

Short note

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Yet another carnivorous semi-slug found in Belgium: *Daudebardia rufa* (Draparnaud, 1805) (Gastropoda: Oxychilidae)

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This note reports the first record of the semi-slug *Daudebardia rufa* (Draparnaud, 1805) in Belgium and adds a new record of *D. brevipes* (Draparnaud, 1805). After the first report of *D. brevipes* in Belgium (Trooz, May 2020) [1], ten surveys were conducted at random natural or semi-natural locations along the river Vesdre, in order to assess to what extent the species was established. The surveys were carried out between September and December 2020. On December 20th 2020, the first author found two fresh empty shells of *D. rufa* on cobblestones at the bottom of a railway bridge embankment, situated between the Vesdre and a road in Ensival (50.5742° N, 5.8310° E), a village in the centre of the Province of Liège, Belgium (Fig. 1). Two days later, on December 22nd 2020, the second author found a living adult on the embankment wall at the opposite entrance of the bridge. On December 25th 2020, a fresh dead adult specimen was found. Another one was found on January 29th 2021, along with a live juvenile and an empty shell. An empty shell of *D. brevipes* was also collected at the same locality.

The site is located at the crossing between the left riverbank of the Vesdre valley (142 m above sea level) and a railway bridge, around a small tunnel. The soil consists of recent alluvial deposits of clay and sand. The bedrock is characterized by Devonian shales and dolomitic limestones. The bridge and its embankments are made of limestone. The slopes of these embankments are poorly consolidated, allowing the development of mosses, herbs, ferns, trees and shrubs, particularly on the northern side. Trees and



Fig. 1 – Site description: (a) Orthoview (scale bar = 50 m, the yellow arrows indicate where the specimens of *D. rufa* were found) [2]; (b) view of the northern side of the tunnel; (c) view of the southern side of the tunnel; (d) details of the stony slopes of the railway embankment. Pictures taken in December 2020 and January 2021.

shrubs had been cut in 2019, with the resulting wood chips scattered on the railway embankment, mainly at the NE of the tunnel. The riparian vegetation (including *Rubus* sp., *Fallopia japonica* and *Urtica dioica*) along the Vesdre had also been recently cut. Deduced from historical maps and image archives from [2][3][4], at least three cycles of maintenance and cutting were carried out over the last 20 years. Vegetation on the NW railway embankment, where most specimens were found, is dominated by *Salix caprea*, *Corylus avellana*, *Rubus* sp., *Asplenium trichomanes*, *Dryopteris* sp. and mosses. The NE embankment displays the same shrub assemblage, with the addition of *Acer pseudoplatanus*. The SW embankment is dryer and more sun-exposed, with very little vegetation. *Corylus avellana*, *Sambucus nigra*, *Crataegus monogyna*, *Rubus* sp., *Rosa canina*, *Senecio inaequidens* and *Urtica dioica* are the main species on the SE embankment, where two specimens of *D. rufa* were found. The woodland located at the SE is dominated by *C. avellana* and *Quercus robur*.

The empty shells and the live adult-sized specimen of *D. rufa* collected in Ensival (Fig. 2) fit the description of the species and differ from the closely related *D. brevipes* [5][6][7]. The stretched body length of the adult *D. rufa* measured 16 mm and its shell width measured 4.5 mm. The last whorl of the adult shell is strongly ear-shaped and the upper and lower parts of the shell mouth are almost parallel, so that the shell appears oblong. The coiled part of the shell occupies 40 to 50% of the total width; in comparison, *D. brevipes* has a concave shell outline and the coiled part occupies only 30 to 40% of its total width [5][6][7]. There are no significant anatomical differences between *D. rufa* and *D. brevipes* [5].

