



**ADDIS ABABA UNIVERSITY**  
**SCHOOL OF GRADUATE STUDIES**  
**COLLEGE OF NATURAL SCIENCES**  
**DEPARTMENT OF ZOOLOGICAL SCIENCES**  
**ECOLOGICAL AND SYSTEMATIC ZOOLOGY STREAM**

**FEEDING ECOLOGY OF THE AFRICAN CIVET (*CIVETTICTIS CIVETTA*) AND IMPROVED CAPTIVE MANAGEMENT FOR SUSTAINABLE UTILIZATION IN ILLUBABORA, ETHIOPIA**

**By**

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ADDIS ABABA UNIVERSITY

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*A Dissertation Presented to the School of Graduate Studies of the Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Zoology (Ecological and Systematic Zoology stream)*

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By Bekele Tsegaye Degefa,

### ABSTRACT

The study was conducted during 2011-2014 in Bedele District, Illubabora Zone of southwestern Ethiopia. The aim was to investigate feeding ecology of the African civet in the wild to assess the effect of time range on the civet musk production, to study the influence of different food items on the amount of civet musk production and to demonstrate modern methods of civiculture through awareness creation. There were about 25 'civeteries' in the study area to study food items of the African civets in their natural habitat. Food types, seasonal variations in food items, availability of food and food preferences of civets were studied. The difference in food availability was statistically significant between wet and dry seasons. Trapping civets using modern cage was found to be more suitable than the traditional methods of trapping. The difference in the weight of civet musk extraction based on intervals of 5, 10 and 15 days was studied. Extraction with 10 days gap was found to yield optimum civet musk while the second is 15 days interval. The food items given were maize soup, meat and mixed food made of bone, blood and meat products. The civet musk production with mixed food was found to yield optimum civet musk, and the regular supply of meat is the next. The different 'civet' collection of pure musk extraction is highly correlated ( $r = 0.990$ ,  $P < 0.05$ ). The correlation of 'debisa' extraction are significant ( $r = 0.993$ ,  $P < 0.05$ ). The amount of civet musk extracted from African civets was statistically significant ( $F = 2039.5$ ,  $df = 2$ ,  $P < 0.05$ ). The production of civet musk was influenced by time gap and quality of food containing high protein contents. Male civet was found to produce more musk. Modern methods to manage African civets in captivity were demonstrated. Modern cages for trapping and keeping civets were demonstrated and attitudinal changes of civet farmers were observed.

**Key words:** African civet, Civet farmers, Civet musk extraction, feeding ecology, captive management.

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## **ACRONYMS**

AAU	Addis Ababa University
BAMRC	Bako Agricultural Mechanization Research Centre
EWCA	Ethiopian Wildlife Conservation Authority
EWCO	Ethiopian Wildlife Conservation Organization (former name for EWCA)
IFRA	International Fragrance Associations
OARDB	Oromia Agricultural and Rural Development Bureau
OFWE	Oromia Forest and Wildlife Enterprise
ORNS	Oromia Regional National State of Ethiopia
SNNPR	Southern Nations, Nationalities and Peoples Regional State of Ethiopia
WAP	World Animal Protection
WSPA	World Society for Protection of Animals (old name for WAP)

# 1. INTRODUCTION AND LITERATURE REVIEW

## 1.1 Introduction

The African Civet (*Civettictis civetta*, Schreber, 1776) has been historically the main source of civet musk used in perfume industry. The word “civet” also refers to the distinctive musky scent produced by civets. The genus name “*Civettictis*” is derived from the French word ‘*civette*’ and the Greek ‘*ictis*’, meaning weasel, Old Italian Zibetho. Civets are also called "musang" in Malay (Mathai, 2010).

Civets are nocturnal animals of the family *Viverridae* that includes civets, linsangs, genets. Viverrids include diverse groups of carnivorous mammals restricted to the Old World (South western Europe, Southern Asia, East Indies and Africa) (Kingdon, 1977; Wright, 2011).

*Viverridae* are shy animals, which are solitary or live in pairs or in small groups. Most of them are good climbers, some are almost exclusively arboreal (for example *Paradoxurus hermaphroditus* and *Poiana richardsonii*), and two species, the otter civets and the aquatic genet (*Osbornictis piscivora*) are aquatic. Some of the species of viverrids use secretions from their anal glands to scent mark territories. Scent marks are deposited either passively when moving through vegetation, or actively by squatting and rubbing the anal region on the ground or on prominent environmental objects or sign-posts. Scent marks allow assessment of social status, individual recognition, kin recognition, territory demarcation and sexual receptiveness of the individual responsible for the mark.

Vocalizations are well developed in some of them (Gittleman, 1996; Hutchings and White, 2000; Burfield, 2005).

The family Viverridae comprises 71 species of 36 recent genera of 8 sub-families (Nowak, 1999; Macdonald, 2001). Among these, the sub-family *Viverrinae* comprises 19 species that include the true civets, linsangs, and genets. They are the most primitive of modern carnivores, little modified descendents of the progressive Miacids that may be regarded as late Eocene (Ray, 1995; Shalu, 2000).

Viverrids are native to Africa, Madagascar, the Iberian Peninsula, Southern China, and Southeast Asia. Their habitat preferences include woodland, savanna, mountain biomes and tropical rainforest. Many are faced with severe loss of habitat, which is one of the main reasons for several of them to be listed as vulnerable, while the Otter Civet is classified as endangered (Macdonald, 2001). Civets vary in size with large heavily built, long-bodied, long-legged and dog-like viverrids preferring to be near water. They have some cat-like appearance with long noses, slender bodies, pointed ears, long furry tail, short legs, non-retractile claws, and unlike other cats they are digitigrades (Wright, 2011).

The African civet, *Civettictis civetta* is recognized as a distinct genus. However, some authors still include *C. civetta* in the genus *Viverra*. *Civettictis* is distinguished from *Viverra* by the much longer molar teeth and far broader lower carnassials. Each of the anal glands is excavated to form a pouch communicating with interglandular space by

constricted orifices. These are not so excavated in the case of *Viverra* (Estes, 1991; Nowak, 1999).

The African civet is the largest of the African viverrids. It has the size of a medium-sized dog and is considered to be the most primitive of living carnivorous mammals. Viverrids evolved during the last 40–50 million years ago. They were once found throughout the tropical Africa, wherever there were adequate cover and permanent water (Nowak, 1999).

Civets are commonly grayish, with black spots or stripes or both. Their fur may be gray or brown, and may be marked in various patterns. All civets have perineal glands or scent-producing glands, located in a double pouch near the genitals. The fatty yellow secretion of these glands has a distinctive musky odor used for olfactory communications. Commercially, it is used as a perfume fixative (Hillman, 1992; 1993). There are some Melanin members of African civets showing genetic variation with the dark coloration (Appendix 2)

*Civettictis civetta* inhabits a variety of habitats ranging from moist tropical forest of southern and central Africa to dry scrub savannahs. They are rarely found in arid regions; however, can be found along river systems that project into the arid areas of Niger, Mali and Chad (Ray, 1995). It is a terrestrial mammal climbing trees only under emergency conditions.

Civets eat almost anything. African civets eat small mammals, birds, reptiles, amphibians, invertebrates and fruits. They have an excellent sense of smell, and they hunt prey in stalking manner like a cat. The African civet hunts exclusively on the ground at

night, resting in thickets or burrows during the day (Macdonald, 2001; Williams, 2003; Wright, 2011). African civets deposit their droppings in one place creating middens or “civtries” or dung piles. They mark their territory using their perineal gland secretion known as ‘civet’ or civet musk (Hillman, 1993; Ewer, 1998; Nowak, 1999).

Civets with spotted or striped coat have five toes on each foot. There is webbing between the toes, and the claws are non-retractile or semi-retractile. The pointed ears extend above the profile of the head. Like domestic cats, ear flap has pockets or bursae on outside margins. Their teeth are specialized for an omnivorous diet, including shearing carnassials teeth and flat-crowned molars in both upper and lower jaws (Ray *et al.*, 2008; Gauberts *et al.*, 2005). The African civet has gray coats with black markings, erectile mane, and long tail.

The main purpose of keeping African civets under captivity is to collect their secretion from their perineal gland. Major suppliers of crude ‘civet’ supporting perfume industry are African countries, primarily Ethiopia (Ray, 1995).

Civet musk is a foul smelling scent (strong smell) produced by the glands of the male civet (FAO, 2000). Males produce larger quantity and better quality musk than that of females. It is collected by scraping the glands at regular intervals of about a week using a spatula made of horn. A civet will yield from 800 to 1300 g musk a year. Ethiopia has a worldwide monopoly for civet musk production and annually exports more than 3,000 kg of musk worth about US\$ 3,000,000 (FAO, 2000). It is exported mainly to Europe (especially France) and rarely to other nations including the United States, for perfumery (Dannenfeldt, 1985). Far East countries such as China, Japan and Korea are also

importing civet musk. Civet musk is also used in traditional medicinal practices to treat various ailments.

African Civet farming is an ancient practice in Ethiopia. Queen Sheba allegedly presented civet musk to King Solomon as a gift during her visit, and even today civet musk is an important export commodity. The number of farmers holding civet farm is not clearly known as most of them are not legally registered. At present, there are only less than 200 civet farmers registered in Ethiopia under government regulations. Each holding at an average has 25 civets. Most of these farms are located in the low-lying areas of Western Ethiopia whereas only few are located in southern Ethiopia (FAO, 2000; Kumera Wakjira, 2005).

Almost all the civet farmers trap civets from the wild and keep for life time utilization to collect civet musk. Civet cat rearing is a fairly profitable business and serves as a means of improving the livelihood of the farmers to contribute to poverty alleviation, but the civet musk market is not regulated (Olani Kebede, 1999; Kumera Wakjira, 2005).

Civet musk is generally used as a fixative or a base in high quality perfumes, and continues to be highly in demand in spite of the development of synthetic substitutes. Few thousand African civets are kept in farms in Ethiopia, although the exact number is unknown (Kumera Wakjira, 2005). During this research survey through the Western Oromia it was revealed that the number of civet farmers were more than 250, holding about more than 4000 captive African civets. It is known that there are more unregistered farmers

involved in civet farming. But, several of them have stopped civet farming due to low income from the civet musk market.

World Society for Protection of Animals (WSPA) suggestion of 1973, cited in report of 1998 were taken into consideration by the Ethiopian Government and several subsequent government bodies', especially EWCO, confirmed the existence of animal mistreat and have tried to improve the situation with ORNS (Kumera Wakjira, 2005; Kifle Argaw and Kumera Wakjira, 2003; Olani Kebede, 1999). However, the civet musk producers have been slow to implement these recommendations. The contributing factors could be many among which some are low follow up of the government, poor management, dealers (middlemen), exporters and adulteration of the civet musk. To identify the main problems affecting the industry it is useful to examine the situation in relation to the various stakeholders and the socio-economic conditions in which it operates. Governments (Regional and Federal) should take measures to regulate the civet musk market problems which is directly associated with the suggestions from WSPA, 1998 report.

This research project was initiated in September 2011. It was primarily aimed at studying captive husbandry, influence of food on civet musk production, civet musk collection in relation to the time range and feeding ecology of civets in wild coffee habitats near Bedele town (Illubabora) around Dabena River. Modern captive management of civets was also studied to find out attitudinal changes among civet farmers to help them improve their livelihood activities, better captive management of civets and better income generation. Training on modern methods of captive management was also involved in

two Provinces, and modern cages for trapping and keeping civets were demonstrated and supplied as a model gift to few of them including the cages used in this research program.

## **1.2 Literature Review**

*Viverridae* is an old and primitive carnivore family for which fossil record is scarce. First appearance of *Viverridae* in Europe and Asia occurred in the early Oligocene and in Africa in the early Miocene. Due to incomplete records, the place of origin of viverrids in the Old World is not known (Wozencraft, 2005). Extant species resemble fossil forms, suggesting that skeletal morphology and teeth structures have remained unchanged for 40–50 million years (Ewer, 1998). The diversity within the family is explained by the variety of niches occupied by them, from truly terrestrial, partly to mostly arboreal to aquatic. Mongooses were once considered in the Family *Viverridae* under a different subfamily, Herpestinae. However, most authorities now recognize mongooses under the family Herpestidae (Kingdon, 1988; Wozencraft, 2005; Veron and Heard, 2000).

Viverrids are medium-sized, nocturnal and solitary carnivores (Nowak, 1999). They are elusive and poorly known, and until recently, overlooked by researchers. Wozencraft (2005) recognized four subfamilies: Hemigalinae, Paradoxurinae, Prionodontinae and Viverrinae. However, later studies have shown that the Prionodontinae (Asian linsangs *Prionodon*) are a sister group of Felidae and should now be grouped as a family Prionodontidae (Gaubert and Veron, 2003; Gaubert *et al.*, 2005). Gaubert and Cordeiro-Estrela (2006) have argued that Viverrinae should be split into two subfamilies: the

*Viverrinae* (terrestrial civets) and the *Genettinae* (*Genetta* and *Poiana*) (Macdonald, 2001).

The African civet is a large species of civet found across the sub-Saharan Africa. The African civet is the only remaining member of civets and is considered to be the largest civet-like animal in the African continent. The common use of the name ‘civet cat’ for *C. civetta* is misleading, as the African civets bear little resemblance to felids, and do not even share familiar rank with them. Despite their cat-like appearance and behaviour, the African civets are not felines but are in fact, more closely related to other small carnivores including weasels and mongooses (Wilson and Reeder, 1993; Ewer, 1998).

The African civet is the largest representative of the African viverrid. It is a sturdily built, low-slung animal, about the size of a medium-sized dog, which is more similar in appearance to cat and genet (Hillman, 1992; Kingdon, 1997). It is easily recognizable by its disproportionately large hindquarters, low-headed stance and erective dorsal crest. Hindquarters are higher and more powerful because the hind legs are larger and longer than forelegs (Ray, 1995). The dorsal pelage varies among individuals, and is coarse and wiry, giving the animal a large appearance. The tail is coarse-haired with long bristles. Along the spines from the neck to the tail, a line of shaggy black hairs form an erective crest (Kingdon, 1997). A light colored stripe is situated along the contour alternatively with black and white and is not visible until the animal erects the spinal crest, allowing it to assume a larger and more threatening posture (Estes, 1991; Ray, 1995).

African civet is a nocturnal, omnivorous mammal. The broader and flatter molars of *Civettictis* may be secondary adaptations for a more crushing and grinding of food

(Williams, 2003). African civet has a strong penetrating faecal smell of carnivores partly due to skatole (a white, crystalline, water soluble solid,  $C_9H_9N$ ) (Macdonald, 2001).

The African civet lives in savannahs and forests of South, East and Central Africa, ranging from Senegal to Somalia, south to Namibia and eastern South Africa. They mainly live near permanent water bodies and among the tall grass and thickets of forests and savannahs to hide in for protection. They are solitary animals. They have a high sense of olfaction. They also have vocal means of communication. Their life span is between 15–20 years in the wild, while there is a record of 28 years longevity under captivity (Nowak, 1999; Macdonald, 2001).

The African civet is famous for ‘civetone’ extracted from its perineal gland secretion. This oily substance is also known as ‘civet musk’ or ‘civet’. Naturally it is used in olfactory communication. On ageing and upon dilution, a pleasant odor develops from this, which is highly valued in perfumery (Anonis, 1997; Wozencraft, 2005). It is said that King Solomon’s supply of musk came from East Africa (Woodford, 1990). The animal musk trade has declined over the years due to the availability of modern synthetic musk of similar character. However, the demand for the natural civet musk is still high (Mohan, 1994; Shalu, 2000).

The perineal glands of civets appear as swellings near the genitalia, and on an average two cm wide and three cm long. The male African civets have slightly larger gland than that of females and produces a better secretion in quantity and quality (Randall, 1979; De-Sheng, 1986; Estes, 1991). They use this secretion to scent-mark objects surrounding

'civetries' along their regular pathways. Scent marks are laid usually at a height between 31 and 39 cm from the ground level, and are often overlaid repeatedly by the same or by other individuals, possibly to communicate reproductive condition and territoriality (Bekele Tsegaye, *et al.*, 2008; Wright, 2011).

All members of the family viverridae occur only in the Old World and occupy parts of Western Europe, most of Africa and Southeast Asia. A widespread and abundant species in Africa, the African civet ranges throughout the tropical Africa in the sub-Saharan area from Ethiopia to Senegambia across South Africa, 15 degrees N to 24 degrees S latitude. The east-west range is from Senegal all the way to Djibouti and Southern Somalia (Hillman, 1987).

Their range extends south to Botswana, Namibia and South Africa, although it is more restricted and generally found in the north-eastern regions of these countries. The African civet also inhabits the islands of Zanzibar, but absent in Madagascar. They are rarely found in arid regions; except along river systems that project into the arid areas of Niger, Mali and Chad (Estes, 1991). In southern Africa, distribution of the African civet is more restricted. It is found throughout Zimbabwe and Mozambique. In South Africa, they occur in the northern and eastern regions of Transvaal and in Namibia in the extreme northern and eastern regions. In Somalia, African civets occur in the extreme south, between the Juba River and Kenya. They are absent in Eritrea and drier areas of the horn of Africa (Fig.1.1) (Kingdon, 1997; Shalu, 2000).

They live in forests, marshes, grassy savannas, reed beds and in tall grassy habitats and prefer to live near water sources (Kingdon, 1977). Wherever they live, they require some sort of long grasses and thickets around to hide during the day time. They inhabit tropical rainforests and dry savannas where there are thickets and burrows. They occupy both the forest and open country, in a variety of habitats across Africa. They can be found in lowlands and montane forest, swamp and even open savanna and arid areas (Ray, 1995; Kingdon, 1997).

It has been recorded from sea level up to elevations similar to that of Mount Kilimanjaro. Although the African civet does not depend on permanent water sources, they are more common in areas alongside rivers. African civets usually are not resident of deep primary forest but can exploit deforested and degraded areas despite the fact that they prefer to be near human developments (Kingdon, 1997; Dagnachew Melese *et al.*, 2014).

