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Recent distribution of freshwater pearl mussel (*Margaritifera margaritifera*) at historical localities in the upper part of the Vltava River basin (Czech Republic)

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Abstract
This article summarises data on the presence of the freshwater pearl mussel (*Margaritifera margaritifera*) in the upper part of the Vltava River basin in the Bohemian Forest (Šumava in Czech) and the Novohradské Hory mountains. The data gathering was based on standard Czech methods. Apart from the well-documented situation in the protected National Nature Monuments Blanice and Zlatý Potok, the presence of this species was recently demonstrated based on observations of live individuals in the Teplá Vltava stream in the Šumava National Park and at the Horní Malše Site of Community Importance. In both localities, adult mussels occur in a scattered distribution or in small colonies. Moreover, the presence of young living individuals or their shells was confirmed. Additional isolated findings come from the Blanice River under the Husinec reservoir, and we found older shells in the Otava River in the millrace at Malé Hydčice. All of the recently documented findings were recorded in localities where the presence of the freshwater pearl mussel was confirmed in the 20th century. It follows that the populations of the upper and middle parts of the Vltava River basin have survived at several sites, but at highly reduced densities.

Keywords: bivalves, Bohemian Forest, Šumava Mts., Novohradské Hory Mts.

Introduction

The freshwater pearl mussel (*Margaritifera margaritifera* Linnaeus, 1758) is a highly endangered species, not only in the southern part of Bohemia but throughout its whole distribution area (Bauer & Wachtler 2001, Geist 2010). The main factors affecting the situation of the pearl mussel in southern Bohemia are water pollution (Bílý & Simon 2007, Douda 2010), long term changes in land use and temperature decreases in the upper parts of streams (Hruška 1992), problems with the supply of detrital particles (Absolon & Hruška 1999, Tichá et al. 2012) and changes in populations of its fish hosts (Dušek et al. 2010).

Most of the localities, where the mussels are found are protected by existing or planned management schemes for small specially protected areas or core zones in the Šumava National Park. In general, the protection of this species is based on an Action plan approved by

the Ministry of the Environment of the Czech Republic and pursued by the Nature Conservation Agency of the Czech Republic (Absolon & Hruška 1999, Švanyga et al. 2013).

Although the historical distribution of the freshwater pearl mussel in the Vltava River, Otava River, and Malše River and their tributaries is documented (Shubert 1933, Nowak 1936, Dyk & Dyková 1974, Hruška 1991, 1992), comprehensive data on the recent distribution of this species in the upper Vltava River basin is not available.

The aim of this report was to summarise recent (2003–2012) published and unpublished data for the freshwater pearl mussel distribution in southern Bohemia.

Material and methods

Data about distribution of this species were collected according the recommendations in Action plan for endangered freshwater pearl mussel in Czech Republic (Švanyga et al. 2013).

Live freshwater pearl mussels could not be removed and measured because of the Czech rules regarding the monitoring of protected animals. The character of the collected specimens is described as live adult, live subadult, shell, old shell, or shell fragments. The existence of clearly defined cohorts of old populations permits to distinguish the presence of subadults (Fig. 1). The character (with abbreviation in parentheses) is defined as follows:

Live adult (L) – specimen positioned in the river bed, visible part (open siphos) wider than 3 cm (Fig. 2).

