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SHORT COMMUNICATION

FIRST RECORD OF SUPERNUMERARY TEETH IN SOUTH AMERICAN FOSSIL RODENTS

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The presence of supernumerary teeth has been documented for nearly all living mammals (Wolsan, 1983; Wolsan, 1984; Martin, 2007) as well as many fossil groups (Wilson, 1955; Rose and Smith, 1979). The position in the tooth row and the morphology of the extra teeth is highly variable; this pathology affects individuals of both sexes, upper or lower jaws, and can be unilateral or bilateral. In modern rodents, extra teeth were documented in murids (Johnson, 1952), dipodids (Krutzsch, 1953; Charles and Viriot, 2007), and sciurids (Goodwin, 1998). For hystricognath rodents in particular, the first record of a supernumerary tooth was reported by Lyon (1916), who studied an Old World porcupine with a pair of supernumerary incisors in the upper jaw. Angelici and Luiselli (1999) described two skulls of *Hystrix cristata* from Sicily, Italy, with anomalous dentitions. One of them had extra teeth behind both M3s, whereas its jaws had no signs of extra teeth. For caviomorph rodents, occurrences of this pathology are scarce. Colyer (1936) registered the first case of extra tooth in caviomorphs, specifically in the genus *Proechimys*. Lechtleiner (1958) described a case of an extra tooth in a specimen of *Erethizon dorsatum*, distal to the right upper tooth row. Schitoskey (1971) studied dental and skull anomalies in *Myocastor coipus* and observed two adult males with supernumerary teeth. Rusconi (1930) had already recorded the first case of dental anomalies, not a supernumerary tooth but a spiraled incisor, in a specimen of *Myocastor coipus*. Gupta (1978) detected the presence of an extra pair of lower incisors in a laboratory guinea pig. Miles and Grigson (1990) reedited Colyer's work and mentioned two specimens of *Proechimys longicaudatus* housed at the British Museum of Natural History with supernumerary teeth.

Nevertheless, occurrences of rodent fossils with extra teeth are extremely rare, being documented only for Pleistocene sciurids (Goodwin, 1998).

The causes regarding the appearance of such anomalies in mammals are varied. Krutzsch (1953:265) stated that "in mammals most deviations from the normal number of teeth result from the presence or absence of teeth which are in the process of being lost"; nevertheless, in the particular case of the jumping mouse he studied, Krutzsch proposed a division of the enamel organ as the cause of the disease. Archer (1975) presented examples of genetic, physiological, and nutritional alterations, and of other external causes as the origin of abnormal dental development in marsupials. Gupta (1978) remarked that supernumerary teeth have been associated with hypervitaminosis A and hyperthermia in pregnant guinea pigs. Wolsan (1984:128) proposed that the main causes for the appearance of extra teeth in mammals are "1) the effect of additional creation and development of a tooth germ, caused by the influence of genes which are rare but still present in the gene pool of a given species and which occurred much more frequently in those of its ancestral species, or 2) as the effect of development of a supernumerary tooth germ originated as a result of complete splitting of a tooth germ." The second approach can be inherited, or occur due to the influence of traumas, infections, mutations, nutritional deficiencies, etc.

In this paper, we report the first case of a fossil caviomorph rodent with a supernumerary tooth. We also discuss possible explanations for the presence of this anomaly.

Abbreviations—Upper and lower case letters correspond to upper and lower teeth, respectively. Tooth nomenclature follows Marivaux et al. (2004). **MACN**, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina; **MLP**, Museo de La Plata, La Plata, Argentina; **SALMA**, South American Land Mammal Age.

