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A CHROMOSOMAL STUDY OF TWO DORMOUSE SPECIES FROM TURKEY

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ABSTRACT - The results of a karyological study on the dormice *Myoxus glis* (2n=62) and *Dryomys nitedula* (2n=48) from Turkey are presented in this study. The karyotype was analyzed cytogenetically by conventional staining, G- and C-banding techniques and the banding patterns were compared with those from previous works. The C-banded karyotype of *M. glis* is reported here for the first time. Furthermore, the G- and C-banding patterns are also provided for the first time for Black Sea Region populations in Turkey of the two species. C–banding showed in most autosomes at least faint heterochromatic bands in the centromeric regions in both species. The comparison of our G-banding patterns for these species with those of previous studies showed extensive homology.

Key Words: Cytogenetics, *Dryomys nitedula, Myoxus glis,* Turkey

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INTRODUCTION

Myoxidae is one of the oldest extant rodent families and its members are found in Africa, Europe, Asia Minor, Russia, India, China and Japan (Corbet 1978; Wilson and Reeder 2005; Vaughan et al. 2011). Among the representatives of the family Myoxidae, the two common species in the Black Sea Region of Turkey are the fat dormouse *Myoxus glis* Linnaeus, 1766 and the forest dormouse *Dryomys nitedula* Pallas, 1778. Their karyotypes in several Palearctic regions are characterized by 2n=62 and 2n=48, respectively (Dulić et al. 1971; Diaz de la Guardia et al. 1980; Cristaldi and Amori 1982; Zima and Kral 1984; Filippucci et al. 1985; Zima 1987; Belcheva et al. 1988; Doğramacı and Kefelioğlu 1990; Doğramacı and Tez 1991; Graphodatsky and Fokin 1993; Civitelli et al. 1994; Peshev and Delov 1994; Zima et al. 1994; Mitsainas et al. 2008).

Graphodatsky and Fokin (1993) reported the G- and AgNOR banded karyotypes of *M. glis* and *D. nitedula* from Kazakhstan, Turkmenistan and northern Caucasus. G-banding studies of *D. nitedula* populations were performed by Zima et al. (1994) from Ankavan, the Little Caucasus, and by Civitelli et al. (1994) from Israel and Turkey. Filippucci et al. (1985) demonstrated the C–banded karyotype of *D. nitedula* from Italy. Mitsainas et al. (2008) carried out G- banding patterns of *M. glis* and G- and C-banding patterns of *D. nitedula* from Greece. However, the C-banded karyotype of *M. glis* has not been illustrated until now, with the

exception of some descriptions provided by Belcheva et al. (1988), Civitelli et al. (1994), and Mitsainas et al. (2008).

For this reason and because very little is known of the cytogenetic constitution of the above two species from Turkey, the aim of this study was to provide cytogenetic data on the karyotypes of the two species, using the G- and C-banding staining techniques.

MATERIAL AND METHODS

In the present study four individuals of *M. glis* and three individuals of *D. nitedula* werekaryologically studied. *M. glis* specimens were collected from Giresun (40° 55' N, 38° 24') and *D. nitedula* specimens were collected from Ordu (41° 00' N, 37° 53') in Turkey. The collection localities and the number of individuals collected per species are given in *Figure 1* and *Table 1*, respectively. Chromosome preparations were obtained from the bone marrow cells of the femur in colchicine treated animals. The bone marrow preparations were carried out according to Ford and Hamerton (1956). The G–banding staining technique for chromosome identification and the C–banding staining technique to demonstrate the distribution of the heterochromatin in the karyotype were performed according to Seabright (1971) and Sumner (1972), respectively.

