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Is *Chondrula tridens* (Müller, 1774) an invasive snail species in Lithuania?

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The aim of the present paper is to answer the question whether the species is invasive or not and describe the studied peculiarities of the Lithuanian population of the species: 1) distribution pattern; 2) relation to vegetation; 3) land snails' community composition in the studied sites.

All literature data about the distribution of this species in Lithuania is reviewed. Research was made in 17 sites in August of 2010, 2011 and 2012. New data on four sites of *Chondrula tridens* (Müller, 1774) by the railway line Kabeliai–Visaginas are given. The results showed that the species is rare, and has fragmented distribution related to urbophytocenoses, in the vegetation from class *Festuco-Brometea* Br.-Bl. et Tx. 43 and its natural alliances, that are really relict because vegetation belongs to steppe-flora of Holocene. There is a possibility that *C. tridens* (Müller, 1774) could have inhabited Lithuania in Holocene. On the whole 30 species were determined. Spearman Rank Order Correlations test showed that the species has a weak significant negative correlation (r = –0.3) with *Pupilla muscorum* (Linnaeus, 1758) and slightly more positive correlation (r = 0.4) with *Nesovitrea hammonis* (Ström, 1765), *Euomphalia strigella* (Draparnaud, 1805) and *Helix pomatia* Linnaeus, 1758. The fact that *H. pomatia* Linnaeus, 1758 is an introduced species to Lithuania and *C. tridens* (Müller, 1774) was found by the railway proves that species distribution has an anthropogenic character, i. e. is related to human activities.

We can conclude that the origin of *C. tridens* (Müller, 1774) in Lithuania is unclear but there is no threat of its invasion.

Key words: Gastropoda, Enidae, land snails, invasive, Lithuania

INTRODUCTION

The assessment of biodiversity and its changes depend upon validated knowledge of its components: the taxonomic diversity. Species identification is the first task toward improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity – one of the goals (C) of the Strategic Plan for Biodiversity for the 2011–2020 period implementing The Convention on Biological Diversity (http://www.cbd.int/sp/targets/). By 2020, Invasive Alien Species and their pathways should be identified and prioritised – this is a part of target (5) of the Strategic Plan for Biodiversity. Many species of molluscs have a tendency to spread fast and become invasive (for example, *Arion lusitanicus* (Mabille, 1868), *Boettgerilla pallens* Simroth, 1912, and others (Engelke et al., 2011; Reise et al., 2000)) so the status of *C. tridens* (Müller, 1774) in Lithuania is unclear as this species in Europe is distributed in steppe and new data in Lithuania appeared only in 2000.

Paleoecological range of *C. tridens* (Müller, 1774) shows that the species is thermophilous (Paleoclimate group), acidity tolerant (Paleohumidity group), gives preference to open habitat (Paleovegetation group) in Central and South-East Europe (Biogeographical group) (Willis et al., 2000). Usually species is rare above 700 m and lives in dry open calcareous places, especially in short-turfed

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grassland and less commonly in rocky habitats (Kerney et al., 1996). The species is very common in steppes as an index species of Early Holocene in Central Europe (Ložek, 2000, 2007) and in modern Central Europe is associated with traditionally managed grasslands in many countries such as France, Luxemburg, Switzerland, Germany. In the Southern Urals it occurs not only in different types of grasslands but even in base-rich maple-lime-elm forests in high abundance in closed-canopy far from the forest edge (Horsák et al., 2010). The same is in East Russia and adjacent countries (Sysoev, Schileyko, 2009) where species is known in Ryazan Region, steppe zone to the Ural River in the east and forest-steppe and some forest zones in Ukraine, Carpathians, Crimea, Caucasus (Sysoev, Schileyko, 2009; Sverlova, 2006).

In summer of 1829 the first finding of *C. tridens* (Müller, 1774) in Lithuania was made by E. Eichwald (1830). It was found in the northwest vicinity of Vilnius. Later authors only quoted E. Eichwald (Möllendorf, 1898; Schlesch, 1927; Ehrmann, 1933) and H. Schlesch (1937) admitted that this species is doubtful for Lithuania. In 2000 entomologist P. Ivinskis found the species in the vicinity of Aukštadvaris and brought some specimens to Tadas Ivanauskas Zoological Museum in Kaunas (Gurskas, 2002; 2010). Concurrently the species was found in the vicinity of Vilnius between Lazdynai residential district and Naujakiemis village during BSc studies of spiders in the period from 2000.10.01 until 2002.02.12 by D. Mikelaitis and identified by G. Skujienė (Mikelaitis, 2002).

As data on *C. tridens* (Müller, 1774) in Lithuania were doubtful and new data appeared only from 2000, the aim of the present paper is to describe the studied peculiarities of the Lithuanian population of the species: 1) distribution pattern; 2) relation to vegetation; 3) land snails' community composition in the studied sites.

MATERIALS AND METHODS

All literature data about the distribution of the species in Lithuania (Eichwald, 1830; Gurskas, 2002, 2010; Mikelaitis, 2002; Vaivilavičius, 2008) are reviewed in order to describe priority to vegetation communities and distribution peculiarities. As the species was found in the railway station of Marcinkonys and we had a hypothesis of its distribution by the railway line in other places too, additional research was made in August of 2010, 2011 and 2012. Search for *C. tridens* (Müller, 1774) was performed by the railway line Kabeliai–Visaginas in 17 sites (Table 1, No. 4–20). We searched for *C. tridens* (Müller, 1774) by walking from Pamerkiai to Matuizos, from Visaginas to Gerkonys, from Gerkonys to Dūkštas, from Družiliai to Santaka stations and stopping every 100 m to look for *C. tridens* (Müller, 1774) in homogenous habitats (Valovirta, 1996). For further analysis molluscs were collected in 8 sites of different railway stations (Table 1, No. 4–10 and 20) by the methods described below.