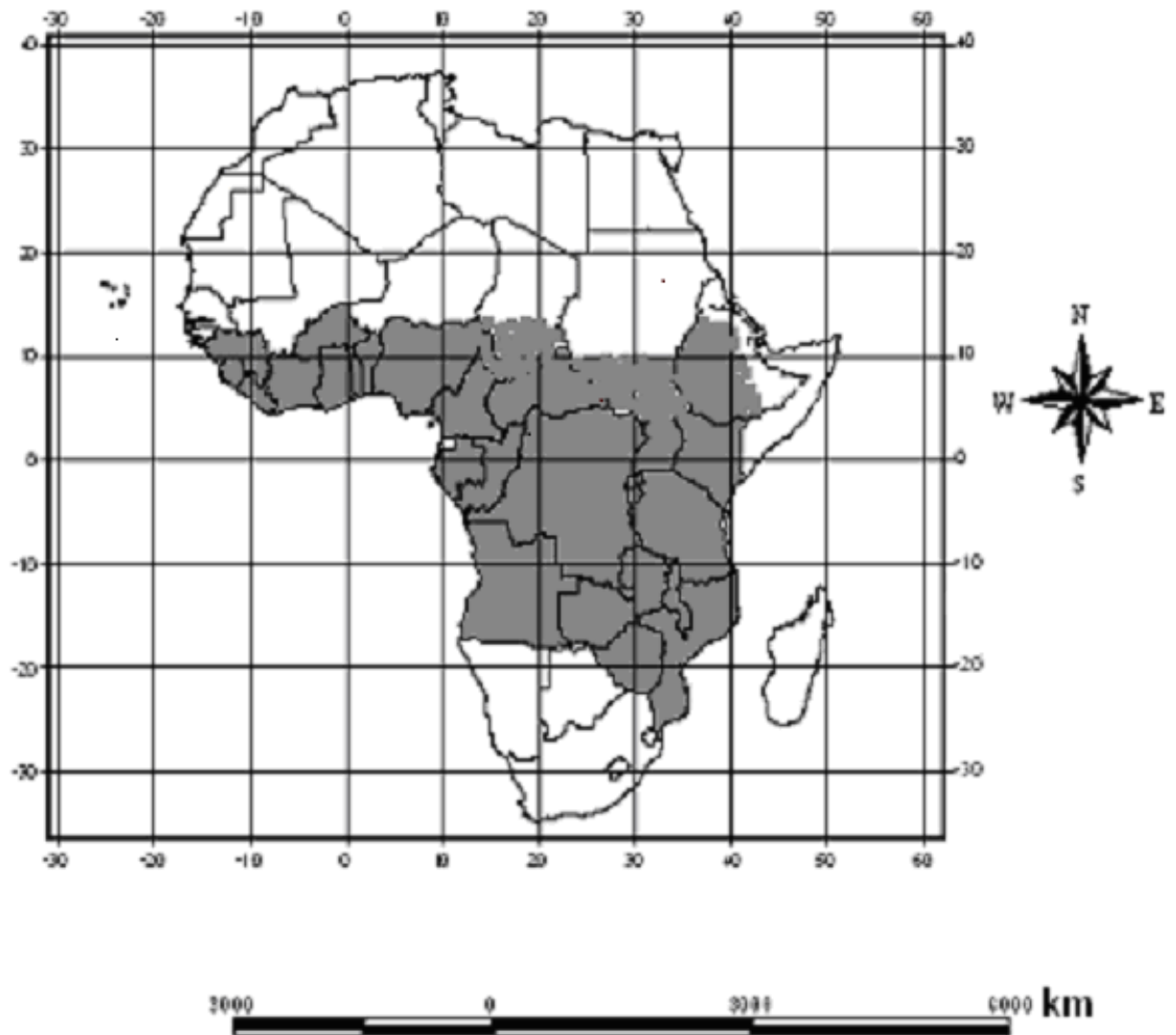


Figure 1.1 Distribution map of African civet (Source: Skinner and Smithers, 1990)

Most viverrids are secretive, nocturnal, shy, and occupy dense vegetation that makes studies on them difficult (Hussain, 1999; R-Zu-2-U, 2000). They raise their young in

underground burrow which were dug by other animals. The young rely on their mother's milk for the first six weeks of life. Unlike most carnivores, young civets are born well developed. They have fur and are able to crawl at birth, and within the first week, they are able to support their body and walk around. Females raise young by themselves. Males mate randomly (Mallinson, 1972; Hongfu, X. and Helin, 1994).

For many reasons, the African civets practice promiscuity. The male has no part in raising the young probably because of uncertainty of paternity and due to solitary behavior. Only shorter period of maternal care is needed among civets unlike most mammals. Predation is at lower levels in the case of civets (Ray, 1995; Gittleman, 1996).

The most common vocalization is a "ha, ha, ha" sound, although they are capable of growling, screaming, and coughing-spitting. Civets make three types of sounds – a growl, a cough-spit, and a scream, but the most commonly heard is the "ha ha ha" used in making contacts (Schliemann, 1990; Nowak, 1999).

The African civet is omnivorous in diet and feeds mainly on fruit and small animals. It is even known to depend upon domestic food wastes. The omnivorous diet includes carrion, rodents, birds, eggs, reptiles, frogs, crabs, snails, insects, centipedes, millipeds, small mammals, fruits, and other vegetation. The African civet is able to eat items that are usually poisonous or distasteful to most mammals, including the fruits of *Stychnos* (bitter tasting plant), poisonous invertebrates (such as the centipedes and millipedes which most other species avoid) and snakes and highly-decayed carrion (Gittleman, 1996; Smithers, 1986). Prey is primarily detected by smell and sound rather

than by sight. Poultry and young lambs are sometimes taken. They are most active about an hour or so after dark when they forage (Ray and Sunquist, 2001).

African civets do not use their paws and claws for catching prey. Instead, they kill the prey with their teeth. The killing methods include shaking their heads to break the prey's spine, throwing it around or the use of a killing bite wherein the grip is not released until the prey is dead. Civets display various hunting behaviours. The prey may be shaken so violently (death shake) that the spinal column is broken or a rodent may be bitten and thrown around (Schliemann, 1990; Estes, 1991; Shalu, 2000).

African civets can consume about 2 kg of food at a time. They also can stay without food for about two weeks (Kingdon, 1977). They seem to have a unique digestive system to eat a variety of food items. The African civets hide and wait for prey to come along, and then they pounce and kill it by biting with their strong jaws (Hussain, 1999). When the civet grabs the prey in their jaws, it shakes the prey violently. When the prey is dead, civets then scarf down the food with little chewing in a very short period of time. This enables them to eat quickly and keep moving so that they are not targeted by larger predators (Estes, 1991; Nowak, 1999).

African civets have communal latrines or dung piles called 'civetries'. 'Civetries' or dung piles are often established around tracks in clearings. Civetries also serve for olfactory communication and to mark territory boundaries. Scats are left in an unburied pile (Kingdon, 1997; Trites *et al.*, 2005; Bekele Tsegaye *et al.*, 2008).

Humans kill civets as a revenge for raiding poultry and crops. They are also killed for their meat, but there is no such practice in Ethiopia. Predators of African civets include lions, hyaenas and leopards, but these predators are not as lethal as humans. African civets are also victims of road kill.

To avoid predators, civets walk with their heads down very close to the ground and the tail parallel to the back. This helps them to move around freely without being noticed in addition to the camouflaging of the colouring of their back and tail. The white colour of the face cannot be visible for predators when the civet is in this position. Occasionally they gallop into the surroundings for protection. They can also make the hair on their back erected so that the bodies double in size (Kingdon, 1988). Usually predators may not locate civets as they camouflage (Trites *et al.*, 2005).

The reproductive behaviour of African civets in the wild is not known in detail. Usually, females sexually mature after one year of age, whereas males mature slightly earlier, from 9 to 12 months. Females have their first litter when they are around 14 months old and may have 2 – 3 litters, every year. The gestation period ranges from 60 to 72 days. A litter contains 1– 4 young, born in a nest in a burrow or hollow tree trunk (Hillman, 1987; Nowak, 1999).

When the males and females find each other, the female approach the male and then dart back away in a fighting manner. This is an indication to the male about the receptiveness of the female. The male will not retaliate against the female's behavior. The female will then run past the male, which will end when the female lies down and the male mounts

her. The male will place its front paws on the female's shoulders and will tread his hind feet while making a pelvic thrusting motion. The first mount will last a few seconds and then the female will scoot forward. The male then remounts and grabs the female's fur by teeth at the peak of copulation. All these acts take only about 40 seconds. The female will meow during copulation. When copulation is complete and the male dismounts, both individuals will lick their own genitalia (Ewer, 1998; Proctor, *et al.*, 2005; Ritland, 2000).

Following a gestation period, the young (3 – 4 litters) are born in an advanced stage relative to most carnivores. African civet pups are born with soft, dark fur and light markings. They can crawl at birth and by five days old able to walk. Mothers nurse their pups for about six weeks. They start leaving the nest between 17 – 18 days, and the first sign of play behaviour is seen, when they are two weeks old (Gittlman, 1996; Macdonald, 2001).

The young are completely dependent on mother's milk for about six weeks. At the age of around 40 days, the mother provides solid food. By the second month, they are able to catch prey by themselves, although the mothers give solid food until they develop hunting abilities. The behaviour of mouth suckling, in which the young licks its mother's mouth and drinks her saliva, is seen just before the mother begins to provide the young with solid food. The mother transports the young in her mouth, clasping them by the back or by the neck. Captive mothers sometimes kill and consume their young at birth (Schliemann, 1990; Shalu, 2000).

If a mother happens to lose her pups, she will go back into oestrus within 14 days. If pups were to become lost before it is ready to leave its mother, both will meow until they find each other. This is used so that the mother and pup can find each other (Kingdon, 1997).

The African civet has various breeding seasons throughout the continent, but they are known to mate in warmer months when insects are readily available. African civets living in West Africa breed year round. The breeding season in the central and southern Africa is from August to January, whereas on the east coast in Kenya and Tanzania civets breed from March to October, when insect populations increase. Thus, the female ensures increased and plentiful resources for her offspring (Smithers, 1986; Ewer, 1998). As they are solitary, they must communicate well to ensure a mate during their mating season. They mark trees and other vertical objects by their perinael gland secretion, the civet musk. This musk has a very strong odour that can be noticed for at least four months (Ray, 1995; Kingdon, 1997).

Amongst other purposes, scent marks give other African civets sexual and hormonal information so that males know when females are in oestrus and females will know when males are around and available. If a civet smells a marking of another civet, they will sniff around it, and then mark on the top of the first mark (Alberts, 1992). This could be because the second civet knows the first individual must be close around and will walk by the site sometimes. Their marks could help to find each other to mate for breeding. During times of sexual activity, the females also contact the males through olfactory senses that are in the female's urine. The female will urinate on objects around her range so that the male can locate her (Williams and Curtis, 1994). Females will also meow

when in oestrus to attract the attention of males in her range. Like most cats, both sexes of the African civets will also increase range size during mating time. This is to increase the chances of contacting an individual of the opposite sex. When looking for a female, the male walks with his mouth slightly open in the enlarged range (Ewer, 1998; Williams, 2003).

Derived from the Latin name of a species, 'civet' is the secretion of civets, which has been in use as a traditional medicine for treatment of pimples and wrinkles in south India (Xavier, 1994). The magical effect of the civet oil is useful in getting relief from pimple, ache (pain), freckles (red or brown spots on the skin), wrinkles, pigmentation and sunburns. Nicolas Lemery, a French Doctor (17<sup>th</sup> C) believed that civet was useful for all diseases of the head, brain and womb, and could be used to perfume cordial waters and powders when mixed with musk and ambergris (Fisher, 2001; Sreedevi, 2001). If civet musk is put in the ears with a little cotton, it would help to relieve hardness of hearing (Schreiber *et al.* 1989, William, 2003). There are also a number of names for this substance such as "Zibethum, Zibetha, Civeta, Zepetium or, in English, Civet musk (Mohan, 1994; Williams, 2003).

Musk is a class of aromatic substance commonly used as base in perfumery. They include glandular secretions from animals such as the musk deer, numerous plants emitting similar fragrances, and artificial substances with similar odours. Musk is a name originally given to a substance with a penetrating odour obtained from the musk gland of the male musk deer of the genus *Moschus* (Wright, 2007).

This substance has been used as a popular perfume fixative since ancient times and is one of the most expensive animal products in the world. This is pure anointing oil for external use only. Civet essential oil is one of the most expensive and exotic oils that are used in perfume Industry (Heal, 1988; Anonis, 1997; Wright, 2007).

Civets use their 'civet' (civet musk) as a means of olfactory communication signal. They scent-mark on environmental objects or sign-posts by civet musk to communicate with their mates, partners and other civets. Scent-marks appear to be concentrated on trees fronting roads and pathways, especially trees that produce fruits eaten by civets. A passing civet pauses at intervals to press the averted perineal gland against a trunk (Estes, 1991). The secretion is thick, yellowish grease that hardens and turns dark brown and more visible with age, while the powerful and disagreeable scent remains detectable for at least four months (Kingdon, 1988; Wozencraft, 2005).

Civets themselves smear their oil on their dunghills and on rocks and branches in their territories as signs of ownership, warning others to keep out and for mating purposes. They mark their perineal gland secretion by backing up to an object, raising the tail, averting the gland, and pressing it onto the surface to scent mark. Civets communicate through various calls, scent marking, urine and dung piles. Individuals may have defined and well-marked territories. The scent glands have a major social role, leaving scent along their pathways to convey information on their social and reproductive status (Randall, 1979; Mohan, 1994).

The use of smell to attract the opposite sex is commonly adopted and practiced by animals and humans and hence the use of a scent to attract partners. Among the scents, the most widely used fragrance is the civet oil. Perfume comes from the Latin “per” meaning “through” and “fumum” or “smoke”. Many ancient perfumes were made by extracting natural oils from plants through pressing and steaming and the oil was then burned to scent air (Wozencraft, 2005). While fragrant liquids used for the body are often considered perfume, true perfumes are defined as extracts or essences and contain a percentage of oil distilled in alcohol and water (Wright, 2011). Perfumes are used to heal, make people feel good and improve relationships particularly between members of the opposite sex. The sense of smell is a brain activity, which rules emotions, memory and creativity (Alberts, 1992; Williams and Curtis, 1994).

The secretion of the civet musk has a strong-smelling odour, but when it is diluted and processed, it gives a deep feminine pleasant odor. This is made through purification of the animal's perineal secretion in alcohol and then the perfume is diluted and used in minute quantities (strong amount can provoke vomiting in humans). The compound in the ‘civet’ is a molecule named ‘civetone’, a cyclic ketone closely related to muscone (the principal odoriferous compound found in musk). Civetone has a heavy, musky, smokier, sweaty and pleasant odor that is still considered essential in perfumery, where it is used as a stabilizing, fixative agent in many most quality perfumes because it lasts longer.

“Civet” contains about 62% unsaponifiable matter, 34% low-melting fatty acids, and small amount of wax. The unsaponifiable matter consists of hydrocarbons, alcohols and

ketones. Ketones include the characteristic musk-like odour component called “civetone”, which occurs at the concentration of 2–4% (Kingston, 1965). Recently, 52% of civetone was reported to occur in pure civet musk by laboratory analysis. Civetone is a colorless crystalline compound with an unpleasant odour. It has a melting point of 32.5°C a boiling point of 158°–160°C, and is soluble in alcohol. Civetone is the source of the characteristic odour of civet. It is a 17-member ring-ketone, as opposed to the 15-membered muscone from the musk deer. It is used in the form of a tincture in the preparation of perfumes (Kingston, 1965; Dennenfeldt, 1985). C<sub>17</sub>H<sub>30</sub>O 9-Cycloheptadecen-1-one, a macrocyclic ketone component of civet musk is used in perfumes because of its pleasant odour and lasting quality, believed to function as a sex attractant among civets (De-Sheng, 1986; Wright, 2011). Already in 1936, the famous Croatian-Swiss Chemist Leo Ruzicka identified the most important musk compound in civet to be 9(Z)-cycloheptadecenone (Fisher, 2001) an unsaturated alicyclic ketone having the following structural formula:

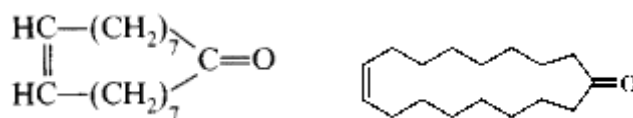


Figure 1.2 Chemical structure of Civetone

Ancient historical trade of Africa across the Sahara or down the Red Sea into the wider Islamic world had been black slaves and gold. However, two important and valuable

African tropical export market commodities from at least the early Middle Ages were wild civets and the civet musk ('civet') they produced (Al-hassan and Hill, 1992). It was highly valued for fragrance and a stabilizer by perfume-makers in the Arab Maghreib, Egypt, Middle East and later in Europe, musk was widely traded in Africa, across the Sahara, the Red Sea and in the Mediterranean (Mohan, 1994; Prescott-Allen and Prescott-Allen, 1996).

In past centuries there was a very wide trade across Africa and the Middle East in 'civet' and other ingredients for perfume and medicine (Pankhurst, 1961; 1968). In the mid-fifteenth century, Venetian merchants visited the coast of West Africa and its offshore islands, finding a trade of civet musk even in Senegambia. 'They give an ounce (oz) [1oz = 28.349523 g] of civet musk as an exchange for something that was not worth even 40 or 50 marchetti (60–75 g of gold), sold not by weight but by estimate (Bovill, 1966; Hopkin, 1973; Goitein, 1993).

In the early 19<sup>th</sup> century, the Swiss John Lewis Burckhardt, travelling on behalf of the African Association, learned that merchants brought civet musk from the Blue Nile, which they then carried across the Red Sea to Jidda (Poncet, 1709). There it was sent to Massawa, the Red Sea port of Ethiopia, and to Mecca during the Haj season, or taken up to Cairo by merchants from Jidda (Burckhardt, 1819; Pankhurst, 1961). Around the same time, civet musk was one of the recognized diplomatic gifts between Muslim and Christian rulers in Ethiopia (Pankhurst, 1968; Fisher, 2001; Wright, 2011).

