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Research Article

Macro-anatomical studies of the African giant pouched rat (Cricetomys gambianus) axial skeleton

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Abstract

The Axial skeleton of the African Giant Rat (*Cricetomys gambianus)* was studied using 12 adult rats of both sexes. Characteristics of the bones were studied by gross observation after preparation. Measurements of different segments of the Axial skeleton were also taken. The bones of the rat were found to be generally similar in both structure and number to other rodent species. Variation came only in the size of the bones and the number of coccygeal vertebrae which was found to be an average of 26 bones with an average length of 39.0±2.27cm. Each segment of the Axial skeleton was measured giving a total length of 69.7cm out of which the tail takes 39.0cm (58%).The average total number of bones in the Axial skeleton of the rat was 91 bones. The vertebral formula of the African Giant Rat is C7 T13 L6 S4 C15-37.

Keywords: African giant rat, Axial skeleton, vertebral formula.

INTRODUCTION

The domestication of the African Giant Pouched Rat *Cricetomys gambianus* has been encouraged by the Nigerian Wildlife Conservation Committee as a result of its numerous potentials which include Supplementation of dietary meat supply especially in the rural areas of the country (Ikede and Ajayi, 1976), its use as a laboratory animal in the passage of *Schistosoma mansoni* and *Trypanosoma evansi* (lariviere, 1961), its use for detection of landmines (ABC, 2005; Lindow,2008), its use to sniff out Tuberculosis in Humans (Mekee, 2003; Moth 2004) and recent use as a pet animal in the United States of America.

For this domestication to be successful there is need to understand its physiological needs which can only be achieved by making available certain base line data and information on its morphology. Literature search revealed that efforts have been made at studying various systems of this rat in order to facilitate its domestication; however there is limited information on the complete axial skeleton of the rat. Broadly speaking, the skeleton of any animal presents two sets of characters, Morphological and structural characters which are connected with an animal's position in the class of vertebrate and Teleological or secondary characters which are connected with an animal's habit or mode of living acquired during the development of the animal species (Peter and Roger 1980). Consequently, this study was therefore conducted to document the gross anatomical structure of the rat's Axial skeleton and expose its adaptive morphology. Secondly, to serve as a baseline for phylogenetic comparison.

MATERIALS AND METHODS

A total of 12 adult African Giant Pouched rats (*Cricetomys gambianus*) of both sexes were captured alive in the wild around Samaru villages in Zaria, Kaduna state, Nigeria, using metal cage traps. They were then housed in customized laboratory rat cages in the department of Veterinary Anatomy, faculty of Veterinary Medicine, Ahmadu

Bello University, Zaria, Nigeria and fed with fruits, groundnut pellets and water adlibitum for a week prior to commencement of study. The rats were euthanized using gaseous chloroform in a confined container and weighed using a balance (EMPEROR model p.1210) with a sensitivity of 0.1g. They were then dissected to remove skin, thoracic, abdominal and pelvic contents. The muscles were carefully dissected and teased from the bones to leave the bones with minimal soft tissue attachments, then submerged into different plastic buckets containing water. The plastic buckets were then covered and placed under the sun for four (4) days after which the water was drained and the bones recovered and dried.

Photographs of the bones were taken individually and segmentally in some cases. The total number of bones recovered were counted and recorded. Measurements of the Skull, Sternum and Vertebral segments were taken.

RESULTS

The bones of the African Giant Pouched Rat (Cricetomys gambianus) were found to be similar to other members of the rat family with little difference in the morphology of some of the bones.

The **Skull** presented flat bones separated by sutures. It also presented long nasal bones located dorsally which formed the nasal cavity with the premaxilla bone. The frontal bone extends horizontally from the parietal bone to meet with the nasal and premaxilla bone and perpendicularly to meet the maxilla. One interparietal bone crosses the paired parietal bone caudally (figure1a). The skull also presented anterior and posterior foramen lacerum located ventrally. The pterygoid bone ventrally located divides caudally into two processes, the internal and external pterygoid process (figure31b).The anterior palatine foramen located ventrally crosses the suture between the maxilla and premaxilla bone. The petrous part of the temporal bone presented a structure called the periodic capsule (figure1c).

The **Mandible** presented a mandibular symphysis. There is a masseteric fossa dermacated by a prominent masseteric ridge on the ramus of the mandible (figure 2a,b,c).

The **Hyoid** bone is U shaped with no segmentation or cartilages (figure3).