In each studied site all molluscs were collected from five or more 1 × 1 m^2 plots with additional

Table 1. **Locations and the number of the collected *Chondrula tridens* (Müller, 1774) in Lithuania: 1–3 – literature data; 4–20 – investigations in August of 2010, 2011 and 2012; "?" – unclear biotope**

No.	Location	Coordinate (WGS)	Biotope	Number/year
1.	Vilnius: between Lazdynai (7 km) residential district and Naujakiemis village	N54°41'10.6" E25°9'43.8" N54°41'20.7" E25°10'6.4" N54°41'8.2"E25°9'46.5"	Grassland Electric line grassland Pine clump	1/2001 13/2001 1/2001
2.	Aukštadvaris: Čižiūnai	?N54°36'19.31" E24°34'28.72"	? Reliable grassland	1/2000
3.	Kaunas: Island of the Nemunas River. Žemieji Šančiai	N54°53'31.14" E23°54'19.25" N54°51'37.9" E23°56'21.8"	Bank grassland Bank grassland	1/2010 8/2009
4.	Railway station: Marcinkonys	N54°3'8.76" E24°24'26.86"	Embankment grassland	2/2008 11/2010 17/2012
5.	Railway station: Pamerkiai	N54°18'52.15" E24°42'25.7"	Embankment grassland	29/2010 5/2012

Table 1 (**continued**)

6.	Railway station: Matuizos	N54°16'42.92" E24°41'19.31"	Embankment grassland	23/2010 –/2012
7.	Crossroads of railway and road from Družiliai	N54°41'40.44" E25°38'57.81"	Embankment grassland	36/2012
8.	Crossroads of railway and road to Kabeliai	N53°58'11.83" E24°15'54.75"	Embankment grassland	–/2011
9.	Railway station: Zervynos	N54°6'33.62" E24°29'15.61"	Embankment grassland	–/2012
10.	Railway station: Gerkonys	N55°33'45.91" E26°21'31.51"	Embankment grassland	–/2012
11.	Railway station: Visaginas	N55°36'57.19" E26°24'57.48"	Embankment grassland	–/2012
12.	Railway station: Dūkštas	N55°31'15.58" E26°19'33.41"	Embankment grassland	–/2012
13.	Railway station: Ignalina	N55°20'25.02" E26°9'54.87"	Embankment grassland	–/2012
14.	Railway station: Pakretuonė	N55°16'50.27" E26°5'2.44"	Embankment grassland	–/2012
15.	Railway station: Švenčionėliai	N55°10'2.38" E25°59'53.55"	Embankment grassland	–/2012
16.	Railway station: Pabradė	N54°58'43.81" E25°45'50.22"	Embankment grassland	–/2012
17.	Railway station: Pailgis	N54°55'58.2" E25°39'41.97"	Embankment grassland	–/2012
18.	Railway station: Santaka	N54°53'55.92" E25°38'30.1"	Embankment grassland	–/2012
19.	Railway station: Bezdonys	N54°48'41.21" E25°31'27.61"	Embankment grassland	–/2012
20.	Railway station: Varėna	N54°12'19.35" E24°33'38.32"	Embankment grassland	–/2010

samples of soil with litter (25 × 25 × 5 cm^3) according to the method described by Valovirta (1996). In total, 95 samples were taken, molluscs were identified using identification guide by Kerney et al. (1996). Nomenclature follows Fauna Europaea (Bank, 2007). The collected individuals were preserved in 75% ethyl alcohol for anatomical verification and dry conchs are deposited in the Museum of Zoology of Vilnius University.

A total of 5 357 specimens of 30 species were examined. STATISTICA 7 software was applied for statistical analysis. The significance of relationships between different sites in number of *C. tridens* (Müller, 1774) and abundance of other mollusc species were determined using non-parametric statistics (Kruskal-Wallis, Kolmogorov-Smirnov tests). Spearman Rank Order Correlations were used to determine correlations between *C. tridens* (Müller, 1774) and other mollusc species.

RESULTS

Distribution pattern in Lithuania

Three major features of *C. tridens* (Müller, 1774) distribution in Lithuania were established: 1) specific, non-typical for Lithuanian land snails, landscape; 2) fragmented location; 3) rarity.

Although we cannot check the landscape of the first finding place by E. Eichwald (1830) we know that this place has been in north-west of Vilnius. A casual finding by D. Mikelaitis (2002) of 2001–2002 hibernating *C. tridens* (Müller, 1774) in the empty conchs of *H. pomatia* Linnaeus, 1758 confirmed the existence of this species although earlier investigations carried out by different malacologists in Vilnius and its suburbs had been unsuccessful (Möllendorf, 1898; Schlesch, Krausp, 1938; Šivickis, 1960). Our search for this species in natural habitats of the same area or in other green

zones of Vilnius have been unavailing too (Kuznecova, Skujienė, 2011).

We cannot point out the exact place for a single individual that was found in the vicinity of Aukštadvaris (Table 1, No. 2) but it is possible that it inhabited some grasslands round Čižiūnai (Gurskas, 2002, 2010). Later search for this species made by us and A. Gurskas (personal communication) in the vicinity of Aukštadvaris has been unavailing.

