

Current Distribution of the Striped Field Mouse (*Apodemus agrarius* Pallas, 1771) in Eastern Transbaikalia: New Findings in the Disjunction Area

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Abstract—Materials on the new findings of the striped field mouse (*Apodemus agrarius*) in Transbaikalia, within an earlier disjunction area in the habitat of this species (in the basins of the Onon and Ingoda rivers), are presented. Possible causes of the expansion of the species range are discussed. It is most probable that the species was introduced from the basin of the Argun River with a cargo of agricultural products to the lower reaches of the Onon River or the upper reaches of the Shilka River. Currently, the striped field mouse is a common species inhabiting a floodplain shrub biotope in the lower reaches of the Ingoda and Onon rivers.

Keywords: striped field mouse (*Apodemus agrarius*), Eastern Transbaikalia, invasion, disjunction area

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INTRODUCTION

The striped field mouse (*Apodemus agrarius* Pallas, 1771) is widespread in the Palearctic region and is a highly abundant agrophilous rodent species in some areas (Karaseva and Toshchigin, 1993; Tupikova et al., 2000). Its range comprises two wide isolated parts: European–Siberian–Kazakhstan and Far Eastern–Chinese (Karaseva, 1979). This is an example of classical European–East Asian disjunction (Matyushkin, 1976), which is confined to the arid and mountain regions of Inner Asia. In Russia, the habitat disjunction of *A. agrarius* occurs in Transbaikalia (Buryatia and Zabaikalsky krai).

A. agrarius has significantly expanded its habitat over recent decades, which is associated with the economic activity of humans (Karaseva et al., 1992; Tikhonova et al., 1992; Tupikova et al., 2000; Kos-tenko, 2000).

The aim of this communication is to describe the current distribution of *A. agrarius* in Transbaikalia on the basis of new findings of this species.

MATERIALS AND METHODS

The materials presented in this work were obtained during the joint expeditions of the Daurisky State Nature Biosphere Reserve and the Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences, as well as in the course of regular censuses of rodents performed by the Chita Plague Control Station (PCS) in the steppe and forest-steppe regions of Zabaikalsky krai.

RESULTS AND DISCUSSION

In 1948, *A. agrarius* was first found in Transbaikalia, in Verkhniy Kaltan (15 km southwest of Suktui-Milozan), by Khokhlov, a zoologist (Lipaev et al., 1957). Subsequently and until recently, all the known habitats of *A. agrarius* in these regions were limited to the floodplain of the Argun River in the steppe zone along Russia's national boundary with China (Lipaev et al., 1957; Nekipelov, 1960).

A. agrarius was caught in Transbaikalia, far beyond the floodplain of the Argun River, over the period from 1999 to 2013 (table, figure). The findings of this species in the basin of the Argun River, in the cultivated lands of Zabaikalsky and Krasnokamensk districts of

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Area of finds and abundance of *A. agrarius* in Transbaikalia, 1999–2013

