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Artículo

SUPERNUMERARY TEETH IN *Necromys lasiurus* (RODENTIA, CRICETIDAE): THE FIRST RECORD IN SIGMODONTINAE

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ABSTRACT. There are several kinds of anomalies related to the teeth reported in mammals, and one of them is known as supernumerary teeth and is commonly noticed in the literature, being reported in nearly all orders of mammals. Here, we report the occurrence of supernumerary molars in the sigmodontine rodent *Necromys lasiurus*, a common and widespread small rodent of tribe Akodontini. In order to assess the patterns of morphometric variation of *N. lasiurus* in eastern South America, we examined the skulls of 1763 specimens. The supernumerary molars were found in 2 individuals, which represent a frequency of 0.11%. The origin of supernumerary teeth started a long discussion on tooth homology, whether this anomaly is a result of heredity, a mutation or an atavism. Based on the morphologies presented by the extra teeth encountered in *N. lasiurus* and on the evidences and hypothesis available in the literature, we consider that the presence of these supernumerary molars in one of the studied animals could be considered an atavism, and we also consider the extra molar presented by the other specimen is a malformation, due to some kind of random process occurred in later stages of the development of distal dental germ. To the best of our knowledge, this represents the first record of supernumerary molars in the subfamily Sigmodontinae and one of the few known cases in rodents.

RESUMO. **Dentes supranumerários em *Necromys lasiurus* (Rodentia, Cricetidae): primeiro registro em Sigmodontinae**. Diversos tipos de anomalias dentárias já foram descritas para mamíferos e uma delas é conhecida como dente supranumerário comumente reportada na literatura para quase todas as ordens de mamíferos. No presente trabalho apresentamos a ocorrência de molares extras em *Necromys lasiurus*, uma espécie de pequeno roedor sigmodontíneo comum e amplamente distribuído, membro da tribo Akodontini. Durante o levantamento de dados para avaliação morfométrica da variação da espécie no leste da América do Sul, foram examinados os crânios de 1763 espécimes. Os dentes supranumerários foram encontrados em dois indivíduos, representando 0.11% da amostra investigada. A ocorrência dos dentes supranumerários há muito tempo levanta questões acerca da homologia dentária, das mutações e dos atavismos que podem estar relacionados à origem desta anomalia. Baseados na morfologia apresentada pelos molares extra numerários de *N. lasiurus*, nós consideramos que a presença dos mesmos em um dos espécimes é um atavismo, e no outro, trata-se de uma malformação devido a um processo de origem tardia no desenvolvimento das gemas dentárias. Com base em nosso conhecimento de outras espécies e em toda a revisão bibliográfica, a ocorrência dos dentes supranumerários em *N. lasiurus* trata-se dos primeiros registros da anomalia para a subfamília Sigmodontinae e um dos poucos já registrados para a ordem Rodentia.

Key words: Akodontini. Brazil. Development. Extra teeth. Molar. Premolar.

Palavras-chave: Akodontini. Brasil. Dentes extras. Desenvolvimento. Molar. Pré-molar.

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INTRODUCTION

There are several kinds of anomalies related to the teeth reported in mammals captured in nature, such as congenital agenesis (Smith et al., 1977; Beaver et al., 1981; Stewart and Stewart, 1987); irregular placement (Heran 1970; Beaver et al., 1981; Smith et al., 1977); divided tooth and other crown anomalies (Van Gelder and McLaughlin, 1961; Wolsan, 1983; Stewart and Stewart, 1987; Smith et al., 1977; Angelici and Luiselli, 1999); post trauma repair (Graipel et al., 1997), and many others (see Smith et al., 1977, and Winer et al., 2012, for more examples).

