

The invasive Chinese mystery snail *Bellamya chinensis* (Gastropoda: Viviparidae) expands its European range to Belgium

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Abstract – In this paper we report the first Belgian records of the invasive Chinese mystery snail *Bellamya chinensis*. A walkover-survey along the Laak, a small lowland river, yielded a total of 20 live *B. chinensis*. The presence of both juvenile and adult individuals, with a shell height ranging from 16.6 to 47.5 mm, indicates that the species is firmly established. The most probable source of introduction is a nearby garden center that specializes in ornamental fish and plants for garden ponds.

Keywords: *Bellamya chinensis* / invasive species / Belgium

Résumé – L'escargot vivipare envahissant *Bellamya chinensis* (Gastropoda : Viviparidae) étend sa répartition européenne à la Belgique. Dans cet article, nous rapportons les premiers enregistrements belges de l'escargot vivipare invasif *Bellamya chinensis*. Une prospection le long du Laak, une petite rivière de plaine, a récolté un total de 20 *B. chinensis* vivants. La présence d'individus juvéniles et adultes, avec une hauteur de coquille allant de 16,6 à 47,5 mm, indique que l'espèce est solidement établie. La source d'introduction la plus probable est un centre de jardinerie voisin qui se spécialise dans les poissons d'ornement et les plantes pour les mares de jardin.

Mots clés : *Bellamya chinensis* / espèce envahissante / Belgique

Bellamya chinensis (Gray, 1834), often referred to as *Cipangopaludina chinensis* (but see Smith, 2000), is a large freshwater snail, with a maximum shell height of 70 mm (Soes *et al.*, 2011). The species occurs in a wide variety of waterbodies, including ponds, lakes, ditches, canals and slow flowing parts of rivers (Jokinen, 1982; McCann, 2014; Soes *et al.*, 2016). The species prefers silt or sand substrates and water with dissolved calcium levels above 5 ppm (Jokinen, 1982). *B. chinensis* tolerates a wide range of water temperatures, from near freezing up to 30 °C (Karatayev *et al.*, 2009). It feeds mainly on epiphytic and benthic algae (Jokinen, 1982) and is also capable of filter-feeding (Olden *et al.*, 2013). Female *B. chinensis* live up to five years and males three to four years (Jokinen, 1982). Stephen *et al.* (2013) estimate that female *B. chinensis* produce about 30 young per year. *B. chinensis* originates from SE Asia. Its native range includes China, Taiwan, Korea and Japan, although there are doubts about the taxonomic status of several subspecies described from these areas (Jokinen, 1982; Soes *et al.*, 2016). The species also occurs outside its natural range. It was introduced into North America in the early 1890s and is now a widespread

invasive alien species, with firmly established populations throughout the USA and in the SE of Canada (Jokinen, 1982; McAlpine *et al.*, 2016). Recently, European non-indigenous populations of *B. chinensis* have been found in The Netherlands (Soes *et al.*, 2011, 2016). In this paper we report the first Belgian records of *B. chinensis* and provide clues about the viability of the population and its possible origins.

On 5th May 2016, three freshly dead *B. chinensis* were found near the source of the river Laak in Balen, Belgium (N 51°8'51.8"; E 5°8'1.9"). The largest shell measured 60 mm in height. The specimens were found among sediment and riparian vegetation deposited on the bank of the river after mechanical cleaning. The Laak is a small lowland river with a total length of 1800 m. It is a tributary of the river Grote Nete (Fig. 1). During spring and summer the river Laak is about 1 m wide and water depth rarely exceeds 30 cm. The river bed consists mainly of silt, sand, sandstone and organic detritus. Stream velocity is low, almost stagnant in most parts of the river. Aquatic vegetation is nearly absent, because the river is heavily shaded by trees or tall riparian herbs along most of its course.

On 16th July 2016, walk-over surveys were carried out along the river Laak in an effort to collect living *B. chinensis*

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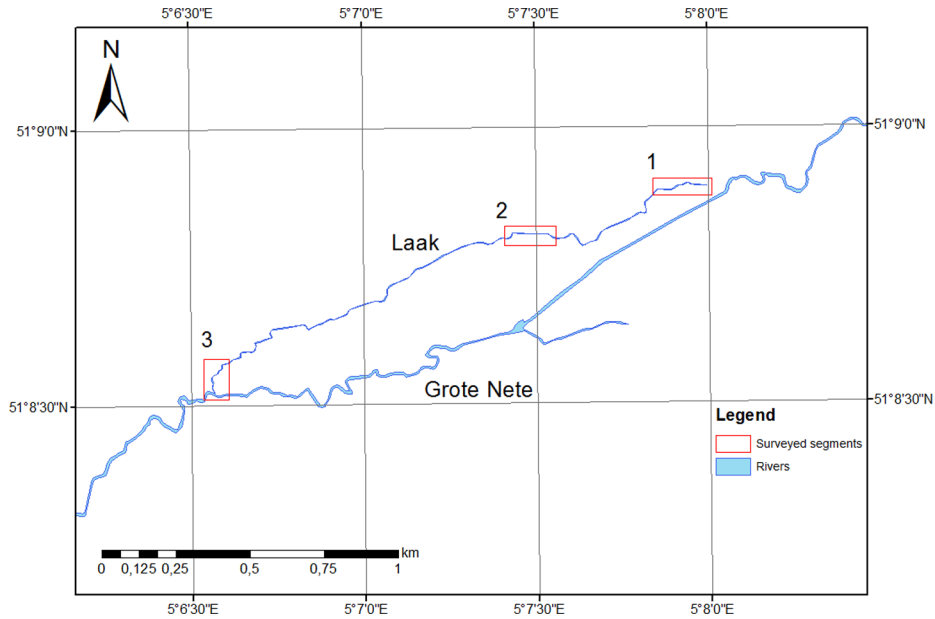


Fig. 1. Surveyed river segments along the river Laak (Balen, Belgium).