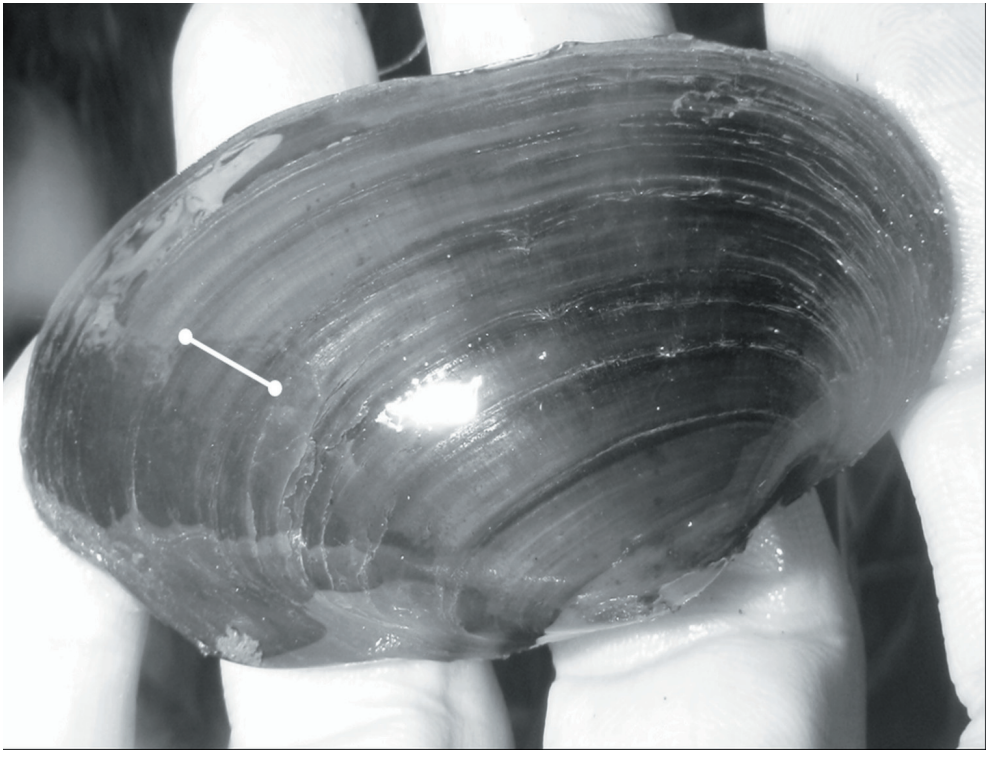

Fig. 1. The shell of the first subadult of *Margaritifera margaritifera* found in the Malše River; its total length is 38 mm, the bar (ca. 6 mm) indicates the last completed growth period (photo by J. Hruška).

Live subadult (Ls) – specimen positioned in the river bed, visible part (open siphons) smaller than 3 cm (Fig. 2, live specimens were observed by magnifying aquascope or the photo was taken).

Shell (S) – specimen without any soft tissue, shell not substantially corroded or only in the part of ligament, nacre layer maintained in the whole of surface.

Old shell (OS) – shell markedly corroded in the whole of surface or particularly destroyed, more than half part of one shell.

Shell fragments (SF) – less than half part of one shell.

The juvenile phase in the shells is defined by the length of yearly shell growth wider than 4 mm (Fig. 1). The length of yearly shell growth of adults is less than 1 mm in the Czech Republic. The length of the last completed period is noted because of the risk of mortality during growth in the last period. The shells were measured lengthwise (anterior-posterior) to the nearest 0.1 mm with vernier callipers.

Published data are listed in the Results in the following order: code of the faunistic mapping grid of the Czech Republic (Pruner & Míka 1996), locality GPS (WGS84) coordinates marking borders of the observed parts of stream, character of the specimens, and source; whereas unpublished data are listed as follows: code of the faunistic mapping grid, locality,