One of them is known as supernumerary teeth and is commonly noticed in the literature, being reported in nearly all orders of mammals, mostly in Didelphimorphia (Takahashi, 1974; Moraes et al., 2001), Pilosa (McAfee and Naples, 2012), Primates (Berkovitz and Musgrave, 1971; Wolsan, 1984; see also Smith et al., 1977), Soricomorpha (Hooper, 1946; Feldhamer and Stober, 1993), Chiroptera (Ramírez-Pulido and Müdespacher, 1987; Rui and Drehmer, 2004), Carnivora (Paradiso, 1966; Beaver et al., 1981; Stewart and Stewart, 1987; Drehmer and Ferigolo, 1996; Graipel et al., 1997; Andersone and Ozolins, 2000; Peters et al., 2013; Winer et al., 2012), Artiodactyla (Knowlton and Glazener, 1965; Chaplin and Atkinson, 1968; Pekelharing, 1968; Zurowski, 1970; Steele and Parama, 1979; Natsume et al., 2005), and Rodentia, both extant (Johnson, 1952; Krutzsch, 1953; Dearden, 1954; Harris and Fleharty, 1962; Sheppe, 1964; Sofaer and Shaw, 1971; Goodwin, 1998; Angelici and Luiselli, 1999) and extinct (Goodwin, 1998; Arnal and Vucetich, 2011). The occurrence of supernumerary teeth in rodents is generally related to extra molars placed posteriorly the toothrow (Johnson, 1952; Sofaer and Shaw, 1971) and is comparatively rarer in natural populations other than Carnivora (Wolsan, 1984), which is the group with higher number of documented cases in literature.

In the present contribution we report the occurrence of supernumerary molars in the sigmodontine rodent *Necromys lasiurus* (Lund, 1840). This species is a common and widespread small rodent of tribe Akodontini that inhabits preferentially open vegetation areas, on the Caatinga, Cerrado, and Chaco biomes, as well as grasslands and shrublands that occur in the central portion of South America (Musser and Carleton, 2005). However, being an extremely versatile rodent, this species is also found in transitional areas, margins of forests and secondary forests, as well as anthropogenic habitats, like plantations and pastures (Mares et al., 1986; Henriques et al., 1997; Pardiñas et al., in press).

MATERIALS AND METHODS

In order to assess the patterns of morphometric variation of *N. lasiurus* in Brazil, we examined the skulls of 1763 specimens deposited in the following Brazilian collections: Universidade Estadual do Mato Grosso, Cuiabá (UFMT); Universidade Federal de Lavras, Lavras (CMUFLA); Universidade Federal de Minas Gerais, Belo Horizonte (UFMG); Museu de Ciências Naturais, Pontíficia Universidade Católica, Belo Horizonte (MCN-M); Museu de História Natural Capão da Imbuia, Curitiba (MHNCI); Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro (MN); Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP); Museu de Zoologia da Universidade Estadual de Campinas (ZUEC); and Museu de Ciências Naturais, Universidade Luterana do Brasil, Canoas (MCNU).

The nomenclature employed for dental morphology follows Reig (1977) and dental measurements (length of upper molar series) are accordingly to Percequillo et al. (2008). For age determination we followed Libardi (2013) and Voss (1991), and recognized 5 classes defined by tooth eruption and wear of major cusps, lophs and flexi.

In order to compare the length of the supernumerary toothrows to regular series presented by the same individuals and by other specimens, we calculated the descriptive statistics (mean, standard deviation, minimum and maximum values) and designed a boxplot graph, using the descriptive information of length of toothrow from individuals with supernumerary molars and from some selected samples. We gathered individuals of the same age class and same or nearby localities of the specimens with extra teeth to avoid the effects of other variation factors that could mislead the interpretation of the comparisons of the toothrow length, once the species seems to present age variation and geographic structure in toothrow and other skull dimensions, as highlighted

by Macêdo and Mares (1987) and Libardi (2013). A list of the specimens employed in comparisons from the same and nearby localities where the individuals with supernumerary teeth were found is provided in the **Appendix**.

We calculated the frequency of occurrence of extra teeth in *N. lasiurus* by simply dividing the number of specimens captured in nature presenting the oral feature by the total number of analyzed individuals, and therefore multiplying by 100 in order to obtain a value expressed in percentage. We also provide a list of frequencies and extra teeth positions on several mammalian orders, including Rodentia, in order to compare our findings to some described throughout in past decades for mammals. Some orders were not assessed due to the few information available or due to the unique nature of their dentition, as Cingulata and Cetacea.