Description—The material studied is an adult specimen of *Sciamys principalis* Ameghino, 1887 (Octodontoidea, Acaremyidae). It comes from the Santa Cruz Formation (Santacrucian SALMA, early Miocene) of Patagonia (Fig. 1). The exact geographic location is unknown because the collector, Carlos Ameghino, only reported "Barrancas del Río Santa Cruz" for his 1887 collection for the MLP. The specimen, a right mandible with the alveolus of p4, broken m1, m2–m3, an extra tooth and incisor (Fig. 2A–B), is deposited at MLP under the collection number MLP 63-XII-19-127. *S. principalis* was very abundant in the Santacrucian SALMA and has the generalized dental formula of caviomorphs: I1/1 C0/0 P1/1 M3/3. Lower cheek teeth of *S. principalis* are slightly longer than wide (Table 1); they have four principal crests, corresponding to metalophulid I, metalophulid II, hypolophid, and posterolophid, respectively. In adult specimens metalophulids I and II fuse and delimit an anterior lobe. In MLP 63-XII-19-127 cheek teeth have the usual adult morphology and implantation (Fig. 2C). The extra tooth is located posterolingually with respect to the m3, well below the tooth row, and is anteriorly inclined (Fig. 2B–C). It is slightly hypsodont, almost as much as the normal teeth, and the crown can be clearly distinguished from the root. It is much smaller than the other teeth (Table 1) and rounded in outline (Fig. 2D). The occlusal morphology is simplified. We tentatively homologize the main topographic features with those of normal molars. An almost continuous crest, made in part by small cuspules, surrounds it. We homologize cusps with the highest points in this crest. The anterior margin of the tooth is partially included in the jaw, therefore most of the metalophulid I is hidden inside the bone. The protoconid and hypoconid are small. The metaconid is well developed and placed more lingually than the other dental structures (Fig. 2D). The entoconid is smaller than the metaconid but bigger than the labial cusps; it is aligned with the hypoconid, and obliquely oriented (Fig. 2D). From the posterior margin of the protoconid extends an ectolophid, which is only slightly oblique in comparison with normal cheek teeth and ends at the anterior rim of the hypoconid; it defines a small and scarcely penetrating hypoflexid (Fig. 2D). A posterolophid extends lingually from the hypoconid; this crest is anteriorly concave and reaches the entoconid labially. At the anterolingual portion of the tooth is a well-developed elongated structure, anterolabially-posterolingually oriented (Fig. 2D). The homologies of this structure are dubious, and could be part of the metalophulid II, mesolophid, or other elements. Three

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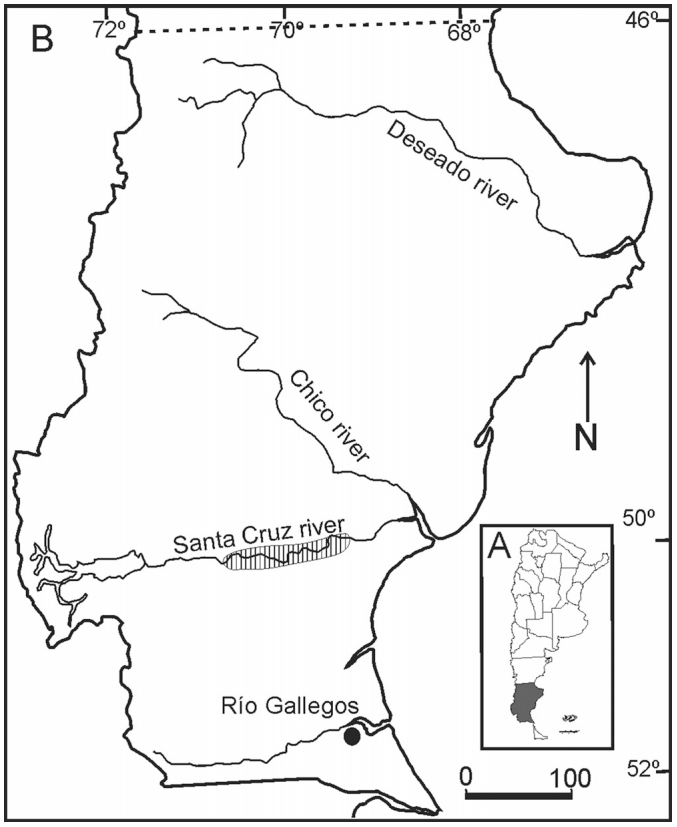

FIGURE 1. Location map. **A**, Argentina. **B**, area of the Río Santa Cruz (striped area) in Santa Cruz province, Argentina, where MLP 63-XII-19-127 was collected. Scale bar equals 100 km.

TABLE 1. Dental measurements (mm) of lower cheek teeth of MLP 63-XII-19-127, and other *Sciamys* specimens for comparison.

