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IDENTIFICATION OF *VERTIGO ANGUSTIOR* (JEFFREYS, 1830), *VERTIGO MOULINSIANA* (DUPUY, 1849) AND ASSOCIATED SPECIES IN THE LOWER CIUC BASIN

Keywords: Sit Natura 2000, *Vertigo angustior*, *Vertigo moulinsiana*

Introduction

The purpose of this study was to identify and establish the distribution area of *Vertigo angustior* and *Vertigo moulinsiana* on the Natura 2000 site Lower Ciuc Basin (ROSCI0007). Both species are protected by the Habitats Directive – Council Directive 92/43 EEC, Annex II., Law 49 – Annex 3, 4A (code N 2000: 1014 and 1016 respectively). On the Global Red List (IUCN) *Vertigo angustior* is classified as Near Threatened / Decreasing, while *V. moulinsiana* as Vulnerable.

Whereas there are no references in the literature about the presence of the target species in the studied area, the collection points and the identification of their favorable habitats are completely new data. Knowing that the Lower Ciuc Basin is a white spot on the malacological map of the country, we have identified all species in the collected samples. Since we only investigated wetlands, the faunal list is far from complete, but it represents a first step towards knowing/exploring it.

As the volume in which this paper appears will be used by the managers of the Natura 2000 site, and knowing that these two species are not really known and rarely identified because of their small size, we present a more detailed description. We describe in detail the research methods in order for the assessment to be repeatable in a long term monitoring program.

Material and methods

Description of species

Vertigo angustior (Fig. 1.)

Size: height 1.6 to 1.8 mm, width 0.8 to 0.9 mm. The shell is sinistral, egg-shaped, smooth and striated regularly especially at the middle turns. The coil consists of 4.5 to 5 turns which increase

regularly, its color is reddish brown, the umbilical slit is open and visible, the apex is obtuse, aperture almost triangular due to the straightening of the outer edge. The apertural dentition consists of two parietal blades, of which the one next to the suture is more developed, and the other with a more inner position. The columellar blade is strong and slightly curved, it has two palatal folds, the first long and elongated towards the inside of the shell, the other is smaller and sometimes absent. The peristome is reflected, thickened with a white external edge. The outer edge of the aperture is concave and recessed.¹

It is a hygrophilous species, almost paludous, it lives in damp places, among mosses, on marsh plants at the waters edge. It can also be found in damp deciduous forests among wet leaves and among rotting wood. It feeds on hyphae and fructification bodies of parasitic fungi. In dry periods it retracts into the ground or to plant bases, in the mosses or among plant roots.² Soós³ considers that it is a lowland and low hill species.

Geographic distribution. Already Clessin⁴ shows a wide distribution in Europe but draws attention to the fact that it was identified only in a few places because of its small size. In a similar way Kobelt⁵, Rossmässler⁶ and Geyer⁷ indicate a European distribution and its presence in Southern France and Sweden. According to Soós⁸, it is widespread in the temperate parts of Europe from Portugal to the Caucasus, it is not known in the Balkans, Southern Italy and Spain, in the northern part of Scandinavia or northern Russia and Finland. Grossu⁹ indicates a geographical distribution identical to that of Soós.

Distribution in Romania. The first author who pinpointed exact locations of the species in Transylvania is A. E. Bielz¹⁰, who identified the species near Brasov and near Sighișoara as *Pupilla*

¹ SOÓS Lajos 1943; GROSSU, Alexandru V. 1987.

² SOÓS Lajos 1943; GROSSU, Alexandru V. 1987.

³ SOÓS Lajos 1943.

⁴ CLESSIN, Stefan 1876, 1887–1890.

⁵ KOBELT, Wilhelm 1871.

⁶ ROSSMÄSSLER, Emil Adolf 1835–1920.

⁷ GEYER, David 1927.

⁸ SOÓS Lajos 1943.

⁹ GROSSU, Alexandru V. 1987.

¹⁰ BIELZ, Albert Eduard 1867.

Venetzi Charp., considering it to be synonymous with *P. angustior*. M. v. Kimakowicz¹¹ identifies the species near Sibiu, and later (1890) in the Târnava valley near Mediaş and near Făgăraş.

More recent authors have taken information from A. E. Bielz and M. v. Kimakowicz stating the same locations in Transylvania.¹² Grossu¹³ also identified the species in the Comana Forest, Giurgiu county, in the Snagov-Ilfov forest, in the Tisaru mountains, Vrancea county and he selected shells from the sediments of the Siret River near the village of Ciorăni, Vrancea county.

