

## BEHAVIOURAL ATTITUDES ASSOCIATED WITH CAPTIVE AFRICAN GIANT RATS (*CRICETOMYS GAMBIANUS*) IN IBADAN, NIGERIA

<sup>1</sup>BADMUS, Hafiz Ayinde, <sup>2</sup>ALA, Adeola Adefoluke and <sup>3</sup>OLAOGUN, Sunday Charles

<sup>1</sup>Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria.

<sup>2</sup>Department of Zoology, University of Ibadan, Ibadan, Nigeria.

<sup>3</sup>Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria.

**Corresponding Author:** Badmus, H. A. Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria. **Email:** [badmus.hafiz@gmail.com](mailto:badmus.hafiz@gmail.com) **Phone:** +234 803 826 7691

*Received* December 02, 2024; *Revised* December 16, 2024; *Accepted* December 18, 2024

### ABSTRACT

*African giant rats are recognized as one of the important small mammal species in Nigeria. They are highly priced and as an essential food item that is consumed as bush meat and a cheaper alternative protein source for the common man, especially in rural settings. As delicious as this particular species is there are some associated taboos with this animal because of their strange behaviour. This study therefore evaluates some behavioral attitudes associated with captive African giant rats. Thirty-six adult African giant rats (18 males and 18 females) were captured from the wild and their behaviour was studied for 8 – 10 weeks. They were monitored for feeding, sleeping, cannibalism, and reproductive behaviour. Feeding behaviour indicated that the animals manifested postures such as sitting on their haunches, standing on their legs, gnawing and acting coprophagy while eating. Sleeping attitudes revealed behaviour such as; assuming the shape of the letter O, maintaining a curve-shaped position, and lying on their back while sleeping. Commonly cannibalism behaviour observed includes; adult male-female cannibalism, mother-pup's cannibalism, and hunger-induced cannibalism. The animals also showed some peculiar reproductive behavior; these include; courtship, mating, and nursing attitudes. The study has been able to elucidate the behavioural characteristics of African giant rats and concludes that some behaviours and attitudes of captive African giant rats were strange and unique indeed. The study recommends that these characteristics should be factored into any plan for the domestication of African giant rats, and further studies to evaluate reasons for some of these behaviours.*

**Keywords:** African giant rat, Behaviour, Captivity, Ibadan

### INTRODUCTION

African giant rats - *Cricetomys gambianus* Waterhouse, 1840 (Rodentia: Nesomyidae) are found in the rainforest zone where they are confined to farmlands, grasslands and human habitations. In local Nigerian parlance, they are called *Ewi* in the Igbo language, *Burugu* in the Hausa language and *Okete* in the Yoruba language (Olawuwo *et al.*, 2020). They are also called African pouched rats or Gambian pouched rat and the word 'pouched' in the common name

is an indication of the animals' habit of using the cheek pouches to store or carry food (Ali *et al.*, 2008). African giant rats have adapted to fossorial lifestyle and are one of the notable fossorial species known (Olaogun *et al.*, 2021). They live in burrows with about 6% oxygen and 3.8% carbon dioxide concentrations. They usually come out at night in search for food and this explains their nocturnal habit (Ibe *et al.*, 2011). Although, they have very poor eye sight, they have well developed sense of smell and this is an attribute that makes them an excellent candidate

species for the diagnosis of tuberculosis and detection of land mines (PBS, 2010). They are being trained effectively by the Belgian firm Apopo at Sokoine University of Agriculture in Morogoro, Tanzania, to detect landmines and sniff out tuberculosis (Cooper, 2008).

