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## First Report of the Herb Field Mouse, *Apodemus uralensis* (Pallas, 1811) from Mongolia\*

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### Abstract

**Key words:** *Apodemus uralensis*, Mongolian Altai Mountains, Dzungarian Gobi, measurements, mitochondrial cytb

The herb field mouse, *Apodemus uralensis* (Pallas, 1811) is recorded for the first time in Mongolia, from western part of the Mongolian Altai and the adjacent Mongolian part of the Dzungarian Gobi. In addition, we discovered several additional findings of this species recorded as early as 1976 from different scientific collections. Body and skull measurements are presented along with a molecular genetic analysis of one specimen.

**Article information:**

Received: 06 June 2015

Accepted: 29 Nov. 2015

Published: 02 Dec. 2015

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**Cite this paper as:**

Shar, S., Batsaikhan, N., Dolch, D., Gardner, S. L., Kullmer, O., Lebedev, V. S., Lkhagvasuren, D., Menz, U., Samiya, R., Stubbe, M. & Ansorge, H. 2015. First report of the herb field mouse, *Apodemus uralensis* (Pallas, 1811) from Mongolia. *Mong. J. Biol. Sci.*, 13(1-2): 35-42.

### Introduction

The genus *Apodemus* Kaup, 1829 has had a complicated taxonomic history with a varying and eventful taxonomy during the last few decades (Wilson & Reeder, 2005). So it is hardly

\*Results of the Mongolian-German Biological Expeditions since 1962, contribution No. 324

surprising that the “*Apodemus* problem” as termed by Demeter & Lázár (1984) also includes the mammal fauna of Mongolia. Although up to the current time, only two species were generally known to live in this country. Bannikov (1954) had already reported the Asian wood mouse, *Apodemus speciosus* Temminck, 1847 from several localities in Mongolia. Bannikov also mentioned the species collected by the large expeditions of Kozlov, Andrews, and the Russian Academy of Sciences at the beginning of the 20th century (Bannikov, 1954).

The checklist of Mongolian mammals that resulted from collections made during the first Mongolian-German biological expeditions in the 1960’s refers to *Apodemus flavicollis peninsulae* (Thomas, 1906) and *Apodemus agrarius* (Pallas, 1771) without providing further information on the former species in the text (Stubbe & Chotolchu, 1968). However, since then it has been widely accepted that the East Asian mouse also known as the Korean field mouse, *Apodemus peninsulae* (Thomas, 1907) is one of the most common species of rodents in Mongolia with a distribution ranging from forests to steppes mainly in the north of the country, but also south to the Mongolian Altai Mountains and in the Mongolian part of the Dzungarian Gobi Desert (Sokolov & Orlov, 1980; Clark *et al.*, 2006; Batsaikhan, *et al.*, 2010). Although some authors casually mentioned *Apodemus uralensis* as occurring in the Mongolian Altai or Mongolia in general (Wilson & Reeder, 2005; Grimmberger & Rudloff, 2009), up to the current report, there had been no convincing evidence that this species did occur in Mongolia.

It was, therefore, totally unexpected that in the summer of 2011 an American-Mongolian parasitological/mammalogical expedition led by the University of Nebraska-Lincoln and the National University of Mongolia, and independently a Russian-Mongolian mammalogical expedition led by the Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, collected specimens of *Apodemus* from the southwestern edge of Mongolia that appeared to be different from *A. peninsulae*. Additional work on the mammals collected during this time showed that this species was, in fact, *A. uralensis* (Pallas, 1811). During the following two years, the Mongolian and German mammalogists were collected

more specimens from this region confirming the field and museum-based diagnosis. Preliminary information on this species can be found in the publication “Areas of rodents and pikas of Mongolia” with a map of the currently known distribution of *A. uralensis* in Mongolia (2013) at the home page of the Severtsov Institute of Ecology and Evolution ([http://www.sevin.ru/menues1/index\\_rus.html?..news/661.html](http://www.sevin.ru/menues1/index_rus.html?..news/661.html)).

Also, in the recently published second edition of “A field guide to the mammals of Mongolia” (Batsaikhan *et al.*, 2014), the species is also reported. In this article, we present proof and a report on the status of this species in Mongolia including biological and ecological data.