		MLP 63-XII-19-127	MACN A 4115	MACN A 4127	MACN A 4131
p4	apl		1.9	2.0	2.0
	T ant.		1.6	1.6	1.8
	T post.		1.8	1.8	2.2
	h. post.		1.7	1.3	1.9
m1	apl	2.2	2.3	2.2	2.1
	T ant.		2.0	2.1	2.1
	T post.		2.1	2.1	2.1
	h. post.	1.6	1.5		1.5
m2	apl	2.3	2.2	2.3	2.2
	T ant.	2.2	2.2	2.3	2.3
	T post.	2.0	1.5	2.2	2.0
	h. post.	1.7	1.8	1.3	1.5
m3	apl	1.9	1.9	2.0	1.9
	T ant.	1.8	1.5	2.1	1.9
	T post.	1.7		1.6	1.7
	h. post.	1.5		1.2	
m?	apl	0.9*			
	T ant.	0.9*			
	T post.	0.8			
	h. post.	1.5			

Abbreviations: **ant.**, anterior; **apl**, anteroposterior length; **h.**, height; **post.**, posterior; **T**, transverse. * denotes approximate.

conspicuous cuspules on the ectolophid extend to the central basin of the tooth (Fig. 2D). In functional teeth, this kind of structure would result in spurs with wear.

Discussion—From a total of 66 specimens of *S. principalis* and 96 of *Sciamys* sp. studied, only MLP 63-XII-19-127 has an extra tooth. Based on its low implantation, and considering that MLP 63-XII-19-127 is an adult specimen, this extra tooth would have never been functional. Supernumerary teeth may be