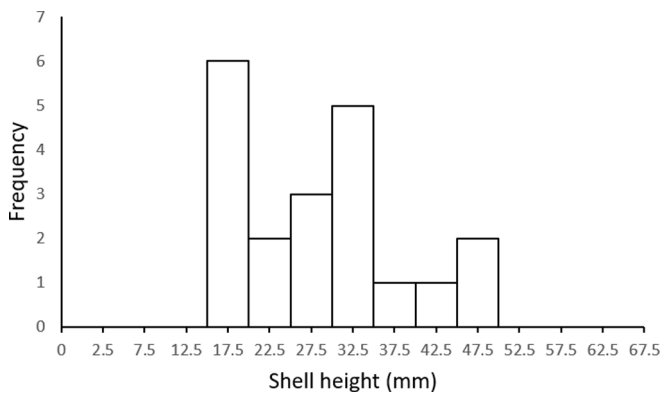


Fig. 2. Frequency distribution of shell height measurements of living *B. chinensis* collected in the river Laak ($N=20$) on 16th July 2016. Shell height was measured to the nearest 0.1 mm with a Vernier micro calliper.



Fig. 3. An adult specimen of *B. chinensis* (shell height 60.6 mm) offered for sale in a garden center near the river Laak (Balen, Belgium).

and to assess whether a viable population had established. Surveys were carried out along three 100 m river segments: near the source of the river, in the middle section and at the river mouth (Fig. 1). Murky water made it impossible to carry out a visual search in the main stem of the Grote Nete. The surveys along the Laak yielded a total of 20 living specimens: one snail was found near the source of the river, 18 were collected in the middle section and one near the river mouth. Both juvenile and adult *B. chinensis* were found, with a shell height ranging from 16.6 to 47.5 mm (Fig. 2).

The number of specimens collected during our search may not reflect the real density of *B. chinensis* in the river Laak. Visibility was limited because of murky water near the source and intense shading by trees in the downstream stretches. Consequently, several snails may have been overlooked during the survey. Still, the wide range of shell sizes indicates that the Laak harbours an established *B. chinensis* population, capable of sustaining itself through natural reproduction.

The most probable source of introduction is a nearby garden center that specializes in ornamental fish and plants for garden ponds. Large quantities of *B. chinensis* were offered for sale in the garden center at a price of 1.25 euro a piece (Fig. 3). Moreover, a series of rearing and stocking ponds owned by the garden center are situated next to the Laak. Therefore, *B. chinensis* may have been unintentionally introduced into the Laak during maintenance of the ponds and aquaria.

Its presence in the river Laak and its availability in garden centers may facilitate colonization of other lowland rivers in Belgium. Most Belgian lowland rivers have muddy river beds and slow currents, which fits the habitat preference of *B. chinensis* described in literature (Jokinen, 1982; McCann, 2014; Soes *et al.*, 2016). The aquarium and ornamental trade has contributed significantly to the spread

of other non-native aquatic invertebrates in Belgium (Boets *et al.*, 2016) and is considered the most likely introduction pathway of *B. chinensis* in The Netherlands (Soes *et al.*, 2011, 2016). The current widespread distribution in North America likely results from several independent unintentional introductions. The aquarium and ornamental trade are also considered important vectors in North America, but recreational activities such as boating are suspected to contribute to its further spread (Jokinen, 1982; Karatayev *et al.*, 2009; Havel, 2011).

There are concerns that *B. chinensis* could have adverse effects on native fauna and flora (Karatayev *et al.*, 2009). So far, only a few studies have addressed this issue. One possible concern is that *B. chinensis* may serve as an intermediate host for parasites. However, introduction of non-native parasites associated with *B. chinensis* is considered unlikely (Soes *et al.*, 2011). Also, the capability of *B. chinensis* to serve as a vector for native parasitic trematodes may be limited (Harried *et al.*, 2015). Other studies have focussed on potential negative impacts on native snail species (Johnson *et al.*, 2009; Solomon *et al.*, 2010). Solomon *et al.* (2010) found no impacts on native snail assemblages in a lake in Wisconsin (USA), although some native snails did not occur at sites where *B. chinensis* was abundant. This may suggest that *B. chinensis* is a rather benign invasive species. However, laboratory experiments showed that *B. chinensis* may alter algal biomass and nutrient cycling (Johnson *et al.*, 2009). Other experiments showed that the filter-feeding capacity of *B. chinensis* is comparable to that of invasive bivalves and revealed that the species could cause a shift in microbial communities when densities are high (Olden *et al.*, 2013). Furthermore, *B. chinensis* is a facultative filter-feeder that has the potential to serve an important role in coupling benthic and pelagic food webs, in particular in lake ecosystems (Olden *et al.*, 2013). The species can be abundant in optimal habitats, up to 38 individuals per m² (Solomon *et al.*, 2010; Chaine *et al.*, 2012). Although densities in The Netherlands are lower (Soes *et al.*, 2011, 2016), our observations confirm that *B. chinensis* expands its European range. Therefore, its ability to establish viable populations in cool to warm temperate climates (Jokinen, 1982; Karatayev *et al.*, 2009) should justify the development of management strategies to prevent further spread in Belgium and elsewhere in Europe.

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