Analysing the general and Romanian distribution of this species, it should be noted that it has few references in the literature because its small size and hidden lifestyle among plants or detritus makes it difficult to identify. Finding the specimens involves sorting soil samples, especially in dry periods when they retreat in the soil among plant roots.

In the *Vertigo* genus, only *Vertigo pusilla* and *Vertigo angustior* have sinistral shells. *V. angustior* is easily distinguished from *V. pusilla* by its smaller size (height 1.6 -1.8 mm, width 0.8 to 0.9 mm, compared to *V. pusilla* which has a height of 2 to 2.2 mm and width of 0.5 to 1 mm), by the very sharp apertural thickening, by the and widely developed subvertical columellar blade, and especially by the superior palatal blade that is very elongated towards the interior and slightly curved. In addition, the shell surface is heavily grooved, visible however only at higher magnification.¹⁴

Vertigo moulinsiana (Fig. 2.)

Size: Height 2 – 2,5 mm, width 1.5 to 1.65 mm, hence expanded as compared to its height; the aperture's height is more than one-third of the total length of the shell. The shell is dextral, dilated, oval spherical, its spiral is very robust and the apex flattened, shiny, smooth, of reddish-brown color, transparent, deeply wrinkled and umbilicated. It has 4.5 to 5 coils, the last one is not narrowed towards the base, but with a strong callosity on its rear part and a very short hull at the bottom. The aperture has thickened edges inside with a strong white frame. Due to the inwards bending of the outer edge, the aperture's hole is heart-shaped. The reinforcement of

the aperture usually has four well developed blades or teeth: a parietal, a columellar, upper and lower palatal, sometimes also appears a basal, which is short, almost unnoticeable.¹⁵

It is a hydrophilous species, found among *Carex* vegetation, mosses, wet grass meadows, near ponds and on river floodplains. It can be found on the leaves of hydrophilous plants (in wet periods) and it feeds on the hyphae and fructification bodies of parasitic fungi on these plants. In dry periods it retreats into the ground or at the base of plants, among mosses and roots.¹⁶

Geographic distribution. Kobelt in a paper published in 1871 did not mention this species, but in a paper published in 1881 describes it as present in Switzerland, Southern France and Denmark.¹⁷ Clessin¹⁸ and Geyer¹⁹ mention it in Switzerland in the canton of Bern, in South Tyrol, Germany, and Hungary. It is a Mediterranean species, distributed from the Iberic Peninsula in Southern Europe until the Transcaucasus. In Western Europe it reaches England, western Germany and to Denmark, appears at several points in Hungary.²⁰ Currently it occurs in isolated areas in Europe and because of widespread drainages it has become a rare species. In the Quaternary it was very widespread, commonly found in river alluvium. Soós²¹ considers it a species threatened by extinction.

Distribution in Romania. Bielz, M.²², Bielz, E. A.²³ and Kimakowicz²⁴ in their books and catalogs about the snail fauna of Transylvania do not mention this species. Grossu²⁵ collected it from Turda Gorge, where he found live specimens, this being the first record in the Romanian fauna. The same author has found shells from the sediments of the Siret River in the village of Ciorăni, Vrancea county, but these can originate from both extant and fossil forms.

There are no bibliographic data about *V. moulinsiana* or *V. angustior* for the Lower Ciuc Basin. This area is a blank spot on the malacological map Romania, there is not a single published source about the mollusk fauna, except some mentions at Tuşnad-Băi and these refer to other species.

¹¹ KIMAKOWICZ, Moritz von 1883–1884.

¹² CSÍKI Ernő 1906; ROTARIDES, Mihály 1941; SOÓS Lajos 1943; GROSSU, Alexandru V. 1987, 1993.

¹³ GROSSU, Alexandru V. 1987.

¹⁴ GROSSU, Alexandru V. 1987.

¹⁵ SOÓS Lajos 1943; GROSSU, Alexandru V. 1987.

¹⁶ SOÓS Lajos 1943.

¹⁷ KOBELT Wilhelm 1871.

¹⁸ CLESSIN, Stefan 1876, 1887–1890.

¹⁹ GEYER, David 1927.

²⁰ SOÓS Lajos 1943.

²¹ SOÓS Lajos 1943.

²² BIELZ, Michael 1851.

²³ BIELZ, Albert Eduard 1867.

²⁴ KIMAKOWICZ, Moritz von 1883–1884.

²⁵ GROSSU, Alexandru V. 1987.

