

RIVER FLOODPLAINS AS HABITAT AND BIO-CORRIDORS FOR DISTRIBUTION OF LAND SNAILS: THEIR PAST AND PRESENT

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ABSTRACT

River floodplains of Czech rivers serve as refugia to woodland or hydrophilous gastropods, in current intensively agriculturally utilised, urbanised and largely fragmented landscape. This habitat often forms one of the last refuges and replaces the natural habitat of these species. River floodplains also represent linear bio-corridors in landscape and allow gastropods to spread through the landscape in both directions, up and down the stream. We showed based on available fossil mollusc successions that development of the floodplain mollusc fauna took place quite differently in various river floodplains, depending on their specifics and geographical location, because especially the ones situated in the chernozem area of the Czech Republic had very different history in comparison with those in higher altitudes. The species richness and composition of recent floodplain malacofauna arises from historical development of particular area/site and depends also on environmental factors such as an elevation, humidity gradient, vegetation type and its biomass, light conditions of the site and soil reaction. Recently, the invasive plants represent a serious problem for current floodplain ecosystems; species richness and abundances of terrestrial mollusc floodplain assemblages are changing due to their effect. The impact on gastropods is species-specific and was described for the following species: *Impatiens glandulifera*, *Fallopia japonica* subsp. *japonica*, *F. sachalinensis*, *F. ×bohemica*.

Key words: terrestrial gastropods, river floodplain, bio-corridor, plant invasions, historic development

INTRODUCTION

River floodplain can be defined as a flat bottom of the valley with a characteristic biota, formed and influenced by the river stream (Štěrba *et al.*, 2008; Ložek, 2007; 2011). River floodplains are one of the most dynamic ecosystems in Central Europe. They fulfil numerous functions in the landscape and their ecological research is therefore of a long tradition (Gurnell, 1977; Schnitzler *et al.* 2005), concerning to study of vegetation (Schnitzler, 1994; Brown *et al.* 1997). A number of regional studies have been carried out in the area of Central Europe since the second half of the 20th century (e.g. Ložek, 1955; Bába, 1977; Frank, 1984,

1985; Obrdlík *et al.*, 1995; Čejka, 1999; 2003; Čejka *et al.* 2008; Ilg *et al.* 2009; Čejka & Hamerlík, 2009), and part of them were dealt with malacofauna of Czech rivers (e.g. Ložek, 1947; Horsák, 2000; Vašátko *et al.* 2002; Myšák & Horáčková, 2011; Horáčková *et al.* 2011a,b; 2013a,b,c; 2014a). Some studies were investigated the inundation influence on the river floodplain malacofauna (Ilg *et al.*, 2009) or the function of river as bio-corridor (Myšák & Horsák, 2011) but the majority of the above mentioned studies is only descriptive and is missing the analysis of the main patterns of the species composition and diversity of floodplain mollusc assemblages in relation to ecological gradients of the environment. A large number of studies dealing with analysis of the main factors of the environment influencing the species diversity and composition of gastropod assemblages in various types of European temporal woodlands have been published (e.g. Wärebörn, 1969; Bishop, 1980; Martin & Sommer, 2004a; Cameron & Pokryszko, 2005; Pokryszko & Cameron, 2005; Hylander *et al.*, 2005). However until now, the fauna of alluvial forests was neglected. Studies on the floodplain forests of the Danube River (Čejka *et al.*, 2008) and the Elbe River including its tributaries (Horáčková *et al.*, 2014b) were published in the last couple of years.

Floodplain forests and riparian vegetation in the Czech river and brook floodplains serve as refugia for woodland and hydrophilous gastropods, because in the current fragmented and extensively human-utilized country are often ones of the last and hardly replaceable natural habitats.

HISTORY OF RIVER FLOODPLAIN FORMATION

If we are trying to understand the dynamics of river floodplains, we have to analyse them from the point of view of their establishment. Recently, there are 16 strictly river floodplain sites with fossil mollusc successions (Horáčková *et al.*, 2015) within the area of the Czech Republic and Slovakia. They can help to understand the development of floodplain mollusc assemblages in the post-glacial period. The most detailed evidence comes from the wider area of the tributaries of the lower Elbe River and the Ohře River, which will be used as a model study area in the following text.

