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New data on the geographic distribution of chromosome races of *Sorex araneus* (Soricidae, Eulipotyphla) in European Russia

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ABSTRACT. New information is presented on the distributional ranges of the West Dvina, Moscow, Neroosa, Serov, Sok and Yuryuzan chromosome races in European Russia. Our study provides chromosome data on 67 common shrews from 28 localities in various parts of the East European Plain and foothills of the Ural Mountains. No new chromosome races were discovered but our data added substantially to the known geographic range of the Serov race both north- and southwards from the Asian slopes of the Ural Ridge where it was first described. This race also extends into northern Europe far to the west of the Ural Ridge. The known distribution of the Neroosa race has also been considerably extended. These data allow us to predict locations for contact zones between the following pairs of races: West Dvina – Moscow, Moscow – Neroosa, Sok – Serov.

KEY WORDS: common shrew, chromosome race, contact zone, geographic range, *Sorex araneus*.

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Новые данные о географическом распространении хромосомных рас обыкновенной бурозубки (Soricidae, Eulipotyphla) в Европейской России

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РЕЗЮМЕ. Получены новые данные о распространении хромосомных рас Западная Двина, Москва, Нерусса, Серов, Сок и Юрюзань в Европейской России. Представлены хромосомные характеристики 67 обыкновенных бурозубок из 28 мест в разных частях Восточно-Европейской равнины и предгорий Урала. Новые хромосомные расы не обнаружены, вместе с тем наши данные дополняют существенно сведения об ареале расы Серов, как на юг, так и к северу от азиатского склона Урала, где она была впервые описана (Polyakov *et al.*, 2000). Показано распространение этой расы на европейском севере России далеко к западу от Уральских гор. Ареал расы Нерусса также значительно расширен. Новые данные по хромосомным российским расам обыкновенной бурозубки позволяют предсказывать расположение межрасовых зон контакта. Намечены, в частности, зоны контакта между следующими парами рас: Западная Двина – Москва, Москва – Нерусса, Сок – Серов.

КЛЮЧЕВЫЕ СЛОВА: обыкновенная бурозубка, хромосомные расы, зоны контакта, географическое распространение, *Sorex araneus*.

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Introduction

The most recent list of chromosome races of the common shrew *Sorex araneus* includes 13 races from European Russia (Wójcik *et al.*, 2003), the majority of which were discovered in the last 10 years or so (Orlov *et al.*, 1996; Bulatova *et al.*, 2000; Kozlovsky *et al.*, 2000; Bystrakova *et al.*, 2003). Now the focus is shifting to a search for the contacts between these races (Bystrakova *et al.*, 2003). The first description of a hybrid zone in European Russia is given in this volume (Bulatova *et al.*, 2007). Here we report distribution data on six previously described chromosome races and use these data to suggest locations for new contact zones. Some of these data were reported previously in Shchipanov *et al.* (2005) and Bystrakova *et al.* (2005), but this is the first time that any of this material has been presented in English.

Material and methods

Shrews were collected for chromosome studies during the field seasons of 2003–2005. Conventional preparations were obtained from bone marrow and spleen cell suspensions of colchicized animals. A standard trypsin G-banding technique was applied and the chromosome races were defined according to the rules of the International *Sorex araneus* Cytogenetics Committee, ISACC (Searle *et al.*, 1991).

Results and discussion

Tab. 1 and Fig. 1 present new chromosome data and we interpret these data on a race-by-race basis.

Moscow race. In addition to 11 localities previously reviewed in Bulatova *et al.* (2000), the typical karyotype of the Moscow race with five stable diagnostic

Table 1. Karyotype and location data for 67 common shrews from 28 localities in nine regions of European Russia (only diagnostic chromosomes indicated).