Daudebardia rufa is found in parts of Central and Southern Europe (Fig. 3), the Ukraine, Turkey and Algeria [6][7]. Recently, *D. rufa* was also found in Western Europe, including the Netherlands [8] and UK [9]. Fossil records of *D. rufa* dated to the Eemian interglacial period (circa 130-115kyr BP) from the Somme region in France [10] suggest that its range reached further westward than known at present, apart from the recent find in the UK [9]. *Daudebardia rufa* is found in humid deciduous highland and montane forests, typically between 300 and 1500 m elevation, often near water [6][7][11]. In Central

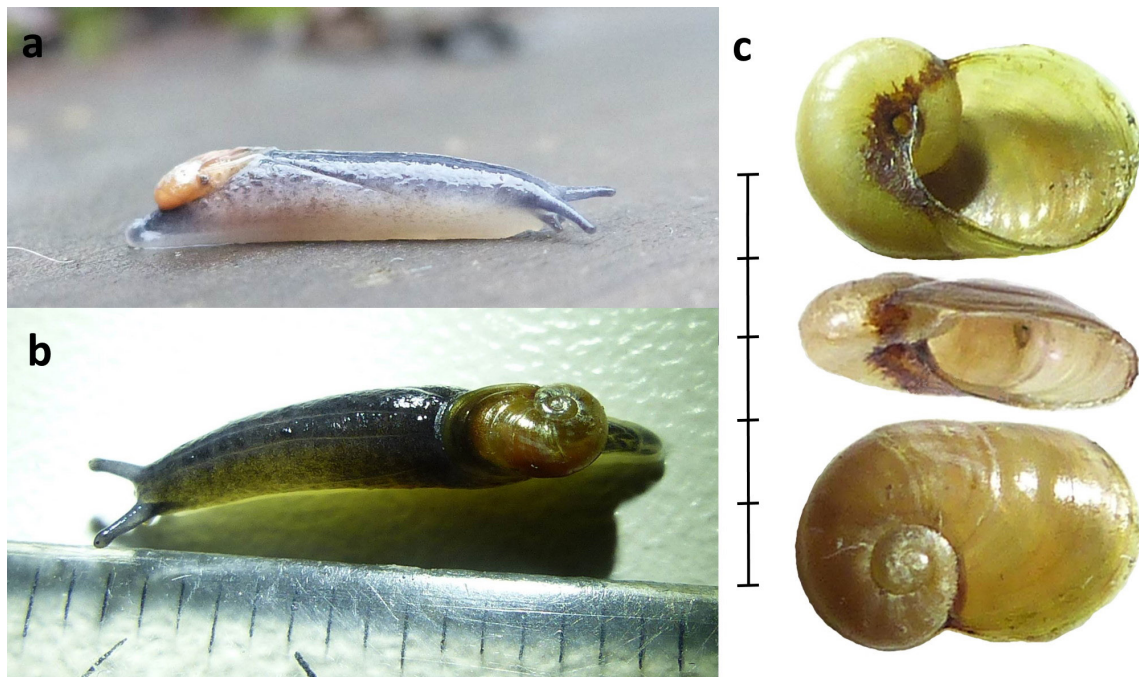


Fig. 2 – The live adult specimen of *Daudebardia rufa* found in Ensival (a–b) and its shell (c). Scale bar is in mm.

Europe, *D. rufa* has been reported from *Fagus*, *Fraxinus*, *Quercus*, *Carpinus* and *Salix* forests [11][12][13][14], as well as from scrublands and grasslands on mountain slopes [13]. In southern regions, it has been recorded in *Fagus* forests, sparse *Quercus* and *Fraxinus* forests and ravine forest fragments with *Acer pseudoplatanus* [15][16][17]. Like *D. brevipes*, *D. rufa* is mesohygrophilic and cold-resistant [18]. The species does not tolerate warm and dry conditions, and is therefore mostly subterranean, living in deep, loose soil. Acidic soils are avoided [6][7][11]. During cooler periods, in spring, late autumn, and on mild winter days, *D. rufa* can be found under stones, moss, leaf litter and decaying wood [11]. *Daudebardia rufa* is carnivorous and mainly feeds upon molluscs, earthworms, isopods and insect larvae [6][7][11].