Field research method

The two species have similar ecological requirements. They inhabit wet areas, but avoid areas that are under permanent water cover. They can be identified on the riverbanks and river floodplains, on or among marsh plants, moss or on the plant detritus. In wet periods (after rains) they climb up the plants and feed on the hyphae and fructification bodies of parasitic or saprophytic that live on hydrophilic plants or plant debris.

The field research began with the identification of wetlands in the Natura 2000 site Lower Ciuc Basin, first on the map and consequently in the field. We focused on the floodplain of the river Olt, the former meanders, oxbows, fens and limonitic springs, which maintain smaller or larger wetlands.

Species identification by eye in the field is virtually impossible due to the small size 1,5–2 mm. Direct observation in the field is hampered by the fact that during the day (when humidity is low) and especially during dry periods the snails withdraw among plants and even in the soil among plant roots.

The classical method for small snails is the collection of soil samples together with vegetation. Larger plants can be removed after careful observation even with a magnifying glass. Samples are collected in an area of 25 × 25 cm and a depth of 3 cm, so the data obtained are also applicable for quantitative estimates.²⁶ In the field are recorded the coordinates of the collection points. Samples were collected in those habitats that meet the requirements of the species, described in the first paragraph. Soil samples are placed in bags, numbered with the same number as the recorded GPS point and transported to the laboratory.

Soil samples must be dried, especially if they were collected in wet (rainy) periods. This is necessary to prevent rotting and the formation of mould. During drying it is necessary to loosen the sample because otherwise the soil dries and hardens, and during the sorting it could lead to the crushing of snail shells. The screening is done under a magnifying glass with a large diameter and high magnification (6–7 x) and under stereomicroscope. Every grain of soil is examined and these tiny gastropods are selected. Usually screening-selection and the identification of shells resulted from a single sample lasts from three to 6 hours.

The identification of species is done in all cases under stereomicroscope. The results are summarized in tables that contain the coordinates of the sample and habitat condition, according to field notes.

Results and discussion

As a result of our research conducted in the Lower Ciuc Basin, out of the 96 samples taken, *Vertigo angustior* was identified in 15 samples (Table 1), distributed in relatively different areas as follows: Borsáros 0,67 ha, Feketés 2,36 ha, Vermed 7,84 ha, Hódos 0,77 ha, Csemő – Külső Égés 0,75 ha, Datkora 30,65 ha, Aszó 13,5 ha, Kicsi Csemő 12,7 ha (Table 1 contains the coordinates of the collection points). The identified favorable habitats cover an area of 69,24 ha (see map below). Given the very sporadic distribution of *V. angustior* in the country, the Lower Ciuc Basin Natura 2000 site is an extremely important refuge of this species.

Vertigo moulinsiana was identified in 12 samples of the total number of 96 samples (Tab. 1), distributed in relatively different areas as follows: Borsáros 0,67 ha, Hódos 0,77 ha, Tuşnad (Nadas south of Csemő) 15,3 ha, Datkora 30,65 ha, Bészék 5,7 ha, Hosszú rész 19,9 ha, Kicsi Csemő 12,7 ha (see Map). The identified favorable habitats cover an area of 85,69 ha. Given the very sporadic distribution of *V. angustior* in the country, the Lower Ciuc Basin Natura 2000 site is an extremely important refuge of this species, being the second distribution area of this species after the Turda Gorge. In the case of Borsáros and Hódos stations both species were identified, fact that indicates similar habitat requirements. The number of individuals of the two species in the examined samples varies between 1 and 5.

During the field research we observed that the ideal habitats for the target species are wet hay meadows that are used in a traditional way, that is they are regularly mown, fact which prevents the accumulation of dead plant material. The burning of vegetation and drainage leads to the extinction of the native fauna. We observed the burning of the vegetation at station Hódos 47 (coordinates: 46.23283 / 25.87436). Accumulations of plant debris were found at station Tuşnad, Nadas 66 (coordinates: 46.21051 / 25.88855).

We emphasize the role of different types of freshwater and mineral water springs in maintaining high water content of soils. Among these, we highlight the springs on the Eastern edge of the Olt river's floodplain, which represents the Eastern border of the Natura 2000 site in the same time, between Sântimbru and Sânsimion (sites named Datkora and Hosszú rész), where the identified habitat of the two species covers more than 50 hectares. A second type of springs that have to be highlighted are the springs West of the Olt that break out either on the floodplain

²⁶ GROSSU, Alexandru V. 1986.

