Mastozoología Neotropical, 14(2):249-255, Mendoza, 2007

ISSN 0327-9383
Versión on-line ISSN 1666-0536
www.sarem.org.ar

CYTOGENETICS AND REDESCRIPTION OF *Graomys* (RODENTIA, SIGMODONTINAE) FROM CHUMBICHA, CATAMARCA, ARGENTINA

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ABSTRACT: The taxonomy, phylogenetic relationships and distribution of the genus *Graomys* are confusing. In this note we report karyotypic data for specimens of *Graomys* collected in Chumbicha, Catamarca Province, Argentina. Their karyotypes agree with *G. centralis* with 2n = 42. The individuals from Chumbicha are similar in morphology to *G. griseoflavus* but smaller. Our results suggest that Chumbicha's specimens are conspecific with *G. medius*. Moreover, we propose to synonymize *G. medius* with *G. centralis*. Other data of the genus suggest that the name *G. chacoensis* should be applied to specimens with 2n = 42.

RESUMEN: Citogenética y redescripción de *Graomys* (Rodentia, Sigmodontinae) de Chumbicha, Catamarca, Argentina. El estado taxonómico, las relaciones filogenéticas y distribución de algunas especies del genero *Graomys* son confusas. Aquí reportamos datos de cariotipos para especímenes de *Graomys* colectados en Chumbicha (Catamarca, Argentina). Los cariotipos coinciden con *G. centralis* con 2n = 42. Los individuos de Chumbicha son similares en morfología a *G. griseoflavus,* pero mas pequeños. Nuestros resultados sugieren que los ejemplares de Chumbicha son conespecíficos con *G. medius.* Por lo tanto proponemos sinonimizar *G. medius* con *G. centralis*. Otros datos del genero sugieren que el nombre *G. chacoensis* debería ser aplicado a los especímenes con 2n = 42.

Key words. Chromosomes. Morphometry. Phyllotine. Rodents. Taxonomy.

Palabras clave. Cromosomas. Morfometría. Roedores filotinos. Taxonomía.

The taxonomy and systematics of South American rodents are a matter of continuous revision and debate (e.g., Hershkovitz, 1962; Reig, 1981; Musser and Carleton, 1993; Steppan, 1995, 1998; Smith and Patton, 1999; D' Elía, 2003). Within sigmodontines, those of the Phyllotini tribe are primarily distributed throughout the arid and semiarid biomes. Among these, the genus *Graomys* Thomas, 1916, is distributed from Paraguay and Bolivia to southern Argentina (Musser and Carleton, 2005). Several species have been described in this genus; however their taxonomic status, phylogenetic relationships and overall distribution are confusing (Braun 1993; Steppan, 1995; Steppan and Sullivan, 2000).

After its original description (Thomas, 1916), some earlier reviews of phyllotines included the genus *Graomys* within the genus *Phyllotis* (Hershkovitz, 1962). Later research recognized

Recibido 25 agosto 2006. Aceptación final 3 mayo 2007.

Graomys as an independent genus, but the identity of species it contains has not been completely clarified (Pearson and Patton, 1976; Braun, 1993; Steppan, 1993, 1995). Recently, Musser and Carleton (2005) and Díaz et al. (2006) recognized it as a polytypic genus with four species: *G. domorum* (Thomas, 1902a) distributed on the east of the Andes in Bolivia and northwestern Argentina; *G. edithae* (Thomas, 1919) confined to Catamarca Province in Argentina; *G. centralis* (Thomas, 1902b) distributed in central Argentina; and *G. griseoflavus* (Waterhouse, 1837) as the most widely distributed species in Bolivia, Paraguay, Argentina and probably in southern Brazil. In addition, the taxonomic status of *G. cachinus* (Allen, 1901), *G. chacoensis* (Allen, 1901), *G. lockwoodi* (Thomas, 1918) and *G. medius* (Thomas, 1919) is uncertain and they are considered synonymous with *G. griseoflavus* (Musser and Carleton, 2005; Díaz et al., 2006).