African giant rat is one of the rodent species known to cause damage of economic importance to crops (Akpan *et al.*, 2022). They depredate diverse agricultural produce ranging from grains to tuber crops. They are omnivorous and highly destructive species (Kingdon *et al.*, 2013). Meanwhile, this species also serves some ecological roles. Notable among the ecological roles they play is the fact that they are excellent seed dispersers and this could be attributed to their fossorial habit as they are adept in hoarding seeds in the soil while burrowing. They are associated with forested land, farmland, and human habitation. Although it is a digging species, the African giant rat does not show great readiness to burrow in captivity. Contrarily, the animals gather nesting material very enthusiastically and frequently mend and rearrange the nest in the cage. They weigh between 1 and 1.4 kg and attain sexual maturity between 5 and 7 months in the wild (Cooper and Erlwanger, 2007). African giant rats live up to 14 years in captivity, reaching maximum body weights of approximately 2.80 kg in bucks and 1.39 kg in does (Cooper and Erlwanger, 2007).

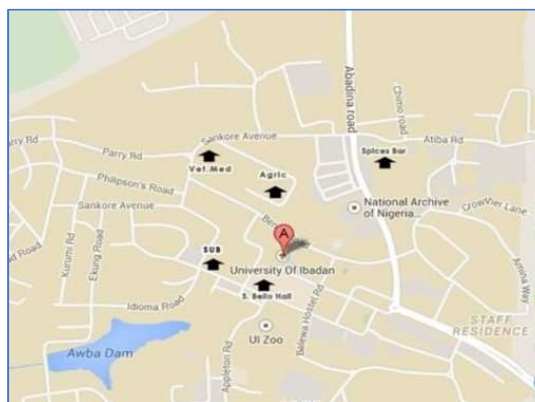
Some countries use them as exotic pets (Cooper and Erlwanger, 2007). African giant rat is one of the rodent species that is edible (Badmus and Ala, 2020). They have been reported to serve as an important source of animal protein in many African countries (Olayemi and Adeshina, 2002). In some African countries including Nigeria, efforts are being made to domesticate African giant rats in captivity for food and research purposes (Ray and Duplantier, 2013). They are easy to tame, frequently eating out of a trainer's hand shortly after capture (Cooper, 2008). CITES did not list them as rare or endangered species (Cooper, 2008).

African giant rat reportedly shows a tendency to develop as a counterpart to the white rat in nutritional, pharmacological and clinical studies, and have also been confirmed as

a cheaper and available alternative economic source of meat for human consumption (Ali *et al.*, 2010). African giant rats are used by some people for occultist activities, been a traditional belief of some societies or cultures in Nigeria. And that this belief emanated from some strange behaviour being manifested by this animal species, which were tagged as taboos in some cultures. Most of these strange behaviours have not been previously studied and reported in Nigeria. This study, therefore, highlights and evaluates some of these behavioural attitudes associated with captive African giant rats, in Ibadan, Oyo State, Nigeria.

## MATERIALS AND METHODS

**Description of Study Location:** This study was carried out in the Central Animal House, University of Ibadan. The study area falls within Oyo State which is characterized by tropical wet (April – October) and dry climate (November – March). It lies approximately between longitude N07° 26'850" and N07 0 27'087" and latitude E003 0 53'899" to 003 0 53'552 (Figure 1).



**Figure 1: Map showing University of Ibadan (Ayofe *et al.*, 2018)**

## Experimental Procedures

**Capturing and Housing of African Giant Rats:** A total of 36 African giant rats (*C. gambianus*) were captured from the wild within Ibadan (18 females and 18 males) and weighed. They were captured between January and February 2021. The study was carried out for a period of 10 weeks from February to May 2021. Each of them was held in captivity in a fabricated

metal cage with thirty-six housing units. Each housing unit (with dimensions: 60 × 35 × 25 cm<sup>3</sup>) was designed in such a way that it has a separate feeding trough, a drinking trough, and a tray for collecting faecal droppings (Figure 2).



**Figure 2: Fabricated metal cage (with thirty-six housing units) in Central Animal House, University of Ibadan, Nigeria**

The cage was adapted from the rehabilitation, experimental feeding, and breeding cages as reported by (Ray and Duplantier, 2013) with some modifications.

