

Pupilla loessica LOŽEK 1954 (Gastropoda: Pulmonata: Pupillidae) – “A Living Fossil” in Central Asia?

STEFAN MENG & MATTHIAS H. HOFFMANN *)

Abstract: LOŽEK (1986) is of the opinion that *Pupilla loessica* has been found recently in Central Asia. The aim of this study is to provide some initial, concrete contributions to the discussion of this subject. It should be understood as a basis for further investigations. During recent visits on site between 1995 and 2006 in Central Asia in the Russian Altay, in Northern Mongolia, in the Baikal region and in the Tien Shan, numerous recent malacocenoses were examined. In many places evidence was found of a form of *Pupilla* which had not previously been described from this region; its shell morphology cannot be distinguished from *Pupilla loessica*. Its distribution is concentrated in the strongly continental Khrebet Saylyugem in the South Eastern Altay. The probability of the occurrence of *Pupilla loessica* in Central Asia is supported, apart from the shell morphology criteria, by the preference of this species for more continental types of habitat with average annual temperatures markedly below 0° C and the corresponding accompanying fauna adapted to the cold, including e.g. *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris*, etc., which make these fauna easily comparable to the Pleistocene glacial associations of the Central European region.

[*Pupilla loessica* LOŽEK 1954 (Gastropoda: Pulmonata: Pupillidae) –“Ein lebendes Fossil” in Zentralasien?]

Kurzfassung: LOŽEK (1986) vertritt die Ansicht, dass *Pupilla loessica* rezent in Zentralasien vorkommt. Die vorliegende Studie hat das Ziel zu diesem Thema erste konkrete Diskussionsbeiträge zu liefern. Zu verstehen ist diese Arbeit als Grundlage für weitergehende Untersuchungen. Bei neueren Geländeaufenthalten von 1995-2006 konnten in Zentralasien im Russischen Altay, in der nördlichen Mongolei, im Baikal-Gebiet und im Tien Shan zahlreiche rezente Malakozönosen untersucht werden. An vielen Lokalitäten wurde eine bisher aus dieser Region unbeschriebene Form von *Pupilla* nachgewiesen, welche gehäuse-morphologisch von *Pupilla loessica* nicht zu unterscheiden ist. Einen Schwerpunkt der Verbreitung bildet das stark kontinental geprägte Khrebet Saylyugem im SE-Altay. Für das Vorkommen von *Pupilla loessica* in Zentralasien spricht neben den gehäuse-morphologischen Kriterien, die Präferenz dieser Form zu stärker kontinental geprägten Habitaten, mit Jahresdurchschnittstemperaturen, die deutlich unter 0° C liegen sowie die entsprechenden kälteangepassten Begleitfaunen, z. B. mit *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris* u. a., welche diese Faunen gut mit den pleistozänen kaltzeitlichen Assoziationen des mitteleuropäischen Raumes vergleichbar machen.

Keywords: *Pupilla loessica*, living fossil, Central Europe, Central Asia

* Adresses of authors: S. Meng, Ernst Moritz Arndt University Greifswald, Institute of Geography and Geology, Friedrich-Ludwig-Jahnstrasse 17a, 17487 Greifswald, Germany. stefan.meng@uni-greifswald.de; H. Hoffmann, Martin Luther University Halle-Wittenberg, Institute of Biology, Geobotany and Botanical Gardens, Am Kirchtor 3, 06108 Halle, Germany. matthias.hoffmann@botanik.uni-halle.de

1 Introduction

The interpretation of fossil terrestrial gastropod faunas constitutes a suitable tool for paleo-ecological reconstructions in the Quaternary. The prerequisite for reconstructing ecological parameters of fossil systems is knowledge about the history of the distribution and the ecological requirements of each species or fauna community (LOŽEK 1964, MANIA 1973, ALEXANDROWICZ 1987, FÜKÖH, KROLOPP & SÜMEGI 1995, FRANK 2006).

As far as the interglacial gastropod faunas of central Europe are concerned, the equivalent recent faunas are generally quite well known. Temperate pleistocene fauna communities are characterised – like the corresponding flora – in similar ways by exotic (southern, south-east European and Pontic) components (LOŽEK 1964, MANIA 1973, MANIA & MAI 2001).

For the glacial (e.g. Weichselian) associations, however, the corresponding recent equivalents in Europe are missing. According to LOŽEK (1999), studies of glacial terrestrial gastropods to date show that the analogies with the glacial ecosystems of Central Europe should not be sought in the Arctic or sub-Arctic biomes of Europe or Northern Eurasia but are to be expected, or are indeed present, in the continental regions of Central Asia. It is also significant that certain glacial index species of molluscs were initially found in the Quaternary of Central Europe and only later recently in Central Asia.

Vallonia tenuilabris (A. BRAUN 1843) was described for the first time in the loess of Wiesbaden (Germany). It is only in the past few decades that its recent occurrence in Central Asia has been recognised. This species ranges from the Central Asian highlands (Altay, Tien

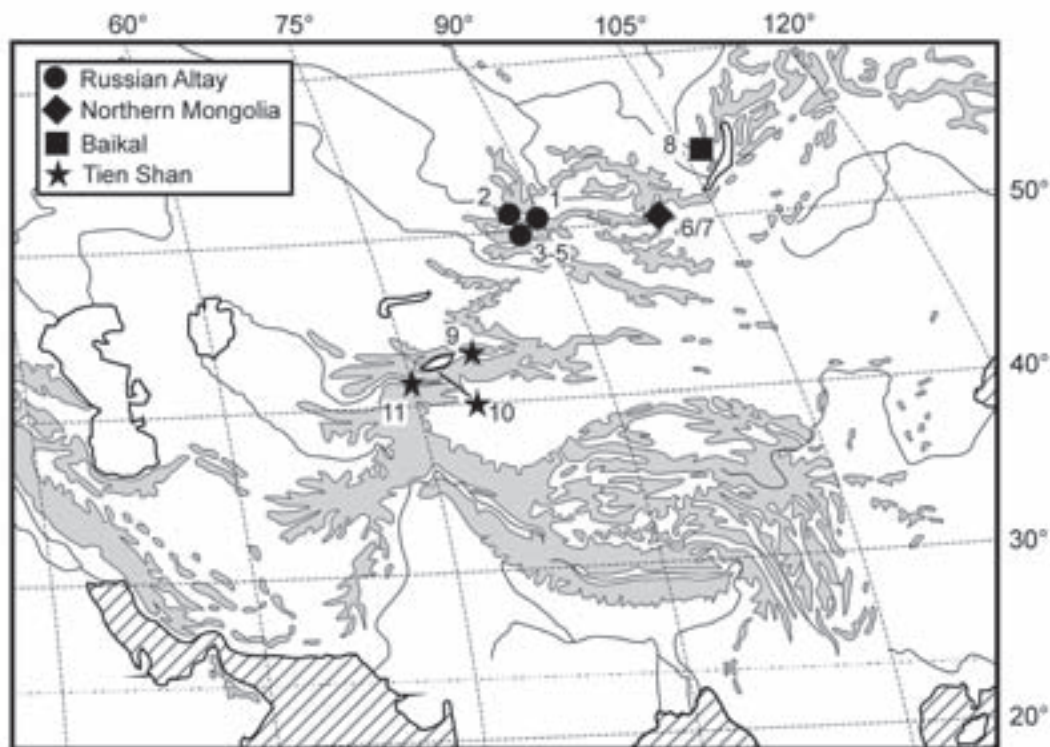


Fig. 1: Localities with *Pupilla* cf. *loessica* in Central Asia (see Table 1).