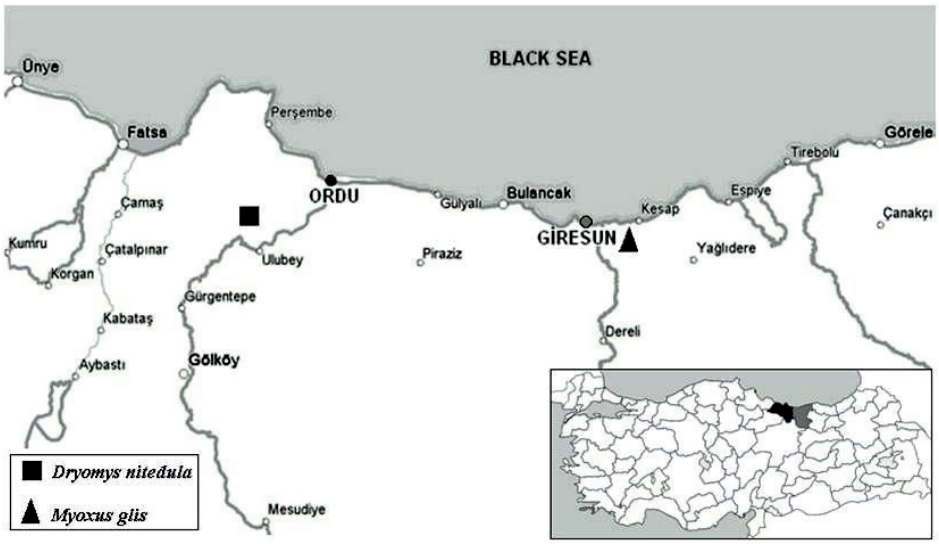

Figure 1 - Map showing the collection localities of the studied animals.

Table 1 - Sampling localities of the studied animals and their karyological characteristics.

Taxon	Locality	No. of individuals			2n	FNa	FN
		Total	♂	♀			
Myoxus glis	Duroğlu village, Giresun	4	2	2	62	120	124
Dryomys nitedula	Günören village, Ordu	3	1	2	48	92	96

RESULTS

The karyological study of *M. glis* revealed a karyotype of 2n=62, FN=124 and FNa=120 (*Fig. 2a*). Autosomes were found to be metacentric, submetacentric or subtelocentric (4, 6 and 23) chromosome pairs of gradually decreasing size. In addition, secondary constrictions were clearly visible in one small autosomal pair (20). The X chromosome was large and metacentric, whereas the dot-like Y chromosome was most probably acrocentric and the smallest one in the karyotype. C–banding showed that most autosomes possessed at least faint stained dark heterochromatic bands in the centromeric/pericentromeric regions, with the exception of some chromosomes (13, 19, 27, 28, 29 and 30) which seemed C-negative (*Fig. 2c*). Some pairs (1, 2 and 3) showed additional heterochromatic bands at different positions of the long arms. Chromosome no. 4 seemed largely heterochromatic on its short chromosomal arms, whereas chromosome no. 21 probably possessed heterochromatic large arms. Furthermore, three pairs (20 with secondary constrictions, 24 and 25) seemed largely heterochromatic. The X chromosome showed a centromeric band**,** whereas the Y chromosome was partially faintly heterochromatic.

In *D. nitedula,* a karyotype of 2n=48, FN=96 and FNa=92 was found (*Fig. 3a*). Autosomal pairs were metacentric or submetacentric and three pairs were subtelocentric (5, 8 and 10). The first autosomal pair was distinctly larger than the rest of chromosomes in the complement. One of the small autosomal pairs appeared to bear a secondary constriction (21). The X chromosome was a medium to large sized submetacentric, whereas the dot-like Y chromosome was the smallest one in the karyotype and most probably acrocentric. The C–banding staining technique showed that most autosomes possessed at least faint centromeric/pericentromeric bands (*Fig. 3c*). One pair (10) demonstrated a heterochromatic band in the middle of large chromosomal arms. Chromosome no. 21 with a secondary constriction seemed faintly heterochromatic. The X chromosome demonstrated two very faintly stained pericentromeric bands and, partially faint and dark two heterochromatic bands at the distal positions. The Y chromosome seemed partially heterochromatic.

The G-banded karyotypes of *M. glis* and *D. nitedula* are illustrated in *Figure 2b* and *Figure 3b*. All chromosomes in the two species were identified on the basis of size, staining density and distribution of G-bands.

DISCUSSION

Our results and those of previous works for other populations support the view that *M. glis* is characterized by a conservative karyotype of 2n=62. As in our case, all the autosome chromosomes are commonly reported as biarmed (Zima 1987; Belcheva et al. 1988; Doğramacı and Tez 1991; Graphodatsky and Fokin 1993; Civitelli et al. 1994; Mitsainas et al. 2008), with the exception of the one acrocentric pair in Bulgarian populations (Peshev and Delov 1994). The secondary constriction, which is characteristic for