We expressed the value of the frequencies of the revised literature, when available, in percentage as it appears in the article; when it was not directly informed, we applied here the same method as to *N. lasiurus*; when no information on total number of analyzed individuals were available, we did not calculate any frequency, providing then a "?" symbol.

The positions of extra teeth in each mammalian species revised are based on the accuracy of the information of the descriptions and figures provided by the authors. It is important to emphasize that we used the same nomenclature employed for the mammalian species in the articles.

RESULTS

The supernumerary molars were found in 2 individuals out from a sampling of 1763 specimens of *N. lasiurus*, which represent a frequency of 0.11%. The specimen MN 44035 is an adult male age class 2, collected at Gleba José Nani (also Bairro Santa Luzia), Caçapava municipality, São Paulo state, Brazil (23°06'S, 47°36'W; see Weksler and Bonvicino, 2005), collected on May 7, 1973, during the field survey performed by the Campaign for Combating Schistosomiasis (CACEsq). The MN 44035 present 2 extra teeth, one at each upper toothrow, at the distal end of dental series (**Figs**. **1A** and **1B**). The extra teeth are molar-like, covered by enamel, present reduced wear and no dentine exposition, peg-like, with no lophs or flexi discernible on molar topography and completely aligned with the other molars of both toothrows; these supernumerary teeth exhibit the crown positioned slightly higher than the remaining teeth (**Fig. 2A**). All remaining teeth show reduced wear and present a typical configuration of other specimens of *N. lasiurus* from other localities observed with similar molar wear. The total length of the upper right toothrow is 5.29 mm (ca. 4.60 mm without the extra molar) and of the upper left toothrow is 5.25 mm (ca. 4.48 mm without the extra molar). The mandible does not show any supernumerary teeth and all molars present the typical morphology. Both upper and lower series occluded perfectly, with the supernumerary teeth being positioned posteriorly to the lower third molars. It was also noted that the presence of the extra teeth did not cause any kind of injury on the other teeth, as well as no evidence of excessive wear on the posterior

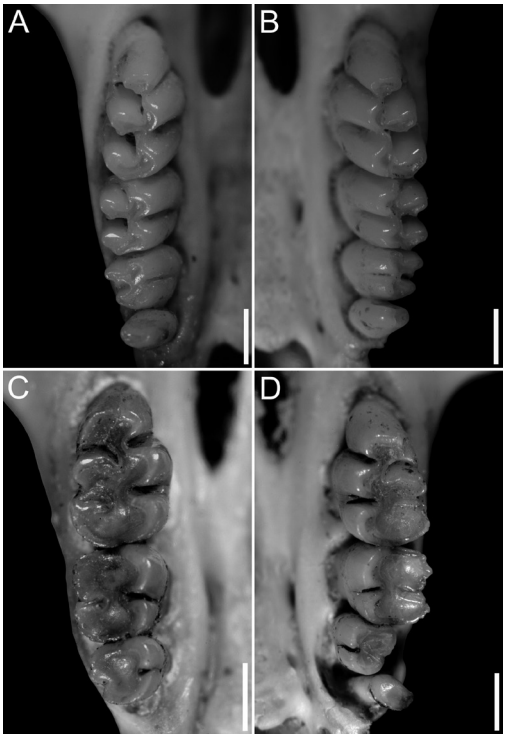

Fig. 1. *Necromys lasiurus*: Occlusal view of the left upper toothrow of specimens MN 44035 (A, right; B, left), from Caçapava, São Paulo; and UFMT 839 (C, right; D, left), from Rio Juruena, Mato Grosso, presenting the supernumerary molars, distally to other tooth; length of molar series provided in **Table 1**. Scale = 1 mm.

surface of the lower third molar, or even on the hard palate.

The individual UFMT 839 is an adult, age class 3, presents no information on sex, and was collected at Rio Juruena, Sapezal municipality, Mato Grosso state, Brazil (13°27'24"S, 59°00'07"W) on August 22, 2006. In this specimen, there is only 1 extra tooth in the left upper toothrow, also positioned at the distal end of this dental series (**Figs. 1C** and **1D**). The extra tooth is molar-like, enameled, with some wear on occlusal surface and small dentine exposition, with no lophs or flexi visible and its crown is positioned slightly higher than the remaining of molar series (**Fig. 2B**). The extra tooth is erupted transversally towards the labial direction, and the entire toothrow is unaligned, producing no precise occlusion of the upper and lower molar series. Moreover, the alveolus of the third tooth and the supernumerary tooth are confluent and very wide, probably with some maxillary bone reabsorption. The lack of alignment of the toothrow, especially the supernumerary tooth, suggests that there could have been some injury to the gum and the roots during the chewing movements. The total length of the upper right toothrow is 4.56 mm and of the upper left toothrow is 5.17 mm (ca. 4.56 mm without the extra molar).

