N O T E

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Nipples in the edible dormouse *Glis glis*

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A b s t r a c t . Number of nipples varied between ten and twelve in a sample of 51 female edible dormice *Glis glis* from Slovenia. Ten nipples were by far the most common condition (82 % of specimens) and only two females had twelve. Animals with eleven nipples were asymmetric in the anterior inguinal pair. Three females from Monte Gargano (Italy) had 10, 11 and 11 nipples, but the asymmetric pair was the posterior abdominal one. Since the prevailing condition among dormice (family Gliridae) is eight nipples, it is suggested that high nipple count in the edible dormouse is an ecological adaptation to a multi-annual variation in resources. Due to irregularities in mast-production years, females do not reproduce annually, which possess demands for larger litters. Either the anterior inguinal (Slovenia) or posterior abdominal pair (Italy) is involved in a switch from ten to twelve nipple condition, with the difference possibly showing a geographic pattern.

Key words: Gliridae, nipple counts, litter size

Introduction

Mammary glands (mammae) are a unique feature of mammals. The milk they produce during lactation is carried via the duct system to projecting nipples where the fluid is sucked by the young. The number of both, mammae and nipples, varies among species from two to twenty (F e l d h a m e r et al. 1999) and roughly corresponds to the number of the young born in a litter (P o u g h et al. 1996). However, number of nipples is normally stable within a species and as such also of interest for taxonomic purposes, at least in some groups (e.g. C a r l e t o n 1985).

Various numbers of nipples are stated for the edible dormouse *Glis glis* (Linnaeus, 1766). M i l l e r (1912) claims there are twelve nipples, namely two pairs of each, the pectoral, the abdominal and the inguinal ones (Fig. 1). Same number is reported also by C o r b e t & S o u t h e r n (1977) and G o s à l b e z (1987). Other authors give the number as varying from 10 to 12 (N o w a k 1999), 10 or 12 (V i e t i n g h o f f - R i e s c h 1960), 8 to 12 (S t o r c h 1978, P u c e k 1981, C o r b e t & H a r r i s 1991), or ten (S h i d l o v s k i j 1976).

Material

Between 1999 and 2001 I examined over 1,000 edible dormice, both alive (from nest boxes) and dead (collected during traditional autumn dormouse hunting; *cf.* K r y š t u f e k & H a b e r l 2001). All specimens came from the Dinaric Alps of Slovenia and are ascribed to the nominate subspecies (V i o l a n i & Z a v a 1995). Nipples were clearly visible on 51 females, collected between July 30 and October 25. Since the last female still lactating

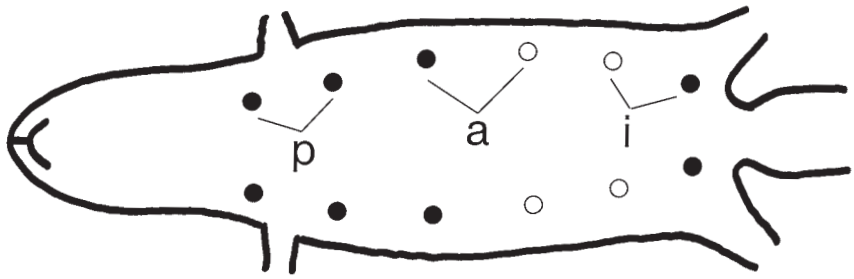

Fig. 1. Position of nipples in the edible dormouse *Glis glis*. Pairs of nipples, which are missing in counts lower than 12, are indicated as empty circles. Abbreviations: p – pectoral, a – abdominal, i – inguinal nipples. See text for further explanation.

was from October 7, part of the material was from the post-lactating period, but with nipples still clearly visible.

I also considered three standard museum skins with visible nipples from the collection of Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn. This material was collected in Monte Gargano, Italy, between July 18 and August 5, 1961, and shows all the characteristics of *G. g. italicus* Barrett-Hamilton, 1898 (W i t t e 1962).

Results and Discussion

In Slovenian dormice, the number of nipples varied between 10 and 12, with ten being by far the most common condition (Table 1). Seven females were asymmetric in having 11 nipples; in four of them, six nipples were on the right side and in the remaining three on the left side. The asymmetry is evidently random rather than directional.

Table 1. Frequency of nipples in the edible dormouse *Glis glis* from the Dinaric Alps of Slovenia.

# nipples	# females	percentage
10	42	82.4
11	7	13.7
12	2	3.9
Total	51	100.0

V i e t i n g h o f f - R i e s c h (1960) states that the reduction of nipples from 12 to 10 is due to the missing abdominal pair. All my females from Slovenia with 11 nipples invariably lacked one of the anterior inguinal nipples, thus suggesting that the presence / absence of this pair is responsible for the actual number observed. The three Monte Gargano females show 11, 11, and 10 nipples, respectively. Noteworthy, the asymmetric pair in two females with 11 nipples was the posterior abdominal one, which agrees with the explanation proposed by V i e t i n g h o f f - R i e s c h (1960). Evidently, different nipples might be involved in a switch between 10 and 12 nipple conditions, i.e. the posterior abdominal (in Italy) or the anterior inguinal (in Slovenia). Since *G. g. italicus* is well differentiated genetically from other European edible dormouse populations (F i l i p p u c c i & K o t s a k i s 1995), the pattern responsible for differences in nipple numbers might have genetic background.