The **Sternum** has 6 sternebrae with the manibrium being fan shaped and providing articular surfaces for the cartilage articulation. The xyphoid cartilage is a relatively small flat structure at the caudal end of the long rod like 6th sternebra (figure5)

The **Vertebral formula** for the African Giant Rat was C7 T13 L6 S4 C15-37. The 6th cervical vertebrae presented a plate of bone extending ventrally and projecting caudally from the transverse process (figure6). The lumbar vertebrae presented prominent mammillary and accessory processes (figure8). The sacral bones presented no distinct dorsal and ventral foramina and unfused spinous processes while the 1st two sacral vertebra presented wings (transverse process) for articulation with the ilium (figure9). The coccygeal vertebrae presented an average of 26 bones with its cranial, middle and caudal portions being of different sizes and morphology (figure10).

The **rib cage** presented 13 pairs of ribs with 7 pairs sternal and 6 pairs asternal out of which 2 pairs were floating (figure4).Each segment of the axial skeleton was measured giving a total length of 69.7cm out of which the tail takes 58% (39.0cm).

Table 1 shows the number of bones as well as percentage of the Axial skeleton. The Axial skeleton which comprises the Skull, Sternum, Ribs and Vertebral segments has an average of 91 bones which form 30.8% of the total number of bones.

Table 2 shows the length of different segments of the rat's axial skeleton. The mean weights of the male and female African giant rats used in this study were 1.0063±0.08369kg and 0.8750±0.12500kg respectively. It was however observed that the weight of the rats positively affect the size of each bone, the length of each segment as well as the number of coccygeal vertebrae.

Figure1a, b and c presents the dorsal, ventral and lateral views of the skull respectively. Figure2 a, b and c shows the lateral, medial and dorsal views of the mandible. Figure3 presents the Hyoid bone. The various vertebral segments are presented in Figures. 6,7,8, 9,10,11,12. The ribs and sternum are shown in Figs. 4 and 5 respectively.

Table1. Number of bones that make up the Axial Skeleton of the African Giant Rat

Bone	Number
Skull	1
Hyoid	1
Mandible	1
Sternum	6
Ribs	13pairs
Cervical vertebrae	7
Thoracic vertebrae	13
Lumbar vertebrae	6
Sacral vertebrae	4
Coccygeal vertebrae	15-37
Total number	**80-102 Av.91 30.8%**

Skeletal parts	Length	
	Range (cm)	Mean (cm)
Skull with mandible	7.1000-7.2000	7.1000±0.04082
Cervical vertebrae	2.9000-4.0000	3.3500±0.25331
Thoracic vertebrae	8.3000-10.0000	9.0500±0.39686
Lumbar vertebrae	6.4000-8.5000	7.1000±0.57155
Sacral vertebrae	4.0000-4.5000	4.2250±0.13150
Coccygeal vertebrae	34.0000-45.0000	39.0000±2.27303
Rib cage	9.0000-11.0000	9.7500±0.47871
Sternum	5.5000-7.4000	6.3250±0.41307

THE SKULL

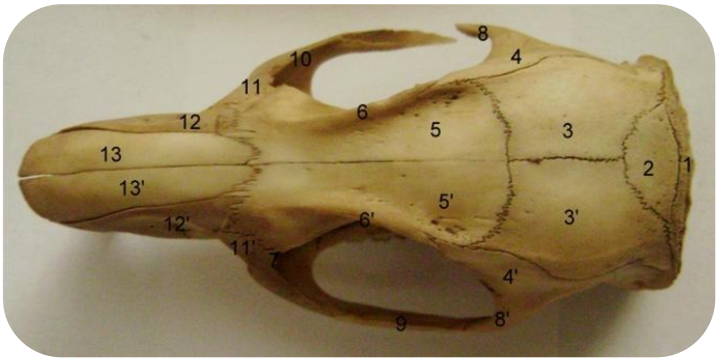

Figure1a. SKULL,dorsal view.