Region: Site	Coordinates	Number of specimens	2NA	Karyotype	Race	Ref.
Tver Province						
Toropets	N 56°45', E 31°30'	2	18	<i>gm, hk, ip, no, qr</i>	West Dvina	1
Konakovo	N 56°44', E 36°33'	4	18	<i>gm, hi, kr, no, pq</i>	Moscow	1
Moscow Province						
Antsiferovo	N 55°35', E 38°46'	2	18	<i>gm, hi, kr, no, pq</i>	Moscow	1
Ryazanovskiy	N 55°09', E 39°30'	4	18	<i>gm, hi, kr, no, pq</i>	Moscow	1
Ryazan Province						
Rybnoye	N 54°47', E 39°21'	2	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Starojilovo	N 54°12', E 39°55'	4	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Ryazan	N 54°33', E 40°08'	1	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Spassk	N 54°39', E 40°45'	11	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Shilovo	N 54°22', E 40°52'	7	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Putyatino	N 54°05', E 41°24'	3	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Voronezh Province						
Lisky	N 51°00', E 39°18'	2	18	<i>go, hi, kr, mn, pq</i>	Neroosa	2
Pavlovsk	N 50°29', E 40°02'	1	18	<i>go, hi, kr, mn, pq</i>	Neroosa	2
Rostov Province						
Belaya Kalitva	N 48°20', E 40°51'	1	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Volgograd Province						
Kletskiy	N 49°06', E 42°30'	1	18	<i>go, hi, kr, mn, pq</i>	Neroosa	1
Orenburg Province						
Kvarkeno	N 52°10', E 60°01'	1	18	<i>go, hn, ip, km, qr</i>	Serov	1
Bashkiria Republic						
Beloretsk, Southern Ural Nature Reserve	N 54°11', E 57°37'	1	19 (j/l)	<i>go, hn, ip, kr, mq</i>	Yuryuzan	1*
Komi Republic						
River Roptcha	N 63°00', E 52°19'	3	18	<i>go, hn, ip, kq, mr</i>	Sok	1

Table 1 (continued).

Region: Site	Coordinates	Number of specimens	2NA	Karyotype	Race	Ref.
Komi Republic						
Ust-Nem vic.	N 61°40', E 54°53'	1	18	<i>go, hn, ip, kq, mr</i>	Sok	1
Nem River (Vychegda River basin)	N 61°40', E 56°14'	2	18	<i>go, hn, ip, km, qr</i>	Serov	3
Ukhta vic.	N 63°14', E 54°21'	2	18	<i>go, hn, ip, km, qr</i>	Serov	3
Berezovka River (Kama River basin)	N 61°41', E 56°31'	2	18	<i>go, hn, ip, km, qr</i>	Serov	3
Volosnitsa River (Pechora River basin)	N 61°42', E 56°44'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3
Pechora River, Yaksha vic.	N 61°49', E 56°50'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3
Foothills, Pechora River	N 62°03', E 58°25'	4	18	<i>go, hn, ip, km, qr</i>	Serov	3
Ural Mts. (Pechora)	N 62°05', E 59°05'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3
Foothills, Ilych River	N 63°03', E 58°36'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3
Foothills, Ilych River	N 62°38', E 58°55'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3
Foothills, Ilych River	N 62°28', E 58°58'	1	18	<i>go, hn, ip, km, qr</i>	Serov	3

References: 1 — present study; 2 — Bystrakova *et al.*, 2005; 3 — Shchipanov *et al.*, 2005; * — data corrected from that published in Zima *et al.* (1996).

metacentrics (*gm, hi, kr, no, pq*) was detected in three new localities. These findings clarify the boundaries of the Moscow race (#7 in Fig. 1) along the Upper Volga and its right tributary the Oka and show, first, that it crosses the Volga to the north of the type locality, and second, that it occurs further to the south-east than described previously, where it comes very close to the Neroosa race (#6). While the contact between the Moscow and Neroosa races is unconfirmed, samples of the Moscow race to the north-west of its range have helped to define a hybrid zone between the Moscow and Seliger races (Bulatova *et al.*, 2007).

West Dvina race. This race with characteristic metacentrics *gm, hk, ip, no, qr* was previously described from only one locality (Bulatova *et al.*, 2002). Now we have found it in a new locality further north in the same Tver region (Tab. 1). These two localities are on opposite banks of the upper reaches of the West Dvina River in the Valdai Heights. It is notable that this race (#14 in Fig. 1) was found close to where the Moscow and Seliger races form a hybrid zone (near the type locality of the Seliger race #8; see Bulatova *et al.*, 2007). Thus, it is likely that the Moscow race (#7) forms a continuous hybrid zone with two other races, the West Dvina (#14) and the Seliger (#8), along its western edge.