**Acclimatization of African Giant Rats:** The wildy caught African giant rats were acclimatized for one month. Before the acclimatization period commenced, they were all weighed to know their weight as they were coming from the wild. In the first week of acclimation, they were fed the foods they were accustomed to in the wild such as cassava, yam, pawpaw, banana, cooked rice etc. and water was provided *ad libitum*. In the second week, commercial rat feed (Vital feed pelletised growers feed, 18% crude protein, 2600 Kcal/kg metabolisable energy, Grand Cereals Limited, Jos, Plateau State, Nigeria) was introduced to them by giving them less of the feed and more of their accustomed food. In the third week, more of the feed was given while in the fourth week, they were fed commercial feed only. They were weighed at the end of the acclimation period and recorded appropriately.

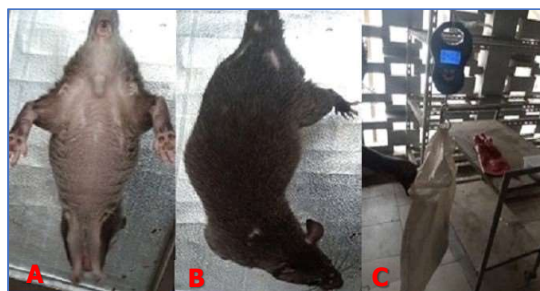
**Measurement of African Giant Rats' Body Weight:** The body weights of the African giant rats were measured using a 50 kg capacity portable digital weighing scale. Each animal was weighed by placing it in a pre-weighed bag and

then suspended on the scale. The reading was then displayed on the scale (Figure 3 A and B).



**Figure 3: A - Digital weighing scale, and B - display of the animal's weight on the scale**

Figure 4a and b show the venter and dorsum of African giant rat, respectively, while Figure 4c shows how African giant put in a sack was suspended during weighing.



**Figure 4: African giant rats: A and B show the venter and dorsum of the rat, respectively, while C shows how the rat put in a sack was suspended during weighing**

**Monitoring the Behaviour of African Giant Rats:** Some aspects of the behaviour of the captive African giant rats were monitored such as feeding, sleeping, cannibalism, and reproductive behaviour.

**Procedures for Monitoring Feeding Behaviour:** The feeding behaviour of both male and female captive African giant rats was monitored both during the day and at night. In the daytime, the animals were served commercial rat pelletised feed, grains, and grip food alternately. This procedure was repeated at night to know the differences in their feeding behaviour at different times of the day.

**Procedures for Monitoring Sleeping Behaviour:** The sleeping behaviour of the captive African giant rats was studied during the day and at night in such a way that their postures and position

were monitored while sleeping by visually observing them in the daytime and using camera recording at night.

**Procedures for Monitoring Cannibalistic Behaviour:** Monitoring of their cannibalistic tendencies was done using camera recording at night. Meanwhile, during the daytime, the monitoring was done by visual observation.

**Procedures for Monitoring Reproductive Behaviour:** The reproductive behaviour of the captive African giant rat was monitored by pairing male and female and onward monitoring of their courtship and mating behaviour during the day and at night. The nursing mothers were also monitored on how their pups were breastfed.

## RESULTS

**Different Postures Displayed by African Giant Rats While Eating in Captivity:** African giant rats do not only sit on their haunches while eating. They can also be in a standing position with their pes (hind feet) and hold the food/food materials with their manus whether during the day or at night when they are very active in captivity (Figure 5).



**Figure 5: Standing position of an African giant rat while eating in captivity**

If the food provided for the captive African giant rats is granule-like, they consume the food by stretching their neck into the food container (Figure 6).



**Figure 6: Postures of an African giant rat while eating granule-like food substance from the container**

Rats generally can gnaw both food and non-food materials with the aid of their incisors. Therefore, the African giant rats were served food and water using containers that could not be easily gnawed.

African giant rat is otherwise known as a pouched rat or African pouched rat. They are called pouched rats because their cheek is characterised by having pouches in which they store food substances or hoard them for later consumption. They exhibit this unique habit not only in the wild but also in captivity as shown below (Figure 7).



**Figure 7: An African giant rat eating its excised tail in captivity**

Coprophagy was an act performed by African pouched rat in captivity during this study. It was observed that they consumed their faeces.

