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The Karyotypes of Some Rodent Species (Mammalia: Rodentia) from Eastern Turkey and Northern Iran with a New Record, *Microtus schidlovskii* Argyropulo, 1933, from Eastern Turkey

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Abstract: During a field excursion in eastern Turkey and the Zanjan province of Iran, 9 rodent species were captured, and the diploid number of chromosomes (2n), the number of autosomal arms (FNa) and the fundamental number (FN) were determined for these species. *Microtus schidlovskii* with 2n = 60 and FNa = 58 was recorded for the first time from Özalp (Van) and Yüksekova (Hakkari). The karyological record of *Meriones vinogradovi* in Turkey was also given for the first time. The karyological results were determined as follows: *Spermophilus xanthophrymnus* (2n = 42, FNa = 78, FN = 82 in Turkey), *Mesocricetus brandti* (2n = 42, FNa = 78, FN = 82 in Iran), *Microtus socialis* (2n = 62, FNa = 60 FN = 62 in Iran, 2n = 60, FNa = 58 FN = 60 in Turkey), *Meriones tristrami* (2n = 72, FNa = 78, FN = 80 in Iran, 2n = 72, FNa = 82, FN = 84 in Turkey), *M. vinogradovi* (2n = 44, FNa = 74, FN = 77 in Turkey), *Meriones libycus* (2n = 44, FNa = 76, FN = 80 in Iran), *Apodemus iconicus* (2n = 48, FNa = 46, FN = 48 in Iran), and *Mus domesticus* (2n = 40, FNa = 38, FN = 40 in Iran and Turkey).

Key Words: Rodent, karyotype, Turkey, Iran

Türkiye'nin Doğusu ve İran'ın Kuzeyinden Bazı Rodent (Mammalian: Rodentia) Türlerinin Karyotipi; Türkiye'nin Doğusundan Yeni Bir Kayıt *Microtus schidlovskii* Argyropulo, 1933

Özet: Türkiye'nin doğusunda ve İran'ın Zanjan şehri civarında yapılan arazi çalışmasında, 9 kemirici türü yakalandı ve bu türlere ait diploid kromozom sayıları (2n), otozomal Kromozomların kol sayıları (FNa) ve kromozom kol sayıları (FN) belirlendi. 2n = 60, FNa = 58 karyolojik değerlere sahip *Microtus schidlovskii* Özalp (Van) ve Yüksekova'dan (Hakkari) ilk kez kaydedildi. Çalışılan türlerden *Meriones vinogradovi*'nin karyolojik bulguları Türkiye'den ilk kez bu çalışmayla verildi. Karyolojik çalışmalarda; *Spermophilus xanthophrymnus* (Türkiye; 2n = 42, FNa = 78, FN = 82), *Mesocricetus brandti* (İran; 2n = 42, FNa = 78, FN = 82), *Microtus socialis* (İran; 2n = 62, FNa = 60 FN = 62, Türkiye; 2n = 60, FNa = 58 FN = 60), *Meriones tristrami* (İran; 2n = 72, FNa = 78, FN = 80, Türkiye; 2n = 72, FNa = 82, FN = 84), *M. vinogradovi* (Türkiye; 2n = 44, FNa = 74, FN = 77), *Meriones libycus* (İran; 2n = 44, FNa = 76, FN = 80), *Apodemus iconicus* (İran; 2n = 48, FNa = 46, FN = 48), *Mus domesticus* (İran ve Türkiye; 2n = 40, FNa = 38, FN = 40) karyolojik değerlere sahip olduğu saptandı.

Anahtar Sözcükler: Kemirici, karyotip, Türkiye, İran

Introduction

To date, more than 65 rodent species have been recorded from Turkey, and the karyotypes of Turkish rodents have been intensively investigated (Soldatovic and Savic, 1978; Gülkaç and Yüksel, 1989; Dođramacı and Kefeliođlu, 1991; Dođramacı et al., 1994; Çolak et al., 1994; Yiđit et al., 1997, 1998a, 1998b, 1998c, 2000a, 2000b, 2001; Ivanitskaya et al., 1997; Çolak et al., 1997a, 1997b, 1997c, 1998, 1999, 2005; Kivanç et al.,