Karyotypic data for several phyllotine rodents have significantly contributed to the taxonomic delimitation of some of their species (Pearson 1972; Pearson and Patton, 1976; Zambelli et al., 1994; Tiranti, 1998; Spotorno et al., 2001; Bonvicino et al., 2003; Lanzone and Ojeda, 2005; Lanzone et al., 2007). In *Graomys*, three basically different chromosome complements were reported: *G. domorum* with 2n = 28 (Pearson and Patton, 1976), *G. griseoflavus* with diploid numbers ranging from 2n = 34 to 2n = 38 and *G. centralis* with 2n = 42 (Zambelli et al., 1994; Tiranti, 1998). The latter two are considered sister species and both karyotypes can be derived from successive Robertsonian translocations (Zambelli et al., 1994; 2003). This chromosomal diversity has been achieved without major phenotypic changes in the group (Theiler and Blanco, 1996a; Tiranti, 1998; Theiler et al., 1999; Catanesi et al., 2002; Rodríguez, 2005). The existence of a marked genetic differentiation and reproductive barriers between *G. centralis* and *G. griseoflavus* has been demonstrated, supporting that they are true biological species (Theiler and Blanco, 1996a and b; Catanesi et al., 2006).

In his pioneering works, Thomas (1919) recognized three species of *Graomys* coexisting in sympatry at the locality of Chumbicha, Catamarca Province, Argentina: *G. cachinus* Allen 1901 corresponding to the largest species, *G. medius* Thomas 1919, having an intermediate size; and *G. edithae* Thomas 1919, the smallest species in the genus. However, these species are considered as of doubtful taxonomic assignment or as synonymous with *G. griseoflavus* (Williams and Mares, 1978; Musser and Carleton, 2005; Díaz et al., 2006).

During a field expedition to the locality of Chumbicha (28° 53' 23" S/66° 17' 05.1" W; 390 m) in March 2006, we collected three specimens of *Graomys*. This region corresponds to the transition area between the Chaco and Monte desert biomes (Cabrera, 1976). It is a semiarid woodland dominated by *Acacia*, *Prosopis* sp., *Larrea* sp., *Opuntia* sp., *Aspidosperma quebrachoblanco* and *Suaeda divaricata*, among others. The specimens were collected using Sherman traps baited with oatmeal and peanut butter. Two of the three individuals were adults (one female and one male) and one was a juvenile (female). The specimens (skin, skull, cellular suspensions and tissues) are housed at the Colección Mastozoológica - IADIZA (CMI-07254, CMI-07253, CMI-07252). External and cranial features were measured using a digital caliper (Martin et al., 2001). Qualitative morphological data were compared with *G. griseoflavus* (N = 5; 3 males and 2 females) from Ñacuñán, Mendoza Province, Argentina. *G. griseoflavus* was selected for the comparison for being the best characterized species in the genus, and to include in its synonymy the possible species present at the studied locality. Chromosome preparations were obtained from bone-marrow using standard techniques (Ford and Hamerton, 1956), with minimal modifications, and chromosomes were stained with Giemsa. Ten metaphase spreads were counted for each specimen. The nomenclature for chromosome morphology and fundamental number (FN) follows Patton (1967).

The karyotypes of the three specimens from Chumbicha are similar, with 2n = 42 (**Fig. 1**),

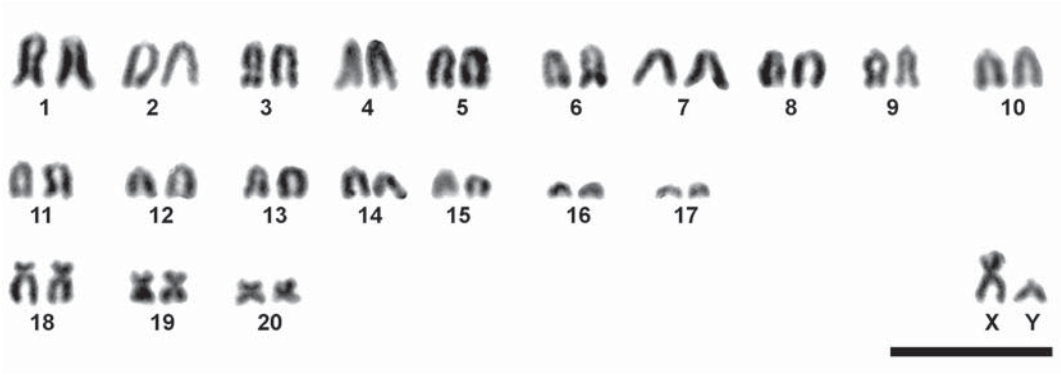

Fig. 1. Standard Giemsa stained bone marrow karyotype of one male of *Graomys* from Chumbicha with 2n = 42, FN = 46.

