

Westward expansion of the known range of the semi-slug *Vitrinobrachium breve* (A. Férussac, 1821) (Gastropoda, Pulmonata: Vitrinidae) with comments on the use of citizen science in snails

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Abstract. We report the first sightings of the semi-slug *Vitrinobrachium breve* for Belgium. Along with the recent records in France, the Netherlands, Luxembourg, and the western German states, our records considerably widen the distribution range north of the Alps. We discuss why this expansion could be apparent due to the species having been previously overlooked and the role of citizen science in the detection of previously overlooked species.

Keywords: first record, snail, glass snail, Belgium, Saarland, Luxembourg, citizen science, overlooked species.

The semi-slug *Vitrinobrachium breve* (A. Férussac, 1821) is essentially distributed around the Alps and the Dinarides (Switzerland, Italy, Austria, Liechtenstein, Slovenia, Croatia, Bosnia-Herzegovina, Serbia) and in Germany in the south and along the Rhine valley (De Mattia 2003, Karaman 2006, Štamol 2010, Boschi 2011, Welter-Schultes 2012, Wiese 2014, Bank & Neubert 2020, Pfarrer et al. 2021). On the German side, close to the Polish border, the distribution is scattered, and the only report in the Czech Republic has never been confirmed (Umiński 1980, Reise et al. 1996, Juříčková et al. 2001, Renker 2002, Wiktor 2004). At the north-western edge of its distribution area, *V. breve* is also a rare species (Fig. 1).

In the Netherlands *V. breve* was found in 1964 in Millingen aan de Rijn, along the German border (Butot 1964, bij de Vaate 1999a,b). Later, new places have been found in the Rhine basin and the Meuse basin, in the very south of the country (Reinink 1999, de Bruyne et al. 2001, de Bruyne et al. 2003, Majoor & Keulen 2009, Anonymous 2021a). In Luxembourg, the only mention dates from 1998 (Groh, Bad Dürkheim, pers. comm. 2021). In France, two sites are reported in Alsace (Geissert 1996a,b, Falkner et al. 2002, Bichain 2012, Bichain & Orio 2013, Audibert & Bertrand 2015, Hey 2017, Bichain et al. 2021). In Saarland (Germany), three sites were found in 2015 and 2018 (Groh & Renker, Bad Dürkheim & Harxheim, pers. comm. 2021). We report the first records from Belgium in the Meuse and the Rhine basin. Altogether, those data extend the range north of the Alps about 100 km westwards compared to the published maps (Kerney et al. 1983, Welter-Schultes 2012).

On 2 November 2017, the second author pictured an unknown semi-slug in Vieuxville (Belgium; Table 1; Fig. 2). The first author later found live individuals and shells of the same species at different localities (Table 1); one live adult was collected in Ferrières. After the natural death in captivity, the corpse was dissected by the third author.

The dissection was made using an Olympus stereo microscope (10x1 and 10x4 magnification). Pictures were taken using a Canon EOS 7D with an MP-E65 lens and stacked using Adobe Photoshop.

