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Comparative Craniometric Study Of Fat Sand Rat (*Psammomys Obesus*) And Four Toed Jerboa (*Allactaga Tetradactyla*) Live In The Similar Habitats

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Abstract

Aim of the work: The present study deals with the skull structure in two species of rodents, namely *Psammomys obesus*, the common name is Fat Sand rat, and *Allactaga tetradactyla*, the common name is four toed jerboa that live in the same habitat.

Material and Methods: The skulls of *Psammomys obesus* and *Allactaga tetradactyla* are studied

Results : The skull of *Psammomys obesus*, is triangular, strongly ridged and the sutures between its components are faintly apparent. It has two large parietals which are qudrate in shape. The frontal bone have triangular shape. The squamosal bone is triangular in shape. The zygomatic arch is slender and weak. The tympanic bullae are greatly expanded and the extrnal auditory meatus is swollen. It has irregular shaped sphenoid bone consists of two unfused parts, presphenoid and basisphenoid. The occipital bone encloses the foramen magnum which is guarded laterally by two smooth articular occipital condyles. Exoccipital is broad. The mandible of *Psammomys obesus* consists of right and left halves firmly united in life at the mandibular symphysis. The body of the mandible can be divided into two parts, one bears the incisor teeth and the other contains the molar teeth.

However, the cranium in *Allactaga tetradactyla* is broadly flattened in shape and the sutures between its component bones are apparent. It has two large parietals and the interparietal is narrow and triangular in shape. The frontal bones are flattened. On each side of the cranium, the squamosal which lies between the tympanic bullae and orbit. Supraoccipital is large, the zygomatic arch is slender, weak and consists of two parts, the zygomatic process of maxilla and zygomatic process of temporal. The nasal bones are elongated. The maxillary bone is irregular in shape. The tympanic bulla, exoccipital and paraopccipital process are short.

Keywords: Comparative Study, Fat Sand Rat, Four Toed Jerboa

Introduction

Fat Sand Rat *Psammomys obesus* lives in the coastal and presaharan region. The preferred habitats are saline marshes and wadis where halophytic (salty) plants (family *Chenopodiaceae*) are abundant (Petter, 1961; Haines *et al.,* 1965; Osborn and Helmy, 1980; Happold, 1984; Marquie, *et al.*, 1984; Kam and Degen, 1989; Zaime and Gauter, 1989; Degen, 1993; Fichet-Calver *et al.,* 1999). They are found in gardens and farmlands where moist conditions and green plants are available. They build a network of fairly shallow burrows and because they are frequently diurnal, they may be seen feeding on halophytic plants and climbing shrubs during the day(Castanat *et al* ., 2004).

One of the jerboas *Allactaga tetradactyla* which inhabits the Egyptian desert is the four-toed one. This species with very specific habitat requirements, and a restricted range along the coast of Egypt and Libya , it can be found in Arabian Peninsula, and across southwestern and central Asia. This is likely to have been a loss of suitable habitat with the range of the species, which suggests that the population may be declined but there is no information

available to determine whether this species does indeed meet any of the criteria necessary to consider it as threatened. This is a species in urgent need of survey work to assessment of the remaining habitat of this species is required. *Allactaga tetradactyla* is found on salt marshes and clay desert areas of coastal plains. They are nocturnal rodents spending most of the day light hours in underground burrows and emerging at night to forage. This species has a very restricted range that may be threatened by desert reclamation (Osborn and Helmy, 1980 and MacDonald, 1984).

Allactaga tetradactyla occupies four different kinds of simple burrows: temporary summer day burrows for hiding the day (nocturnal rodents), temporary summer night burrows for hiding the night, permanent summer burrows used as a home for producing young and permanent winter burrows for hibernation (MacDonald, 1984). Most of these burrows are only 60-150cm deep. All burrows have side tunnels erupting at the surface, through which a jerboa can escape if predator threatens them. *Allactaga tetradactyla* often lines its nests with camel hair or their own belly hair (Nowak, 1991). The previous author added that jerboas walk with a show bipedal movment but when they are escaping from predator, they leap in a zigzag pattern and often cover 1- 3 meters per jump.

Different authors have been described the skull of rodents (Harisson, 1968; Evans and Christensen, 1979; Osborn and Helmy, 1980; Madkour, 1981; Ben-Moshe *et al.*, 2001and Renaud *et al.*, 2007). Osborn and Helmy (1980) briefly described the external features, cranial and dental characters of the rodents in Egypt including *Psammomys obesus* and *Allactaga tetradactyla.* Therefore, the present study aimed to investigate, in detail, the structure and measurements of the skull in *Psammomys obesus* and *Allactaga tetradactyla.*

Material And Methods

The investigated animals include two desert rodents belongs to two different families. Muridae is the largest family of rodents in the world; this family is represented in our work by Fat Sand Rat *Psammomys obesus*. Four-toed Jerboa *Allactaga tetradactyla* represents another family called Dipodidae. Fat Sand Rat *Psammomys obesus* specimens were collected from the Western Desert. The second species, Four-toed Jerboa *Allactaga tetradactyla*, were collected from Mersa Matrouh (coastal belt of the Western Desert). The specimens were weighed and transferred alive to the laboratory in separate cages. The animals were classified according to Osborn and Helmy (1980).

The skull of some specimens were prepared by maceration and then were left in the sunlight to bleach, other wise, some speciemens were prepares by using koH (2.5 %) and then were left in $H_2 O_2$ for 24 hours. The skulls of these specimens were measured for showing some craniometric points, (Evans and Christensen, 1979). The skull was photomicrograph in various aspects.

Both the external and cranial measurements of the investigated species were used in comparison between the investigated species *Psammomys obesus* and *Allactaga tetradactyla.* The facial length is measured from nasion to prothion. Facial width is the widest interzygomatic distance. The cranial length is measured from the inion to nasion. The cranial height is measured from middle of external auditory meatus to bregma.

Skull length is measured from the inion to prosthion. Skull width is the widest interzygomatic distance; the skull base length is measured from the basiom to prosthion. The mandibular length is from caudal border of condyle to pogonion. It must show that:

Inion: The central surface point on the external occipital protuberance.

Bregma: The junction on the median plane of the right and left frontoparietal sutures.

Nasion: Is the junction on the median plane of the right and left nasofrontal sutures.

Prosthion: The rostral end of the interincisive suture located between the roots of the upper central incisor teeth.

Basion: The middle of the ventral margin of the foramen magnum and the pogonion is the most rostral part of the mandible, at the symphysismentes.

Results

The investigated animals used in the present study are two species of rodents. One of them called *Psammomys obesus*, the common name is Fat Sand rat. The mean body weight is 133gm, the body sides are characterized by narrow brown or sandy dorsal pelage (Fig. 1 & Table 1). This species is found in Eastern, Western and Sinai deserts of Egypt. The other one called, *Allactaga tetradactyla*, with common name, four toed jerboa. The body weight up to 48 gm. It is a small jerboa with dorsum speckled black and orange side grayish and venter white. Ear pigmented, longer than one half of hind foot length (Fig. 15). This species is found in the Western Mediterranean coastal desert, north of the Western Desert.