although some differences are observed in the biarmed autosomal pairs that produce variations in the FN. In one of the specimens, pairs 1 to 18 are acrocentrics decreasing in size. Pair 19 is composed of medium size submetacentric chromosomes and pair 20 is a small submetacentric. This karyotype has an FN = 44. The other two specimens have one small extra pair of biarmed chromosomes, which increases their FN to 46. The X chromosome is a large submetacentric, and the Y a small acrocentric in all thee specimens (**Fig. 1**). These karyotypes agree with the chromosome complement described and assigned to *G. centralis* by proximity (30 Km NW) to the type locality in Cruz del Eje, Córdoba Province (Zambelli et al., 1994; Tiranti, 1998).

On the other hand, specimens from Chumbicha are similar in general morphology to *G. griseoflavus* but smaller in size (**Fig. 2**). Externally they present a white undersurface, with wholly white hair up to the base. The dorsal and lateral coloration is similar to that of *G. griseoflavus*, but the lateral band is less marked, the tail is less tufted and bicoloured. Compared to *G. griseoflavus*, the skull is smaller; nasals are narrower and shorter at the distal portion. The rostrum of the Chumbicha specimens is smaller and has greater downward curvature at the anterior end. The maximum breadth of the braincase is smaller and in dorsal view the tympanic bullae do not present a lateral expansion as in *G. griseoflavus*. In lateral view, the zygomatic plate in the Chumbicha specimens is more robust, slightly wider and more concave at its anterior insertion. The zygomatic notch is less expanded in the anterior-posterior axis. In ventral view, the tympanic bullae are less inflated, with slightly larger and cylindrical bullar tubes; the external auditory meatus is more prominent in ventral view. The petrotympanic fossa is more expanded in its lateral portion, possibly due to the smaller size of the bullae compared to *G. griseoflavus.* In this latter species, the petrotympanic fossa is covered by the tympanic bullae in the internal portion. The foramen ovale is smaller in the individuals from Chumbicha. The posterolateral palatal pits are located posteriorly to M^3. In the upper molar toothrow, M^3 possesses a more rounded shape and the labial and lingual folds are not in contact. It differs from that observed in *G. griseoflavus*. In this last species, the labial fold is deeper than in specimens from Chumbicha.

In morphology, the general description and the range of variation observed in most (11/14) external and cranial measurements of the specimens from Chumbicha studied here are concordant with, or very close to, those recorded for the type of *G. medius* from this locality (**Table 1**). But, the same measurements are smaller when compared with specimens of