The obvious starting point for the succession of European rivers floodplains was the last Ice Age. In the prevalently forest-free landscape rivers formed wild streams (Pokorný, 2011) causing strong erosion and transporting inorganic material. In warmer landscapes or during the warmer periods, so called gallery forests formed around the wild streams, for example in the river floodplain of the Slovak part of the Danube River. Apparently, they could have a character of small forests as confirm the presence of a strictly woodland land-snail species climbing on tree trunks of taller trees, *Ena montana*, in Zlatná u Dunaje (Juříčková *et al.*, 2014). At the beginning of the Holocene, rivers became centres of development and spreading of woodlands through the landscape. The landscape around the rivers started covering by vegetation faster thanks to an amount of nutrients deposited in the river floodplains. Remarkable so called river phenomenon occurred where rivers cut into the hard bedrock with deep canyons creating mosaic of habitats of different orientation and humidity. (Jeník & Slavíková, 1964; Ložek, 1988). This can be observed in the middle stretches of the Vltava River or the Berounka River in the Křivoklátsko or in the Bohemian Karst areas.

Agriculture and human settlement concentrated around the rivers especially on nutritious chernozem soils from the Neolithic age. River alluvia were gradually changing as a result of the Neolithic people activity into an agricultural, more or less forest-free landscape (Jiráň & Venclová, 2007–2008; Pleinerová & Pavlů, 1979; Pleinerová, 1990) prevented by these activities from spreading of woodlands as well as woodland species of gastropods. Forest-free

landscape is in some parts of Bohemia also preserved due to very low precipitation and relatively high average temperatures and is naturally supported by the sub-continental climate as confirmed in palaeobotanical surveys from Zahájí on the lower stream of the Ohře River (Pokorný, 2005; Pokorný *et al.*, 2015) or in the palaeomalacological survey of the neighbouring České Středohoří Mts. (Ložek, 1963; 1964a,b; 1976; 2005; Juříčková *et al.*, 2013a). Climate and human agricultural settlements thus resulted in preserving the mosaic of woodlands, wetlands and open landscape in some areas during the whole Holocene as can be seen in the lower stream of the Ohře River and in the České Středohoří Mts. (Juříčková *et al.*, 2013a,b; Pokorný *et al.*, 2015).

The arrival of agriculture caused a kind of return to glacial conditions in that sense that the open landscape deforested by agriculture became a subject to further, intense erosion. Due to the fact that the eroded landscape was before the arrival of agriculture covered by woodland to a large extent, transported soils sedimented as huge alluvial material that became substrate for floodplain forests. A mosaic of woodland and forest-free areas was formed this way and became typical for the entire area of nutritious soils in the Czech Republic (Ložek, 1964a,b; Pokorný, 2005). Despite the fact it is difficult to confirm this exactly, the up-to-date research of Quaternary sediments in the river floodplains of Czech as well as west-European Rivers suggests that current floodplain forests are younger than Neolithic colonisation and it is related to erosion in landscape caused by the first farmers (Evans, 1993; Lespez *et al.*, 2008; Pišút & Čejka, 2002; Juříčková *et al.*, 2013a,b). This process is not possible to confirm without detailed survey of fossiliferous sediments, because nowadays floodplain forests give the impression of primeval woodlands. As an example can serve the Myslivna Nature Reserve on the Ohře River protected as an original natural old floodplain forest. However, based on fossil mollusc succession (Juříčková *et al.*, 2013a) and composition of recent malacocoenoses that are missing mainly woodland species of gastropods (Horáčková *et al.*, 2014b) we consider this protected floodplain forest as relatively recent. While there are recently living many woodland snail species in the upper stretches of the Ohře River, almost half of them are missing in the lower stream of the river despite the fact that there are large protected woodland complexes of floodplain forests offering seemingly ideal habitat for the woodland snails. The impact of human settlement and agriculture on floodplain mollusc assemblages of the Ohře River throughout Holocene is indirectly confirmed due to comparison with Mid-Pleistocene interglacial fauna from three sites in Louny area (middle stream of the Ohře River) (Kovanda *et al.*, 2005). There were numerous woodland species occurring on the site during that period, but these species were only rarely or not occurred during the Holocene interglacial. Based on these facts, it is clear that while there were living fully developed mollusc assemblages in river floodplains of an other parts of Europe until the period of woodland climatic optimum (e.g. Limondin-Lozouet & Preece, 2004), the agricultural chernozem areas of Central Europe probably never contained woodland malacofauna in the postglacial period due to the impact of early human settlement and agriculture.