Abb. 1: Vorkommen mit *Pupilla* cf. *loessica* in Zentralasien (s. Tab. 1).

Shan, Pamir and Himalayas), Northern Mongolia and the Baikal region into Northern Asia (SCHILEYKO 1984, UVALIEVA 1990, MENG 1995, GERBER 1996).

Vertigo pseudosubstriata LOŽEK 1954 was first identified in the Weichselian loess of Dolní Věstonice (Moravia, Czech Republic). Further Pleistocene evidence followed in Central Europe (KROLOPP 1958, MENG 1995, BIBUS et al. 1996). The first indications of recent occurrences of the species in the Tien Shan were submitted by MATĚKIN (LOŽEK 1964). UVALIEVA (1967) discovered the species anew in the Southern Altay and initially described it as *Vertigo laevis* (synonym). In recent times to date, this species has been found in the Tien Shan, Altay, Pamir and Himalayas where it is relatively widespread in their alpine altitudes (SCHILEYKO 1984, UVALIEVA 1990, MENG 1995). *Vertigo parcedentata* (A. BRAUN 1847), like *Vallonia tenuilabris*, was first described in the loess of Wiesbaden (BRAUN 1847). Until recently, this species was believed to be extinct. Quite surprisingly, it was found alive in the Dovrefjell, Norway (POKRYSZKO 1993). MENG (2008 a) found evidence of the occurrence of *V. parcedentata* in the Altay and Tien Shan. The material has been photographed for the first time and compared with fossil material from Central Germany. POKRYSZKO & HORCÁK (2007) also found evidence of the recent occurrence of this species in the Altay region. PREECE, WHITE & SHCHETNIKOV (2007) additionally have the first Holocene findings from the Baikal region. Parallels on this issue have also been provided by *Pisidium stewarti* PRESTON 1909. This mussel, which is known in Europe as a decidedly Pleistocene glacial species, has also been identified as recent in the Central Asian high mountainous massifs of Tien Shan, Pamir and the Himalaya (KUIPER 1962, LOŽEK 1964, MENG 1995, KANTOR & SYSOEV 2005, BÖSSNECK & MENG 2006).

In the Central Asian highlands and also in the high regions of Northern Mongolia or in the Baikal area, numerous paleoartic, holarctic and "Scandinavian alpine" species are widespread which had become known as typical

examples of the Pleistocene glacial associations of the Central European region, such as *Pupilla* fauna of many types and shapes, *Cochlicopa lubrica* (O. F. MÜLLER 1774), *Columella columella* (MARTENS 1830), *Vertigo genesii* (GREDLER 1856), *Euconulus* cf. *fulvus* (O. F. MÜLLER 1774), *Nesovitrea petronella* (L. PFEIFFER 1853), *Nesovitrea hammonis* (STRÖM 1765) and others (SCHILEYKO 1984, UVALIEVA 1990, MOISSEVA 1996, MENG 2008a).

The glacial fauna of the Central European region also differs considerably from the present day sub-arctic or alpine gastropod associations by the characteristic occurrence of a series of species in steppe. These also include the xerothermic genus *Pupilla triplicata* (STUDER 1820) which is also found in the high mountainous habitats of Central Asia (SCHILEYKO 1984, LOŽEK 1999, MENG 2008b).

Pupilla loessica was first described by LOŽEK (1954) from late Pleistocene loess from Předmostí near Přerov (Moravia, Czech Republic). At an early date (1986), LOŽEK supported the view that *Pupilla loessica* was alive at the present time in Central Asia. However, no further concrete investigations of this were conducted.

The shells of *Pupilla loessica* are about 3 mm high, thin, cylindrical-ovate and have a rounded conical apex. The approximately 5 strongly curved whorls gradually increase in height and are finely and irregularly ribbed. The short elliptical aperture has no denticles, no palatal callus and is only slightly broadened. The crest is at most indicated by a weak band. The species differs from *Pupilla muscorum* (LINNAEUS 1758) by its smaller size, the strongly rounded and ribbed whorls and the lack of denticles and crest (Fig. 3-7).

For the Pleistocene in Central and Eastern Europe and also in parts of NW Europe, *Pupilla loessica* constitutes a significant glacial index species (LOŽEK 1964, MANIA 1973, ALEXANDROWICZ 1988, 1989, MENG 1995, 1998, FÜKÖH, KROLOPP & SÜMEGI 1995, KROLOPP 2003, DMITRUK 2004, SÜMEGI & KROLOPP 2006). It was widespread above all in the middle and late Pleistocene but individual specimens had also

Table 1: Collections of *Pupilla cf. loessica* with accompanying fauna in Central Asia (absolute individual figures).

- Russia, SE Altay, Khrebet Saylyugem, north east of Kosh Agach (Fig. 2.1-2), habitats (cf. Table 2), 2200-2650 m a.s.l., 50°00.30'/89°13.50'-50°01.45'/89°15.20', 08.2006
- Russia, Aygulakskiy Khrebet, Central Altay, north of Aktash, around Lake Sorulukol, open *Pinus sibirica* woodland, in low bushes and mosses, humid mesophilic, 1940 m a.s.l., 50°30'/87°40', 08.08.2006
- Russia, South Central Altay, Severo Chujskiy Khrebet, south of Čibit, stony slope, in mosses, 1150 m a.s.l., 50°18'/87°30', 18.07.1997
- Russia, South Central Altay, Severo Chujskiy Khrebet, south of Čibit, humid stream bank, 1900-2250 m a.s.l., 50°08'/87°25'-50°15'/87°30', 07.97
- Russia, South East Altay, Yuzhno Chujskiy Khrebet, humid shrubland, c. 2340 m a.s.l., 49°50'/87°52', 08.2006
- Northern Mongolia, western shore of Lake Khövsgöl Nuur near Khatgal, flat shore plateau in meadow with very open *Larix sibirica* woodland (Fig. 2.4), humid mesophilic, on pieces of wood, 1668 m a.s.l., 50°32'43.4"/100°06'09.6", 08.09.2001
- Northern Mongolia, east of Khövsgöl Nuur near Khatgal, stony ground, dry slope exposed to the south (Fig. 2.3), in light soil, mesophilic, surroundings *Larix sibirica* woodland, 1750 m a.s.l., 50°27'51.9"/100°14'35.7", 09.09.2001
- Russia, Yelantsy, west of the Baikal Lake, steep slope with block detritus, in moss, mesophilic, 560 m a.s.l., 52°47'/106°24', 10.08.1997
- Kyrgyzstan, Central Tien Shan, Khrebet Sary Dzash, northern slope, alpine meadow, in part stony sub-surface, 2850-3500 m a.s.l., 42°14'/79°07'-42°16'/79°08', 07.1995
- Kyrgyzstan, Inner Tien Shan, Khrebet Terskey Alatau, northern slope, alpine meadow with abundant herbage, humid, 3400 m a.s.l., c. 41°56'/77°05', 01.07.1995
- Kyrgyzstan, Inner Tien Shan, around Lake Song Köl, Kek Bulak valley east of the Song Köl, through flow moor, 3050 m a.s.l., 41°46'/75°23', 19.07.2005

