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# The first finding of *Pupilla pratensis* for Ukraine in the Crimean Mountains with remarks on its conservation status and differences from *Pupilla muscorum* (Stylommatophora, Pupillidae)

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**ABSTRACT.** Rare European species *Pupilla pratensis* is registered in the same calcareous fen in the Crimean Mountains, where *Vertigo moulinsiana*, another rare European species, was found earlier. Both species are known in Ukraine only from this small site (less than 0.01 km<sup>2</sup>), which is disturbed and not protected, therefore both species are clearly “Critically Endangered” here. In the materials of *Pupilla muscorum* from Ukraine some unusually large specimens with shell width 1.9–2.0 mm were revealed. Therefore *P. pratensis* and *P. muscorum* can’t be distinguished by this character alone, as it was sometimes considered before.

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The Crimean Mountains are a small mountain system located parallel to the Black Sea coast in the south of the Crimean Peninsula (southern Ukraine). Their extension is about 160 km and width is up to 50 km, highest point – 1545 m (Roman-Kosh Mountain). Terrestrial molluscs of the Crimean Mountains were studied in details as early as the late nineteenth century – beginning of the twentieth century, when most known now species were recorded. But each mountain system contains very diverse habitat conditions, and some invertebrate populations can exist in a very restricted area. Therefore new species still can be found in Crimea. In this way probably native species such as *Vertigo moulinsiana* (Dupuy 1849), *Deroceras subagreste* (Simroth 1892), *Boettgerilla pallens* Simroth 1912 and *Selenochlamys* cf. *ysbryda* Rowson et Symondson 2008 were registered for the first time in Crimea in 2009–2012 [Gural-Sverlova *et al.*, 2009; Balashov, Palatov, 2011; Balashov, 2012; Balashov, Baidashnikov, 2012]. The 104 species of terrestrial molluscs currently registered in Crimea, include 21 endemics [Balashov, Gural-Sverlova, 2012; Balashov, 2012; Balashov, Baidashnikov, 2012, 2013]. New rechecking of the materials collected together with *V. moulinsiana* in 2009–2010 has shown that one shell, which was earlier identified as *Pupilla muscorum* (Linnaeus 1758) [Balashov, Palatov, 2011],

actually belongs to *Pupilla pratensis* (Clessin 1871), which was not registered in Ukraine yet.

*P. pratensis* was mostly considered as an eco-morph of *P. muscorum* until 2009. Recent revision clearly separated these species by morphology, ecology and DNA-barcoding [Proschwitz *et al.*, 2009]. Presently the specific status of *P. pratensis* seems to be generally accepted, this snail is currently known in Norway, Sweden, Denmark, Germany, Poland, Czech Republic, Slovakia, Ireland [Proschwitz *et al.*, 2009; Proschwitz, 2010; Horsák *et al.*, 2010, 2012] and probably Austria, Switzerland, Hungary, and England [Welter-Schultes, 2012]. In most of these countries no more than few recent locations are known. Habitat of *P. pratensis* is calcareous fens and wet meadows. Species is considered to be endangered at least in Poland, Czech Republic, and Slovakia [Horsák *et al.*, 2010, 2012].

## Material and methods

Material was collected by the author on 06.07.2009, 26.08.2010 and 10.10.2010 in the Pjataja Balka (“fifth ravine”) tract, about 2 km north to Ternovka village and about 2 km west to Hodzha Sala village, between the Shuldan cave monastery and ruins of Eski-Kermen cave town-fortress. Most part of tract, including main site with fen, is located in Balaklava district of Sevastopol city council, lower part is located in Bakhchysarai district of Autonomous Republic of Crimea. A main site, where *P. pratensis* and *V. moulinsiana* were collected, is 400 m above sea level, at 44°35'55"N–33°45'36"E. This site is a small fen with few springs on the banks of two small lakes and stream on a bottom of the large rocky ravine. Length of ravine with stream is about 1100 m, fen is located in its upper part among oriental hornbeam forest, which grows along the stream below a fen, on the slopes of ravine and above the ravine. Also some steppes and dry meadows located around. Among the plants on the fen there are *Carex* spp., *Petasites hybridus*, *Equisetum*

*telmateia*, *Eupatorium cannabinum*, *Typha latifolia*, *Epilobium* spp., *Stachys palustris*, *Chaiturus marrubiastrum*, *Sambucus herbacea*, *Sphagnum* sp. and others. Area of fen is less than 0.01 km<sup>2</sup>.