At the end of the 19<sup>th</sup> century, it was reported that some caravans crossing the Sahara from the Sudan to Tripoli were bringing as much as 50–80 kg of civet musk, which might have been regarded as an acceptable, substitute for the black slave trade (Waltz, 1978; Wright, 2007). Although at present widely replaced by artificial ingredients, civet musk is still used in perfume making; but there is increasing concern about the animal rights implications of obtaining the musk from live animals (Fisher, 2001; Wright, 2007).

The practice of keeping civets in captivity to extract and sell musk in Ethiopia is a tradition since centuries. It is written in the history of Ethiopia that the legendary Queen Sheba (1013-982 B.C.) presented civet musk as a precious gift to King Solomon when she visited Jerusalem. In Ethiopian early history, civet musk was expensive and used as a currency (Pankhurst, 1961 as cited in Yilma Delelegn, 2000) and traded with Egypt, Zanzibar and India. Civet musk was valued above ivory, gold or myrrh. Traditionally, it was used as a medicine for various ailments and is taken with tea and coffee (EWCO, 1995; Jemal Mohammed, 1999).

Poncet, the French traveler, who arrived in Gonder in the 17<sup>th</sup> Century noted that Enfranz (North Gonder) as an important town for civet farming (civiculture). This term seems misleading or overlapping with the clan known as Enfranz, who are said to start civet keeping as one group of Alebets tribe known to be experts in trapping African civets from the wild in the area of Limu (currently District of Jimma Zone). Since then civiculture spread to neighbouring areas including Enarya, Jimma, Illubabora, Wollega and many parts of Ethiopia (Pankhurst, 1961; 1968; EWCO, 1999).

Enfranz town could have been the market center for civet musk (zibad in Amharic) trade as it was the center for other export trade items as well. But, captive management of African civets was believed to have been started and practiced in Limu Districts of Jimma. Before his arrival at Gonder, Poncet had witnessed civet musk trade alongside ivory, tamarind and gold (WSPA, 1998, currently WAP). The history is controversial, but it is possible to conclude that civet musk was one of the major trade items exported from Ethiopia to Northern Africa, the Middle East and to other parts of the world (Waltz, 1978).

Chronicles of Napoleon Bonaparte's 18<sup>th</sup> Century expedition to Egypt as well as accounts of other expeditions of that period refers to the civet musk trade (WSPA, 1998). In 1872, Anatolia Cheche noted that the King of Jimma, Aba Jifar Abagamol had an area in his palace for civiculture (EWCO 1999; WSPA, 1998). According to Pankhurst (1968), civet musk was exported directly from Gondar. It was a major Ethiopian export item in the 1800s and in 1840 accounted for 13% of the export trade (Woodford, 1990). Today, the districts of Illubabora, Wollega, Jimma, Shoa, Kaffa, Sidama and Gedeo are known to produce civet musk in large quantities.

At present civiculture has a complex social dimension. In Ethiopia, mostly people of Muslim community are practicing civiculture. According to oral history, the legendary leader Nessiru Allah, who lived in Limu suffered from an eye affliction that was cured by application of civet musk. Once cured, Nessiru Allah ordered followers of Islam to practice African civet farm (Mesfin Admasu, 1995). Perhaps the most interesting fact

about the African civet musk trade is that it has persisted for so long and its husbandry practices have undergone only little change (Fikadu Shiferaw, *et al.*, 1997).

The practice of keeping civets in captivity was developed in the Oromia region, Jimma Zone/Province specifically Limu Districts. According to personal communication with civet farmers in Wollega (Haji Muktar from Nekemte and Haji Isa from Gimbi), those who initiated civet farming were settlers, whose origin is thought to be from Yemen, settled in Limu-Saka. The tradition of civet keeping was estimated to have started about 50 generations back. The beginner groups were known as ‘Alebeds’, who claim themselves as relatives of Prophet Mohammed. Therefore, civet keeping practice and expansion of Islam seems to be associated with each other. The first clan was known as ‘Infranz’, people with similar name in Gondar, the ancestors of Nagesso, who are inheritants of families of Alebeds. The practice of civet trapping and keeping was transformed to other Muslim families of Alebeds, such as Yamine, Darita, Infranze, Saddo, Haji, Mantina, Wasil and Sherifi. Captive civet keeping then extended and practiced by the people in area King Aba Jifar Aba Gomol as the result of marriage with the civet keepers of Limu area (Kifle Argaw and Kumera Wakjira, 2003). Currently, Ethiopian civet keepers are centered in Illubabora, Jimma, Wollega and West Showa. There are also few farmers in SNNPRS, practicing the tradition in Hararge, Sidama, Gedeo, Wondogenet, Kaficho and in some other areas in Ethiopia.

Some civet keepers believe that Islamic leaders blessed and ordered civet farming for their followers, and since then most of civet keepers in Ethiopia are Muslims, even though currently there are few non-Muslim civet farm owners in the central part of the country.

Poor captive management is the main problems of civet farms, as the traditional belief hinders civet farmers from allowing veterinary professionals to treat captive civets. Other problems are poor management under captivity such as feeding, sanitation and use of traditional cages. Adulteration of the civet musk is also common, which is directly related to the prevailing marketing problems of civet musk.

The majority of civet musk of Africa originates in Ethiopia. Civet farming in Ethiopia is concentrated mostly in western, southwest and southern parts of the country. The farmers have inherited the tradition from their forefathers and have maintained it for centuries. Civets are trapped from the wild and kept in captivity in cages to extract the musk. Some of the civets die within the first three weeks of captivity due to severe stress and physical pain during capture, transportation and quarantine (WSPA, 1998).

Improved management is also basic to the conservation of civets in Ethiopia. Breeding practice is another component of this research program to avoid problems associated with trapping and to contribute to the conservation of the animals as suggested by WSPA (1998).

Due to cultural and religious beliefs handed down from forefathers through generations, many civet farmers do not allow entry of strangers and even family members into the house where civets are kept. Also almost all of them do not reveal the exact number of civets they have in captivity. Another belief is that if a stranger looks at food supplied to civets, the amount of civet musk production decreases and also the civet will eventually die. These beliefs made the investigation so difficult. But conditions are improving

through the efforts being taken by EWCA, Oromia Regional Government, OARDB and OFWE, and mainly with this research work through training and awareness creation, demonstration and supply of sample modern cages for trapping and keeping civets. Some civet farmers have shown attitudinal changes and are permitting visit of captive civets by veterinarians and officials.

Civet musk production is not constant from year to year (Table 1.1). Most probably, this could be attributed to fewer efforts to promote civet farming and management as well as due to civet musk marketing problems. Despite the fact that Ethiopia has a long history in civet musk trade, it is yet to produce adequate amount to fulfill the global market demand.

The demand for civet musk from perfume industries is high, but Ethiopia is able to supply only a maximum of 25% of the global demand. There are also external factors including the opposition by animal welfare groups such WSPA, which has not considered the core of the problem and worsened the plight of the animals and kill the industry at the same time. The lobby by animal rights groups is asymptomatic approach to a sickness that ignores the whole body (Yilma Delelegn, 2000).

All stakeholders have their contribution to the poor captive civet farm management and less production of civet musk as well as for problems associated with civet musk trade. Therefore, all stakeholders should come together to discuss and find a solution to develop

Table 1.1 Revenue (USA) from Civiculture in Ethiopia (1985 to 2011).

Year	Musk in kg/y	Revenue (US\$)	Income /year (Birr)	Musk service charge (Birr)	Total income (Birr)
1985	1,836.74	826,533.00	-	55,102.00	55,102.00
1986	1,840.60	828,270.00	-	55,818.00	55,818.00
1987	1,858.01	836,104.50	-	55,740.30	55,740.30
1988	1,412.73	635,728.50	-	42,381.90	42,381.90
1989	1,022.90	460,305.00	-	60,637.00	60,637.00
1990	1,732.00	779,400.00	-	51,960.00	51,960.00
1991	342.70	154,215.00	-	10,281.00	10,281.00
1992	359.00	161,550.00	-	10,770.00	10,770.00
1993	536.00	241,200.00	-	38,278.95	38,278.95
1994	880.00	395,136.00	-	64,240.00	64,240.00
1995	1,005.00	452,250.00	-	73,365.00	73,365.00
1996	776.00	349,200.00	2,339,640.00	56,648.00	2,396,288.00
1997	337.00	151,200.00	1,038,744.00	24,601.00	1,063,345.00
1998	1,162.00	749,900.00	3,592,323.00	84,826.00	3,677,149.00
1999	1,131.40	509,130.00	4,159,592.10	82,592.20	4,242,184.30
2000	530.00	238,500.00	1,948,545.00	48,180.00	1,996,725.00
2001	725.00	326,250.00	2,720,925.00	46,172.50	2,767,097.50
2002	1,559.00	701,550.00	6,005,268.00	113,807.00	6,119,075.00
2003	702.2	315,990.00	2,711,194.00	51,260.60	2,762,454.80
2004	721.3	324,585.00	2,814,151.95	52,654.90	2,866,806.85
2005	739.3	332,685.00	2,877,725.25	53,968.90	2,931,694.15
2006	640.53	288,238.50	2,408,358.69	46,758.69	2,455,117.38
2007	975.83	439,123.50	3,847,698.10	71,236.00	3,918,934.10
2008	820.00	369,000.00	6,033,330.00	59,860.00	6,093,190.00
2009	580.50	261,225.00	2,717,514.00	42,376.50	2,759,890.50
2010	1,157.70	520,965.00	6,363,675.00	84,552.10	6,448,227.10
2011	1,116.00	502,200.00	8,305,841.03	81,468.00	8,387,309.03
2012	1745.00	-	-	-	-
<b>Total</b>	<b>26,499.44</b>	<b>11,923,434.00</b>	<b>59,884,525.32</b>	<b>1,519,536.54</b>	<b>61,404,061.86</b>
%			<b>97.53</b>	<b>2.47</b>	<b>100</b>

Source: EWCA archive, 2012)

and maximize their contribution in promoting better income generation for all who involve in the business and contribute to the economy of the country through foreign exchange earnings. African civet captive maintenance practice by itself should not be taken as a threat to the welfare survival of civets.

Ethiopia supplies about 90% of the world's civet musk, which amounts on average of about 1500 kg per year. This is about 25% of the total global demand. The world demand is about 6000 kg per year. Niger and Senegal export small quantities. Past exporters include Ghana and Zanzibar (Jemal Mohammed, 1999).

Traditionally, the civet musk is used for medicinal purposes in Ethiopia, especially for body ailments ranging from the relief of headache, discoloration on skin, itching and as a cure for several other diseases. Usually minute amount of the musk is taken with coffee (Jemal Mohammed, 1999; Bultuma Queno and Bekele Tsegaye, 2004). It is also known that in India civet musk is used for various purposes as a major component of tribal medicine in treating asthma, respiratory ailments, as remedy for pimples and skin discolorations, and in several Ayurvedic drug preparations (Sreedevi, 2001). Further, it is also used in traditional incense stick preparations and for flavouring tobacco. It also serves as an aphrodisiac. In earlier times some tribal people were offering dried civet musk pouch as a gift to their Kings during the annual ceremony (Xavier, 1994).

Ethiopia is the country where African civet farming was initiated. Although people have been holding civets for generations, scientific husbandry and modern management practices are not well established. The traditional civet farming practice and its trading system have undergone only little changes during the past centuries.

It was in this context that the present investigation was initiated to study the civet farming practice in Ethiopia and to try to improve the practice with the intention of improving the livelihood of the civet farmers and the welfare of captive civets in Ethiopia.

### **1.3 OBJECTIVES**

#### **General objectives**

The general objectives of this research was to study the feeding ecology, breeding, captive management and socio-economics of civet farmers in Bedele District, Abdela area of Illubabora Zone, Ethiopia.

#### **Specific objectives**

The specific objectives of the present study were;

1. To study the feeding ecology of the African civets in an area of mixed natural forest, farmland and coffee plantation in Abdela areas of Bedele district in Illubabora Province.
2. To study the effect of quality and the quantity of food items on civet musk production in productivity
3. To study the differences in the amount of civet musk available for collection based on different time intervals of extraction.
4. To compare the differences in the quantity of civet musk production between males and females under captivity.

5. To study civet husbandry and management using modern cages and modern husbandry techniques.
6. To study the attitude of civet farmers on captive management of civets and conservation of the African civet, and to convince them to implement modern husbandry methods.
7. To analyze and study civet musk trade to improve the livelihood of civet farmers and their contribution in foreign currency earnings of Ethiopia.

### **Significance of the study**

Captive management of African civets has a very long history in Ethiopia, but the practice is less developed even though it has been practiced through generations. Civet musk has been a valued item of trade, and used in traditional medicine in Ethiopia. The trade in civet musk was established as early as the legendary Queen Sheba. Despite the long history in civet musk production and trade, Ethiopia could not produce adequate amount to meet the global demand for the musk mainly in perfume industry.

The 1998 report by World Society for the Protection of Animals (WSPA) on captive civet management in Ethiopia has brought negative impact on the civet musk trade. The report calls international customers not to buy civet musk from Ethiopia unless improvements are not made on the captive maintenance and management of civet farms.

The intention of civet farmers is to get better market access to get good price for their product. The civet musk market is secret and is led by middle men, exporters and

importers. The market is determined by middle men and there is no increase in price compared with the cost during the last two or more decades. The cost for captive civet management has increased ten folds in the recent past. Civet farmers appeal to work on improving civet musk market. They have promised to work to promote modern captive management and handling towards modern ways of management.

## **Research hypothesis**

### **1. Feeding ecology in the wild**

1.1 There is significant difference in the feeding habits of the African civets in the wild with seasonality in the study area. There is variation in food availability and preference of feeding during the wet and dry seasons. Some food items are consumed more than the other and some are least consumed.

1.2 There are several food items most frequently consumed by African civets in the study area based on availability and preference of feeding.

1.3 Feeding in the wild is influenced by food availability. Some foods are consumed more than the other while some are consumed less due to scarcity even though they are more preferred.

### **2. Civet musk Extraction**

2.1 The time gap of civet musk collection influences the quantity of civet musk production. Extraction of different days gap could give different amount of civet musk results.

2.2 Some of the food items influence the musk production. The quality of food fed to the civets could determine the amount of civet musk production.

### **3. Civet musk production difference between male and female African civets**

3.1 There is a major difference in musk production between male and female African civets. Civet musk production could be influenced by sex of the African civets.

#### **4. Trapping**

4.1 Modern trapping could be more appropriate for trapping African civets from the wild.

#### **5. Attitudinal changes of the civet farmers**

5.1 Most civet farmers are willing to change their attitude through awareness creation demonstration and improve captive maintenance of civets following modern management plans.

## 2. THE STUDY AREA AND METHODS

### 2.1 The Study Area

This research was carried out in Illubabora Zone Gore and Bedele Districts. Abdella Village is the study area in Bedele District (Fig. 2.1) where captive study was conducted with civet farmers. Illubabora Zone is one of the 18 Administrative Zones (Provinces) of Oromia Region of Ethiopia. This zone is known for its extensive coffee forest and broad leaved natural forest with high biodiversity. Illubabora Zone is the second largest zone of the region. The land area coverage of this Zone is 1,644,478 ha. This Zone has 22 Rural and 2 Urban Districts and 501 Farmers Associations. The population of this Zone is estimated to be 1, 278, 183 people, out of whom 640,159 are males and 638,024 are females. The population density is 72.31 km<sup>2</sup>. Out of this, about 95% is dependent on agriculture for livelihood. Around 88% of this population lives in rural areas. The total cultivated land of the Zone accounts 44.22%, grazing land 7.45% and forest land about 28.5% (ECSA, 2012). African civet farms are distributed throughout the western part of the country but some of the visited farms were in West Showa, Wollega, Jimma and Illubabora are presented in (Fig. 2.2).

According to the climatic zonation, Illubabora Zone is categorized by three agro-ecozones. These are three major climatic zones in this area as highland (13%), intermediate land (57.25%), and lowland (29.75%). The mean annual temperature is about 20°C, and ranges from mean minimum of 12.7°C to maximum of 26.1°C (Fig. 2.3). Rainfall is bimodal in most of the areas with about 600 mm in lowlands and 2,500 mm in the highlands (Fig. 2.4).