So far Vietinghoff-Riesch (1960) proposed the only hypothesis about the mechanism involved in different nipple counts. By suggesting that 10-nipple condition is derived from the 12-nipple condition, he claims the latter to be also the primitive one. If so, the derived condition is now the prevailing one, at least in the nominate subspecies, and the intermediate morph is more common than the primitive one. However, the hypothesis does not accord the fact that in all recent dormice genera, with the exception of *Myomimus*, the number of nipples is lower than 10 (Fig. 2).

Genus *Glis* does not hold the basal phyllogenetic position among Gliridae, being one of the most derived genera (Storch 1995, Wahlert et al. 1993). Consequently, the number of nipples above eight unlikely reflects the primitive condition in glirids, but is rather a matter of ecological adaptation. The edible dormouse is possibly the only European mammal with adaptations to unpredictable ecological dynamics of the deciduous forest ecosystem to which it is closely tied (Krystufek 2001a). Key trees (*Quercus* spp., *Fagus* spp.) of the Holarctic deciduous forests are mast seeders, producing large seed crops every two to six years, while production in the intervening years is low or even fails (Sork et al. 1993). Young fat dormice are born mainly in August (Krystufek 2001b), i.e. at the peak of mast availability, but reproduction fails in years of low mast production (Bieber 1998). Data from mixed montane forests of central Slovenia gathered over 33 years indicate 15 years of low density with hardly any reproduction, or with no juveniles at all (Krystufek & Zavodnik, in press). Although the maximum age in the edible dormouse from central Slovenia, as deduced from the growth layers of the lower jaw (Pistotnik 2002), is seven years, only 3.5% of the animals, which survived their first hibernation, were older than five years (N=85; Pistotnik 2002). Thus, an average female has poor chances of producing more than two litters during her entire lifespan, since

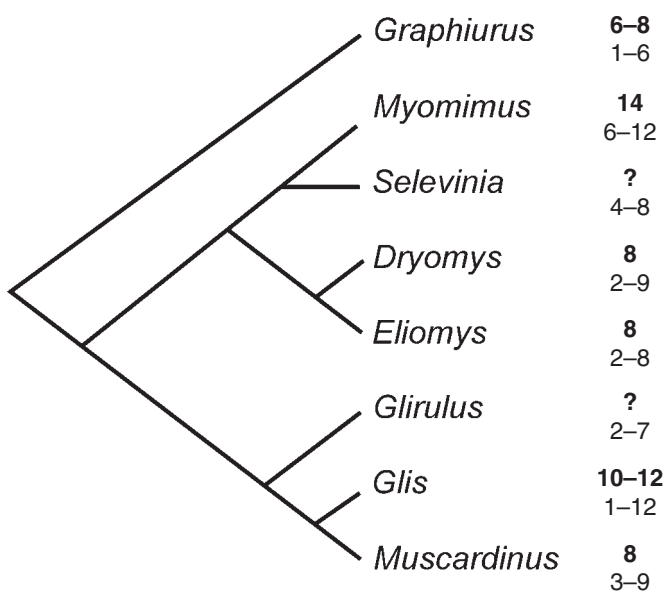

Fig. 2. Tree showing relationships among living dormice genera (from Wahlert et al. 1993). Number of nipples (upper row, bold) and maximum litter size (lower row) are given for each genus (from Lozan 1970, Nowak 1999, and Rossolimo et al. 2001).

she will deliver litter only every second year on average. As a consequence, litters are large, up to ten (Rossolimo et al. 2001), eleven (Storch 1978, Corbet & Harris 1991), or even twelve young (Özkan et al. 2002). In the Dinaric Alps of central Slovenia, litter size, estimated from embryos and placental scar counts, varies between 4 and 9 (mean = 5.8; Kryštufek 2001b) and from 1 to 10 (mean = 4.9) when based on juveniles in nest boxes (Kryštufek et al., in press). Other dormice of temperate Palaearctic evidently do not depend so heavily, or indeed not at all, on mast years and reproduce annually, which allows them to maintain smaller litters (*cf.* Fig. 2). I therefore suggest that ten to twelve nipple condition originates from a lower ancestral count, which was possibly eight nipples. The driving force, which generated the process, was presumably unpredictability in the multi-annual resource availability. As a consequence, females do not reproduce each year, which necessitates increase in litter size. High nipple number and large litter size in mouse-tailed dormice (*Myomimus*) is hard to explain since little is known about the life of this genus (Rossolimo et al. 2001). Litter size evidently varies in the edible dormouse across its range, e.g. from 2 to 8 in Moravia (Gaisler et al. 1977), 2–7 in Vicenza, Italy (Pilastro 1992), and 3–6 in Lithuania (Juškaitis 1999). Thus it would be an intriguing task to study geographic variation in nipple counts, as a possible response to the litter size, as well as the variation in asymmetric pairs.

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