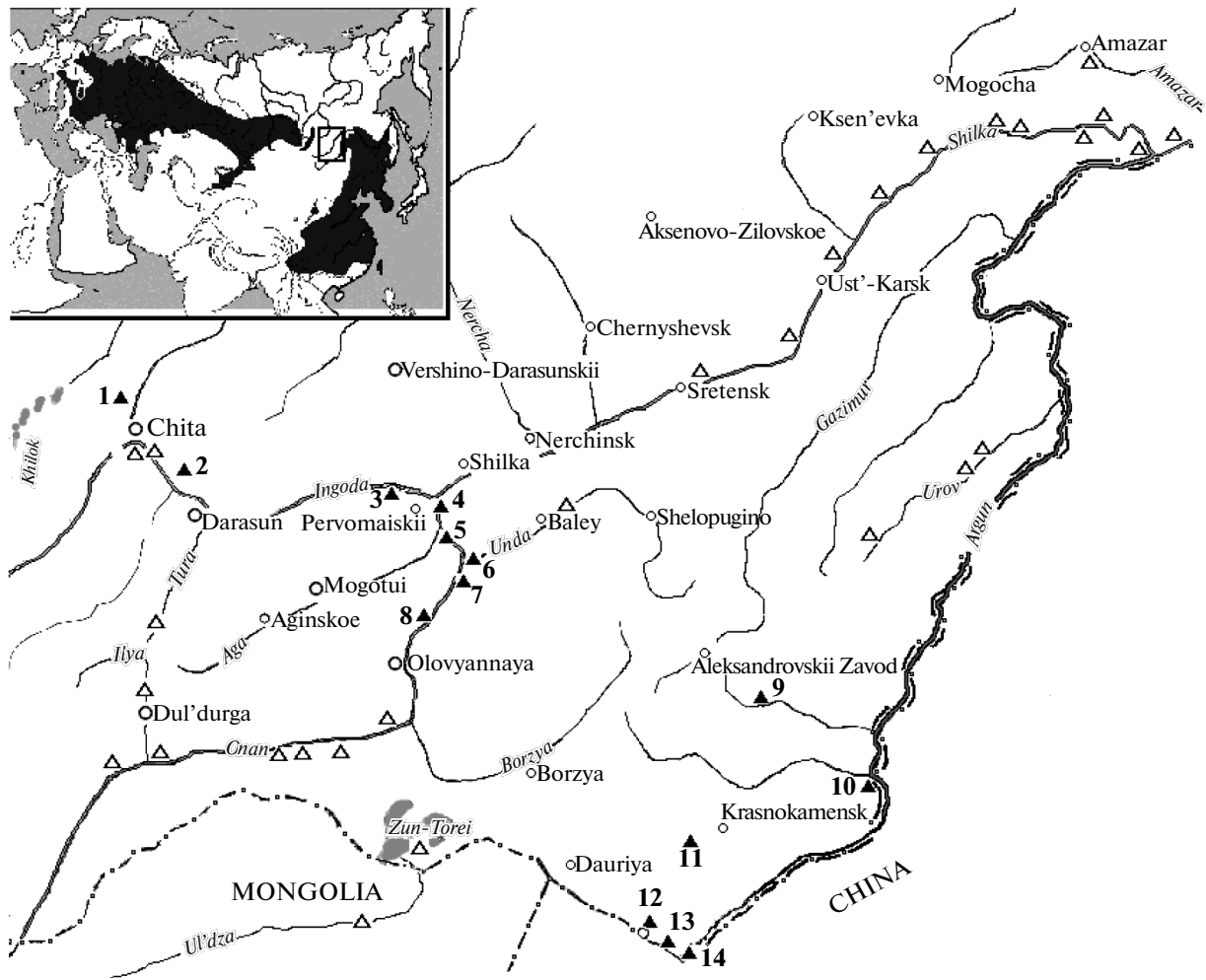
No.	Area of trapping (locality)	<i>n</i>	Year	Biotope	Abundance (specimens/100 trap-days)	Number of trap-days
1	Chita district, Tyrgyven Rivulet (Chita River tributary), 7 km west of Verkh-Chita village	1	2012	Floodplain shrubs	0.1	1440
2	Chita district, left bank of the Ingoda River, Novokurchininskii village	1	2013	Floodplain shrubs	0.5	200
3	Shilka district, right bank of the Ingoda River, 3 km west of Krasnoyarsovo village	8	2013	Floodplain shrubs	7.4	108
4	Shilka district, left bank of the Onon River, 6 km from the estuary	1	2013	Floodplain shrubs	1.9	53
5	Shilka district, left bank of the Onon River, 6 km east of the estuary of the Aga River	2	2012	Floodplain shrubs	1.9	52
6	Baley district, left bank of the Unda River, 2 km from the confluence into the Onon River	1	2009	Floodplain shrubs	2.9	35
7	Border between Baley and Olovyanninskii districts, right bank of the Onon River, 10 km north of Karaksar village	1	2004	Floodplain shrubs	2.5	40
8	Mogoitui district, left bank of the Onon River, 4 km north of Nurinsk village	2	2013	Floodplain shrubs	4.0	50
9	Aleksandrovo-Zavodskii district, Buldurutui Rivulet (tributary of the Verkhnyaya Borzuya River), 3 km north of Savvo-Borzuya village	1	2013	Floodplain shrubs	5.0	20
10	Priargunsk district, Priargunsk village	1	2006	Shrubs of fallow fields near forest belts	5.0	20
11	Krasnokamenskii district, Suktui-Milozan village	2	1999	Field	2	100
		13	2001	Field	13	100
		1	2002	Field	1	100
12	Zabaikalsky district, Zabaikalsk village	1	2010	Village or summer cottage outskirts	1	100
13	Zabaikalsky district, 14 km east of Zabaikalsk village	1	1999	Field	1	100
		8	2002	Field	8	100
14	Zabaikalsky district, Abagaitui village	2	2006	Field	2	100