Fat Sand Rat *Psammomys obesus*

The colour of fat sand rats are brown in the upper parts while in the under parts are lighter. The head and body length range from 132–165mm. The tail is fully haired and has terminal, black tuft and the external form is stocky. The tail length is ranged from 60–120mm. The ears are pigmented, not very big, ranged from 12–19mm in length, thick, rounded, and lay against the head. The eyes are almond in shape. The hind foot lengths are ranged from 34-38mm (Fig. 1)

The color of dorsal surface of *Psammomys obesus* is brownish; the body weight is about 138gm. The head and body length (HBL) is about 161mm; the tail length (TL) measured about 60mm. The ear length (EL) measured about 19mm; the hind foot length (FL) is equal 3.8 mm. The ratio of tail to head body length averaged about 57%.

The craniometric points of the skull of the two species are present in table (2). The facial length of *Psammomys obesus* is about, 16.5 mm; the skull length measured about 40.8mm. The cranial length measured about 25.1mm; skull base length measured about 38.3mm. The palatal length is 23.5mm in. The mandibular length of *P. obesus* measured 23.3mm.

Four toad Jerboa *Allactaga tetradactyla*

Allactaga tetradactyla is a small kangaroo-shaped animal with long, slender ears that are approximately the same length as their head. Their head and body length is 108 mm and their tail length is approximately 147mm (Table 1, and Fig. 15). The ear length is about 42mm; they have large eyes (a typical trait of nocturnal animals). Their hind legs are four times greater than their fore legs, as true of other jerboas. The hind foot is approximately 53 mm in length. The ratio of tail to head body length averaged 137%. *Allactaga tetradactyla* is the only species within the jerboa that has four toes (hence, the common name 4–toed jerboa). It has only one small lateral digit. The sole of the hind foot has a tuft of stick hairs which acts as a steering mechanism while they leap. This hair also helps them to kick sand backwards while burrowing.

Table (2) shows the cranial points of skull of *Allactaga tetradactyla*. The facial length of skull was measured about 11mm, skull length about 29.6 mm, cranial length about 21.1mm, palatal length about 21.2mm and mandibular length about 20 mm.

Description of skull

I- Skull of *Psammomys obesus*:

In *Psammomys obesus*, the skull is triangular and strongly ridged but not exceeds in length than 41.1mm and the sutures between its components are faintly apparent, while in *Allactaga tetradactyla*, the skull length measured about 28.6mm. However, the lower jaw was described only from the lateral view.

A- Dorsal view

The dorsal surface of the cranial part of the skull consists of, from back to forward, the supraoccipitals which are greater expanded and enclosing the foramen magnum between them, two large parietals which are quadrate in shape. The parietal bones measured about 7.9mm in length and about 12.4mm in width. Rostrally, they articulate with two elongated frontal bones and ventrally with the temporal bone.

Frontal bone is produced into an

incomplete supraorbital process not reaching the posterior margin of the lacrimal. A wide interparietal is found between the supraoccipitals and the parietals. The frontal bone has triangular shape and contributes to the formation of the cranial cavity restrodorsally and to the formation of the face and orbit, it measures about 12.7mm in length. They articulate with the parietal bone caudally, with the maxilla and lacrimal bones rostrally and with the sphenoid and palatine bones ventrally. The frontal bones are dorsally flattened, the lacrymal bones are present. On each side of the cranium, the squamosal is present. It is triangular in shape and lies over the external auditory meatus. The zygomatic arch is slender and weak. It is wide at its junction with the temporal and maxillary processes (Figs.2 & 3).

At the junction of the facial and cranial parts, on each side, is the orbital cavity, which is oval in shape. The lacrimal bone is present and the orbital constriction is remarkable. The dorsal surface of the facial part of the skull is formed by the dorsal surfaces of the frontal, nasal and maxillary bones. The nasal bone articulates with the frontal bone laterally and with the opposite nasal bone medially. It measure about 17.4 mm in length.

The zygomatic process projects lateroventrally. The frontal fossa is a midline depression rostrally where the nasal bone articulates with the frontal bones. Rostral to the frontal bones are the nasal and maxillary bones. The nasal bone is V-shaped and articulates with the frontal bone caudally, with maxillary bone laterally and with the opposite nasal bone medially. It measures about 17.4 mm in length.

The maxillary bone is an irregular shaped bone that articulates dorsocaudally with the frontal bone, medially with the nasal bone, rostrally with the incisive bone (premaxilla) and caudolaterally with the lacrimal, zygomatic and ventrally with palatine bone and caudomedially with the opposite incisive bone, it measures about 9.9mm in length. The incisive and nasals bones enclose the preform aperature.

B- Ventral view

The ventral surface of the cranial part of the skull extends from the foramen magnum to the end of hard palate. Caudally, it presents the small rounded occipital condyles and the median basioccipital which extends forward between the greatly expanded tympanic bullae. The basioccipital has a small ridge at its articulation anteriorly with the sphenoid. The tympanic bullae are greatly expanded, between the bulla and occipital condyle, on each side, is the ventral condyloid fossa in which small circular hypoglossal foramen opens. The external auditory meatus is swollen. Contacting zygomatic process of the temporal. Basioccipital is narrow and constricted by swelling of bullae (Figs. 4 & 5).

The ventral surface of the facial part of the skull is largely formed by the horizontal parts of the palatine, maxillary and incisive bones, which form the hard palate. The alveolar arch forms the rostral and lateral boundaries of the hard palate. The alveolar arch in the incisive contains two incisors, while in the maxilla contains three premolars and three molars. The palatine constricted, deeply ridged and grooved, reached about 14.3mm in length. Vomer is a scent angular process pointed posteriorly and enclosed by the maxillary bones. The incisive foramina are large and the palatine foramina are small. The maxillary bone is irregular in shape, in which molar teeth are rooted. The incisive is a small bone in which incisor teeth are rooted. It is connected coudolaterally with the maxillary bone.

The pterygoid bone is located ventral, lateral to the sphenoid bone, and caudal to the palatine bone. The tympanic are also a prominent feature of the ventral aspect of the skull. They are greatly large; it measured about 13.9mm in length (about 33.8% of the skull length).

C- Lateral view

The temporal bone is the most prominent bone that forms the lateral aspect of the neurocranium. It consists of squamosal and tympanic bones. The squamosal part forms the lateral wall of the neurocranium and articulates with occipital bone caudally, the parietal bone dorsally and sphenoid rostrally, it reaches about 7.9mm in length.

The zygomatic bone projects laterally and rostrally from the squamosal part. The tympanic part of the temporal

bone is ventral to the squamosal. The most prominent features of the tympanium is the bulbous tympanic bulla. It is greatly inflatted and articulates caudally with the jugal process, medially with the occipital and rostrally with sphenoid bone. The large lateral opening into the tympanic cavity is the external auditory meatus. It articulates dorsally with squamosal part of the temporal bone. Anterior lip of auditory meatus swollen to the level of zygomatic process of tomporal bone.The zygomatic arch formed by the zygomatic process of temporal bone caudally and zygomatic process of maxillary bone rostrally (jugal) (Figs. 6 & 7).

The orbit is the cavity containing the eye, only a portion of it formed by bone. It is rostral limits are formed by the frontal, maxillary, lacrimal and zygomatic bones. The medial wall of the orbit is formed mainly by the frontal bone. The ventral wall of the orbit is rostrally located and is formed by maxillary bone. The lacrimal bone is present ventrally in the orbit region, sphenoid bone caudally and by the palatine bone rostrally.