**Behavioural Attitudes Associated with Sleep:** They show three major sleeping positions in their housing units where they were held. They either assumed the shape of the letter "O" while sleeping (Figures 8 A and B), lay down and maintained a curved shape (Figure 8 C), or lay on their back (Figure 8 D).



**Figure 8: Different behavioral attitudes associated with sleep (A and B: "letter O" position while sleeping, C: curve shaped position while sleeping, D: lying on its back position while sleeping)**

**Cleaning of the Parts of the Body:** In captivity, African giant rats were observed to carry out cleaning of the parts of the body such as the head and face, tail, and genitals. The head and face were cleaned by using both the left and right manus to wipe the forehead and the face two to three times. It cleaned its tail using its tongue to do the wiping while the lower jaw of the mouth was used to scratch the tail. The genitals (especially the penis) were cleaned by wiping it with its tongue.

**Cannibalism Behaviour:** Some incidents of cannibalism were witnessed in African giant rats in captivity. They include the following: i). In a cohabitation trial, a male killed the female and removed her intestine and nasal portion of the head. ii). During the period of acclimatization, a female gave birth to four (4) pups in the daytime and ate up all the pups overnight without leaving

any traces even though it was provided with varieties of fruits such as banana, roasted, fried fish, and bread. iii). Another female also gave birth to four pups in captivity during the acclimatization period. The nursing mother showed parental care to the pups by breastfeeding them regularly. However, it cannibalized one of the pups 15 days after giving birth despite providing food and water *ad libitum*. iv). It was observed that one of the pups which had grown hair all over its body strayed into a female housing unit and was killed by the female. This was confirmed because the remnant of cannibalized pup skin was found the following day in the tray meant for collecting faeces underneath the housing unit. v). There was also an incident whereby a hairy pup strayed into a male housing unit and was cannibalized by the male. Remnant of the pup's body seen in the collecting tray confirmed this. vi) There were cases in captivity whereby the captive African giant rat cut part of its tail and ate it whether an injury was sustained on the tail or not. This incident was predominant among the males (Figure 9).



**Figure 9: Mating position of the male and female African giant rat in captivity**

**Some Aspects of the Nursing Mother's Behaviour in Captivity:** One of the females which must have been pregnant from the wild gave birth to four pups naked (with their eyes closed) after two weeks in captivity and its behaviour was studied starting from the time of giving birth till the time of weaning the pups. It was witnessed that the pregnant female gave birth to the pups one after the other with each

pup having its umbilical cord attached to the placenta. It was observed that during the parturition period, as the female gave birth to each pup, it ate up its umbilical cord and also cleaned up the pup before the next pup was given birth. Breastfeeding of the pups did not commence until the female was delivered of all the pups. The four pups were individually weighed at birth (Table 1).

**Table 1: Weight of African giant rat pups at birth and weaning**

S/N	Weight at birth (g)	Head body length (mm)	Total length (mm)
1	22.4	85.2	121.3
2	20.5	83.5	120.1
3	25.1	87.4	121.5
4	19.7	82.7	119.7
	Weight at weaning (g)	Head body length (mm)	Total length (mm)
1	135.6	158.9	226.3
2	145.2	167.7	234.2
3	105.3	146.5	241.4
4	149.2	153.2	229.8

They were marked with a permanent ink marker and put in a wooden box for easy breastfeeding by their mother and to ensure they were safe in the cage (Figure 10A). Figures 10B and C show the positions assumed by the nursing female when breastfeeding as observed in captivity. Figure 10D shows the three-week-old pups in captivity already covered with hair. The pups did not open their eyes until they were three weeks old. It was also observed that they started eating from the food provided for their mother at this age. Weaning was confirmed in one of the pups when it was 29 days old when it left its mother and gained independence. It was noticed that all the pups did not have the same weaning period in captivity as some had delayed weaning period but none of the pups was breastfed for more than 35 days.

## DISCUSSION

**Different Postures Displayed by African Giant Rats While Eating in Captivity:** In captivity, African giant rat has omnivorous habits as they consume both food and non-food materials supplied to them.



