Vol. 20(1): 21–26
FOLIA MALACOLOGICA
ISSN 1506-7629
The Association of Polish Malacologists
& Faculty of Biology, Adam Mickiewicz University
Poznań 2012
doi: 10.2478/v10125-012-0003-5

THE SECOND SITE OF *PUPILLA ALPICOLA* (CHARPENTIER, 1837) AND THE FIRST RECENT RECORD OF *PUPILLA PRATENSIS* (CLESSIN, 1871) IN POLAND

MICHAL HORSÁK, VERONIKA SCHENKOVÁ, JAN MYŠÁK

Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic
(email: horsak@sci.muni.cz)

ABSTRACT: The second site of *Pupilla alpicola* (Charpentier) was found in Poland in 2010. It is a treeless alkaline fen located close to the village of Czarny Dunajec (Nowy Targ region, S. Poland). The site is the north-western extension of the Western Carpathian distribution of the species, being more than 30 km away from the previously known Polish site near Niedzica village and also from its known sites in Slovakia. The first recent record of *Pupilla pratensis* (Clessin) in Poland was found in the north-easternmost part of Poland close to the border with Lithuania, in the vicinity of the village of Rowele. It is an extension of the species' distribution in NW. Europe and also the easternmost known record of this taxon. Both species are exclusive inhabitants of calcareous fens and fen meadows, highly endangered and mostly isolated, and deserve attention of nature conservation agencies. They seem to be very rare in Poland, because no further population was documented at 25 suitable alkaline fen sites sampled mainly in 2010 and 2011 across the southern and eastern part of Poland.

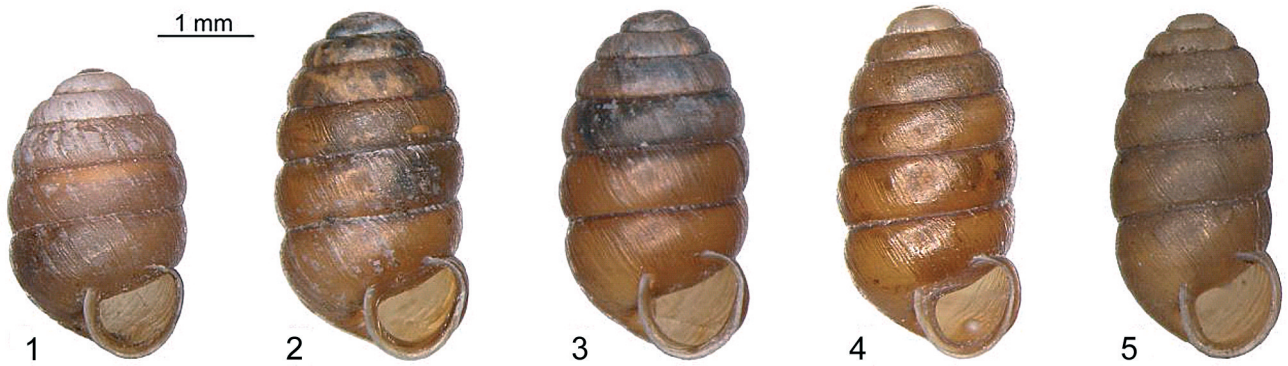
KEY WORDS: calcareous fens, *Pupilla alpicola*, *Pupilla pratensis*, Poland, new records

INTRODUCTION

Pupilla alpicola (Charpentier, 1837) is a minute terrestrial snail (Figs 1–3) with a scattered distribution in central Europe; most of its sites are located in the Alps and the Western Carpathians (HORSÁK et al. 2011). It is a threatened glacial relict limited to small and isolated calcareous fen habitats. The first record from Poland was published by ALEXANDROWICZ (1992, 1994), who found this snail in a small spring, tufa-forming fen close to Niedzica village in the Pieniny Mts. The site is located only 2 km away from the Slovak border and ca 10 km from a relatively common occurrence of the species in Slovakia (Fig. 6, see also HORSÁK et al. 2007, 2011). The time when the species colonised the site in Niedzica was estimated based on radiocarbon dating as about one thousand years ago (ALEXANDROWICZ 1994).