	Russian Altay					N Mong.		B.	Tien Shan		
	1	2	3	4	5	6	7	8	9	10	11
<i>Novisuccinea altaica</i> (MARTENS 1871)	-	5	-	-	-	-	-	-	10	-	-
<i>Novisuccinea cf. altaica</i> (MARTENS 1871)	-	-	-	-	-	-	-	-	-	-	X
<i>Cochlicopa lubrica</i> (O. F. MÜLLER 1774)	-	-	1	-	-	-	-	-	-	-	-
<i>Columella columella</i> (MARTENS 1830)	31	-	-	-	-	-	-	-	31	-	-
<i>Vertigo alpestris</i> ALDER 1838	-	3	-	-	-	-	-	-	14	-	-
<i>Vertigo cf. alpestris</i> ALDER 1838	-	-	3	-	-	-	-	-	-	-	-
<i>Vertigo genesii</i> (GREDLER 1856)	56	-	-	-	-	-	-	-	-	-	X
<i>Vertigo parcedentata</i> (A. BRAUN 1847)	-	-	-	2	-	-	-	-	2	-	-
<i>Pupilla alluvionica</i> MENG & HOFFMANN 2008	90	-	-	-	-	-	-	-	-	-	-
<i>Pupilla cf. loessica</i> LOŽEK 1954	750	3	2	10	29	95	11	33	28	6	X
<i>Pupilla muscorum</i> (LINNAEUS 1758)	-	5	-	26	-	75	-	-	-	-	X
<i>Pupilla turcmenica</i> (O. BOETTIGER 1889)	-	-	-	-	-	-	-	-	96	-	-
<i>Vallonia kamschatica</i> LIKHAREV 1963	-	-	2	-	-	-	14	27	-	-	-
<i>Vallonia cf. ladacensis</i> (NEVILL 1878)	-	-	-	-	-	-	-	-	18	-	-
<i>Vallonia tenuilabris</i> (A. BRAUN 1843)	183	-	-	1	-	112	5	-	24	9	-
<i>Vallonia</i> sp.	-	-	-	-	-	-	-	-	-	-	X
<i>Nesovitrea petronella</i> (L. PFEIFFER 1853)	-	5	-	-	-	-	-	-	-	-	-
<i>Deroceras cf. altaicum</i> (SIMROTH 1886)	-	1	-	-	-	-	-	-	-	-	-
<i>Euconulus cf. fulvus</i> (O. F. MÜLLER 1774)	12	11	-	3	-	-	-	1	2	-	-
<i>Euconulus cf. praticola</i> (REINHARDT 1833)	-	-	-	-	-	-	-	-	-	-	X
<i>Fruticicola transbaikalia</i> (SCHILEYKO 1978)	-	-	-	-	-	-	-	10	-	-	-
Samples with <i>Pupilla cf. loessica</i>	35	2	1	3	2	1	1	1	2	1	1

B.: Baikal region, N Mong.: Northern Mongolia

Tabelle 1: Aufsammlungen von *Pupilla* cf. *loessica* mit Begleit-Faunen in Zentralasien (absolute Individuenzahlen).

1. Russland, SE-Altay, Khrebet Saylyugem, nordöstlich Kosh-Agach (Abb. 2.1-2), Habitate (siehe Tabelle 2), 2200-2650 m NN, 50°00.30'/89°13.50'-50°01.45'/89°15.20', 08.2006
2. Russland, Aygulakskiy Khrebet, Zentral Altay, nördlich Aktash, Umfeld lake Sorulukol, offener *Pinus sibirica*-Wald, in niedrigen Sträuchern und Moosen, feucht-mesophil, 1940 m NN, 50°30'/87°40', 08.08.2006
3. Russland, S-Zentral Altay, Severo Chujskiy Khrebet, südlich bei Čibit, felsiger Hang, in Moosen, 1150 m NN, 50°18'/87°30', 18.07.1997
4. Russland, S-Zentral-Altay, Severo Chujskiy Khrebet, südlich von Čibit, feuchte Bachufer, 1900-2250 m NN, 50°08'/87°25'-50°15'/87°30', 07.97
5. Russland, SE-Altay, Yuzhno Chujskiy Khrebet, feuchte Staudenflur, ca. 2340 m NN, 49°50'/087°52', 08.2006
6. N-Mongolei, westliche Ufer des lake Khövsgöl-Nuur bei Khatgal, flaches Ufer-Plateau mit Wiese in offenen *Larix sibirica*-Beständen (Abb. 2.4), feucht-mesophil, an Hölzern, 1668 m NN, 50°32'43,4"/100°06'09,6", 08.09.2001
7. N-Mongolei, östlich Khövsgöl-Nuur bei Khatgal, Felsflur, südlich exponierter Trockenhang (Abb. 2.3), in Mulm, mesophil, Umfeld *Larix sibirica*-Wald, 1750 m NN, 50°27'51,9"/100°14'35,7", 09.09.2001
8. Russland, Yelantsy, westlich vom Baikalsee, Steilhang mit Blockschutt, in Moos, mesophil, 560 m NN, 52°47'/106°24', 10.08.1997
9. Kirgyzstan, Zentral-Tien Shan, Khrebet Sary Dzash, nördlicher Hang, Hochgebirgswiesen, z. T. felsiger Untergrund, 2850-3500 m NN, 42°14'/79°07'-42°16'/79°08, 07.1995
10. Kirgyzstan, Innerer Tien Shan, Khrebet Terskej Alatau, nördlicher Hang, krautreiche Hochgebirgswiese, feucht, 3400 m NN, ca. 41°56'/77°05', 01.07.1995
11. Kirgyzstan, Innerer Tien Shan, Umfeld Song Köl, Kek Bulak-Tal östlich des Song Köl, Durchströmungsmoor, 3050 m NN, 41°46'/75°23', 19.07.2005, leg. U. JUEG

been found since the early Pleistocene (MÜNZING 1968, MANIA 1973). This species often accompanies the so-called *Pupilla* fauna and *Columella* fauna (according to LOŽEK 1964). Although it is a frequent loess mollusc (LOŽEK 1965), it apparently lived in various glacial habitats. In addition to *Pupilla* spp., species which like humidity, such as *Columella columella* or *Vertigo genesii*, are also often found together with *Pupilla loessica*.