Zabaikalsky krai, were made during the census trappings conducted by the Chita PCS (sites 11–14). It should be noted that *A. agrarius* was not registered annually despite regular censusing in the areas where the findings were made. During the short expeditions, one *A. agrarius* specimen each was found in Priargunsk (site 10) and Aleksandrovo-Zavodskii (site 9) districts. The above findings of *A. agrarius* refer to the steppe areas in the basin of the Argun River but are 50–70 km away from its floodplain.

Only two findings of *A. agrarius* in Transbaikalia, both yielding little information, were known outside the steppe Argun River region before our trappings. *A. agrarius* is listed among 19 species of rodents and lagomorphs caught in the anthropogenic stations of

Borzinskii district during 1986–1988 (Puzanskii, 1990). According to the map in the review paper by Karaseva et al. (1992), there was only one finding of the species outside the floodplain of the Argun River, i.e., on the Shilka River (probably in Nerchinsk district). Unfortunately, no detailed data on these findings are available.

In the lower reaches of the Onon River (on its right bank), 10 km north of Karaksar (on the border between Baley and Olovyanninskii district, site 7), an adult female *A. agrarius* specimen (parous, with 11 placenta spots) was registered by us in September 2004 (Pavlenko et al., 2007). During the expeditions organized in subsequent years (2009, 2012, and 2013), *A. agrarius* was caught in four other areas on the banks



Distribution of *A. agrarius* in Eastern Transbaikalia. Areas where small-sized mammals inhabiting floodplain shrubs were trapped in 1999–2013: *A. agrarius* detected (filled triangles) or not (empty triangles). Numbers of localities as in table. The map of global habitat according to (<http://www.sevin.ru/vertebrates/>).

in the lower reaches of the Onon River (sites 4–8) and one more area in the lower reaches of Ingoda River (site 3). *A. agrarius* specimens from these six localities were caught in the dense floodplain shrubs (willow, Siberian crabapple, and wild rose) bordering the river channels and meadow areas.

In 2012 and 2013, the plague control service trapped one specimen of *A. agrarius* in each basin of the Ingoda River within Chita district (sites 1, 2). It should be emphasized that neither we nor other researchers have registered *A. agrarius* in the valley of the Ingoda River near the district's largest transportation center (Chita), although small mammals have been trapped here more or less regularly. The recent findings are likely to be related to the habitat expansion of *A. agrarius* up in the valley of the Ingoda River, from the lower reaches of this river, where the abundance of the species, according to our trappings, is currently high (table). The following rodent species were trapped along with *A. agrarius* in the floodplain

shrubs in the downstream flows of the Onon and Ingoda rivers: Maximowicz's vole (*Microtus maximowiczii* Schrenk, 1859), northern red-backed vole (*Clethrionomys rutilus* Pallas, 1779), Korean field mouse (*Apodemus peninsulae* Thomas, 1907), brown rat (*Rattus norvegicus* Berkenhout, 1769), and Siberian chipmunk (*Tamias sibiricus* Laxmann, 1769). The share of *A. agrarius* relative to all mammals that were caught was 37% (sites 3–6, 8).