**Figure 10: Nursing female of African giant rat and the pups in captivity (A) the mother and a day-old pups (B) a breastfeeding position of the nursing mother (C) another breastfeeding position of the nursing mother (D) three week-old pups**

Some of the food items supplied to it in captivity include nuts, fruits, grains, pellet substances, paps, fried foods etc. The animal grips any food substance large enough to be gripped with its manus and stands on its haunches before putting the food in its mouth. Any food substance in the form of grains or that cannot be gripped is usually consumed by sticking the neck inside the feeding trough. This is in agreement with the findings by Cooper (2008) and Ray and Duplantier (2013) that the African giant has a basic diet such as pawpaw, orange, avocado, palm kernels, groundnut, and coconut. This is corroborating the present report that this animal is omnivorous not only in the wild but also in captivity. The feeding activities of *C. gambianus* on maize crops had been previously reported by Badmus *et al.* (2024). They are described as one of the destructive species that have a preference for tuber crops such as cassava. This could be because it is a fossorial species whereby it comes across the tuber in the course of its burrowing activities. Badmus and Alarape (2023) also reported *C. gambianus* as one of the vertebrate pest species causing economic damage to legumes.

African giant rats consume a slight amount of food at regular intervals in a day. This habit exhibited by African giant rats can be said to be natural as it is regarded as a food hoarder because it normally keeps the nest stocked with food.

The pouches in their cheek are therefore used to convey both nesting material and food among other functions. For instance, when two or more African giant rats are consuming food together, the cheek pouches serve to avoid food stealing. This is mostly noticeable among a litter of young: full cheek pouches do not hinder eating and the minors will consume one piece of food while the pouches are crowded with a standby supply.

It is also important to observe a minor who is eating a piece of food hastily pouches it if a litter mate approaches. In ontogeny, this is the first use to which the pouches in the cheek are put and this occurs very soon after eating solid food starts. In food consumption, food is first picked up in the mouth and then held between the two paws while small pieces are gnawed off with the incisors and then passed back to the cheek teeth, where they are chewed with a predominantly transverse grinding action. The animal may either be seated on its haunches as it eats or lie on its belly, supporting itself on its elbows. Things too large to be appropriately held in the paws are gnawed as they lie on the ground.

The present study revealed that both male and female African giant rat indulges in coprophagy at regular interval in captivity. However, this was not in any way a result of their nutritional deficiency because the animals were always provided with diverse food items. Similar to the report of the present study was that reported by Kingdon *et al.* (2013) who explained that *C. gambianus* practices the act of coprophagy at will.

**Cleaning of the Parts of the Body:** It was revealed that African giant rat held in captivity in the present study usually used their mouth and tongue to clean parts of their body including genitals. They did that by scratching and scrubbing or wiping their body parts. It had earlier been reported that in many mammals possessing dense hair, pelage maintenance is of considerable importance and the African giant rat is no exception (Kingdon *et al.*, 2013). Another rodent species which was commensal in habit (*Rattus* spp.) was also reported to exhibit the act of cleaning the fur (Barnett, 2017).

Ray and Duplantier (2013) further reported that every part of the body of *C. gambianus* is judiciously scrubbed once daily or more. It was however reported that aside from the very short-term rubbing or biting, toilet activities come first either by the animal moving from sleep or by consumption. The grooming ensuing feeding is regularly restricted to cleaning the face and paws.

The tail was another part of the body usually cleaned by African giant rats as revealed in the present study. They usually licked the whole length of the tail. This is in line with the report given by Ray and Duplantier (2013) that the tail is scrubbed just like the pes, mostly by licking, but incisor nibbling is used often. Just like the pes, the paws grasp the tail in place. They may be positioned fairly close together one on either side of the tail so that the part being scrubbed is held more or less vertically and the animal licks the part distal to the paws or the paws may be more widely detached, hold the tail from the same side and hold it bent in a more or less horizontal curve in front of the face, while the rat then licks the part between the two paws. The grip is moved from time to time and the whole length of the tail is worked over several times, sometimes from base to tip and sometimes in the opposite direction.