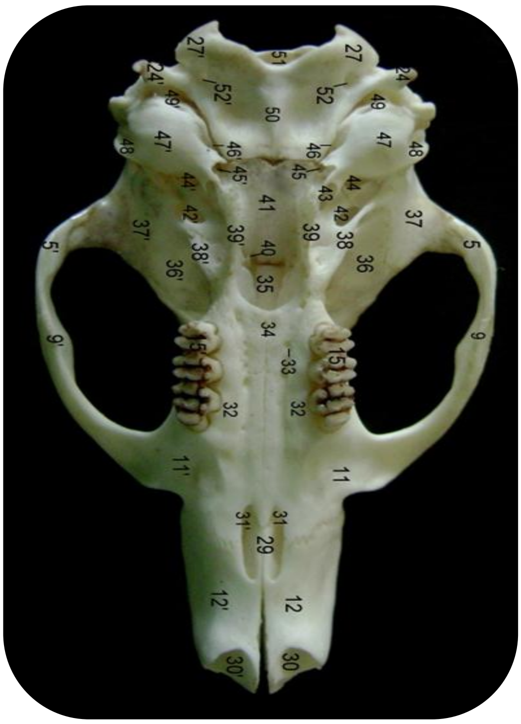

Figure1b. SKULL,ventral view

1,Occipital crest; 2,Interparietal bone; 3,Parietal bone; 4,Squamosal bone; 5,5',Frontal bone; 6,6',Frontal crest; 7,Lacrimal bone; 8,8',Zygomatic process; 9,9',Zygomatic bone; 10,Malar bone; 11,11',Maxilla bone; 12,12',Premaxilla bone; 13,13',Nasal bone; 14,Incissor; 15,Molars; 16,Internal pterygoid process; 17,Anterior ethmoidal foramen; 18,Optic foramen; 19, Anterior foramen lacerum; 20,Petrous bone; 21,Postglenoid foramen; 22,External acoustic meatus; 23,Stylomastoid foramen; 24,Paramastoid process; 25,Periotic capsule; 26,Post tympanic hook; 27,Occipital condyle; 28,Occipital bone; 29,Palatine process; 30,Incissor groove; 31,Anterior palatine foramen; 32,Alveolar process; 33,Posterior palatine foramen; 34,Palatine bone; 35,Presphenoid; 36,36',Wing of sphenoid; 37,37',Squamosal; 38,38',External pterygoid process; 39,39',Internal pterygoid process; 40,Anterior foramen lacerum; 41,Basisphenoid; 42,Foramen ovale; 43,Middle foramen lacerum; 44,Petrotympanic fissure; 45,45',Eustachian canal; 46,46'Carotid canal; 47,47',Tympanic bulla; 48,External acoustic meatus; 49,49',Posterior foramen lacerum; 50,Basilar part of occipital bone; 51,Occipital foramen; 52,Hypoglossal foramen.

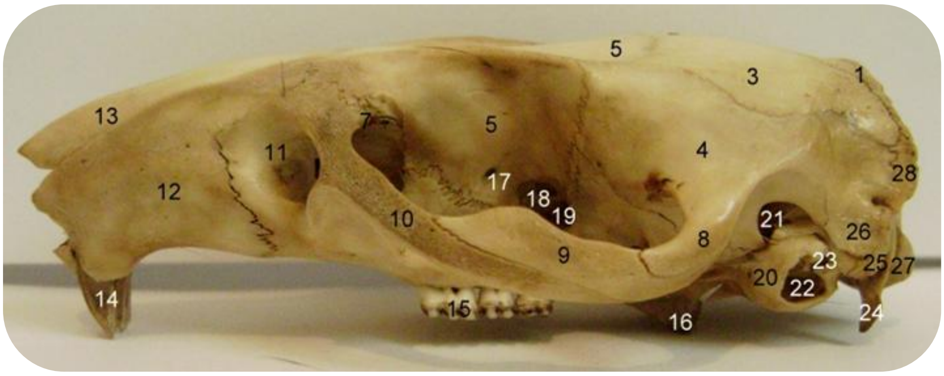

Figure1c. SKULL, lateral view

Very prominent Premaxilla bone (12) compared to what is obtainable in ruminants and Horse.

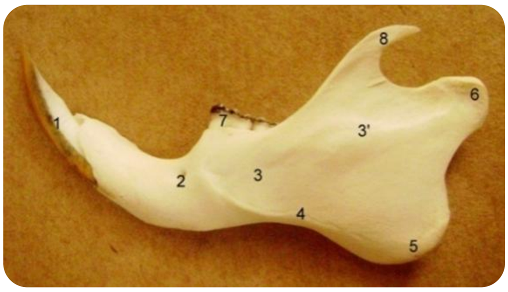

Figure2a. MANDIBULAR HALF, lateral view

1,Incissor; 2,Mental foramen; 3,3',Horizontal and vertical parts of ramus of mandible; 4,Masseteric ridge; 5,Mandibular angle; 6, Condyloid process; 7,Molars; 8,Coronoid process.

Figure2b. MANDIBULAR HALF, medial view

Figure2c. WHOLE MANDIBLE, dorsal view

1,Condyloid process; 2,Coronoid process; 3,Mandibular foramen; 4,Mandibular notch; 5,Mandibular angle; 6,Alveolar process; 7,Molars; 8,Ventral boarder; 9,Interalveolar boarder; 10, Symphysis; 11,Incissor.