The findings of *A. agrarius* in the valleys of the Onon and Ingoda rivers are of high interest, because they were performed in the disjunction area of the vast range of this species. Taking into consideration that the findings in the valley of the Onon River and in the lower reaches of the Ingoda River were made during the short-term studies of small mammals (trappings per one night) with a significant proportion of the species among other rodents that were captured, it can be assumed that *A. agrarius* is one of the dominant species in the floodplain community of the lower reaches of

these rivers and, probably, the upper reaches of the Shilka River. At the same time, *A. agrarius* must have failed to penetrate into the middle reaches of the Onon River, because it was not registered in our trappings near the following settlements: Ust-Borzya, Nizhny Tsasuchey, Kubuhay, Bol'shevik, and the estuary of the Ilya River (figure).

Raising the question about possible ways of expansion of *A. agrarius* into the valleys of the Onon and Ingoda rivers, we need to consider the distribution of this species into the regions adjacent to Zabaikalsky krai. In the western part of Transbaikalia (Buryatia), *A. agrarius* is not found (Borisov et al., 2001). The eastern edge of the range in the west runs in Cisbaikalia (including Olkhon Island), where it is a rare species with limited habitat (Timoshenko and Lipin, 1988; Durnev et al., 1996). In Northeast China, *A. agrarius* is a common and widespread species. In particular, it was detected in Inner Mongolia, in Hailar district (Argun River) and Three Rivers (Yiching et al., 1986; Yongzu et al., 1997). The recently obtained data on the distribution, abundance, and ecology of the species in the neighboring areas of Mongolia are insufficient (Clark and Munkhbat, 2006). Previously, *A. agrarius* was known to inhabit the extreme east of Mongolia in the foothills of the Greater Khingan Range (Sokolov and Orlov, 1980). The species was not found in the Mongol Daguur Reserve bordering with Russia (Tseveenmyadag, 2003). No data on the species are available on the southern border with Mongolia, near the Dauriskii (our data) and Sokhondinskii Reserves (Ushakova, 2011) and the Tsasucheyskii Pine Forest Federal Reserve (our data).

To explain the findings of *A. agrarius* in the valley of the Onon and Ingoda rivers, several hypotheses may be introduced. In our opinion, it is hardly probable that the species could have long ago penetrated and existed as a long-term population, because the steppes of Southeast Transbaikalia are among the most well studied areas in Russia when it comes to the fauna of rodents owing to the work of the plague control service (Karaseva et al., 1992; Karaseva and Toshchigin, 1993). In most areas of Transbaikalia where the rodents were regularly trapped before the 1990s, *A. agrarius* was not found (Karaseva et al., 1992). A single site on the Shilka River is indicated on the map by Karaseva et al. (1992), but it is not known from the works of biologists who worked directly in Transbaikalia.

The second hypothesis is natural distribution of *A. agrarius* into the west of the Amur-Ussuri part of the range. In this case, there are two main variants: from the Amur River upstream along the Shilka River and from the steppe part of the valley of the Argun River through the Onon-Argun interfluvial areas. The first variant is unlikely, because the low population density and the lack of floodplain habitats in many taiga parts of the lower reaches of the Shilka River should prevent penetration of the species. In addition, *A. agrarius* has only recently penetrated into the very

upper reaches of the Amur River (Bobrov et al., 2008). The species was not detected during our expedition (2012) in the valley of the lower half of the river flow (figure). In the floodplain biotopes similar to those occupied by *A. agrarius* in the lower reaches of the Onon and Ingoda rivers, *A. peninsulae* is dominant. Natural distribution of *A. agrarius* from the steppe floodplain of the Argun River is very likely to have taken place. When discussing the possible distribution of the species from the eastern, Amur-Ussuri, massif of the species range, it should be noted that two of the *A. agrarius* specimens caught by us on the Onon River (in the vicinity of and Karaksar and Priargunsk, sites 7 and 10) were studied genetically: animals were karyotyped and their mtDNA cytochrome *b* gene was sequenced. On the basis of their characteristics, those of the karyo- and haplotype, they belong to the Far Eastern group (Pavlenko et al., 2007; Sakka et al., 2010).