The irregular shaped sphenoid bone consists of two unfused parts, presphenoid and basisphenoid. The basisphenoid bones are the more caudal of the two. It articulates caudally with the temporal and occipital bones, ventrally with the ptrygoid bone and rostromedially with the the frontal and presphenoid bones. The peripendicular lamina of the palatine bone formed the remainder of the medial wall of the orbit

D- Occipital view

The caudal aspect of the neurocranial portion of the skull is formed by the occipital bones. This bone is triangular in shape with a rostral projection, it articulate dorsorostrally with the temporal bones and ventrorostrally with sphenoid bone. The occipital bone encloses the foramen magnum which is guarded laterally by two smooth articular occipital condyles. Exoccipital is broad and paraoccipital process is large and extending laterally (Figs. 8 & 9).

E- Lower jaw (the mandible)

The mandibule of *Psammomys obesus* consists of right and left halves firmly united in life at the mandibular symphysis, which is strong, rough-surface with fibrous joint. Each half is divided into a horizontal part or body and a vertical part or ramus. The body of the mandible can be further divided into two parts, one bears the incisor teeth and the other contains the molar teeth. The sockets or alveoli are conical cavities for the roots of the teeth, indent the alveolar border of the body of the mandible. There is a single alveolus for the root of the incisor and three alveoli for the roots of the three molar teeth.

The lower jaw bones are paired, contain the ventral dental arcade and articulate with the skull at the mandibular fossa. The mandibular length is reaching about 28.5 mm. The incisive part of the body of the mandibule consists of an alveolar arch which bears the two incisor teeth. The molar part of the mandibule bears alveoli for the remainder of ventral dental arcade. The ramus of the mandible runs vertically. The medial surface of the ramus is smooth.

The angular process projects caudally from the ventral border of the mandible. It is large and broad. The coronoid process projects caudodorsally and is located rostral to the zygomatic arch. It is long, slightly curved, strong and triangular in shape. The mandibular notch is the concave surface between the coronoid and condylar process (Figs. 10 & 11). The ramus of the mandible is the caudal non-tooth bearing and forms the vertical part of the bone. It contains three salient processes. The cronoid process is a very small process and extends upward and outward. The condyloid or articular process is large, elongated thin palate of bone with a thickened rostral border forms the temporo-mandibular joint by articulation with the temporal bone. The mandibular notch is located between the condyloid and coronoid processes. The angular process is a long hooked process with a pointed free end serves for the attachment of the pterygoids medially and the masseter laterally. Figures 12, 13 and 14 showing the craniometric points of the skull of *Psammomys obesus.*

II- Skull of *Allactaga tetradactyla*:

In *Allactaga tetradactyla*, the skull of *Allactaga tetradactyla* is similar to that in *Psammomys obesus* except slight differences. The cranium is broadly

flattened in shape and the sutures between its component bones are apparent. It measures about 28.6mm in length. Also, the description of the skull followed from the, dorsal, ventral, lateral and occipital view.

A- Dorsal view

The roof of the cranium is formed of: from behind forward, two large parietals and frontals. The parietal bones are measured about 6.1 mm in length and 14.6 mm in width. The interparietal is narrow and triangular in shape. The frontal bones are flattened and measures about 6.1mm and the supraorbital process of frontal are present while the lacrimal bones are absent. On each side of the cranium, the squamosal lies between the tympanic bulla and orbit. Supraoccipital is large; the zygomatic arch is slender, weak and consists of two parts; the zygomatic process of maxilla and zygomatic process of temporal. At the junction of the facial and cranial parts on each side are the orbital cavities. The facial part of the skull is formed by the dorsal surfaces of the nasal, incisive and maxillary bones. The nasal bones are elongated and measured about 11.1mm in length. The maxillary bone is irregular in shape and measures about 6.8mm. Zygomatic process of temporal extending beyond the level of the external auditory meatus lip. Tympanic bulla is slightly inflated or small (Figs. 16 &17).

B- Ventral view

The ventral surface of the cranial part of the skull extends from the foramen magnum to the hard palate. In the floor of the cranium, from behind forward, the basioccipital is present, which has a small ridge at its articulation with the basisphenoids. The exoccipitals are relatively small and are located between tympanic bullae and the occipital condyle.

As in *Psammomys obesus,* the hard palate is formed from premaxilla, maxillary and palatine bones. The alveolar arch forms rostral and lateral boundaries of the hard palate. The alveolar arch in the premaxilla includes two incisive teeth, one premolar in number and three molars (Figs. 18 &19). The lacrymal bones are absent. The palatine reaches about 10.5mm in length. Also, the pterygoid bone is located ventral and lateral to the sphenoid bone and caudal to the palatine bone. The tympanic bullae are also a prominent featured of the ventral aspect of the skull. They are greatly small which measures about 7.2mm in length (about 25.1% of the skull length).

C- Lateral view

The salient features of the lateral surface of the cranial part of the skull are the prominent zygomatic arch and the orbit. The zygomatic arch is slender, weak and wide at its junction with the temporal and maxillary processes. It is nearly horizontal throughout and strongly bowed outwards. The orbit is elongated in shape. As in *Psammomys obesus,* the temporal bone is the most prominent bone that forms the lateral aspect of the neurocranium. It consists of squamosal and tympanic bones. The squamosal part forms the lateral wall of the neurocranium and articulates with occipital bone caudally, the parietal bone dorsally and sphenoid bone rostrally; it reaches about 6.1mm, which is smaller than that in *Psammomys obesus* (Figs. 20 & 21).

D- Occipital view

The caudal aspect of the cranial portion of the skull is formed by the occipital bone. This bone is roughly broad in shape with a rostral projection. It articulates dorso-rostrally with the temporal bones and ventrorostrally with sphenoid bone. The occipital bone encloses the foramen magnum which is guarded laterally by two smooth articular occipital condyles. The exoccipital and paraoccipital process are short (Figs. 22 & 23).

E- Lower jaw

As in *Psammomys obesus* the lower jaw bones are paired and contain the ventral dental arcade and articulate with the skull at the mandibular fossa. The mandibular length measured 20.2 mm. Lower jaw with angle uniflected and perforated by a single large oval foramen. Fossa between posterior molar and outer side of jaw is deep. The coronoid process is short and slightly curved. The angular process is short with blunted ends (Figs. 24 & 25). Figures 26, 27 and 28 showing the craniometric points of the skull of *Allactaga tetradactyla.*