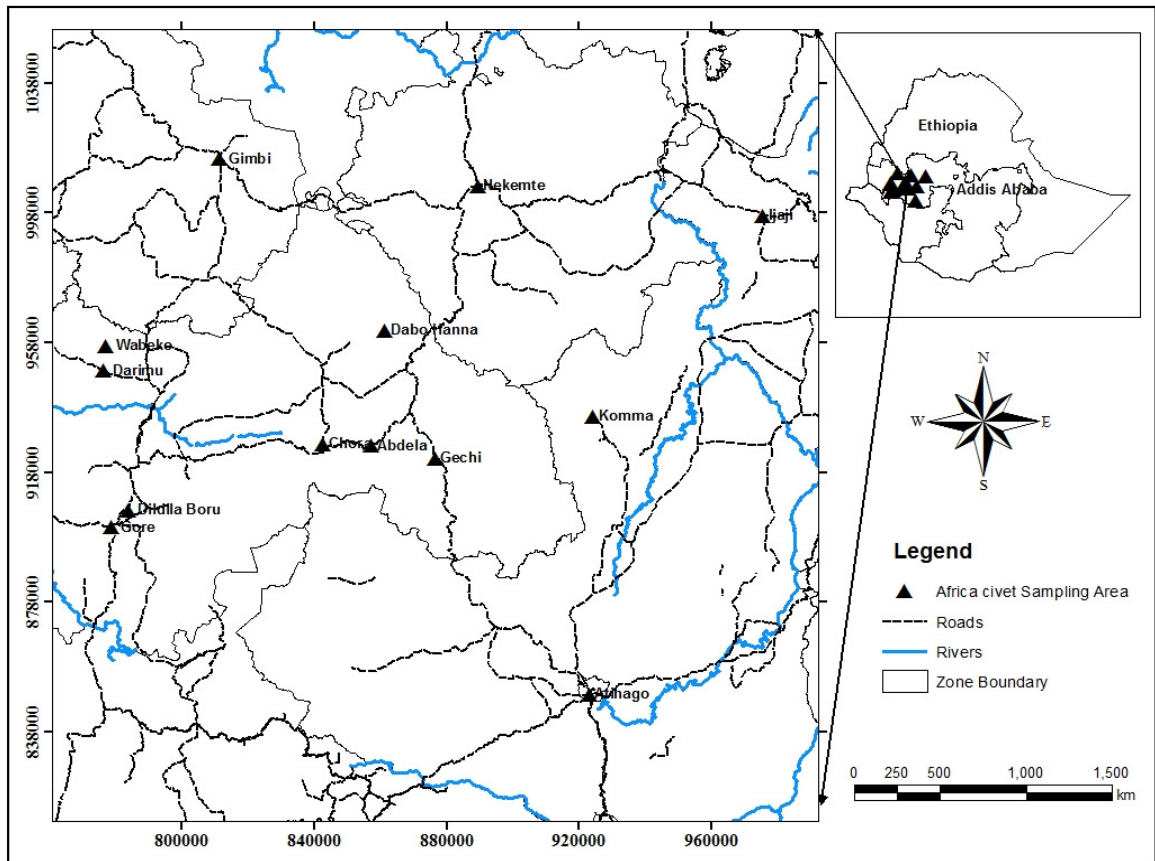


Figure 2.1 Map of African civet farm distributions in Western Ethiopia

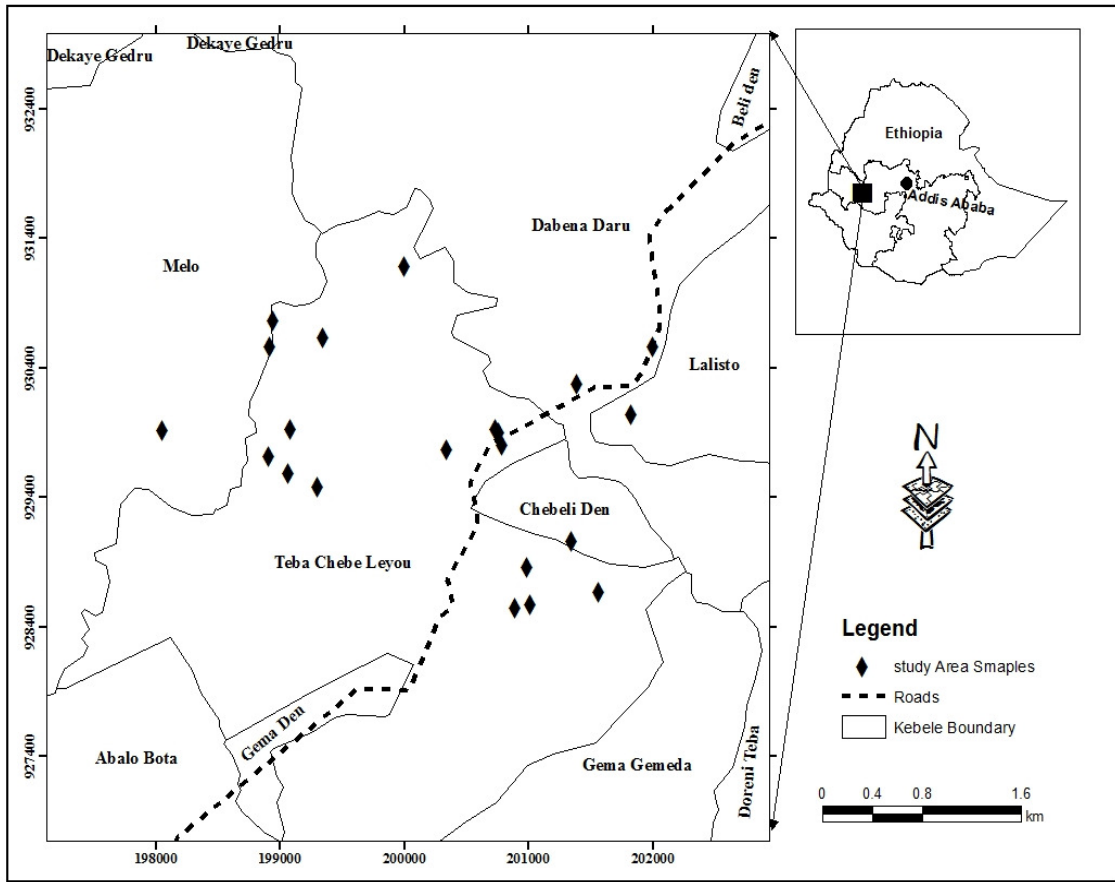


Figure 2.2 Map of the study area of showing 'civtries' location

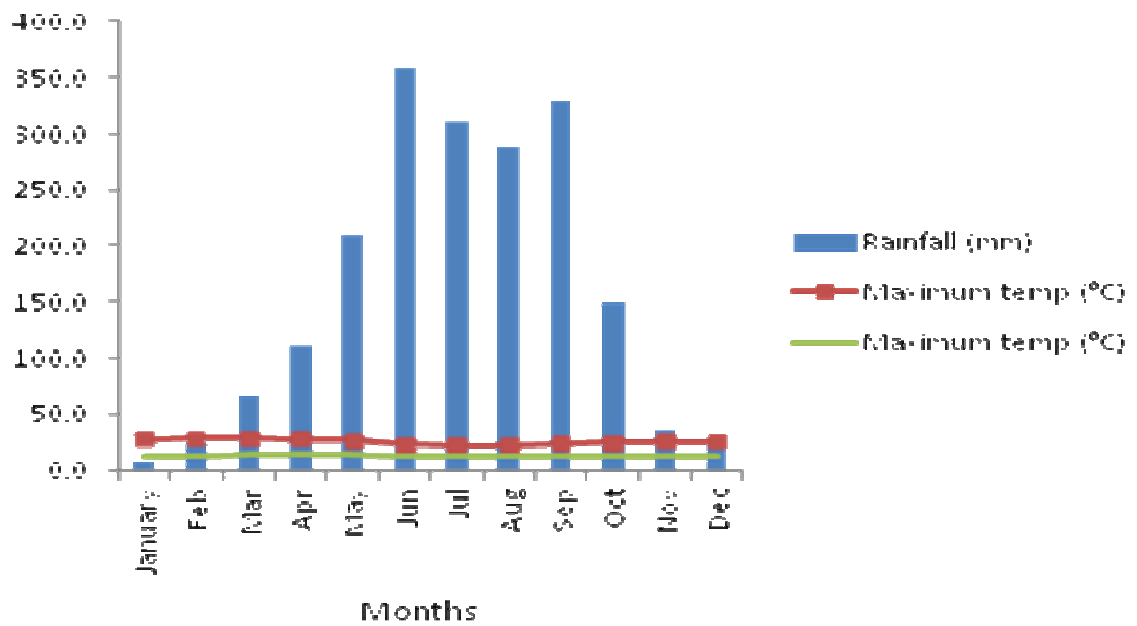


Figure 2.3 Maximum and minimum temperature and Annual Rainfall of Bedele area from 2000-2012

## 2.2 Methods

Feeding habits of the African civets were studied by direct observations and examination of fresh droppings collected from dung piles ('civetries') during wet and dry seasons. Fresh dropping samples were analyzed by observing undigested remains of foods such as seeds, bones, hairs, exoskeleton of insects and other undigested remains of plant items. The analysis was made by washing and filtering or by direct physical observation of the droppings. Fresh droppings were identified from the old ones by observing the overlaid grasses and leaves after each visit. During the dry season identification of the fresh droppings from the old one was easy due to fast rate of drying. Daily samples were collected and the components were identified. Presence and absence of fresh droppings were also recorded every day. Twenty five 'civetries' were identified and visited daily for 400 days of the study periods during wet and dry seasons. Identification of the local names of remains of food items recorded in the droppings was made with the help of local elders and civet farmers. Scientific names were identified with the help of professionals of the Department of Plant and Biodiversity Management, Addis Ababa University and with the help of herbarium collections of the University. Some civetries were washed away by flood or the over flow of streams during the wet season and such civetries are not used for data collection and analysis. During the dry season, some of the civetries that were abandoned were also excluded from analysis.

African civets are trapped traditionally by different methods and techniques. These are Net trap or 'Debbo' locally, String snare or 'Futassa', pit or ground hole trap or 'Bendo', and metallic snare or 'Kamatira' (foot trap). Some of these methods have risks of injury

while some are good if they are applied with precautions. To overcome the problem associated with traditional trapping, modern technique is developed and introduced by BAMRC (Bako Agricultural Mechanization Research Center). This modern trapping method is by using the modern cage, which also serves for transporting the animal to any destination.

Net trap is locally prepared and is used for trapping civets. This method involves at least three or more individuals to stretch the net around the animal during trapping. The method is applied after resting site of civet is specifically located. Netting will not harm civets, and hence this is a suitable method to trap them.

String trap involves 1.5 m string, a soft wooden pole that can bend down, pieces of twigs and a small shallow about 35 cm deep dug out pit in the ground. The pole bends down and is connected to twigs arranged on the opening of the pit. The trap is fixed on the pathways of civets and when a civet passes through and steps on the twigs it is trapped by the leg. The trappers stay around the trap to release the animal as soon as it is trapped to prevent injury due to animal pulls by the trapped leg and struggle to escape.

Metallic trap is a trap made up of metal. It is mostly used to trap carnivores such as leopard. It traps the leg of the animal which may cause injury.

The two traditional methods pit and metallic traps are rarely used due to high risks of injury. Civet farmers do not accept injured civets as the injury could result in the death of the animal.

The modern trap was made up of metal sheets and metal wire, originally invented by BAMRC. Based on complaints from some civet owners, it has been refabricated with wood. Modern cage trap is the best type, which has no risk of injury to the animal trapped. It is set with small piece of meat as bait in the area where civets visit frequently. This cage is also used for transporting the trapped civet to the desired destination by any means of transportation.

This modern trapping cage was demonstrated to civet farmers, and basic training was offered to farmers to create awareness on trapping and transporting civets.

The influence of intervals between the days of extraction of musk was studied by extracting civet musk under different time intervals of 5, 10 and 15 days gaps. Effect of diverse food items on the production of musk was studied after the supply of different food items such as maize soup, meat and mixed food items. There were nine civets involved in each of these studies. They were grouped into three as A, B and C (each with three individuals).

The soup was made up of maize with addition of butter or egg occasionally. Meat was purchased from the nearby butcher shop. It was composed of products such as digestive tract and boney parts of livestock. The meat was cooked and given to civets.

Mixed food items were with high protein composed of blood, ground bone, and other animal products. Mixed food items were processed and prepared by Addis Ababa abattoir as dog feed. The food was given to civets with soup and eggs.

Group A was supplied with soup group B was supplied with meat and group C was supplied with mixed food. Each of these was given for one month continuously and the groups were shifted for other food items for the second month. By the third month, each group was given all the three food items for one month. The results of the amount of civet musk collected after feeding each food item were recorded.

The effect of time gap on the amount of civet musk was studied at three time intervals as mentioned earlier. The weight of the musk extracted each time from each individual was collected in a pre-weighed container and the weight was recorded on a digital balance and compiled as a group data.

Extraction of civet musk was done following two methods. One was “Pure” extraction and the second “debisa” extraction. Pure extraction is the collection of civet musk without addition of other substances directly from the perineal gland. Traditionally, civet farmers do not apply this method except in rare cases, when they desire to collect civet musk for domestic use as traditional medicine. Debisa extraction is the method in which honeybee wax or butter is applied on the perineal gland of the civet after each extraction. According to the explanation of the civet farmers, it prevents itching and pain that could result due to scrapping by the spatula made of cattle horn to extract civet musk from the perineal gland. The other purpose is to prevent the flow of civet musk out of the perineal gland until the next musk collection time. The honeybee wax or butter added into the perineal gland is collected with the civet musk during the next extraction.

The extraction of civet musk in this study was done from male African civets only. The male African civets produce more civet musk quantity than the female. The smell of civet

musk from the male is stronger than the female. This was identified by smelling fresh collected civet musk and by weighing the civet extracted using balance beam. Civet musk production of male and female African civets was also compared.

Husbandry and handling of the African civet under captivity included housing, feeding, sanitation, health and extraction of civet musk. Modern methods of practices were compared with the traditional methods to convince the civet farmers by showing the difference between the two, and basic advantages of modern methods. Awareness creation trainings were offered. The use of modern cages for keeping the animal was also demonstrated.

Visit by a veterinarian was conducted and attitudinal changes were recorded among the civet farmers. Better maintenance and sanitation of the civet house was introduced on a daily basis by convincing the farmers about its importance of health for captive civets. The floor of the civet house was cemented for better sanitation and to maintain the civet house in hygienic condition. The need for proper construction of civet house with essential ventilation for free air circulation and light was advocated among the farmers. The application of modern cage for keeping civets was also demonstrated and model cages were supplied to model civet farmers.

Questionnaires were prepared and presented to evaluate the basic capacity and abilities of civet farmers to see their attitudes towards the modern methods (Appendix I). It was targeted to show the advantage of modern management practice over the traditional management practice. It was also included to evaluate the attitudinal changes of the farmers on the modern methods.

The data collected were analyzed using SPSS 20.0 version statistical programmes. Descriptive statistics for analysis of data, t-test for independent samples, chi-square and one-way analysis of variance (ANOVA) for comparison of means were applied. The statistical data analysis for feeding of African civets applied was Pearson test and multiple variant statistics. One-way ANOVA was used to compare mean seasonal variation whereas two-way ANOVA was employed to compare mean food item between habitats and seasons. The musk extraction analysis was analyzed by t-test statistics. Difference in the availability of musk in the experimental groups of civets with that of the control were analyzed by using P-value and t-test.

### 3. RESULTS

#### 3.1 Feeding Ecology of Civets in the Wild

There were 35 civetries in the study area from which food items were analyzed. However, continuous observations were carried out only on 25 civetries for 200 days during wet and 200 days during the dry seasons (Fig. 3.1). The remaining civetries were excluded due to rare visit by the civets and due to seasonal overflow of streams and flooding.



Figure 3.1 Field observation of the sight of one of the civetries of the African civet in the study area

Most of the food items were observed at different rates and frequencies.

Altogether, there were 31 food items identified from civetries throughout the study period. Out of these, 19 were during the wet season and 12 during the dry seasons (Tables 3.1 and 3.2). Among these food items, seven were common for both during dry and wet seasons.

There were 19 food items identified from civetries during the wet season throughout the study period (Fig. 3.2). The most frequently observed undigested remains of food items in the civet droppings were of worms, maize, insects, coffee and *Croton macrostachyus* (with 72%, 68%, 64%, 60%, and 52% ), respectively (Table 3.1). The least consumed food items were grasshopper (20%) *Podocarpus fulcutus* (20%) and *Prunus africanus* (16%) and these were occurred only during the dry season.

Table 3.1. List of food items identified from droppings of African civets during the wet season

Food items	F	Rank	Percent
<i>Coffea arabica</i>	15	4	60.0
<i>Croton macrostachyus</i>	13	5	52.0
<i>Ehretia cymosa</i>	11	6	44.0
<i>Prunus africana</i>	4	19	16.0
<i>Cyprus rigidifolius</i>	11	6	44.0
<i>Juniperus procera</i>	8	12	32.0
<i>Zea mays</i>	17	2	68.0
<i>Millettia ferruginea</i>	6	15	24.0
<i>Podocarpus falcatus</i>	5	17	20.0
Feather	9	9	36.0
Ants	11	6	44.0
Birds claw	7	13	28.0
Bones	9	9	36.0
Cockroach	6	15	24.0
Coleoptera	7	13	28.0
Grasshopper	5	17	20.0
Hairs	9	9	36.0
Insect exoskeleton	16	3	64.0
Worms	18	1	72.0

(Multiple variant Statistics)

Table 3.2 List of food items identified from civetries of African civet during the dry season

Food items	F	Rank	Percent
<i>Prunus africana</i>	7	6	29.2
<i>Cyprus rigidifolius</i>	4	9	16.7
Feather	5	8	20.8
Ants	7	6	29.2
Bones	9	3	37.5
Coleoptera	7	5	29.2
Hair	6	7	25.0
<i>Cordia africana</i>	14	2	58.3
<i>Ficus</i> spp.	21	1	87.5
<i>Dracaena steudneri</i>	9	3	37.5
Bushbuck hair*	3	10	12.5
Egg shell	3	10	12.5

(Multiple variant statistics, \* represents scavenging of bushbuck flesh)

There were 12 food items identified in the civet droppings during the dry season (Fig. 3.3). During this season, the most frequently consumed food items were *Ficus* spp. (87%) and *Cordia africana* (58%). This was followed by bones (37%) and *Dracaena steudneri* (37%). The least consumed food items were egg (12.5%) and bushbuck hairs (12.5%). These were seven food items totally absent during the dry season (see table 3.2).

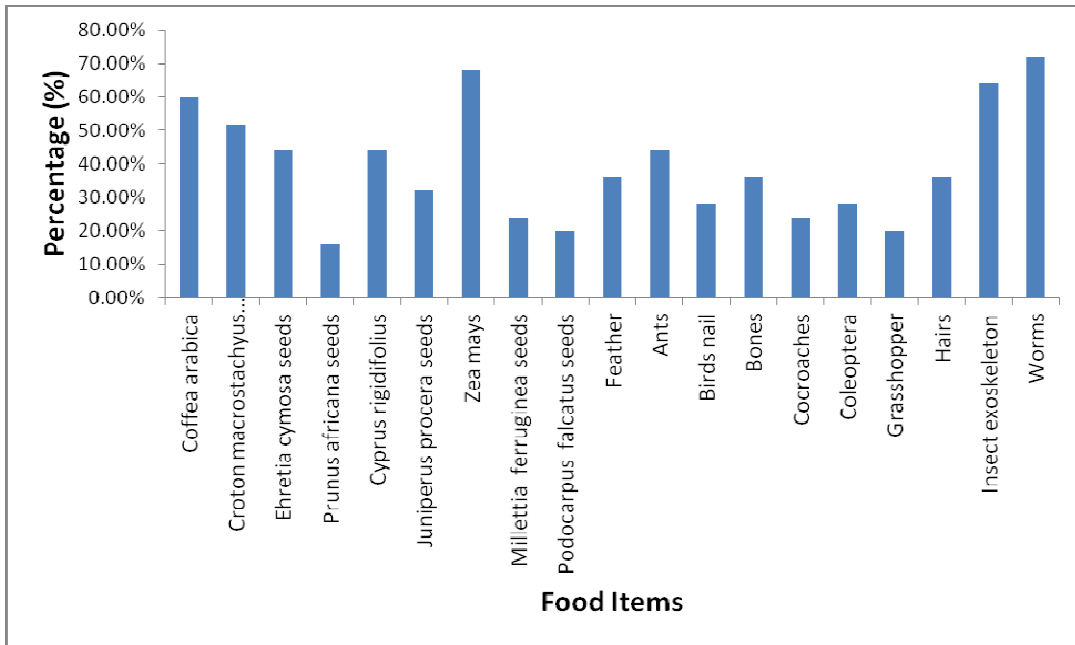


Figure 3.2 Percentage of food items of civets identified from civetries during the wet season.