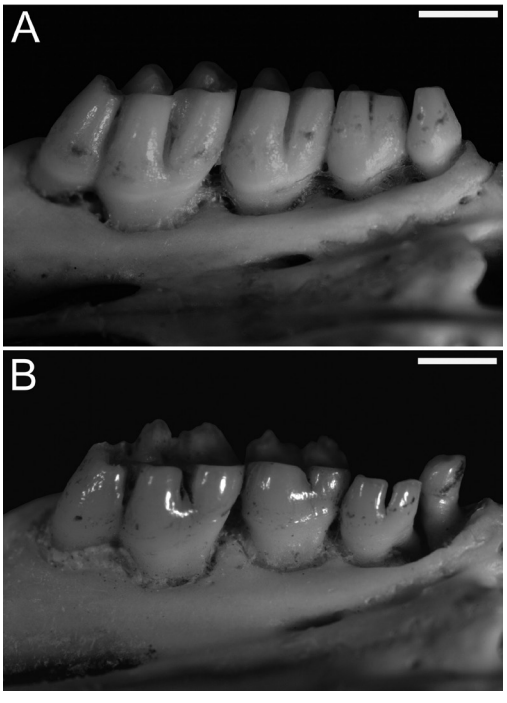

Fig. 2. *Necromys lasiurus*: Lingual lateral view of the upper left toothrow of specimens MN 44035, from Caçapava, São Paulo, and UFMT 839, from Rio Juruena, Mato Grosso, both presenting the supernumerary distal molars. It is possible to observe the occlusal surface of the extra teeth positioned above the surface of the other teeth; length of molar series provided in **Table 1**. Scale = 1 mm.

We compared the length of the molar series of the specimens MN 44035 and UFMT 839 to the toothrow length of syntopic individuals, from Caçapava and Rio Juruena with the same molar wear (**Table 1** and **Fig. 3**). Due to the existence of only 1 specimen with normal dentition from Caçapava, we decided to generate a boxplot considering also the individuals from Estação Biológica de Boracéia, Salesópolis, São Paulo state, the best available sample in the region, and which is nearly 60 km to the south of Caçapava. **Table 1** shows the results of the descriptive statistics: in all comparisons, the molar series with extra molars are consistently longer than regular molar series with three teeth. It is also interesting to notice that the measurements of the right normal series of specimen UFMT 839 and of the molar series of MN 44035 excluding the extra teeth are within the limits of variation of samples employed in comparisons.

DISCUSSION

The frequency of occurrence of the supernumerary teeth in *N. lasiurus* is low (0.11%), and we are confident that this represents information for the species (and not for a restricted sample), since the sample we studied is quite robust and presents specimens throughout the distribution of the species. It is noteworthy that this frequency is smaller than those frequencies exhibited by many other species: apparently in felids, which experienced drastic reductions on the number of post canine teeth, the expression of supernumerary teeth (especially molars) is more common than in other groups; in marsupials, which present complete dentitions with all possible teeth, the frequency is similar to that observed in *N. lasiurus*. The position of the

Table 1

Descriptive statistics of the toothrow lengths of the samples of *Necromys lasiurus* which presented normal molars and of the molar rows of the individuals with supernumerary molars. The "*" indicates absolute values; N = sampling number; SD = standard deviation. All measurements are provided in millimiters.

