.6	31, 36	3, 7
Myrsine melanophloeos	7	9.1	33, 36, 31, 36, 30, 36, 36	4, 7, 4, 5, 6, 3, 7
Olea europaea subsp. *cuspidata*	2	2.6	29, 37	8, 5
Pennisetum schimperi	2	2.6	28, 36	0.1, 0.1
Podocarpus falcatus	2	2.6	39, 35	85, 16
Pinus radiata	4	5.2	35, 31, 38, 41	20, 37, 80, 66
Pinus patula	3	3.9	41, 36, 37	97, 40, 56
Prunus africana	4	5.2	32, 36, 35, 34	6, 16, 9, 8
Metallic pole	3	3.9	39, 35, 35	32, 32, 32
Stump	3	3.9	38, 37, 34	77, 60, 76
Rock or stone	1	1.3	26	20

Table 2. Number of scent marks of African Civets observed during wet and dry seasons in the Menagesha–Suba State Forest and nearby areas (N – number of markings observed).

Season	Month	*N*	Mean/month
Wet	August	3	5.3
	September	5	
	October	8	
Dry	November	10	15.2
	December	15	
	January	17	
	February	19	

sexual and individual status (Kingdon 1977). Sign-posts are repeatedly marked by pressing and rubbing the glandular area. An earlier study revealed that African Civet markings were almost exclusively along roads (Randall 1979). The present investigation revealed that the sign-posts close to civetries were marked more frequently than were similar objects away from civetries. Scent marking along roads and near civetries could be attributed to the efficient transmission of communication signals related to territorial and reproductive activities, because these are places where Civets are likely to traverse or visit. Most scent marks of African Civets faced along the road, with none being orientated more than 90° away (Randall 1979). Olfactory signals would be more effective at higher rate of diffusion (although this would require more frequent re-marking by the animal) and at closer range. When the signals are laid facing pathways, they would be more efficiently perceived by individuals of the same species during transit (Alberts 1992).

It was not easy to collect all the glandular secretion from the marked sites. Hence, the amount of musk used for scent-marking at a time was difficult to determine. Results of the present study have also revealed that African Civets reinforce scent-markings by repeated markings at the same site, as reported earlier (Randall 1979). The effectiveness of the scent to persist for long duration makes it unnecessary to mark repeatedly at short intervals. This would help Civets to scent-mark on more environmental sign-posts within their areas of movement.

The primary environmental factors, which affect spatial and temporal parameters of chemical signals in terrestrial habitats are temperature, humidity and wind (Alberts 1992). There were more sites of scent-marking during the dry season than during the wet season. This can be associated with the effect of temperature on the secretary output of the gland. Because the molecular weight of highly volatile compounds is low, the rates of evaporation and diffusion are fast, particularly during the summer months. This also makes it necessary for Civets to mark the sites repeatedly during the summer months, to maintain sign-posts.

There are various plant species and types that are found to be scent-marked by the African Civets. More marking on *Juniperus procera* may not be due to specificity for that species, but could simply reflect the high density of this tree in the forest plantation. Civets have no preference to the size of the plant for scent-marking. Scent-marking was seen on a variety of large trees, shrubs, herbs and grasses, as observed by Randall (1979). Use of smooth-surfaced objects may avoid injury to glandular areas whilst they press and rub the sign-posts during scent-marking, but during the present observations, hairy stems and hard rough-barked stems were also found marked.

The marking height might allow inference of the height of the Civet, to allow rough estimation of the age. Lower markings could be of young and sub-adults, but there is no direct evidence of this. A signalling animal can influence the signal's range by varying the height at which signals are emitted (Alberts 1992). The highest and lowest heights may also be due to the bending of slender stems while the Civets press to mark the plant.

Ethiopia is known for extraction and export of African Civets' perineal gland secretion since time immemorial. Such activities are common in the western, south-western and southern parts of the country. However, the local community around the Menagesha–Suba State Forest has no experience of keeping Civets in captivity and collecting the 'civet', despite the presence of good number of them locally. 'Civet' is a natural wildlife resource, but for it to provide long-term benefit, it is the responsibility of the government and of concerned institutions to introduce sustainable systems without affecting the natural Civet populations. With no Civet farms in this study area, the glandular secretion can be collected by establishing a scientifically oriented model farm in the area, and/or by collection of the secretion from the natural markings of Civets in the habitat.

Sustainable use of the African Civet could be a good foreign exchange earner for Ethiopia and support the livelihood of the surrounding community. The government and the concerned institutions and NGOs can initiate this activity and train suitable individuals among the local community. Use of modern traps and cages, health care services, proper feeding, extraction of musk without disturbing the animal and captive breeding are essential components under such a model Civet farm.

The observation that the Civets re-mark the sign-posts from where the glandular secretion was experimentally removed shows that they do not abandon their scent-marking sites in response to human intrusion and activities. It might therefore be possible to extract the Civet musk constantly from such marked sites. However, the increased frequency of re-marking may be problematic for the Civet, if production of 'civet' is energetically or otherwise demanding. Hence, further studies are needed before assuming that wild collection of 'civet' could be carried out without detrimental effects to Civets.

WSPA (2000) urged consumers not to buy products containing natural Civet musk, given the deplorable conditions of the captive Civets in Ethiopia. Balakrishnan & Sreedevi (2007a) suggested that alternative means be developed by which this excellent resource, renewable if managed on a scientific basis, can support rural livelihoods in the poorer regions of the world. In response to the criticism against Civet farming practice (Pugh 1998, WSPA 2000), the Ethiopian Wildlife Conservation Department has initiated programmes to revive Civet farming by permitting trapping only of male Civets from the wild and by providing nominal incentives to the farmers through the supply of cages at a subsidised rate. The decision to issue permits to trap only male Civets shows that the government agency is yet to consider developing breeding colonies for sustainable 'civet' production in Ethiopia. In the absence of captive breeding colonies, the free ranging wild populations of the African Civets will continue to be under stress. Farming and handling methods can be improved through awareness creation. The biological and socio-economic dimensions of this practice need to be assessed. Improving the well-being of the local people and ecosystems are logical goals in this regard. The Civet industry should sustain, without depleting or negatively af-

fecting, the animal and the ecosystem. Another potential way of Civet use is harbouring Civets in large semi-natural enclosures and collecting musk from the marked sign-posts in the habitat (see Balakrishnan & Sreedevi 2007b). The findings of the present investigation suggest that Civet musk could be collected with minimal trouble to Civets in their natural habitat and without keeping them in captivity.

Acknowledgements

We are grateful to the School of Graduate Studies and the Department of Biology, Addis Ababa University for financial support and facilities. We are also grateful to the authorities of the Menagesha–Suba State Forest, Ethiopia for permission to undertake this investigation and the staff for their assistance during the period of field work.

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