Pupilla pratensis (Clessin, 1871) was recently confirmed as a distinct species from *P. muscorum* (Linné, 1758) based on morphological (Figs 4, 5), ecological and molecular evidence (VON PROSCHWITZ et al. 2009). So far, the occurrence of the species has been reliably confirmed from Norway, Sweden, Denmark, Ireland, Germany, Poland, Czech Republic and Slovakia, however, mostly only on the basis of voucher specimens (VON PROSCHWITZ et al. 2009, VON PROSCHWITZ 2010, HORSÁK et al. 2010). It was reported from Poland (Kobylno, Upper Silesia) based on more than 120 year old voucher material (GOLDFUSS 1883, deposited in the Westerlund Collection, no. 2306; see VON PROSCHWITZ et al. 2009). The species' ecology is similar to that of *P. alpicola*. It occurs in calcium-rich fen meadows, also treeless calcareous fens and sloping wetlands with calcium-rich springs. However, it was also found in Nordland County of Norway, inhabiting calcareous, rocky slopes close to the sea (VON PROSCHWITZ 2010).

The purpose of this paper is to present two new important records of these two species in Poland and to draw attention to their conservation in that country.



Figs 1–5. Comparison of some *Pupilla* spp. shells: 1–3 – shells variation of *Pupilla alpicola*; 4 – *P. pratensis*; 5 – *P. muscorum*. Shell measurements are in millimetres (high/width). 1 – Niedzica (Poland), 2.95/1.82, (M. HORSÁK lgt., April 2004); 2 – Baligówka (Poland), 3.61/1.93, (see Table 1B); 3 – Blatnica (Slovakia), 3.60/1.94, (M. HORSÁK lgt., September 2001); 4 – Rowele, 3.63/1.85, (see Table 1C), 5 – Brno (Czech Republic); 3.62/1.71, (M. HORSÁK lgt., October 1997). For details about species identification characters see VON PROSCHWITZ et al. (2009) and HORSÁK et al. (2010)

MATERIAL AND METHODS

Between 2002 and 2011, we sampled molluscs at 27 alkaline treeless fen sites in southern and eastern part of Poland (Figs 6, 7). These sites were mostly not previously searched for molluscs; they were chosen based on botanical data about fen vascular plants. In each site a 12 l sample was collected and processed using a wet sieving method (HORSÁK 2003). All previously reported records of *P. alpicola* in the Western Carpathians (HORSÁK et al. 2011) were used for the construction of a distribution map to show the position of the two Polish sites of the species in relation to its distribution in Slovakia (Fig. 6). All voucher materials are preserved in M. HORSÁK collection, Brno.

RESULTS

Between 2002 and 2011, eleven isolated fen sites were sampled in the Polish Carpathians and the second site of *P. alpicola* in Poland was found in the Nowy Targ region in 2010 (Figs 2, 6). The new site of *P. alpicola* in Poland is located close to the village of Czarny Dunajec (Nowy Targ region), in the area called Baligówka (49°28'06.1"N, 19°49'10.6"E; 647 m a.s.l.). It is an alkaline fen with a slight and spatially limited calcium carbonate precipitation. The site is still relatively large in area (ca 1 ha); however most of it was damaged by peat exploitation. *P. alpicola* forms a rather sparse population there; only two live and adult individuals and three empty shells were found in two 12 l samples collected at two 4×4 m^2 plots (Table 1A, B). The age of the site and the date of colonisation by the species are not known for this site, but the occurrence of a rich fen mollusc fauna with several fen specialists (e.g. *Vertigo angustior*) and a relict species *Vertigo geyeri* (SCHENKOVÁ et al. in press) clearly suggests a relict origin and a rather old age of the site. The site is more isolated from the other recently known sites of the species than that near Niedzica (Fig. 6).