(Borsáros) or on the alluvial fans. These springs have high limonite content which form insoluble mud and thus it leads to the formation of limonitic cones (i. e. small hills with up to 10–15 m diameter and with a spring on the top, often with a floating mat of vegetation), (Fig. 4, 5.). Such habitats are found on the following sites: Borsáros, Vermed, Hódos, Aszó, Csemő-Külső Égés. These springs lead to the formation of peaty soils which also seems to favor the presence of the target species.

Besides the two mentioned species we identified two other species of the genus *Vertigo*: *Vertigo pusilla* (O. F. Müller, 1774) and *Vertigo antivertigo* (Draparnaud, 1801) (Fig. 3). Finding them in the studied area is remarkable, because they were identified especially in Transylvania in relatively few places.²⁷

Tab.1 contains a list of all species identified in the samples. The most common of the aquatic pulmonate snails are *Galba truncatula*, *Aplexa hypnorum*, *Planorbis planorbis*, *Gyraulus laevis*, *Physa fontinalis*, *Aplexa hypnorum*. The terrestrial species that prefer moist habitats are *Carychium minimum*, *Columella edentula*, *Cochlicopa lubrica*, *Vallonia pulchella*.

It should be noted that the summers of 2012 and 2013 when we collected samples were very dry, fact which made difficult the identification of wetlands and their separation from those areas that in years with normal rainfall are flooded for longer periods. This explains why our samples contained several aquatic gastropods.

Ideally for the permanent elimination of any future threats it is necessary to maintain (but in most cases to restore) the natural bed of the river Olt together with its floodplain. Spring and summer floods lead to the formation of flood ponds, meanders, oxbow lakes, wetlands, wet meadows, habitats that through their natural evolution, mineral and biological colmatation maintain wetlands in various stages of development, offering a variety of natural wetland habitats. The existence of diverse wetland habitats (in various stages of development) along natural rivers provide ideal conditions for a wide range of species with specific requirements each, i.e. high biodiversity along the river.²⁸

Being interested in the clam fauna (Unionidae) of the river Olt, which in the previous decades had been destroyed by pollution, we could not find any

live specimen in the riverbed. The two valves of *Unio crassus* found in gravel deposits in the former floodplain (now the riverbed is much lower due to the regulation) are clear evidence that this species inhabited the riverbed. The Olt River in this area is still heavily polluted.

Conclusion

The Lower Ciuc Basin Natura 2000 site is an extremely important refuge for the protected species *V. moulinsiana* and *V. angustior*.

Based on the field observations we consider that potential threats are low because most habitats are maintained by traditional management, moreover this traditional use was the main factor that contributed to the formation of wet hay meadow with favorable conditions for these species.

We recommend :

1. The prohibition of water drainage on wetlands.
2. The cessation of the deepening of the bed of the Olt river, which lowers groundwater table.
3. The prohibition of the changing of land use (e.g. plowing of meadows or other significant changes)
4. The introduction of special protection status to limonite springs, which contribute to the maintenance of wet meadows too.
5. In order to prevent future threats, we recommend the extension of the boundaries of the Natura 2000 site to include the following stations: Datkora 452 (46.2776 / 25.8666), Datkora 455 (46.2748 / 25.8679) and Datkora 458 (46.2746 / 25.8687), more precisely the entire surface of 30.65 ha, where the species *Vertigo angustior* and *Vertigo moulinsiana* are present.

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²⁷ BIELZ, Albert Eduard 1867; KIMAKOWICZ, Moritz von 1890; CSÍKI Ernő 1906; SOÓS Lajos 1942; GROSSU,

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²⁸ SÁRKÁNY-KISS, Andrei 2000, 2003.

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***Vertigo angustior* (Jeffreys, 1830), *Vertigo moulinsiana* (Dupuy, 1849) fajok
és kísérőfajaik azonosítása az Alcsíki-medencében**

(Kivonat)

A tanulmány az 2012–2013-ban az Alcsíki-medence nedves területein végzett malakológiai kutatás eredményeit mutatja be. A vizsgálat fő célkitűzése a *V. angustior* és a *V. moulinsiana* Natura 2000-es fajok azonosítása, valamint a számukra alkalmas élőhelyek körülhatárolása volt. A 96 terepen begyűjtött 25 × 25 cm-es, 3 cm mélységben vett mintát laboratóriumban sztereomikroszkóp alatt dolgoztuk fel. A *V. angustior* fajt 15 mintában azonosítottuk, 8 élőhelyen, 69,24 ha összterületen. A *V. moulinsiana* fajt 12 mintában azonosítottuk a faj számára kedvező 8 élőhelyen, 85,69 ha összterületen. A két védett faj azonosítása a kutatott területen, új és jelentős faunisztikai adatok, különösen a *V. moulinsiana* esetében, amelynek egyetlen előfordulási adatát ismertük az ország területéről, a Tordai-hasadékból, de a *V. angustior* is csak néhány helyről ismeretes. Ezeknek a fajoknak az Alcsíki-medencében található élőhelyei hagyományosan művelt nedves kaszálók, amelyeknek fenntartása a fajok fennmaradásának záloga. A tanulmány javaslatokat is megfogalmaz a védett fajok élőhelyeinek kedvező állapotban való fenntartására.