A-Mandibular symphysis; B-Dorsal boarder.

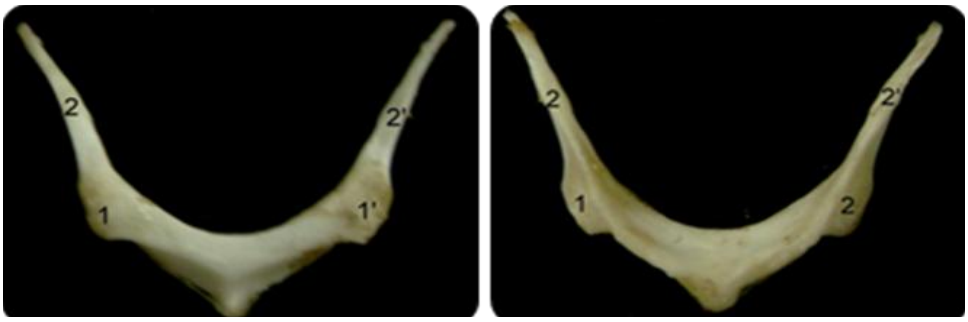

Figure3. HYOID BONE, cranial (L) and caudal (R) views

1, 1', Lesser horn; 2, 2', Greater horn.

Figure 4. RIBS ATTACHED TO THE VERTEBRAE, lateral view

Thoracic vertebrae 2, Tubercular articulation of ribs; 3,

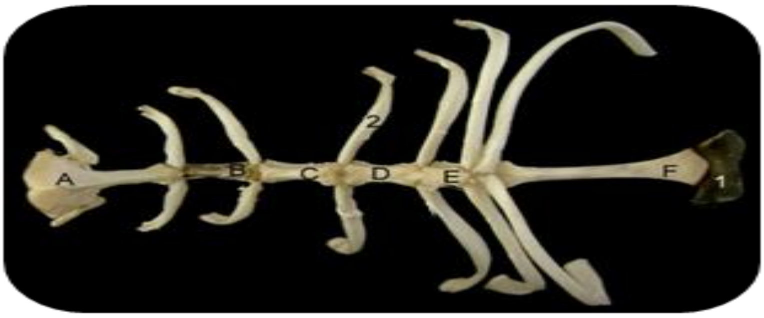

Figure 5. STERNUM, Ventral view

A-F, Sternebra; F, Xyphoid; 1, Xyphoid cartilage;   2, Sternal cartilage.

THE VERTEBRAL BONES

Figure 6. CERVICAL VERTEBRAE, lateral view

A-Atlas; B-Axis; C-G,3rd to 7th cervical vertebra. 1,Transverse foramen; 2, Alar foramen; 3, Spinous process; 4, Transverse process; 5, Cranial and caudal articulation; 6, Ventral process; 7, Body.
6th cervical vertebra showing prominent ventral process

Figure 7. THORACIC VERTEBRAE, lateral view

1,Body; 2,Intervertebral foramen; 3,Transverse process; 4,Spinous process; 5,Mammillary process; 6, Accessory process.

Figure 8. LUMBER VERTEBRAE, lateral view

1, Accessory process; 2, Mammillary process; 3, Transverse process; 4, Intervertebral foramen; 5, Spinous process.
Showing prominent mammillary and accessory processes.

Figure 9. SACRUM, dorsal view

1, Cranial articular surface; 2, Wing of sacrum; 3, 3', Foramen; 4, Auricular surface; 5, Spinous processes. Showing unfused spinous processes of sacrum and no visible dorsal foramina.

Figure10. CRANIAL, MIDDLE AND CAUDAL PORTIONS OF THE COCCYGEAL VERTEBRAE, dorsal view

1,Spinous process; 2,Transverse process; 3,Posterior transverse process; 4,Body; 5,Cranial articular surface; 6,Caudal articular process.