Another finding of *C. tridens* (Müller, 1774) by railway station of Marcinkonys was also casual and only two individuals of *C. tridens* (Müller, 1774) were found by G. Vaivilavičius (2008). Our studies confirmed that this species can be found here and in different places of the same railway embankment (Table 1, No. 4–7).

The latest findings of *C. tridens* (Müller, 1774) by R. Ferenca in Kaunas (Table 1, No. 3) (Gurskas, 2010) showed that the species can inhabit dry terraces–banks of the Nemunas River.

There is no doubt that the landscape where *C. tridens* (Müller, 1774) inhabits in Lithuania is artificial or partly destroyed: population of *C. tridens* (Müller, 1774) inhabits open dry gravelly grasslands under electric lines, at the railway embankment or at the river banks–terraces in the middle of the city (Fig. 1).

The fragmental distribution was detected by walking by the railway embankment from Pamerkiai to Matuizos, from Visaginas to Gerkonys, from Gerkonys to Dūkštas, from Družiliai to Santaka stations and searching for *C. tridens* (Müller, 1774) in all homogenous habitats. *C. tridens* (Müller, 1774) inhabited in some places only on a small-scale areas not greater than one acre (20 × 5 m^2) and abundance of species was low: the population density of species was 2.37 ± 5.04 individuals in 1 m^2. Our data showed that occurrences of *C. tridens* (Müller, 1774) were always associated with either railway stations or crossroads with railway (Fig. 2). In total, by the entire railway line Kabeliai–Visaginas merely four places with *C. tridens* (Müller, 1774) were found though 17 places were examined (Fig. 2).

Relation to vegetation

All plant communities where *C. tridens* (Müller, 1774) inhabits (Table 1, No. 1–7) have particular structure and species diversity that developed in human settlements and their subsystems (establishments of industry, transport roads, electric lines, etc.) under the influence of various degree of urbanization so they can be attributed to urbophytocenoses (Zukopp et al., 1981).

According to EUNIS habitat classification (http://eunis.eea.eu.int) all *C. tridens* (Müller, 1774) habitats along the railway embankment (Table 1, No. 4–7) can be described as 'J4.3 – Rail networks' biotope (Hill et al., 2001). The vegetation in those localities belongs to the alliance of meadow community *Arrhenatherion elatioris* Luquet 1926 with influence of plant species from the class *Festuco-Brometea* Br.-Bl. et Tüxen ex Soó 1947 though all sites are near railroad and have some transformation to ruderal vegetation of alliance *Dauco carotae – Melilotion* Görs ex Rostański et Gutte 1971 with diagnostic species such as *Artemisia vulgaris, Melilotus albus, Solidago canadesis, Tanacetum vul-*

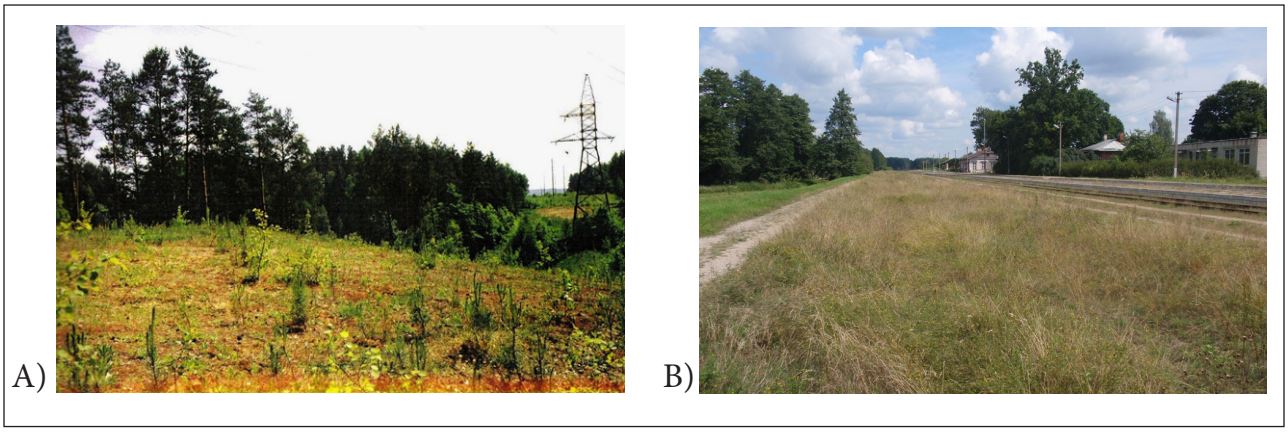

Fig. 1. View of landscapes within which samples of *C. tridens* (Müller, 1774) were taken: A) 'Electric line' in northwest of Vilnius (from D. Mikelaitis, 2002, Fig. 2); B) fragment of 'Railway embankment' of Kabeliai–Vilnius–Visaginas railway line in Marcinkonys (photo by V. Kuznecova)