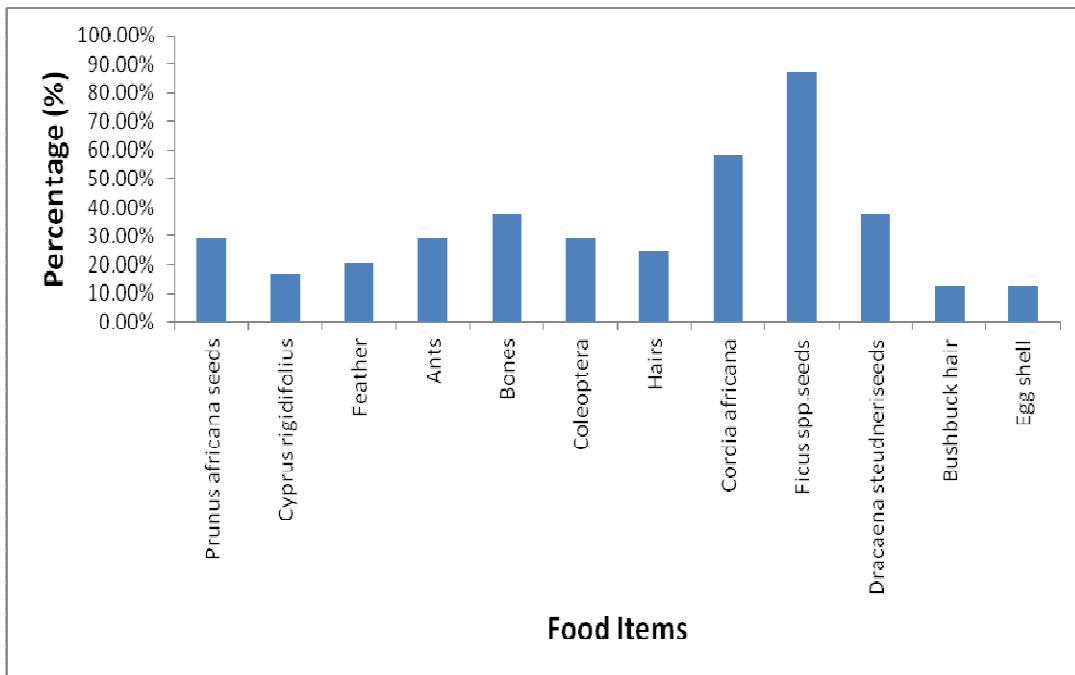


Figure 3.3 Percentage of food items of civets identified from civetries during the dry season.

Seasonal changes in the feeding behaviour of African civets were highly significant ( $t=6.87$ ,  $df = 48$ ,  $P < 0.05$ ). However, seasonal variation in the frequency of occurrence in the droppings was not significant for most of the food items except for bones, beetles, ants, feathers, hairs, *Prunus africanus* and *Cyprus rigidifolia*. The overall correlation was positive for most food items (bush back hairs, feather, hair, *Cyprus rigidifolius*), whereas it was negative for (worms, insect exoskeleton, *Coffea arabica*, *Croton macrostachyus*) ( $P < 0.05$ ).

The variations in the rate of food consumption of civets during the two seasons depended primarily on food availability and food preferences. The extent of food consumption was correlated with each other except in some food items that were present only seasonally.

There were seven food items (bones, Coleoptera, ants, feathers, hairs, *Prunus africanus* and *Cyprus rigidifolias*) commonly consumed by civets during both wet and dry seasons. Five food items were consumed only during the dry season was (*Ficus* spp., *Cordia africana*, *Draceana steudneri*, bushback and egg shell).

Twelve food items were consumed only during the wet season (*Coffea arabica*, *Croton macrostachyus*, *Ehretia cymosa*, *Juniperus procera*, *Zea mays*, *Millettia ferruginea*, *Podocarpus falcatus*, birds claw, cockroaches, insect exoskeleton and worms).

During the dry season, there were no remains of coffee, *Croton macrostachyus*, *Juniperus procera*, *Zea mays*, *Millettia ferruginea*, *Podocarpus falcatus*, birds nail, grasshopper, insects and worms. The differences in the type of food and food availability between the wet and dry seasons were significant ( $P < 0.05$ ).

Generally, the least frequent food items observed in the droppings were those of bushbuck hair and egg shell followed by *Cyprus rigidifolias* and *Prunus africanus*.

### **3.2 Frequency of defecation during wet and dry seasons**

The frequency of defecation was 0.935 per day during the wet season and 0.475 per day during the dry season per the civetry observation. The frequency was higher during wet season than during the dry season. The frequency of defecation of civets during wet and dry seasons was statistically different (see table 3.1 and 3.2). The average values of each of the wet and dry seasons showed difference (61.29% and 38.70%) respectively. The presence and absence of fresh droppings on every day of the two seasons have considerable differences between the two seasons. The difference of presence and absence of defecation was significant for the dry season while the difference was not significant for the wet season.

Out of the 200 days of observations on the civetries during the wet season, 187 days had fresh droppings of and 13 days had no fresh droppings. Defecation observations during the wet season have revealed that 93.5% of the days of observation were with presence and 6.5% of the days of observation were with absence of fresh droppings. There was no significant difference in the number of days of presence and absence of defecation during the wet season.

There were 95 days of occurrence and 105 days of absence of defecation during the dry season observations. The dry season observation of defecation has revealed 47.5% of the days of with presence and 52.5% of days of observation with absence of defecation at the

civetry sites. The difference is significant for the dry season for the presence and absence of droppings on daily basis.

### **3.3 Trapping African Civet from the Wild**

During the present research, both modern and traditional methods of trapping were employed to compare the difference of success of each and suitability of the two methods. Traditional methods used were Net trap and String snare while the modern technique used was the use of trapping cage.

Trapping with the net trap was found to be without major harm to the civets trapped. To locate the resting place of the civet to set the trap, it was necessary to spend several days in identifying and follow up. In most of the cases, the discovered sites were near streams and river banks, following pug marks (foot prints) of the civet in the mud. This method was applied during the wet season, when tracking with foot print was easy.

Trapping with net was done with five individuals to stretch the net and to chase the animal. Civets showed disturbances, which could be associated with the number of humans involved in trapping. There was no visible injury, but civets struggle to escape from the net when in the net. Netting was made during the end of the wet season of the local area starting from September, 2011. There was additional trapping employed at different time after this trapping. A total of 16 civets were trapped during this research period. Out of these, seven were females. Among the female civets, four were used in the breeding research experiments and the remaining three were released in the wild from where they were trapped.

The second traditional trapping method applied was string trap. It involved the use of string thread, ringing bell with a flexible wooden pole that bends down to be fixed with the cover twigs at the openings of the pit and small twigs fixed on the ground at the periphery of the pit hole. In this method, civet is trapped by tying on one of the legs and it can be released and transferred safely into a cage for transportation.

When trapping with this method, no significant injury was observed on the animal because the trappers were alarmed with ringing bell and they arrive at the location immediately. There were minor injuries in one case out of five trappings during this study using this traditional method. There is the risk of injury if they are not released within a couple of minutes. So, this method necessitates the trappers to wait around until the civet is trapped and released.

The third method of trapping African civet was made by modern trapping cages with suitable bait to attract civets to the trap (Fig. 3.4). The trap also serves to transport the trapped animal to the destination. During the research period, the trapped civets were carried by humans and by car. The traditional methods of trapping were found safe when applied with precaution, but not as effective as modern cage trap. Modern trapping technique saves time and manpower requirements.



Figure 3.4. A modern cage fabricated to trap African civet (Photo: Bekele TD)

### 3.4 Musk Extraction

During the present research programme musk was collected from captive African civets to study the productivity of civets under different feeding conditions. The study was based on consideration of two basic conditions of time interval and food (Fig. 3.5).



Figure 3.5. African civet musk in Bullocks made up of cattle horn (Photo: Bekele TD, 2012)

The amount or weight of civet musk extracted at each time interval for each animal group was different, and there were significant variations between the different time intervals (Fig. 3.6). The difference for average weight of the musk extracted between different time intervals was significant and the weight of civet musk produced by different individual was not significant for the different animal groups within the same time interval (Fig. 3.6 and Table 3.3).

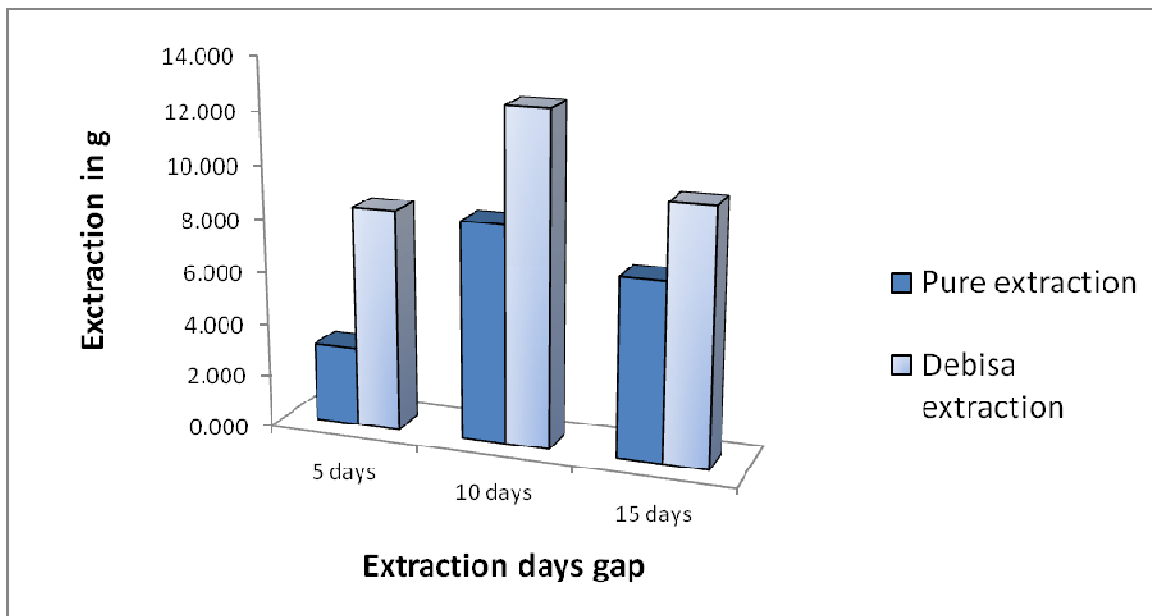


Figure. 3.6 Amount of civet musk extraction at different days of intervals

Civet musk extracted and collected within five days gaps had the lowest weight in all the cases of animal groups. The weight of musk extracted after ten days interval was the highest in all cases. The extraction of 15 days interval was higher than that of five days interval but lower than that of ten days interval. The results were similar in proportion

and weight for the three groups of African civets involved at each time interval but different in weight between each time intervals (Fig. 3.6 and Table 3.3).

In both cases, the results were similar in proportion or percentage for each 5, 10, and 15 days intervals, but the weight of each extraction for both Pure and 'debisa' showed significant difference. Data was collected under similar conditions and the food supplied to the civets was the same in all the cases (Tables 3.3 and 3.4).

**Table 3.3 African civet pure musk extraction with different time intervals and traditional feeding**

<b>Animal No.</b>	<b>Days gap</b>	<b>1<sup>st</sup> Extraction</b>	<b>2<sup>nd</sup> Extraction</b>	<b>3<sup>rd</sup> Extraction</b>	<b>4<sup>th</sup> Extraction</b>	<b>5<sup>th</sup> Extraction</b>	<b>Sum (g)</b>	<b>Average (g)</b>	<b>Cumulative average (g)</b>
1	5 days	3.8	4.2	3.9	4.3	3.7	19.9	3.98	
2		4.4	3.9	4.4	4.3	3.7	20.7	4.14	
3		3.7	3.8	4.1	3.9	3.9	19.4	3.88	4
1	10 days	7.9	8	7.9	8.1	8	39.9	7.98	
2		7.9	8	8.2	8.1	7.8	40	8	
3		8	7.9	8.1	8.1	8	40.1	8.02	8
1	15 days	6.3	5.9	5.8	6.1	5.8	29.9	5.98	
2		6.2	5.9	6	6.1	6.1	30.3	6.06	
3		5.9	5.7	5.9	6.2	6.1	29.8	5.96	6

In the pure and debissa extractions the results of five and 15 days intervals were lower than the collections of ten days interval while the 15 days extractions were higher than those of five days extractions. The weight for the pure and debissa are different but the percentages of the amount were similar with the three time gaps. The weight of civet musk obtained by debissa is higher than the weight collected by pure extraction. The use of honey wax in debissa extraction contribution was not significant since the difference with pure extraction was not significant in proportion except in weight (Fig 3.7; Tables 3.3 and 3.4).

The 'civet' collected by pure extraction from different individuals under similar conditions is highly correlated ( $r = 0.990$ ,  $P < 0.05$ ). The correlation of 'debissa' extraction are significant ( $r = 0.993$ ,  $P < 0.05$ ) for different individuals and similar conditions. The amount of civet musk extracted from African civets was statistically significant ( $F = 2039.5$ ,  $df = 2$ ,  $P < 0.05$ ). The amount of civet musk collected after ten day interval was more than the amount of musk collected during the other two time intervals was significant ( $P < 0.05$ ). The difference in the amount of musk available between 5 days and 15 days gaps was not significant ( $P < 0.05$ ).

The amount of civet musk collected from each individual at different sessions during 5 and 15 days time interval were correlated ( $r = 0.990$ ,  $P < 0.05$ ), where as the musk collected after ten days interval was not correlated with those of five and 15 days intervals ( $P < 0.05$ ). The results of the collection by pure extraction are highly correlated.

**Table 3.4 African civet debisa musk extraction with different time intervals and traditional feeding**

Animal no.	Days gap	1 <sup>st</sup> Extraction	2 <sup>nd</sup> Extraction	3 <sup>rd</sup> Extraction	4 <sup>th</sup> Extraction	5 <sup>th</sup> Extraction	Sum (g)	Average (g)	Cumulative average (g)
1	5 days	9.5	9.4	9.2	9.2	9.3	46.6	9.32	
2		9.4	9.2	9.5	9.4	9.3	46.8	9.36	
3		9.2	9.4	9.3	9.1	9.1	46.1	9.22	9.3
1	15 days	9.9	10.1	10.1	10.1	9.8	50	10	
2		10.2	9.8	10.2	10.1	9.9	50.2	10.04	
3		9.8	9.9	10.1	10.1	9.9	49.8	9.96	10
1	10 days	13	13.3	13.1	12.9	12.9	65.2	13.04	
2		12.8	12.9	13.3	13	13	65g	13	
3		12.8	12.9	13	13	13.1	64.8	12.96	13

The musk collected from civets during five days and 15 days intervals was less than the quantity collected at 10 ten days interval. The quantities available after 15 days interval were higher than that of five days interval. The results were similar in proportion for all the animal groups (see table 3.3).

The result of musk extraction after maintaining civets with traditional food items showed more or less similar results (Table 3.5), when civets were maintained on soup only, the musk output was comparatively less. Supply of meat and meat products helped to enhance the musk output. When civets were maintained on mixed diet, the musk was highest (Fig. 3.7).

**Table 3.5 African civet pure musk extraction (g) with different time intervals and modern feeding**

Amount of musk available, g									
Animal No.	Days gap	1 <sup>st</sup> Extraction	2 <sup>nd</sup> Extraction	3 <sup>rd</sup> Extraction	4 <sup>th</sup> Extraction	5 <sup>th</sup> Extraction	Sum (g)	Average (g)	Cumulative average (g)
	5								
	1 days	7.1	7.1	7	6.9	6.8	34.9	6.98	
	2	7.1	7.4	7.2	6.9	6.9	35.5	7.1	
	3	6.9	6.9	6.8	7.1	7	34.7	6.94	7
	15								
	1 days	11.7	12.1	11.8	12.4	12.3	60.3	12.06	
	2	11.8	11.8	11.9	12.1	12.2	59.8	11.96	
	3	12.1	11.9	11.8	11.9	12.2	59.9	11.98	12
	10								
	1 days	15	14.7	15.3	15.1	14.9	75	15	
	2	14.8	14.9	15.4	15	15.1	75.2	15.04	
	3	15	15.1	14.9	15	15.1	75.1	15.02	15

The proportions of the amount of civet musk extracted under different time intervals and the food supplied have shown similar trends of variation, but differ in the weight with each food supply and with each time interval. The variation in time interval is similar as recorded from the other study (Fig. 3.7 and Table 3.7).