1997a, 1997b; Çolak and Yiđit, 1998; Yiđit and Çolak, 1998, 1999; Kefeliođlu and Kryštufek, 1999; Özkurt, et al., 1999, 2002; Çoşkun, 1999, 2003; Sözen et al., 2000; Özkan et al., 2003; Çolak 2003; Gözceliođlu et al., 2005). However, karyotypes of Iranian rodents are poorly known (Mathey, 1954; Nadler and Lay, 1967; Benazzou et al., 1982; Gharkheloo and Kivanç, 2003). Furthermore, karyotypes of certain species show geographical variation in the fundamental number of

chromosomes as well as the diploid number of chromosomes as in the genera *Nannospalax* and *Meriones* (Nevo et al., 1994; Yiğit et al., 1998a, 1998b, 1998c; Sözen et al., 2000). The present study focused on the karyotypes of rodent species from eastern Turkey and northern Iran due to the very rare karyological records from those areas, and aimed to reveal the geographical variation in the fundamental number and the diploid number of chromosomes of these species.

Materials and Methods

During a field excursion in eastern Turkey and the Zanjan province of Iran, we caught 8 rodent species (Figure). Measurements of 4 external characters (total length, tail length, ear length and hindfoot length in mm) and weight (g) were taken from specimens, which were karyotyped in accordance with the conventional bone marrow method. A total of 20 slides were prepared for each specimen, and well-spread metaphase cells were analyzed. The diploid number of chromosomes (2n), the number of autosomal arms (FN_a) and the fundamental number (FN) were determined by examining photographs of the slides. The zygomatic index (ZI = width of malar process / width of upper part of zygomatic arch) and tail length percentage to head and body length (tail length × 100 / head body length = T / HB) were determined to identify *Mus* species. Voucher specimens were skinned and stuffed in the standard museum manner. The skin, skulls and karyotype preparations were deposited in

Ankara University, Faculty of Science, Department of Biology.

Specimens karyotyped: *Spermophilus xanthophrymnus* (Coll. Nr. 4518, 4595, 4600), *Mesocricetus brandti* (Coll. Nr. 4865, 4431, 4432, 4867), *Microtus socialis* (Coll. Nr. 4375, 4616), *Microtus schidlovskii* (Coll. Nr. 4607, 4608, 4616, 4617, 4618, 4619), *Meriones tristrami* (Coll. Nr. 4385, 4396), *Meriones vinogradovi* (Coll. Nr. 4404), *Meriones libycus* (Coll. Nr. 4381), *Apodemus iconicus* (Coll. Nr. 4606), and *Mus domesticus* (Coll. Nr. 4381, 4421).

Results and Discussion

Spermophilus xanthophrymnus (Bennet, 1835)

We karyotyped 2 female specimens and 1 male specimen from 3 different localities, namely Doğubeyazıt (Iğdır), Digor (Kars) and Başkale (Van). The karyotype is composed of 2n = 42, FN_a = 78 and FN = 82 with 2 pairs of metacentric, 17 pairs of submetacentric and a pair of acrocentric chromosomes. The X chromosome is medium-sized and metacentric, and the Y chromosome is the smallest acrocentric (Table). Our findings are consistent with those given by Özkurt et al. (2002).

Mesocricetus brandti Nehring, 1898

Two female specimens and 1 male specimen of *Mesocricetus brandti* were examined from Zanjan

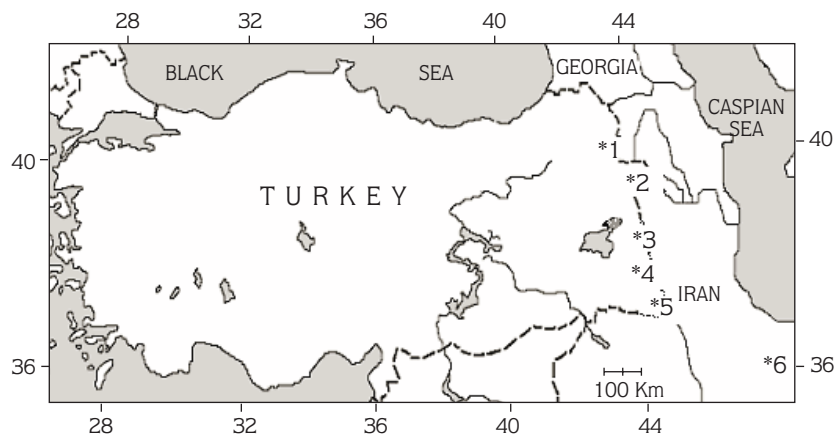


Figure. Map showing the sampling locations in eastern Turkey (1 = Digor, 2 = Doğubeyazıt, 3 = Özalp, 4 = Başkale, 5 = Yüksekova) and northern Iran (6 = Zanjan).

