

Original Article

ANATOMICAL PARTICULARITIES OF THE MAMMARY GLANDS IN THE ADULT FEMALE GRASSCUTTER (THRYONOMYS SWINDERIANUS, TEMMINCK, 1827)

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ABSTRACT

This study aimed to characterize the mammary apparatus of the adult female grasscutter, or aulacode (*Thryonomys swinderianus* Temminck, 1827), by providing a detailed topographical description of the mammary anatomy in five adult, farm-raised females with an average body weight of 3.5 kg. Examination of the mammary gland revealed anatomical features that are broadly comparable to those observed in other rodent species and even in lagomorphs; however, several specific features were observed in this species. Three pairs of mammary papillae, which are relatively short but noticeably broader than those of commonly described domestic rodents, were observed in the pectoral, thoracic, and abdominal regions, respectively. Subcutaneously, the mammary glands on each flank are fused into a continuous mass of glandular tissue extending from the pectoral region to the inguinal region. Longitudinally—that is, from the pectoral to the inguinal region—the length of each mass averages 21.5 ± 3.5 cm. As for the lateromedial extent, that is, the width of this glandular mass, it averages 6.5 ± 1.5 cm. This structural configuration represents a distinctive characteristic of the species when compared with domestic rodents and lagomorphs that exhibit similar litter sizes. The biomorphometric features described here are likely to influence maternal behavior in captive female grasscutters and should support improved anatomophysiological management of reproduction in this characteristically African rodent. This is particularly relevant for the implementation of cross-fostering strategies in grasscutter farming, aimed at managing litter sizes and adjusting the weight of young, especially in cases of lactation difficulties or hyperprolific litters.

Keywords: Grasscutter (*Thryonomys Swinderianus*), Mammary Gland, Topography, Conformation, Reproductive Characteristics.

INTRODUCTION

The grasscutter, or aulacode (*Thryonomys swinderianus* Temminck, 1827), is a wild hystricomorph rodent whose intensive captive breeding is increasingly expanding in sub-Saharan Africa for food production and wildlife management. In parts of Central and West Africa, where grasses form their natural habitat and primary food source, these rodents are commonly referred to as

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“grasscutters.” In South Africa, however, they are associated with cane plantations, where they are known as cane rats and regarded as significant agricultural pests. Accordingly, the distribution of the greater cane rat is largely determined by the availability of, or preference for, particular grass species as a food source (Baptist and Mensah, 1986; Byanet et al., 2009).

The meat of this rodent, which is not subject to any cultural taboos, is highly valued by African consumers of bushmeat. Numerous studies have been conducted on the aulacode to improve breeding techniques by enhancing understanding of its reproduction, growth, and behavior Ewer (1969), Asibey (1974), Adjanohoun (1992), Tondji and Agbessi (1992), Yewadan (1992), Houben (1999), Fantodji and Soro (2004), Abe (2010), Broalet et al. (2012). However, very few investigations to date have focused specifically on the reproductive characteristics of this typically African rodent during the process of domestication Adjanohoun (1992), Addo et al. (2007), Soro (2007).

To address the scarcity of anatomical data on aulacode reproduction, we conducted a descriptive study of the mammary glands in adult females. In pubertal females, the glands are functional, producing colostrum and milk after parturition. Colostrum is a nutritive fluid for the neonate, rich in maternal immunoglobulins that confer passive humoral immunity. Milk is a complete nutritional source capable of fully meeting the offspring's needs and remains the sole source of nourishment until weaning. Among all females, the mammary glands are not identical; they may differ in their position along the ventral surface of the trunk and in their anatomical characteristics Raynaud (1961), Grassé (1971), Hoshino (1979), Hovey and Trott (2004), Vallantin (2023). This is essential, as anatomy underpins medical and surgical practice. Compared with domestic species, the grasscutter is relatively disease-resistant due to its natural hardiness; however, captive individuals are more susceptible to dystocia or other birthing difficulties Jori et al. (2001); Fantodji and Soro (2004), Houben et al. (2004), Yapi et al. (2013), *Vétérinaires Sans Frontières*. (n.d.). Consequently, improved management of this species depends on a deeper understanding of its morphology, physiology, and behaviour. In particular, morphological studies require the integration of multiple anatomical disciplines, including general, descriptive, topographical, functional, developmental, and comparative anatomy.