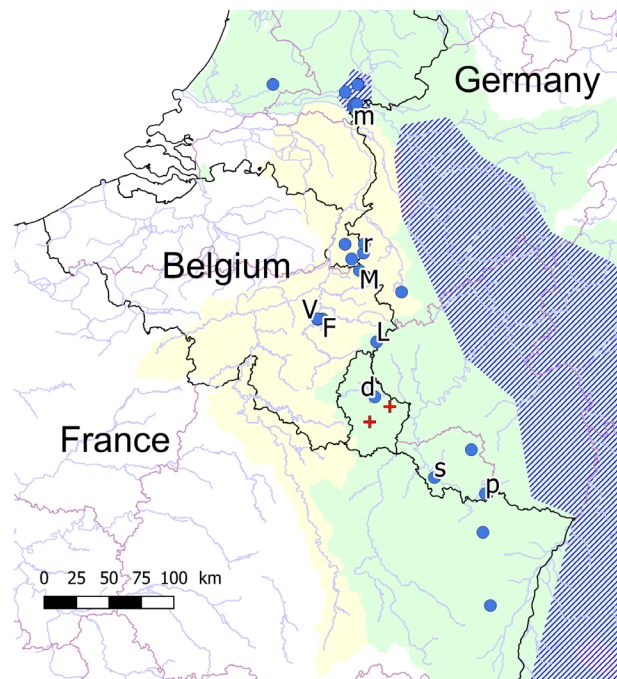


Figure 1. The north-western part of the range of *Vitrinobrachium breve*. The range of Welter-Schultes (2012; blue hatching) is completed by recent records (blue dots) from the literature (Geissert 1996a, Hey 2017, Anonymous 2021a,b), unpublished records (Renker & Groh, pers. comm.; Groh, pers. comm.) and records reported in the present paper. Red crosses indicate fossils from the Holocene (about 9400 BP; Granai et al. 2018, Granai et al., 2020). Pale yellow: basin of the Meuse; pale green: basin of the Rhine. d : Diekirch, F: Ferrières, L: Lommersweiler, M: Moresnet, m: Millingen aan de Rijn, p: Piningen, r: Rimbürg, s: Saarelouis, V: Vieuxville.

Studies of the shell and comparison of the reproductive system of the live individual collected in Ferrières with the literature (Eckhardt 1914, Wagner 1915, Hesse 1923, Künkel 1929, 1933, Forcart 1956, Kerney et al. 1983, Gittenberger et al. 1984, Nardi et al. 2007, Giusti et al. 2011, Hey 2017) establish the first proof of the expected presence (Van Goethem 1988) of *V. breve* in Belgium (Fig. 3-4).

Table 1. Records of *Vitrinobrachium breve* in Belgium.

| Date | Locality | Altitude (m) | Latitude | Longitude | Number of specimens | Environment | Observer |
|------------|---------------|--------------|----------|-----------|------------------------------|----------------------------|----------|
| 02.11.2017 | Vieuxville | 226 | N50,4010 | W5,5502 | 1 live adult | open field, along a hedge | MV |
| 19.02.2021 | Ferrières | 194 | N50,4042 | W5,6027 | 1 live adult, 3 shells | deciduous woodland | LB |
| 23.02.2021 | Vieuxville | 249 | N50,4054 | W5,5474 | 1 shell | deciduous woodland | MV |
| 24.09.2021 | Vieuxville | 249 | N50,4054 | W5,5474 | 17 live juveniles, 27 shells | deciduous woodland | LB |
| 30.04.2021 | Lommersweiler | 379 | N50,2384 | W6,1844 | 4 shells | garden | LB |
| 27.02.2022 | Moresnet | 243 | N50,7325 | W6,0062 | 15 shells | edge of deciduous woodland | LB |



Figure 2. The first live individual of *Vitrinobrachium breve* found in Belgium (Vieuxville). Photo: Manuel Valdueza, 2 November 2017.



Figure 3. The shell of the *Vitrinobrachium breve* individual collected in Ferrières. (A) Dorsal side, (B) ventral side. Scale bars = 1 mm. Photos: Ingrid Margry-Moonen.

Habitat

The valleys of the Rivers Our (Lommersweiler) and Lembrée (Ferrières and Vieuxville) and the deciduous wood in Moresnet are high-quality habitats. Therefore, a major part of the two valleys is included in the Natura 2000 network (Anonymous 2021d). *Vitrinobrachium breve* is known to live in wet and open deciduous forests, especially in river valleys; it requires shady habitat with mosses and deep soils on rocky grounds (Kerney et al. 1983, Welter-Schultes 2012). Four of the five sites found in Belgium are situated close (1–150 m) to an intermittent or permanent water course. Trees and shrubs offer shade, and mosses and rocks are omnipresent. On the other hand, the malacocoenoses of the five sites quite diverge; only species largely spread in all kinds of environments in southern Belgium (De Wilde et al. 1986; pers.obs.) are common to three localities or more (Table 2).