Indications of the occurrence of *Pupilla loessica* in late Pleistocene loess have also been found in southern Siberia (LAURIN et al. 2000, VELICHKEVICH et al. 2004). However, in the loess sequences of Southern Tajikistan and Southern Kazakhstan no evidence has been found as yet of *Pupilla loessica* (MENG 2008 b, MENG & GERBER 2008). The diversity of the Central Asian Pupillidae is generally relatively complex (SCHILEYKO 1984, UVALIEVA 1990, MENG & HOFFMANN 2008). The following varieties have been found to date in the Altay region: *Pupilla muscorum* (LINNAEUS 1758), *Pupilla triplicata* (STUDER 1820), the

endemic species *Pupilla altaica* MENG & HOFFMANN 2008 and *Pupilla alluvionica* MENG & HOFFMANN 2008 as well as a number of other so far undescribed types of *Pupilla* (POKRYSZKO & HORČÁK 2007, MENG & HOFFMANN 2008). In the Tien Shan area, for example, in addition to *Pupilla muscorum* and *Pupilla triplicata*, *Pupilla turcmenica* (O. BOETTGER 1889) has also been found as well as the local endemic species *Pupilla gallae* TZVETKOV 1940, *Pupilla inequidenta* SCHILEYKO & ALMUHAMBETOVA 1979 and *Pupilla striopolita* SCHILEYKO 1984.

In addition to the types listed, at many sites in Central Asia during recent investigations between 1995-2006 evidence was found of a specimen so far undescribed in this region which is indistinguishable from *Pupilla loessica* in its shell morphology.

2 Material and Methods

In connection with private visits and sponsored projects, it has been possible to investigate nu-

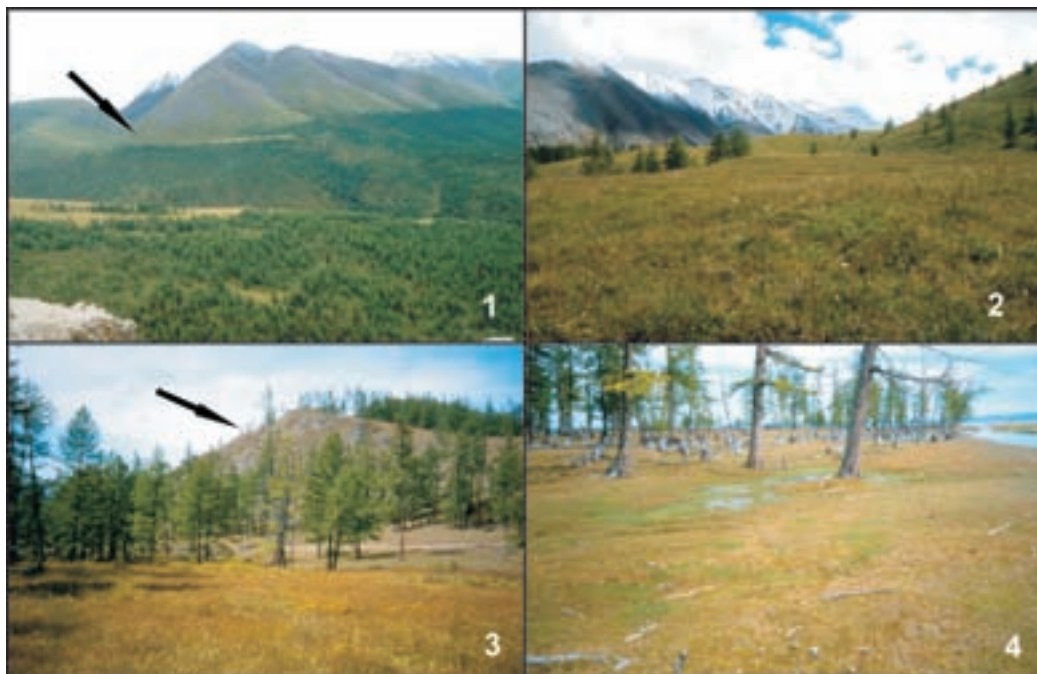


Fig. 2: Habitats of *Pupilla* cf. *loessica* in Central Asia, 1.-2. Russia, SE Altay, Khrebet Saylyugem (Table 2), 1. Panorama, 2. „Alpine tundra“, 2430 m a.s.l. (arrow in 1. is equivalent to 2.), 3.-4. Northern Mongolia near Khatgal (Table 1/6-7), 3. East of Lake Khövsgöl Nuur, dry slope (arrow), 4. Western shore of Khövsgöl Nuur.

Abb. 2: Lebensräume von *Pupilla* cf. *loessica* in Zentralasien, 1.-2. Russland, SE-Altay, Khrebet Saylyugem (Tabelle 2), 1. Panorama, 2. „Alpine Tundra“, 2430 m NN (Pfeil in 1. entspricht 2.), 3.-4. Nord-Mongolei bei Khatgal (Tabelle 1/6-7), 3. Östlich vom See Khövsgöl Nuur, Trockenhang (Pfeil), 4. Westliche Uferbereich vom Khövsgöl Nuur.

merous recent malacocenoses in Central Asia; about 150 specimens collected in the Russian Altay (1997, 2006), 20 specimens from Northern Mongolia (2001), about 20 specimens from the Baikal region, Russia (1997) and more than 130 specimens from Tien Shan, Kyrgyzstan (1995, 1998, 1999, 2005).

The distribution and composition of the fauna communities studied including the potential *Pupilla loessica* (*Pupilla* cf. *loessica*) were documented (Table 1-2, Fig. 1-2). The extensive section of Figures (3-7) provides a comparison between the recent material and Pleistocene forms of *Pupilla loessica* from Central Europa.

The fossil *Pupilla loessica* material from the late middle Pleistocene and late Pleistocene (Saale, Weichsel) came from various sites in

Central Germany, e.g. Erfurt (Thuringia). Freiburg and Karsdorf (Saxony-Anhalt).

3 Results

Altay: In the context of a single expedition supported by the DAAD in August 2006 to the Russian Altay at the intersection of the Western and Eastern Altay (Korgonskiy Khrebet, Seminskiy Khrebet, Onguday, Aykulakskiy Khrebet, Yuzhno Chujskiy Khrebet and Khrebet Saylyugem) 130 malacocenoses were examined.