Fig. (1): Photographic picture of the adult *Psammomys obesus.*

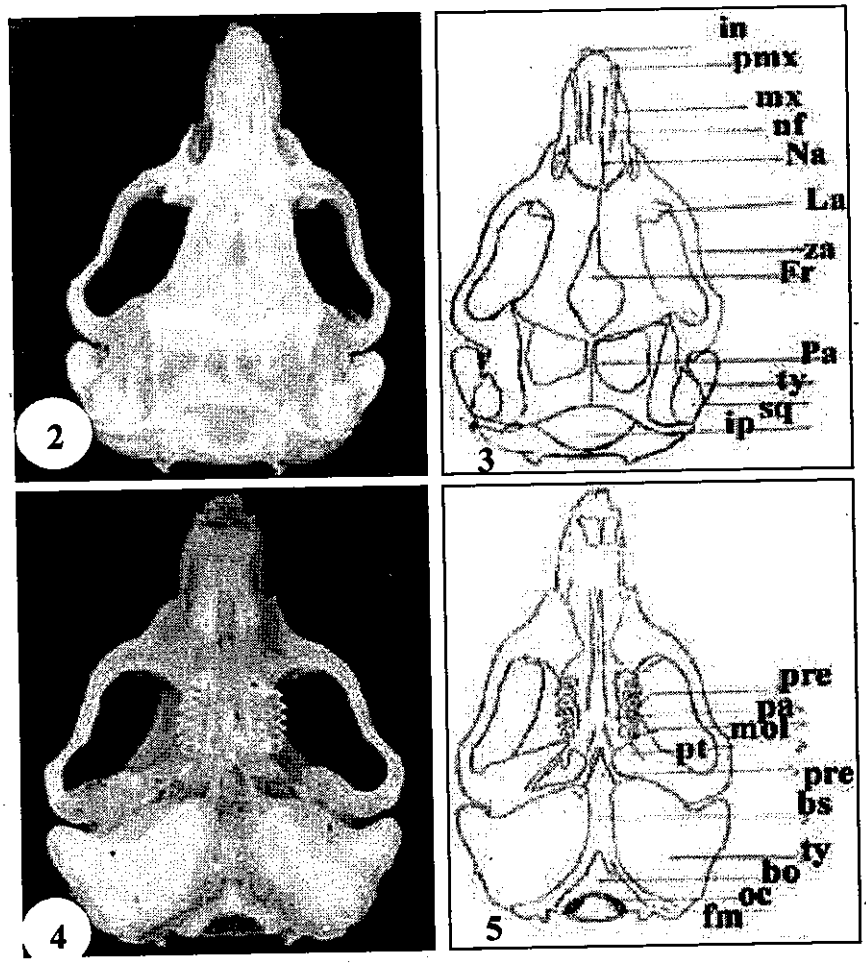
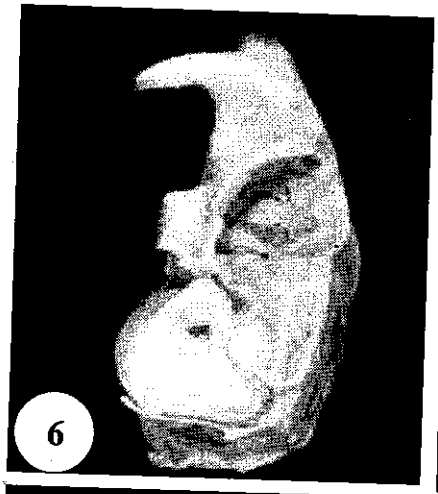
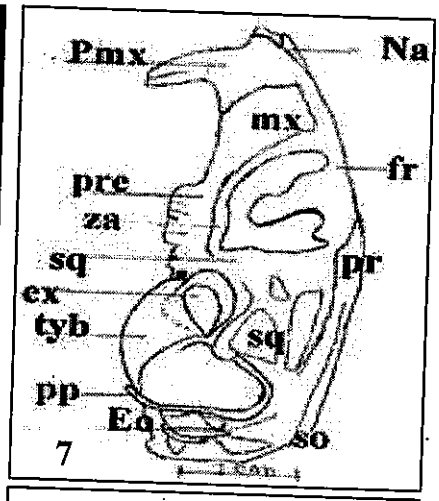
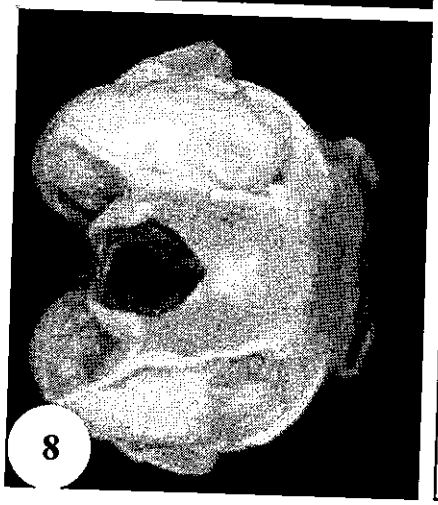


Fig. (2): Photographic picture of the dorsal surface of the skull of *Psammomys obesus*
Fig. (3): Drawing the dorsal surface of the skull of adult *Psammomys obesus.*
Fig. (4): Photographic picture of the ventral surface of the skull of *Psammomys obesus.*
Fig. (5): Drawing the ventral surface of the skull of adult *Psammomys obesus*. Na= nasal, La= lacrimal, Fm= foramen magnum, Fr= frontal, Pr= parietal, Sq= squamosal ip= interparietal, Za= zygomatic arch, Pmx= premaxilla, in= incisor, nf= incisive foramen Pre= premolar, mol= molars, Pa= palatine, Pt= pterygoid, Ty= tymbanic bulla, La= lacrimal, B.oc.= basioccipital, bs= basisphenoid.







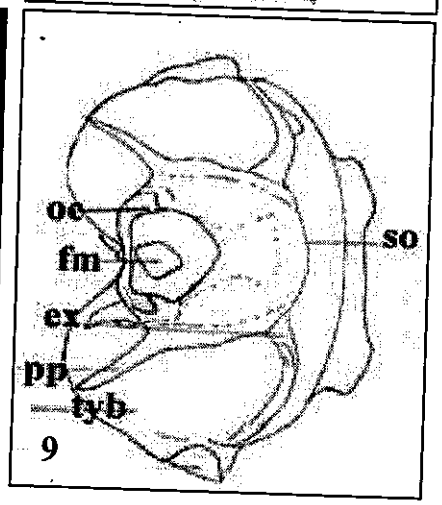
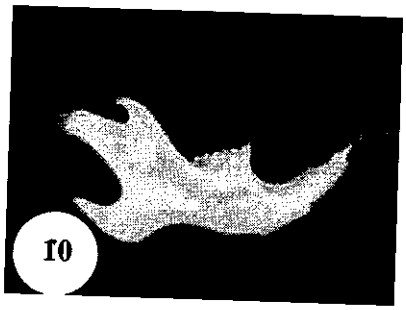


Fig. (6): Photographic picture of the lateral surface of the skull of *Psammomys obesus*
Fig. (7): Drawing the lateral surface of the skull of adult *Psammomys obesus*
Fig. (8): Photographic picture of the occipital surface of the skull of *Psammomys obesus*
Fig. (9): Drawing the occipital surface of the skull of adult *Psammomys obesus*. Pmx= premaxilla, mx= maxilla, pr= parietal, mol= molars, Ty= tympanic bulla, So= supraoccipital, Na= nasal, Eo= exoccipital, Fm= foramen magnum, Pre= premolars, Pp= paraoccipital process, Fr= frontal, Pre= presphenoid, ex= external auditory meatus.