In Pjataja Balka tract 33 mollusc species were collected: *Pupilla pratensis* (Fig. 1A), *Vertigo moulinsiana* (Fig. 1C), *Vertigo pygmaea* (Draparnaud, 1801), *Vertigo pusilla* Müller, 1774, *Columella* cf. *columella* (Martens, 1830), *Columella edentula* (Draparnaud, 1805), *Truncatellina costulata* (Nilsson, 1823), *Lauria cylindracea* (Da Costa, 1778), *Acanthinula aculeata* (Müller, 1774), *Vallonia costata* (Müller, 1774), *Cochlicopa lubrica* (Müller, 1774), *Cochlicopa lubricella* (Porro, 1838), *Merdigera obscura* (Müller, 1774), *Peristoma rupestre* (Krynicky, 1833), *Chondrula tridens* (Müller, 1774), *Mentissa canalifera* (Rossmässler, 1836), *Mentissa gracilicosta* (Rossmässler, 1836), *Punctum pygmaeum* (Draparnaud, 1801), *Euconulus fulvus* (Müller, 1774), *Zonitoides nitidus* (Müller, 1774), *Vitrea contracta* (Westerlund, 1871), *Perpolita hammonis* (Strøm, 1765), *Aegopinella minor* (Stabile, 1864), *Oxychilus diaphanellus* (Krynicky, 1836), *Vitrea pellucida* (Müller, 1774), *Tandonia cristata* (Kaleniczenko, 1851), *Deroceras tauricum* (Simroth, 1901), *Helix lucorum* Linnaeus, 1758, *Monacha fruticola* (Krynicky, 1833), *Succinea putris* (Linnaeus, 1758), *Oxyloma sarsii* (Esmark, 1886), *Carychium minimum* Müller, 1774 and *Carychium tridentatum* (Risso, 1826). *O. sarsii* was earlier reported from Pjataja Balka as *Oxyloma* sp. by the empty shells [Balashov, Palatov, 2011], but later I have found one preserved in alcohol specimen in my materials, it was overlooked earlier, and now the species was identified by reproductive system anatomy.

For comparison collections of *Pupilla muscorum* in Schmalhausen Institute of Zoology NAS of Ukraine (Kyiv) and State Museum of Natural History NAS of Ukraine (Lviv) were examined: more than 1100 shells from 58 locations in 16 regions of Ukraine (Lviv, Ivano-Frankivsk, Chernivtsy, Ternopil, Khmelnytsky, Vinnytsia, Cherkasy, Kirovograd, Mykolaiv, Odessa, Kyiv, Chernigiv, Poltava, Kharkiv, Lugansk and Crimea).

## Results and discussion

In studied materials a single specimen similar to *Pupilla pratensis* was found in the Pjataja Balka tract (Fig. 1A). Shell elongate-oval, much narrowed to apex relatively to its middle part, comparatively thin, dark brown, of 5.5 moderately convex whorls. Striation (growth lines) relatively well pronounced. Aperture rounded, with moderate lip. Parietal and palatal teeth very weak. Palatal tooth looks like unclear ovate prominence. Callus moderate, light. Umbilicus partly closed, drop-shaped, width 0.15

mm. Height of shell 2.9 mm, width of shell 1.80 mm, height of aperture 0.9 mm, width of aperture 1 mm.

Specimen was collected alive after rain in October from the lower side of a living *Petasites hybridus* leaf, in about 1 m above the ground. Density of molluscs is probably very low, since site was studied quite intensively and only one specimen was found.

Found shell differs from *P. muscorum* in the same way as *P. pratensis* [Clessin, 1871; Proschwitz *et al.*, 2009; Proschwitz, 2010; Horsák *et al.*, 2010, 2012]: it is thinner, much darker, with more pronounced sculpture and similar to *P. pratensis* in aperture shape and width of shell. It also was collected exactly in same habitat where *P. pratensis* normally lives, and which *P. muscorum* usually does not (or even never) inhabit – undisturbed calcareous fen, and moreover quite high above ground. *P. muscorum* did not occur on the surrounding plots, it was not registered in this part of the Crimean Mountains and is very rare in Crimea. I have studied only 4 shells of *P. muscorum* from the Crimea (State Museum of Natural History NAS of Ukraine) that were collected in two forest locations of the southern Crimean Mountains (near Yalta and Orlineo). These shells are typical *P. muscorum* (width of shell 1.65-1.7 mm). Since the latter species is rare in the Crimea it is unlikely that discussed specimen can be an anomalous shell of *P. muscorum*, just similar to *P. pratensis* and was occasionally transferred to unusual habitat.

Furthermore this shell of *P. pratensis* slightly differs from all European *Pupilla* species by its unusual elongate-oval shape: shell is much narrowed to the apex relatively to its middle part in similar way to some *Vertigo* species. Most similar known for me shape of the shell in *Pupilla* is showed on a photograph of *P. pratensis* in revision of this species [Proschwitz *et al.*, 2009: fig. 1 F]. Syntype of *P. pratensis* is also slightly elongate-oval [Proschwitz *et al.*, 2009: fig. 1 A]. From *P. pratensis* Crimean shell also differs by slightly shorter shell and lower number of whorls: 2.9 mm at 5.5 whorls instead of minimal known 3.25 mm and 6 whorls in *P. pratensis* [Proschwitz *et al.*, 2009; Proschwitz, 2010; Horsák *et al.*, 2010, 2012; Welter-Schultes, 2012]. These differences may signify that described shell belongs to a new subspecies of *P. pratensis* or even to the new species.