**Identificarea speciilor *Vertigo angustior* (Jeffreys, 1830), *Vertigo moulinsiana*
(Dupuy, 1849) și a speciilor însoțitoare în Bazinul Ciucului de Jos**

(Rezumat)

Lucrarea prezintă rezultatele cercetărilor efectuate în perioada 2012–2013 în zonele umede a Sitului Natura 2000 Bazinul Ciucului de Jos pentru identificarea speciilor *Vertigo angustior* și *Vertigo moulinsiana* prin ridicarea probelor de sol de 25 × 25 cm, care au fost triate în laborator. Specia *V. angustior* a fost găsită în 15 probe, respectiv în 8 habitate, totalizând o suprafață de 69,24 ha. Specia *V. moulinsiana* în 12 probe, respectiv în 8 habitate totalizând o suprafață de 85,69 ha, favorabile speciei. Prezența celor două specii ocrotite (Natura 2000) în situl cercetat reprezintă date faunistice noi de mare importanță, cu atât mai mult cu cât *V. moulinsiana* era cunoscut doar din Cheile Turzii, acesta fiind a doua semnalare, iar *V. angustior* este cunoscut doar din câteva localități din țară. Lucrarea prezintă și lista celorlalte specii de gastropode determinate din probe. Habitatele speciilor ocrotite din Bazinul Ciucului de Jos sunt fânațe higrofile folosite în mod tradițional, fapt care garantează perpetuarea speciilor. În lucrare sunt prezentate recomandările menite să contribuie la conservarea habitatelor în stare favorabilă.

Identification of *Vertigo* species in the Lower Ciuc Basin

Table 1.

List of gastropod species identified in the soil samples collected in the Lower Ciuc Basin Natura 2000 site (ROSCI0007).

Collection point	Species	Geographic coordinates	Toponym and habitat type	Observations
Borsáros 36	<i>Carychium minimum</i>	46.31221 25.82548	Borsáros Fen Ditch with <i>Carex</i>	
Borsáros 38	<i>Carychium minimum</i>	46.31506 25.82913	Borsáros Fen Bank of an oxbow lake with <i>Carex</i> and <i>Phragmites</i>	
Borsáros 39	<i>Planorbis planorbis</i> <i>Anisus spirorbis</i> <i>Oxiloma elegans</i> <i>Carychium minimum</i> <i>Columella edentula</i> <i>Cochlicopa lubrica</i>	46.31357 25.82944	Borsáros Fen Near a spring with <i>Carex</i>	
Sântimbru 40	<i>Carychium minimum</i>	46.29845 25.85602	Upstreams from Sântimbru wet meadow	Vegetation was burnt in spring 2013
Sântimbru 41	<i>Planorbis planorbis</i> <i>Planorbis septemgiratus</i> <i>Carychium</i> <i>minimum</i>	46.30099 25.85738	Upstreams from Sântimbru Edge of a marsh with <i>Thypha</i>	Vegetation was burnt in spring 2013
Sântimbru 41	<i>Planorbis planorbis</i>	46.29970 25.86006	Upstreams from Sântimbru Edge of <i>Phragmites</i> stand	
Feketés 43	<i>Galba truncatula</i> <i>Carychium minimum</i>	46.25574 25.86540	Feketés Edge of <i>Phragmites</i> stand	
Feketés 44	<i>Anisus leucostoma</i> <i>Succinea oblonga</i> <i>Carychium</i> <i>minimum</i> <i>Vertigo pusilla</i>	46.25699 25.86794	Feketés Edge of <i>Carex</i> and <i>Juncus</i> stand	
Feketés 45	<i>Vertigo angustior</i> <i>Carychium</i> <i>minimum</i> <i>Vertigo pusilla</i>	46.25346 25.86991	Feketés Wet meadow between a <i>Phragmites</i> stand and the Olt river with <i>Carex</i> and mosses	
Hódos 46	<i>Anisus spirorbis</i> <i>Hippeutis complanatus</i>	46.23488 25.87680	Hódos wet meadow with <i>Carex</i>	Vegetation was burnt in spring 2013
Hódos 47	<i>Vertigo moulinsiana</i> <i>Carychium minimum</i>	46.23283 25.87436	Hódos wet meadow with <i>Carex</i>	Vegetation was burnt in 2012
Hódos 48	<i>Carychium minimum</i>	46.23554 25,86817	Hódos Ditch with <i>Typha</i> and <i>Carex</i>	Vegetation was burnt in spring 2013
Hódos 49	<i>Carychium minimum</i>	46.23220 25.86612	Hódos Spring with <i>Carex</i> and mosses	
Hódos 50	<i>Carychium minimum</i>	46.23075 25.86460	Hódos wet meadow with <i>Carex</i>	
Aszó 51	<i>Carychium minimum</i>	46,22534 25,97649	wet meadow with <i>Carex</i> and mosses	