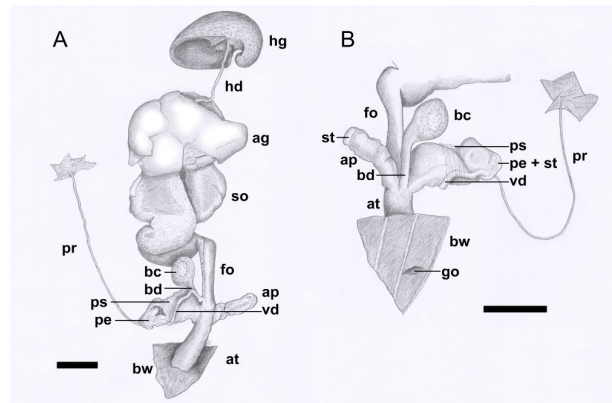


Figure 4. (A) The genitals of the *Vitrinobrachium breve* individual collected in Ferrières, ventral side, (B) detail close to the genital orifice, dorsal side. Scale bars = 1 mm. ag = albumen gland, ap = appendix, at = atrium, bc = bursa copulatrix, bd = bursa copulatrix duct, bw = body wall, fo = free oviduct, hg = hermaphroditic gland, go = genital orifice, hd = hermaphrodite duct, pe = penis, pr = penial retractor muscle, ps = penial sheath, so = spermooviduct, st = spongial tissue on the penis, vd = vas deferens. Drawings: Kees Margry.

Origin

Records of *V. breve* east of the main range have been considered non-native (Reise et al. 1996). The finds in North-western Europe could be due to a recent expansion of the range, man-assisted or not, or indicate that the species has long been overlooked. The sequence of the finds could seem to indicate a natural range expansion upstream, both in the Mosel basin (Diekirch LU 1998 → Saarelouis DE 2015 → Pinnigen DE 2018; Diekirch LU 1998 → Lommersweiler BE 2021) and in the Meuse basin (Millingen aan de Rijn NL 1964 → Rimburg NL 2009 → Ferrières BE 2021/Moresnet BE 2022). Nevertheless, the hypothesis of a range extension in the 20th and 21st centuries cannot be retained without at least some kind of anthropochory, mammalochory, or ornithochory as it would imply an average yearly expansion of at least 500 m (900 m in the Meuse basin) and the suitability of the waterside along the whole run of the rivers. The species having been overlooked seems, however, the simplest hypothesis. Many gastropod species that spread westwards during the interglacials to both sides of the English Channel have withdrawn to Central Europe (Limondin-Lozouet & Peerce 2014). Some isolated populations may, however, have survived in-between without getting noticed. That could be the case for *Platyla polita* and *Daudebardia rufa*, which have recently been discovered in Belgium (Marquet 1983, de Bruyne 1995, Bronne et al. 2021) and whose fossils have been found in the Somme (Antoine et al. 2006). Fossils of *P. polita* have also

been found in England (Holyoak & Peerce 1986, Rousseau 1992). Similarly, *V. breve* appears quite frequently in the British deposits of the middle Pleistocene (Holyoak & Peerce 1986, Parfitt & Roberts 2014). In the Netherlands, fossil records date from the early to the late Pleistocene (Briele,

Tegelen, and Hendrik-Ido-Ambacht: Tiglien; Breda: Waalien; Amsterdam and Wijdewormer-Zaandam: late Pleistocene) (Kuijper 1973, Meijer 1973, 2010). In Luxembourg, fossils are recorded from the Holocene (about 9400 BP; Granai et al. 2018, 2020).

Table 2. Other terrestrial gastropods found in a 30 m radius around the individual and shells of *Vitrinobrachium breve*.

| | Vieuxville (2017 site) | Vieuxville (woodland) | Ferrières | Lommersweiler | Moresnet | Count |
|--------------------------------------|---------------------------|--------------------------|-----------|---------------|----------|-------|
| <i>Aegopinella nitidula</i> | v | v | | v | v | 4 |
| <i>Aegopinella pura</i> | | | v | | | 1 |
| <i>Arion (Carinarion) sp.</i> | | v | v | | | 2 |
| <i>Arion (Kobeltia) sp.</i> | v | v | v | v | v | 5 |
| <i>Arion (Mesarion) sp.</i> | | | | v | | 1 |
| <i>Arion intermedius</i> | v | | | | | 1 |
| <i>Arion vulgaris</i> | | | v | | v | 2 |
| <i>Cepaea hortensis</i> | v | v | v | v | | 4 |
| <i>Clausilia bidentata</i> | | v | v | | v | 3 |
| <i>Cochlicopa lubricella</i> | | | | v | | 1 |
| <i>Cochlicopa lubrica</i> | v | v | | v | v | 4 |
| <i>Deroceras reticulatum/agreste</i> | | | | v | | 1 |
| <i>Helix pomatia</i> | v | v | v | v | v | 5 |
| <i>Macrogastra rolphii</i> | | v | v | | | 2 |
| <i>Monachoides incarnatus</i> | | | v | v | v | 3 |
| <i>Nesovitrea hammonis</i> | v | | | | | 1 |
| <i>Oxychilus draparnaudi</i> | | | v | v | v | 3 |
| <i>Phenacolimax major</i> | v | | v | v | v | 4 |
| <i>Succinea putris</i> | | v | v | | | 2 |
| <i>Trochulus hispidus</i> | v | | | v | v | 3 |
| <i>Vallonia costata</i> | | v | | v | | 2 |
| <i>Vallonia excentrica</i> | | | | v | | 1 |
| <i>Vitrea contracta</i> | | | | v | | 1 |
| <i>Vitrina pellucida</i> | v | v | | | | 2 |