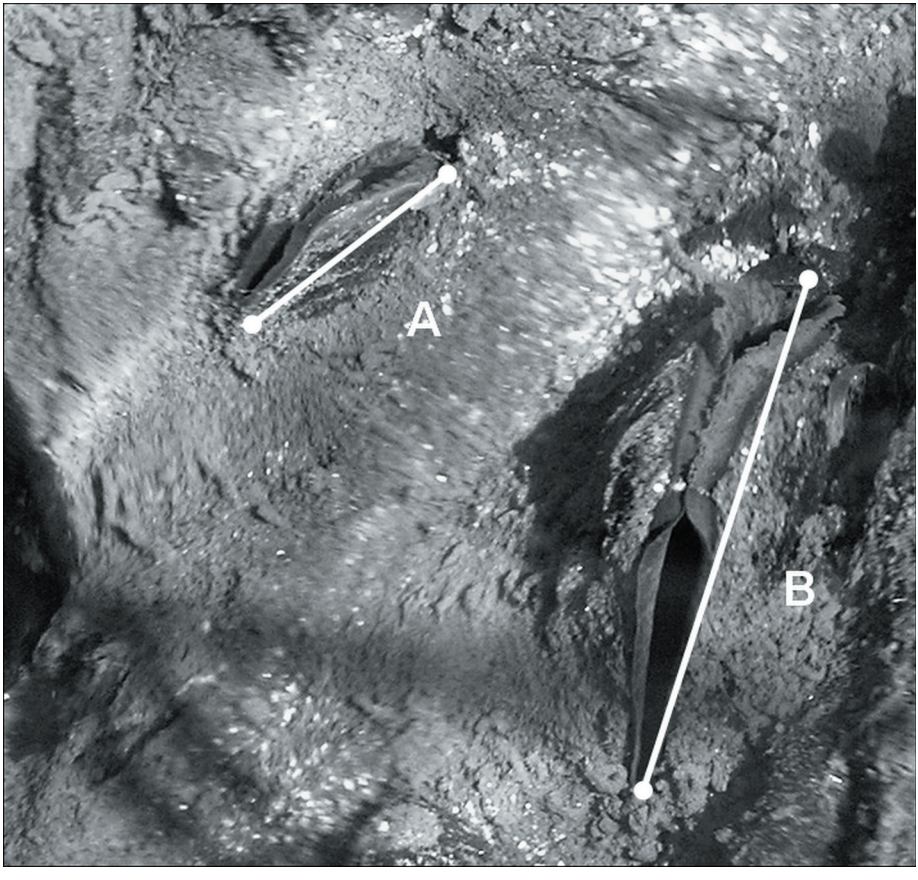

Fig. 2. The comparison of adult (B) and subadult (A) specimen according to the length of siphons, bars: A = 22 mm, B = 47 mm (photo by O.P. Simon).

GPS coordinates marking borders of the observed parts of stream, number of individuals, character of the specimens, length of the shell (in parenthesis), year of collection, and collector.

Results

All known published and unpublished recent data (2003–2012) on the freshwater pearl mussel distribution are listed below. The data are divided into the results of detailed monitoring performed in the Blanice River, Zlatý Potok stream, Teplá Vltava stream, and the Malše River, and coincidental findings from the middle part of the Blanice River, lower Zlatý Potok stream, millraces in the middle Malše River, and the Otava River. Data are presented in the same form as other faunistic data about distribution in this contribution. For clarity data are also presented in grid map of the Czech Republic, focused on area of South Bohemia (Fig. 3).

Published data

6850:
Blanice River at Blanička (49°5'55.516”N, 14°4'21.644"E–49°6'4.137"N, 14°4'46.735"E), 1 L (Peltánová & Švanyga 2013).
7049:
Blanice River between ruins of tower house Hus and Spálenec (48°57'24.289"N, 13°55'45.326"E–48°54'0.822"N, 13°58'55.945"E), 23 332 L (Hruška 2003) and 10 154 L+Ls (Spisar 2010).
7050:
Zlatý Potok stream millrace at Frantoly (48°59'35.024"N, 14°4'57.329"E–48°59'24.858"N, 14°4'53.579"E), 307 L, (Hruška 2005).
Zlatý Potok stream between Frantoly and Miletínky (48°59'24.858"N, 14°4'53.579"E–48°55'34.074"N, 14°5'4.817"E), 338 L (Hruška 2005).
Zlatý Potok stream between Miletínky and Skříněřov (48°55'34.074"N, 14°5'4.817"E–48°56'41.696"N, 14°0'53.426"E), 231 L (Hruška 2005).
7149:
Teplá Vltava stream (48°54'13.088"N, 13°49'32.915"E–48°48'23.910"N, 13°56'49.406"E), 35 L, 20 S (Böhm 2008).
7353:
Malše River at Dolní Přibrání (48°37'28.388"N, 14°36'53.360"E–48°37'30.787"N, 14°35'57.062"E), 11 Ls, 2 L (Dort & Hruška 2009).
Malše River between Leopoldschlag and the confluence with the Felberbach stream (48°36'12.045"N, 14°33'40.954"E–48°36'59.919"N, 14°30'14.998"E), 14 OS (Dort & Hruška 2009).

Unpublished data

6647:
Otava River millrace at Malé Hydčice (49°17'56.470"N, 13°39'27.562"E–49°18'5.219"N, 13°39'44.756"E), 3 S (116, 103, 120 mm), OS, 2012, Bílý.
6850:
Blanice River millrace at Blanička (49°5'56.730"N, 14°4'19.550"E–49°6'13.071"N, 14°4'30.096"E), unknown number of OS, 2011, Douda.
Zlatý Potok stream up to the inflow to the Blanice River at Čichtice (49°6'3.891"N, 14°4'48.416"E–49°5'50.076"N, 14°4'46.008"E), 1 S (105 mm), 2012, Simon & Douda.