This study primarily aimed to advance knowledge of grasscutter anatomy, with particular emphasis on providing a detailed topographical description of the adult female mammary apparatus. It also provides baseline information to assist farmers and researchers in promoting sustainable grasscutter farming and reducing reliance on wild populations.

MATERIALS AND METHODS

MATERIALS

The grasscutter (*Thryonomys swinderianus* Temminck, 1827) is currently listed as Least Concern (LC) on the International Union for Conservation of Nature (IUCN) Red List Child (2016).. In this context, the comparative anatomy collection of the Department of Anatomy, Histology, and Embryology at the Ecole Inter-Etats des Sciences et Médecine Vétérinaires (EISMV) in Dakar is sourced from two main origins. The primary source, representing approximately two-thirds of the specimens, consists of tissues obtained from carcasses of animals slaughtered in establishments specializing in the preparation and sale of grasscutter meat for human consumption. The secondary, less frequent source comprises specimens from animals that died suddenly in captivity or were euthanized for medical (e.g., poor health, severe suffering) or sanitary reasons. It should be noted that, in addition to Senegal, the animals included in this comparative anatomy collection originate from farms in various countries of the sub-region, such as Abidjan (Côte d'Ivoire) and Cotonou (Benin). When necessary, and to facilitate their transport to Dakar, the carcasses are exsanguinated and either refrigerated or frozen to minimize the degradation of anatomical structures.

In addition to facilitating comparative studies of anatomical structures across different vertebrate groups, this collection—established at the founding of EISMV—allows the study of various animal species without the need for additional sampling from the wild. In this context, the animals used in the present study were adult females that had completed their reproductive cycle and were therefore retired from breeding and sold as grasscutter meat for human consumption. Specifically, five adult female grasscutters with an average live weight of 3.5 kg, obtained from intensive captive breeding facilities (grasscutter breeding), were used. The dissection of the entire mammary apparatus was performed using small surgical instruments suitable for laboratory animals.

ETHICAL CONSIDERATIONS AND EXPERIMENTAL PROCEDURES

The EISMV is affiliated with Cheikh Anta Diop University (UCAD) in Dakar. Accordingly, all experimental procedures were carried out in compliance with the recommendations of the UCAD Research Ethics Committee UCAD (2024), the provisions of the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (1986), the ARRIVE guidelines (Animal Research: Reporting of In Vivo Experiments), and applicable Senegalese legislation on animal welfare.

Where applicable, the dissection and mammary gland visualization techniques followed methods described by previous authors Popesko (1972), Barone (1976), Bourdelle and Bressou, 1978, Dyce et al. (1996), which are standard for laboratory animals. For each animal, five procedural steps were performed: immobilization and restraint (manual for docile individuals or using a cage for non-docile subjects); sedation and anesthesia with ketamine (Imalgène ND) at a dose of 0.7 mg/kg, administered via the external jugular vein located in the jugular groove; exsanguination; cleaning; and, finally, skinning. Prior to skinning, with the animal positioned in dorsal recumbency, a topographical description of the mammary chain was performed over the thoraco-abdomino-pelvic region.

Thereafter, the animal was skinned using a scalpel and mouse-tooth forceps to fully expose the mammary apparatus. The mammary glands were subsequently examined and described in accordance with models established for anatomical studies in other animal species [Barone et al. \(1973\)](#), [Lebas \(2002\)](#). The anatomical characteristics recorded focused primarily on the topography, conformation, and anatomical relationships of the mammary glands.

RESULTS

Regarding the topography of the mammary glands, in female grasscutters positioned in dorsal recumbency, small pinkish nodules were observed on the ventral region of the trunk beneath the white coat, which is sparsely covered with subspiny hair. These nodules correspond to the mammary papillae or teats, arranged on either side of the midline in three rows, corresponding to three pairs of mammary glands. Specifically, beneath the hair, the mammary glands are located in the pectoral, thoracic, and abdominal regions [Figure 1](#).