**Behavioural Attitudes Associated with Sleep:** It was revealed that male or female African giant rats assumed three major sleeping positions in captivity, including forming the shape of the "letter O", lying down and maintaining a curved shape or lying on their back. This sleep posture is in tandem with the earlier observation of Stenvers *et al.* (2016) in their work on behavioural characteristics of sleep in rats under different light-dark conditions.

**Cannibalism Behaviour:** Different incidents of cannibalism were recorded among the captive African giant rat as revealed in the present study. For instance, Sexual cannibalism occurred between a male who killed a female and removed her intestine and nasal portion of the head. This could be probably because the male wanted to forcefully mate with the female counterpart without considering whether it was on heat or

not. This confirms the observation of Chapman *et al.* (2003) who have previously reported that sexual conflict always results in sexual cannibalism and has been linked to differences in the reproductive interests of male and female animals.

Another incident of cannibalism recorded in captivity was a female who cannibalized all four pups overnight without leaving any traces despite being provided with diverse food items. This could be attributed to the wildness in the animal since the cannibalization took place in the early days of acclimatization when the animal gave birth. This observed parent-offspring cannibalism in this present study is also in tandem with the observation of Klug and Bonsall (2007) who also reported that parents of many species readily cannibalise offspring under their care.

It was revealed from the present study that a pup strayed into another mature female housing unit was cannibalized by the mature female. A similar incident was recorded in the case of a mature male whereby a hairy pup strayed into a male housing unit and was cannibalized by the male. This observation has been previously reported by Cooper (2008) and Qin *et al.* (2004). This may be due to territorial integrity protection either against a high population density or an alternative source of food when there is food scarcity or starvation (Kingdon *et al.*, 2013).

The captive African giant rat was reported to cut part of its tail and ate it (auto-cannibalism), it not necessarily because the animal had earlier sustained injury or not. This auto-cannibalism or self-cannibalism observed in this present study has been previously reported by Preti (2007) and Cooper (2008). This attitude has been linked to captivity and isolation in many species leading to self-destructive behaviours, ranging from self-mutilation to self-cannibalism. This behaviour was predominantly observed in males' animals compared to females.

**Reproductive and Nursing Behaviours of African Giant Rats in Captivity:** As revealed from the present study, the cohabitation among the African giant rat in captivity was possible after the expiration of the four weeks of

acclimatization and no fight was observed between the mature male and female. In an attempt to mate with the female, the male stood on its pes behind the female in readiness for mating to occur. The male then placed its manus around the midway of the female's body. A similar report was given by Ray and Duplantier (2013). It was however reported that it was hard to see what was happening whether intromission occurred following the processes that preceded mating.

It was revealed that a pregnant female gave birth to four naked pups (with their eyes closed) one after the other with each pup having its umbilical cord attached to the placenta after two weeks in captivity suggesting that it must have been pregnant from the wild. The female, after giving birth to each pup, ate up its umbilical cord and also cleaned up the pup before the next pup was given birth to. Breastfeeding of the pups did not commence until the female was delivered of all the pups. The female fed the pups with the breast-milk by gathering the young under its body, and crouching over them. This pattern of parturition and nursing is in consonance with the report by Ngalameno *et al.* (2024) who stated that the first pup born was licked unsoiled. Then, placenta was released and the female ingested it as it came out from her vulva. Thereafter, the second youngster was born and the third and last. The young were licked unsoiled and the membranes consumed and there was almost no staining of the nest observed in this present study.

It was recorded that after three-weeks, the eyes of the pups were opened and their body already covered with hair. It was also observed that they started eating from the food provided for their mother at this age. Weaning was confirmed from one of the pups when it was 29 days old when it left its mother and gained independence. It was noticed that all the pups did not have the same weaning period in captivity as some had delayed weaning period but none of the pups was breastfed for more than 35 days. This agrees with what Ngalameno *et al.* (2024) described that the pups were delivered unpigmented, with eyes and ears sealed and nude. Fur was visible by the 5<sup>th</sup> day and at 10<sup>th</sup> days formed a silky covering. The first attempts to



consume solid food were made about the 17<sup>th</sup> day and the growth rate then increased reaching a maximum around 40 days of age, after which it decreased.