The first recent occurrence of *P. pratensis* in Poland was recorded in 2011. The site is located in north-easternmost corner of Poland (Fig. 7), close to the border with Lithuania, in the vicinity of the village of Rowele (54°20'29.3"N, 22°55'00.7"E; 172 m a.s.l.). It is a highly calcareous spring fen on a gentle slope, very small in area (ca 60 m^2). *P. pratensis* was rather scarce at the site; only two live individuals and 34 empty shells were found in one 12 l sample collected at 4×4 m^2 plot (Table 1C).

DISCUSSION

Up to date, two isolated and more than 30 km distant fen sites with the occurrence of *P. alpicola* are known from Poland. Unfortunately, the site in Niedzica is a very small spring fen (ca 50 m^2) and currently highly threatened by the succession towards more productive *Junco inflexi-Menthetum longifoliae* vegetation, mainly due to the cessation of mowing or grazing and increasing nutrient load from the sur-

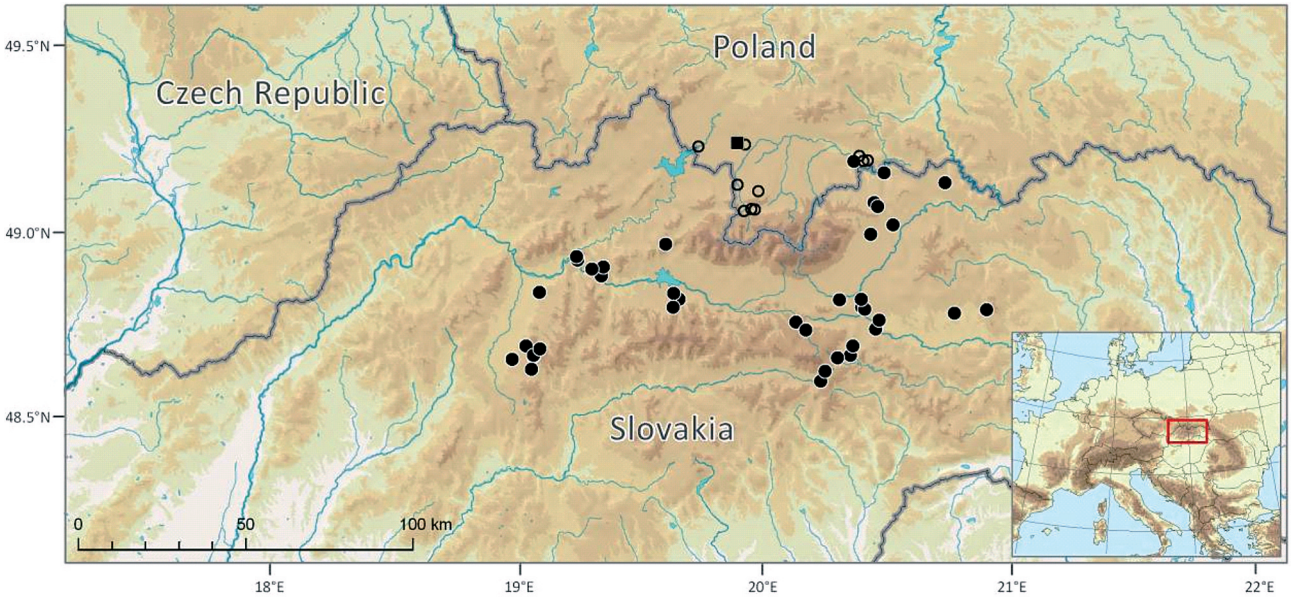


Fig. 6. Map of recently known sites of *Pupilla alpicola* in Slovakia and Poland (solid circles). Hollow circles show position of the studied fen sites in Poland where the species was not found. The new site of the species in Poland is denoted by solid square