Table. A comparison of karyological records of the given rodent species.

Species	Location / Country	2n	NFa	NF	References
<i>S. xanthophrymnus</i>	Doğubeyazit / Turkey	42	78	82	Present study
<i>S. xanthophrymnus</i>	Western Turkey	42	78	82	Özkurt et al. (2002)
<i>M. brandti</i>	Zanjan / Iran	42	78	82	Present study
<i>M. brandti</i>	Turkey	42	78,80	80,84	Yiğit et al. (2000a)
<i>M. socialis</i>	Zanjan / Iran	62	60	62	Present study
<i>M. schidlovskii</i>	Özalp & Yüksekova / Turkey	60	58	60	Present study
<i>M. schidlovskii</i>	Caucasia, Georgia	60	58	60	Golenishchev et al. (2002)
<i>M. socialis</i>	Turkey	62	60	62	Kefelioğlu (1995)
<i>M. socialis</i>	Turkey	62	60	62	Kefelioğlu and Kryštufek (1999)
<i>M. tristrami</i>	Doğubeyazit / Turkey	72	82	84	Present study
<i>M. tristrami</i>	Zanjan / Iran	72	78	80	Present study
<i>M. tristrami</i>	Iran	72	82	84	Benazzou et al. (1982)
<i>M. tristrami</i>	Iran and Palestine	72	70	74	Matthey (1957)
<i>M. tristrami blackleri</i>	Manisa / Turkey	72	72	76	Yiğit et al. (1998a)
<i>M. tristrami lycaon</i>	Karaman / Turkey	72	78	82	Yiğit et al. (1998a)
<i>M. tristrami kilisensis</i>	Kilis / Turkey	72	74	78	Yiğit and Çolak (1998)
<i>M. vinogradovi</i>	Doğubeyazit / Turkey	44	74	77	Present study
<i>M. vinogradovi</i>	Iran	44	78	-	Nadler and Lay (1967)
<i>M. libycus</i>	Zanjan / Iran	44	80	76	Present study
<i>M. libycus</i>	Iran	44	77	74	Benazzou et al. (1982)
<i>M. libycus</i>	Jordan	44	77	74	Qumsiyesh (1986)
<i>A. iconicus</i>	Zanjan / Iran	48	46	48	Present study
<i>A. iconicus</i>	Turkey	48	46	48	Çolak (2003)
<i>M. domesticus</i>	Zanjan / Iran	40	38	40	Present study
<i>M. domesticus</i>	Northwest Turkey	40	38	40	Gözcelioğlu et al. (2005)

province (Iran). Their karyotypes have $2n = 42$, $FN_a = 78$ and $FN = 82$. The karyotype consists of 8 metacentric chromosomes, 32 submetacentric chromosomes and 2 acrocentric chromosomes. The X chromosomes are middle-sized metacentric and the Y chromosome is smaller than the X chromosome and metacentric (Table). Yiğit et al. (2000a) reported $FN_a = 80$, $FN = 84$ for Eastern Anatolia (Ardahan and Van specimens), and $FN_a = 78$, $FN = 80$ for Central Anatolia. FN_a and FN of Iranian specimens were similar to those of the specimens from Central Anatolia.

Microtus socialis (Pallas, 1771)

The diploid number of chromosomes ($2n$) is 62 in a specimen from Zanjan (Iran), and the karyotype has 62

acrocentric chromosomes with $FN_a = 60$ and $FN = 62$. The X and the Y chromosomes are both acrocentric and the X chromosome is larger than the Y chromosome (Table). The karyological values of Iranian specimens were similar to those reported for Turkish specimens by Kefelioğlu (1995) and Kefelioğlu and Kryštufek (1999).

Microtus schidlovskii Argyropulo, 1933

In the specimens from Özalp (Van) and Yüksekova (Hakkari), the karyotype has $2n = 60$, $FN_a = 58$ and $FN = 60$. The autosomal set contains 29 pairs of acrocentric chromosomes. Both sex chromosomes are acrocentric and the Y chromosome is smaller than the X (Table). Kefelioğlu and Kryštufek (1999) reported a new diploid number of chromosomes ($2n = 60$) in Central Anatolia

for social voles. They also stated that these specimens have very enlarged bullae anteriorly, and then described these specimens as a new species, *Microtus anatolicus*. However, the specimens of Özalp and Yüksekova have smaller mastoid parts of tympanic bulla than *M. anatolicus* and show the typical cranial features of *M. socialis*. Golenishchev et al. (2002) recorded *Microtus schidlovskii* from Caucasus. They also stated that this species has $2n = 60$, and belongs to the *socialis* group of voles. When the geographical proximity and karyotype are taken into consideration, it can be concluded that Turkish specimens with $2n = 60$, $FNa = 58$ are *Microtus schidlovskii*.