Sample or specimen	N	Mean ± SD	Range
MN 44035 (right toothrow)	-	5.29*	-
MN 44035 (left toothrow)	-	5.25*	-
UFMT 839 (right toothrow)	-	4.56*	-
UFMT 839 (left toothrow)	-	5.17*	-
MN 44033 (from Caçapava, with normal toothrows)	-	4.91*	-
Boracéia sample	17	4.55 ± 0.168	4.22-4.87
Rio Juruena sample	4	4.79 ± 0.092	4.69-4.91

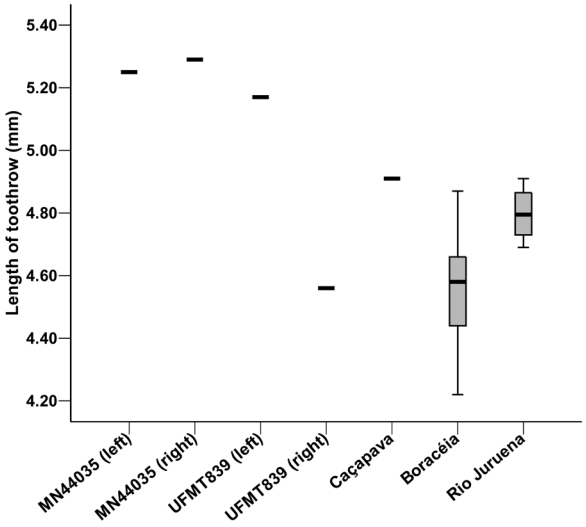

Fig. 3. Individual values and box-plot of the length of the upper toothrows of MN 44035 and UFMT 839 and of individuals from the same (Caçapava and Rio Juruena) and near localities (Boracéia) without supranumerary teeth for *Necromys lasiurus*. The black dashes represent the individual values for individual specimens or the mean value for samples; the gray boxes represent the quartiles and the whiskers represent the maximum and minimum values of each sample.

extra teeth found in *N. lasiurus* is also congruent to the other cases in Rodentia (**Table 2**).

The origin of supernumerary teeth started a long discussion on tooth homology (Wolsan, 1984; Peterkova et al., 2006; see also Hinton, 1923 for former hypothesis), whether this anomaly is a result of heredity, a mutation or an atavism. The present dentition of muroid rodents is currently understood as a result of the loss of the canines, incisors and premolars, and only the molars and a pair of incisors remained (see Peterkova et al., 2006). Nevertheless, the occurrence of extra molars posterior to the current third molar, raised the hypothesis that the first molar could be a modified premolar and the dental formula of rodents would be 1 incisor, 1 premolar and 2 molars (premolar theory): therefore, the extra tooth would represent the expression of a suppressed third molar during development (Johnson, 1952; Sheppe, 1964). Based on the timing of developmental patterns of the cheekteeth of embryos of *Mus musculus* in comparison to the timing of human embryos, Peterkova et al. (2006) suggest that the rodent M1, M2 and M3 teeth could correspond to the human dP3, dP4 and M1, respectively. This configuration would explain the presence of supernumerary teeth in the posteriormost portion of the maxillary.

The supernumerary teeth found in MN 44035 are nearly conventional, being aligned and symmetrically bilateral. This configuration could result of heredity (see Sofaer and Shaw, 1971),

Table 2

Frequencies and kinds of extra teeth found in other mammalian taxa disponible in literature. The superscripted and subscripted numbers indicate the upper and lower teeth, respectively, when it was posible to determine their position precisely; n.c. = not comparable.