The body weight range of litters at birth as revealed from the present study was 19.7 – 25.1 g and the body length was 82.7 – 87.4 mm. Similar report was given by Ngalameno *et al.* (2024) that the average range of weight and body length of African giant rat were 16.0 – 28.0 g and 77.0 – 97.5 mm respectively. The body weight range of litters of African giant rat at weaning as revealed from the present study was 105.3 – 149.2 g and the body length was 146.5 – 167.7 mm. Similar report was given by Kingdon *et al.* (2013) and Ngalameno *et al.* (2024) that the average range of weight and body length of African giant rat at weaning were 66.0 – 186.4 g and 130.6 – 201.0 mm respectively.

At birth, the tail was 30 – 40 mm of the body length, but its growth soon exceeded that of the body and by 80 days the tail was almost as long as the body as reported by Ngalameno *et al.* (2024). The growth rate at first increased gently, reached its maximum at 20 – 25 days and later declined. The tail, however, showed a much sharper peak around 35 days, its growth during this peak period being at least three times as rapid as it was during the first 10 days of life. After that, the rate of growth fell quickly.

**Conclusion:** We therefore conclude that African giant rats possess some unique and strange behaviour that must be considered in the domestication plan for this species of animals. We recommend further studies to evaluate reasons for most of these behaviours and evaluate other characteristics of this animal species.

#### ACKNOWLEDGEMENTS

The authors would like to thank Dr R. A. M. Adedokun (Faculty of Veterinary Medicine, University of Ibadan) and Dr S. A. Shittu (Department of Physiology, College of Medicine, University of Ibadan) for their support and encouragement throughout the period of the research.

#### REFERENCES

- AKPAN, M. O., OLAOGUN, S. C. and RAHMOM, M. O. (2022). Distribution and histological features of sebaceous and sweat glands in different regions of the skin of tree squirrels in Ibadan, Nigeria. *European Journal of Pharmaceutical and Medical Research*, 9(10): 01 – 07.
- ALI, M. N., BYANET, O., SALAMI, S. O., IMAM, J., MAIDAWA, S. M., UMOSEN, A. D., ALPHONSUS, C. and NZALAK, J. O. (2008). Gross anatomical aspects of the gastrointestinal tract of the wild African giant pouched rat (*Cricetomys gambianus*). *Scientific Research and Essays*, 3(10): 518 – 520.
- ALI, M. N., ONYEANUSI, B. I., OJO, S. A., AYO, J. O., MAIDAWA, S. M. and IMAM, J. (2010). Biometric and morphologic studies of the female reproductive organs of the African giant rat (*Cricetomys gambianus*: Waterhouse). *Folia Morphologica*, 69(4): 213 – 215.
- AYOFE, N. A., OLADOYE, P. O. and JEGEDE, D. O. (2018). Extraction and quantification of phthalates in plastic Coca-Cola soft drinks using high performance liquid chromatography (HPLC). *Chemistry International*, 4(2): 85.
- BADMUS, H. A. and ALA, A. A. (2020). Peoples' perception of rodents as pest and their control in Ibadan, South-western Nigeria: A case study of University of Ibadan, Ibadan, Oyo State. *Journal of Animal Science and Veterinary Medicine*, 5(4): 129 – 135.
- BADMUS, H. A. and ALARAPE, A. A. (2023). Economic importance and control of vertebrate pests in legumes. Volume 2, Chapter 5, Pages 83 – 94. MANGENA, P. and ADEJUMO, S. A. (Ed.). *Advances in Legume Research: Physiological Responses and Genetic Improvement for Stress Resistance*. Bentham Science Publishers, Singapore.
- BADMUS, H. A., OLUBODE, O. S. and OJO, S. (2024). Evaluation of depredation activities of rodent pest on maize cultivated in Sasa-Ajibode Farm, Ibadan, Southwest, Nigeria.