The third hypothesis is accidental introduction of *A. agrarius* by trains and cars. The initial delivery could have occurred through either the Trans-Siberian Railway or M 58 highway running along it. The species could have been introduced in the lower reaches of the Ingoda River or the upper reaches of the Shilka River from Amur oblast or the upper reaches of the Argun River. The last variant is the most probable. In recent decades, the lower reaches of the Onon River and the upper reaches of the Shilka River have served as one of the few areas of grain cultivation in Zabaikalsky krai. Accidental introduction of this species with a cargo of grain or other agricultural products transported from the most agriculturally developed area of Zabaikalsky krai (steppe Argun River area) with a permanent stable population of *A. agrarius* is very probable. Such introduction must also have been favored by the natural distribution of *A. agrarius* in the steppe zone of the basin of the Argun River.

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REFERENCES

- Bobrov, V.V., Varshavskii, A.A., and Khlyap, L.A., *Chuzherodnye vidy mlekopitayushchikh v ekosistemakh Rossii* (Alien Species of Mammals in Ecosystems of Russia), Moscow: KMK, 2008.
- Borisova, N.G., Abramov, A.V., Starkov, A.I., Boronoeva, G.I., and Dagdunova, A.A., Fauna of mammals in Buryatia Republic, in *Fauna i ekologiya mlekopitayushchikh Zabaikal'ya* (Fauna and Ecology of Transbaikalian Mammals), Abramov, A.V. and Borisov, N.G., Eds., St. Petersburg: Zool. Inst., Russ. Akad. Nauk, 2001, vol. 288, pp. 3–95.