Species	Frequency (%)	Tooth	Literature
DIDELPHIMORPHIA			
Caluromys philander	1.2	distal lower right molar	Moraes et al., 2001
Chironectes minimus	0.7	distal lower right molar	Moraes et al., 2001
Didelphis sp.	3.2	incisors	Takahashi, 1974
Didelphis albiventris	0.5	distal molars	Moraes et al., 2001
D. aurita	0.3	distal upper molars	Moraes et al., 2001
D. marsupialis	1.0	molars	Moraes et al., 2001
Philander andersoni	2.8	upper left molar	Moraes et al., 2001
P. frenata	0.8	distal upper molars	Moraes et al., 2001
P. opossum	0.3	distal upper molars	Moraes et al., 2001
DIPROTODONTIA			
Petrogale concinna	n.c.	distal lower molars	Rodrigues et al., 2011
SIRENIA			
Trichecus sp.	n.c.	distal lower molars	Domning and Hayek, 1984; Rodrigues et al., 2011
PILOSA			
Choloepus didactylus	?	right upper molar	McAfee and Naples, 2012
Choloepus hoffmanni	?	duplicated M1 and right M2	McAfee and Naples, 2012
PRIMATES			
Callimico goeldii	?	distal upper left molar	Schwartz, 1984
Cebus sp.	?	lower premolars	Schwartz, 1984
Leontopithecus rosalia	?	distal lower molars	Schwartz, 1984
Gorilla sp.	?	distal lower molars	Schwartz, 1984
Hylobates sp.	?	distal molars	Schwartz, 1984
Pongo sp.	?	distal lower and upper molars	Schwartz, 1984
Pongo pygmaeus	?	upper premolars	Berkovitz and Musgrave, 1971
RODENTIA			
†*Democricetodon*	?	distal lower molars	Mein, 1986
†*Sciamys principalis*	1.51	distal lower right molar	Arnal and Vucetich, 2011
†*Spermophilus richardsonii*	0.5	distal upper molars	Goodwin, 1998
Heliophobius argenteocinereus	n.c.	distal lower molars	Rodrigues et al., 2011
Hystrix cristata	0.55	distal upper molars	Angelici and Luiselli, 1999
H. leucura	?	distal molar	Johnson, 1952
Mesembriomys gouldi gouldi	?	distal upper right molar	Johnson, 1952
Microtus agrestis	?	distal molar	Johnson, 1952; Hinton, 1923
Necromys lasiurus	0.113	distal upper molars	this study

Species	Frequency (%)	Tooth	Literature
Peromyscus sp.	0.071	distal upper molars/distal upper left molar	Sheppe, 1964
Proechimys sp.	?	distal molar	Johnson, 1952
Saccostomus hildae	?	distal molar	Johnson, 1952; Hinton, 1923
Spermophilus richardsonii	0.105	distal upper molars	Goodwin, 1998
hybrid *Spermophilus*	5.88	distal upper molars	Goodwin, 1998
Zapus princeps	?	distal upper molars	Krutzsch, 1953
SORICOMORPHA			
Blarina brevicauda	0.5	distal upper molars	Feldhamer and Stober, 1993
Cryptotis parva	0.8	upper right premolar	Feldhamer and Stober, 1993
Sorex saussurei	?	upper right unicuspids	Hooper, 1946
CHIROPTERA			
Artibeus fimbriatus	2.27	upper right post-canine	Rui and Drehmer, 2004
A. lituratus	1.92	upper incisor/right M3	Rui and Drehmer, 2004
A. l. palmarum	?	upper incisors	Ramirez-Pulido and Müdespacher, 1987
Balantiopteryx plicata	4.12	upper incisors	Ramirez-Pulido and Müdespacher, 1987
Carollia subrufa	1.56	lower right incisor	Ramirez-Pulido and Müdespacher, 1987
Choeronycteris mexicana	26.5	upper incisors/upper canines	Ramirez-Pulido and Müdespacher, 1987
Glossophaga soricina	2.03	incisors/upper premolars	Ramirez-Pulido and Müdespacher, 1987
Myotis velifer	0.64	upper right incisor/upper left premolars	Ramirez-Pulido and Müdespacher, 1987
CARNIVORA			
Arctocephalus australis	?	upper right post-canine	Drehmer and Ferigolo, 1996
A. tropicalis	?	lower post-canines	Drehmer and Ferigolo, 1996
Canis latrans	1.4	premolars and molars	Paradiso, 1966
C. lupus	5.3-6.83	several places	Andersone and Ozolins, 2000; Buchalkzyc et al., 1981
Conepatus sp.	1.0	upper left incisor	Bateman, 1970
Felis bengalensis	78.1	P2	Wolsan, 1984
Lutra canadensis	4.3	P1/near P1/distal upper molar	Dearden, 1954; Beaver et al., 1981
Lynx lynx	3.0-30.0	M2	Kvam, 1985; Wolsan, 1984
Meles meles	?	premolars/M2	Ruprecht, 1965
Mustela sp.	13.7	upper incisors	Bateman, 1970
Mustela putorius	?	P3	Ruprecht, 1965
Otaria byronia	0.77	lower post-canines	Drehmer et al., 2004
Otocyon megalotis	3.17	lower and upper molars	Van Valen, 1964
Puma concolor	5.26	microdont tooth between upper canine and P2	Graipel et al., 1997
ARTIODACTYLA			
Alces alces	3.7	lower left incisors/lower right molar	Steele and Parama, 1979