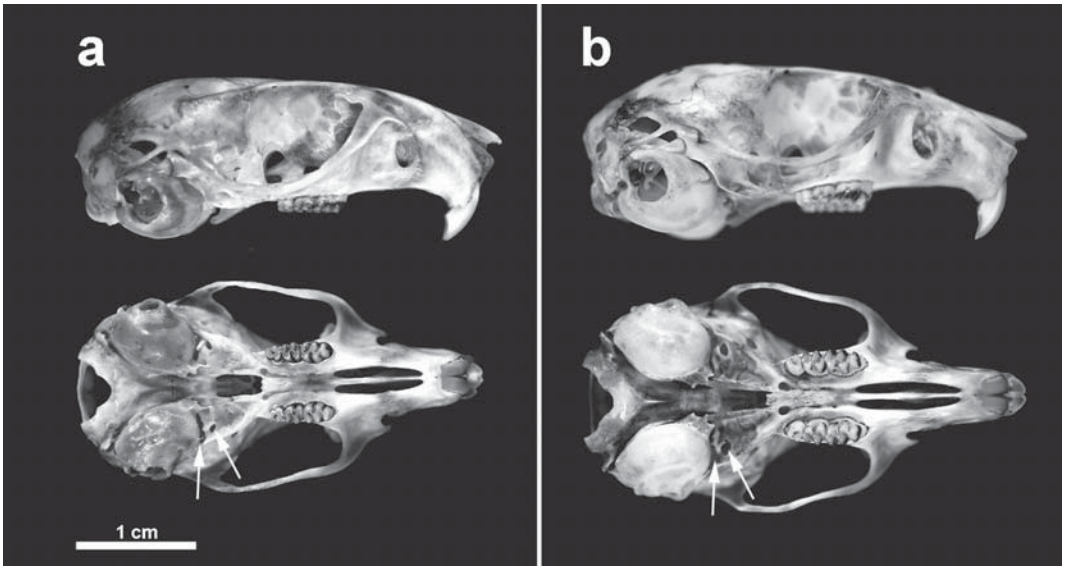

Fig. 2. Lateral and ventral views of the skull of: a) *Graomys* from Chumbicha and b) *G. griseoflavus* from Ñacuñán. Note the differences in the petrotympanic fossa and the foramen ovale (arrows).

G. cachinus (Allen, 1901; Thomas, 1919). Some measurements (8/14) are also concordant with those of the type of *G. edithae*, but the others are larger. Considering that specimens from Chumbicha assigned by Thomas to the last species are of doubtful assignment (Williams and Mares, 1978), the morphological results seem to indicate that the specimens analyzed here are conspecific with that described as *G. medius*.

If the karyotype is a good indicator of species in this genus, our results suggest that *G. medius* must be synonymous with *G. centralis* and not with *G. griseoflavus* as was proposed by some authors (Musser and Carleton, 2005; Díaz et al., 2006). Nevertheless, several external and cranial measurements for the type of *G. centralis* are not concordant with those of the specimens studied here (**Table 1**), but nothing is known about the range of morphological variation in specimens with 2n = 42.

Furthermore, specimens from the Paraguayan Chaco, 460 km NW of Villa Hayes, Department of Boquerón, have the same 2n and FN as our specimens from Chumbicha (Patton, pers. comm. and unpubl. data), which shows a previously unsuspected wide geographic range for this karyomorph. Moreover, in a recent phylogenetic analysis, a specimen assigned to *G. griseoflavus* from Bolivia was found to group closely with specimens from Argentina assigned to *G. centralis* on the basis of karyotypic data (Steppan et al., 2007). Altogether, these data suggest that the specimens from the northern part of the distributional range of the genus could belong to the same species. If this were true and only one *Graomys* species inhabits the Chaco biome, the name *chacoensis* Allen (1901) should be applied to those specimens, with *medius* and *centralis* as junior synonyms. However, no information is available about specimens of *G. chacoensis* from the type locality in Waikthlatingwayalwa, Paraguay, to sustain this hypothesis.

This proposition is also supported by the geographical distribution of *Graomys* species in different biomes. Whereas *G. chacoensis* (2n = 42) is distributed over the Gran Chaco and Espinal, from central Argentina (Theiler and Blanco, 1996a; Tiranti, 1998) and Paraguay, *G. domorum* occurs in the Yungas and

Table 1

External and cranial measurements (in mm) of the type specimen of *G. medius* (Thomas, 1916), *G. cachinus* (Allen, 1901), *G. edithae* (Thomas, 1916) and *G. centralis* (Thomas, 1902b). Descriptive statistics (mean ± SD and range) of *Graomys* from Chumbicha, Catamarca Province, examined in this work (female and male, respectively) and of *G. griseoflavus* from Ñacuñán, Mendoza Province.