Larger shell width was considered as one of the more or less constant differences between *P. pratensis* and *P. muscorum*: 1.75-2.1 mm (usually 1.8-2.1 mm) in the first species against 1.65-1.8 mm (usually 1.65-1.75 mm) in the second [Proschwitz *et al.*, 2009; Proschwitz, 2010; Horsák *et al.*, 2010, 2012; Welter-Schultes, 2012]. In this respect it is quite notable that in studied materials of *P. mus-*

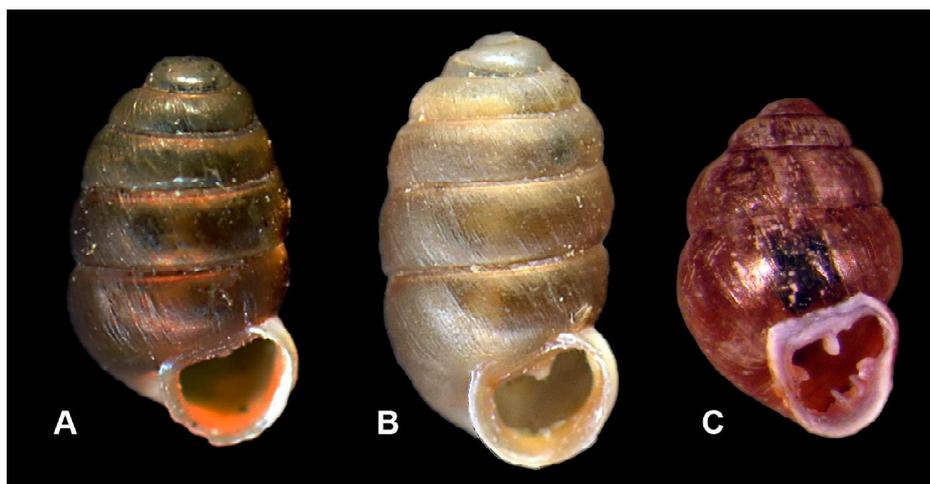


FIG. 1. *Pupilla pratensis* (2.9x1.8 mm, photo by A.A. Baidashnikov) [A] and *Vertigo moulinsiana* (2.5x1.6 mm) [C] from Pyataya Balka tract in Crimea; large shell of *Pupilla muscorum* from Mykolaiv region (3.5x1.9 mm, photo by A.A. Baidashnikov) [B].

РИС. 1. *Pupilla pratensis* (2,9x1,8 мм, фото А.А. Байдашников) [А] и *Vertigo moulinsiana* (2,5x1,6 мм) [С] из урочища Пятая балка в Крыму; крупная раковина *Pupilla muscorum* из Николаевской области (3,5x1,9 мм, фото А.А. Байдашников) [В].

*corum* from Ukraine there are some shells with width 1.9-2.0 mm (Fig. 1B). These larger shells occur mainly sporadically among usual shells with width 1.7-1.8 mm in the materials from Podolian Upland and Black Sea Lowland. In one series of the 14 adult shells from the Dmytrovka village (Black Sea coast, Mykolaiv region, leg. Kramarenko S.S., 2006) shell height is 3.2-3.6 mm and shell width is 1.8-2.0 mm (Fig. 1B), most of the shells have width 1.9 mm and only three – 1.8 mm. All these larger shells of *P. muscorum* from Ukraine differ from *P. pratensis* by the other distinctive characteristic and were collected in relatively dry habitats. Consequently, these two species can't be distinguished only by the shell width. Species should be determined mainly by the thinner, darker, slightly more striated shell, less variable aperture (toothless or with very weak parietal and palatal teeth), usually weaker lip and callus in *P. pratensis* and by the habitat preferences. Perhaps clearly elongate-oval shape of shell is also characteristic of some *P. pratensis* only.

Subspecies *Pupilla muscorum densegyrata* Ložek, 1954, that was described from the Pleistocene of Czech Republic, seems to be similar to *P. pratensis*. It was already noticed in original description [Ložek, 1954, 1955]. Nevertheless the status of *P. densegyrata* and its relationships with *P. pratensis* can not be easily established, since the former is a fossil species, while *P. pratensis* can be clearly determined only by the fresh shells and ecological preferences or by the structure of DNA. Therefore many reports of *P. densegyrata* can probably refer to fossil *P. pratensis*. There are some reports of *P. densegyrata* from the late Pleistocene of Podolian

Upland in Ukraine that were used as an indicator of the cold climate here [Kunica, 2007]. It is quite possible, that these fossil shells from Podolian Upland belong to *P. pratensis*. Perhaps exactly in the cold periods of late Pleistocene *P. pratensis* extended to Crimea from the mainland part of Ukraine and remain till today in the studied refuge of the Pjataja Balka tract.