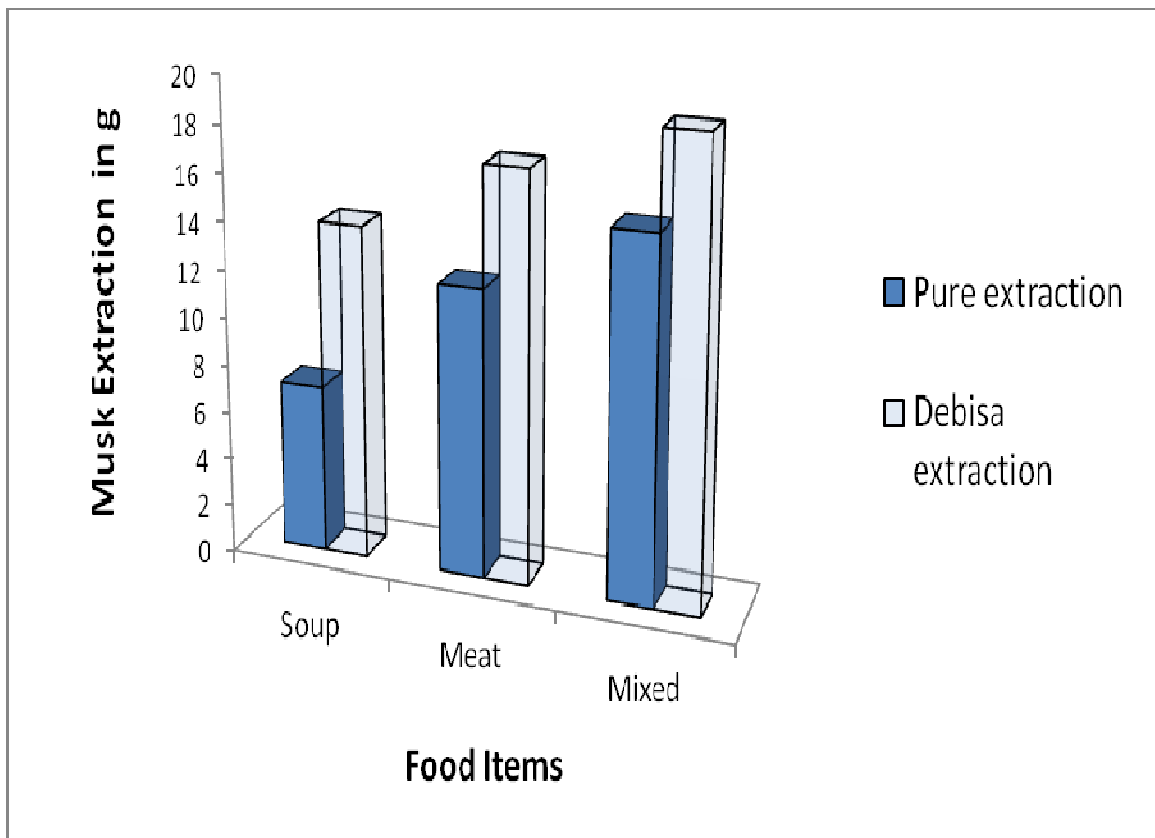


Figure 3.7 Data on civet musk extraction with different food supply

**Table 3.6 African civet Debisa musk extraction with modern feeding**

<b>Animal no.</b>	<b>Days gap</b>	<b>1<sup>st</sup> Extraction</b>	<b>2<sup>nd</sup> Extraction</b>	<b>3<sup>rd</sup> Extraction</b>	<b>4<sup>th</sup> Extraction</b>	<b>5<sup>th</sup> Extraction</b>	<b>Sum (g)</b>	<b>Average (g)</b>	<b>Cumulative average (g)</b>
1	5 days	7.1	7.1	7	6.9	6.8	34.9	6.98	
2		7.1	7.4	7.2	6.9	6.9	35.5	7.1	
3		6.9	6.9	6.8	7.1	7	34.7	6.94	7
1	15 days	11.7	12.1	11.8	12.4	12.3	60.3	12.06	
2		11.8	11.8	11.9	12.1	12.2	59.8	11.9	
3		12.1	11.9	11.8	11.9	12.2	59.9	11.98	12
1	10 days	15	14.7	15.3	15.1	14.9	75	15	
2		14.8	14.9	15.4	15	15.1	75.2	15.04	
3		15	15.1	14.9	15	15.1	75.1	15.02	15

**Table 3.7 The quantity of musk produced (g) by pure and debissa methods after feeding different food items**

<b>Amount musk produced, g</b>										
	<b>Pure</b>					<b>Debissa</b>				
<b>Food type</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Session 5</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Session 5</b>
Soup	7.03	7.13	7.00	6.97	6.90	14.03	13.90	14.00	14.07	13.90
Meat	11.87	11.93	11.83	12.13	12.23	16.87	17.17	16.97	16.93	17.10
Mixed	14.93	14.90	15.20	15.03	15.03	19.20	18.87	19.07	18.87	19.03
<b>Mean</b>	<b>11.28</b>	<b>11.32</b>	<b>11.34</b>	<b>11.38</b>	<b>11.39</b>	<b>16.70</b>	<b>16.64</b>	<b>16.71</b>	<b>16.62</b>	<b>16.68</b>

The civet musk extracted from male and female African civets was compared to investigate whether there was significant difference in the amount of the musk produced by both sexes under similar conditions of food and time intervals (Fig. 3.8).

The amount of musk collected from male African civets was more in weight than the amount collected from females under similar conditions. The quantity available from male civet was higher than that of the female civets (Table 3.9). The intensity of the odor of pure and debisa musk can be differentiated by smelling. The smell of civet musk from the female was weaker, compared to that of the males. The difference in the quantity produced by male and female African civet was significantly different ( $t = 4.53$ ,  $df = 28$ ,  $P < 0.05$ ).

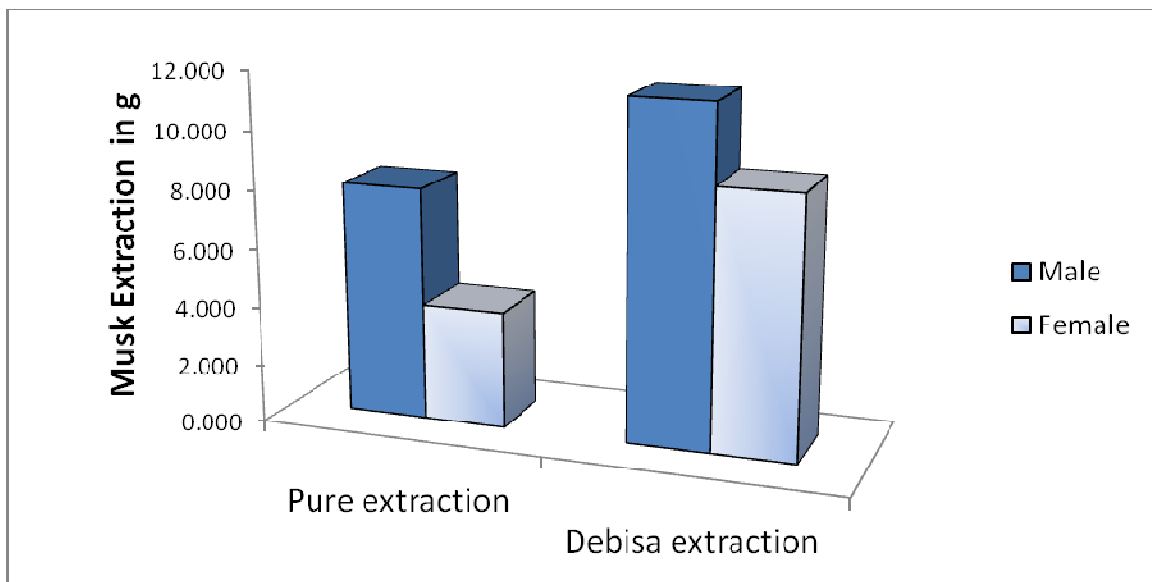


Figure 3.8 Civet musk produced by male and female African civets

The amount of civet musk available from male African civets under pure and debisa extraction conditions was statistically significant ( $F = 2600$ ,  $df = 2$ ,  $P < 0.05$ ) and ( $F$

=1271.67, df = 2, P < 0.05) respectively. The amount of civet musk from female African civets was also statistically significant under pure extraction (F =216.67, df = 2, P < 0.05) and for 'debissa' (F =318.18, df = 2, P < 0.05).

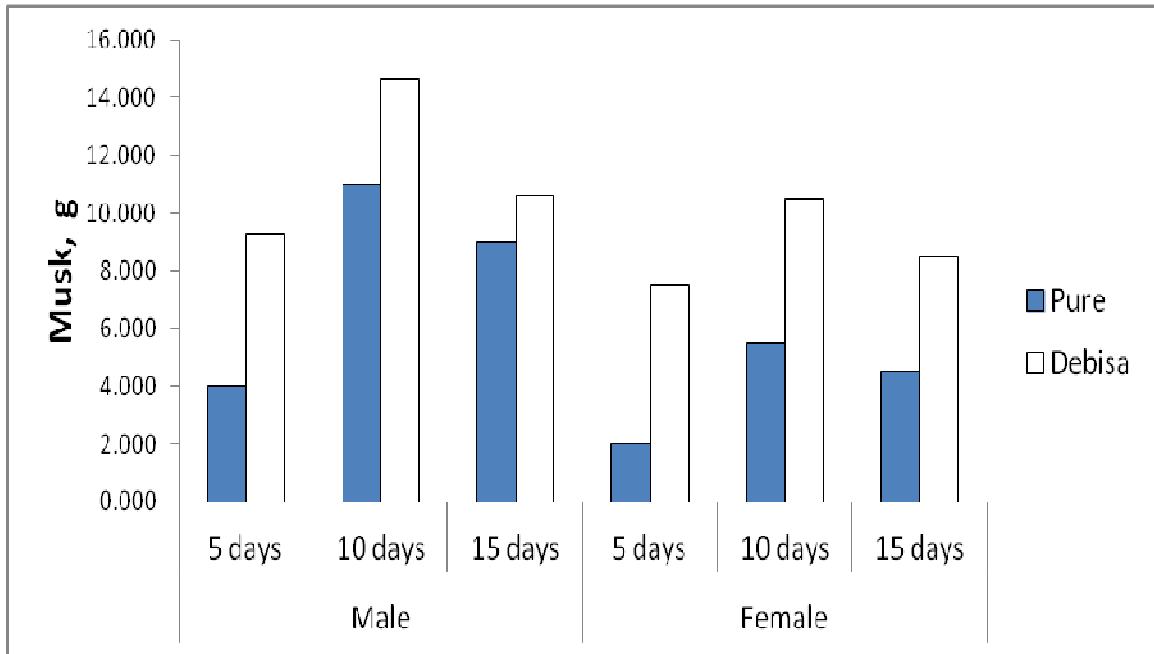


Figure 3.9 Civet musk collected from male and female civets after specific days of intervals

### 3.5 Captive breeding

The breeding study was conducted with three pairs of male and female African civets. The male and female African civets were released together in a cage (4.5 m length x 2.5 m width x 1.5 m height) (Fig 3.10). The breeding trial was made repeatedly with considerable month gaps with different pairs, but none of the cases was successful.



Fig. 3.10 Breeding cage for African civets (Photo: Bekele TD, 2012)

### **3.6 Findings from Questionnaire study**

Most of the civet owners responded that the purpose of keeping African civet is for civet musk extraction (60%), while few answered that it is for cultural and religious reasons (15.6% and 6.7%, respectively). Some responded that they keep civets for all the above purposes (17.8%). Most civet farmers (62.2%), mentioned the number of captive civet they have while 37.8% have not revealed the number of civets they are holding. Most farmers (91.1%) responded that they have no experience of keeping female African civets and breeding practice under captivity. Farmers' response to the question of breeding under captivity is that they have never tried.

The questionnaire result showed a positive outlook of the farmers on the modern methods of captive management and husbandry of civets. The civet farmers have shown good attitudinal changes from traditional practice as a result of awareness creation and training conducted during this research work. In general, the questionnaire results have shown the willingness of the farmers to accept and implement modern ways of trapping and captive management of African civets

As per the responses of civet farmers on the method of trapping African civets for captivity, they are using traditional methods such as net trap (64.4%), string trap (28.9%), and metal snare (6.7%). All of them approved that net and string traps do not harm the animal (86.7%) if it is done with precautions, except metallic snare. Most of the farmers (80%) have the knowledge of modern trapping cage, but few (20%) have no idea about it. Those who are familiar with the modern cage suggest that it is better than the traditional methods, but difficult to afford the high price to get adequate number of cages for their captive civets. Only few of civet farmers (6.7%) use modern cages for their captive civets.

According to the response of the civet farmers, trapping civets from human surroundings is becoming very difficult. They have to move long distance to trap or to buy civets from local trappers. The farmers responded that captive breeding of African civets could be an alternative (80%) to have sustainable supply of civets for captivity, but only if financial support is available to implement breeding program. Some farmers (13.9%) move long distances to get better variety of civets that produce more musk than others. Best varieties of African civets are identified by their larger perineal gland compared to others.

All civet farmers (100%) responded positively to the request to permit veterinarians and concerned professionals to visit captive civets. They confirmed that veterinarians can visit their farms at any time. Even they suggested that visit of veterinarians should be included in the programmes of annual plan of Animal Health Offices as being done for cattle and other domestic animals.

According to the responses some civet farmers (40%) treat their, sick, wounded or injured civets traditionally, (33.3%) give modern drugs, while others (20%) give no treatment. The farmers also revealed that they have no information about rabies, which could be transmitted through civets to humans.

As per the response in most of the farms (80%) cleaning is done once every seven days, and in others (20%) once in three days. Most of the civet farmers stated that daily cleaning is difficult and not necessary to clean civet house every day.

Civet farmers responded that they provide, maize soup to their captive civets every day and meat once a week or more in addition to the soup. The farmers agreed that feeding civets with protein-rich foods such as meat is useful to get more musk, but the limitation is their low financial income. They also justified that the civet musk price is very low and the reward from musk sale is less compared to the cost of maintaining civets, in captivity. They also explained that they supply food mixed with egg, cooked meat and soup immediately after extraction of musk. The foods supplied to captive civets vary with the individual farmer both in quality and quantity, which is based on the financial capacity of the farmer.

Almost all civet farmers were using traditional cages for keeping captive civets. They prefer the modern cage, but it is difficult for them to afford to buy due to the high price (Fig. 3.11).



Fig. 3.11 Modern wooden cage (left) and traditional cage (right) for keeping civets in captivity (Photo : Bekele TD)

The civet farmers release the captive civets once in a few days in the closed civet house during the night to make them relax for some time. This is considered to be good for the health of the civets.

The practice of smoking civet house with burning wood was supported by (60%) of the respondents, for the purpose of keeping flies away. Others (31%) of the view that moderate warming the house is helpful to have more civet musk.

Civet owners responded to the question on the condition of the house of captive African civets. Majority of them (60%) have stated that they are keeping civets in a separate

house, while others (40%) stated as keeping them in the same house, but in a separate room. Those who prefer separate room reasoned that, it is good for the protection of civets from small carnivore predators and ants.

All farmers (100%) responded that the best preferable time interval for civet musk extraction as 9 – 10 days interval as the optimum interval to collect good quantity and quality musk. According to their explanation, collection at a delayed interval will result in less quantity as musk flows out of the perineal gland. Farmers also answered that the amount of civet musk collected shows slight variation from individual to individual.

Civet farmers are concerned about adulteration of the musk. They revealed that they have information about adulteration, but they denied that it is not practiced by civet farmers. One of the opinions was that adulteration was done by middle men or buyers. They explained that they have heard about the items used in adulteration to be butter and honey wax (51.1%), vaseline (20%) and a combination of both (28.9%).

Most of the farmers responded to the question whether they have license to keep civets under captivity or not and some respondents stated that they have licence to keep civets under captivity. But, many of them have no permission or license to trap civets from the wild. Majority of the civet farmers (60%) responded that license for keeping civet under captivity serves also for trapping, while 31.1% of the respondents stated that a license was not required for trapping civets and the remaining (8.9%) remarked that they do not know whether it is necessary or not. Some of them also explained that they do not know anything about illegal permission for trapping and keeping civets under captivity.

This shows that stakeholders responsible for enforcement of law and awareness creation are not effectively carrying out their job. Thus, there is much work to be done with civet farmers to bring attitudinal changes among them in their civet farming and husbandry practices.

Majority of the farmers (91.1%) sell their civet musk in loan and others (8.9%) in partial payment. They also stated that the amount paid is not satisfactory. Even sometimes buyers may not pay the remaining amount under the cover of adulteration. Farmers have seriously complained about the civet musk trade problem associated with middle men and exporters.

Farmers responded to the question about whether their poor captive management of civets and the low quality of civet musk production and adulteration to be the reason for low price offered for the musk (Table 3.8). Majority of the civet farmers (60%) agreed with this view while others (40%) disagreed. The farmers suggested that the government should work in finding out better market access at international level to support them to improve their civet farm management by providing loan free of interest. Also, they suggested that export of musk should be done through governmental agencies. The farmers also have long term plan to export musk through their association if they get support.

Table 3.8 Responses of civet owners on captive management of African civet

Qn. No.	Response Percent					Others
	A %	B %	C %	D%	E%	
1	60	16	6	18	0	**
2	60	40	0	0	0	
3	0	90	10	0	0	
4	0	94	6	0	0	**
5	6	64	30	0	0	**
6	0	84	16	0	0	
7	50	20	30	0	0	
8	6	44	50	0	0	
9	20	80	0	0	0	
10	64	6	0	30	0	**
11	80	10	0	10	0	
12	40	50	10	0	0	
13	30	30	20	20	0	
14	6	40	20	34	0	**
15	30	40	30	0	0	
16	0	90	10	0	0	
17	100	0	0	0	0	
18	0	20	80	0	0	
19	0	100	0	0	0	
20	100	0	0	0	0	
21	0	0	0	100	0	
22	10	20	40	30	0	
23	100	0	0	0	0	
24	88	2	10	0	0	
25	40	20	40	0	0	
26	100	0	0	0	0	
27	30	10	60	0	0	
28	60	40	0	0	0	
29	100	0	0	0	0	
30	0	100	0	0	0	
31	94	6	0	0	0	**
32	0	0	0	100	0	
33	60	40	0	0	0	
34	0	94	6	0	0	
35	0	0	0	100	0	
36	50	20	0	30	0	
37	90	10	0	0	0	
38	0	100	0	0	0	
39	60	30	10	0	0	
40	80	20	0	0	0	
41	100	0	0	0	0	
42	0	90	10	0	0	
43	0	100	0	0	0	
44	60	40	0	0	0	
45	60	40	0	0	0	
46	0	0	0	100	0	
47	0	0	0	0	100	
48	100	0	0	0	0	
49	0	0	0	100	0	
50	100	0	0	0	0	

(N.B. A, B, C, D, and E are question choices and \*\* represents no response)

## 4. DISCUSSION

### 4.1 Feeding ecology of the African civet

The feeding behaviour of the African civet is diverse as they are adapted to eat a wide range of food items of plant and animal origin in the natural environment (Ray and Sunquist, 2001). During the present study in the natural environment through observations of undigested remains of food materials in the dropping in civetries also revealed a variety of items from the faeces of civets. They were found to eat fruits of different plants and animal species such as invertebrates and vertebrates (Bekele Tsegaye *et al.*, 2008).