Neroosa race. Here we describe 10 new localities of the Neroosa race (#6 in Fig. 1), all characterised by the fully metacentric complement *go, hi, kr, mn, pq*. We can now say with more confidence that this race forms the southern species boundary in the vicinity of the Lower Don at latitudes below 50° N. Our new findings in this southern area also extend the known range of the race eastwards to 42°30' E (Tab. 1; Fig. 1).

Additionally, we have clarified the distribution of the Neroosa race to the north. In the middle reaches of the Oka River (around longitude 40° E), the Moscow

(#7) and Neroosa (#6) races occur close to each other on the left bank of the river. They are separated by 50 km of marshland. Elsewhere, the Oka River appears to form the boundary between the Neroosa and Moscow races. Further studies are needed to determine whether there is a contact between the Neroosa race and the Mologa race (#9; *gm, hn, io, kr, pq*), to the north-east (N 56°20', E 41°25' — see Bulatova *et al.*, 2000).

Sok race. Two new findings reported here (Tab. 1) extend the known distribution of this race (*go, hn, ip, kq, mr*) further to the north with latitudes 61°40' N and 63°00' N in the very east of Europe (#11 in Fig. 1), close to the Serov race (#12).

Serov race. We provide substantial new data on the Serov race (*go, hn, ip, km, qr*). This race was first described on the Asian side of the Ural Ridge (Polyakov *et al.*, 2000) and we have now shown that it also occurs on the European side. We have also extended the known range of the race both to the north and the south. The Serov race is found near the southern species boundary in the Orenburg region, close to Kazakhstan (#12 in Fig. 1).

In total, findings of the latter two races, Sok (#11) and Serov (#12), reveal large ranges alongside the Ural Ridge extending from arctic conditions in the north down to desert conditions in the south. The Yuryuzan race (#10) appears to separate the two races in the south (Fig. 1). As is also clear from Fig. 1, there is very likely a hybrid zone between the Sok and Serov races in the north.

Yuryuzan race. An interesting finding relating to this race is the revision of the previously-described Bashkiria race (XX/XY₁Y₂, *af, bc, gm, ho, in, j/l, kp, qr, tu*) as the Yuryuzan race. The Bashkiria race was listed provisionally with other common shrew chromosome races by Zima *et al.* (1996, with reference to Gabitova,

