

MICROTUS TATRICUS (KRATOCHVIL, 1952) IN THE EASTERN CARPATHIANS: CYTOGENETIC EVIDENCE

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A b s t r a c t

The chromosome set of a female of the pine vole captured in the Mt. Goverla region in the Eastern Carpathians is described. The karyotype contains 32 chromosomes including 14 biarmed and 18 acrocentric elements. The comparison of this set with karyotypes of the Tatra pine voles from the Western Carpathians has proved their apparent similarity. This is the first cytogenetic evidence of the occurrence of *Microtus tatricus* (K r a t o c h v i l , 1952) in the Eastern Carpathians. The distribution range and phylogenetic origin of the species are discussed.

Introduction

The mountain range of the Carpathians can be divided lengthwise into the Western, Eastern, and Southern part. Most of the Western Carpathians lie in the territory of Czechoslovakia and their northern edge extends to Poland. The boundary between the Western and Eastern Carpathians lies in the Kurovské sedlo Col (Przelecz Tylicka in Polish) at the border between Czechoslovakia and Poland. The Eastern Carpathians thus extend from the eastern part of Slovakia over southwestern Ukraine to Rumania. The Predeal Pass in Rumania separates the Eastern and Southern Carpathians. The main ridge of the Southern Carpathians is then directed to the Iron Gate upon the Danube River. Only two endemic vertebrate species occur in this large mountain complex, *i.e.*, the newt *Triturus montadoni*, and the pine vole, *Microtus tatricus*.

The Tatra pine vole, *Microtus tatricus*, was described by K r a t o c h v i l in 1952 according to specimens collected in the Velká Studená dolina Valley in the High Tatras, the highest part of the Western Carpathians. The occurrence of the species in the Polish part of the Tatras was reported by K o w a l s k i (1960). K r a t o c h v i l (1970) provided a redescription and systematic revision of *Microtus tatricus*, and in his conclusions he considered this species endemic to the Tatras. In his opinion, *Microtus tatricus* lived only in habitats lying at higher elevations of the Western Carpathians, *i.e.* in the High, Western and Low Tatras. Nevertheless, the species also occurs in other mountain ranges belonging to the Western Carpathians in Poland (H a i t l i n g e r 1970, 1981) as well as in Slovakia (D u d i c h & al. 1981, K o v á č i k & Š t o l l m a n n 1984, O b u c h & al. 1985). Populations of *Microtus tatricus* are often isolated from

each other in this region. *Microtus tatricus* was thus considered a Western Carpathians' endemic species, and a Pleistocene relict of this mountain range (D u d i c h & al. 1981). The first findings of *Microtus tatricus* in the Eastern Carpathians have been those of F l o u s e k & al. (1985) reporting its occurrence in the Rodnei Mts. in North-Western Rumania, and Z a g o r o d n y u k (1988, 1989) in the Ukrainian part of the Carpathians. The determination of the voles reported in these new findings was based solely on morphological characters. Z a g o r o d n y u k (1989) separated the Eastern Carpathian populations as a new subspecies, *Microtus tatricus zykovi*. This subspecies differs from the nominate one especially by smaller body and skull dimensions. Both subspecies of *Microtus tatricus* are obviously allopatric.

Karyotypic studies confirmed the separated position of *Microtus tatricus* among other European pine vole species, often included in a separate genus *Pitymys* or *Terricola*. The diploid number of 32 chromosomes is unique among these species, and substantially different from any known European form belonging to this group. Data on the karyotype have so far been derived from studies based on specimens collected in the terra typica in the High Tatras (M a t t h e y 1964), and in the neighbouring Western Tatras (K r a l 1972). The karyotypic status of the other geographically isolated and morphologically different populations has so far remained unknown. In this paper, the karyotype of *Microtus tatricus* from the Eastern Carpathians is described, and the results are compared with chromosomal data obtained in specimens from the Western Carpathians collected in region situated outside the High and Western Tatras.