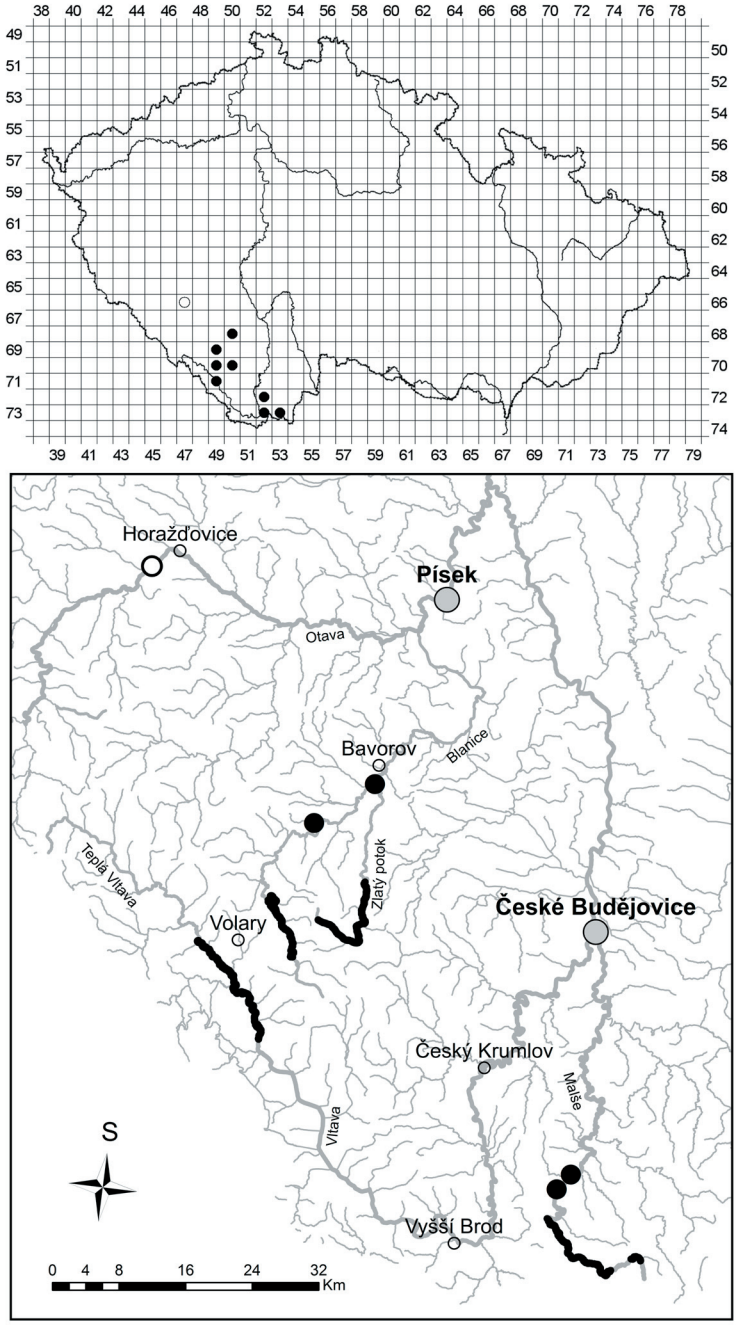

Fig. 3. Grid map of the distribution of *Margaritifera margaritifera* in the Czech Republic – a detailed insert shows localities in south Bohemia, where freshwater pearl mussel has been found recently (2003–2012): black thick line indicates its occurrence along a stream stretch, solid circles show localities of its limited distribution, and an open circle (○) only shells found in the Otava River at Malé Hydčice.