### Materials and Methods

To identify the individual specimens to the species level, we checked the available materials representing species of *Apodemus* from southwestern Mongolia in the collections of the National University of Mongolia, the Zoological Museum of the Moscow State University, the Division of Mammals, Museum of Southwestern Biology, University of New Mexico, the Institute of Zoology, Martin Luther University Halle and the Senckenberg Museum of Natural History Görlitz. To distinguish among related species, the presence of a supraorbital ridge in the interorbital region of the skull of the Korean field mouse, *A. peninsulae* (Fig. 1) was used as the main character of the subgenus *Apodemus*. In the opposite and typical for species allocated to the *Sylvaemus* subgenus, the skull of the herb field mouse, *A. uralensis* shows a smooth interorbital

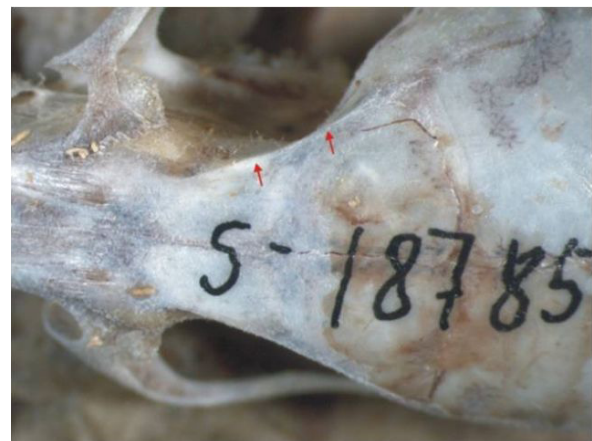


Figure 1. Skull of *Apodemus peninsulae* (red arrows point the supraorbital ridge).

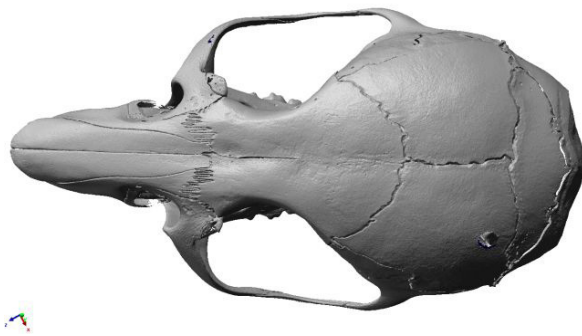


Figure 2. Virtual reconstruction from  $\mu$ -computer tomography data of a skull of *Apodemus uralensis*, dorsal view (M. 9548, 2013/06/14, Baitag Bogd region, male).



Figure 3. Virtual reconstruction from  $\mu$ -computer tomography data of a skull of *Apodemus uralensis*, lateral view (M. 9522, 2013/06/12, Baitag Bogd region, male).

region without any supraorbital ridge (Pavlinov *et al.*, 2002; Smith & Xie, 2008). The lack of a supraorbital ridge of the material in question is clearly demonstrated by a computed tomography scan of two specimens (Figs. 2–3).

The sex and standard body measurements in the list given below were taken from 27 specimens with the collection labels or field catalogue records. The following measurements were recorded, including: m=mass, hbl=head-body length, tl=tail length, hfl=hind foot length, el=ear length. The age of individuals was estimated and a distinction was made between juveniles and adults, primarily by measuring extent of tooth wear (abrasion) of the molars. The following skull measurements were made with a digital caliper, following Demeter and Lázár (1984), including: cbl=condylobasal length, nasl=length of nasals, nasb=breadth of nasals, zb=zygomatic breadth, iob=interorbital breadth, ocb=occipital breadth, utr=length of upper tooth row, fori=length of incisive foramen, ltr=length of lower tooth row. From one specimen in the Zoological Museum of the Moscow State University (S-188967, 2011/08/12, Bulgan gol, adult male) a fragment of the mitochondrial cytb gene (positions 80-655) was sequenced, after Montgelard *et al.* (2002).

## Results and Discussion

Examining the relevant collections shows that *A. uralensis* was obtained from seven localities in Mongolia (Table 1, Fig. 4). These localities are restricted to the southwestern part of the

Mongolian Altai Mountains and the adjacent Mongolian part of the Dzungarian Gobi Desert, representing the easternmost border of the whole Eurasian distribution area (Wilson & Reeder, 2005). In this area, the only species of *Apodemus* that occurs is the herb field mouse. The closest occurrence of another species of *Apodemus* (*A. peninsulae*) was about 100 km distant in the eastern foot hills of the Mongolian Altai.