Daudebardia rufa is a rare species, although it is more common and widespread than *D. brevipes* [7] (Fig. 3). The conservation status of *D. rufa* differs regionally. In Germany, *D. rufa* is categorized as endangered [19]; in the Czech Republic, as near threatened [20]; in Switzerland, as vulnerable [11]; and in Austria, as of least concern [21]. At the western edge of its range (Fig. 3), the presence of *D. rufa* has been established for a long time in Luxembourg [22] as well as in France and Germany along the Rhine valley [23][24]. Remarkably, both *D. rufa* and *D. brevipes* have recently been reported from several new localities in Western Europe (Fig. 3). In 2016, a population of *D. rufa* was found in Wales (UK) [9]. In 2017, fresh shells of *D. rufa* and *D. brevipes* were found together in the western part of the German Eifel, at two different sites in the Urft valley (Pardey, pers. comm.), and a live juvenile of *D. rufa* south of Aachen (Majoer, pers. comm.). In 2019, a single specimen of *D. brevipes* was found in a greenhouse in Ghent, Belgium [25]. In May 2020, live specimens of *D. brevipes* were found in a natural environment in Belgium, along the Vesdre [1]. Finally, in November 2020, empty shells and live specimens of both species were found in the valley of the Eyserbeek in the Netherlands [8]. Interestingly, the rivers Urft