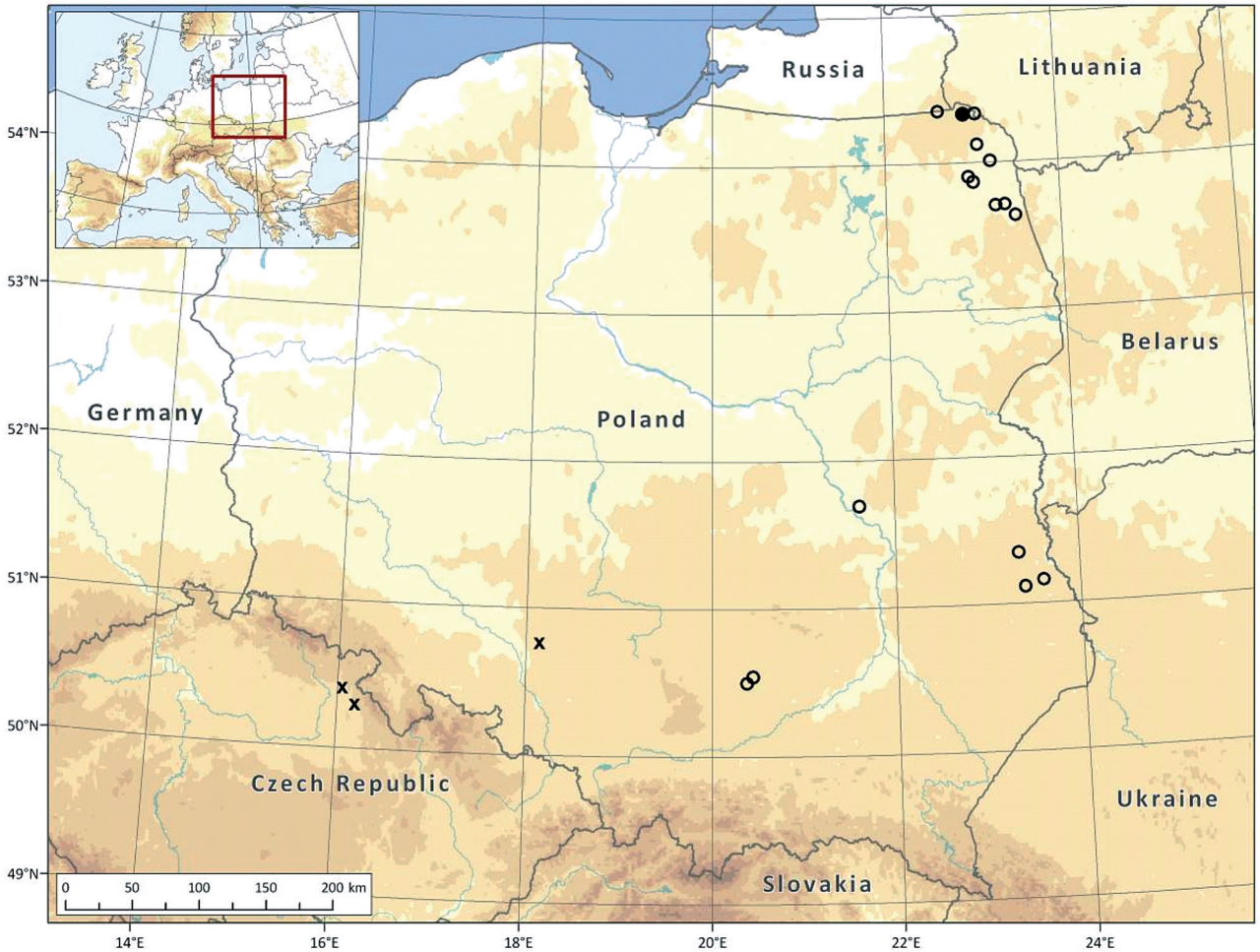


Fig. 7. Distribution of 16 alkaline fens searched in 2010 and 2011 in Poland outside the Carpathian region (hollow circles). The extant population of *Pupilla pratensis* discovered in NE. Poland is denoted by solid circle. Historical records in E. Bohemia and S. Poland (Kobylno near Opole Town) are denoted by crosses