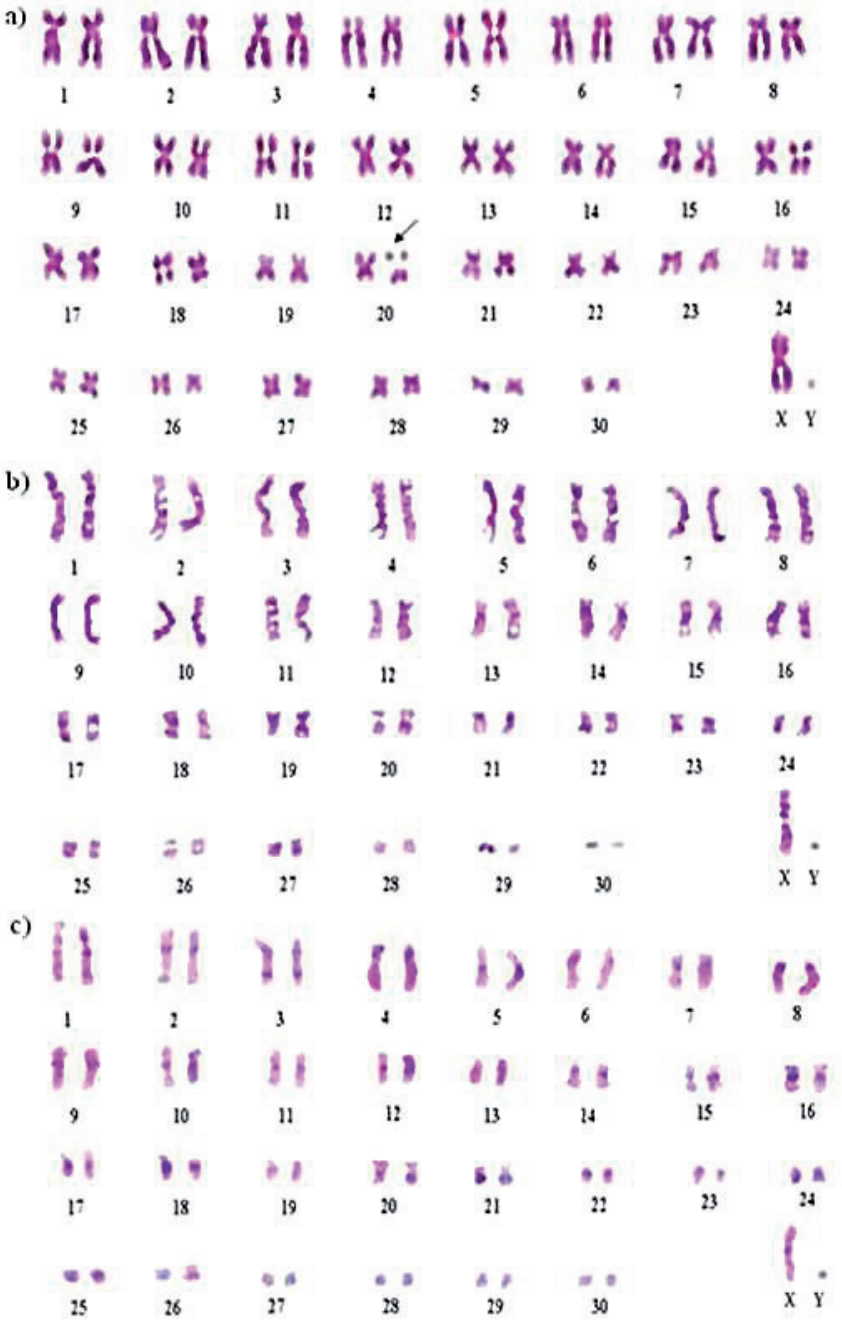

Figure 2 - *a*) Conventional staining, *b*) G–banded and *c*) C–banded karyotype of a male dormouse, *Myoxus glis* with 2n=62, FN=124. Arrow indicates the 20th chromosomal pair with secondary constrictions.