There was even documented a similar development in the neighbouring area of the České Středohoří Mts. (Juříčková *et al.*, 2013b). Woodlands composed only a part of landscape mosaic together with wetlands and open biotopes. While the reduction in woodland snails is much more obvious in the floodplain forests of the lower Ohře River caused by human activities in the alluvium itself, these impacts become not so evident in a small brook floodplain of the Milešovský potok Brook in the České Středohoří Mts. There was an impoverishment of recent woodland mollusc assemblages caused rather indirectly through the prevention of their spreading from the surrounding human-colonized and deforested landscape. Nevertheless, wetland fauna was relatively rich here during the mid-Holocene

period compared to the recent. It included several relic species of land snails, such as *Nesovitrea petronella*, *Vertigo geyeri* a *V. genesii*, gradually disappearing during the Early Holocene and are completely extinct nowadays. In the Úštěcký potok brook floodplain (Horáčková *et al.*, 2013c) in the eastern part of the České Středohoří Mts., we recorded relatively poor woodland fauna of the Early Holocene enriched by numerous wetland and aquatic mollusc species, gradually changing into rich fauna of woodlands, open biotopes and wetlands during Atlantic period. At the end of the sub-Boreal period the woodland fauna suddenly disappeared from this site and the entire habitat became more acidic and oligotrophic leading to the extinction of majority of woodland snails. Similarly, this development leading from rich forest land snail assemblages to a recent poor malacofauna was described in the nearby Polomené hory Mts. thick-bedded sandstones area (Ložek, 1998; 2003).

As shown in this review, the development of river and brook floodplains and their biota took place in various ways in different geographical parts of the lower Elbe River and its tributaries in the Czech Republic. It is evident that a current state of recent malacofauna and the overall biota in particular sites is closely related to postglacial development of areas studied and it is necessary to consider it during an actual ecological researches.

RIVER FLOODPLAINS AS LINEAR BIO-CORRIDORS IN LANDSCAPE

Not every linear element in the landscape necessarily fulfils the function of a bio-corridor for land snails. While road verges that could be considered to be a brilliant way for spreading of synanthropic or steppe species through the landscape do not fulfil this function (Juříčková & Kučera, 2007), the river floodplains do. As an example can serve direct observations of spreading of individual species along streams documented in recent decades on species such as *Arianta arbustorum* and *Urticicola umbrosus* through the river floodplain of the Berounka River into Prague in Central Bohemia (Juříčková, 1995) or also the spreading of *Merdigera obscura* and *Fruticicola fruticum* along the river floodplain of the Úslava River into Plzeň in Western Bohemia (Juříčková, 1998). Spreading of snail species through the floodplains can be confirmed based on fossil findings, too. While no individuals of the species of *Urticicola umbrosus* were found in either of the five Holocene fossil mollusc successions in the lower stream of the Ohře River (Juříčková *et al.*, 2013a), this species is nowadays one of the most abundant ones in the river floodplain malacofaunas of the entire stream (Horáčková *et al.*, 2011a).

The floodplain mollusc assemblages have a relatively fast dynamics, hardly comparable with, for example, relatively conservative primeval forest land snail assemblages (Horsák *et al.*, 2006). While species rich floodplain mollusc assemblages with species such as *Urticicola umbrosus*, *Perforatella bidentata*, *Macrogastra ventricosa* and *Clausilia pumila* formed on the confluence of the Berounka and Elbe Rivers before the flood in 2002 (Juříčková, 1995), only *Urticicola umbrosus* remained after the flood (Juříčková, unpublished data).

The fast dynamics of the floodplain land snail assemblages can be demonstrated on two floodplain sites in the lower stream of the Elbe River (Tab.1). The land snail assemblages of these sites were sampled using the same methods in four consecutive seasons, always at the same time. Table 1 shows relatively dramatic oscillations in annual occurrence of individual species.

Table 1: Occurrence of land snails on sites: Roudnice nad Labem – floodplain forest (left) and Nebočadský luh – floodplain forest (right). Both sites were sampled using the standard methods (Horsák *et al.*, 2013a) - the same person was taking the leaf litter sample on the same route in 2005–2008.