Figure 1

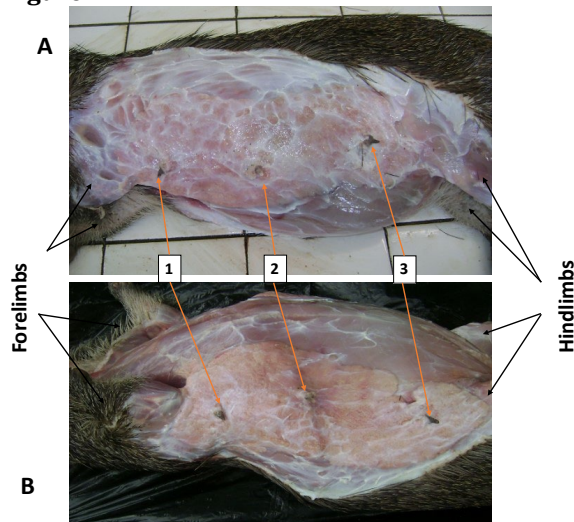


Figure 1 Subcutaneous Topography of the Mammary Gland of the Female Grasscutter: A- Right Lateral Recumbency; B- Left lateral recumbency; 1- Pectoral teat; 2- Thoracic teat; 3- Abdominal teat

To examine the morphology of the mammary glands [Figure 1](#) and [Figure 2](#), the ventral region of the trunk was skinned to expose the glands. Each mammary gland was observed to consist of two elongated, thick layers of glandular tissue arranged parallel to the linea alba. Consequently, the mammary glands on each flank are fused into a continuous mass of glandular tissue extending from the pectoral region to the inguinal region. Longitudinally—that is, from the pectoral to the inguinal region—the length of each mass averages 21.5 ± 3.5 cm. Regarding the lateromedial extent, that is, the width of this glandular mass, it averages 6.5 ± 1.5 cm.

Figure 2

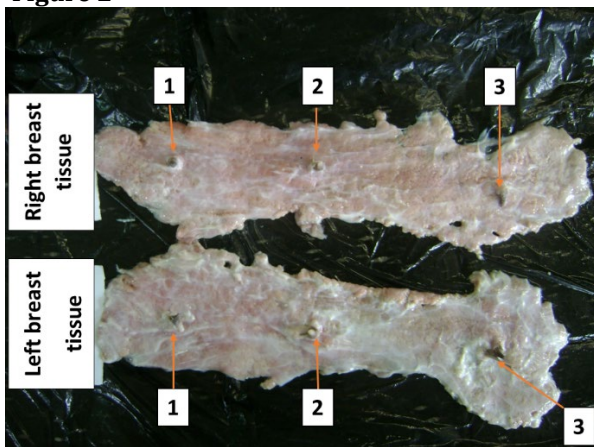


Figure 2 External Conformation - Continuous Mass of Mammary Glandular Tissue in the Female Grasscutter: Ventral View of Isolated Mammary Glands. 1- Pectoral teat; 2- Thoracic teat; 3- Abdominal teat

DISCUSSION

The grasscutter trade remains far less developed and structured than that of cattle, sheep, or poultry [Fantodji and Soro \(2004\)](#), [Houben et al. \(2004\)](#), [Yapi et al. \(2013\)](#), [Ibe et al. \(2023\)](#), [Mpagike and Makungu \(2024\)](#), [Ataba et al. \(2025\)](#). This is largely due to the species' ongoing domestication and the lack of structured development within the aulacode (grasscutter) sector, coupled with the limited scientific knowledge currently available [Addo et al. \(2007\)](#), [Byanet et al. \(2009\)](#), [Nteme et al. \(2009\)](#), [\(2010\)](#), [\(2014\)](#), [Onwuama et al. \(2018\)](#), [Ibe et al. \(2023\)](#), [Mpagike and Makungu \(2024\)](#), [Ataba et al. \(2025\)](#), [Nteme et al. \(2025\)](#). Various methods of restraint and anesthesia have been documented, including the use of acepromazine or ketamine alone or in combination with xylazine [Mensah et al. \(1992\)](#), [Houben et al. \(2004\)](#), [Mensah et al. \(2006\)](#), [Abe et al. \(2010\)](#), [Vétérinaires Sans Frontières. \(n.d.\)](#).