Material and Methods

S p e c i m e n s e x a m i n e d : 1 female, Breskul (24° 20' E; 48° 20' N; 1060 m above sea level) (terra typica of *M. t. zykovi*) western slopes of Mt. Goverla, Chernagora Massif, Rachov District, Ukraine; 1 male, Krcahovo (19° 40' E, 48° 58' N; 1 300 m above sea level), northern slopes of Mt. Dumbier, Low Tatras, Czechoslovakia; 1 female, Skalni vrata (20° 18' E, 49° 12' N, 1 600 m above sea level), dolina Siedmich prameňov Valley, Belianske Tatras, Czechoslovakia.

The direct treatment of the bone marrow cells was used for karyotype analysis, followed by air-drying of slides and staining in Giemsa. The animals and microscopic slides examined are deposited in the collections of the Zoological Institute (Kiev) and the Institute of Systematic and Ecological Biology (Brno).

Results and Discussion

The karyotype of a female collected in the Eastern Carpathians contains 32 chromosomes, including 14 biarmed (meta- and submetacentric) and 18 acrocentric elements. The same karyotype has been ascertained in a female from the Belianské Tatra Mts. and in a male from the Low Tatra Mts. A medium-sized acrocentric chromosome is identified as the X, and a small subtelocentric chromosome as the Y in the complement of the male from the Low Tatras. All these findings are very similar to the former results of M a t t h e y (1964) and K r a l (1972). There is a slight difference concerning the centromere position in the Y chromosome. K r a l (1972) described

this sex chromosome as the smallest acrocentric in complements of specimens collected in the Western Tatra Mts. The Y chromosome of the male from the Low Tatra Mts. has distinct short arms and it is clearly larger in comparison with the Y described in the Western Tatra males. Furthermore, the relative size difference between two largest banded autosomal pairs seems to be greater in a male from the Low Tatra Mts. than in karyotypes of specimens examined in the other populations, both in the Western and in Eastern Carpathians. The present karyological investigation thus confirms the general stability of the basic karyotype characteristics of *Microtus tatricus* in different geographically isolated populations, and the pertinence of the populations from the Eastern Carpathians to this species. The slight intraspecific karyotype variability mentioned should be reevaluated in chromosome banding studies. Karyotypes of the specimens studied are shown in Pl. I.

The karyological evidence of the presence of *Microtus tatricus* in the Eastern Carpathians permits a new notion of its geographical distribution and phylogenetic history. *Microtus tatricus* may be considered a Carpathian endemic species showing insular distribution over the entire north-western part of the mountain range. The evidence of the occurrence in the Southern Carpathians is missing for the present. Anyway, the Southern Carpathians reach locally up to elevations of about 2 500 m above sea level, and the possibility of the occurrence of *Microtus tatricus* could not be excluded there. According to D u d i c h & al. (1981), this species inhabits preferably the zone of natural spruce forests in the Western Carpathians. It seems probable that the distribution range in the Eastern Carpathians in Ukraine and Romania corresponds to this original landscape type. This may indicate possible occurrence sites also in various mountain ranges belonging to the Southern Carpathians in Rumania. It is possible, however that *Microtus tatricus* might prefer slightly different habitats in the southern parts of the mountains.

According to K r a t o c h v í l (1970), the evolutionary origin of *Microtus tatricus* can be looked for in populations having survived the cold period of the Pleistocene in protected localities in the Western Carpathians. It does not seem probable, that the northern parts of the Carpathian mountain range, covered by local glaciers, could create suitable conditions for the survival of populations of small mammals during periods of glaciation. A more satisfactory explanation may be presented by a hypothesis suggesting an ancestral wide-spread form occurring in forest tundra and/or dispersed coniferous taiga habitats surrounding the Carpathians in the Pleistocene period. The recent *Microtus tatricus* populations may represent the remnants of this wide-spread form that retreated to the mountains after the end of the Ice Age. The phyletic divergence of *Microtus tatricus* from this hypothetic ancestor could be very rapid owing to changed environmental conditions and the mosaic distribution of small and isolated populations. This assumption is supported by the fact that the oldest known fossil findings of *Microtus tatricus* date back to the Lower Holocene (D u d i c h & al. 1981), and that it is missing from the paleontological records in older layers. Morphological features by which *Microtus tatricus* resembles other Euro-

pean pine vole species may evolve in a parallel or convergent way. This is supported by the isolated character of karyotype morphology in *Microtus tatricus*. The ancestral form of *Microtus tatricus* may be thus looked for among representatives of the genus *Microtus* sensu lato, distributed over the Central and Eastern Europe during the last glaciation, and having withdrawn back to the North in the postglacial period.

