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Short communication

G-, C-, and NOR-stained karyotype of the Eversmann's hamster *Allocricetulus eversmanni* and comparison with the karyotype of *Cricetulus* species (Rodentia: Cricetinae)

Irina V. Kartavtseva[1,*] and Aleksey V. Surov[2]

[1] *Institute of Biology and Soil Science, Far East Branch of Russian Academy of Sciences, Vladivostok, Russia, 690022*
[2] *A. N. Severtsov Institute of Ecology and Evolution, Moscow, Russia, 119071*

Differential chromosomal stainings for various species belonging to genera in the tribe Cricetini of the Eurasian Cricetinae including *Cricetus, Cricetulus, Tscherskia, Phodopus,* and *Mesocricetus* are available (Gamperl et al. 1978; Kartavtseva et al. 1979; Popescu and DiPaolo 1980; Kral et al. 1984). Hitherto, however, no differential chromosomes stainings for species in the genus *Allocricetulus* have been described and the phylogenetic position of this genus in the Cricetini, based on chromosomal data, has not been determined.

The Eversmann's hamster *Allocricetus eversmanni* Brandt, 1859 occurs in dry steppes and semi-deserts between the Volga and Ural rivers in Russia and in Kazakhstan, and includes three subspecies. The karyotype of *A. eversmanni* (2n = 26) was first described by Matthey (1960) from Kazakhstan, then subsequently those for subspecies, *A. e. eversmanni* and *A. e. beljaevi* (2n = 26, NF = 40: 8M + 10T + 6ST, X – SM, Y – SM) and *A. e. pseudocurtatus* (2n = 26; NF = 38: 8M + 12T + 4ST, X – M/SM, Y – SM/ST) were described. Kartavtseva and Vorontsov (1992) found distinctions in the morphology of one pair of large autosomes, pair no. 5, and in the size and morphology of the Y-chromosome and have suggested that the difference in the chromosome pair no. 5 appeared in *A. e. pseudocurtatus*.

One female *A. e. eversmanni* was captured in the vicinity of Djakovka Village, Saratov Region, near the Lower Volga River, Russia. Chromosome preparations were obtained from bone marrow cells. After colcemid-treatment and hypotonic treatment with KCl-solution, the cells were fixed with acetic-methanol (1 : 3) and air or flame-dried. We arranged the chromosomes as described previously by Kartavtseva and Vorontsov (1992). The procedure of tripsin treatment was used for G-banding (Seabright 1971). The distribution of heterochromatin in chromosomes was shown using Sumner's (1972) modified C-banding technique. The locations of nucleolar organizer regions (NORs) of metaphase chromosomes were determined after 50% aqueous $AgNO_3$ treatment for 12 hours at 50–60°C (Bloom and Goodpasture 1976).

The karyotype consisted of 24 autosomes (2n = 26, NF = 40): four pairs of metacentrics (M) and submetacentrics (SM): one pair large, one pair medium and two pairs small, two pairs of large subtelocentrics (ST) and six pairs of acrocentrics (A), ranging from medium-sized to small. The X chromosome was a medium sized submetacentric (Fig. 1).

Differential G-staining made it possible to define the homologues in the karyotype (Fig. 1a). The short arm of the large subtelocentric no. 5 had no clear bands, while the short arm of the large subtelocentric no. 6 had a clear band in the pericentromeric region. The least acrocentrics nos. 11 and 12 had no clear bands.

The C-staining of chromosomes obtained a low amount of heterochromatin in *A. e. eversmanni* in biarmed chromosomes nos. 1, 2, 5, 6, and acrocentric no. 7 had no positive band. The two pairs of small metacentrics nos. 3, 4 and small acrocentrics nos. 8–12 had heterochromatin in pericentromeric areas. The X chromosome carried one dark C-block in the pericentromeric region of the short arm (Fig. 1b).

NORs were ascertained in five pairs of chromosomes. In pairs 2, 4, and 5 of biarmed chromosomes, the NORs were found at the telomeric ends (pair 5 had NORs in short arms). In the acrocentric pairs 8 and 10, very small NORs were observed at the centromeric positions (Fig. 1c).

Earlier we assumed that distinction among *A. e. eversmanni, A. e. beljaevi* and *A. e. pseudocurtatus* based on the occurrence of deletion in the short arm of

