Research article

New data on the rare snail *Soosia diodonta* (A. Ferussac, 1821) (Gastropoda: Helicodontidae) in Bulgaria

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Abstract: In the present article, we summarised all known information on the species *Soosia diodonta* (A. Ferussac, 1821) from Bulgaria. A new locality in urban environment, photos of live animals and the reproductive system of the species are given. New information on its ecology and biology is provided.

Keywords: biology, Bulgaria, distribution, ecology, *Soosia diodonta*

Introduction

The snail *Soosia diodonta* (A. Ferussac, 1821) was described by Férussac in 1821 from Banat, Romania as *Helix diodonta* (Férussac A. & Deshayes, 1819–1851). Based on the anatomical features Hesse (1918) placed the species in a separate genus, *Soosia* Hesse, 1918. Presently, *S. diodonta* is the only member of the genus (Schileyko, 2006; Bank & Neubert, 2017). *Soosia diodonta* is reported for the first time for Bulgaria, after only one live specimen, by Urbanski (1964) from the Vitosha Mountains, Boyana Waterfall area. Despite the collecting efforts during the last 25 years in the area of the waterfall, the species has not been confirmed again. Georgiev & Stoycheva (2007) reported *S. diodonta* from a new locality in the Eastern Balkan Mountains, western of Kotel Town.

Outside Bulgaria, the species is found in the southern Carpathians, in the Western Balkan Mountains (eastern Serbia) and in the lowlands of the Lower Danube River. There are only a few known locations, summarised by Fehér (2020): Moldova Noua, Baile

Herculane, Padurea Caldarusani, Jurilofca; Padurea Prahova, Surdulica; Cerna valley, Motru Sec, Closani, Tismana and Nera gorge near Sasca Montana.

In the present article, new information is given about the distribution and biology of the Bulgarian population of the species, as well as pictures of the reproductive system and live animals in situ.

Material and methods

The snail was collected from two localities in the region of the Balkan Mountains: 1) western of Kotel, road to Zelenich area (Fig. 1); 2) Tryavna, in the town, ruins (Fig. 2). The type of habitats is determined according the Council Directive 92/43/92 and the EUNIS habitat classification. Both literature and new distribution data of the species *S. diodonta* in Bulgaria are summarised in Table 1. The snails were hand collected and photographed in situ. Some species were killed, fixed and stored in 75% ethanol for further analyses. Abbreviation used: Coll. ID = identification number in the

Fig. 1. The locality of *S. diodonta* after Kotel Town, road to Zelenich area and in situ photos of live animals. A – the habitat of the species and the location of the specimens under log (B); C – live specimens from Zelenich.

Fig. 2. The locality of *S. diodonta* in Tryavna Town and in situ photos of live animal. A – the urban habitat of the species; B – live specimens from Tryavna Town.

Table 1. Localities of *S. diodonta* in Bulgaria.

Geographic Region	Locality	Habitat	Date, collectors/observers/collection	GPS coordinates, altitude, remarks
Vitosha Mountains	Boyana Waterfall	Asperulo-Fagetum beech forests (9130)	Urbanski (1964)	N42.6295° E023.2542°, 1303 m a.s.l. (restored)
Eastern Balkan Mountains	W of Kotel (road to Zelenich area)	Medio-European limestone beech forests of the Cephalanthero Fagion (9150)	Georgiev & Stoycheva (2007)	N42.8866° E026.3943°, 612 m a.s.l. (restored)
ditto	W of Kotel (road to Zelenich area)	Medio-European limestone beech forests of the Cephalanthero Fagion (9150)	12.X.2013, leg. U. Schnepat, F. Knetche, D. Georgiev, I. Dedov, 2adl, 1jvd (IBER, Coll.No.1642)	N42.88248° E026.38868°, 625 m a.s.l. (original)
Central Balkan Mountains	Tryavna, in the town	Urban and suburban derelict spaces – ruderal communities of <i>Sambucus ebulus</i> , <i>Humulus lupulus</i> , <i>Rubus caesius</i> , <i>Clematis vitalba</i> etc. (J1.51), under tiles	14.X.2013, leg. U. Schnepat, F. Knetche, I. Dedov, D. Georgiev 12adl, 2jvd (IBER, Coll.No.1645)	N42.872037° E025.497549°, 432 m a.s.l. (original)

molluscs collection of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia.

Results

Distribution in Bulgaria

In Bulgaria, the species is considered to be rare. Presently, the species is known from three localities: one in the Vitosha Mountains (Fig. 3) and two in the region of the Balkan Mountains (Table 1) (Urbanski, 1964; Georgiev & Stoycheva, 2007; present article). Despite the collecting efforts, the species was not found again in the area of the Boyana Waterfall, Vitosha Mountains. The new locality is in the town of Tryavna, in the region of the Central Balkan Mts.