Species	Frequency (%)	Tooth	Literature
Capreolus capreolus	0-16.7	upper canines	Chaplin and Atkinson, 1968
Cervus canadensis	0.77	duplicated left M3	Pekelharing, 1968
C. elaphus	0.17	duplicated M3	Pekelharing, 1968
Naemorhedus crispus	1.3	several places	Natsume et al., 2005
Odocoileus virginianus	0.013-17.9	upper canines	Knowlton and Glazener, 1965
O. v. borealis	?	lower left incisor	Fowle and Passmore, 1948

once the symmetry in position and morphology between the extra teeth suggests that their formation occurred before the differentiation of both sides of maxillae, so resulting from a genetically inducted formation process of the tooth germ instead of developmental interferences, mutation or random split of one single germ (Wolsan, 1984; Goodwin, 1998). Although the possibility of these extra teeth to have hereditary origins, we did not find any other *N. lasiurus* specimen from Caçapava and nearby localities, which counted 75 individuals (**Appendix**). This information, together with all the records we gathered from available bibliography (**Table 2**), is in agreement with the statement that supernumerary teeth are rare in natural populations of sigmodontine rodents.

In the other hand, the asymmetric eruption of the extra molar and the lack of alignment of toothrow found in UFMT 839 seem to be related to other random developmental or mutation processes (Wolsan, 1984:131; Goodwin, 1998). The occurrence of abnormal morphologies and unusual patterns of eruption is far more common in literature than the configuration observed in specimen MN 44035 (e. g., Harris and Fleharty, 1962; Smith et al., 1977; Graipel et al., 1997; Andersone and Ozolins, 2000; Winer et al., 2012).

Based on the morphologies presented by the extra teeth encountered in *N. lasiurus* and on the evidences and hypothesis available in the literature, we consider more likely that the supernumerary molars of specimen MN 44035 is in fact a result of genetic heredity (based on Sofaer and Shaw, 1971), once its alignment with the molar series, which is also well developed, suggests they originated at the earlier stages of embryonic development. Thus, if the hypothesis advocated by Johnson (1952) and Peterkova et al. (2006), in which the present dentition of muroid rodents is composed by the dP3, dP4 and M1 of the basic eutherian dentition, are true, the presence of these supernumerary molars in this specimen of *N. lasiurus* could be considered an atavism, i.e., the reappearance of a lost ancestral character (Peterkova et al., 2006). We also consider that the extra molar presented by the specimen UFMT 839 is a malformation, due to some kind of stochastic process during later stages of development of the distal tooth germ (see Glasstone, 1952; Wolsan, 1984:131), rather than earlier developmental process like reported by Sofaer and Shaw (1971). We cannot hypothesize if in this case the origin of supernumerary tooth is related or not to any kind of atavism, and if it is related to the hypothesis proposed by Johnson (1952) or Peterkova et al. (2006).

As observed in other species of rodents (**Table 2**), the positions of supernumerary teeth in both *N. lasiurus* specimens are posterior to the "normal" molar series, and therefore if we accept the conventional hypothesis that rodent molars are M1, M2 and M3, these teeth would represent a "fourth molar" due to the origin of a new dental germ, an unlikely event. However, if we accept the hypothesis regarding the dental formula of rodents, composed by the dP3, dP4 and M1, as valid (Johnson, 1952; Peterkova et al., 2006), these extra teeth would be the M2. As such, their presence could be more likely explained and would adjust adequately to the recurrent expression of supernumerary teeth in the same position for the order Rodentia, in natural populations; experimental breeding