- Clark, E.L. and Munkhbat, J., *Mongolian Red List of Mammals. Regional Red List Series*, Dulamtseren, S., Baillie, J.E., Batsaikhan, N., Samiya, R., and Stubbe, M., Eds., London: Zool. Soc. Lond., 2006, vol. 1.
- Durnev, Yu.I., Mel'nikov, Yu.I., Boyarkin, I.V., Knizhin, I.B., Matveev, A.N., Medvedev, D.G., Ryabtsev, V.V., Samusenok, V.P., and Sonina, M.V., *Redkie i maloizuchenyye pozvonochnyye zhivotnye Predbaikal'ya* (Rare and Little-Studied Animals of Cis-Baikal Region), Irkutsk: Irkut. Gos. Univ., 1996.
- Karaseva, E.V., The striped field mouse (*Apodemus agrarius* Pallas, 1771), in *Meditinskaya teriologiya* (Medical Theriology), Kucheruk, V.V., Ed., Moscow: Nauka, 1979, pp. 194–203.
- Karaseva, E.V., Tikhonova, G.N., and Bogomolov, P.L., Habitat of the striped field mouse (*Apodemus agrarius*) in the Soviet Union and habitat peculiarities of a species in different parts, *Zool. Zh.*, 1992, vol. 71, no. 6, pp. 106–115.
- Karaseva, E.V. and Toshchigin, Yu.V., *Gryzuny Rossii: Obraz zhizni, znachenie v narodnom khozyaistve, metody izucheniya i kontrol' chislennosti* (Rodents in Russia: Life Conditions, Significance for Economics, Study Methods, and Population Control), Moscow: Inst. Evol. Morfol. Ekol. Zhivotn., 1993.
- Kostenko, V.A., *Gryzuny (Rodentia) Dal'nego Vostoka Rossii* (Rodents (Rodentia) of the Russian Far East), Vladivostok: Dal'nauka, 2000.
- Lipaev, V.M., Dubovik, I.M., Dubovik, V.I., and Busododova, N.M., Rodents of the Arguni River flood land, *Izv. Irkut. Gos. Nauchno-Issled. Protivochumn. Inst. Sib. Dal'n. Vost.*, 1957, vol. 16, pp. 39–55.
- Matyushkin, E.N., European-East Asian break of the habitat of terrestrial vertebrates, *Zool. Zh.*, 1976, vol. 55, no. 9, pp. 1277–1291.
- Nekipelov, N.V., Distribution of mammals in Southeastern Transbaikalia and population size of some species, in *Biologicheskii sbornik* (Collection of Research Works in Biology), Irkutsk: Irkut. Gos. Univ., 1960, pp. 3–48.
- Pavlenko, M.V., Korablev, V.P., Kartavtseva, I.V., and Kardash, A.I., Changes of the habitat borders of the field mouse *Apodemus agrarius* Pallas, 1771 (Rodentia, Muridae) in Transbaikalia: new finds in the disjunction zone and their genetic characteristics, in *Mater. conf. "Prirodookhrannoe sotrudnichestvo Chitinskoi oblasti (Rossiiskaya Federatsiya) i avtonomnogo raiona Vnutrennaya Mongoliya (KNR) v transgranichnykh ekologicheskikh regionakh"* (Proc. Conf. "Nature Protection Collaboration in Chita Oblast (Russian Federation) and Autonomous District of the Central Mongolia (People's Republic of China) in Transboundary Ecological Regions"), Chita: Ekspres-Izd., 2007, pp. 260–264.
- Puzanskii, V.N., Population number of small mammals in forest-steppe of southeastern Transbaikalia, in *Mater. V S"ezda Vses. Teriologicheskogo O-va Akad. Nauk SSSR* (Proc. V All-Union Theriological Society, Academy of Sciences of USSR), Vorontsov, N.N., et al., Eds., Moscow, 1990, vol. 1, pp. 297–298.
- Sakka, H., Quéré, J.P., Kartavtseva, I., Pavlenko, M., Chelomina, G., Atopkin, D., Bogdanov, A., and Michaux, J., Comparative phylogeography of four *Apodemus* species (Mammalia: Rodentia) in the Asian Far East: evidence of Quaternary climatic changes in their genetic structure, *Biol. J. Linn. Soc.*, 2010, vol. 100, no. 4, pp. 797–821.
- Sokolov, V.E. and Orlov, V.N., *Opredelitel' mlekopitayushchikh Mongol'skoi Narodnoi Respubliki* (Guidance for Identification of the Mammals of the People's Republic of Mongolia), Moscow: Nauka, 1980.
- Tikhonova, G.N., Karaseva, E.V., and Bogomolov, P.L., General changes of the habitat of the field mouse in the Soviet Union over last 30–40 years, in *Sinantropiya gryzunov i ogranichenie ikh chislennosti* (Synanthropy of Rodents and Limitation of Their Population), Moscow: Nauka, 1992, pp. 301–322.
- Timoshenko, A.F. and Lipin, S.I., Field mouse in agricultural landscapes of Cis-Baikal region, in *III Vses. konf. "Problemy ekologii Predbaikal'ya," Tezisy dokladov* (The III All-Union Conf. "Ecological Problems of Cis-Baikal Region," Abstracts of Papers), Irkutsk, 1988, p. 102.
- Tupikova, N.V., Khlyap, L.A., and Varshavskii, A.A., Field Rodents in the Northeastern Palaeartic, *Zool. Zh.*, 2000, vol. 79, no. 4, pp. 492–494.
- Tsevenmyadag, N., Terrestrial vertebrates of Mongol Daur Nature Reserve, in *Nazemnye pozvonochnye Daurii* (Terrestrial Vertebrates of Dauria), Kirilyuk, V.E., Ed., Chita: Poisk, 2003, no. 3, pp. 33–43.
- Ushkova, M.S., Small mammals, in *Kadastr zhivotnogo mira yuga Vostochnogo Zabaikal'ya* (The Register of the Fauna of South of Eastern Transbaikalia), Malkov, E.E., Ed., Chita: Ekspres-Izd., 2011.
- Yiching, M., Jizhen, Ch., Chengzhao, T., et al., *Mammals of Heilongjiang Province (Fauna Heilongjiangica)*, Harbin: Heilongjiang Sci. Technol. Press, 1986.
- Yongzu, Zh., et al., *Distribution of Mammalian Species in China*, China For. Publ. House, 1997.

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