	2005	2006	2007	2008		2005	2006	2007	2008
<i>Acanthinula aculeata</i>				1					
<i>Alinda biplicata</i>	104	20	66	26					
<i>Arianta arbustorum</i>	2	1	61	20			5	3	4
<i>Carychium minimum</i>			9				2		6
<i>Carychium tridentatum</i>			3						2
<i>Clausilia pumila</i>	11	8	10	8					
<i>Cochlicopa lubrica</i>		1	123	52		2	121	55	48
<i>Cochlodina laminata</i>	20	9	14	1					
<i>Fruticicola fruticum</i>	7	5	5	8			2		1
<i>Helix pomatia</i>		1	1						
<i>Monachoides incarnatus</i>	5	10	19	7				1	
<i>Nesovitrea hammonis</i>	4	6	18	26			2		
<i>Pseudotrachia rubiginosa</i>						1	11	26	12
<i>Punctum pygmaeum</i>			2						
<i>Succinella oblonga</i>						2	1	4	1
<i>Succinea putris</i>	1	1	3	1			28	38	18
<i>Trochulus hispidus</i>	20	21	93	46		3	1		1
<i>Urticicola umbrosus</i>	3		2	13			2		1
<i>Vallonia costata</i>				3					2
<i>Vallonia pulchella</i>							1	2	
<i>Vertigo pygmaea</i>							1		
<i>Zonitoides nitidus</i>			3	1		9	20	100	27

HOW ARE SNAILS SPREADING THROUGH RIVER FLOODPLAINS?

Considering the fact that terrestrial gastropods are animals with low mobility (e.g. Cameron, 2015) the question arises how are snails spreading through the river floodplains. The dispersion through vertebrates or insects was documented many times before (e.g. Baur & Bengtsson, 1987; Gittenberger *et al.*, 2006; Wada *et al.*, 2012). Probably, it is the way, how some species spread between particular rivers. A much more common way of spreading is floating of land snails by the rivers and transport together with flood deposits.

Geologically, river drift is defined as inorganic sediment deposited by the river stream. It can be deposited in the cores of meanders where they form so called aggradational levees. From the biological point of view, these are flood accumulations of organic material consisting of vegetation remains, seeds and shells of molluscs, alternatively also living individuals (Figure 1). This organic flood material is washed ashore and sedimented on the other side of meanders (i.e. undercut-slope banks) than the inorganic one (Ložek & Juříčková, 2012). The accumulation therefore represents sedimented organic material which is not local. Due to the whirling of the water the material thrown on the bank is already separated in various fine fractions.

Fig. 1: Flood deposits of the lower reaches of the Ohře River by Břežany nad Ohří



Apart from the fact that snails can successfully spread through flood deposits (Čejka *et al.*, 2015; Podroužková *et al.* in prep.), the sediments are also of faunistical importance (Ložek & Juříčková, 2012, Podroužková *et al.*, in prep.) for allowing of findings of very rare or secretly living snail species that would otherwise remain undiscovered in landscape. As an example can serve the terricolous gastropod *Lucilla scintilla*. Its vast majority of findings even comes from the fluvial deposits where it lives between grains of sand in the river substrate (Horsák *et al.*, 2009).

ECOLOGICAL FACTORS INFLUENCING THE COMPOSITION OF FLOODPLAIN SNAIL ASSEMBLAGES

The composition and the species diversity of the floodplain snail assemblages are related mainly to altitude and moisture gradients (Horáčková *et al.*, 2014b). The influence of altitude on mollusc assemblages has been described many times and is obviously related to winter temperatures (e.g. Horsák & Cernohorsky, 2008). This effect becomes more evident where the differences in altitudes are considerable, e.g. the malacocoenoses of lowlands are quite varied in comparison with those in montane or alpine vegetation zone. Generally, it is possible to say that with increasing altitude the species diversity of land snails decreases and conversely. In addition, the lower stretches of studied rivers flow through the warm and productive old-settlement region as shown the examples of the lower stretch of the Ohře River (Juříčková *et al.*, 2013a) and elsewhere (Juříčková *et al.*, 2013b; Smolíková & Ložek, 1978; Ložek, 2005) while the upper streams flow through cold, hilly area with higher average annual precipitation where the human colonisation came much later than in the productive lowlands (Břízová & Juříčková, 2011). These facts are reflecting in the composition of the floodplain mollusc assemblages and in their species richness which is usually higher in the upper river streams and includes much more woodland and less synanthropic species in comparison with the lower streams of rivers.