revealed that this seems to be the tendency in *Oryzomys palustris* (Sofaer and Shaw, 1971). The fewer cases of occurrence of extra teeth in other positions reported for Rodentia (Goodwin, 1998:1166) are more difficult to relate to this pattern and also to atavistic origins, compared to the occurrence of the distal extra molars. Nevertheless, Rodrigues et al. (2011) have reported a special case of continuous dental replacement in the African mole-rat *Heliophobius argenteocinereus* (Rodentia: Bathyergidae), which is related to the supernumerary molars. As the authors claim, this kind of unique teeth replacement system, which occurs also only in the species of the manatee genus *Trichechus* and in the pygmy rock-wallaby *Petrogale concinna*, is a convergent mechanism which combines specific dental traits, as dental mesial drift, delayed eruption and the occurrence of supernumerary molars. In the *H. argenteocinereus* case, the supernumerary molars emerge in the distal portion of toothrows continuously and drift anteriorly as the frontal teeth are worn and atrophied and, subsequently, reabsorbed (see Rodrigues et al., 2011). Although it is difficult to determine the number of teeth, the occurrence of extra teeth agrees with the general pattern observed in Rodentia, with extra teeth emerging distally.

The occurrence of supernumerary teeth in *N. lasiurus* seems to be an odd event in the subfamily Sigmodontinae. Although one of the authors (ARP) personally analyzed nearly 7000 individuals of several species of the tribe Oryzomyini, no extra teeth were observed. U. F. J. Pardiñas (pers. comm.) reported to us the occurrence of extra molars in the same position and presenting similar morphology as presented the individual MN 44035, in a partial skull of *Abrothrix olivacea* (Sigmodontinae, Abrotrichini) found by D. Procopio in an owl pellet from Southern Patagonia. The only other records on literature are from experimental colonies of rice rats (Sofaer and Shaw, 1971).

CONCLUSIONS

To the best of our knowledge, this represents the first record of supernumerary molars in wild-caught specimens in the subfamily Sigmodontinae and one of the few known cases in rodents, and it is very likely that these teeth represent a vestigial structure. Considering the complex and poorly understood history of the evolutionary pathways on the origin and evolution of mammalian dentition, we hope that this contribution provide useful information on the knowledge of this important subject.

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APPENDIX 1

Specimens examined of genus *Necromys* employed in quantitative and qualitative comparisons in this study; the symbol * indicates that the specimen was used in the boxplot comparisions.

Caçapava (23º06'S; 45º43'W; Weksler and Bonvicino, 2005): MN 24193, 24194; also includes Gleba José Nani and José Nani, Bairro Sta. Luzia MN 44033*, 44035*.

Fazenda Mombaça, Pindamonhangaba (22º55'S; 45º27'W in Pindamonhangaba - IBGE): MN 44036.

Faz. Sto. Ângelo, Represa de Americana, Sumaré (22º49'S; 47º15'W in Sumaré - IBGE): MN 24187.

Guararema (23º25'S; 46º02'W; Weksler and Bonvicino, 2005): ZUEC 1402, 1410, 1414.

Ribeirão da Lagoa, Boracéia, Salesópolis (23º38'S; 45º52'W; Percequillo, 1998): MZUSP 10746, 10757, 10765*, 10766, 10770*, 10771*, 10815*, 10824, 10828*, 10831, 10832, 10834*, 10835*, 10836, 10837, 10840, 10842, 10844*, 10846, 10848, 10851, 10855, 10857*, 10861, 10862*, 10863*, 10865, 10867*, 10868*, 10877, 10879*, 10886, 10892*, 10893, 10894, 10897, 10899*, 10905, 10918*, 10919, 10920, 10927, 10945, 21196.

Rio Juruena, Sapezal (13º27'24"S, 59º00'07"W): UFMT 832*, 839*, 849*, 856*, 4012*.

São Luís do Paraitinga (23º13'S; 45º18'W in São Luís do Paraitinga - IBGE): ZUEC 2421, 2422, 2423, 2424, 2425.

Taubaté (23º01'S; 45º32'W in Taubaté - IBGE): ZUEC 1405, 1409, 1413; also includes Bairro do Barranco: MZUSP 11211, 11227; Faz. Antonio Taino (Foco 30): MN 24185; Gleba Paulo Japonês, Bairro Barranco: MN 44029, 44030, 44031, 44034, 44037, 44039, 44040, 44043, 44044, 44050, 60426.