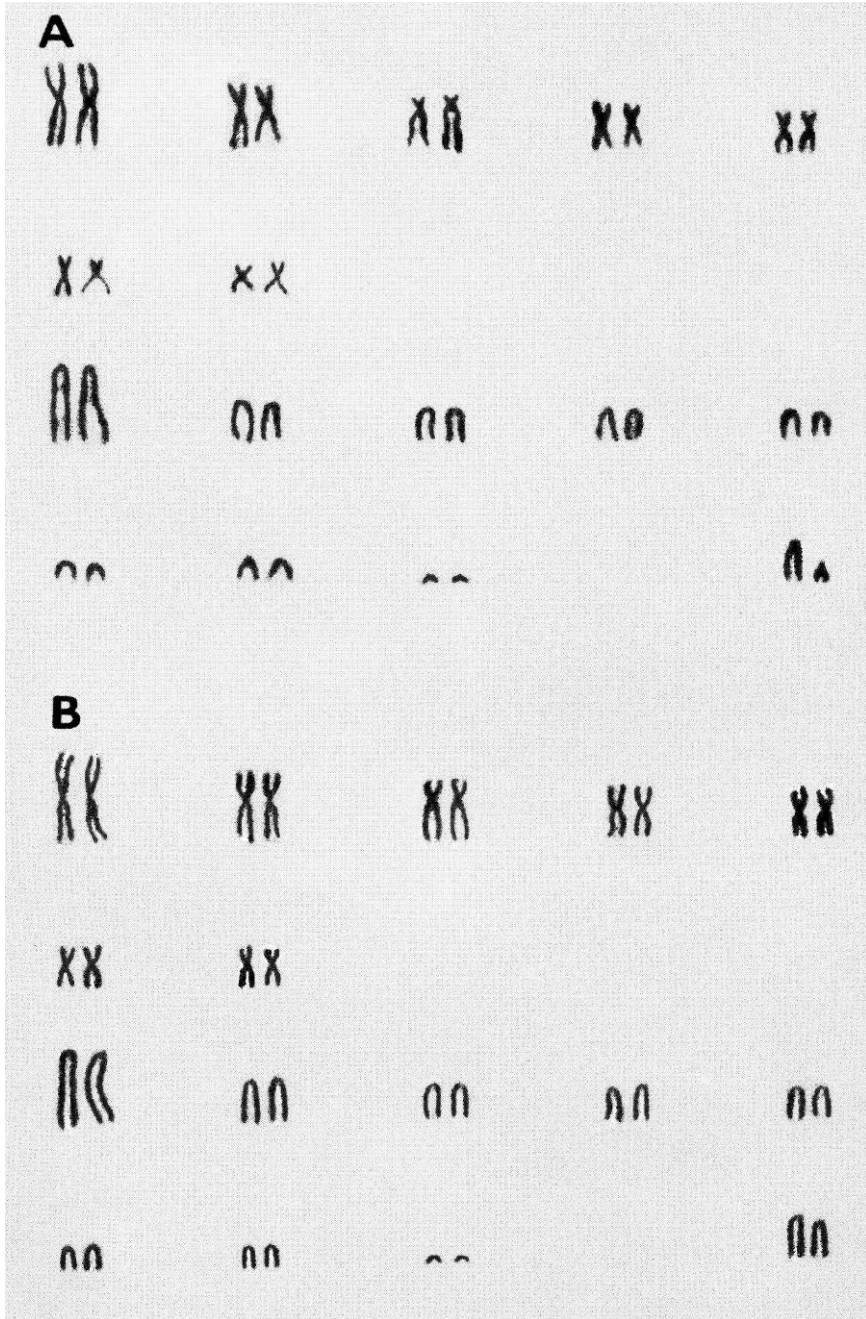
LITERATURE

- DUDICH, A., KOVACIK, J., STOLLMANN, A., OBUCH, J., 1981: Dalsie poznatky o rozšírení *Sicista betulina* Pallas, 1779 a *Pitymys tatricus* Kratochvíl, 1952 (Mammalia, Rodentia) Západných Karpatoch [Further knowledge concerning distribution of *Sicista betulina* Pallas, 1779, and *Pitymys tatricus* Kratochvíl, 1952 (Mammalia, Rodentia) in the West Carpathians]. *Biologia* (Bratislava), 36: 659—688 (in Slovak, with a summary in English).
- FLOUSEK, J., FLOUSKOVA, Z., TOMASOVA, K., 1985: To the knowledge of small mammals (Insectivora, Rodentia) in the Rodnei Mts. (Rumania). *Vest, čs. Společ. zool.*, 49: 6—17.
- HAITLINGER, R., 1970: *Pitymys* Me. Murtrie, 1831 from the Beskyd Ziwiecki and the Sudetes. *Acta Theriol.*, 15: 365—370.
- HAITLINGER, R., 1981: *Pitymys tatricus* Kratochvíl, 1952, w Polsce [*Pitymys tatricus* Kratochvíl, 1952 in Poland]. *Prz. Zool.*, 25: 405—408 (in Polish, with a summary in English).
- KOVÁČIK, J. & ŠTOLLMANN, A., 1984: Vyskyt hrabaca tatranskeho, *Pitymys tatricus* Kratochvíl, 1952 na Muranskej planine potvrdený [Occurrence of Tatra pine vole, *Pitymys tatricus* Kratochvíl, 1952 in Muranska planina]. *Lynx* (Praha), n.s., 22: 89 (in Slovak, with a summary in English).
- KOWALSKI, K., 1960: *Pitymys* Me. Murtrie 1831 (Microtidae, Rodentia) in the Northern Carpathians. *Acta Theriol.* 6: 81—91.
- KRAL, B., 1972: Chromosome characteristics of Muridae and Microtidae from Czechoslovakia. *Acta Sc. Nat. Brno*, 6(12): 1—78.