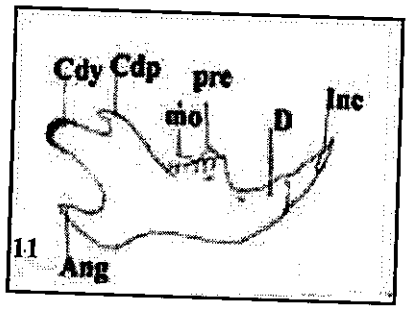


Fig. (10): Photographic picture of the lower jaw of *Psammomys obesus*.
Fig. (11): Drawing the lower jaw of *Psammomys obesus*. Inc= incisor, D= dentary, Ang= angular process, Cdp= coronoid process, Cdy= condyloid process, Pre= premolars, mo= molars, PL= Palatal length.

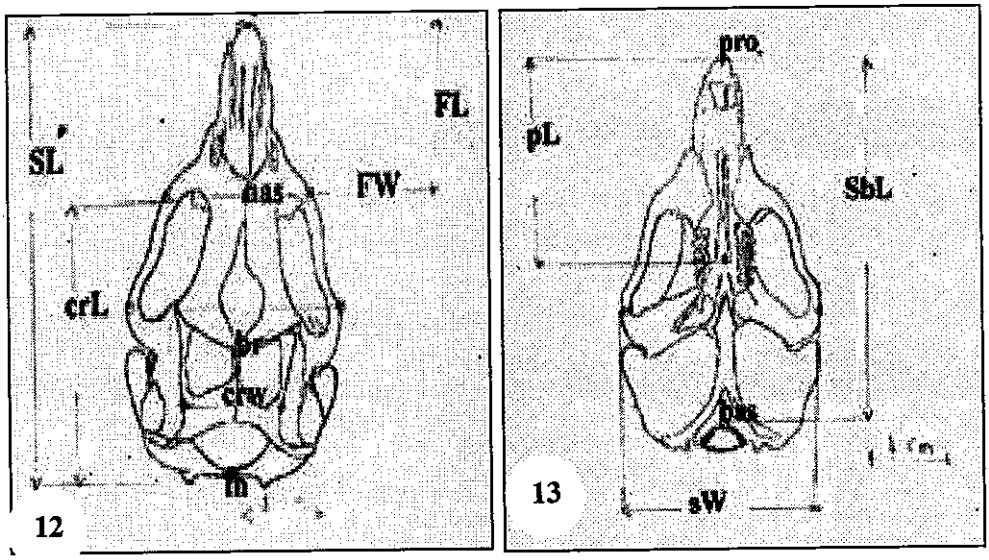


Fig. (12): Drawing the dorsal surface of the skull of adult *Psammomys obesus* showing the craniometric points

Fig. (13): Drawing the ventral surface of the skull of adult *Psammomys obesus* showing the craniometric points. SL= skull length, FL= facial length, CrL= cranial length, SbL= skull base length, Sw= skull width, Fw= facial width, br= bregma, In= inion, Pro= prosthion, nas= nasion, bas= basion, crw=cranial width.

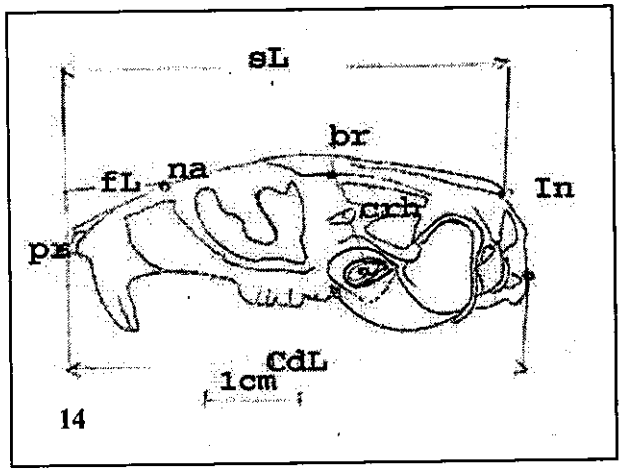


Fig. (14): Drawing the lateral surface of the skull of adult *Psammomys obesus* showing the craniometric points. SL= skull length, FL= facial length, Cr h= cranial height, cd L= condyloid length, br= bregma, Pr= prosthion, na= nasion, In = inion.

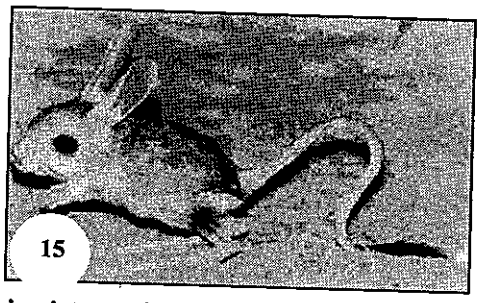
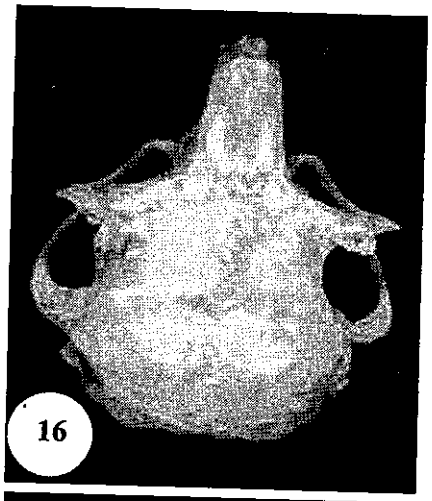
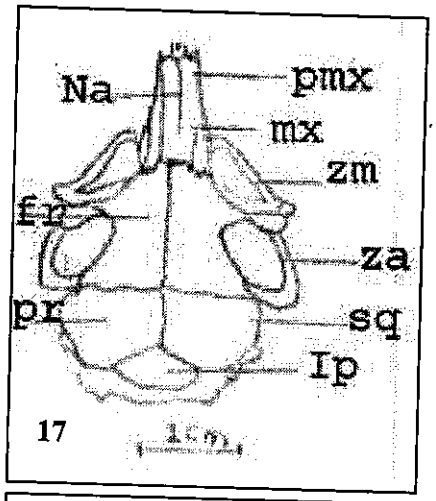
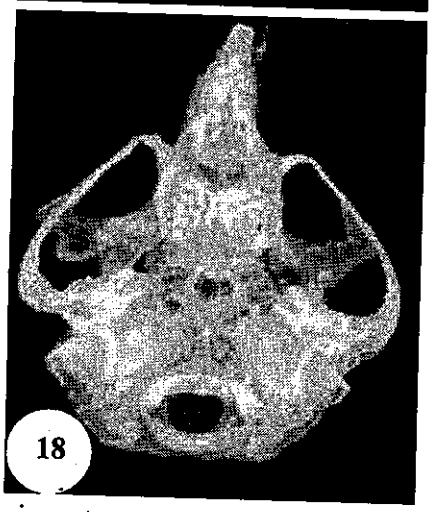


Fig. (15): Photographic picture of the adult *Allactaga tetradactyla.*







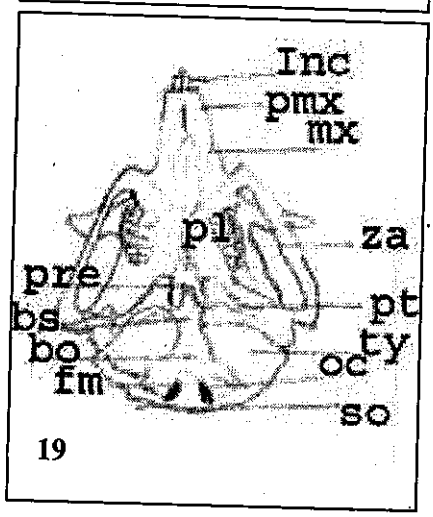


Fig. (16): Photographic picture of the dorsal surface of the skull of *Allactaga tetradactyla*
Fig. (17): Drawing the dorsal surface of the skull of adult *Allactaga tetradactyal*
Fig. (18): Photographic picture of the ventral surface of the skull of *Allactaga tetradactyla*
Fig. (19): Drawing the ventral surface of the skull of adult *Allactaga tetradactyal.* Pr= parietal, Na= nasal, Fm= foramen magnum, Ty= tympanic bulla, Pre= presphenoids, bs= basisphenoid, Sq= squamosal, Ip= interparietal, Za= zygomatic arch, Pmx= premaxilla, Inc = incisor, Pre= premolar, mol= molars, pre= presphenoid, Zm= zygomatic process of maxilla, Oc = occipital condyle.