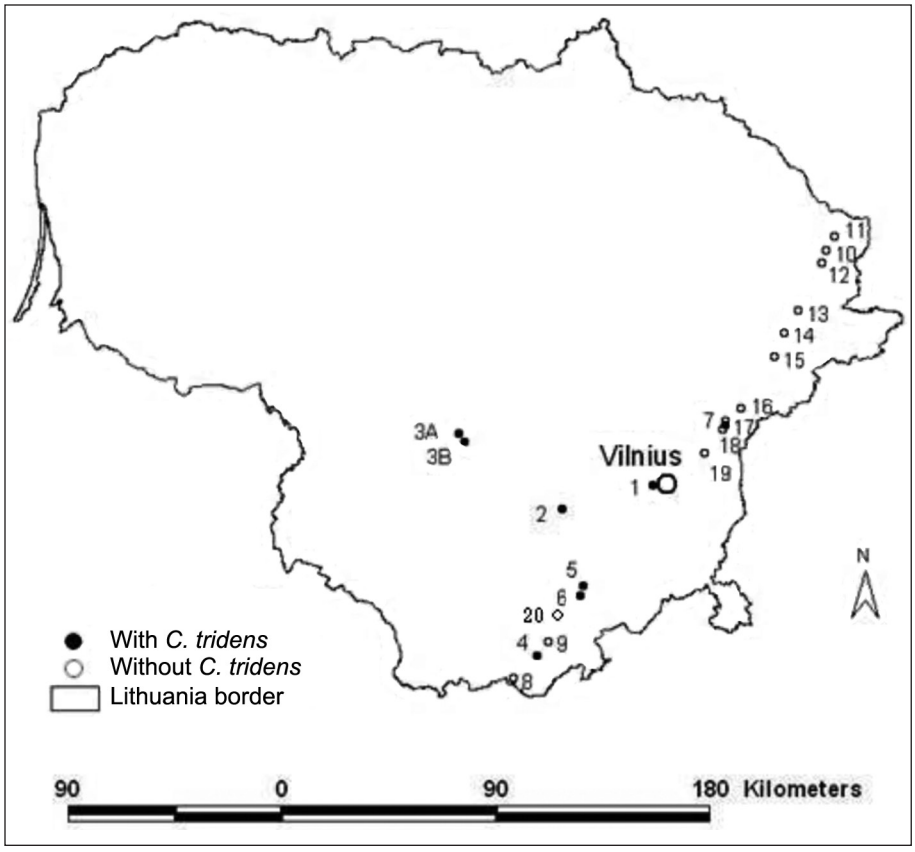

Fig. 2. Map showing the locations with *C. tridens* (Müller, 1774) from literature data and our research. The sites indicated in literature data: 1) Vilnius, Lazdynai; 2) Aukštadvaris, Čižiūnai; 3A) Kaunas, the island in the Nemunas River; 3B) Kaunas, Žemieji Šančiai, Nemunas embankment. The sites of our research include railway stations or crossroads in: 4) Marcinkonys; 5) Pamerkiai; 6) Matuizos; 7) Družiliai. Research sites without *C. tridens*: 8) Kabeliai; 9) Zervynos; 10) Gerkonys; 11) Visaginas; 12) Dūkštas; 13) Ignalina; 14) Pakretuonė; 15) Švenčionėliai; 16) Pabradė; 17) Pailgis; 18) Santaka; 19) Bezdonys; 20) Varėna

gare or form mosaic with communities of *Calamagrostis epigejos* (L.) Roth, 1788. The most abundant population of *C. tridens* (Müller, 1774) was found in the grassland between terraneous parts of herbages and small rocks on the ground in Družiliai (Fig. 3).

The plant dominants of 'Electric line' in the vicinity of Vilnius (Table 1, No. 1; Fig. 1, A) such as *Sedum acre*, *Oenothera biennis*, *Festuca rubra*, *Pilosella* sp., *Viscaria vulgaris*, *Achillea millefolium*, *Veronica officinalis*, *Dactylis glomerata* (Mikelaitis, 2002) and some *Artemisietum vulgaris* show relation to *Tanaceto-Artemisietum vulgaris* Br.-Bl. 1949 association which belongs to ruderal vegetation of alliance *Dauco carotae-Melilotion* Görs ex Rostański

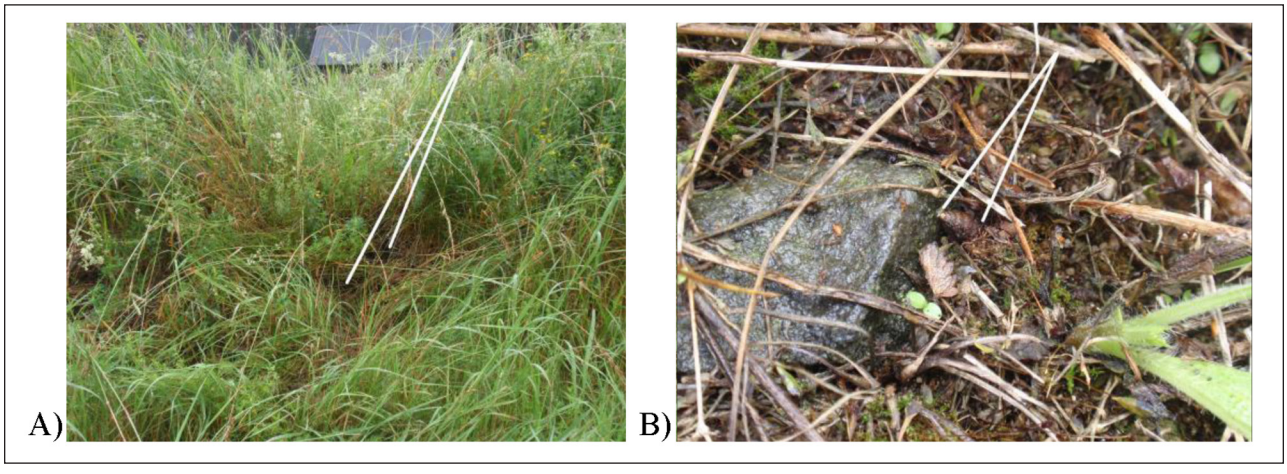

Fig. 3. View of grassland (A) in Družiliai within which one of the most abundant populations of *C. tridens* (Müller, 1774) was found and the species (B) is between terraneous parts of herbages and small rocks in the same place. White lines indicate the exact position

et Gutte 1971 (Motiekaitytė, 2002). According to EUNIS habitat classification, all *C. tridens* (Müller, 1774) habitats under 'Electric line' (Fig. 1, A) can be described as 'E 1.1 – Inland sand and rock with open vegetation' biotope (Hill et al., 2001) as it is open, thermophile grassland of sandy and gravelly ground.