In the Gobi, the herb field mouse occurs in the oasis at the altitude of 1,421 m a.s.l. as well as in the mountain river valleys of the Baitag Bogd Mountains at the altitude up to 2,104 m. In the Mongolian Altai, individuals were collected from several habitat types ranging from the river oases in the foothills (1,147 m) through mountainous regions as high as 2,468 m.

Suitable habitats for *A. uralensis* in western

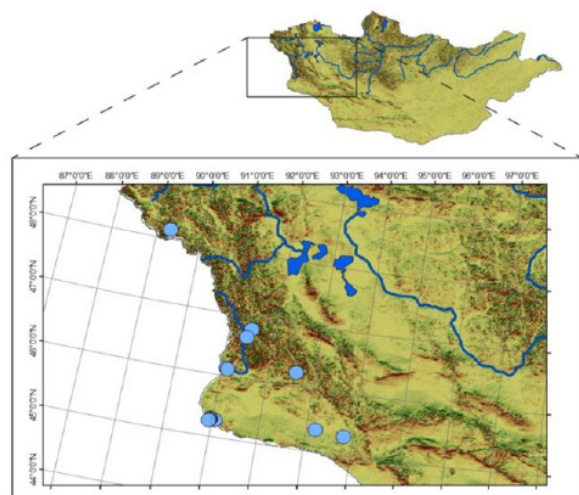


Figure 4. Records of the herb field mouse, *Apodemus uralensis* in Mongolia.

Table 1. Records of the herb field mouse, *Apodemus uralensis* from Mongolia.

No	Locality	Coordinates	Date	Collector
1	Khovd province, Bulgan district, Bulgan gol, lower reaches	N46.11162, E91.12366	1974-05-17 - 1988-05-28	A. Stubbe, M. Stubbe, H. Ansorge
2	Gobi-Altai province, Bugat district, Gun-Tamga Us (Dzungarian Gobi)	N45.30000, E93.81666	1976-08-25	V. Orlov
3	Bayan-Ulgii province, Altai district, Yolt-gol, upper reaches (Mongolian Altai)	N48.15000, E89.28800	1979-08-20	Yu. Shvetzov
4	Khovd province, Bulgan district, Bulgan gol	unknown	1982-08-14	G. Sapozhnikov
5	Khovd province, Bulgan district, Baitag Bogd mountains	unknown	1985-07-13	A. Lushekina
6	Khovd province, Bulgan district, Baitag Bogd mountains	N45.25000, E90.93333	1986-07-22	O. Podtyazhkin
7	Khovd province, Munkhkhairkhan district, Munkhkhairkhan Mountains, Gurt gol	N46.80505, E91.49033	2010-07-26	S. Shar
8	Khovd province, Altai district, Bodonchiin gol (Dzungarian Gobi)	N46.22355, E92.60541	2010-08-06	A. Stubbe, M. Stubbe
9	Khovd province, Bulgan district, Bulgan gol	N46.14222, E91.49777	2011-07-20	D. Dolch
10	Khovd province, Bulgan district, Baitag Bogd mountains, Tsagaanburgast valley	N45.26469, E91.06372	2011-08-04	N. Batsaikhan, J. Cook, S. Gardner
11	Khovd province, Bulgan district, Baitag Bogd Mountains, Khargait valley	N45.27997, E90.96455	2011-08-07	N. Batsaikhan, J. Cook, S. Gardner
12	Khovd province, Bulgan district, Bulgan gol, lower reaches	N46.11750, E91.11416	2011-08-12	G. Ryurikov, S. Shar, A. Surov, M. Ushakova
13	Khovd province, Bulgan district, Baitag Bogd mountains, northern slope	N45.28916, E90.97666	2011-08-14	N. Feoktistova, I. Mescherskiy, S. Shar, A. Surov, M. Ushakova
14	Khovd province, Bulgan district, Bulgan gol, upper reaches (Mongolian Altai)	N46.66519, E91.41150	2012-07-09	N. Batsaikhan, S. Gardner
15	Khovd province, Altai district, Khonin-Us (Dzungarian Gobi)	N45.35177, E93.20641	2012-07-26	N. Batsaikhan, S. Gardner
16	Khovd province, Bulgan district, Baitag Bogd Mountains, Buduun Khargait valley	N45.25015, E90.93579	2013-06-11 - 2013-06-14	H. Ansorge, M. Hanelt, D. Lkhagvasuren, R. Samiya