DISCUSSION AND CONCLUSION

The study of the skeleton of the African Giant Pouched rat (*Cricetomys gambianus*) has revealed significant similarity and differences in morphology to that of other rodents and mammals. The Skull was made up of flat bones separated by sutures. This is true for most rodents except for the Guinea pig which contain partly cartilage and partly fibrous membrane with total of six (6) suture joints (Animal corner 2009). The nasal bones are long and positioned dorsal to the premaxilla bone only and together they form the nasal cavity. This was different from most domestic mammals in which the nasal bones are dorsal to both the maxilla and premaxilla (Sisson and Grossman 1975).This finding may not be unconnected to the fact that the rat is a burrowing animal and need a simple and straight passage for the low oxygen tension in the burrow (Ibe et al, 2010). The Pterygoid bone divides caudally into two processes, the internal and external pterygoid process. This finding agrees with the works of Green (1935) on the Albino rat and Cook (1965) on the laboratory mouse showing that this is a prominent feature in rodents. The principal feature of the skull which is also seen in all rodents is the presence of the foramen lacerum (Anterior and Posterior). The Hyoid bone is U- shaped with no segmentation by cartilages into several parts as seen in domestic animals. This also agrees with the works of Green (1935) and Cook (1965) on the anatomy of the Albino rat and laboratory mouse respectively. The vertebral column consists of 7 cervical vertebrae, 13 thoracic vertebrae, 6 lumbar vertebrae, 4 sacral vertebrae and 15-37 caudal vertebrae. The sixth cervical vertebra displays a marked peculiarity as it presented a plate of bone extending ventrally and projecting caudally from the transverse process. The caudal projection is not seen in domestic animals like the ruminants, dog, horse and pig (Sisson and Grossman 1975). The mammillary and accessory processes are very prominent on the lumbar vertebrae. In domestic animals, these processes may or may not be present depending on the species. The spinous processes of the sacrum are not fused with no dorsal and ventral foramina and the sacroiliac articulation is formed between the first two sacral vertebrae and the ilium unlike what is found in other mammals where the articulation is formed between the first sacral vertebral wing and the ilium (Sisson and Grossman 1975). The cranial, middle and caudal portions of the caudal vertebrae present differences in size and morphology typical of any other mammalian coccygeal bones.

The mean weight of the male African giant rat (1.006kg) is greater than that of the female (0.875kg) which agrees with the findings of Ewer (1967) that the “mean mass varies greatly in groups of rats, but individuals normally weigh between 1 and 2 kg, with males being heavier than females”. Variation in body sizes in the African giant rat accounted for variation in the size and length of various bone segments. The lengths of the skeletal segments of the African giant rat shows how large it is when compared to the laboratory rats used for researches. This gives it more advantage over the laboratory rats as there is more surface area for biochemical analysis and more visibility in terms of structure making this animal a suitable replacement for laboratory rats in conducting researches.

This study has presented the morphology and morphometry of the African Giant Rat axial skeleton. The bones were found to be similar in structure and number to other species of the rat that has been worked on. The only exception was in the number of coccygeal bones which is very long compared to other rat species. This study is an addition to the body of information that is gradually building up to enhance the domestication of this valuable rat.

References

Abc Encyclopedia Britanicca. 11ed (2000)

A B C News online, Sunday, January 16 2005 African giant rat sniffs out Mozambique landmines.

Ajayi SS(1975). Observations on the biology, domestication and reproductive performance of the African giant rat *Cricetomys gambianus* waterhouse in Nigeria. Mammalia 39: 343-364.

Cook J Margaret(1965). Anatomy of the laboratory mouse. Academic press, Pp. 1-20.

Dipeolu OO, Akinboade OA, Ogunji F(1981). Observation on the African giant rat *(Cricetomys gambianus).* Bulletin of Animal Health and production in Africa, 29: 393-397.

Eunice Cage Green (1935). Anatomy of the rat. Hafner publishing company New York and London. Pp.1-29.

Eunice Cage Green (1963). Anatomy of the rat. Hafner publishing company New York and London. 27: 1-50.

Ewer RF(1967). The behaviour of the African giant rat (*Cricetomys gambianus waterhouse*). Zeitschrift fur tierpsychologie. 24 (1): 6-79.

Larivierie M, Buttner A(1961). *Cricetomys gambianus* Hote Expta de *Schistosoma mansoni* Helminthology Abstract, 31: 437.

Lindow M(2001). The landmines – sniffing Rats of Mozambique Time Magazine. Retrieved on 2008-06-23.

Mekee M (2003) Giant rats to sniff out tuberculosis. http://www.newscient.Com/article.nsd=dn4488.

Moth M(2004). Bees giant African rat used to sniff landmines. http://www.national geographic.com /news/2004/02/0210-040210 mine rats.

Olude MA, Olopade JO, Fatola IO, Onwuka SK (2009). Some aspects of the neurocraniometry of the African giant rat (Cricetomys gambianus Waterhouse). Folia Morphol. 68: 224-227.

Perry D, B Hanson, W Hobgood, RL Lopez, CR Okraska, K Karem, IK Damon, DS Caroll(2006). New invasive species in southern Florida: Gambian rat *(Cricetomys gambianus).* J. mammology 87: 262-264.

Sisson and Grossman’s (1975). The anatomy of the domestic animals fifth edition, vol 1.

http://www.animalcorner.co.uk