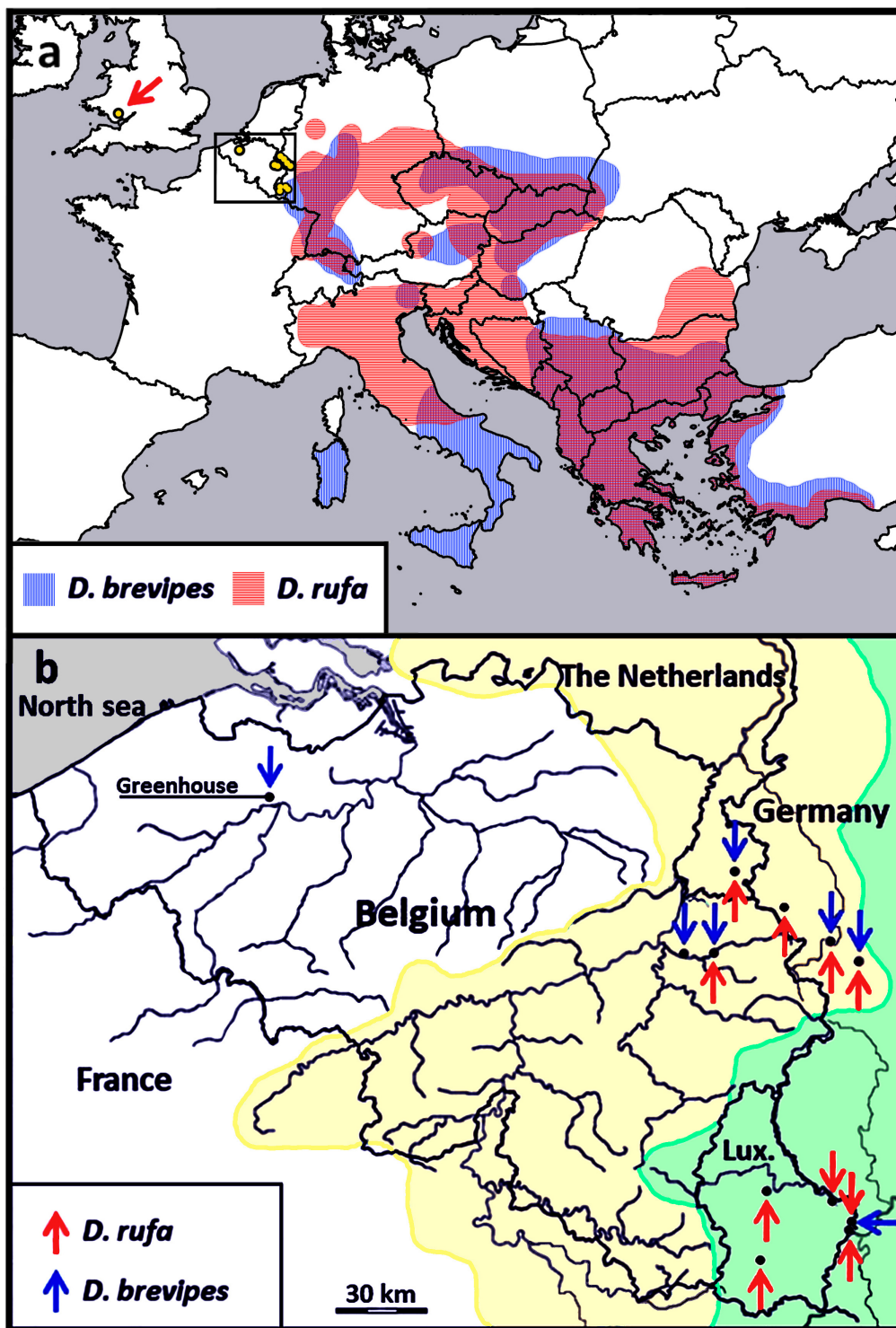


Fig. 3 – (a) Range map of *Daudebardia rufa* and *D. brevipipes* in Europe, redrawn from WELTER-SCHULTES [7]. Yellow dots indicate recently reported localities along the western part of their ranges. The locality of *D. rufa* in the UK [9] is indicated by the red arrow. (b) Reported records of *Daudebardia* from Benelux and adjacent localities in Germany are indicated in the cut-out below, corresponding with the black rectangle in the top panel (a). The Meuse and Rhine basins are indicated in pale yellow and pale green, respectively. Black dots on the bottom panel (b) indicate published and unpublished records (see text) and records available from the GBIF portal [28].

in Germany, Vesdre in Belgium and Eyserbeek in the Netherlands, all belong to the Meuse basin. This suggests that *D. rufa* and *D. brevipes* are firmly established along the Meuse basin, despite the Rhine basin long being considered as the westernmost range limit of both species (Fig. 3).

The recently established presence of both *Daudebardia* species in the Meuse basin could be the result of a westward range expansion. However, BRONNE & VAN DEN NEUCKER [1] hypothesised that the *D. brevipes* population along the Vesdre in Trooz may have been previously overlooked, based on the relatively pristine habitat. This may also be the case for *D. rufa*, although the site at Ensival is clearly more disturbed than the site at Trooz, and it therefore cannot be ruled out that *D. rufa* was introduced. Likewise, OWEN *et al.* [9] expressed uncertainty about whether *D. rufa* is an overlooked native species or a species recently introduced in Wales (UK). The find of *D. rufa* along the Vesdre in Ensival resulted from surveys carried out after the earlier find of *D. brevipes* in Trooz. Similarly, the find of *D. brevipes* in the Netherlands along the Eyserbeek was the result of targeted searches after the previous find of *D. rufa*, which was first reported on a data portal for citizen scientists [8]. Online data portals such as iNaturalist and Waarnemingen.be/Observations.be are valuable early warning systems to detect upcoming invasive species [26], but could also play an important role in monitoring neoforeign species (i.e., species that have expanded their range as a response to human-induced environmental changes [27]) and in detecting previously overlooked native species.

Although it is not clear whether *D. rufa* and *D. brevipes* were introduced or should be considered (neo)native, our study shows that both species are firmly established in the Meuse basin. The presence of juvenile specimens of *D. rufa* indicates that the Belgian population is self-sustaining. The rapid communication of the first Belgian records of *D. rufa* and *D. brevipes* and the overview of the current distribution of both species in Western Europe (Fig. 3) could serve as a baseline for further monitoring the newly recorded populations. Given that *D. rufa* and *D. brevipes* may be (neo)native in Belgium and given their general rarity in Europe, protective measures should be considered for both species, although the uncertainty regarding the origins of the Belgian *Daudebardia* populations should be taken into account. Such measures may include protection of their preferred habitat, in particular deciduous forests with deep soils in the vicinity of small rivers [6][7][11].

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