Considerable changes in the composition of species richness of the floodplain mollusc assemblages is related to the moisture gradient (Horáčková *et al.*, 2014b). Moisture is often the limiting factor in species composition and abundances of the land snail assemblages because majority of them are susceptible to drying (Cook, 2001) even despite the fact that they fight it either physiologically by estivation in the shell or by the creation of a temporary epiphragma or by mechanical burrowing in the ground (Ložek, 1949). The dependence on moisture is known from the studies dealing with snails of various types of temperate woodlands (Wäreborn, 1969; Martin & Sommer, 2004a,b) and was described, together with the frequency of floods, as the key factor affecting for example the species composition and diversity of floodplain vegetation (Schnitzler, 1994) or the floodplain mollusc fauna of the Danube River (Čejka *et al.*, 2008). The poorest mollusc assemblages are living usually in the alder carrs (Horáčková *et al.*, 2014b; Čejka *et al.*, 2008) and/or the willow-poplar softwood forests in starting succession phases, representing the moistest and most flood-affected vegetation types in river floodplains. On the contrary, the richest land-snail assemblages are living in the terminal stages of softwood and transitional forests. The species diversity of land snails decreases slightly towards the more dry hardwood forests. Generally, due to a close relationship between molluscs and site moisture, the mollusc assemblages compose of predominantly mesophilic and hydrophilous land snails in the Czech or central European conditions respectively, in contrasts to xerophilous species. This is closely related to the fact that woodland species are more common in Central Europe than species of open habitats (Kerney *et al.*, 1983; Horsák *et al.*, 2013a).

Another gradient proving crucial for gastropods is production of biomass in the herb layer. It probably represents a whole complex of correlated environmental conditions closely related to vegetation composition and structure which is influencing the composition and species richness of mollusc assemblages not only in floodplains. The vegetation structure and species composition control for example micro-climatic site conditions for gastropods (Boycott, 1934; Cameron *et al.*, 1980; Labaune & Magnin, 2001; Čejka *et al.*, 2008; Dvořáková & Horsák, 2012 etc.), the amount and quality of food sources (Horsák *et al.*, 2010), sufficiency of suitable shelters (Horsák *et al.*, 2013b) or the amount and quality of leaf litter (Sulikowska-Drozd & Horsák, 2007; Čejka *et al.*, 2008) all of them directly influencing snail assemblages.

There was numerously observed a positive correlation between the amount of calcium in soil and/or leaf litter and the species richness and composition of mollusc assemblages in various woodland types (Burch, 1955; Wärebom, 1969; 1970; 1979; Millar & Waite, 1999; Martin & Sommer, 2004a; Hylander *et al.*, 2005; Juříčková *et al.*, 2008) and was observed also on open non-forested habitats such as wetlands (Pokryszko, 1993; Horsák & Hájek, 2003; Horsák 2006) or meadows (Ondina *et al.*, 1998; Dvořáková & Horsák, 2012). Where the calcium content does not present a limiting factor due to a sufficiency of this element, it is no longer a key factor for mollusc assemblages (Gleich & Gilbert, 1976; Getz & Uetz, 1994) as we documented in the case of floodplain forests (Horáčková *et al.*, 2014b). The sufficient amount of calcium utilizable for molluscs in floodplain habitats can be explained by the composition of vegetation, including trees such as *Fraxinus excelsior*, *Acer pseudoplatanus*, *A. platanoides*, *Ulmus laevis*, *U. glabra*, sometimes also *Tilia cordata*, which are often holding high content of citrate form of calcium in their fallen leaves (Čejka *et al.*, 2008; Horáčková *et al.*, 2014b).

IMPACT OF INVASIVE PLANTS ON LAND SNAIL ASSEMBLAGES IN RIVER FLOODPLAINS

The present state of floodplains in Central Europe is unfortunately closely related with often mass occurrence of invasive plants, primarily of the *Fallopia* congeners and *Impatiens glandulifera*, changing the local habitat conditions (Hejda & Pyšek, 2006; Hejda *et al.*, 2009; Koutika *et al.*, 2011). There is still a limited number of studies dealing with the impact of invasive plants on invertebrate species and/or their assemblages. In several studies, it was clearly established that a decrease in abundances and species richness or changes in species composition in selected groups of arthropods are closely related with plant invasions (Slobodchikoff & Doyen, 1977; Herrera & Dudley, 2003; Greenwood *et al.*, 2004; Ernst & Cappucino, 2005; Topp *et al.*, 2008; Wilkie *et al.*, 2007; etc.). Rather surprisingly, the impact of invasive plants on the abundance, species richness and composition of land snail assemblages has been minimally studied so far, despite the fact that molluscs are non-specific herbivores (Speiser, 2001) and thus form a very suitable model group due to their close relation with the vegetation as well as the habitat. Majority of studies concerning with molluscs in invaded floodplains occur in the last decade (Hedge & Kriwoken, 2000; Lenz *et al.*, 2003; Kennedy *et al.*, 2005; Kappes *et al.*, 2007; Gerber *et al.*, 2008; Stoll *et al.*, 2012; Ruckli *et al.*, 2013; etc.). It has been confirmed that for example the invasive *Tamarix ramosissima* decreases abundances of land snails in the south-west part of the USA (Kennedy *et al.*, 2005). Similar effect was observed in the invasive genus *Fallopia* in the river bank vegetation in western Germany (Kappes *et al.*, 2007) or on analogous sites in Switzerland (Stoll *et al.*, 2012), while, for example, in temperate mixed woodlands with invasive *Impatiens glandulifera* in northern Switzerland the abundance and species richness of land snails increased (Ruckli *et al.*, 2013). This short overview shows that the impact is species-specific and can result in a positive or negative influence on mollusc assemblages.