Whereas only limited *Pupilla* cf. *loessica* material is available from the Central Altay, the findings were concentrated particularly in the more continental SE Altay. There were no findings from the W Altay which is maritime. *Pupilla* cf. *loessica*

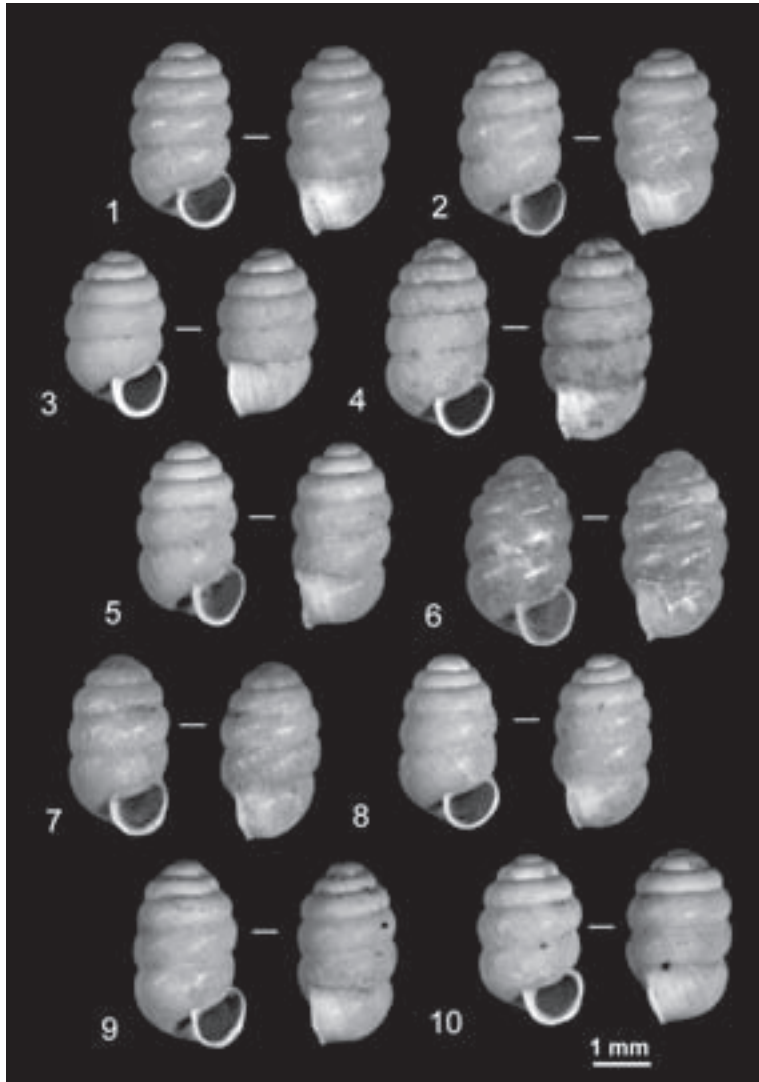


Fig. 3: Pleistocene *Pupilla loessica* from Central Germany.

- 1-2 Karsdorf/Steigra (Saxony-Anhalt), soil, Saalian Complex
- 3-4 Kühnhausen near Erfurt (Thuringia), late Weichsel gravel deposits of the river Gera
- 5 Stotternheim near Erfurt (Thuringia), early Weichsel gravel deposits of the river Gera
- 6 Prömmerberg near Freyburg (Saxony-Anhalt), Weichsel loess
- 7-8 Strienberg, Erfurt-Stedten (Thuringia), Weichsel loess
- 9-10 Mellingen (Thuringia), Weichsel loess

Abb. 3: Pleistozäne *Pupilla loessica* aus Mitteldeutschland.

- 1-2 Karsdorf/Steigra (Sachsen-Anhalt), Fließerde, Saale-Komplex
- 3-4 Kühnhausen bei Erfurt (Thüringen), spätweichselzeitliche Flussschotter der Gera
- 5 Stotternheim bei Erfurt (Thüringen), frühweichselzeitliche Flussschotter der Gera
- 6 Prömmerberg bei Freyburg (Sachsen-Anhalt), weichselzeitlicher Löss
- 7-8 Strienberg, Erfurt-Stedten (Thüringen), weichselzeitlicher Löss
- 9-10 Mellingen (Thüringen), weichselzeitlicher Löss

Table 2: Collections of *Pupilla* cf. *loessica* in the Khrebet Saylyugem, South Eastern Altay, with accompanying fauna (absolute individual figures).

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Alluvions, c. 2230 m a.s.l. 2. Mesophilic meadows some with abundant herb-
age, 2200-2480 m a.s.l. 3. Shrubland and humid stream and river banks,
2240-2400 m a.s.l. 4. Open <i>Larix sibirica</i> woodland, with mosses,
dwarf birch and <i>Dryas oxyodonta</i>, 2200-2400 m
a.s.l. | <ol style="list-style-type: none"> 5. "Alpine tundra", humid alpine meadows with <i>Dryas oxyodonta</i> and <i>Carex</i> sp. also showing frost cracks, 2420-2630 m a.s.l. (Fig. 2.2) 6. Dry slopes with block detritus below the tree line, snails under stones, 2250-2350 m a.s.l. 7. Dry slopes, rocky steppe type, above the tree line, snails under stones, 2410-2510 m a.s.l. |
|--|--|

Tabelle 2: Aufsammlungen von *Pupilla* cf. *loessica* im Khrebet Saylyogem, SE Altay, mit Begleitfaunen (absolute Individuenzahlen).

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Alluvionen, ca. 2230 m NN 2. Mesophile, z.T. kräuterreiche Wiesen, 2200-
2480 m NN 3. Staudenfluren sowie feuchte Bach- und Flus-
sufer, 2240-2400 m NN 4. Offener <i>Larix sibirica</i>-Wald, mit Moosen, Zwerg-
birke und <i>Dryas oxyodonta</i>, 2200-2400 m NN | <ol style="list-style-type: none"> 5. „Hochgebirgstundra“, feuchte Hochgebirgswie-
sen mit <i>Dryas oxyodonta</i> und <i>Carex</i> sp. sowie
Frostaufbrüche, 2420-2630 m NN (Abb. 2.2) 6. Trockenhänge mit Blockschutt im Bereich der
Waldzone, Schnecken unter Steinen, 2250-
2350 m NN 7. Trockenhänge, felssteppenartig, oberhalb Wald-
zone, Schnecken unter Steinen, 2410-2510 m NN |
|--|---|

	1	2	3	4	5	6	7
<i>Columella columella</i> (MARTENS 1830)	-	-	8	11	12	-	-
<i>Vertigo genesii</i> (GREDLER 1856)	-	-	-	3	53	-	-
<i>Pupilla alluvionica</i> MENG & HOFFMANN 2008	88	-	-	-	-	2	-
<i>Pupilla</i> cf. <i>loessica</i> LOŽEK 1954	4	239	68	65	175	163	36
<i>Vallonia tenuilabris</i> (A. BRAUN 1843)	5	33	46	3	64	32	-
<i>Euconulus</i> cf. <i>fulvus</i> (O. F. MÜLLER 1774)	-	-	-	4	8	-	-
Samples with <i>Pupilla</i> cf. <i>loessica</i>	2	9	4	9	7	2	2

occurred most frequently in the Khrebet Saylyugem (Table 1.1-5). Therefore these findings have been examined in greater detail (Table 2).