Majority of the registered in the Pjataja Balka tract molluscs species are more or less common for the Crimean Mountains, mainly for its forests. Most unusual here are three species – *P. pratensis*, *Vertigo moulinsiana* (for both of them it is an only known locality in Ukraine) and arctoalpine *Columella* cf. *columella*. Also there are four Palearctic species that are confined mainly to the rivers and lakes – *Carychium minimum*, *Zonitoides nitidus*, *Succinea putris* and *Oxyloma sarsii*. These species are quite common in the plain parts of Ukraine, but there are only few findings in the Crimean Mountains. So it can be said that in species composition of the terrestrial molluscs of Pjataja Balka tract there is some unusual for Crimea hygrophilous and cold-loving element, which probably remain due to the specific humid and cold microclimate of this ravine. Maybe it is associated with humid and cold climate of some Pleistocene periods [Kunica, 2007] and it is possible that this ravine is a Pleistocene refuge.

*Vertigo moulinsiana* is one of the most protected molluscs species in Europe, it is listed in the Annex II of the European "Habitats Directive" and in the numerous regional, national and international red lists. This species occurs sporadically across Europe, to Caucasus and Atlas Mountains, and lives

in well-preserved wet calcareous habitats. It declines mainly due to the anthropogenic changes in hydrological regime of the various wetlands [Cameron *et al.*, 2003]. On the global level conservation status of *V. moulinsiana* is considered as “Vulnerable” (IUCN Red List). For Crimea and Ukraine it was considered as “Critically Endangered” [Balashov, Palatov, 2011].

*P. pratensis* lives in the similar habitats to *V. moulinsiana* and other *Vertigo* species from Annex II of the “Habitats Directive”, first of all *Vertigo geyeri* Lindholm, 1925. For Central Europe *P. pratensis* is even more endangered and has narrower ecological niche than mentioned species [Horsák *et al.*, 2010, 2012]. Probably *P. pratensis* declines mainly due to the same reasons as *V. moulinsiana* and *V. geyeri* – changes in hydrological regime of its habitats.

Pjataja Balka tract is not a protected area. Some anthropogenic hydrological transformation was taking place here. It seems that some small fill dam was created to make lakes more full-flowing. But it is hard to say how much it changes habitat. Largest spring here is transformed by placing a drain well in lower part of the tract. Outside tract a bed of this stream is completely transformed, it flows in ditch along a dirt road in pastures. So currently wetland of Pjataja Balka tract is isolated from any other similar habitats.

But the main problem for biodiversity here is a recreational activities. This area is attractive for the tourists. Along the stream and lakes in Pjataja Balka tract there is a dirt road that is intensively used by the touristic off-road vehicles. In a result the banks of the stream and lakes are very rutted, including places where *P. pratensis* and *V. moulinsiana* lives. On the banks of lakes and along a stream there are several places regularly used for the tent camps, in spite of equipped place for this on adjacent to tract area. All these activities considerably reduce occupancy area of *P. pratensis* and *V. moulinsiana* in this fen, which area is less than 0.01 km<sup>2</sup>. If recreation activities would become more intensive or if new significant hydrological transformation will take place, both species will certainly get extinct here. Consequently, *P. pratensis* and *V. moulinsiana* are obviously “Critically Endangered” in Ukraine by the criteria of IUCN – CR B1ab(i-iv) and B2ab(i-iv) [IUCN..., 2001; Guidelines..., 2003]. Protected area should be created in Pjataja Balka tract, where recreation should be severely regulated and any further habitat transformation should be forbidden.

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Первая находка *Pupilla pratensis* для Украины в Крымских горах с замечаниями о его природоохранном статусе и отличиях от *Pupilla muscorum* (Stylommatophora, Pupillidae)

И. БАЛАШЁВ

**РЕЗЮМЕ.** Редкий европейский вид *Pupilla pratensis* зарегистрирован на том же болотистом карбонатном лугу в Крымских горах, где ранее был найден другой редкий европейский вид – *Vertigo moulinsiana*. Оба вида известны в Украине только из этого небольшого участка (менее 0.01 км<sup>2</sup>), который нарушается и не защищен, потому оба вида здесь отчуждены “Critically Endangered” (“под критической угрозой”). В материалах *Pupilla muscorum* из Украины присутствуют некоторые необычные крупные экземпляры с шириной раковины 1.9-2.0 мм, потому *P. pratensis* и *P. muscorum* не могут быть отличены только по этому признаку, как это отчасти считалось ранее.