Table 1. List of species found in three 12 litre samples (each collected at 4×4 m^2 square plot) in the studied fens: A – Baligówka fen (Czarny Dunajec env., S Poland); part with deeper peat sediment and more productive vegetation (7 October 2010, M. HORSÁK & J. MYŠÁK lgt.); B – Baligówka fen (Czarny Dunajec env., S Poland); an initial and spring part with higher calcium precipitation and low productive vegetation (25 May 2011, M. HORSÁK & V. SCHENKOVÁ lgt.); C – the Rowele fen (NE Poland): a small calcareous spring fen on a gentle slope (26 June 2011, M. HORSÁK & V. SCHENKOVÁ lgt.). Numbers of both live individuals and empty shells were counted together

Species	A	B	C
Bythinella austriaca (von Frauenfeld, 1857)	~	4	~
Galba truncatula (O.F. Müller, 1774)	7	117	47
Radix peregra (O.F. Müller, 1774)	~	29	~
Stagnicola palustris (O.F. Müller, 1774)	~	38	~
Anisus leucostoma (Millet, 1813)	1	1	~
Carychium minimum O.F. Müller, 1774	14	44	78
Carychium tridentatum (Risso, 1826)	~	~	3
Cochlicopa lubrica (O.F. Müller, 1774)	~	~	170
Oxyloma elegans (Risso, 1826)	~	126	39
Succinella oblonga (Draparnaud, 1801)	~	~	22
Vallonia costata (O.F. Müller, 1774)	~	~	2
Succinea putris (Linné, 1758)	20	~	24
Vallonia pulchella (O.F. Müller, 1774)	10	34	135
Columella edentula (Draparnaud, 1805)	~	~	1
Vertigo angustior Jeffreys, 1830	27	22	82
Vertigo antivertigo (Draparnaud, 1801)	20	73	1
Vertigo geyeri Lindholm, 1925	12	5	24
Vertigo pygmaea (Draparnaud, 1801)	4	11	21
Vertigo substriata (Jeffreys, 1833)	~	1	35
***Pupilla alpicola* (Charpentier, 1837)**	**3**	**2**	~
***Pupilla pratensis* (Clessin, 1871)**	~	~	**36**
Punctum pygmaeum (Draparnaud, 1801)	~	1	29
Euconulus praticola (Reinhardt, 1883)	13	7	23
Perpolita hammonis (Ström, 1765)	3	~	87
Perpolita petronella (L. Pfeiffer, 1853)	4	~	23
Zonitoides nitidus (O.F. Müller, 1774)	3	1	52
Vitrina pellucida (O.F. Müller, 1774)	~	6	1
Vitrea crystallina (O.F. Müller, 1774)	~	~	5
Perforatella bidentata (Gmelin, 1791)	~	~	16
Pisidium casertanum (Poli, 1791)	154	239	35
Pisidium obtusale (Lamarck, 1818)	~	~	107
Pisidium personatum Malm, 1855	3	~	19
Pisidium milium Held, 1836	~	3	~

rounding meadows. In 2011 the site was covered by a thick layer of dead litter of *Juncus inflexus* (Fig. 8), which limited the occurrence of mosses and fen specialists at most of the fen area. This also resulted in a lower water table and changes of substratum from tufa to a rather muddy surface. The only fen plant species recorded at the site was *Carex flava*, forming few small tussocks. A small sample was collected, but no single shell of *P. alpicola* was found. However, in 2004 two live individuals and three empty shells (Fig. 1) were found in the same sample volume (2 April 2004, M. HORSÁK lgt.). Due to the rather small sample volume it is not possible to decide whether or not the species has already become extinct at this site, but the negative influence of vegetation succession on the species' population is obvious. To maintain the occur-