- Fudma Journal of Sciences*, 8(6): 17 – 23.
- BARNETT, S. A. (2017). *The Rat: A Study in Behavior*. Routledge, New York, USA.
- CHAPMAN, T., ARNQVIST, G., BANGHAM, J. and ROWE, L. (2003). Sexual conflict. *Trends in Ecology and Evolution*, 18(1): 41 – 47.
- COOPER, R. G. (2008). Care, husbandry and diseases of the African giant rat (*Cricetomys gambianus*). *Journal of the South African Veterinary Association*, 79(2): 62 – 66.
- COOPER, R. G. and ERLWANGER, K. H. (2007). Hyperzincemia in a pet African giant rat (*Cricetomys gambianus* Waterhouse, 1840): Clinical communication. *Journal of the South African Veterinary Association*, 78(3): 163 – 165.
- IBE, C. S., SALAMI, S. O. and ONYEANUSI, B. I. (2011). Macroscopic anatomy of the lower respiratory system in a nocturnal burrowing rodent: African giant pouched rat (*Cricetomys gambianus*, Waterhouse 1840). *Anatomia, Histologia, Embryologia*, 40(2): 112 – 119.
- KINGDON, J., HAPPOLD, D., BUTYNSKI, T. and HAPPOLD, M. (2013). Mammals of Africa. *Choice Reviews Online*, 50: 4188. <https://doi.org/10.5860/choice.50-4188>
- KLUG, H. and BONSALE, M. B. (2007). When to care for, abandon, or eat your offspring: the evolution of parental care and filial cannibalism. *The American Naturalist*, 170(6): 886 – 901.
- NGALAMENO, M. K., LUZIGA, C., HART, D. W. and BENNETT, N. C. (2024). The pattern of reproduction in the African giant pouched rat, *Cricetomys gambianus*, from Tanzania: Unravelling the environmental triggers for breeding. *Canadian Journal of Zoology*, 102(6): 545 – 555.
- OLAOGUN, S. C. (2021). Effects of graded crude protein diet on serum biochemical parameters of African giant rat (*Cricetomys gambianus*) reared in Ibadan, Nigeria. *African Journal of Biomedical Research*, 24(1): 115 – 122.
- OLAWUWO, O. S., OLAOGUN, S. C., AZEEZ, O. I. and OYEWALE, J. O. (2020). Effects of graded crude protein diet on haematological indices and body weight of African giant rat (*Cricetomys gambianus*). *Sahel Journal of Veterinary Sciences*, 17(4): 8 – 15.
- OLAYEMI, F. and ADESHINA, E. (2002). Plasma biochemical values in the African giant rat (*Cricetomys gambianus*, Waterhouse) and the West African hinge backed tortoise (*Kinixys erosa*). *Veterinarski Arhiv*, 72(6): 335 – 342.
- PBS (2010). *How Giant African Rats Are Helping Uncover Deadly Land Mines in Cambodia*. PBS News Hour. <https://www.pbs.org/newshour/show/how-giant-african-rats-are-helping-uncover-deadly-land-mines-in-cambodia> Accessed July 11, 2014.
- PRETI, A. (2007). Suicide among animals: A review of evidence. *Psychological Reports*, 101(3): 831 – 848.
- RAY, J. C. and DUPLANTIER, J. M. (2013). *Cricetomys*, giant pouched rat. Pages 157 – 159. In: HAPPOLD, D. C. D. (Ed.), *Mammals of Africa*. Volume III, Bloomsbury Publishing, London.
- STENVERS, D. J., DORP, R. V., FOPPEN, E., MENDOZA, J., OPPERHUIZEN, A., FLIERS, E., BISSCHOP, P. H., MEIJER, J. H., KALSBECK, A. and DEBOER, T. (2016). Dim light at night disturbs the daily sleep-wake cycle in the rat. *Scientific Reports*, 6: 35662. <https://doi.org/10.1038/srep35662>



This article and articles in *Animal Research International* are Freely Distributed Online and Licensed under a [Creative Commons Attribution 4.0 International License \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/) <https://creativecommons.org/licenses/by/4.0/>