Without the modern ease to document sightings and the use of a data portal for citizen scientists also adapted for mollusk records (observations.be; Natagora et al. 2022), the accidental finding of a semi-slug provisionally identified as *V. breve* by the second author would most probably have kept unnoticed and wouldn't have motivated subsequent specific searches. This is a new illustration of the boost in primary biological knowledge driven by the rise of the data portals for citizen scientists. Online data portals are valuable early warning systems to detect upcoming invasive (e.g., Swinnen et al. 2018, Claerebout et al. 2019, Langerhaert et al. 2021, Bronne & Delcourt 2022) and nonnative species (sensu Essl et al. 2019) (e.g., Vantieghem 2018), but those portals can also play a role in detecting possibly native species previously overlooked (e.g., Scheers 2020, Tempelman 2021).

From the accidental find of *Daudebardia brevipes* in Belgium (26.05.2020; Bronne & Van den Neucker 2020) up to February 2022, the first author gathered 5394 records of terrestrial gastropods in prov. Liège (Belgium), where all the records of *V. breve* occurred. The amount of data is the same order of magnitude as the only massive previous dataset about terrestrial gastropods: the 40,000 records collected in the whole of Belgium (7.96 times bigger than prov. Liège) before the Atlas provisoire des gastéropodes terrestres de la Belgique (De Wilde et al. 1986, Van Goethem 1988). In

addition, the special focus of the new surveys on riversides, especially close to the German border, could be a simple explanation of the later finds of *D. rufa* (Bronne et al. 2021) and *V. breve*. Renker & Groh (2020) and de Bruyne et al. (2003) also consider *V. breve* indigenous in Saarland and the Netherlands.

Conservation

At a global level, the IUCN considers *V. breve* as of Least Concern (LC) (last assessment 2011; von Proschwitz et al. 2011), as it is in Switzerland (Boschi 2011) and Germany (Wiese 2014). But in Germany, the status depends on the state: Saarland: LC (Renker & Groh 2020), Nordrhein-Westfalen: LC (last assessment 2009, Anonymous 2021c), Baden-Württemberg: Nearly Threatened (NT) (Arbeitsgruppe Mollusken BW 2008), Hesse: Endangered (EN) (Jungbluth 1995), Sachsen-Anhalt: Data Deficient (DD) (Hartenauer et al. 2020) – in the other states the species has not been assessed. In the Netherlands, *V. breve* is considered NT (de Bruyne et al. 2003), and in France, DD (Régnier et al. 2021). For the distribution area in northern France, Bichain et al. (2021) provide an analysis of the protected status of *V. breve* with recommendations for compensatory measures. In Wallonia (southern Belgium), Dufrière (2017) suggests comparing the count of 1x1 km square of presence with

given thresholds to apply IUCN criterion B3a. But as no targeted search has been conducted yet for this species, except very partially in one province, the status DD is the most reasonable. *Vitrinobrachium breve* should be actively searched in all suitable habitats in the basin of the Meuse and the Rhine in Belgium and the neighbouring countries. Meanwhile, special attention should be paid to protecting the habitat of the few known populations, especially as only one of them (Ferrières) is situated in the Natura 2000 network (BE33027 - Vallée de la Lembrée et affluents).

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