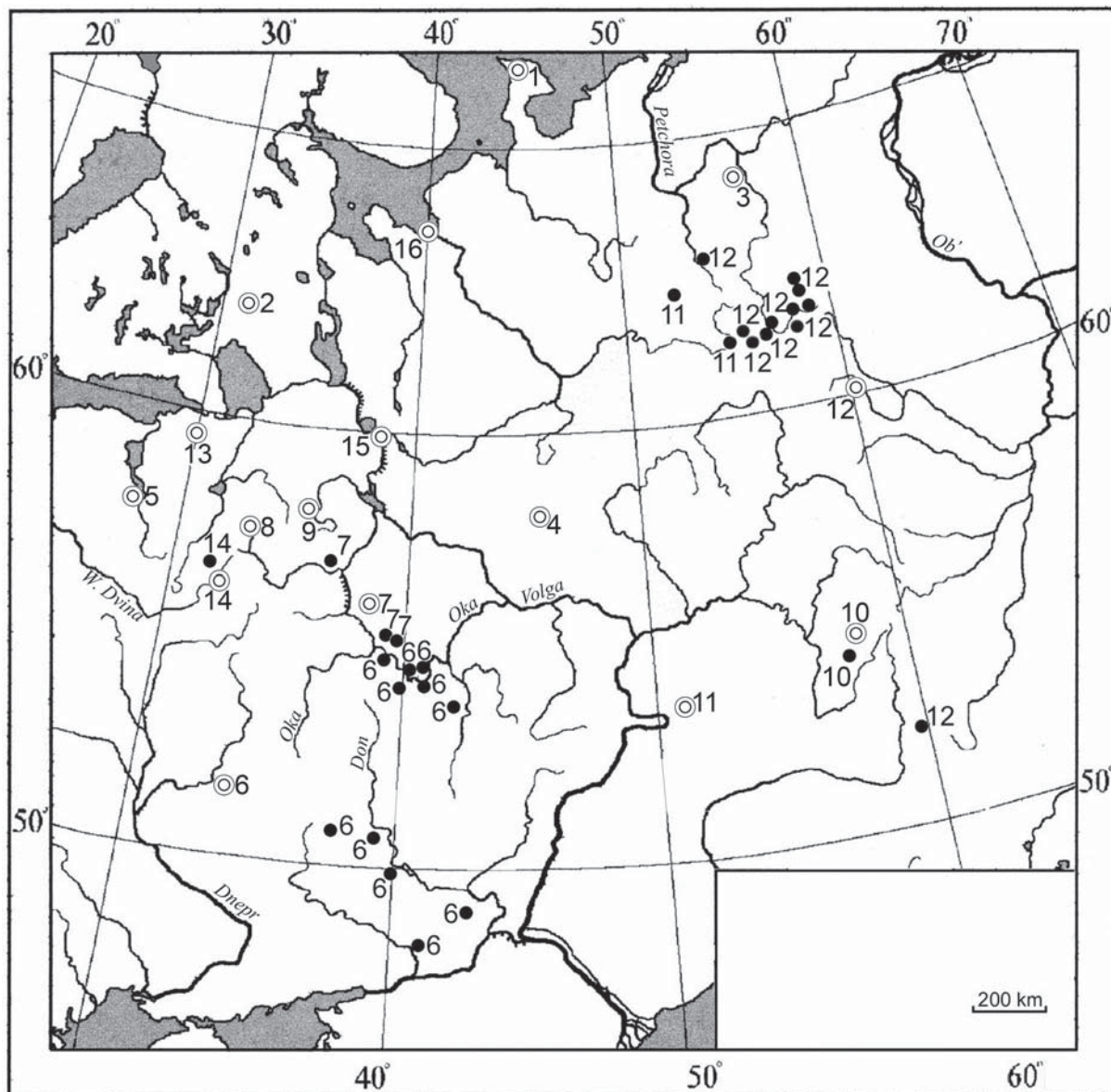


Figure 1. Map showing sampling localities for all 28 new samples from European Russia (black dots) and their racial designation (numbers). The type localities of all chromosome races known in the area are indicated (double circles) based on published sources (Bulatova *et al.* 2000, 2002; Polyakov *et al.*, 2000; Bystrakova *et al.*, 2005; Shchipanov *et al.*, 2005; Orlov *et al.*, 2007): 1 — Kanin, 2 — Ilomantsi, 3 — Pechora, 4 — Manturovo, 5 — Pskov, 6 — Neroosa, 7 — Moscow, 8 — Seliger, 9 — Mologa, 10 — Yuryuzan, 11 — Sok, 12 — Serov, 13 — St. Petersburg, 14 — West Dvina, 15 — Kirillov, 16 — Yagry.

1992 therein) but then removed from the most recent listing (Wójcik *et al.*, 2003) as not proved because of the absence of a G-band karyotype. A single G-band spread from an individual originally described as the Bashkiria race was presented by Alfia Volkova (formerly Gabitova) at the Eighth meeting of the National Theriological Society held in Moscow, 31 January – 2 February 2007. The clarity of the G-banding allowed Nina Bulatova to identify the specimen as a member of the Yuryuzan race, fully metacentric (*go*, *hn*, *ip*, *kr*, *mq*) except for heterozygosity for *jl*, the only polymorphism that we observed in this study (Tab. 1).

In conclusion, our new data extend the known ranges of six races in European Russia. Additionally, we have localised likely contact areas between the West Dvina and Moscow races, the Moscow and Neroosa races and the Sok and Serov races. Interestingly, in the areas where we have best identified contact of these races there are no geographic barriers (e.g. rivers, mountain ridges) separating them.

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