As noted by other authors [Siter et al. \(1991\)](#), [Mensah et al. \(1992\)](#), [Annor et al. \(2009\)](#), [Kingdon et al. \(2015\)](#) [Vétérinaires Sans Frontières. \(n.d.\)](#), while one may question the impact of captivity on animal behaviour (docility and aggressiveness), we consider this impact to be minor or negligible compared with concerns related to feeding, hygiene, and social interactions among individuals. In this context, it is important to underscore that ethological and welfare considerations are particularly critical for these rodents, as they are highly sensitive to neglect in terms of nutrition and hygiene.

In the wild, newborns in grasscutter follow their mother for at least one month. The most common litter size in the grasscutter is four, although litters of eight or more have also been reported [Onadeko and Amubode \(2002\)](#), [Fantodji and Soro \(2004\)](#), [Abioye et al. \(2008\)](#); [Opara et al. \(2010\)](#). Birth weight ranges from 70 to 160 grammes, and the sex ratio is generally balanced. Both the number and size of the offspring appear to be influenced by the dam's nutritional status [Asibey et al. \(1974\)](#), [Fantodji and Soro \(2004\)](#), with indications that larger females tend to produce larger litters. The weight of each offspring, however, is largely independent of its position within the uterine horn during embryonic development [Addo et al. \(2003\)](#), [Opara et al. \(2010\)](#).

Lactation is crucial for the survival of newborns in mammals [Hoshino et al. \(1979\)](#), [Gittleman and Thompson \(1988\)](#), [Hovey and Trott \(2004\)](#), [Vallantin et al. \(2023\)](#). Within a few minutes after birth, the mammary glands of the female grasscutter fill with milk, and the first suckling occurs approximately thirty minutes after the birth of the last newborn. Young grasscutter instinctively suckle and may feed from multiple mothers, which ensures the survival of orphans. The frequency of suckling varies with age, ranging from three to eight times per day at birth, to eight to fifteen times per day shortly before weaning [Fantodji and Soro \(2004\)](#).

Suckling gradually decreases with age. Within three to four days after birth, the young begin nibbling and consuming forage. During the fattening period, the juveniles require less water, as they obtain most of their liquid from maternal milk or the forage provided. In general, the young remain with their parents until weaning, which occurs around one to one and a half months of age, after which they are separated and adopt the adult diet [Fantodji and Soro \(2004\)](#).

Overall, our findings align with previous studies on the mammary apparatus of various rodents, particularly the mouse and rat, which have been the most extensively studied [De et al. \(2010\)](#), [Ferrier et al. \(2012\)](#). As in all mammalian species [Ferrier et al. \(2012\)](#), the mammary tissue of the grasscutter develops along the ventral region of the trunk. Examination of the female grasscutter's mammary glands reveals both similarities and species-specific differences compared to other rodents and lagomorphs. Notably, in the female grasscutter, the mammary papillae (teats) are relatively short but noticeably broader than those of commonly described domestic rodents. In addition, the female grasscutter, like the female chinchilla, possesses three pairs of teats [Carpentier et al. \(1994\)](#), [Leck et al. \(1998\)](#), [Mayer et al. \(2004\)](#), [Stekelorom-Parmentelat et al. \(2006\)](#), which is fewer than in other species such as the rabbit, mouse, and hamster, each of which has five pairs [Crispens et al. \(1975\)](#), [Tremblay et al. \(2002\)](#), [Ferrier et al. \(2012\)](#), [Rédaction et al. \(2017\)](#), and the rat, which has six pairs [Tremblay et al. \(2001\)](#), [De et al. \(2010\)](#), [Ferrier et al. \(2012\)](#). More specifically, as detailed in Table 1, the adult mouse has three thoracic pairs, one abdominal pair, and one inguinal pair, whereas the rat has one cervical pair, two thoracic pairs, two abdominal pairs, and one inguinal pair [Ferrier et al. \(2012\)](#). Additionally, in both rabbits and hamsters, the number of teats can vary depending on the breed [Barone et al. \(1973\)](#), [Lebas et al. \(2002\)](#), [Rédaction Mon hamster. \(2017\)](#).