6949:
Blanice River millrace at Husinec (49°2'42.662''N, 13°59'1.859''E–49°3'6.991''N, 13°59'13.779''E), 5 L, 4 S (78, 102, 63, 52 mm), OS, 2010, Douda.
7049:
Blanice River between Zbytiny and Spálenec (48°55'41.283''N, 13°58'5.148''E–48°56'24.227''N, 13°57'14.905''E), 2 S (97, 96 mm), 2008, Tichá; 1 S (100 mm), 2011, Simon.
Blanice River between Zbytiny and Blažejovice (48°57'2.813''N, 13°56'30.434''E–48°57'12.270''N, 13°56'2.303''E), 3 S (84, 89, 83 mm), 2012, Simon.
7050:
Zlatý Potok stream at Plánská, Tisovka (48°56'35.821''N, 14°4'43.039''E–48°55'51.185''N, 14°5'6.274''E), 10 L, 2012, Simon.
7149:
Teplá Vltava stream at Dobrá (48°54'11.207''N, 13°49'26.278''E–48°52'56.514''N, 13°51'53.772''E), 4 Ls, 2009, Dort; 45 L, 14 Ls, 2011, Dort; 8 L, 8 Ls, 2 OS, 2012, Dort.
Teplá Vltava stream close to Chlum (48°52'56.514''N, 13°51'53.772''E–48°51'10.973''N, 13°53'57.868''E), 17 L, 2009, Dort; 267 L, 6 S (101, 112, 94, 101, 98, 107 mm), 2 OS, 2011, Dort.
Teplá Vltava stream close to Volary (48°51'32.522''N, 13°53'35.406''E–48°52'54.824''N, 13°52'6.381''E), 14 S (100, 99, 104, 96, 68, 90, 96, 88, 101, 103, 91, 95, 102 mm), 2012, Simon; 1 S (97 mm), OS, 2011, Simon; OS, 2012, Douda.
7252:
Malše River millrace at Ješkov (48°42'26.011''N, 14°28'52.916''E–48°42'32.035''N, 14°29'7.339''E), 2 S (66, 65 mm), 2 OS, 2007, Bílý; 2 L, 1 S (64 mm), 1 OS, 2012, Simon.
7352:
Malše River at Hiltshen Leopoldschlag (48°37'59.828''N, 14°29'29.067''E–48°37'34.768''N, 14°29'45.344''E), SF, 2012, Simon.
Malše River between Leopoldschlag and Dolní Dvořiště (48°37'3.008''N, 14°30'10.278''E–48°39'23.940''N, 14°27'15.648''E), 2 S, (93, 91 mm), 4 OS, 2011, Dort; 81 L, 14 Ls, 2011, Dort; 286 L, 38 Ls, 2012 Dort; 1 L 2007, Bílý & Rebec; 7 L, 2012, Simon & Douda; 1 S (75 mm), 1 OS, 2012, Simon & Douda.
Malše River millrace at Nažidla (48°41'17.806''N, 14°27'42.201''E–48°41'27.435''N, 14°27'51.491''E), 1 S (73 mm), 2012, Simon.
Malše River millrace at Stiegersdorf (48°38'30.014''N, 14°28'31.684''E–48°38'37.492''N, 14°28'23.983''E), 1 S (37 mm), 2012, Dort.
7353:
Malše River at Dolní Přibrání (48°37'33.674''N, 14°36'7.592''E–48°37'40.867''N, 14°36'27.664''E), 1 OS, 2012, Douda; 10 L, 2012, Dort.
Malše stream at Mairspindt (48°36'13.093''N, 14°33'44.070''E–48°36'34.938''N, 14°34'5.371''E), 1 S (92 mm), 2012, Douda.

Comments to selected localities

Teplá Vltava stream

Only data on the presence of the freshwater pearl mussel in the Teplá Vltava stream before the floods in 2002 are documented in Beran (1994). The sporadic presence of the mussel from the inflow of the Jedlový Potok stream to the inflow of the Korunáč stream was confirmed by Böhm (2008) during monitoring performed of the Teplá Vltava stream (between Dobrá na Šumavě and Nová Pec).

Later, detailed monitoring of the stream was performed under the direction of the National Park Authorities between 2009 and 2012. This monitoring was focused on live adult and subadult individuals (Dort 2009, 2010). In total, 288 live animals and 27 shells were found in the map grid no. 7149.

The occurrence of *M. margaritifera* in localities in the Teplá Vltava stream was highly scattered. The size of some live individuals corresponded to the expected size of juveniles. One of the juvenile shells collected showed that this individual was still growing intensively (approximately 8 mm in last completed growth period, total length 68 mm). Detailed monitoring of the whole length of the Teplá Vltava stream is necessary.