This adaptation of the African civets has helped them to have high survival rate under different environmental conditions and habitat types. The food items identified during the present investigation are limited, but this does not mean that civets consumed only these identified food items. Civets are believed to eat more food items, but most probably some food items are soft, and have been completely digested and were difficult to identify by physical observations of droppings. The habitat of the present study also might have limited dominant food sources, which could be the other reason for the limited food items identified during the present study. Seasons also have impacts in limiting the food items available for the civets. The dominant food items such as insects, coffee and *Zea mays* during the wet season which were absent during the dry season while *Ficus* spp. and which was dominant during the dry season were absent during the wet season. Diversity of vegetation also could be another factor for the limited food items because the undergrowth weeds might have covered the fallen fruits and seeds making it difficult for

civets to collect such items during the wet season. The food preferences also could be another contributory factor during the wet season when such food items were plenty in the habitat during the wet season (Laurance, 1999).

The number of civetries during the wet season was more than that of the dry season. During the dry season, there is the general decline in the availability of food items and civets were travelling long distances. Such a wider home range covering would help them to get essential nutrients. Further, the undergrowth cover vegetation is cleared especially in the coffee plantation area leading to a shift in their dwelling sites and abandons the civetries during the wet season (Trites *et al.*, 2005).

The most consumed food items during the wet season were worms, maize and insects (72%, 68%, 64% and 60%, respectively). During the wet season, the availability of such food items was high as the study area has high biodiversity of natural forest, coffee forest and farm lands of maize, *teff*, sorghum and potatoes.

During the dry season, the food items of civets were less than the wet season. The most consumed food types during the dry season were *Ficus* spp. and *Cordia africana* and the least observed remain of food consumed was common bushbuck hair and eggs shell. These food items were among the types that have preference compared to those of plant origin and their least consumption could be associated with the scarcity or less availability of such food items during the dry season. Availability of food type could be the main reason as the undergrowth cover is not a factor for hiding the food items during the dry season.

Civets might change their home range as the ground cover decreases during the dry season (Brooks *et al.*, 1999). The number of civetries has decreased during the dry season. This also could be directly associated with the less availability of food items in the study area during the dry season. It also could be due to the local movement of the civets in search of water and other resources. The variation in the consumption of certain food types may be due to the frequent availability of such items as well as due to the preference of the species.

The difference in the presence and absence of defecation during the wet and dry seasons could be attributed to the availability of food items and food preference of the African civet. They feed on almost everything, thus absence of defecation during the dry season is more related with scarcity of food than food preference. There is no significant daily difference in the rates of defecation during the wet season, as it occurs every day except for 13 days during the 200 days of observations. This could be related to the availability of plenty of food for consumption. The few days of absence of defecation could be associated with the food preference or it could be adaptation of the animal to defecate occasionally at intervals as availability of food was not limited (Hillman, 1993). It may also be possible that they occasionally defecate in other location and hence the observer might miss it.

The difference in the presence and absence of defecation during the dry season was most probably associated with the scarcity of food. The difference between the occurrence and absence of defecation was highly significant as there were fresh droppings only on 47.5% of the days of observation. The amount of days of defecation was absent (105 out of 200)

was higher than the number of days defecation was present days (52.5%) of defecation. This is directly related to the low availability of food items for consumption and not be related to the food preference during the dry season (Ray and Sunquist, 2001).

## **4.2 Trapping African civet**

Traditional trapping was tried to compare the labour demand, time expended, injuries to the animal and the problem of unsuccessful trapping attempts compared to the modern trapping method.

The net trap is one of the traditional traps with low risk of injury if the trappers are present around. Sometimes, there could be rare chances of minor injuries as the trapped animal struggles to escape when the trappers try to transfer them to the cage for transportation. During trapping for this research work, there was no injury for civets trapped by this method. Net trapping method is time consuming as it may require some days until to locate the place where they are hiding during the day time. There is also a chance to be bitten by the netted civet during the time of transfer from the net to the cage. It also demands more human labour. This method is relatively better than the other traditional trapping methods as it has less risk of injury to those civets trapped.

String trap is the method used traditionally by civet farmers. It also causes only less injury if the trappers stay nearby to release the animal immediately when the bell rings. But, if trappers are not around, the animal could harm itself as it struggles to escape. Sometimes this could cause death also. Farmers usually stay around the site as they are aware that the animal may pull the string and make injuries and even sometimes escape

from the trap. They stay at a short distance to listen to the sound of the bell attached to the trap. This method demands time, labour staying the whole night and sometimes several nights at the site. String trap is less preferred by local civet trappers compared to the net trap as it may cause injury to the animal. The complain from animal welfare groups on the injury or death of the civet in traditional trapping is not the major problem as far as the trapping activity is managed (WSPA, 1998). Civet trappers are not happy if the trapped civet is injured as buyers never accept injured civets as they suspect that it may die due to the injury and subsequent infection. Civet farmers buy civets with their long term keeping and trappers trap for income generation and hence give priority to trap animals without injuries. As a result, trappers become aware to take necessary care during trapping.

Metallic trap (foot trap) is the one which involves risk of injury on the animal in which the injury can lead to amputation of the leg or even death of the animal trapped. This method is not used by most civet trappers. Sometimes, domestic animals are also trapped and become victims of injury. It is mainly used for trapping larger carnivores like leopard which are killed for their skin or in retaliation to raiding domestic animals. Therefore, this method is not appropriate to use for trapping civets for captivity use. This trap is made locally, but originally adopted from Italian invaders in the late 19<sup>th</sup> or mid 20<sup>th</sup> century, according to the information from local elder civet trappers and farmers.

‘Bendo’ is the trap which has less efficiency and taking more time. It is not widely practiced by the trappers. Therefore, it was excluded from applying during the research work. This method has no risk on the animal. But, the pit hole dug into the ground could

be a problem for domestic animals and even human beings. Domestic animals could be harmed sometimes as they fall into the pit.

Some of the methods especially metallic snares and 'Bendo' that were practiced traditionally for trapping were not safe. In most cases, the animal is injured leading to death. In all these cases, transportation of the African civet is made by transferring the animal in to a sack or a container, which can allow only air circulation, but with discomfort to the animal.

The application of modern trapping is very crucial in response to the criticism of WSPA, (1998). The animal can stay longer time and avoids suffering or death resulting from injury during trapping as there is no loophole to get the trapped animal injured in the modern trap.

Problems associated with trapping of civets from the wild seem to be eliminated by the newly introduced modern trapping cage. There is no wastage of human labour by staying near the site of trapping except for occasional checking for the success of trapping. This new cage also helps to transport the civet to the destination. Therefore, it is an appropriate trapping technique for trapping African civets from the wild. Trapped civets face disturbance and discomfort in the traditional methods of transportation as they were kept in sacs, and this problem is eliminated in modern cage traps as the animal can be transported in the trap itself as there is no need to transfer into other cages.

Civet trappers have been following traditional methods of trapping as they are not familiar with the modern trapping cage and have no exposure to use it. Those who were

introduced during this research work were happy to use the modern trap, but were disappointed by the current price of the cage. The cage is expensive and it is difficult for them to afford. They request support from the government or stakeholders either in the form of long term interest-free loan or other financial support. Each civet farmer needs about fifteen cages on an average, which is expensive for them.

When the modern cage is widely used, civet farmers themselves can trap enough civets from their surroundings, and hence can avoid trappers from the practice. Hence, even if the price of this trap cage is little higher, the farmers need not have to pay trappers a price for the civets. This is advantageous for the farmers in the long-run. Hence, more awareness creation work among the civet farmers should be made by the stakeholders.

#### **4.3 Civet cages and housing**

Captive African civets are kept in a house made of wood, mud and thatched roof with grass or rarely of tin sheets. Most of the civet houses were poorly ventilated, dark and most have no means of drainage of the waste materials such as feed left over and even droppings and urine of civets. In some cases, human dwellings are partitioned and converted as civet enclosures.

Civet houses should be properly built to maintain normal temperature, moderate light allowing windows, regulated air circulation, guarding from predators and preventing from ants. Cemented floor is advisable for proper cleaning and frequent washing to maintain healthy atmosphere inside, and it is also important to prevent ants from entering civet houses. The civet house should be separate from human dwellings to avoid sound

and other disturbance, especially during the day time when civets rest (Jemal Mohammed, 1999). Fire facility for cooking food for civet must be placed outside the civet room.

Government bodies and stakeholders are expected to support civet farmers to implement modern captive management of the African civet, in addition to facilitating modern clean housing practice and management (Kumera Wakjira, 2005).

The main problem associated with captive civets is the cage for keeping civets. Traditionally, cages made up of sticks and twigs have been used. These cages are very narrow and rough. Such cages do not allow free movements of the civets and cause injury when the civet tries to move around. Due to such problems including handling civets for musk extraction, there has been criticism about captive civet management practice in Ethiopian (WSPA, 1998). Based on the five main points suggested by WSPA (1998), improvement has been made, and there are promising attitudinal changes in the handling of captive African civets by the civet farmers. The works are at the preliminary stage and responsible government bodies and others are expected to work hard for its implementation to bring attitudinal changes of the civet farmers and their livelihood. Therefore, improved modern civet cages should be widely demonstrated among the civet farmers throughout Ethiopia. The cage prepared by BAMRC was found to be appropriate (see Fig.3.11). Civet farmers are willing to use this modern cage for their captive civets. Awareness creation, financial support and market access are essential to help civet farmers across the country.

The modern cage is well suited and good for free movement of the animal and it also has provision to handle the animal for musk extraction without any harm. It also has darkened portion for the day time resting. The inside moving space can be narrowed and widened when necessary. Narrowing is applied to restrict the movement of civets in the cage at the time of the musk extraction.

As part of the present research, awareness creation was made to convince civet farmers to allow veterinarians to visit and to treat captive civets. Modern cages fabricated modern cages by Bako Agricultural Mechanization Research Centre (BAMRC) were also advocated. The feedback from the farmers is promising. Currently, there is high demand for the cage, but the high cost is hindering them from buying. This is another major problem to be solved as far as there is need to promote the civet musk production and satisfy the global market demands. It also helps to improve the livelihood of civet farmers, who also contribute to the economic development of the country through foreign exchange earnings of the nation.

#### **4.4 Musk extraction**

The lowest amount of musk was extracted from five days interval, which shows that the interval was insufficient to accumulate optimum secretion of the perineal gland of civets. This supports the traditional reasoning of civet farmers, who do not extract musk within such short intervals. On the other hand, 10 days interval provided maximum musk, and this is the correct interval for musk extraction from the African civets. Ten days is required for the accumulation of the civet musk to its maximum that could be accommodated in the pouches of the perineal glands of civets. This finding also agrees

with the views of traditional civet owners, as they regularly extract musk at about ten days interval.

Musk extraction after fifteen days interval resulted in less amount of musk, as average amount was below the level of the quantity collected five to ten days intervals. Civet owners have reported that the secretion could accumulate in the gland for up to ten days and this oozes out and hence the amount will be less during extraction, after around ten days of interval. Under natural conditions, the animal scent marks on environmental objects. This adaptation of scent marking on environmental objects or sign posts could be attributed to the removal of excess civet musk out of the perineal gland in addition to its adaptation for olfactory communications with other civets (Homes, 1999; Hutchings and White, 2000).

According to the civet farmers, the purpose of applying honey bee wax over the perineal glands of captive civet after each civet musk extraction is to prevent the flow of musk out of the gland. This is unreasonable as the difference in the proportion of civet musk collected by pure extraction and debissa extraction are not significantly different. The contribution of honey bee wax in debissa extraction for absorption of civet musk is not confirmed in this research work. There was no major difference in the weight of the musk collected by both the extraction methods. The other purpose of application of honey bee wax was to free the animal from itching of the gland as a result of scrapping of the civet musk during extraction. This could be convincing, but the effect of it may be studied as impurity of the civet musk remains is one of the major problems in marketing civet gland secretion (Olani Kebede, 1999; Rimkus and Sommer, 2004).

As the results of pure and debissa extraction are not different in proportion in all the time intervals, especially for 15 days interval, the use of honey wax for the purpose of absorbing civet musk is not confirmed. If honey wax serves as an absorbing agent for civet musk, the weight of civet musk of 15 days interval would have been higher than that of 10 days. However, in the present study the weight of civet musk of 15 days was similar in proportion with that of the pure extraction. Therefore the use of honey wax for absorbing the flow out of excess civet musk is not convincing. It is only contributing to the impurity problems of civet musk market. The weight of honeybee wax introduced into the perineal gland after each extraction was known at the beginning, but it is difficult to determine the amount after extraction because some amount is expelled out of the perineal gland starting from the time of introduction into the gland.

Addition of wax in the musk is considered as adulteration of the musk and hence when detected, the price will decrease. Other substances such as butter, vaseline and grease are also added with the civet musk to increase the weight of the musk. Such impurities remain with the sample of musk, decreasing the price. Therefore, honey bee wax added into the gland has negative impacts on the quality of the civet musk collected and also on the civet musk market indirectly (Tamiru Geno, 1995; William, 2003; Burfield, 2005).

The pure civet musk collection is the best compared to the collection of debissa method. The purity of the civet musk decreases with debissa as it involves the application of wax and sometimes butter. The weight of civet musk collected by pure method was less than when collected by debissa method. It is better to increase the price of civet musk than using debissa method due to the addition of wax. Even exporters of civet musk explain

that it is better to buy pure civet musk with higher price than buying the one extracted by debissa method (Michael, 1999). They complain that there is a problem with their customers abroad due to the impurity of the civet musk they export. The impurity could be due to adulteration or it could be associated with the production method of debissa. Pure extraction of civet musk has strong smell and quality for which importers give priority and higher price. As far as the target chemical compound from civet musk is civetone, extraction without debissa would increase the price of the civet musk (Wondmagegne Daniel *et al.*, 2011).

Civet musk is extracted as pure and debissa. In both methods the amount of the production shows variation in weight. The reason for this weight difference of the civet musk production is attributed to the duration of the secretion. Civet musk extraction at different intervals had revealed differences in the amount (weight) of musk availability. Ten days interval was proved to be the best to get the highest amount of civet musk. The traditional process of extracting civet musk known as 'Salge' (ninth day) which means nine days interval was found to be the interval at which better production is obtained. During the other two time intervals of five and 15 days, collected civet musk was low compared to that of the ten days interval. Therefore extraction of civet musk at each ten days interval is appropriate as revealed in this research.

Stakeholders are expected to work more intensively on the awareness creation of the production of pure civet musk. Training and awareness creation have been given to the farmers during this research study programme. Repeated training is mandatory to

improve the situation. This can be achieved by improving captive management and musk extraction process.

The amount and proportion of civet musk collected was high with the supply of mixed food compared to the other two food types supplied. The results after feeding meat revealed that the amount was less than that was available after feeding mixed food, but higher than when fed only with soup. Mixed food has higher protein content than meat, and the animals produced the maximum amount of musk after consuming such food items. Musk extraction from those civets fed with soup was less in quantity as the protein content was very low compared to mixed food and meat (Tesfaye Hundessa, 1995). Therefore, it is not only the time gap that determines the amount of civet musk production but also is influenced by the quality of food the animal consumes. Musk is collected under the supply of traditional food items and mixed food or meat when these are compared under similar extraction intervals, the one collected with the supply of mixed food recorded high. Civet farmers also have the experience of supplying protein-rich foods to get better amount of civet musk. Hence, the secretion of civet musk is related to the type of food available to the captive civets (Hutchings and White, 2000).

The differences in the quantity and quality of the civet musk from male and female civets agree with the traditional reasoning of the civet farmers. The civet farmers keep only male civets under captivity to extract civet musk. Males produce higher quantity and quality musk than females. The present research findings support the view of the civet farmers on this issue. The difference in the quality of the musk also could be associated with that of scent-marking in the wild. Male and female scent marks are identified by

other civets, and this could be based on the differences in the chemical composition of the civet musk of male and female African civets (Trites *et al.*, 2005).

In the wild females scent mark environmental objects or sign-posts to signal the male her reproductive status. The male civet also scent-mark its territory to warn intruders of the species about its own territory (Estes, 1991). The male also scent-mark to communicate with females and other alien individuals around. These olfactory communications are not random, it might be related to the difference in biochemical composition of the musk of male and female African civets. This supports the traditional explanation of civet farmers that the male civet musk is higher in quantity and strong in quality than that of the female. Civet musk collected from the male African civet was found to be stronger in smell compared to that of the females (Alberts, 1992; Anonis, 1997).

Civet farmers traditionally use male African civets for extraction of civet musk. There are different reasons given by the civet farmers but one main reason is that the male African civets produce better quality and quantity. The other reasoning is that civet musk obtained from females is low in quality and quantity because it mixes with urine. This reasoning does not seem true because there is no means in which the female urine mixes with the civet musk as far as the concerned organs are located separately.

Ecologically, using only males for captivity and leaving females in the wild is a contribution to conserve the animal as females will give birth to their young to compensate for the trapped males. However, the other challenge to this practice is that the animal is facing ecological problems in the natural environment due to clearing of the habitat as a result of settlements and extended agricultural activities. Injuries that could

result in the death of the civets at the time of trapping is another potential challenge for the survival of the African civets in Ethiopia (Brooks *et al.*, 1999; Brook *et al.*, 2003).