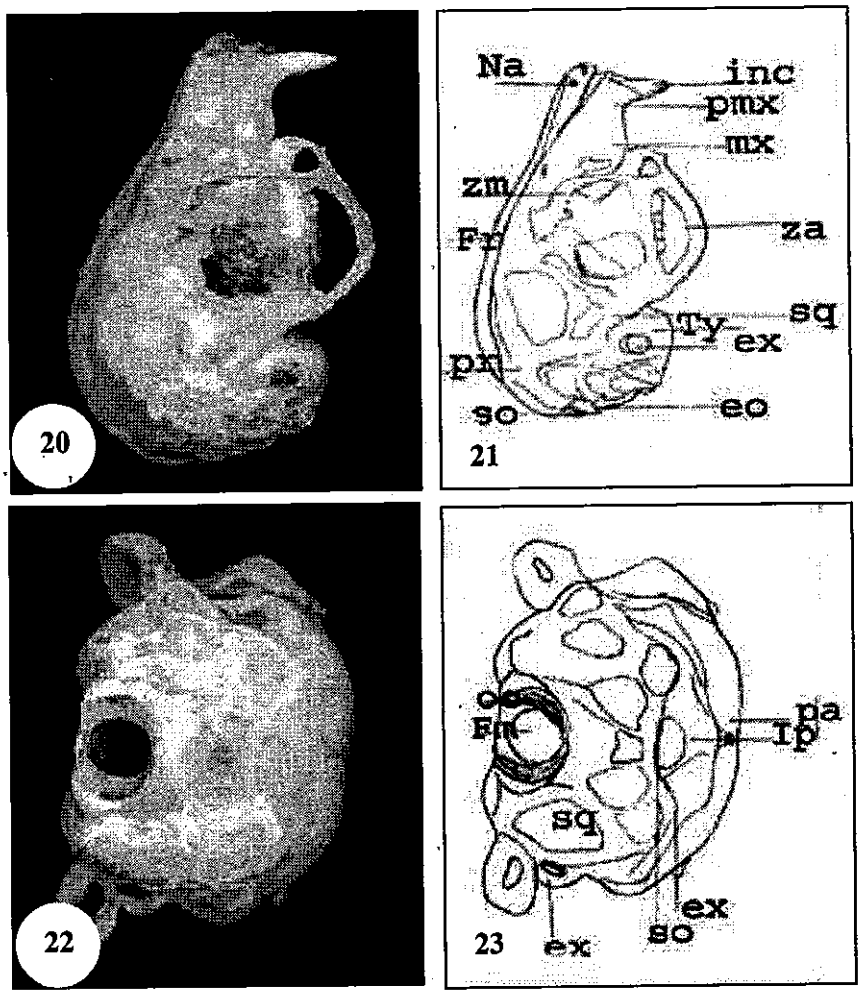


Fig. (20): Photographic picture of the lateral surface of the skull of *Allactaga tetradactyla*.
Fig. (21): Drawing the lateral surface of the skull of adult *Allactaga tetradactyal*.
Fig. (22): Photographic picture of the occipital surface of the skull of *Allactaga tetradactyla*.
Fig. (23): Drawing the occipital surface of the skull of adult *Allactaga tetradactyal*. Na= nasal, Pmx= premaxilla, mx= maxilla, Fr= frontal, Pr= parietal, So= supraoccipital, Exd= external auditory meatus, Ty= tympanic bulla, Sq= squamosal, Eo= exoccipital, F m= foramen magnum, inc= incisor.

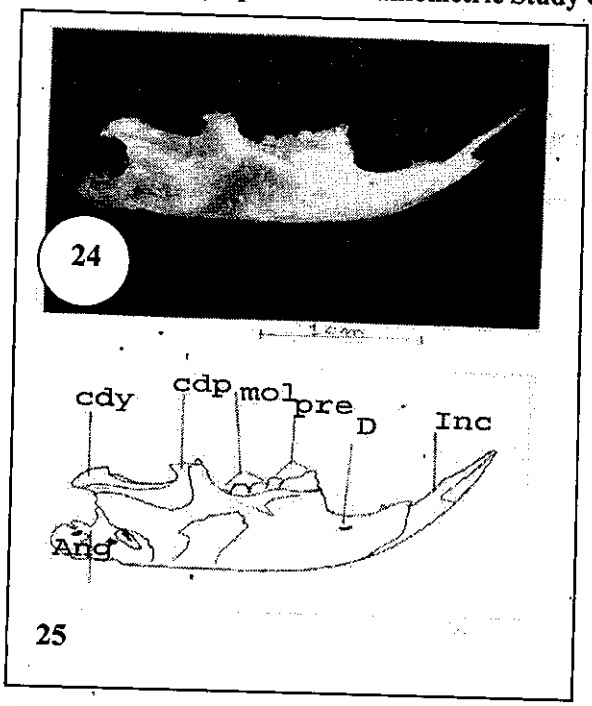


Fig. (24): Photographic picture of the lower jaw of *Allactaga tetradactyla.*

Fig. (25): Drawing the lower jaw of *Psammomys obesus.* Inc= incisor, D= dentary, Ang= angular process, Cdp= coronoid process, Cdy= condyloid process, Pre= p remolars, mol = molars

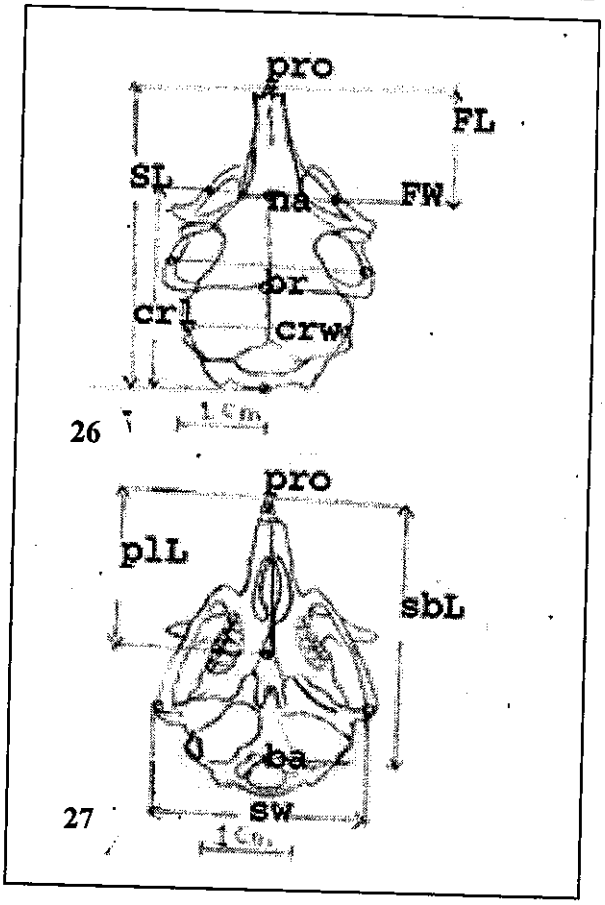


Fig. (26): Drawing the dorsal surface of the skull of adult *Allactaga tetradactyla* showing the craniometric points.