Mongolia include riparian zones of the river valleys that contain significant ground-cover vegetation, usually consisting of shrubs and trees. At the base of Baitag Bogd Mountains, for example, individuals of the herb field mouse were collected along the banks of a small river lined, and partially overgrown, with dense willow bushes, *Salix ledebouriana* Trautv. and *Salix tenuijulis* Ledeb., old larch (*Larix sibirica*

Ledeb.) of the flood plain, and poplar trees, *Populus laurifolia* Ledeb. intermixed with willows (Fig. 5). In areas of higher elevation in the Mongolian Altai, individuals of *A. uralensis* also occur in riparian larch forests. Interestingly, occurrence of *A. uralensis* in lower altitude oases including of Gun-Tamga and Khonin-Us suggests that this species can also live and thrive in habitats with only sparse tree cover, as

Table 2. Body and skull measurements (in mm resp. g) of *Apodemus uralensis* from Mongolia (abbreviations are explained in the text).

Collection number	Date	Locality	Sex	Age	M	Hbl	Tl	Hfl	El	Cbl	Nasl	Nasb	Zb	Iob	Ocb	Utr	Fori	Ltr
M.9511	2013-06-11	Baitag Bogd	♂	adult	23	92	80	20	16	23.7	8.0	2.5	12.8	3.9	11.0	3.6	4.8	3.5
M.9521	2013-06-12	Baitag Bogd	♂	adult	22	91	76	20	16	23.9	8.9	2.3	13.0	4.1	10.7	3.5	3.5	3.4
M.9522	2013-06-12	Baitag Bogd	♂	adult	22	88	79	20	16	23.4	8.2	2.5	13.0	4.2	10.9	3.9	4.6	3.7
M.9548	2013-06-14	Baitag Bogd	♂	adult	20	77	74	20	15	22.8	7.6	2.4	12.9	4.1	10.5	3.5	5.4	3.8
M.9549	2013-06-14	Baitag Bogd	♂	adult	19	82		19	13	23.8	7.0	2.2	12.6	4.1	10.0	3.6	4.7	3.7
M.9550	2013-06-14	Baitag Bogd	♂	adult	19	76		20	14				12.5	4.1	10.6	3.5		3.6
4144	1988-04-25	Bulgan gol	♂	adult	22	97	71	19	14.5	23.0	8.0	2.2		3.9	10.5	3.7	4.7	3.4
4147	1988-05-19	Bulgan gol	♂	adult	20.5	93	85	18	14.5	22.6	6.7	2.1	12.1	4.1	10.5	3.8	4.9	3.4
4115	1988-05-12	Bulgan gol	♂	adult	21	96	87	20	15	23.5	8.0	2.4	12.7	4.0	10.6	3.8	4.2	3.6
138-11	2011-07-20	Bulgan gol	♂	adult	21.5	90	85	19	14	22	8.2	2.4	12.8	4.2	11.4	3.7	4.8	3.7
1978/81	1978-05-18	Bulgan gol	♂	adult	26	95	77	19	14	23.9	8.9	2.6	13.1	4.1	11.4	3.6	4.4	3.5
M.9512	2013-06-11	Baitag Bogd	♀	adult	27	90	75	19	15	23.5	9.4	2.3	13.0	4.0	10.6	3.6	4.9	3.6
M.9538	2013-06-13	Baitag Bogd	♀	adult	17	74	73	19	19	22.2	7.0	2.5	11.5	4.1	10.3	3.6	4.5	3.8
4150	1985-05-20	Bulgan gol	♀	adult	17.5	90	69	18	14	22.8	7.1	2.2	11.9	4.0	10.4	3.8	4.7	3.8
4148	1988-05-22	Bulgan gol	♀	adult	17	95	71	18	15	22.1	7.9	2.0	11.9	4.0	10.3	3.7	4.0	3.4
M.9551	2013-06-14	Baitag Bogd	♂	subadult	15	85	72	18.5	15	22.6	8.9	2.1	12.2	3.8	11.0	3.7	4.4	3.8
4146	1988-05-17	Bulgan gol	♂	subadult	23	89		20	15		9.0	2.4	12.7	4.1	10.6	3.5	4.9	3.4
M.9529	2010-08-06	Bodonchijn gol	♂	subadult	17.5	90	76	19	13.5	22.1	8.5	2.7	11.8	4.0	10.1	3.5	5.0	3.4
	2013-06-13	Baitag Bogd	♂	juvenile	12	75	62	18	14	20.6	6.6	2.0	11.3	4.1	10.0	3.6	3.9	3.3
4149	1988-05-28	Bulgan gol	♀	juvenile	8	78	62	17	12	18.9	7.3	2.4	11.2	3.8	9.1	3.6	4.3	3.3



Figure 5. Habitat of the herb field mouse with dense willow bushes (*Salix* sp.) in a small river valley of the Baitag Bogd.

has been shown for European populations of *A. uralensis* that occur in both agricultural lands and open dry habitats (Grimmberger & Rudloff, 2009).