***Meriones tristrami* Thomas, 1892**

The specimen from Doğubeyazit has $2n = 72$, $FNa = 82$ and $FN = 84$. Autosomes consist of 12 meta/submetacentric chromosomes and 58 acrocentric chromosomes. The X is large acrocentric and the Y is small acrocentric (Table).

The karyotype of Iranian specimens is composed of $2n = 72$, $FNa = 78$ and $FN = 80$. There are 4 metacentric and 4 submetacentric chromosomes in the autosomal chromosome set. The others are acrocentric. Sexual chromosomes are both acrocentric and X is larger than Y (Table). Three different FN values for *M. tristrami* were formerly reported from Turkey: $FN = 76$ for *Meriones tristrami blackleri*, $FN = 78$ for *Meriones tristrami kilisensis* and $FN = 82$ for *Meriones tristrami lycaon* (Yiğit et al., 1998a; Yiğit and Çolak, 1998). These findings support the idea that there are variations in the chromosome arms in this geographical race of *M. tristrami*.

***Meriones vinogradovi* Heptner, 1931**

The karyotype of the specimen from Doğubeyazit (Coll. No. 4404) showed $2n = 44$, $FNa = 74$ and $FN = 77$. The autosomal complement is composed of 16 pairs of biarmed chromosomes (5 large, 8 varying in size from medium to small, and 3 small) and 5 pairs of acrocentric chromosomes varying in size from medium to small. The X chromosome is large and metacentric and the Y chromosome is small and acrocentric (Table). According to Matthey (1954), Nadler and Lay (1967) and Vorontsov and Korobitsina (1970), this species has similar $2n = 44$

but different FN ($FN = 74$ and 78). Their findings are different from the FN of Turkish specimens, and support the idea that there is a chromosomal variation in the FN of this species.

***Meriones libycus* (Lichtenstein, 1823)**

The karyotype of specimens from Zanjan, Iran (Coll. No. 4381) has $2n = 44$, $FNa = 76$ and $FN = 80$. The karyotype consists of 7 large, 7 middle-sized and 3 small pairs of metacentric or submetacentric autosomes, 4 pairs of acrocentric autosomes, a large metacentric X chromosome and a relatively small acrocentric Y chromosome (Table). Matthey (1957) and Qumsiyeh et al. (1986) stated that FN is 74 in Iranian and Jordanian specimens. Benazzou et al. (1982) also reported $2n = 44$ for Iranian specimens with different FN. These findings supported the idea that there are karyological variations in the chromosomal arms of this species.

***Apodemus iconicus* (Heptner, 1948)**

Based on the criteria given by Filippucci et al. (1996) and Kryštufek (2002), the specimen was assigned to *A. iconicus*. The diploid number of chromosomes is $2n = 48$, $FNa = 46$ and $FN = 48$. The karyotype is composed of 46 acrocentric chromosomes in *A. iconicus* from Zanjan, Iran. The X and Y chromosomes are acrocentric. The X chromosome is larger than the Y chromosome (Table). The karyological values of Iranian specimens are consistent with Turkish specimens (Çolak, 2003).

***Mus domesticus* (Rutty, 1772)**

According to Orsini et al. (1983), Auffray et al. (1990) and Cucchi et al. (2005), ZI value is a distinguishing characteristic among *Mus* species. ZI (0.25 to 0.46) and $T \times 100 / HB$ (0.73 to 1.0) were reported in the northwest population of *Mus domesticus* in Turkey (Gözcüoğlu et al., 2005). The *Mus* specimens from Doğubeyazit and Zanjan were assigned to *M. domesticus* by means of the values of ZI and T / HB . The karyotypes of *M. domesticus* from Doğubeyazit and Zanjan are $2n = 40$, $FNa = 38$ and $FN = 40$. The chromosomal set has 20 pairs of acrocentric chromosomes. The Y chromosome is smaller than the X chromosome (Table).

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