The area investigated in the Khrebet Saylyugem lies at a height of 2200-2600 m NN. The closest known meteorological station is the Kosh Agach Station (www.globalclimatics.org - Climate Diagrams, <http://meteo.infospace.ru>), 50°01' / 88°44' and 1750 m a.s.l. The average annual temperature recorded amounts to -6.7°C (January -32°C, July 13°C) and the annual rainfall amounts to about 110-150 mm on average. In the Khrebet Saylyugem region where we worked, however, as the height increases with corresponding exposure one can assume considerably higher rainfall.

Pupilla cf. *loessica* is found in various different habitats in the Khrebet Saylyugem. These habitats range from stony steppe via open woodland with *Larix sibirica*, shrubland, mesophilic meadows to humid high altitude meadows with *Carex* sp. and *Dryas oxyodonta* (alpine tundra). It is striking that in the Khrebet Saylyugem, despite the numerous specimens of *Pupilla* cf. *loessica* collected, the number of accompanying species identified was relatively small (Table 2). In addition, especially on the humid alpine meadows, the accompanying fauna found comprised *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris* and *Euconulus* cf. *fulvus* which most surprisingly correspond to those of the Pleistocene glacial habitats of

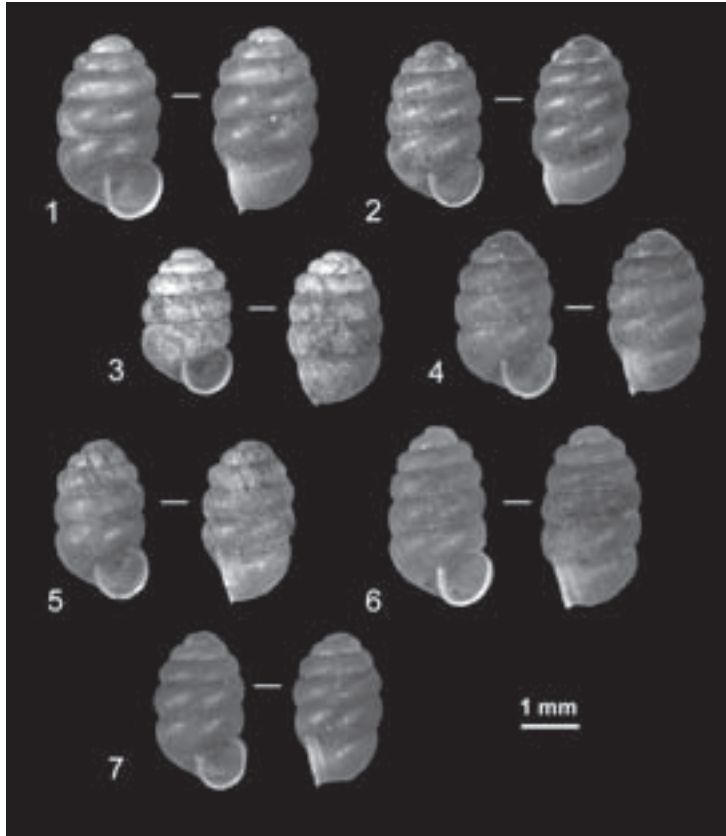


Fig. 4: Recent *Pupilla* cf. *loessica* from Russian Altay, SE Altay.

- 1 Yuzhno Chujskiy Khrebet, humid shrubland (Table 1/5)
- 2-7 Khrebet Saylyugem (Table 2, Fig. 2/1-2)
- 2 "Alpine tundra", humid alpin meadows
- 3 Mesophilic meadows
- 4-6 Dry slopes, rocky steppe type
- 7 Open *Larix sibirica* woodland

Abb. 4: Rezente *Pupilla* cf. *loessica* aus dem Russischen Altay, SE Altay.

- 1 Yuzhno Chujskiy Khrebet, feuchte Staudenflur (Tabelle 1/5)
- 2-7 Khrebet Saylyugem (Tabelle 2, Abb. 2/1-2)
- 2 "Alpine Tundra", feuchte alpine Wiesen,
- 3 Mesophile Wiesen,
- 4-6 Trockene Hänge, felssteppenartig,
- 7 Offener *Larix sibirica* Wald

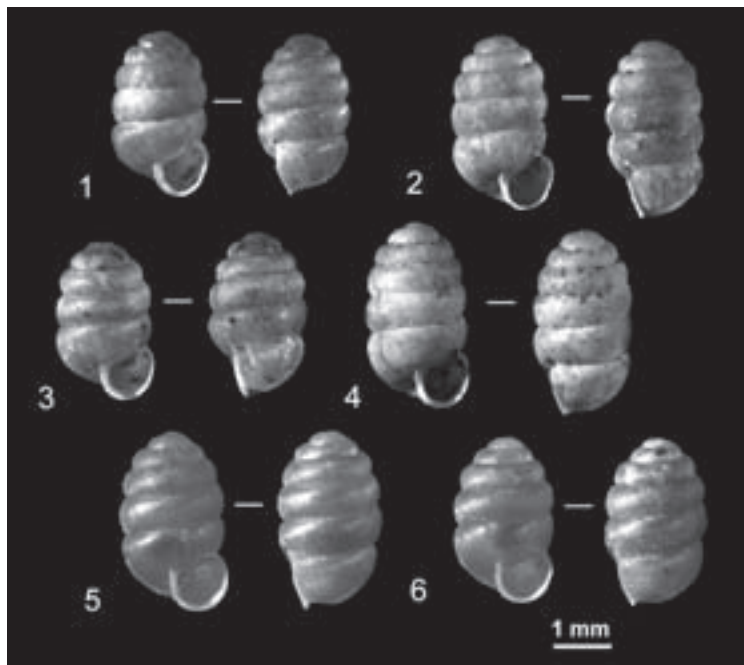


Fig. 5: Recent *Pupilla* cf. *loessica* from Northern Mongolia and from the Baikal region.
 1-3 Russia, Yelantsy, west of Baikal Lake, steep slope with block detritus (Table 1/8)
 4 N Mongolia, east of Lake Khövsgöl Nuur, stony ground, dry slope (Table 1/7, Fig. 2/3)
 5-6 N Mongolia, western shore of Khövsgöl Nuur, flate shore plateau (Table 1/6, Fig. 2/4)