In Kaunas *C. tridens* (Müller, 1774) (Table 1, No. 3) was found in habitat destroyed by trampling and litter with the remaining vegetation of *Mesobromoin* Br.-Bl. et Moor 38 ex Oberd. 49 plant union: *Dactylis glomerata, Daucus carota, Helictotrichon pubescens, Lotus corniculatus, Medicago lupulina, Plantago media, Centaurea jacea, Knautia arvensis*. This is vegetation of class *Festuco-Brometea* Br.-Bl. Et Tx. 43 and according to EUNIS habitat classification it can be described as 'E 1.2 – Perennial calcareous grassland and basic steppes' as it includes the calcareous grassland of the Baltic region with vegetation communities of *Festuco-Brometea* Br.-Bl. et Tx. 43.

Land snails' community composition and abundance

Our data show that *C. tridens* (Müller, 1774) is not abundant in the studied places, mean number per site was 2.37 ± 5.04 individuals on 1 m^2, reaching the maximum of 20 individuals on 1 m^2 in Pamerkiai (Fig. 4; Table 2).

Table 2. **Mollusc species among 5 236 individuals collected at eight railway embankment sites (Table 1, No. 4–10 and 20), mean (standard deviation – SD), range in number of specimens and the number of sites where each species was recorded (Table 1, No. 4–10 and 20). See text for details of sampling**

Species	With (+) *C. tridens*	Mean ± SD	Range (min-max)	No. of sites
Succinella oblonga (Draparnaud, 1801)	+	5.12 ± 15.31	0–90	4, 5, 6, 7, 10, 20
*C ochlicopa lubrica (*Müller, 1774)	+	5.45 ± 12.47	0–57	4, 5, 6, 7, 8, 20
*C. lubricella (*Rossmässler, 1834)	+	22.81 ± 27.19	0–123	4, 5, 6, 7, 8, 9, 10
*Vallonia cos tata (*Müller, 1774)	+	56.29 ± 70.97	0–357	4, 5, 6, 7, 8, 9, 10
*V. pulchella (*Müller, 1774)	+	10.46 ± 25.7	0–176	4, 5, 7, 8, 9
V. excentrica Sterki, 1893	+	8.55 ± 19.04	0–112	4, 6, 7, 8, 9
Pupilla muscorum (Linnaeus, 1758)	+	30.21 ± 48.18	0–219	4, 5, 6, 7, 8, 9
Punctum pygmaeum (Draparnaud, 1801)	–	0.02 ± 0.14	0–1	6, 10
Truncatellina cylindrica (Férussac, 1807)	+	4.36 ± 23.54	0–179	4, 7
Columella edentula (Draparnaud, 1805)	+	0.47 ± 2.48	0–18	4, 6
Vertigo pusilla Müller, 1774	–	0.67 ± 3.18	0–16	8, 10
V. pygmaea (Draparnaud, 1801)	–	0.58 ± 2.79	0–16	8, 9, 10
V. antivertigo (Draparnaud, 1801)	–	0.01 ± 0.1	0–1	8
Chondrula tridens (Müller, 1774)	+	2.37 ± 5.04	0–20	4, 5, 6, 7
Discus ruderatus (Hartmann, 1821)	+	0.01 ± 0.1	0–1	5
Euconulus fulvus (Müller, 1774)	+	3.64 ± 12.34	0–86	4, 5, 6, 7, 8, 9, 10
Nesovitrea hammmonis (Ström, 1765)	+	14.39 ± 29.11	0–133	4, 5, 6, 7, 8, 9
N. petronella (Pfeiffer, 1853)	+	1.69 ± 8	0–67	6, 10
Vitrina pellucida (Müller, 1774)	+	5.88 ± 13	0–86	4, 5, 6, 7, 8, 9
Fruticola fruticum (Müller, 1774)	+	9.19 ± 14.54	0–71	4, 5, 6, 7, 8, 9, 10
Euomphalia strigella (Draparnaud, 1801)	+	3.85 ± 13.58	0–73	4, 5, 7, 10
Perforatella bidentata (Gmelin, 1788)	–	0.51 ± 3.64	0–35	10
Trichia hispida (Linnaeus, 1758)	+	3.62 ± 10.79	0–65	4, 5, 10, 20
Cepaea hortensis (Müller, 1774)	–	0.02 ± 0.14	0–1	6
Xerolenta obvia (Menke, 1828)	–	3.21 ± 21.71	0–181	20
Deroceras agrestis (Linnaeus, 1758)	–	0.01 ± 0.1	0–1	6
D. reticulatus (Müller, 1774)	+	0.01 ± 0.1	0–1	4
Arion circumscriptus Jonston, 1828	+	0.01 ± 0.1	0–1	4
A. fuscus (Müller, 1774)	–	0.01 ± 0.1	0–1	10
Helix pomatia Linnaeus, 1758	+	0.34 ± 1.32	0–9	7, 10, 20
In total:	20			