Collection point	Species	Geographic coordinates	Toponym and habitat type	Observations
Aszó 52	<i>Carychium minimum</i>	46,22464 25,87744	Limonic spring with <i>Carex</i> and mosses	
Borsáros 54	<i>Vertigo moulinsiana</i> <i>Vertigo antivertigo</i>	46.31213 25.83015	Borsáros In the front of the limonic spring under the terrace, fen with <i>Carex</i>	
Sântimbru 57	<i>Cochlicopa lubrica</i>	46.26958 25.86029	Under the chapel, wet meadow with <i>Carex</i>	
Középpatak mocsárrét 60	<i>Cochlicopa kubrica</i>	46.17907 25.88681	Középpatak fen wet meadow with <i>Carex</i>	Burnt in spring 2013
Középpatak mocsárrét 61	<i>Cochlicopa kubrica</i> <i>Vallonia pulchella</i>	46.17993 25.88610	Középpatak fen wet meadow with tall <i>Carex</i>	
Nyírkert (Grădina de mestecenii)lângă Tușnad 62	<i>Perforatella bidentata</i> <i>Cochlicopa kubrica</i> <i>Vallonia pulchella</i>	46.20320 25.90830	Nyírkert On the edge of <i>Typha</i> and <i>Carex</i> stands	
Benes 65	<i>Vertigo antivertigo</i> <i>Vallonia pulchella</i> <i>Crychium tridentatum</i> <i>Galba truncatula</i>	46.21360 25.90618	Benes Meadow with <i>Carex</i> , <i>Juncus</i> and grasses	
Tușnad Nádas 66	<i>Vertigo moulinsiana</i> <i>Vallonia pulchella</i> <i>Vitrea transylvanica</i> <i>Cochlicopa lubrica</i>	46.21051 25.88855	Tușnad, Nádas Meadow with <i>Carex</i> and mosses	
Tușnad Nádas 67	<i>Vertigo antivertigo</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carichium minimum</i> <i>Pisidium sp.</i>	46.21105 25.88908	Tușnadul Nou Nádas On the edge of a <i>Phragmites</i> stand, very wet	Burnt in spring 2013
Sântsimion Feketés 70	<i>Vertigo angustior</i> <i>Galba truncatula</i>	46.25439 25.86929	Feketés, wet meadow between the Olt and a <i>Phragmites</i> stand	
Feketés 71	<i>Vertigo angustior</i> <i>Vertigo pusilla</i> <i>Cochlicopa lubrica</i> <i>Galba truncatula</i> <i>Carychium minimum</i>	46.25604 25.86901	Feketés, wet meadow between the Olt and a <i>Phragmites</i> stand	
Sântsimion Lângă brațul mort 72	<i>Gyraulus laevis</i>	46.25335 25.87534	Sântsimion near oxbow lake, meadow with <i>Carex</i>	Burnt in spring 2013
Sântsimion Lângă brațul mort 73	<i>Gyraulus laevis</i>	46.25573 25.87594	Sântsimion near oxbow lake, meadow with <i>Carex</i>	Burnt in spring 2013
Sântimbru, sub Capelă, lângă lac 74	<i>Vallonia pulchella</i> <i>Carychium minimum</i>	46.27308 25.85469	Sântimbru, under the chapel, near a pond, meadow with <i>Carex</i> and mosses	
Hódos 78	<i>Vertigo angustior</i>	46.23146 25.87649	Hódos; wet meadow with peaty soil	