#### **4.5 Captive breeding of African civets**

The only possible solution for the current challenges of African civets in Ethiopia to maintain its natural population from depletions is captive breeding. In the captive maintenance of civets in Ethiopia, males are kept under captivity for the production of civet musk, while the females are not used for captivity. The use of captive bred civets for captivity has basic advantages in contributing directly to the survival of the animal. One of these is that captive bred individuals will grow with humans and would be familiar in captivity and are free from behavioural stress compared to those trapped from the wild. The other positive effect is that there will not be negative impacts associated with trapping from the wild (Clive, 2007).

Problems associated with captive breeding raised by civet farmers is that it demands adequate amount of financial and materials support in addition to the requirement of land. Currently, such a practice is difficult to implement by civet farmers, but there must be funding source or investors or it could be done in a group as well as by civet farmers associations. Concerned government bodies and stakeholders have responsibility to contribute to solve such problems not only for the purpose of supporting farmers, but also to contribute for the conservation of the animal, and obtain foreign exchange for the country.

During the current research programme, implementation of breeding African civet was unsuccessful. There were two reasons for the failure of breeding. One reason could be the small space of the cage in which the pairs of African civets were released. It might not allow them to move freely for sexual initiation rituals that could lead to mating. The food provided under captivity could be the other probable factor for the failure of breeding. Also, they have stayed for prolonged time (day and night) together unlike their solitary adaptation in the wild. This also might have negatively influenced the sexual initiation between the male and female civets that were released together.

The captive breeding research could be successful if the male and female are released in a relatively wider and fenced semi-natural area where they stay apart from each other during the day time and could come together in the night at their feeding point and also when the female is in estrus (Balakrishnan and Sreedevi, 2007a). This would have most probably restricted the breeding.

If captive breeding populations of civets are established, that might reduce pressure on the natural populations as in the present situation of constant trapping civets from the wild to replace the old and diseased captive civets. Currently, civet farmers are not interested in breeding because the glandular output is considerably reduced during pregnancy and lactation (Xavier, 1994). Old and dead civets are replaced by fresh ones trapped from the wild. This practice has been one of the reasons for the suspected depletion of the civet populations, in addition to habitat disruption as an impact of human population explosion and extended agricultural activities.

As the perineal gland secretion of the small Indian civets is a major ingredient in a number of Ayurveda Pharmaceuticals, a traditional medicinal system in Kerala (India) the Small Indian civet, civets are maintained in captivity for this valuable natural resource. Hence, Balakrishnan and Sreedevi (2007b) have emphasized that it is necessary to implement captive breeding of civets to reduce the pressure on natural populations. The pressure on the African civet is more due to the major role of civetone in perfume industry.

There were no attempts to train civet farmers on the issue how to trap and keep African civets under captivity. This emphasize the need for further attempts in the coming years to study impacts of captive breeding and husbandry of the African civets for the economic advancement and for the welfare of the natural population of African civets.

#### **4.6 Attitude and perception of local people**

Almost all civet farmers, who have civets under captivity, are Muslims and they believe that the African civet was blessed by Prophet Mohammed. This belief is the main reason for them to keep civets under captivity, in addition to the livelihood earnings out of the civet musk extraction. Most civet farmers do not like to mention the number of civets they hold due to the cultural belief that direct counting is not good for the health of the animal, and they may die. However, they tell the number of containers (locally known as Megi) for feeding captive civets. Civet farmers also do not allow outsiders to visit their farm due to the belief that civets will die if seen by strangers in captivity.

Civet farmers are already convinced through training and awareness creation during this study on the need to improve captivity and husbandry programs for civets (Appendix 5 and 6). Those farmers participated in the training program have no hesitation to tell the number of civets they own, particularly to professionals, and they also request veterinarians to visit the farm, whenever there is need for treating sick civets.

Some civet farmers give priority to traditional methods of trapping, without any attempt to try modern methods. Most of them accept that modern method of trapping using modern cage is better than traditional trapping methods but very expensive. It is important to find means through which civet farmers can acquire the modern cage through bank or government support. The other problem raised by some civet farmers is that civets do not enter the modern trapping cage, when set in the field. But, this problem is only a temporary phenomenon of neophobia in the field (Ewer, 1968).

Captive breeding is the basic issue to attract the stakeholders of civiculture, in its contribution to conservation of African civet in the wild, and for sustainable use of this natural resource. It is also one of the five main suggestions of WSPA (1998). Civet farmers complain that natural civet habitats are being cleared for various farming activities, and hence civets are losing their natural habitats (Balakrishnan and Sreedevi, 2007b).

Captive breeding of civets can serve as a solution to replace those civets that die in captivity, instead of trapping new ones from the field. Civets bred in captivity might be free from stress in the presence of human beings (Kebede Seifu *et al*, 1996; Clive, 2007). Further, farmers are of the view that trapping from the wild is getting difficult, and the

purchasing price increases from time to time. Therefore, they support captive breeding, but under the prevailing condition it is difficult to implement in the absence of government support (Hongfa, and Helin, 1994).

Awareness creation is necessary to convince civet farmers to practice modern civet farming and medical treatments by professional veterinarians. Additionally, animal husbandry and health care sectors should include civet farming in their annual plan as they do for other domestic animals, such as livestock. This would reduce the risk of civet farmers from diseases such as rabies, which could be transmitted through civets to humans (Sreedevi and Balakrishnan, 2006).

Civet house should be cleaned every day to avoid accumulation of droppings to reduce bad smell and to avoid attraction of flies. Flies make civets restless as they swarm in the cage and feed on the fluids of the eye and nose as well as on blood. Cemented floor of civet house is another solution for easy cleaning and to protect from invasion of ants, and fleas. Farmers are convinced with cementing the floor, but they complain on additional financial burden as mentioned previously (Balakrishnan and Sreedevi, 2007b).

Civet farmers understand that the quality of the feed determines the quantity and quality of the musk produced (Trites *et al.*, 2005). They have suggested that the lower market price of the civet musk is hindering them from investing to improve captive management of civets. The current market price is controlled by the few exporters, who have interest only in their personal advantage (Kumera Wakjira, 2005). Opening international market access through farmers' co-operatives is the best option in this regard. Improved husbandry and handling are important for the conservation of the civets. Maintaining

civets in semi natural habitat is a good practice (Sreedevi, 2001). If so, captive civets can move freely and relax as they are not confined to the cage for long. It is a positive attitudinal change on captive civet management (Hillman, 1987). Farmers are willing to implement the use of modern cages if financial support is available.

Smoking civet house is assumed to warm captive civets to induce more musk production when the civet is forced to sweat. All civet farmers do not agree with this idea, and they explain that moderate smoking is supported mainly for the purpose of avoiding flies and blood sucking parasites. They also prefer to use smoke to using chemical insecticides.

Keeping civets in a separate room is be adopted by all civet farmers because the animals are not disturbed during the day time. The risk of the animals being attacked by predators and ants can be solved by construction of houses that do not allow their entry. Predators can be avoided by making a metallic wire fencing around the civet house. Cemented floor would help to control the problem of ants and other small animals as it provides facility to wash every day. It is necessary to convince all groups of civet farmers to practice separate house for captive African civets (Fikadu *et al.*, 1997).

The reasons given by civet farmers on the time gap for extraction of civet musk are supported as it is logical and convicting. In the wild, civets scent-mark their surroundings for olfactory communication and it seems to be an adaptation to remove the excess secretion from their perineal glands (Hutchings and White, 2000).

Awareness creation is important to bring attitudinal changes of civet farmers concerning wildlife legislation of Ethiopia. This contributes to the conservation of the animal as there

are ecological issues involved in trapping civets from the wild. Any trapping should be strictly controlled by licensing (Estes, 1991).

The stakeholders in the business should concentrate on the quality of the civet musk produced to strengthen the international market to earn more foreign exchange. This could be effectively done by the civet farmers' associations as it is already started during this research work with the involvement of non-profit making Governmental and Non-governmental Organizations.

Currently, from preliminary survey and training conducted during this research with Oromia Forest and Wildlife Enterprise (OFWE) in 2011 at Nekemte and Mettu, has revealed that the numbers of farmers involved in civet farming are very high, but almost all of them have no license and it is difficult to get an approximate number rather than estimating. To sell civet musk to the exporters or dealers, the farmers should have permit from regional governments with which the exporter gets export permit from the EWCA (Fikadu Shiferaw *et al.*, 1997).

## 5. CONCLUSION AND RECOMMENDATIONS

African civet musk is an important export commodity in several countries including Ethiopia, even though synthetic alternatives have been available for over 60 years. The African civet meat is commonly found in Nigerian bush meat markets, where there is demand for its skin and meat. Poaching, deforestation, and use in traditional medicine have drastically reduced the African civets populations. Rare strains of rabies may also affect the African civet.

Many tropical and subtropical forests around the world are being cleared for timber and other forest products. As a result, civets and many other wild animals are driven away even wiped out from their natural habitats. As civets are nocturnal and shy, it is difficult to make a clear estimate of their populations and study this in detail. This makes it difficult to determine their exact population and conservation status (William, 2003).

Even though the African civet is listed by IUCN as 'Least Concern', the prevailing condition in Ethiopia does not confirm this view. They are becoming victims of local extinction due to traditional wildlife hunting practice in general and due to clearing the undergrowth vegetation in coffee plantations, extended agriculture, predation of young ones and constant trapping for captivity for the extraction of the musk. The destruction of habitat by intensive deforestation is a major threat to African civets in Ethiopia. Riverine areas where civets prefer are also exhaustively being used for irrigation farming.

Local people should be trained to collect civet musk on a sustainable basis. Taking this concept into consideration, organizations that provide community microloans should

involve in improving the livelihood of civet farmers. All civet farmers are interested to request for loan free of interest.

Experience from this research study has shown that the farmers can make attitudinal changes if they are approached in a systematic way when supported by resources for capacity building. The current practice of trapping and captive management can be changed to the modern ways of handling and husbandry if constant follow up is implemented by all stakeholders. Limited action is being taken in Ethiopia to change the traditional civet farming practice, and to implement modern techniques in civiculture. Based on the findings of this research, the following specific recommendations are suggested.

- Relevant governmental authorities, development agencies, stakeholders and planning institutions, dealing with wildlife conservation and research should involve in the process of civiculture in Ethiopia to improve the practice.
- The various national and regional conservation groups who are asked to support this work by providing information and by the occasional funding of selected high priority conservation projects should include the civet farm development, as it supports the economic contribution to earn foreign currency income of the country and the livelihood of the civet farmers.

- Modern way of trapping, handling, health care, feeding and extraction of civet musk should be advocated among civet farmers.
  
- A model civet farm should be established by EWCA to maintain civets under suitable conditions and to collect the civet musk on a sustainable way.
  
- Captive breeding of the African civet should be initiated under a modern civet farm project.
  
- Regional civet farmers associations should be formed to keep civiculture and to apply modern technologies, maintain musk quality and control musk price in the market.

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## **7. APPENDIX**

### **Appendix I: Research Questionnaires for African civet farmers Attitudinal Evaluations**

#### Captive keeping (General)

1. For what purpose do you keep civets?
  - A.** musk extraction
  - B.** cultural value
  - C.** religious reason
  - D.** all

#### Captive civets' number

2. Are you willing to mention the number captive civet you have?
  - A.** yes
  - B.** no
3. Have you ever experienced to keep female African civet under captivity?
  - A.** yes
  - B.** no
  - C.** occasionally
4. Have you ever tried to breed civet under captivity?
  - A.** Yes
  - B.** No
  - C.** conditionally

#### Traditional Trapping

5. How civets are trapped from the wild?
  - A.** snare
  - B.** net
  - C.** string
  - D.** modern cage

**E. All**

Trapping harm

6. Do you think traditional trapping harm the civets?

**A. Yes**

**B. no**

**C. sometimes**

Modern trapping

7. Do you know about modern trapping cage?

**A. Yes**

**B. No**

**C. I have heard about but not practiced**

Trapping type

8. Which trapping kind do you think is better?

**A. Modern cage**

**B. traditional**

**C. not yet used modern cage**

Civets availability

9. Can you trap civet easily from your surrounding areas?

**A. yes**

**B. no**

Reason for scarcity

10. If your answer for qn. No. 8 is no, why?

**A. the animal is getting far away because of shelter problem**

**B. the animal is not found around us**

**C. they are exhaustively trapped from our surrounding**

**D. due to variety preference**

Captive breeding

11. Do you think breeding could be a solution?
- A. Yes, but demands finance and land
  - B. No, it is not necessary.
  - C. it is not possible
  - D. it is laborious action
12. Have you ever tried to breed civet under captivity?
- A. Yes
  - B. No
  - C. conditionally

Visit of captive civets (Health)

13. Do you permit captive civets to be visited by strangers?
- A. Yes
  - B. Sometimes
  - C. No
14. What do you think the possible reasons for civets' early death?
- A. wound during trapping
  - B. stress due to captivity (new environment)
  - C. disease
  - D. does not know

Civet wound treatment

15. What do you do when civets are wounded during trapping?
- A. allow veterinarian treatment
  - B. give local treatment
  - C. no treatment
  - D. gives modern drugs personally

16. What do you do when civets become sick under captivity?

- A. allow veterinarian visit
- B. threat using modern drugs personally
- C. threat traditionally
- D. waits for recovery

Civet disease transmitted

17. Do you think some disease of civets could be transmitted to humans?

- A. Yes
- B. No
- C. doesn't know

18. Do you permit veterinarian visit in the future?

- A. Yes
- B. No

Cleaning civet room

19. In how many days do you remove the wastes (dropping) of your civet?

- A. each day
- B. 2 - 3days
- C. 5 -7 days
- D. two weeks

Feeding

20. At what time usually civets are fed?

- A. morning
- B. evening
- C. day

21. Do you feed special food after extraction?

- A. Yes
- B. No

### Food type

22. What type of food do you feed captive civets?
- A. soup (corn)
  - B. meat
  - C. egg/butter
  - D. all
23. What is the amount of food you feed (in weight) per week?
- A. 4kg Soup, 1kg meat, 5 eggs and 1(one) spoon butter
  - B. 3kg soup, 0.5 kg meat, 4 eggs and 0.5 spoon butter
  - C. 3.5kg soup, 0.5kg meat, 3 eggs and 0.5spoon butter
  - D. 4kgs soup, 0.5 kg meat, 4eggs and 0.5spoonful butter
24. In which time range do you feed meat (the food items) to civets?
- A.1 week
  - B. 2 weeks
  - C. 3 weeks

### Housing (keeping) civets

25. What type of civet cage do you use to keep captive civets?
- A. traditional
  - B. modern cage
  - C. A and B
26. Do you allow civets to come out of cages to relax?
- A. Yes
  - B. No
  - C. sometimes

### Civet cage type

27. Which cage type do you prefer?
- A. modern cage but have no financial capacity

B. traditional cage

C. both cage types

#### Smoking civet rooms

28. Do you think smoking the civets' room is useful?

A. Yes

B. No

C. sometimes to keep flies away

#### Civet room condition

29. In which condition do you keep captive civets?

A. separate house from the family

B. separate room from the family, for protection

C. share the same room for protection

D. all

30. Do you support cemented floor of civet room?

A. Yes

B. No

#### Civet musk extraction time range (Civet musk Extraction)

31. Which time range is preferable for civet musk collection/ extraction?

A. 5 days

B. 9 days

C. 15 days

#### Civets variation in production

32. Is there difference in quality/quantity of civet musk collected between different

A. civets?

A. Yes

B. No

#### Reason for variation in production

33. If the answer for qn. No. 30 is yes, the reason is
- A. the size of the perineal gland
  - B. the variety of the animal
  - C. the type of food supply
  - D. all

Adulteration

34. Do you have information about adulteration?
- A. yes
  - B. no

Type of extraction

35. In which kind/way do you extract civet musk
- A. pure or natural
  - B. debisa (with wax and butter)
  - C. both A and B
36. How do you identify pure civet musk?
- A. by smell/odor rarely
  - B. by color/
  - C. texture rarely
  - D. A and B

Items of adulteration

37. What are items used in adulteration of civet musk?
- A. butter and wax
  - B. Vaseline
  - C. both
  - D. I don't know

License for captive keeping (Regulation)

38. Do you have license for your captive civets?

**A. Yes**

**B. no**

Regulation for trapping

39. Do you trap with permission?

A. yes

B. no

40. If your answer for question no. 38 is No, why?

A. license for keeping civet serves for trapping

B. not required

C. does not know whether it is necessary or not

Regulation for keeping civets

41. Do you know that keeping wild animals without permission is illegal?

A. Yes

B. No

Civet musk buyers (market)

42. To whom do you sell your civet musk?

A. middle men

B. exporter

C. others

Civet musk sale

43. How do you sell your civet musk?

A. in cash

B. in loan

C. in partial payment

44. Do they pay you satisfactory cost?

A. Yes

B. No

#### Adulteration as market problem

45. Do you think that the poor management of captive civets and civet musk quality to be one factor for market problem (low payment)?
- A. Yes
  - B. No
46. Do you think that one factor for civet musk market problem to be adulterations?
- A. Yes
  - B. No

#### Government role on market

47. What do you think the role of the government in finding solution?
- A. enter civet musk trade
  - B. link farmers with Importers
  - C. link farmers with Exporters
  - D. all of the above

#### Government role on management

48. What facilities do you expect (from the government) concerning African civet farm management?
- A. financial support to have modern cages
  - B. work on market access
  - C. facilitate loan without Interest
  - D. Facilitate land for civet farm and for farming to feed civets
  - E. all
48. If you have the access for breeding do you support captive breeding than trapping?
- A. yes
  - B. No

#### Captive breeding

49. What is the advantage of captive breeding?

- A. the pups will be domesticated
- B. conserves labor and financial expense for trapping
- C. the animals serve longer time
- D. all of the above

Conservation

50 Do you think breeding could contribute to survival of the animal in the wild?

- A. yes
- B. No



Appendix 2. Sultan and his civet musk (Ijaji- Illu Gallan, West Showa) Photo by Bekele TD



Appendix 3. Melanic coloration of African civet (source: Phillippe Gaubert)



Appendix 4. Demonstration of civet trapping cage and cage for keeping civets



Appendix 5. Training of civet farmers in Bedelle



Appendix 6. Civet farm visit