- KRATOCHVIL, J., 1952: Hraboší rodu *Pitymys* Me. Murtrie v Československu [The voles of the genus *Pitymys* in the ČSR], *Práce Moravskoslezské Akademie věd přírodních*, 24: 155—194 (in Czech, with a summary in English).
- KRATOCHVIL, J., 1970: *Pitymys*-Arten aus der Hohen Tatra (Mamm., Rodentia). *Acta Sc. Nat. Brno*, 4(12): 1—63.
- MATTHEY, R., 1964: La formule chromosomique et la position systématique de *Pitymys tatricus* Kratochvil (Rodentia, Microtinae). *Z. Säugeierkunde*, 29: 235—242.
- OBUCH, J. & al., 1985: Príspevok k inventarizačnému prieskumu stavovcov (Vertebrata) štátnej prírodnej rezervácie Suchý v Chránenej krajinej oblasti Mala Fatra [Contribution to the inventory research of vertebrates (Vertebrata) in the State Nature Reserve Suchý in the protected territory Mala Fatra], *Ochrana prírody*, 6: 215—224 (in Slovak, with a summary in English).
- ZAGORODNYUK, I. V., 1988: *Pitymys tatricus* (Rodentia) — noviy vid v faune SSSR [*Pitymys tatricus* (Rodentia) — a new species in the fauna of the USSR], *Vestnik Zool.*, 1988 (3): 54 (in Russian, with a summary in English).
- ZAGORODNYUK, I. V., 1989: Taksonomiya, rasprostraneniye i morfologicheskaya izmenchivost polevok roda *Terricola* Vostochnoy Evropy [Taxonomy, distribution, and morphological variation in the *Terricola* voles in Eastern Europe]. *Vestnik Zool.*, 1989 (5): 3—14 (in Russian, with a summary in English).

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Pl. I. A, karyotype of a male from Krčahovo, W. Carpathians; B, karyotype of a female, Breskul, E. Carpathians.