Malše River

Older data on the presence of numerous populations of adult freshwater pearl mussels close to the Czech–Austrian border have been documented (Absolon & Hruška 1999). Subsequently, 36 adult individuals were found in a disturbed millrace near the Velíšek's mill in Ješkov (Dort & Hruška 2009). Additional data on the presence of the species in the Malše River before the floods that occurred in 2002 are summarised in Šimek et al. (2013).

Later, 2009–2012, detailed monitoring was performed on the request of both Nature Conservation Agency of the Czech Republic and Technisches Büro für Gewässerökologie by Dort (2012). A total of 444 live individuals and 34 shells were found in faunistic mapping grids 7352, 7252, and 7353.

The occurrence of the freshwater pearl mussel is scattered in the Malše River. Data suggest that the population in the Stiegersdorf millrace also includes live subadults. One subadult shell collected (Fig. 1) showed that this individual still grew intensively (approximately 6 mm in the last completed growth period, total length 38 mm).

The area below the town of Rychnov nad Malší has not yet been monitored in detail. However, downstream, in the Nažidla and Ješkov mill races, both shells and live adult individuals were found (shells at Nažidla, two adults at Ješkov). Shells found in the millrace in Ješkov showed characteristics of stunted growth, but according to last finished growth line they were adults. Detailed monitoring of the remainder of the Malše River is necessary to determine the status of this population.

Blanice River and Zlatý Potok stream

The occurrence of the freshwater pearl mussel in the Blanice River and Zlatý Potok stream are well documented within National Nature Monuments Blanice and Zlatý Potok (Hruška 2003, 2005, Spisar 2010) and the abundance of freshwater pearl mussels there are definitely higher than in other localities. This part of catchment area could be feasible for next spreading of population (Švanyga et al. 2013). Issues of limiting factors for spread and distribution of freshwater pearl mussel are described in Bílý & Simon (2007).

The presence of specimens in the part of the Blanice River between the Husinec reservoir and Blanička (Husinec millrace, Blanice River close to Blanička, and Zlatý Potok stream close to Čichtice; out of NNM Blanice) demonstrated the survival of the species under some level of eutrophication. In the past, there were numerous populations at these localities (Dyk & Dyková 1974).

Otava River

Data on old shells in the Otava River in the Malé Hydčice millrace pointed to an earlier occurrence of the species (Dyk & Dyková 1974). This locality is currently totally unsuitable for the survival of the freshwater pearl mussel, and its shells most likely decompose slowly at this site due to high conductivity levels (Hruška 1991).

Discussion

The presence of the freshwater pearl mussel was confirmed in nine faunistic mapping grids in the Vltava River basin up to the Lipno reservoir, in the Blanice River up to Čichtice, and in the Malše River up to Skoronice. Isolated individuals were also found in middle stretches of the Blanice River and Malše River. The presence of *M. margaritifera* is widespread, but its populations are less numerous than in the past (Dyk & Dyková 1974, Nowak 1936). Due to the nature of the data (being collected by different persons in different years), some uncertainty in terms of the population assessments remains. In total 60 shells were found and their lengths varied between 37 and 120 mm. Live mussels could not be removed, so that data about size range of whole populations are not yet available.

A considerable portion of the findings were recorded in millraces. Millraces may provide suitable hydraulic conditions for the survival of adult mussels. However, mussels in millraces are considered to originate from drift from main streams (Hruška 1991). In millraces in the middle parts of both the Blanice and Malše rivers, smaller shells were found that showed signs of stunted growth (Blanice River 52–119 mm, Malše River 64–73 mm). All these specimens were adults.

Monitoring in the Malše River and Teplá Vltava stream confirmed the recent occurrence of live, rapidly growing subadults. In the both localities, juveniles from breeding programs were released within the framework of the Action plan for *M. margaritifera* (Švanyga et al. 2013). The existence of natural reproduction should be confirmed via detailed long-term monitoring.

The action plan for the Czech Republic puts emphasis on several localities in upper stretches of the streams (Absolon & Hruška 1999) and positive results of protection of freshwater pearl mussel are significant. Recent findings also demonstrate the importance of populations in the middle parts of stream, which are characterised by the presence of different stunted forms, adapted to these habitats. However, it is not clear if these forms are genetically fixed or if they only represent individual local adaptation to unsuitable conditions (water pollution, eutrophication, long-term land use changes in all catchment).