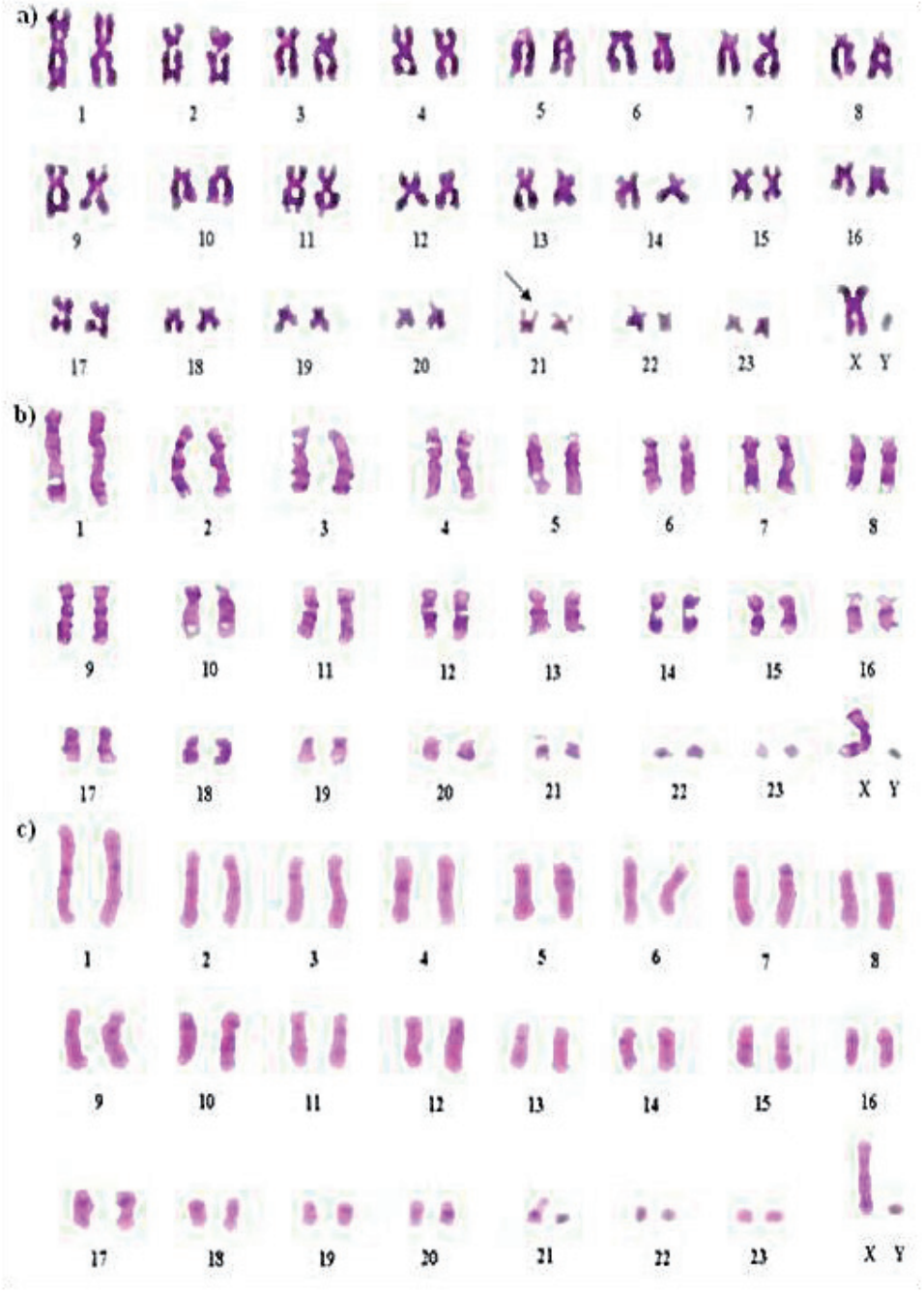

Figure 3 - *a*) Conventional staining, *b*) G–banded and *c*) C–banded karyotype of a male dormouse, *Dryomys nitedula* with 2n=48, FN=96. Arrow indicates the 21th chromosomal pair with secondary constriction.