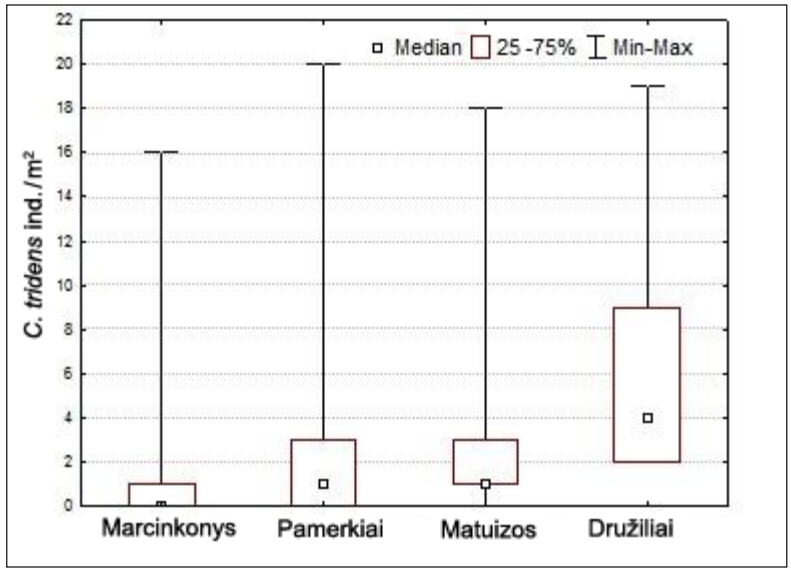

Fig. 4. Mean abundance of *C. tridens* (Müller, 1774) in four sites of our research that include railway stations or crossroads in Marcinkonys, Pamerkiai, Matuizos and Družiliai

Together with *C. tridens* (Müller, 1774) 20 other land mollusc species were found but they were not collected in all sites jointly. Even 16 of these species had greater abundance per site than *C. tridens* (Müller, 1774) and some species reached the maximum of 357 individuals on 1 m^2 (Table 2). In total, 30 mollusc species were collected during the study, but the mean number on 1 m^2 varied from 5 to 10 species (Fig. 5; Table 2).

As it is obvious from Fig. 5, species richness was low and differed marginally (Kruskal-Wallis test: H (6, N = 95) = 21.26; p = 0.0017). Multiple comparisons of mean ranks showed that significant differences exist only between Marcinkonys

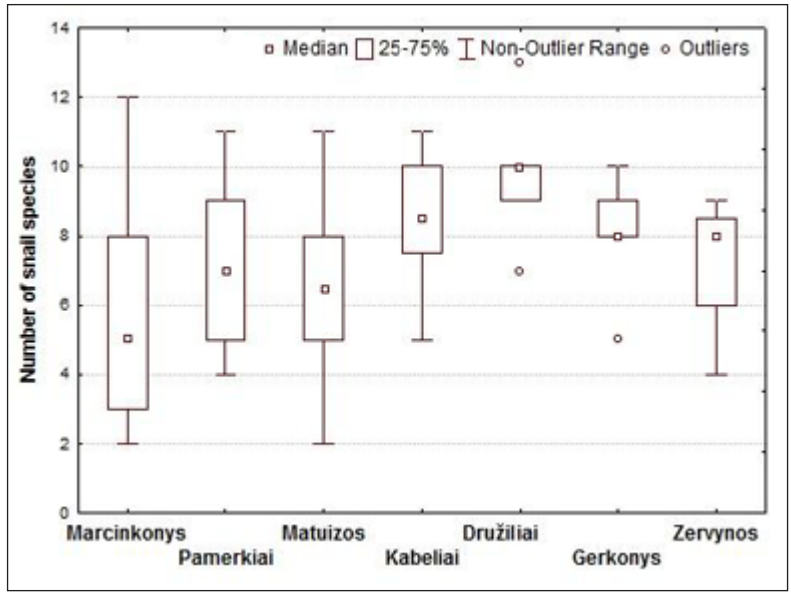

Fig. 5. Snail species richness in seven studied sites. With *C. tridens* (Müller, 1774)*:* Marcinkonys, Pamerkiai, Matuizos, Družiliai. Research sites without *C. tridens* (Müller, 1774): Kabeliai, Zervynos, Gerkonys

and Družiliai stations (p = 0.04) and between Marcinkonys and Kabeliai stations (p = 0.015); the least richness was in Marcinkonys.

There were no significant differences between the abundance of *C. tridens* (Müller, 1774) in 2010 and 2012 though Kolmogorov-Smirnov test ($p < 0.05$) detected significant differences between the abundance of four species – *Cochlicopa lubricella* (Rossmässler, 1834), *Vallonia costata* (Müller, 1774), *Vitrina pellucida* (Müller, 1774), *Fruticola fruticum* (Müller, 1774) and the total number of individuals; the abundance was greater in 2012. Abundance of three species *Succinella oblonga* (Draparnaud, 1801), *Euconulus fulvus* (Müller, 1774), and *Fruticola fruticum* (Müller, 1774) significantly differed (Kolmogorov-Smirnov test, $p < 0.05$) in places with *C. tridens* (Müller, 1774) and without it (Fig. 6): *E. fulvus* (Müller, 1774) and *F. fruticum* (Müller, 1774) had greater abundance in sites without *C. tridens* (Müller, 1774), and *S. oblonga* (Draparnaud, 1801) had greater abundance in sites with *C. tridens* (Müller, 1774), but correlation between the abundance of the aforesaid species and *C. tridens* (Müller, 1774) was not found.

Spearman Rank Order Correlations test showed that *C. tridens* (Müller, 1774) has significant negative correlation ($r = -0.3$; $p < 0.05$) with *Pupilla muscorum* (Linnaeus, 1758) and positive correlation ($r = 0.4$; $p < 0.05$) with *Nesovitrea hammonis* (Ström, 1765), *Euomphalia strigella* (Draparnaud, 1805) and *Helix pomatia* Linnaeus, 1758.

