

**ADDITIONAL KARYOLOGICAL DATA ON GOITERED GAZELLE,
GAZELLA SUBGUTTUROSA, FROM TURKEY**

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Abstract — The chromosomes of goitered gazelle, *Gazella subgutturosa*, in Turkey were karyotyped on the basis of two female specimens. Both specimens have $2n = 30$ with $NF = 60$ and $NFa = 56$. All chromosomes are biarmed. The two female specimens of Turkish *G. subgutturosa* have a smaller diploid chromosome number compared to those of two males previously reported. This chromosomal variation in Turkish *G. subgutturosa* may be important for its conservation biology.

Key words: *Gazella subgutturosa*, female karyotype, Turkey

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Karyological studies treating the number and morphology of chromosomes in mammals have exerted great influence on biological research for the last 50 years (Zima and Kral, 1984a, 1984b, 1984c; Zima, 2000; O'Brien et al., 2006). Mammals with eukaryotic chromosomes have chromosomes varying in size, shape, and number (as NF, NFa, 2n) (Zima and Kral, 1984a, 1984b, 1984c; Schubert, 2007). The diploid chromosome number (2n) in mammals varies between 6 and 102 (O'Brien et al., 2006).

Analyses of the karyotype of goitered gazelle, *G. subgutturosa*, have revealed considerable intraspecific differentiation in the chromosome number and at least four different karyotypes. The chromosome number in this species ranges from $2n = 30$ to $2n = 33$. The fundamental number (NF) of chromosomal arms recorded is nearly the same for all populations of goitered gazelle studied in different areas (Zima and Kral, 1984; Granjon et al., 1991; Vassart et al., 1993; Kingswood and Blank, 1996; Tez et al., 2005; O'Brien et al., 2006).

Of the 10 gazelle species, Turkey currently has only one species of the genus *Gazella*, which is widely distributed in the Middle East: *Gazella subgutturosa* (Wilson and Reeder, 2005). Detailed data

on the distribution of *G. subgutturosa* in Turkey were reported by Kasperek (1986). The distribution of Turkish *G. subgutturosa* is restricted to an area of captive-breeding for protection in Ceylanpınar-Şanlı Urfa, which is in the Anatolian part of Turkey. However, the goitered gazelles in Ceylanpınar-Şanlı Urfa have also been implanted in their natural habitats elsewhere in Turkey of late (Anonymous, 2007).

The karyotype of Turkish *G. subgutturosa* has to date been reported only on the basis of two male specimens (Tez et al., 2005). No data on the karyotype of females of this species in Turkey have been available until now.

In this study, we report the karyotype of two *G. subgutturosa* females, currently undescribed in Turkey. Additionally, the paper will also contribute to knowledge of the chromosomal evolution of this species.

Metaphase chromosomes were prepared from peripheral blood samples of two female specimens at Beştepel Zoo (Kayseri) originating from the Ceylanpınar captive-breeding station (Şanlı Urfa). Peripheral blood samples from these animals were



Fig. 1. Metaphase plate of *G. subgutturosa* from Turkey (Female, $2n = 30$).

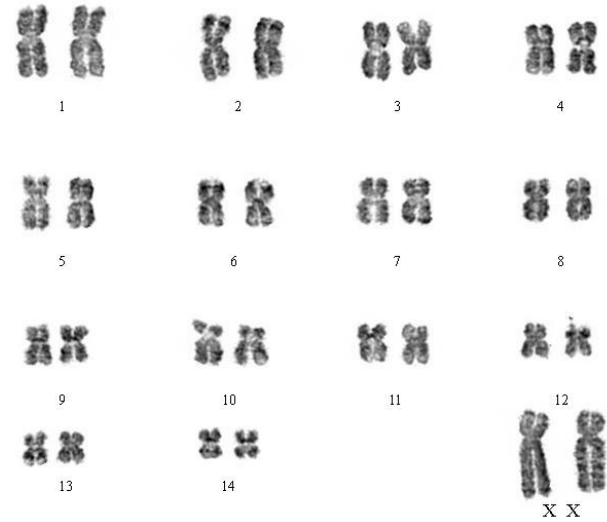


Fig. 2. Karyotype of *G. subgutturosa* from Turkey (Female, $2n = 30$).

taken aseptically and placed in heparinized tubes by the zoo veterinarian. *In vitro* cultures of blood lymphocytes and chromosome preparations were made according to the technique of Rooney and

Czepulkowski (1986). During this study, a minimum of 20 metaphase plates were analyzed from each sample. The slides with chromosomes were deposited at the Department of Biology of Erciyes

Table 1. Some karyological data pertaining to male and female individuals of *G. subgutturosa*.