Variables	***G. medius* Thomas, 1916**	***G. cachinus* Allen, 1901**	***G. edithae* Thomas, 1916**	***G. centralis* Thomas, 1902b**	**Specimens from Chumbicha**	***G. griseoflavus***
Head and body	124	137	108	130	114.5±17.68 (127-102)	125.6±7.54 (115-135)
Tail	150	159	127	156	138.5±20.51 (153-124)	143±24.91 (105-170)
Hind foot	27	29	25	27	26.5±0.71 (27-26)	30.0±0.71 (29-31)
Ear	25	24	20	26	23.5±2.12 (25-22)	27±2.00 (24-29)
Weight (g)	-	-	-	-	40±16.97 (52-28)	63±13.29 (47-83)
Greatest length of skull	31.2	35	28.5	33.5	30.1±2.55 (31.9-28.3)	33.52±1.55 (32-33.9)
Condilobasal length	28.5	-	26.5	-	27.75±2.05 (29.2-26.3)	30.8±1.37 (29.5-30.9)
Zygomatic breath	16.1	17	15	-	15.45±0.78 (16-14.9)	16.8±0.82 (16.2-18.2)
Nasal length	11.8	-	10.5	14	11.85±1.48 (12.9-10.8)	13.8±0.95 (12.6-14.8)
Interorbital length	5.2	5	4.5	5.4	5.15±0.21 (5.3-5)	5.28±0.40 (4.9-5.8)
Breath of braincase	14.2	-	13.5	13.5	13.3±0.57 (12.9-13.7)	14.14±0.36 (13.7-14.6)
Palatilar length	14.1	-	12.8	14.5	12.5±0.42 (12.8-12.2)	14.48±0.64 (13.8-15.3)
Palatal foramina	7	7.2	6.7	-	6.3±0.14 (6.4-6.2)	7.66±0.26 (7.2-7.8)
Bullar length	6.4	-	6	-	6.05±0.35 (6.3-5.8)	7.04±0.38 (6.7-7.5)
Maxillary tooth row length	5.2	5.4	4.7	4.5	5.25±0.07 (5.2-5.3)	5.38±0.36 (5-5.9)
Basal length	-	-	-	-	25.25±2.05 (26.7-23.8)	28.32±1.23 (27.1-30.3)
Bullar width	-	-	-	6	5.95±0.07 (6-5.9)	6.7±0.34 (6.3-7.1)
Mandibular tooth row length	-	5.7	-	-	5.1±0.14 (5-5.2)	5.36±0.27 (5-5.7)
M1 width		-	-	1.5	1.6±0.0 (1.6-1.6)	1.68 ± 0.08 (1.6-1.8)
Greatest length	-	19	-	-	15.8±1.56 (16.9-14.7)	17.98±0.91 (17-19.2)
Diastema length	-	-	-	8.5	7.45±0.35 (7.7-7.2)	8.64±0.51 (8-9.4)
Palatal bridge	-	-	-	-	5.9±0.14 (6-5.8)	6.34±0.53 (5.8-6.9)
Incisive width	-	-	-	-	2.1±0.14 (2.2-2)	2.28±0.19 (2-2.5)
Nasal width	-	-	-	-	3.15±0.35 (3.4-2.9)	3.22±0.23 (3-3.6)
Breath of zygomatic plate	-	-	-	-	3.25±0.49 (2.9-3.6)	3.24±0.23 (3.0-3.6)

transitional forests, and *G. griseoflavus* in the Monte Desert and marginally in the Patagonian steppe (Theiler and Blanco, 1996a; Tiranti, 1998; Rodríguez, 2005).

Our records from Chumbicha help to partially clarify the group's taxonomy and to define more precisely the geographic ranges of the species of *Graomys*. On the other hand, the names *G. edithae* and *G. cachinus* assigned by Thomas (1916) to specimens from Chumbicha are still in an uncertain state, and our small sample size leaves doubts as to how many species inhabit this locality. Future analysis of specimens from type localities as well as of type specimens and broad sampling across the geographic range of the genus, are needed to solve the taxonomy of the group.

ACKNOWLEDGMENTS

We thank Jim Patton who kindly provided us the karyotypes of *Graomys* from Paraguay prepared by Oliver Pearson. We thank Solana Tabeni for her critical comments and suggestions to a preliminary version of this manuscript. We thank Maria Ana Dacar for field help and Marisa Rosi and Agustina Ojeda for assistance with cranial photographs. Nelly Horak assisted in the English version. This work was partially financed by CONICET (PIP 5944 and PIP 6179), SECYT-AGENCIA (PICT 11768).

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