The abundance of the populations of freshwater pearl mussels was observed to have decreased in all of the monitored localities, and implementation of specific measures from the endangered species action plan for *M. margaritifera* is necessary (Švanyga et al. 2013).

References

Absolon K. & Hruška J., 1999: *Záchranný program Perlorodka říční v České republice* [Action plan Freshwater pearl mussel in the Czech Republic]. Nature Conservation Agency of the Czech Republic, Praha, 28 pp. (in Czech).

Bauer G. & Wächtler K., 2001: *Ecology and evolution of the freshwater mussels Unionida*. Springer-Verlag, Berlin, Heidelberg, 364 pp.

Beran L., 1994: Zprávy o výsledcích průzkumu vodních měkkýšů vybraných úseků Vltavy [Results of the survey of freshwater mussels in selected parts of the Vltava River]. Ms., unpublished report, 29 pp. (in Czech). (deposited at the Šumava National Park Authorities, Vimperk)

Bílý M. & Simon O., 2007: Water quality issues in the protection of oligotrophic streams with the occurrence of pearl mussel (*Margaritifera margaritifera*) in the Czech Republic. *Acta Universitatis Carolinae Environmentalica*, 21: 21–30.

Böhm M., 2008: Výsledky průzkumu adultní populace perlorodky říční (*Margaritifera margaritifera* L.) ve vybraném úseku Vltavy a Teplé Vltavy ř.km. 370,45–390,0 [The results of exploration of adults in population freshwater pearl mussel (*Margaritifera margaritifera*) in the selected part between 370th and 390th river kilometres of the Vltava River and Teplá Vltava stream]. Ms., unpublished report, 33 pp. (in Czech). (deposited in the Šumava National Park Authorities, Vimperk)

Dort B., 2009: Perlorodka říční (*Margaritifera margaritifera* L.) v povodí horního toku Teplé Vltavy . [Freshwater pearl mussel (*Margaritifera margaritifera* L.) in the upper part of Teplá Vltava stream basin in 2009]. Ms.,