DISCUSSION

According to literature data molluscs as part of the fauna of northern Europe dispersed from more southerly refuges in Late Pleistocene / Early Holocene and *C. tridens* (Müller, 1774) was very common in steppes as an index species of Early Holocene in Central Europe (Cameron et al., 2010; Hausdorf, Hennig, 2003; Ložek, 2000, 2007; Horsák et al., 2010). So suggestions that *C. tridens* (Müller, 1774) as species from Central and SE European Biogeographical group (Willis et al., 2000) is native for Lithuania can be predicated on its paleontological data, on species relation to natural habitats and its affects to the local snails' community. What are these data?

The paleontological data on terrestrial molluscs from Holocene in Central Lithuania has appeared recently. There is no paleontological data on *C. tridens* (Müller, 1774), although three

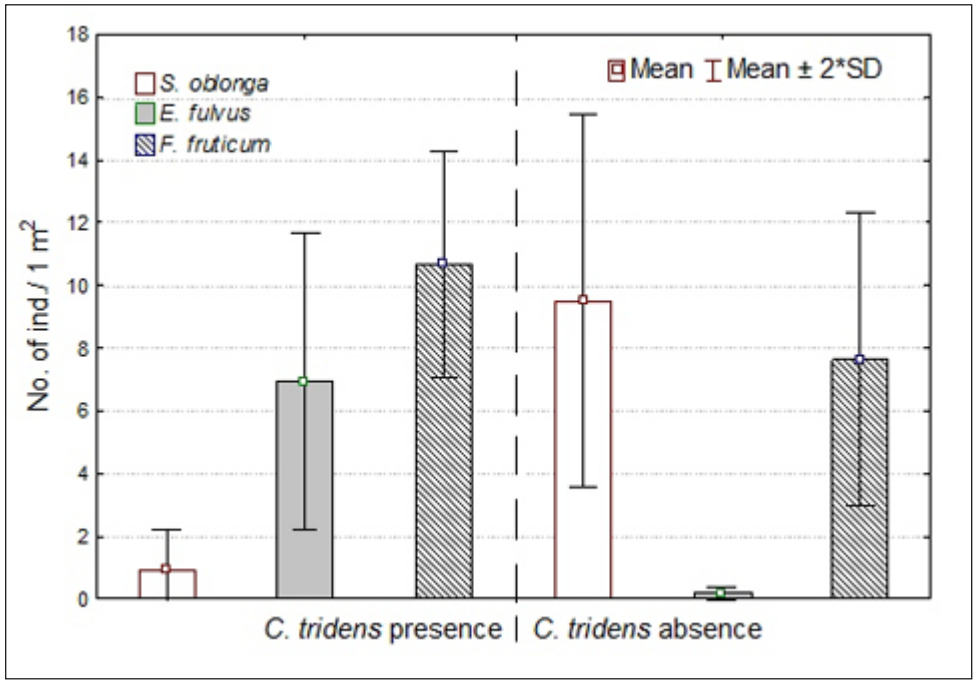

Fig. 6. Abundance of *S. oblonga* (Draparnaud, 1801), *E. fulvus* (Müller, 1774) and *F. fruticum* (Müller, 1774) in seven studied sites based on the presence or absence of *C. tridens* (Müller, 1774)

open-area species were found: *Vallonia pulchella* (Müller, 1774), *V. costata* (Müller, 1774) and *Vitrea crystallina* (Müller, 1774) and the majority of Lithuanian molluscs from Holocene belong to the complex of thermophilic-forests species from South and West Europe (Sanko et al., 2008). As several authors (Ниценко, 1962; Rebassoo, 1987; Balevičienė, 1991) have noted, Lithuania is one of the north-west periphery countries of steppe-vegetation. The vegetation from class *Festuco-Brometea* Br.-Bl. et Tx. 43 and its natural alliances are really relict because they belong to steppe-flora of Holocene. There is a possibility that *C. tridens* (Müller, 1774) could have inhabited Lithuania in Holocene, as natural habitats typical to southern regions still exist, and all sites where *C. tridens* (Müller, 1774) were found were related to this vegetation. According to literature data, such rare habitats are on the open southern terraces–banks of Nemunas, Nevėžis, Jūra, Minija rivers or on the open, dry carbonaceous wealds on the hills in south-west Lithuania (Balevičienė, 1991). Moreover, all known occurrences of species are only in the southern phytogeographical zone of Lithuania (Natkevičaitė-Ivanauskienė, 1970) so theoretically they coincide with the periphery of vegetation from class *Festuco-Brometea* Br.-Bl. et Tx. 43.

Evidence for inter-specific competition in land snails is sparse and mainly confined to examples of closely related or similar-sized species, usually in rather stressed environments with limited faunas (Solem, 1984; Baur, Baur, 1990; Cameron, Pokryszko, 2003). *C. tridens* (Müller, 1774) had not any closely related or similar-sized species in the studied grasslands. Our study emphasises relative invariance of site species richness and composition (Table 2) and abundance of only four species: *Pupilla muscorum* (Linnaeus, 1758), *Nesovitrea hammonis* (Ström, 1765), *Euomphalia strigella* (Draparnaud, 1805), *Helix pomatia* (Linnaeus, 1758) correlate with that of *C. tridens* (Müller, 1774) though these species are not closely related or similar-sized. Total species richness (30 species) in grasslands of railway embankments is similar to species richness in the grasslands of Vilnius parks, 29 species respectively, though 14 species differed (Kuznecova, 2007). Three species: *Truncatellina cylindrica* (Férussac, 1807), *Pupilla muscorum* (Linnaeus, 1758), *Cochlicopa lubricella* (Rossmässler, 1834) confirm the natural origin of habitats of *C. tridens* (Müller, 1774) as these species are typical only for natural and dry grasslands (Cameron et al., 2010; Myšák, Horsák, 2011). Low abundance of *C. tridens* (Müller, 1774) in all habitats shows a low interaction with other species, too.