karyotypes of Myoxidae, which we also noted (the 20th chromosomal pair in *Fig. 2*), has been recorded by the all researchers. As in our case, the X chromosome is commonly reported as metacentric (Dulić et al. 1971; Zima 1987; Belcheva et al. 1988; Doğramacı and Tez 1991; Civitelli et al. 1994; Peshev and Delov 1994; Mitsainas et al. 2008). However, it was described as submetacentric in Spanish (Diaz de la Guardia et al. 1980) and Russian populations (Graphodatsky and Fokin 1993). Furthermore, the large size of the X chromosome, which we also noted, has been reported from Turkey (Civitelli et al. 1994) and from Greece (Mitsainas et al. 2008). The Y chromosome has also been reported as probably acrocentric (dot-like) in most populations (Civitelli et al. 1994; Belcheva et al. 1988; Zima and Král 1984; Zima 1987; Mitsainas et al. 2008). The heterochromatic bands in the chromosomes of *M. glis* have been discussed in a few studies (Belcheva et al. 1988; Civitelli et al. 1994; Mitsainas et al. 2008) but have not been illustrated yet. It has been emphasized that the C-heterochromatin in this species is represented by faint C-positive or C-negative bands. Graphodatsky and Fokin (1993) concluded that the relative absence of heterochromatin bands is a chromosome feature in some dormice species. Belcheva et al. (1988) reported that the constitutive heterochromatin in this species is localized around the centromeres and in the secondary constriction, and the short arms of one submetacentric chromosome are composed entirely of heterochromatin which is similar to chromosome no. 4 in this study. Civitelli et al. (1994) reported that a medium-sized metacentric pair showed a distinct heterochromatic region in the Turkish population. Mitsainas et al. (2008) applied the C–banding staining technique in the chromosomes of *M. glis* from Greece but they did not illustrate the C–banded karyotype. In this study, in addition to centromeric bands, some pairs demonstrated additional heterochromatic bands (*Fig. 2c*).

Our result on diploid chromosome number of *D. nitedula* supports previous works in which this species is characterized by a rather conservative karyotype of 2n=48 (Zima and Kral 1984; Filippucci et al. 1985; Zima 1987; Doğramacı and Kefelioğlu 1990; Graphodatsky and Fokin 1993; Civitelli et al. 1994; Peshev and Delov 1994; Zima et al. 1994; Mitsainas et al. 2008). As in our case, Zima (1987) and Mitsainas et al. (2008) reported the karyotype of *D. nitedula* as having three pairs of subtelocentric chromosomes whereas the other autosomal pairs were metacentric or submetacentric. However, some differences in the number of telocentric or subtelocentric chromosomes have been reported in other studies in which the number of these chromosomes varied from 2 to 9 (Filippucci et al. 1985; Doğramacı and Kefelioğlu 1990; Civitelli et al. 1994; Peshev and Delov 1994). We think the observed differences are probably the result of methodological discrepancies in karyotype preparation and the arrangement of the chromosomal pairs. The largest first autosomal pair, we also noted, has been reported as a karyotypic marker of *D.*

nitedula among Myoxidae species (Filippucci et al. 1985; Mitsainas et al. 2008). Furthermore, the secondary constriction in a small pair, reported by previous researchers (Zima and Král 1984; Filippucci et al. 1985; Civitelli et al. 1994; Peshev and Delov 1994; Zima et al. 1994; Mitsainas et al. 2008), was also observed in the 21th chromosomal pair (*Fig. 3*) in the karyotypes of this study. The X chromosome was described by some researchers as a medium to large size metacentric (Zima and Král 1984; Filippucci et al. 1985; Belcheva et al. 1988; Doğramacı and Kefelioğlu 1990; Civitelli et al. 1994; Peshev and Delov 1994; Zima et al. 1994), whereas in our case it was submetacentric, as was also reported by Zima (1987), Graphodatsky and Fokin (1993) and Mitsainas et al. (2008). On the other hand, all researchers agree that the Y chromosome is very small, probably acrocentric and occasionally dot-like. Mitsainas et al. (2008) reported that most autosomes possessed at least faint heterochromatic bands in the centromeric/pericentromeric regions, one pair possessed a heterochromatic band at the distal end of its large chromosomal arms, one pair displayed heterochromatic large arms and another pair with secondary constriction seemed largely heterochromatic in Greek populations. Like in Greek populations, the C-heterochromatin has been represented by faint positive bands in the centromeric/pericentromeric regions of most autosomal pairs and one pair (21) with a secondary constriction seemed largely heterochromatic in this study (*Fig. 3c*). However, autosomes with a heterochromatic band at the distal end and heterochromatic large arms were not found in our study. We found one pair (10) with