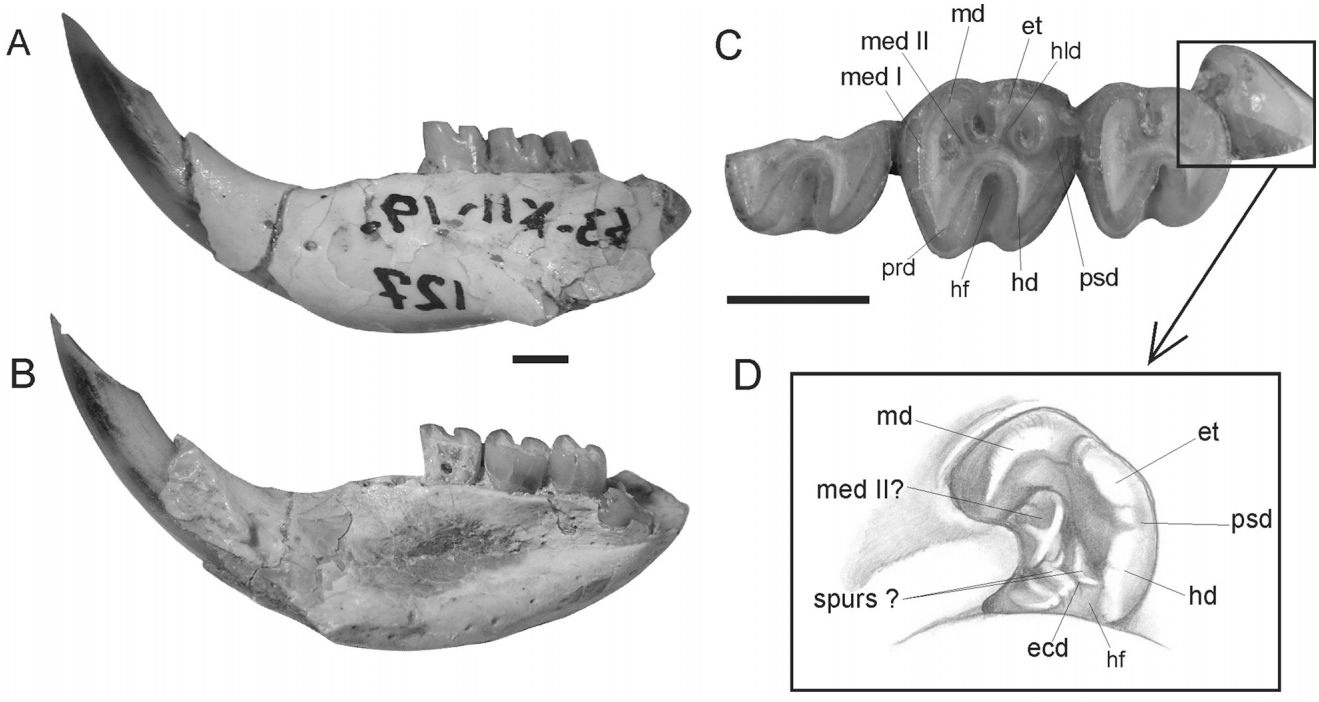

FIGURE 2. *Sciamys principalis* MLP 63-XII-19-127. **A**, mandible in labial view (reversed). **B**, mandible in lingual view. **C**, tooth row showing m1 (broken)–m3 and the extra tooth (reversed). **D**, drawing of the occlusal dental morphology of the extra tooth (reversed). **Abbreviations**: **ecd**, ectolophid; **et**, entoconid; **hd**, hypoconid; **hf**, hypoflexid; **hld**, hypolophid; **md**, metaconid; **med II**, metalophulid II; **prd**, protoconid; **psd**, posterolophid. Anterior to the left. Both scale bars equal 2 mm.

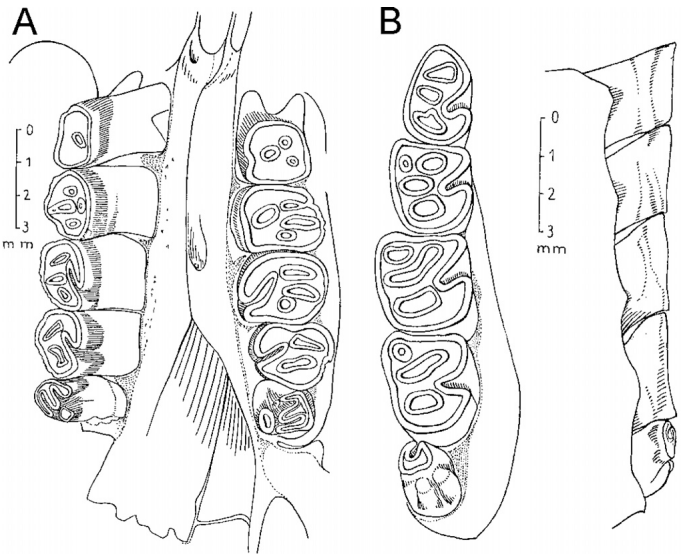

FIGURE 3. *Proechimys* showing extra teeth in upper and lower tooth rows. **A**, left and right DP4-M3 and extra teeth, BMNH 11-5-25-155. **B**, right dp4–m3 and extra tooth, BMNH 23-12-12-12. Anterior to top. Illustrations made by O. Reig.

functional, as in some specimens of the living *Proechimys* (Octodontoidea, Echimyidae), in which the occlusal surface is slightly worn (Fig. 3). Apparently, this supernumerary tooth seems to have not adversely affected the individual represented by MLP 63-XII-19-127, perhaps because it was not functional and/or because it erupted late in life.

The morphology and size of the m2–m3 (as well as the broken m1) are not altered with respect to the normal pattern of *S. principalis* (Table 1), as in *Mesembriomys gouldi* (Johnson, 1951) and *Zapus princeps* (Krutzsch, 1953), and unlike what is observed in *Jaculus orientalis* (Charles and Viriot, 2007). Therefore, we do not believe that this extra tooth was the result of an abnormal development of any teeth within the tooth-row. Since the maximum dental formula for the most basal rodents is I1/1 C0/0 P2/1 M3/3 (Meng and Wyss, 2001), we consider that this extra tooth is not an m4, thus not representing a case of atavism of a phylogenetically lost tooth.

Based on anterior hypotheses (Wolsan, 1984; Angelici and Luiselli, 1999), we propose that the appearance of the extra tooth in MLP 63-XII-19-127 was a consequence of development abnormalities such as a bifurcation of the enamel organ or abnormal activation of an extra enamel organ.

Based on Goodwin's (1998) statement that hybridization increases the occurrence of supernumerary teeth in mammals, we suggest that this can be the case for the specimen MLP 63-XII-19-127. *S. principalis* was sympatric with the closely related *Acaremys murinus* Ameghino, 1887. These two species are recognized as sister taxa, and the characteristics that separate them as two entities are subtle (Ameghino, 1887; Scott, 1905; Vucetich and Kramarz, 2003). We studied 24 specimens of *Acaremys murinus* and 36 of *Acaremys* sp., none of which presented dental anomalies. Nevertheless, we suggest that different populations of *S. principalis* and *A. murinus* could have interacted, leaving hybrid offspring with some kind of anomaly like the one here described.

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