Ecology

In Bulgaria, the species was found in: 1) Asperulo-Fagetum beech forests (9130) (Council Directive 92/43/92), near Boyana Waterfall (Urbanski, 1964), 2) Medio-European limestone beech forests of the Cephalanthero Fagion (9150) (Council Directive 92/43/92), near Kotel (Georgiev & Stoycheva, 2007) and 3)

Fig. 3. The area of Boyana Waterfall, Vitosha Mountains – the first reported locality of *S. diodonta* for Bulgaria by Urbanski (1964).

Fig. 4. *S. diodontia* – eggs (A), offspring (B) and adults from the terrarium of F. K. Glogger – shell (C) and live specimens (D).

Urban and suburban derelict spaces – ruderal communities of *Sambucus ebulus*, *Humulus lupulus*, *Rubus caesius*, *Clematis vitalba* etc. (J1.51) (EUNIS habitat classification), in the town of Tryavna, under tiles (Figs 1–3). The species prefers shady places – under bark, in old trunks, under tiles and other materials, which provide it with good humidity.

Biology

The biology of *S. diodontia* was studied keeping specimens in terrarium (for more details about the conditions in the terrarium and the used food see Table 2). Similarly to many other gastropod species, *S. diodontia* is active at night. The pre-copulation habits and copulation activity were not observed. The first eggs were laid about 20 days (D. Georgiev) and 3.5 months (F. K. Glogger) after the collecting of the adult specimens from Tryavna Town (most probably, the specimens grown by D. Georgiev were taken from nature fertil-

Fig. 5. *S. diodontia*, reproductive system. Abbreviations: ♂♀ at – atrium; ♂: p – penis, pr – penial retractor, vd – vas deferens; ♀: v – vagina, so – sperm-oviduct, ag – albumen gland, c – carrefour, hd – hermaphroditic duct, bc – bursa copulatrix; ad – adult, juv – juvenile, add – adult empty shell, adl – adult collected alive, juvd – juvenile empty shell, juvl – juvenile collected alive.

ised, while the specimens of F. K. Glogger copulated in the terrarium). The eggs were laid in clutches (3–5 eggs in groups, mostly 3–4 eggs together), adhered to the substrate. The eggs were round-elliptic (about 2.5x1.5 mm), milky-whitish, looking dotted. The period from the eggs-laying to hatching was 15–20 days (F. K. Glogger) and 22 days (D. Georgiev). The freshly hatched offspring were with 2 whorls and a size of about 2 mm. It took about 5 months for the offspring to turn into adults (Fig. 4).

Shells

The investigated shells correspond perfectly with the description of Schileyko (2006) and demonstrated stable characters in shell colour and shape (Grossu, 1983). According to Schileyko (2006), the shell is nearly flat, discoidal, rather thin, of 4.5 scarcely convex whorls. Last whorl distinctly angulate, descending in front, constricted at aperture and impressed above. Colour brownish-corneous. Embryonic whorls smooth, the rest of the surface minutely granularly striate. Aperture narrow, very oblique; margins reflexed, with 1 parietal

Table 2. Biology of *S. diodonta*.

	F. K. Glogger – 5 spm	D. Georgiev – 2 spm
Size of terrarium (cm)	60x70x60	10x15x12
Type of substrate	Soil – mixed (brown forest soil, and sort of terrarium soil) with wood (some branches and bark), leaves, moss	Carbonate soil
Temperature regime	Summer 18–19°C, Winter 13–15°C	No observations
Moisture regime	Regularly sprayed rainwater in the terrarium to keep it moist	Keep it moist
Type of food, food preferences	Old leaves, <i>Cucumis sativus</i> L., <i>Cucurbita pepo</i> L. var. <i>zucchini</i> , <i>Daucus carota</i> L., mushrooms. Preferred mushrooms.	<i>Daucus carota</i> subsp. <i>sativus</i> (Hoffm.) Schübl. & G. Martens, <i>Brassica oleracea</i> L., <i>Capsicum annum</i> L., <i>Cucumis sativus</i> L.; fruits: <i>Malus domestica</i> Borkh., 1803; green leaves of grass species: <i>Trifolium</i> sp., <i>Petunia</i> sp.; and mushroom fruiting bodies: <i>Calvatia</i> sp.
Round-the-clock activity	No detailed observations. Always active in the period 21.00–23.00 h. During the daytime they were most time hidden behind a piece of bark (in group).	5 November 2013: the adult snails are always under the leafs, even in the early morning; 9 November 2013: one adult is on the wall of the terrarium at around 19 h, full darkness; 10 November 2013: eating carrot during the night, T 18.4C.
Pre-copulation and copulation habits	No observations	No observations
Date of material collecting	14 October 2013	14 October 2013
Date of eggs-laying/ Number of eggs/Notes	27 January 2014, 31 January 2014, the laid eggs in 9 clutches (each of them from 3 to 5, mostly 3–4 eggs together). Total number laid eggs – 36, 15 of them hatched. t12–15°C	3 November 2013 / 4 eggs, laid in clutch, sticked on a leaf of <i>Platanus</i> under a bark/ t18.4°C
Date of hatching/Period from eggs-laying to hatching	15–20 days	25 November 2013/22 days
Period from offsprings to adult	About 5 months (hatched February – adult in July)	No observations

and 1 basal tooth. Umbilicus wide. Height of Bulgarian specimens: 3.3–4.0 mm. Diameter 10–12 mm. Number of whorls 4.5 (Fig. 4).