Consequently, when we are studying the impacts of individual invasive species of plants and comparing the level of their impact, it is necessary to study also the impact of congener species. Therefore, Horáčková *et al.* (2014c) studied the impact of three invasive species of plants of the *Fallopia* genus (*F. japonica*, *F. sachalinensis* and their hybrid *F. ×bohemica*) and besides also *Impatiens glandulifera* on the land-snail assemblages in the Czech lower Elbe River basin.

They confirmed that all studied invasive species of plants impact the species richness and abundance of land snails and showed that this impact is species-specific even in the case of three various species of the *Fallopia* genus. With the only exception of *F. ×bohemica*, the invasive plants significantly decreased species richness of mollusc assemblages by 16–48% and the abundances of land snails by 29–90%, with the highest negative impact of *F. sachalinensis* on their assemblages. Surprisingly, the much more invasive other two *Fallopia* congeners, did not induce such a vast impact on the mollusc assemblages on the invaded sites. Hybrid *F. ×bohemica* even caused a slight increase (by 20%) of abundances of rare molluscs (such as *Macrogastera plicatula* and *Vertigo pusilla*). Therefore, Horáčková *et al.* (2014c) showed the invasiveness of a particular invasive plant species does not correspond with its impacts on organisms of the other trophic levels as was also shown in other wider studies, summarising the knowledges on invasiveness of introduced species of plants, vertebrates and invertebrates and their impact on biodiversity (Ricciardi & Cohen, 2007). When visiting invaded sites, it is immediately obvious that *Fallopia* species form relatively massive deposits of leaf litter that does not decompose easily (Cornelissen & Thompson, 1997; Pálková, 2007; Mincheva *et al.*, 2014). A huge layer of poor quality leaf litter is formed there, because there are prevailing slow decomposition by fungi with minimal contribution of microorganisms and other soil bioita. Instead of the fast, mostly microbial decomposition, supported by balanced moisture conditions, good air flow and rich herb layer in the floodplain forests non-invaded by noticed invasive plants. Raw form of humus – the so called mor – is formed on the invaded sites under the thick layer of leaf litter. This form of humus contributes, due to limited processes of mineralisation and humification of organic matter, to the formation of acid soils (Rejšek, 1999; Klimo, 2000) and therefore forms, independently on the geological bedrock, rather acidic environment hardly suitable for the majority of land snails. However, some species of snails prefer habitats with the above mentioned invasive plants and occur there more abundantly than in the surrounding natural vegetation (e.g. *Urticicola umbrosus*, *Succinea putris* and others). This phenomenon is probably related to so called *climbing behaviour* (Boss, 1974; Cowie, 1985; Di Lellis *et al.*, 2012) or utilisation of tall herb plants for climbing up. The climbing used to be explained as an escape mechanism of molluscs from the heated surface of the soil, mainly in the Mediterranean. Nevertheless, this is not the case of floodplain habitats. The question arises why do some species of land snails often climb up in large numbers on the tall invasive and other native plants in river alluvia. Podroužková *et al.* 2014 explored whether land snails prefer feeding on invasive plants over native plants which could be the reason for their climbing behaviour. Apart from the above mentioned invasive plant species, they also studied *Helianthus tuberosus* and confirmed that land snails prefer rather senescent plant material to fresh one (Speiser, 2001). The study falsified the hypothesis that molluscs would utilise the selected species of invasive plants as primary sources of food due to the high content of secondary metabolites (Dirzo, 1980) and lignin. Therefore, their climbing behaviour can be explained as a possible escaping strategy from flood or unsuspected fluctuations at the surface of ground water (Rochette & Dill, 2000; Reid *et al.*, 2013) as well from predators (e.g. Reid *et al.*, 2013; Gerber *et al.*, 2008) or even parasites (McCoy & Nudds, 1997).

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