Fig. (27): Drawing the ventral surface of the skull of adult *Allactaga tetradactyla* showing the craniometric points.SL= skull length, FL= facial length, Crl= cranial length, SbL= skull base length, Sw= skull width, br= bregma, In= inion, Pro= prosthion, na= nasion, Fw= facial width, Crw= cranial width, Ba= basion, PIL= Palatal Length.

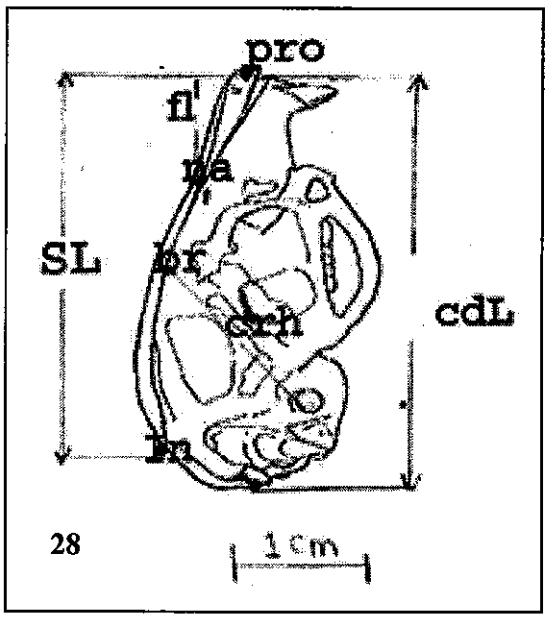


Fig. (28): Drawing the lateral surface of the skull of adult *Allactaga tetradactyla* showing the craniometric points. SL= skull length, Fl= facial length, CrH= cranial height, cd L= condyloid length, Pro= prosthion, na= nasion, br= bregma, In= inion.

Table (1): Morphological measurements (mm) of *Psammomys obesus* and *Allactaga tetradactyla.*

Measurements	*Psammomys obesus obesus*	*Allactaga tetradactyla*
Body weight (gm)	138	49.1
Head and body length (mm) (HBL)	161	108
Tail length (TL)	93	147
Ear length (EL)	19	42
Foot length (FL)	38	53
TL/ HBL %	57	93

Table (2): Craniometric points (mm) of skulls of the three subspecies of *Psammomys obesus &Allactaga tetradactyla.*

Area	*Psammomys obesus obesus*	*Allactaga tetradactyla*
Facial length	16.5	11
Facial width	18.5	19
Skull length	40.8	29.6
Skull width	23.5	21
Cranial length	25.1	21.1
Cranial width	16.5	17.3
Cranial height	11.3	8.7
Skull base length	38.3	24
Palatal length	23.5	21.2
Condylobasal length	41.1	27.9
Mandibular length	23.3	20
Skull index	575	709
Cranial index	657	819
Facial index	1121	1727

Discussion

In agreement with Happold (1984), Marquie *et al.* (1984); Kam and Degen (1989); Zaime and Gauter(1989) the present study showed that *Psammomys obesus* and *Allactaga tetradactyla* preferred habitats of saline marshes and wades where halophytic (salty) plants of Family *Chenopodiaceae* are abundant

The head and body length of *Psammomys obesus* range from 132 – 165mm and the average tail length is about 120mm. The ear length is about range from 12 –19mm and the foot length is range from 34 – 38mm (Osborn and Helmy, 1980).

Allactaga tetradactyla is found in salt marshes and clay desert areas of coastal plains. They are nocturnal rodents spending most of the day light hours in underground burrows and emerging at night to forage. It feeds primarily on seeds and succulent vegetation especially plants with milky juices but it also has been known to feed on insects. It does not drink water at all, but instead lives on metabolic water produced by the chemical breakdown of food (MacDonald, 1984). *Allactaga tetradactyla* has been beneficial for controlling herbivorous crops by preying on insects. The head and body length is 107.5mm and their tail length is 147mm. The ear length is about 42mm and they have large eye (a typical trait of nocturnal animals) (MacDonald, 1984).

In the present study, the skull of *Psammomys obesus* is triangular and strongly ridged but not exceed than 41.1mm. In contrast to this description that of *Allactaga tetradactyla*, the skull is flattened and the sutured between its component bones are apparent. This description is more or less similar to that of Madkour (1977) on the shrews of genus *Crocidura*. He recorded that the skulls of *Crocidura olivieri* and *C. floweri* are large and massive. *C. nana* is characterized by its extremely small size and great delicacy. In the skull of *Psammomys obesus*, two elongated frontals are present which is

triangular in shape, each of which is produced into incomplete supraorbital. The parietal bones cover most of the dorsum of the cranial cavity and the interparietal outline squarish. This description is more or less similar to that of AbdEl-Mawla (2001) on the skull of *Pachyuromys duprasi* and *Spalax ehrenbergi.* In *Allactaga tetradacyla* the parietal bones are flattened and the frontal bones are irregular in shape and measure about 6.1 mm. The interparietal bone is narrow and triangular.

In the skull of *Psammomys obesus*, the zygomatic process projects laterovenrally. The frontal fossa is a midline depression where the nasal bone articulates with the frontal bones. Tympanic bulla is greatly inflated and measured about 13.9 mm in length while in *Allactaga tetradactyla*, tympanic bulla slightly expanded and small. It measures about 7.2 mm in length. The nasal bone of *Psammomys obesus* is V- shaped while in *Allactaga tetradactyla* the posterior margin of nasal truncate with a small median V- shaped. On the other hand, Madkour (1977) mentioned that in the shrews *Crocidura,* the nasal is represented in the adult by a single strip of bone, which is broad anteriorly, and narrow posteriorly.

In *Psammomys obesus*, the tympanic bullae are greatly inflated slightly beyond posterior margin of foramen ovale. Posterior margin of mastoid bulla usually beyond the level of the occipital condyle. Anterior lip of auditory meatus swollen to the level of zygomatic process of temporal bone. While in *Allactaga tetradactyla,* the tympanic bulla slightly expanded and mastoid bulla not inflated. Olds and Olds (1979) described the tympanic bulla of the albino rat as an irregulary globular bone, which houses the middle and inner ear. In contrast to this description, Harrison (1968) stated that in family muridae, the tympanic bullae are never greatly enlarged.