Anatomy

♂♀ The atrium is relatively short and wide; ♂ penis is cylindric-fusiform, vas-deferens enters the penis apically, penial retractor relatively wide and inserts to vas deference at small distance from penis; ♀ vagina rather short, carrefour well visible. Length of spermatheca a

little more than half of sperm oviduct. The investigated reproductive systems from the Balkan Mountains, after the town of Kotel, is typical for the species and match the descriptions of Schileyko (2006) (Fig. 5).

Discussion

According to Grossu (1983), *S. diodonta* occurs in the moist foliage of forests, on the bark of trees in rainy weather, and under the bark of rotten logs. Rarely even

on the rocks. The new locality in the town of Tryavna is the first known finding of the species in an urban environment. This observation is in contrast to the current knowledge on the species' preferable localities – different type of deciduous forest (Urbanski, 1964; Grossu, 1983; Georgiev & Stoycheva, 2007). The abundant population in the town of Tryavna shows good adaptation to the new type of habitat – open terrain with numerous shelters, keeping good shadow and moisture. For Romania, Grossu (1983) considers *S. diodonta* a rare species with limited distribution. According to Fehér (2020), the range of this species is far from being well studied. The new finding in an urban environment may challenge the assumption about the species narrow ecological tolerance. On the other hand, *S. diodonta* is rare in its entire narrow range, which is bounded to well-preserved forests in general. Such type of habitats are diminishing within its potential range (Fehér 2020). Therefore, the species is assessed as Near Threatened by the IUCN. This newly discovered population is very important because it can be a good model to investigate the ecological requirements and the survival potential of this species. A possible reason for the species rarity could be its low reproduction capacity (the small number of eggs), rather than its ecological preferences (the species survives in inappropriate urban environment).

In the sketch given by Grossu (1983), the vagina of the *S. diodonta* is too long and this drawing mistake is corrected in Schileyko (2006). The reproductive system of the Bulgarian specimens of *S. diodonta* is typical for the species – the mucus gland is missing and the vagina is short (Schileyko, 2006).

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References

- Bank R., Neubert E. 2017 [Checklist of the land and freshwater Gastropoda of Europe](#). Last update: 16 July 2017. 170 pp.
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, OJ L 206, 22.7.1992, p. 7–5.
- Damyanov S., Likharev I. 1975 Gastropoda terrestria. Fauna bulgarica 4: 1–425. (In Bulgarian)
- [EUNIS habitat classification](#).
- Fehér Z. 2020 *Soosia diodonta* (amended version of 2011 assessment). The IUCN Red List of Threatened Species 2020: [e.T156467A177159574](#). Downloaded on 27 May 2021.
- Férussac A.E. d'Audebard de baron de, Deshayes G.P. 1820–1851 Histoire naturelle générale et particulière des mollusques terrestres et fluviatiles, tant des espèces que l'on trouve aujourd'hui vivantes, que des dépouilles fossiles de celles qui n'existent plus; classés d'après les caractères essentiels que présentent ces animaux et leurs coquilles. Tome premier. J.-B. Baillière, Paris, i–viii, 402 pp.
- Georgiev D., Stoycheva S. 2007 A new record of *Soosia diodonta* (Férussac, 1821) (Gastropoda: Pulmonata: Helicodontidae) in Bulgaria. *Malacologica Bohemoslovaca* 6: 35–37.
- Grossu A.V. 1983 Gastropoda Romaniae 4, Ordo Stylommatophora, Suprafamilie: Arionacea, Zonitacea, Ariophantacea și Helicacea. Edit. Litera, București, 538 pp.
- Hesse P. 1918 Die Subfamilie Helicodontinae. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft* 50 (3): 99–110.
- Schileyko A.A. 2006 Treatise on recent terrestrial pulmonata molluscs. Part 14. Helicodontidae, Ciliellidae, Hygromiidae. *Ruthenica*, Supplement 2: 1907–2047.
- Soós L. 1917 Vizsgálatok a magyarországi Pulmonáták rendszertani anatómiája köréből. Zur systematischen Anatomie der ungarischen Pulmonaten. *Annales Historico-Naturales Musei Nationalis Hungarici*, Budapest 15: 1–165.
- Urbanski J. 1964 Beiträge zur Kenntnis balkanischer Stylommatophoren (Systematische, zoogeographische und ökologische Studien über die Mollusken der Balkan-Halbinsel. VII.). *Bulletin de la Société des amis des sciences et des lettres de Poznan. Serie D. Sciences biologiques* 4: 19–56.