Although both the female grasscutter and the chinchilla possess three pairs of teats, their anatomical arrangement differs. While both species have thoracic and abdominal pairs, the female grasscutter has an additional pectoral pair, absent in the female chinchilla (Table 1). These differences are significant and can be explained by the intrinsic morphology and behaviour of the two species. For instance, adult chinchillas are smaller than adult grasscutters. Chinchillas can reach up to 25 cm in body length, with the tail adding approximately 15 cm, and females are generally larger than males [Hess et al. \(2025\)](#). In contrast, the adult female grasscutter, excluding tail length, averages 45 cm in body length and approximately 3 kg in body weight [Ettian et al. \(2009\)](#). Moreover, in chinchillas, only the anterior pair of teats is considered functional, which poses a problem when the litter contains more than two newborns [Sciama et al. \(2001\)](#), [Stekelorom-Parmentelat, M. D. \(2006\)](#). This is not an issue in grasscutters, as all teats are functional after parturition. Litter sizes vary in both species (1–6 young in chinchillas; 1–14 young in grasscutters), but the most common litter sizes are two in chinchillas and four to five in grasscutters [Fantodji and Soro \(2004\)](#), [Houben et al. \(2004\)](#), [Stekelorom-Parmentelat, M. D. \(2006\)](#), [Frohlich et al. \(2025\)](#). Furthermore, in the female grasscutter, the mammary glands merge to form a broad layer of mammary tissue along the ventral surface of the trunk (Figure 1 and Figure 2), representing a distinctive feature compared with other rodents and lagomorphs. According to previous authors [Shimer et al. \(1903\)](#), [Steyn et al. \(2018\)](#), [Mpagike and Makungu \(2024\)](#), [Nteme et al. \(2025\)](#), these characteristics likely reflect anatomical adaptations related to the grasscutter's herbivorous diet, habitat

(tall-grass humid savannas, floodplains, marshes, reed beds, and riverbanks), locomotion (adaptation for running), and behaviour (absence of burrowing).

Table 1

Table 1 Topographical Differences in Teat Locations between the Female Grasscutter, Female Chinchilla, Mouse, and Rat				
Female				
Pair by region	Aulacode	Chinchilla	Mouse	Rat
	<i>Thryonomys swinderianus</i> (Temminck, 1827)	<i>(Chinchilla lanigera × Chinchilla brevicaudata)</i>	<i>(Mus musculus)</i>	<i>(Rattus rattus)</i>
Cervical	0	0	0	1
Pectoral	1	0	0	0
Thoracic	1	1	3	2
Abdominal	1	1	1	2
Inguinal	0	1	1	1
Total	3	3	5	6

As in other species, such as the chinchilla [Stekelorom-Parmentelat, M. D. \(2006\)](#), the unique positioning of the teats in the mother, together with the ventral orientation of the young's mouths, determines the specific nursing posture of the female grasscutter. While suckling, the dam supports part of her weight on her forelimbs and hindlimbs to prevent excessive flattening of the abdomen. This teat arrangement allows the young to nurse on either side despite their ventrally positioned mouths. However, if the female grasscutter lies on her flank, access to the lower row of teats becomes extremely difficult or even impossible [Ewer et al. \(1969\)](#), [Asibey et al. \(1974\)](#), [Kingdon et al. \(1974\)](#), [Opara et al. \(2010\)](#).

The anatomical study of the mammary glands of the female grasscutter (*Thryonomys swinderianus* Temminck, 1827) highlights morphological features that may, on the one hand, assist in species identification and, on the other, enhance the understanding of the lactation process, while also contributing to improved clinical veterinary practices in grasscutter farming. Specifically, it has been observed that the young can nurse while their mother is feeding or resting. However, the mammary glands can also be affected by purulent conditions (mastitis) or ectoparasitic infestations, which are highly detrimental to the lactating female and harmful to the development of the young [Fantodji and Soro \(2004\)](#). This is significant because certain anatomical features have contributed to classifying the grasscutter within the suborder Hystricomorpha (porcupine-like rodents) [Wood et al. \(1955\)](#), [Weir et al. \(1974\)](#), [Roberts and Perry \(1974\)](#), [Addo et al. \(2007\)](#), [Granjon et al. \(2009\)](#), [Yapi et al. \(2013\)](#), alongside species such as the crested porcupine (*Hystrix cristata*), the agouti (*Dasyprocta aguti*), and the guinea pig (*Cavia porcellus*), which is also domesticated in sub-Saharan Africa [Ngou et al. \(1995\)](#), [Mballa et al. \(2017\)](#). Membership in the suborder Hystricomorpha also distinguishes the grasscutter from the rat (*Rattus rattus*), mouse (*Mus musculus*), gerbil (*Gerbillinae*), and hamster (*Cricetinae*), which belong to the suborder Myomorpha (rat-like rodents).