Abb. 5: Rezente *Pupilla* cf. *loessica* aus der N-Mongolei und vom Baikal.
 1- 3 Russland, Yelantsy, westlich vom Baikalsee, Trockenhang mit Gesteinsschutt (Tab. 1/8)
 4 N-Mongolei, östlich vom See Khövsgöl Nuur, Trockenhang, felsig (Tab. 1/7, Abb. 2.3)
 5- 6 N-Mongolei, westliches Ufer vom Khövsgöl Nuur, flaches Ufer-Plateau (Tab. 1/6, Abb. 2/4)

the Central European region (LOŽEK 1964, MANIA 1973, MENG 1995). Apart from the shell morphology criteria, the ecological conditions would also seem to indicate that the recent form found may correspond to the Pleistocene *Pupilla loessica*.

The cylindrical, ovate, thin-walled shells are usually a strong brown colour when fresh. The fine ribs evidence very low, fragile rims which are not always visible. On weathered shells the fine ribs are still visible although less pronounced, as on the shells of the Pleistocene *Pupilla loessica*. The height of the shells of this recent form from the Altay amounts to c. 2.5-3.3 mm and the width of the shells is c. 1.6-1.8 mm, thus also corresponding to the variations

of the fossil forms (Fig. 3, 4). There were also a few larger ribbed forms and their shells were more bulbous or more cylindrical. It is not yet clear to what extent these specimens can be distinguished from *Pupilla* cf. *loessica*.

Evidence was found by the authors of *Pupilla muscorum* in the Altay with data so far from the Aygulakiy Khrebet and Severo Chujskiy Khrebet. However, *Pupilla muscorum* occurs very frequently in the Tien Shan area. This species was also found in Northern Mongolia and the Baikal region (Fig. 7).

Northern Mongolia: Two occurrences of *Pupilla* cf. *loessica* were found in a mountainous region of Northern Mongolia in the area

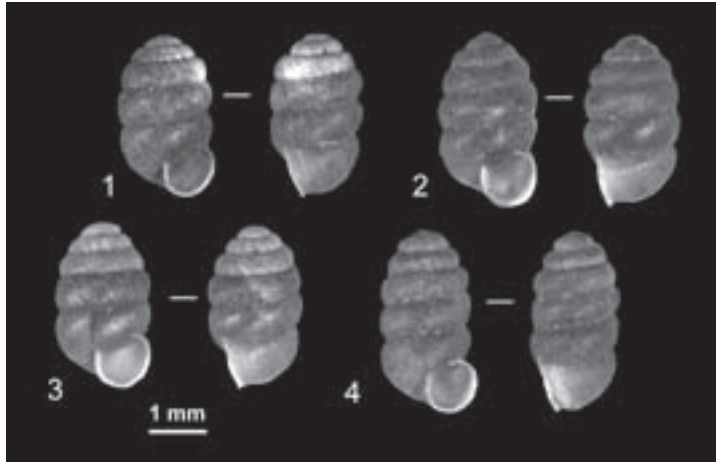


Fig. 6: Recent *Pupilla* cf. *loessica* and *Pupilla turcmenica* from the Tien Shan, Kyrgyzstan
 1-3 *Pupilla* cf. *loessica* (Table 1/9-11)
 1 Khrebet Sary Dzash, alpine meadow
 2 Khrebet Terskey Alatau, alpine meadow
 3 Around Lake Song Köl, through flow moor, alpine meadow
 4 *Pupilla turcmenica*, Khrebet Terskey Alatau, alpine meadow, 3800 m a.s.l.

Abb. 6: Rezente *Pupilla* cf. *loessica* und *Pupilla turcmenica* aus dem Tien Shan, Kyrgyzstan
 1-3 *Pupilla* cf. *loessica* (Tabelle 1/9-11), 1
 1 Khrebet Sary Dzash, alpine Wiesen
 2 Khrebet Terskey Alatau, alpine Wiesen
 3 Umfeld des Sees Song Köl, Durchströmungsmoor, alpine Wiesen
 4 *Pupilla turcmenica*, Khrebet Terskey Alatau, alpine Wiesen, 3800 m NN

around the Khövsgöl Nuur lake near Khatgal at c. 1670 m a.s.l. (Table 1, 6-7). The first site was directly on the shore of the Khövsgöl Nuur on a shore plateau with a sparse scattering of *Larix sibirica* and mesophilic to humid meadows. *Pupilla* cf. *loessica* was accompanied by *Vallonia tenuilabris* and *Pupilla muscorum*. In neighbouring more humid shore areas *Vertigo genesii* and *Columella columella* were also found. The second site of the findings was in a stony steppe habitat and the accompanying species were *Vallonia tenuilabris* and *Vallonia kamschatica*. Whereas the *Pupilla* cf. *loessica* from the lake shore had somewhat more ovate, bulbous shells, those from the steppe slopes were somewhat more cylindrical (Fig. 5).

The meteorological station of Khatgal (1670 m a.s.l.) in the immediate neighbourhood registered an average annual temperature of -4.9°C

(January -23.2°C , July 11.6°C) and an annual rainfall of 292 mm which indicates the continental nature of the area. The climatic data for Northern Mongolia together with the fauna and zoo-geographical relationships also reveal interesting parallels to the conditions in the Central European glacial habitats.

Baikal Region: Specimens of *Pupilla* cf. *loessica* have also been collected from the Baikal region, Yelantsy, 560 m a.s.l., to the west of the Baikal lake (Table 1.8, Fig. 5). The accompanying species on the mesophilic slope with block detritus were *Vallonia kamschatica*, *Euconulus* cf. *fulvus* and *Fruticicola transbaikalia*.

The meteorological station of Trkutsch which is relatively close ($52^{\circ}16'/104^{\circ}21'$), at 485 m a.s.l., reported average annual temperatures of

about 0°C and an annual rainfall of 483 mm. The climate can be described as sub-boreal continental.

Tien Shan: Despite the numerous findings in the Tien Shan mountains, *Pupilla* cf. *loessica* was relatively rare there (Table 1.9-11, Fig. 6). The specimens came from high altitude habitats around 3000 m a.s.l. or considerably higher. The habitats in the areas of the central Tien Shan where findings were made, Khrebet Sary Dzash, and in the inner Tien Shan, Khrebet Terskey Alatau, as well as the area around the Song Köl lake, are normally more humid alpine meadows, some of them with abundant herbage or with *Carex* sp.