Identification of *Vertigo* species in the Lower Ciuc Basin

Collection point	Species	Geographic coordinates	Toponym and habitat type	Observations
Csemő 82	<i>Vertigo angustior</i>	46.22156 25.88519	Csemő, Külső égés, wet meadow	
Bészék 445	<i>Succinea putris</i> <i>Vallonia pulchella</i> <i>Vertigo moulinsiana</i>	46.2439 25.8547	Bészék, limonite cone	
Bészék 446	<i>Succinea oblonga</i> <i>Stagnicola palustris</i>	46.2441 25.8547	Bészék, limonite cone	
Datkora 447	<i>Vertigo angustior</i> <i>Pupilla muscorum</i>	46.2785 25.8666	Datkora peaty soil, mosaic of wet meadows and Phragmites stands	
Datkora 447 cs	<i>Cochlicopa lubrica</i> <i>Succinea oblonga</i> <i>Collumela edentula</i>	46.2785 25.8666		
Datkora 448	<i>Chondrula tridens</i> <i>Vallonia pulchella</i> <i>Stagnicola palustris</i>	46.2764 25.8665		
Datkora 449 cs	<i>Vertigo angustior</i> <i>Vertigo moulinsiana</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carychium tridentatum</i>	46,2775 25,8657		
Datkora 450 cs	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2774 25.8648		
Datkora 451 cs	<i>Vallonia pulchella</i>	46.2765 25.8651		
Datkora 452	<i>Vertigo angustior</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carychium tridentatum</i> <i>Stagnicola palustris</i> <i>Succinea oblonga</i>	46.2776 25.8666		
Datkora 453	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2778 25.8668		
Datkora 454	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Succinea oblonga</i> <i>Carychium tridentatum</i>	46.2781 25.8666		
Datkora 455	<i>Vertigo angustior</i> <i>Vertigo moulinsiana</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carychium tridentatum</i>	46.2748 25.8679		
Datkora 457	<i>Vertigo angustior</i> <i>Carychium tridentatum</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Pupilla muscorum</i>	46.2745 25.8684		
Datkora 458	<i>Vertigo angustior</i> <i>Vertigo moulinsiana</i> <i>Pupilla muscorum</i> <i>Cochlicopa lubrica</i>	46.2746 25.8687		

Collection point	Species	Geographic coordinates	Toponym and habitat type	Observations
Datkora 612	<i>Vertigo moulinsiana</i> <i>Galba truncatula</i> <i>Carychium tridentatum</i> <i>Succinea oblonga</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2719 25.8665	Datkora, peaty soil, mosaic of wet meadows and Phragmites stands	
Datkora 613	<i>Vertigo angustior</i> <i>Anisus rotundatus</i> <i>Cochlicopa lubrica</i> <i>Galba truncatula</i> <i>Pupilla muscorum</i> <i>Carychium tridentatum</i>	46.2725 25.8661		
Datkora 614	<i>Vertigo moulinsiana</i> <i>Anisus vorticulus</i> <i>Gyraulus albus</i> <i>Radix peregra</i> <i>Succinea oblonga</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Pupilla muscorum</i> <i>Chondrula tridens</i> <i>Collumela edentula</i> <i>Carychium tridentatum</i> <i>Campylaea faustina</i>	46.2731 25.8658		
Datkora 615	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Pupilla muscorum</i>	46.2738 25.8657		
Datkora 616	<i>Cochlicopa lubrica</i>	46.2736 25.8651		
Hosszú-rész 620	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.265 25.8704		Fen
Hosszú-rész 621	<i>Vallonia pulchella</i>	46.2648 25.872	Fen	
Hosszú-rész 623	<i>Vertigo moulinsiana</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2638 25.8731	Fen with <i>Phragmites</i>	
Aszó 627	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2246 25.8775	Fen	
Aszó 628	<i>Cochlicopa lubrica</i>	46.2245 25.8771	Fen	
Aszó 629	<i>Vertigo angustior</i> <i>Succinea oblonga</i> <i>Carychium tridentatum</i> <i>Vallonia pulchella</i>	46.2234 25.8771	Limonite cone	
Aszó 632	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carychium tridentatum</i>	46.2237 25.8748	Fen	
Kicsi Csemő 640	<i>Vertigo angustior</i> <i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i> <i>Carychium tridentatum</i>	46.2229 25.8858	Fen with <i>Phragmites</i>	