In the river valley of Baitag Bogd (mentioned above), our field-work shows that during the season in which we made our collections, the numerical density of the herb field mouse was relatively low; in mid-June only 10 specimens of *A. uralensis* were obtained from a total of 378 trap nights although it was the dominant species there beside *Microtus oeconomus* and *Cricetulus migratorius*. Four pregnant females of the herb field mouse carried 5, 6, 6 and 6 embryos, respectively being within the range known for the species (Grimmberger & Rudloff, 2009).

Mongolian herb field mice show a fur color different from that of the western populations. The dorsum appears relatively light brown-grey with a touch of reddish shading (Figs. 6 & 7). The uniform grayish-white underside is sharply distinct from the dorsum, never showing a



Figure 6. Herb field mouse, *Apodemus uralensis* (2013-06-13, Baitag Bogd).

yellow patch on the chest (Fig. 7), and the tail is bicolored.

The body and skull measurements of 20 specimens of *Apodemus uralensis* studied are given in Table 2. Furthermore the body measurements of seven additional *Apodemus specimens* from the Bulgan gol are provided in Table 3. Even though these specimens are currently not available and cannot be verified, they belong most probably to the herb field mouse too. Although the herb field mouse belongs to the smaller *Apodemus* species, the specimens we studied from Mongolia show slightly larger dimensions of both body length and skull size than several series of specimens studied from Europe and Asia Minor (Steiner 1978; Demeter & Lázár, 1984; Filippucci et al., 1996). This contrasts to individuals of the herb field mouse from western Siberia that have smaller body sizes (Kolcheva, 2008). On the other hand, populations from the Talas Alatau and also from Central and Northern Kazakhstan show considerably larger body measurements as well as the closer populations from the Ile Alatau, the northern Dzungarian Alatau and the southern Altai in Kazakhstan (Sludskii, 1977). The population in north-western China corresponds well in skull and body sizes with the Mongolian herb field mice, as expected (Yong et al., 1987). The tail length of adult specimens from Mongolia reaches an average of 85% of the body length. As a key character of *A. uralensis*, the hind foot of the studied specimens is no longer than 20 mm.

The analysis of a fragment of the mitochondrial cytb gene (positions 80-655) of one specimen revealed that our partial sequence



Figure 7. Collection specimens of *Apodemus uralensis* from the Baitag Bogd (M. 9521, 2013-06-12, male; M. 9549, 2013-06-14, male).



Table 3. Body measurements (in mm resp. g) of *Apodemus* (most probably *A. uralensis*) from Bulgan gol (abbreviations are explained in the text).

Collection number	Date	Locality	Sex	Age	M	Hbl	Tl	Hfl	El
1974/38	1974-05-17	Bulgan gol	♂	adult	24	95	70	19	14
1974/97	1974-05-28	Bulgan gol	♂	unknown	17	90	72	20	14
1974/98	1974-05-28	Bulgan gol	♂	unknown	15	95	67	19	14.5
1978/40	1978-05-12	Bulgan gol	♂	adult	22	95		18	14
1978/41	1978-05-12	Bulgan gol	♂	adult	20	94	68	18	14
1978/67	1978-05-16	Bulgan gol	♂	adult	28	102		20	14
1974/96	1974-05-28	Bulgan gol	♀	adult	16	89	69	19	14

is identical to several Genbank sequences (KF839610, KF839599, KF839606, AY389021), which represent specimens from Eastern Kazakhstan (Pavlodar province and Zaisan depression) and northwestern China (Xinjiang, Urumqi region). Based on that, it appears that the mice from southwestern Mongolia belong to *A. uralensis kastschenkoi* (Kuznetzov, 1932), which is sometimes treated as a subspecies within the *A. uralensis* complex (Mezhzherin, 1997; Pavlinov, 2012). In future this should be clarified by collecting more material of the species in question and further morphological as well as molecular genetic investigations.

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