unpublished report, 16 pp. (in Czech). (deposited in the Šumava National Park Authorities, Vimperk)
Dort B., 2012: Flussperlmuschel (*Margaritifera margaritifera* L.) im oberen Flusslauf der Maltsch. Ms., Technisches Büro für Gewässerökologie, DI Clemens Gumpinger, 13 pp. (deposited in the Nature Conservation Agency of the Czech Republic, Prague)
Dort B., 2010: Perlorodka říční (*Margaritifera margaritifera* L.) v povodí horního toku Teplé Vltavy 2010 [Freshwater pearl mussel (*Margaritifera margaritifera* L.) in the Teplá Vltava basin in 2010]. Ms., unpublished report, 38 pp. (in Czech) (deposited in the Šumava National Park Authorities, Vimperk).
Dort B. & hruška J., 2009: Perlorodka říční (*Margaritifera margaritifera* L.) v povodí horního toku Malše [Freshwater pearl mussel (*Margaritifera margaritifera* L.) in the upper part of the Malše River basin in 2008]. Ms., unpublished report, 37 pp. (in Czech). (deposited in the regional office of southern Bohemia)
Douda K., 2010: Effects of nitrate nitrogen pollution on Central European unionid bivalves revealed by distributional data and acute toxicity testing. *Aquatic Conservation-Marine and Freshwater Ecosystems*, 2: 189–197.
Dušek J., Marhoul P., Vondrušková J., Spisar O., Pithart D. & Jirušková L., 2010: Návrh optimalizace rybářského hospodaření s ohledem na ochranu populací perlorodky říční (*Margaritifera margaritifera*) [Plan of optimization of fish management considering protection of freshwater pearl mussel (*Margaritifera margaritifera*)]. Ms., Daphne, 132 pp. (in Czech). (deposited in the Nature Conservation Agency of the Czech Republic, Prague)
Dyk V. & Dyková S., 1974: The pearl oyster (*Margaritifera margaritifera* Linnaeus 1758) a neglected indicator of the pollution of mountain and submontane water flows of the crystalline region in Czechoslovakia. *Acta Veterinaria*, 43: 287–304.
Geist J., 2010: Strategies for the conservation of endangered freshwater pearl mussels (*Margaritifera margaritifera* L.): a synthesis of conservation genetics and ecology. *Hydrobiologia*, 644: 69–88.
Hruška J., 1991: Projekt: záchrana perlorodky říční v České republice [Project Rescue of freshwater pearl mussel in Czeh republic]. *Památky a Příroda*, 16: 545–548, 609–612 (in Czech).
Hruška J., 1992: Projekt: Záchrana perlorodky říční v České republice [Project Rescue of freshwater pearl mussel in Czech republic]. *Ochrana Přírody*, 47: 7–11 (in Czech).
Hruška J., 1992: The freshwater pearl mussel in South Bohemia: Evaluation of the effect of temperature on reproduction, growth and age structure of the population. *Archiv für Hydrobiologie,* 126: 181–191.
Hruška J. 2003: Komplexní vyhodnocení vlivu povodně na přírodu a krajinu – Záchranný program perlorodky říční – Hodnocení vlivu povodně v roce 2002 na biotop a populaci perlorodky říční na horním toku řeky Blanice nad vodní nádrží Husinec [A comprehensive evaluation of the impact of floods on nature and landscape – Action plan for endangered freshwater pearl mussel in Czech Republic – Evaluation of impact of the floods in 2002 on the habitat and population of freshwater pearl mussels in the upper reaches of the Blanice River upstream the Husinec reservoir]. AOPK ČR Praha: 23 pp. (in Czech). (deposited in the Nature Conservation Agency of the Czech Republic)
Hruška J. 2005: Perlorodka říční (*Margaritifera margaritifera* L.) na Zlatém potoce – stav populace v roce 2005 [The freshwater pearl mussel (*Margaritifera margaritifera* L.) in the Zlatý Potok stream – the population state in 2005]. AOPK ČR Praha: 29 pp. (in Czech). (deposited in Nature Conservation Agency of the Czech Republic, Praha)
Nowak W., 1936: Perlorodka říční a její perly (se zvláštním zřetelem k poměrům v republice Československé) [Freshwater pearl mussel and its pearls (focused on conditions in Czechoslovakia)]. *Sborník Výzkumných Ústavů Zemědělských ČSR*, 146, 76 pp. (in Czech).
Peltanová A. & Švanyga J., 2013: Vyhodnocení realizačního projektu záchranného programu perlorodky říční v ČR pro rok 2012 [Evaluation of action plan of protection of freshwater pearl mussel in Czech Republic in 2012]. Ms., unpublished report, 49 pp. (in Czech). (deposited in the Nature Conservation Agency of the Czech Republic, Praha)
Pruner L. & Míka P., 1996: Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny [List of settlements in the Czech republic with associated map field codes for faunistic grid mapping system]. *Klapalekiana*, 32 (supplementum): 1–175 (in Czech, English summary).
Schubert O., 1933: *Über die Perlmuschel- und Perlen-Vorkomen in Böhmen*. Publikation des Zentralkollegiums des Landeskulturrates für Böhmen, Prag, 36 pp.
Šimek L., Simon O., Dort B., Koutecký B. & Brůčková M., 2013: Plán péče o EVL/ZCHÚ Horní Malše [Action plan for the Site of Community Importace Horní Malše]. Ms., unpublished report, 77 pp. (in Czech). (deposited in the Southbohemian Regional Office, České Budějovice)
Spisar O., 2010: Závěrečná zpráva – Monitoring 2010 – Záchranný program perlorodky říční v České republice. [Final report – Monitoring 2010 – Action plan for endangered freshwater pearl mussel in Czech Republic]. Ms., unpublished report, 18 pp. (in Czech). (deposited in the Nature Conservation Agency of the Czech Republic, Praha)
Švanyga J., Simon O., Mináriková T., Spisar O. & Bílý M., 2013: Záchranný program pro perlorodku říční v ČR

[Action plan for the endangered freshwater pearl mussel in the Czech Republic]. Ms., unpublished report, 76 pp. (in Czech). (deposited in the Nature Conservation Agency of the Czech Republic, Praha)
Tichá K., Simon O.P., Douda K. & Kubíková L., 2012: Detrital components in submontane organogenic springs in relation to their morphology, microhabitats and macroinvertebrates. *Polish Journal of Ecology*, 60: 163–175.

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