In *Psammomys obesus*, the zygomatic arch is heavy wide, and consists of two parts; the zygomatic process of maxilla and zygomatic process of temporal. Similar observations are recorded on *Spalax ehrenbergi* (Osborn and Helmy, 1980). In *Psammomys obesus,* paraoccipital process are broad while in *Allactaga tetradactyla* is narrow. However, in *Mustela nivalis subpalmata*, the paraoccipital process are very weak and completely fused to the posterior aspects of the bullae (El-Naggar, 1989). On the other hand, Madkour (1986) mentioned that in the red fox *Vulpes vulpes arabica*, the paraoccipital processes are powerful. Their inner parts are fused with the bullae and their tipes are free and are directed ventro-latyerally.Similar observations are recorded on *Pachuomys duprasi,* the paraoccipital process are elongated while in *Spalax ehrenbergi*, the paraoccipital process are absent (AbdEl-Mawla, 2001).

In Psammomys obesus, the exoccipital is broad and flaring located between the tympanic bullae and the occipital condyles. Similar observations are recorded on *Mustela nivalis subpalmata* (El-Naggar, 1989). While in *Allactaga tetradactyla*, the exoccipital and paraoccipital processes are small. Caudally the large opening through the occipital region, the foramen magnum allows for passage of the spinal cord. Concerning the mandible of *Psammomys obesus*, it has been found that the coronoid process extends upward, long, strong, slightly curved and triangular in form while in *Allactaga tetradactyla*, the coronoid process is short and slightly curved.

More or less similar observations are recorded by Madkour (1977) on the shrews *Crocidura.* In *Psammomys obesus* the angular process is large and broad while in *Allactaga tetradactyla* the angular process is short with blunted ends. In contrast to this description El-Naggar (1989) mentioned that in the mandible of *Mustela nivalis subpalmata*, the angular process is weakly developed and not protruding behind the condyle.

References

1. **Abd El-Mawla E M. (2001):** Comparative anatomical studies on some rodents of Egypt. M. Sc. Thesis, Al-Azhar University Cairo for Girls.
2. **Ben-Moshe A, Dayan T and Simberloff D (2001):** Convergence in Morphological Patterns and Community Organization between Old and New World Rodent Guilds. Am. Nat., 158: 484–495
3. **Castanet J, Croci S, Aujard F, Perret M, Cubo J and De Margerie E (2004):**

Bone lines arrested growth and age estimation in a small primate: Microcebus murinus. J. Zool. Lond., 236: 31-39.

4. **Degen A A (1993):** Energy requirements of the fat sand rat (*Psammomys obesus)* when consuming the saltbush, Atriplex halimus: a review. J. Basic Clin. Physiol. Pharmacol., 4 (1-2): 13-28.
5. **EL-Nagger E R (1989):** Studies on the Weasel *Mustela nivalis* subpalmate (Hemprich and Ehrenberg 1833) M.Sc.Thesis Dept. Zool. Fac. Sci. Tanta University, Egypt.
6. **Evans E H and Christensen C G (1979):** Anatomy of the Dog. W. B. Sauders Company philadelphia, London, Toronto Mexico city, Riodejaneriro, Sudeney and Tokyo.
7. **Fichet-Calver E, Jomma I, Ben Ismail R and Ashford R W (1999):** Reproduction and abundance of the Fat Sand Rat (*Psammomys obesus*) in relation to weather conditions in Tunisia. J. Zool., Lond., 248: 15-26.
8. **Haines H, Hackel D B and Schmidt-Nielsen K (1965):** Expriemental diabetes mellitus induced by diet in sand rat. Amer. J. Physiol., 208 (2): 297-300.
9. **Happold D C D (1984):** Small Mammals in Sahara Desert: 251–275. cloudsley–Thompson, J. L. (ed.,) pergamon press, Oxford, London.
10. **Harrison L D (1968):** The Mammals of Arabia. Vol. II carnivora, *Artiodactyla hyracoidea.* ,Ernest Benn. Limited London
11. **Kam M and Degen A (1989):** Efficiency of use of salt bush (*Atriplex halimus)* for growth by fat sand rat *Psammomys obesus*. J. Mammol., 70 (3): 485–493.
12. **MacDonald D (1984):** Encyclopedia of mammals facts on file publications, New York.
13. **Madkour G (1977):** Osteology of the cranial region in some Egyption shrew of genus Crocidura. Zool. Anz., 198: 380–392.
14. **Madkour G (1981):** Post-cranial osteology in common Egyptian shrews of genus Crocidura. Zool. Anz., 206: 341–353.
15. **Madkour G (1986):** Two Microchiropterans and a carnivora from Qatar . Zool. Anz., 216: 72–80.
16. **Marquie G, Duhault J and Jactor B (1984):** Diabetes mellitus in Sand Rat *(Psammomys obesus*). Metabolic pattern during development of the diabetic syndrome. Diabetes, 33 (5): 438–443.
17. **Nowak R M (1991):** Wakers Mammals of the World. 5th edition. Jhons Hopkins University press & Baltimore . London .
18. **Olds R J and Olds J R (1979):** A Color Atlas of the rat. 2nd edition. Jhons Hopkins University press & Baltimore. London..
19. **Osborn DJ and Helmy I (980):** The contemporary land mammals of Egypt (including Sinai), Fieldiana (Zool.), 5: 1-59.
20. **Petter F (1961**): Repartition geographique et ecologie des rongeurs deseriquies. Mammalia, 25: 1–222.
21. **Renaud S, Chevret P and Michaux J (2007):** Morphological vs. molecular evolution: ecology and phylogeny both shape the mandible of rodents. Zoologica Scripta, 36(5): 525-535.
22. **Zaime A and Guatier J Y (1989):** Comparison des regions alimentaires de trois especes sympatriques de gerbillidae en mileu Saharian, au Maroc. Rev. Ecol. (Terre et vie), 44: 153–163.

دراسة مقارنة لتركيب الجمجمة لفأر الرمل السمين والجربوع رباعي الأصابع اللذان يعيشان في بيئات متشابهة

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تضمن هذا البحث دراسة تراكيب عظام الجمجمة في نوعين من القوارض الصحراوية المعروفين باسم فأر الرمل السمين والجربوع رباعي الأصابع واللذان يعيشان في بيئات متشابهة. تم تجميع العينات من بيئاتها الطبيعية و شملت الصحراء الشرقية ،الصحراء الغربية، صحراء سيناء ومن مرسى مطروح (العلمين) بواسطة مصائد خاصة و تم نقلهم إلى المعمل وتخديرهم بمحلول الكلوروفورم وأجريت عليهم الدراسة سالفة الذكر.

وقد أوضحت الدراسة انه في فأر الرمل السمين كانت الجمجمة مثلثة, قوية و بارزة العظام، غير أن الخياطات (الخطوط الفاصلة) بين مكوّناتِها ظاهرة قليلاً ،عظم الجبهة مثلثي الشكل وعظمة الجدارى كبيرة مربعة الشكل والعظم القشري مثلثي الشكل أما القوس الوجنى فهو أسطواني وضعيف وعظمة القلة الطبلية كبيرة وممتدة. بينما في الجربوع رباعي الأصابع تكون الجمجمة مفلطحة في الشكل والخياطات بين مكوناتها أكثر وضوحاً وعظم الجدارى قوى بينما البين الجدارى فهو ضيق و عظم الجبهى مفلطح و القلة الطبلية أصغر من مثيلاتها في فأر الرمل السمين.