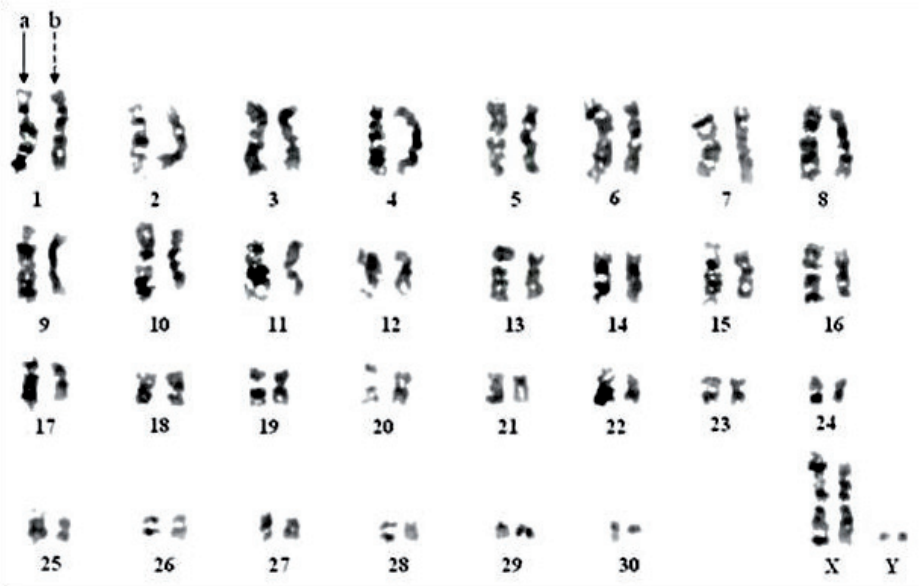

Figure 4 - Comparison of G-banded karyotypes of *Myoxus glis* (*a*: Graphodatsky and Fokin, 1993, *b*: this study).

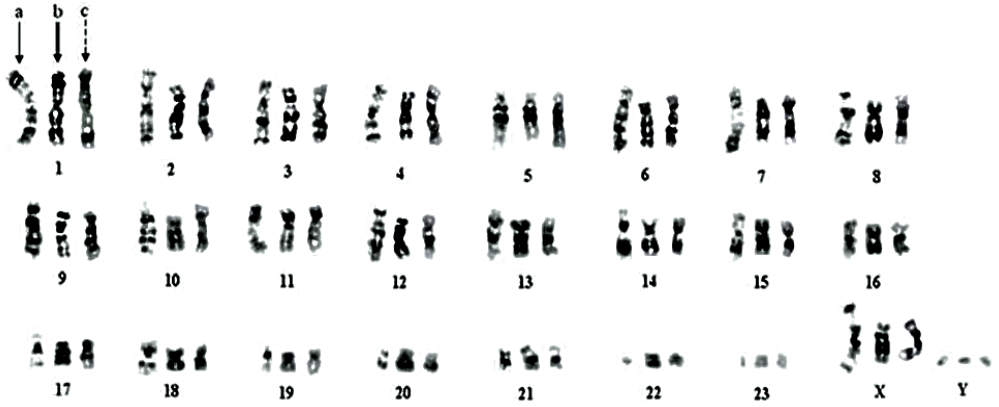

Figure 5 - Comparison of G-banded karyotypes of *Dryomys nitedula* (*a*: Graphodatsky and Fokin, 1993, *b*: Mitsainas et al., 2008, *c*: this study).

heterochromatic bands at in the middle of large chromosomal arms. These differences in heterochromatin distribution may show a small heterochromatin variation between Greek and Turkish populations. Filippucci et al. (1985) reported that the X chromosome possessed two prominent C–bands at pericentromeric position, whereas Mitsainas et al. (2008) presented only faint heterochromatic bands at interstitial and distal positions. In our study this chromosome displayed partially faint stained heterochromatic bands at pericentromeric and distal positions. The Y chromosome was partially heterochromatic in our study, as was also reported by Mitsainas et al. (2008).

When the G-banding results on *M. glis* and *D. nitedula* in the present study were compared with those of Graphodatsky and Fokin (1993) and Mitsainas et al. (2008), extensive homology was indicated between G-bands despite different levels of chromosome resolution in the studied karyotypes (*Fig. 4* and *5*). In spite of small differences, this homology may show that these species have highly conservative karyotypes throughout their geographical ranges. However, since the G-banding of heterochromatic regions of these species given by other researchers is not well defined and the G-banded chromosomes are at different stages of condensation, the degree of their homology is difficult to assess.

Since the karyotype banding studies in dormice have been rather exceptional and limited, it is necessary to perform the more detailed banding studies and completely describe the karyotype features and possible variation in these species.

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