More importantly, one of the key implications of this study concerns the possibility of implementing cross-fostering strategies aimed at equalizing the size of litters and/or adjusting the weight of young grasscutters in commercial farms. For example, in pigs, this practice—where piglets are transferred from one mother to another within the first few hours after birth—is common, especially in the case of highly productive or hyperprolific sows. Indeed, when there are more live-born piglets than available active teats, it becomes necessary to optimize the management of litters. This is particularly crucial when the average birth weight of the newborns is lower than the generally observed average. Furthermore, it is worth noting that this practice also continues in non-hyperprolific farms, as long as they maintain good sanitary status. The goal here is to balance the number of piglets in each litter, with minimal exchange between mothers [Oliveras et al. \(2020\)](#), [Vande et al. \(2021\)](#), [Casanovas and Gasa \(2022\)](#), [Lorente and Sanjoaquin \(2023\)](#), [\(2024\)](#). Our results suggest that in cases of lactation difficulties or hyperprolific litters, the use of foster mothers should be prioritized for female grasscutters.

Although this study was conducted on five captive adult females—thereby minimizing biases related to individual variability [Nteme et al. \(2025\)](#)—the relatively small sample size may limit the generalizability of the findings [Ataba et al. \(2025\)](#). Additionally, these results should be interpreted in light of histological findings, since in rodents, it has been observed that within each mammary gland, the histology of the ducts and alveoli varies according to the gland's location, the animal's age, the stage of its oestrous cycle, and pregnancy [Boorman et al. \(1990\)](#), [Ferrier et al. \(2012\)](#). Furthermore, as sexual dimorphism in grasscutters is minimal, preventing easy visual distinction between males and females [Van der Merwe, M. \(2007\)](#), [Houben et al. \(2004\)](#), [Byanet et al. \(2009\)](#), [Annor et al. \(2009\)](#), future studies should compare the mammary apparatus across sexes. In species with limited sexual dimorphism, such as the crested porcupine (*Hystrix cristata*), which has compound mammary glands forming bilateral complexes and whose secretory products are conveyed via excretory ducts to two latero-pectoral teats, male teats are notably smaller and shorter [Lopez et al. \(2013\)](#), [Mouzoun et al. \(2018\)](#).

Despite these limitations, this study provides novel anatomical insights into the female grasscutter's mammary apparatus, enhancing understanding of its reproductive biology. Together with known features of the female genital tract (*Thryonomys swinderianus* Temminck, 1827) Nteme et al. (2025), these traits likely shape maternal behaviour in captivity and should be considered to improve reproductive management in this characteristically African rodent.

CONCLUSION

In general, mammary glands can vary in number and in their positioning on the ventral surface of the trunk from one female to another. Their conformation and morphology may serve as distinguishing criteria between species. Furthermore, it is generally accepted that the number of teats and mammary glands in a female is proportional to litter size. The aim of this study was to characterize the topography and morphometry of the mammary apparatus in the adult female grasscutter. While our results confirm significant anatomical similarities between the grasscutter and other animal groups, including rodents, it should be emphasized that the mammary glands of the female grasscutter exhibit specific anatomical features unique to this species. These morphological peculiarities influence the lactation process and are particularly important for species diagnosis, for improving clinical veterinary practices in grasscutter farming, and for biomedical research. Collectively, these findings provide insight into the behavioural and socio-feeding patterns of this predominantly African rodent, whose captive breeding is expanding across several sub-Saharan African countries. They also suggest implementing cross-fostering strategies in grasscutter farming to manage litter sizes and adjust the weight of young, particularly in cases of lactation difficulties or hyperprolific litters. Finally, they lay the foundation for further research aimed at a more comprehensive understanding of grasscutter anatomy and the development of comparative frameworks with related or relevant species, including the lesser cane rat (*Thryonomys gregorianus* Thomas, 1894), from which it must be distinguished; hunted species such as the Central African wild rabbit (*Poelagus marjorita*) and the crested porcupine (*Hystrix cristata*); and the guinea pig (*Cavia porcellus*).

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