Identification of *Vertigo* species in the Lower Ciuc Basin

Collection point	Species	Geographic coordinates	Toponym and habitat type	Observations
Kicsi Csemő 642	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2241 25.8851	Fen with Phragmites	
Borsáros 1	<i>Vertigo moulinsiana</i> <i>Vallonia pulchella</i> <i>Carychium minimum</i>	46.3113 25.8315	Borsáros, Omlásalja wet meadow	
Borsáros 2	<i>Carychium minimum</i> <i>Vallonia pulchella</i> <i>Cochlicopa lubrica</i>	46.311 25.8314	Fen	
Borsáros 3	<i>Vallonia pulchella</i> <i>Carychium minimum</i>	46.3111 25.8317	Fen	
Borsáros 4	<i>Vertigo moulinsiana</i> <i>Vertigo angustior</i> <i>Campylaea faustina</i> <i>Vallonia pulchella</i> <i>Cochlicopa lubrica</i> <i>Carychium minimum</i> <i>Baleinae (Subfam.)</i>	46.311 25.8322	Borsáros, Omlásalja wet meadow	
Sântimbru 6	<i>Galba truncatula</i> <i>Stagnicola palustris</i> <i>Gyraulus laevis</i> <i>Planorbis planorbis</i> <i>Cochlicopa lubrica</i> <i>Physa fontinalis</i> <i>Aplexa hypnorum</i>	46.2955 25.858	Former streambed	
Sântimbru 7	<i>Aplexa hypnorum</i> <i>Planorbis planorbis</i> <i>Gyraulus laevis</i> <i>Physa fontinalis</i>	46.296 25.8593	Former streambed	
Sântimbru 8	<i>Vallonia pulchella</i>	46.2968 25.8596	Wet meadow	
Sântimbru 9	<i>Galba truncatula</i> <i>Aplexa hypnorum</i> <i>Planorbis planorbis</i> <i>Gyraulus laevis</i>	46.2969 25.8594	Former streambed	
Vermed 11	<i>Vallonia pulchella</i> <i>Columella edentula</i> <i>Vertigo pusilla</i>	46.2712 25.8531	Former streambed	
Vermed 12	<i>Cochlicopa lubrica</i> <i>Vallonia pulchella</i>	46.2706 25.853	Wet meadow	
Vermed 15	<i>Vertigo angustior</i> <i>Vallonia pulchella</i> <i>Cochlicopa lubrica</i> <i>Columella edentula</i> <i>Carychium minimum</i>	46.2682 25.8517	Kápolnakertek wet meadows, limonitic cones, peaty soil	
Vermed 16	<i>Cochlicopa lubrica</i>	46.2672 25.853	Wet meadow	



Fig. 1. *Vertigo angustior* (foto Zoltán László)

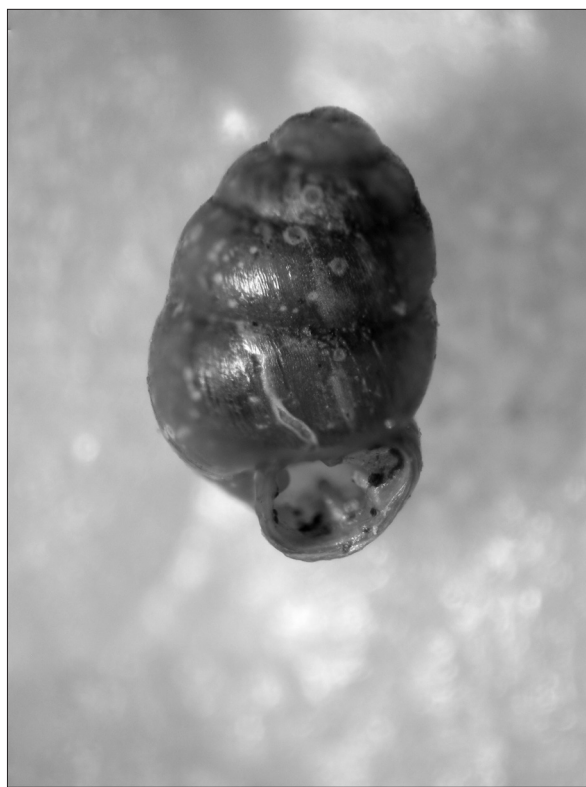


Fig. 2. *Vertigo moulinsiana* (foto Zoltán László)



Fig. 3. *Vertigo antivertigo* (foto Zoltán László)



Fig. 4. The limonitic spring creates wetland habitat (foto Endre Sárkány-Kiss)



Fig. 5. The limonitic con, small hills of 10-15 m diameter with a spring on the top (foto Endre Sárkány-Kiss)