Localities	2n	NF	NFa	X	Y	Y ₁	Y ₂	m/sm	m	sm	st	a	References
*Zoo	31	-	56	sm	-	a	a	-	-	-	-	-	See Zima and Kral (1984)
*Zoo	30	-	56	sm	-	-	-	-	-	-	-	-	See Zima and Kral (1984)
Mongolia	30	-	-	sm	bi-armed	-	-	-	18	10	-	-	See Zima and Kral (1984)
Saudi Arabia	33	-	-	sm	-	a	a	26	-	-	-	4	Granjon et al. (1991)
Saudi Arabia	32	-	-	sm	-	-	-	26	-	-	-	4	Granjon et al. (1991)
Saudi Arabia	31	-	-	sm	-	-	-	27				2	Granjon et al. (1991)
Center for Reproduction of Endangered Species (CRES) Zoological Society of San Diego (unpublished)	Females: 30-32 Males: 31-33												O'Brien et al. (2006)
Turkey	31	60	56	sm	-	a	a	28	-	-	-	-	Tez et al. (2005)
Turkey	30	60	56	sm	-	-	-	28	-	-	-	-	present study

University in Kayseri, Turkey.

The two female specimens of *G. subgutturosa* were found to have 30 chromosomes, and all chromosomes were biarmed. In both specimens, the fundamental number (NF) of chromosome arms was the same, NF = 60. The autosomal sets consisted of meta-submetacentric chromosomes. The X chromosome of Turkish *G. subgutturosa* females was a large submetacentric (Figs. 1, 2). The X chromosomes were identified according to Granjon et al. (1991) and Kingswood and Blank (1996).

The number or size of sex chromosomes in mammalian species can vary among or within species. These chromosomes can be the smallest or the largest chromosomes in metaphase chromosomes. This commonly arises from fusions and/or translocations. There are several theories to explain chromosomal rearrangements, which occur in both males and females. These chromosome rearrangements can play a major role in sterility and fertility (Pathak and Stock, 1974; see Ashley, 2002; King, 1993). Furthermore, chromosomal studies are an important tool in attempting to explain chromosomal evolution and speciation, as well as in determining chromosomal races or species. Chromosomal rearrangements (such as Robertsonian fusion and fission, tandem fusion, translocations, etc.) are a relevant source of information about chromosomal evolution and speciation. Several mammalian taxa have been studied in this regard, including *Spalax ehrenbergi*, *Sorex araneus*, and *Mus musculus domesticus* (King, 1993).

Karyotypes of the goitered gazelle *G. subgutturosa* have been published by various authors, and they reported the occurrence of chromosomal variations (such as 2n, NF, NFa, chromosome morphology) for this species. These variations have also been reported in other genera (Zima and Kral, 1984a, 1984b, 1984c; Granjon et al., 1991; Vassart et al., 1993; Kingswood and Blank, 1996; Ashley, 2002; Tez et al., 2005; O'Brien et al., 2006). Chromosome analysis indicates that there are two different karyotypes in Turkish goitered gazelle (Table 1). The results obtained by Tez et al. (2005) and the present study indicate that there is cytogenetic variation between

males and females of Turkish goitered gazelle. The two examined females of Turkish *G. subgutturosa* have a smaller diploid number than in the two males previously reported by Tez et al. (2005) (Figs. 1, 2; Table 1). The chromosomal variation determined between males and females of Turkish goitered gazelle, *G. subgutturosa*, may provide significant information for conservation of goitered gazelle in spite of the small size of the population.

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КАРИОЛОШКИ ПОДАЦИ КОД *GAZELLA SUBGUTTUROSA* ИЗ ТУРСКЕ

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Хромозоми врсте *Gazella subgutturosa* из Турске су кариотипизовани на основу анализе две женке. Оба примерка поседују $2n = 30$ са $NF = 60$ и $Nfa = 56$. Сви хромозоми су са по две ручице. Две анализиране женке турске *G. subgutturosa*

имају мањи диплоидни број хромозома у поређењу са два претходно проучена мужјака. Овај хромозомски варијабилитет код *G. subgutturosa* из Турске може бити од посебног значаја при утврђивању биологије њене заштите.