*To whom correspondence should be addressed. E-mail: Irina-Kar52@rambler.ru

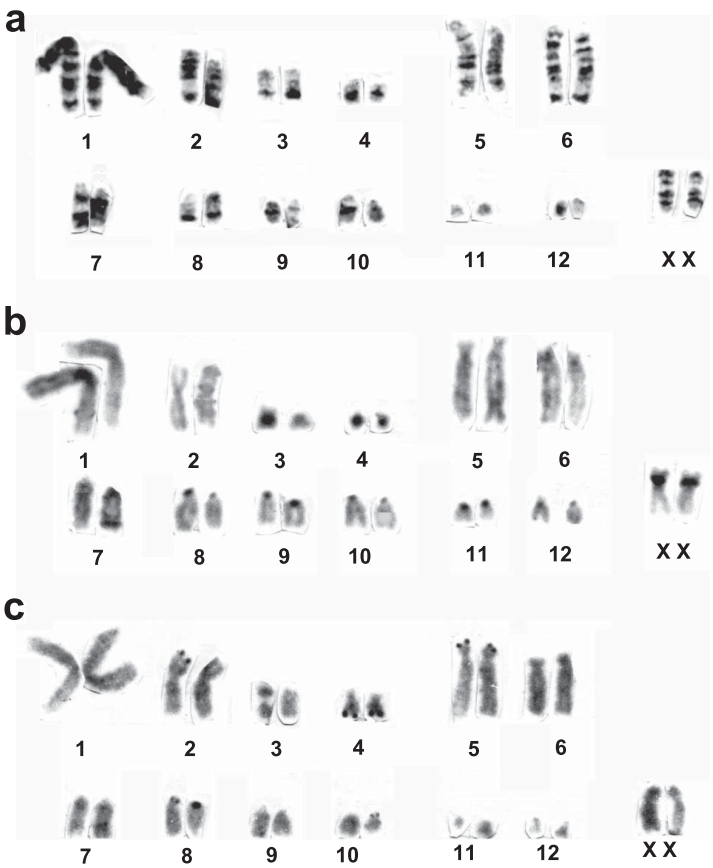

Fig. 1. Differentially stained karyotypes of *A. e. eversmanni:* G-band (a), C-band (b), and NOR-band (c).

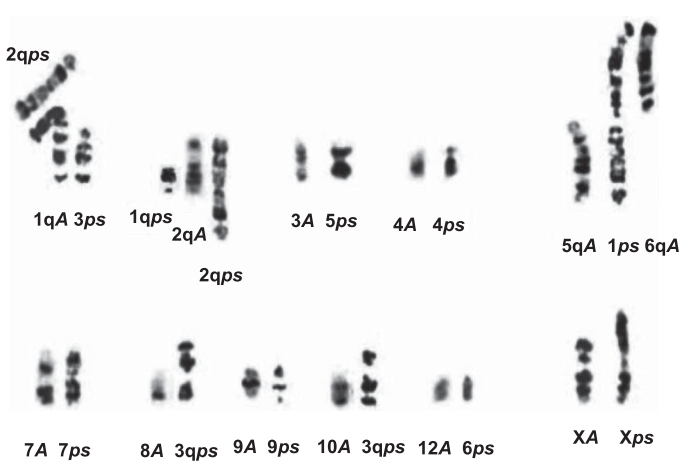

Fig. 2. Comparison of G-banded chromosomes in two species of *Allocricetulus eversmanni* (*A*) and *Cricetulus pseudogriseus* (*ps*) (from Kral et al. 1984).

the subtelocentric chromosome no. 6, required a quantitative change in heterochromatin. Our present research has shown clearly that the short arm of chromosome no. 6 consisted of euchromatin. Therefore we admit that the euchromatin material of this chromosome is not deleted and is displaced to another chromosome region.

We compared the differentially stained chromosomes of *A. eversmanni* with the published data of G- and NOR-stained chromosomes of *Cricetulus pseudogriseus* (2n = 24: 12M + 10T/ST + X – M, Y – SM), *C. griseus* (2n = 22: 14M + 6T/ST + X – M, Y – SM) and *C. barabensis* (2n = 20: 16M/SM + 2T/ST + X – ST, Y – SM)

Table 1. Homologous chromosome regions in *Allocricetulus eversmanni* and *Cricetulus pseudogriseus* inferred from their G-banding patterns.

Chromosome			Ancestral state in hypothetical ancestor**
A. eversmanni		*C. pseudogriseus**	
1	p	2p	1 T/ST
	q	8	2 T/ST
2	p	10	3 T/ST
	q	2q	4 T/ST
3		5	5 M
4		4	6 M
5	p	—	7 T/ST
	q	1q	8 T/ST
6	p	—	9 T/ST
	q	1p	10 T/ST
7		7	11 T/ST
8		3p	12 T/ST
9		9	13 T/ST
10		3q	14 T/ST
11		11?	15 T/ST
12		6	16 T/ST
X		Xq	X

'—': no corresponding chromosome arm is seen.
?: there is some ambiguity in the comparison of chromosome 11.
* Kral et al. (1984).
** Number of pairs and morphology of chromosomes.

(Kral et al. 1984). The G-banded chromosomes of *A. e. eversmanni* had the greatest similarity with *C. pseudogriseus* (Fig. 2, Table 1). The long arms of the two large subtelocentrics (nos. 5q and 6q) of *A. e. eversmanni* were similar to the long and short arms of metacentric no. 1 of *C. pseudogriseus*. We also found a similarity between the automosome pairs of *A. e. eversmanni,* nos. 1, 2, 3, 4, 7, 8, 9, 10, 12 and the X chromosome with corresponding chromosomes or chromosomal arms of *C. pseudogriseus* (Table 1). The comparison of NOR-stained chromosomes of *A. eversmanni* and *Cricetulus* species has not revealed a similarity of localization of blocks on all NOR-carrying chromosomes.

The two genera, *Allocricetulus* and *Cricetulus*, show considerable similarity in the G-banding patterns of the majority of their chromosome arms, but exhibit different combinations of telocentric chromosomes for biarmed chromosomes. This implies that these karyotypes have emerged independently from a common ancestoral karyotype (2n = 34: 2M + 14T/ST + X – M) through chromosomal fusion (Table 1). A similar form of chromosomal reorganization has previously been described for the genera *Cricetus* and *Cricetulus* (Gamperl et al. 1976, 1978).

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