Fig. 8. A small calcareous fen near Niedzica was the first known site of *Pupilla alpicola* in Poland. Successional changes towards more productive *Junco inflexi-Menthetum longifoliae* vegetation (a detailed view in the left bottom corner) are currently threatening survival of this population. Photo M. HORSÁK, April 2011

rence of the species at this site a regular mowing, at least once a year, should be applied. In this regard in the site in the Nowy Targ region the species has a greater chance of a long time survival, although at a low population density. This site is larger and it holds optimal, low productive and sparse fen vegetation, which was found to be preferred by this species (HORSÁK et al. 2011). Besides, a viable population of another threatened snail species, *Vertigo geyeri*, was found at this site (Table 1A, B). This Annex II species was recently recorded from several alkaline fens in the Nowy Targ region (SCHENKOVÁ et al. in press), which is an extension of its relatively frequent occurrence in the Orava region in Slovakia (VAVROVÁ et al. 2009). In the last two years we found that *V. geyeri* was more widely distributed in Poland than previously thought, with many large populations especially in NE. Poland (SCHENKOVÁ et al. in press). This suggests that *P. alpicola* and *P. pratensis* are currently more endangered in Poland than the legally protected *Vertigo* species listed in Annex II of the Habitats Directive. It was also shown that both these *Pupilla* species have notably narrower ecological amplitude than the co-occurring *V. geyeri* (Table 1A, B), as they are limited to calcareous fens (HORSÁK et al. 2010 and 2011). In contrast, *V. geyeri* can tolerate fen sites distinctly poorer in calcium, with the presence of some *Sphagnum* species (HORSÁK & HÁJEK 2005).

Although the occurrence of *P. pratensis* was already reported from Poland (VON PROSCHWITZ et al. 2009), no extant population was known so far. The first report from Poland by VON PROSCHWITZ et al. (2009) was based on a more than 120 year old record near the village of Kobylno in Upper Silesia (GOLDFUSS 1883), and the occurrence in this site was not revised. This historical site is not far from several populations recorded after 1950 in NE. Bohemia (HORSÁK et al. 2010). Unfortunately, these sites have been damaged by draining, which has driven some of these populations to the extinction. The recent record in NE. Poland is more than 500 km away from the historical site near Kobylno and it is a part of the NW. European distribution of the species, though this is the easternmost known record of this snail. Although we sampled many suitable calcareous fens in NE. Poland (Fig. 7), only one population of *P. pratensis* was found. In Europe, this snail seems to have a Northern Atlantic distribution, which does not overlap with the distri-

bution of *P. alpicola* which in Europe is mainly limited to the Alps and Carpathians (HORSÁK et al. 2011). However, based on some preliminary molecular analyses (J.C. NEKOLA pers. comm.), it seems that these two taxa are geographical subspecies of a single, more widely distributed species.

Based on our extensive sampling of alkaline fens across the entire eastern Poland and the Carpathians it is clear that both these species are very rare in Poland. These are extensions of two different distributions, irrespective whether these two taxa are separate species or only geographical subspecies, differing in some conchological characters. They share similar and very specific habitat requirements, thus being typical habitat specialists. Unfortunately, this habitat type, treeless calcareous fens, is very rare, mostly isolated and nowadays highly threatened by draining and succesional changes after the cessation of regular mowing and grazing. Therefore, the records are very important for nature conservation and a much attention should be paid to these two extant populations. Although both sites are currently involved in the NATURA 2000 network (*P. alpicola* — Niedzica, PLH120045; *P. pratensis* — Torfowiska Gór Sudawskich, PLH200017), they deserve more attention and applying proper management practices. Passive protection is not enough as shown by spontaneous succession changes in the first site of *P. alpicola* near Niedzica - this population was included in the Polish Red Data Book of Animals (POKRYSZKO 2004). Also the site near Rowele is currently greatly threatened by shrub and forest succession, which has substantially reduced the original area of the habitat.

ACKNOWLEDGEMENTS

We are very grateful to PAWEŁ PAWLIKOWSKI because without his help we would have never been able to find most of those beautiful fen sites in Poland. ANNA LIPINSKA spent much time to assist in our efforts to obtain official permissions for collecting data at several protected areas. We also thank ONDŘEJ HÁJEK for preparing the maps. The Czech Ministry of Education, Youth and Sports (MUNI/A/0976/2009) and the Grant Agency of the Czech Republic (project no. P504/11/0429 and GD526/09/H025) supported the field research and preparation of the manuscript.

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Received: October 19th, 2011
Revised: November 11st, 2011
Accepted: December 21st, 2011