On the other hand, habitats where *C. tridens* (Müller, 1774) is present can be described as urbophytocenoses as they belong to urban environments or encompass road-railway or communication lines; sometimes grass is mown down, trampled and littered up. Consequently, the habitats even show some transformation toward ruderal vegetation of alliance *Dauco carotae-Melilotion* Görs ex Rostański et Gutte 1971. Thus we can suppose that *C. tridens* (Müller, 1774) was introduced by railway (on embankments) or drifted by the Nemunas River (Kaunas) but it is difficult to explain the occurrence of the species in the environs of Aukštadvaris and Vilnius as dispersal capacity of molluscs is rather weak compared with that of many other animal taxa.

The best known pest molluscs, for example *Arion rufus* (Linnaeus, 1758), *Arion lusitanicus* Mabille, 1868 and others (Godan, 1983; Myšák, Horsák, 2011), which became invasive, spread in a large territory and in different habitats; species had been naturalized and dispersed from the place of introduction usually inhabiting territories of varying sizes. If species has spotted distribution, only in places where it has been introduced, such species is considered as introduced but non-invasive (Pyšek et al., 2002). Animals belonging to relict fauna often have spotted distribution too which shows that species once had wide distribution but now occur very locally (Kay, 1995). As new data on *C. tridens* (Müller, 1774) has been known since 2000 and the population in Lithuania has spotted distribution, we can supposedly state that *C. tridens* (Müller, 1774) could be either introduced or relict, but, in any case, it is not an invasive species.

CONCLUSIONS

We can conclude that *C. tridens* (Müller, 1774) is not invasive and there is no threat of its invasion. The species is rare and has spotted distribution in south Lithuania, but its status of being threatened is uncertain. Accordingly, *C. tridens* (Müller, 1774) should be normally categorised as Not Evaluated in Lithuania.

In Lithuania *C. tridens* (Müller, 1774) is associated with mixed plant communities of xerothermic (class *Festuco-Brometea* Br.-Bl. et Tüxen ex Soó 1947), ruderal (alliance *Dauco carotae-Melilotion* Görs ex Rostański et Gutte 1971) seldom mown down vegetation on gravelly and slightly trampled soils which occur in warm and open ecotopes. Although in total 20 mollusc species inhabit together with *C. tridens* (Müller, 1774), the interaction with land snails' community is weak as only four species show correlation with *C. tridens* (Müller, 1774).

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AR *CHONDRULA TRIDENS* (MÜLLER, 1774) YRA INVAZINĖ SRAIGIŲ RŪŠIS LIETUVOJE?

S a n t r a u k a

Straipsnyje aprašyto tyrimo tikslas buvo atsakyti į klausimą, „ar rūšis invazinė, ar ne“, bei atskleisti rūšies paplitimo Lietuvoje dėsningumus: 1) pasiskirstymo pobūdį, 2) biotopo ypatumus, 3) sausumos moliuskų bendrijos sudėtį tirtose vietose.

Straipsnyje apžvelgti ir apibendrinti literatūros duomenys apie *Chondrula tridens* (Müller, 1774) paplitimą Lietuvoje ir pateikti tyrimų, atliktų 2010, 2011, 2012 metų rugpjūčio mėnesiais, rezultatai. Iš viso surasta 30 moliuskų rūšių. Nustatytos keturios naujos *Chondrula tridens* (Müller, 1774) radimvietės palei geležinkelio Kabeliai–Visaginas bėgius. Rezultatų analizė atskleidė, kad *C. tridens* (Müller, 1774) yra reta, paplitusi fragmentiškai, dažniausiai urbofitocenozėse, bet biotopai susiję su *Festuco-Brometea* Br.-Bl. et Tx. 43 klasės, kuri susiformavo holocene, stepine augalija. Tai rodo, kad ir *C. tridens* (Müller, 1774) galėjo išlikti iš tų laikų. Nustatyta neigiama koreliacija (r = –0,3) su *Pupilla muscorum* (Linnaeus, 1758) ir teigiama koreliacija (r = 0,4) su *Nesovitrea hammonis* (Ström, 1765), *Euomphalia strigella* (Draparnaud, 1805) ir *Helix pomatia* Linnaeus, 1758. Kadangi viena iš koreliuojančių rūšių *Helix pomatia* Linnaeus, 1758 introdukuota, o *C. tridens* (Müller, 1774) radimvietės buvo aptiktos palei geležinkelį, tai rodo, kad ir *C. tridens* (Müller, 1774) galėjo patekti antropogeniniu būdu – su žmogaus veikla.

Apibendrinant galima teigti, kad *C. tridens* (Müller, 1774) rūšies atsiradimo ištakos Lietuvoje lieka neaiškios, bet kadangi pirmą kartą ji buvo aptikta tik 1830 m., o dabartinis šios rūšies paplitimas yra fragmentiškas ir negausus, nėra invazijos grėsmės ir ateityje.

Raktažodžiai: Gastropoda, Enidae, sausumos sraigės, invazinės, Lietuva