The significant species adapted to the cold which were found here were again e.g. *Columella columella*, *Vallonia tenuilabris*, *Vertigo genesii* and *Vertigo parcedentata*. But, compared with the Altay region, these fauna evidenced a greater variety overall, including e.g. *Novisuccinea altaica*, *Vertigo alpestris*, *Pupilla muscorum*, *Pupilla turcmenica*, *Vallonia* cf. *ladacensis*, etc. (MENG 2008a).

The climate in the Tien Shan has a strong exposure effect as a result of radiation and more humid northern slopes. Although Central and Inner Tien Shan are generally considered arid, in the course of the differences in exposure and the variations of altitudes on the mountain slopes in the alpine region, humid conditions are sometimes found. The annual rainfall in the Khrebet Terskey Alatau can amount to as much as 900 mm (GOTTSCHLING 2002). In the Northern Tien Shan it can considerably exceed 1000 mm. In the part of the Khrebet Sary Dzash studied, the annual rainfall amounts to 300-400 mm (Atlas Kirgizskoy SSR, 1987). The annual 0°C isotherm in the Northern Tien Shan is found at about 2900 m a.s.l. At heights in excess of 3000 m a.s.l., the average annual temperature is considerably below 0°C (BOLCH 2005).

It is problematic that the Tien Shan is the main distribution area of *Pupilla turcmenica* because a clear differentiation of the shell morphology of this species from *Pupilla* cf. *loessica* is probably not always one hundred percent possible (Fig. 6.4). Nevertheless, the shells of *Pupilla turcmen-*

ica are narrower and more cylindrical. The form of the aperture is also more strongly developed. The edge of the aperture is markedly thickened and a parietal denticle is also often present. The crest is more pronounced (SCHILEYKO 1984).

4 Discussion

Despite the opinion expressed and published by LOŽEK (1986) that *Pupilla loessica* is a recent occurrence in Central Asia, a discussion of this question has never been started. The aim of this study is to change the situation and to make some initial contributions to the discussion. The study should be understood as a basis for further investigations.

The arguments in favour of the occurrence of *Pupilla loessica* in Central Asia, apart from the shell morphology criteria, are the preference for more strongly continental habitats with average annual temperatures markedly below 0°C and the corresponding accompanying fauna adapted to the cold, e.g. *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris*, etc., which make these fauna clearly comparable to the Pleistocene glacial associations of the Central European region.

POKRYSZKO & HORCÁK (2007 – World Congress of Malacology, Antwerp) mention *Pupilla alabiella* from the Altay (SCHILEYKO 1984). This species also shows greater morphological similarities compared with *Pupilla loessica* (cf. SCHILEYKO 1984). From the zoo-geographical point of view, however, there are major doubts about the occurrence of this species in the Altay because *Pupilla alabiella* has only been found thus far on the islands of Verchovkiy and Dva Brata in the bay of Peter the Great in the Far East, Primorskiy Kray (SCHILEYKO 1984, KANTOR & SYSOEV 2005). In addition, *Pupilla* cf. *loessica* is concentrated mainly in the strongly continental South East of the Altay and appears to be lacking in the maritime Western Altay (Table 1, 2, Fig. 1). Furthermore, the question is also unanswered why *Pupilla alabiella* is not more widespread in the Primorskiy Kray (Red Book, Primorskiy Kray, GULBIN & PROZOROVA 2002). However, should it be established that *Pupilla alabiella* and *Pupilla*

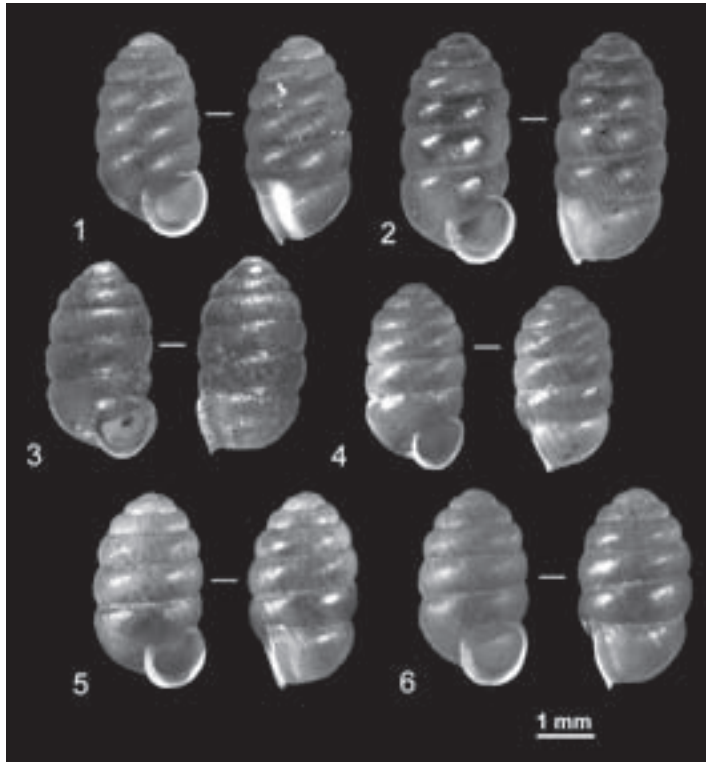


Fig. 7: Recent *Pupilla muscorum* in Central Asia.

- 1 Southern Kyrgyzstan, Tien Shan, Madygen, humid meadow, 1550 m a.s.l.
- 2 Kyrgyzstan, Tien Shan, Khrebet At Bai, alpine meadow, 3200 m a.s.l.
- 3 Russia, Yelantsy, west of the Baikal Lake, humid meadow, 550 m a.s.l.
- 4 Russia, South Central Altay, Severo Chujskiy Khrebet, humid meadow, 2100 m a.s.l.
- 5-6 N Mongolia, western shore of Khövsgöl Nuur, flate shore plateau (Table 1/6, Fig. 2/4)

Abb. 7: Rezente *Pupilla muscorum* in Zentralasien.

- 1 S.-Kyrgyzstan, Tien Shan, Madygen, feuchte Wiesen, 1550 m NN
- 2 Kyrgyzstan, Tien Shan, Khrebet At Bai, alpine Wiesen, 3200 m NN
- 3 Russland, Yelantsy, westlich vom Baikalsee, feuchte Wiesen, 550 m NN
- 4 Russland, S.-Zentral-Altay, Severo Chujskiy Khrebet, feuchte Wiesen, 2100 m NN
- 5-6 N-Mongolei, westliche Ufer vom Khövsgöl Nuur, flaches Uferplateau (Tabelle 1/6, Abb. 2/4)

loessica are synonyms, then precedence should be given to the *Pupilla loessica* species according to the principle of priority.

Our study adds another piece to the puzzle of Pleistocene animal communities and their usage for climatic reconstructions. Recent analogues of the glacial environmental conditions and the species living in them may indeed be sought in the mountains of Central Asia.

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