NEW RECORDS OF RARE VERTIGINIDAE (MOLLUSCA: GASTROPODA) IN LITHUANIA

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Introduction

Three decades after EU governments adopted the Habitats Directive in 1992 (Council Directive 92/43 / EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora), knowledge of Europe's Vertiginidae is deepening. During this period, the biology, distribution, conservation measures of *Vertigo geyeri* Lindholm, 1925, *Vertigo angustior* Jeffreys, 1830 and *Vertigo moulinsiana* (Dupuy, 1849) were better studied, and in some cases it became clear that these species are not so rare as previously thought – they were poorly studied in the past (Beran, 2006; Pilāte, 2004; Drake, 1999; Killeen *et al.*, 2011 a, b; Moorkens *et al.*, 2012; Schenková *et al.,* 2012).

According to the last assessment of IUCN red list category and criteria *Vertigo geyeri* Lindholm, 1925 was assessed and reported for Europe as stable and not being a focus of species conservation although it remained species of Annex II of the Habitats Directive (Killeen *et al.,* 2011b). A couple of years ago the worst situation in Lithuania seemed to be with *V. geyeri*. In 2003, this species was found in several localities of Lithuania quite far away from each other and information on some new localities was provided before the 2019 (Skujienė, 2008; Vaivilavičius, 2008; Arbačiauskas, 2015). The breakthrough came when a well-known specialist in Europe dr. Ian Killeen (Ireland, County Wicklow, Greystones, Malacological Services) advised Lithuanian scientists on identification of these species and which microhabitat types are optimal for these whorl snails. In 2019, during inventory, *V. geyeri* was found in 23 localities, of which 20 were new records for Lithuania (Skujienė *et al.,* 2019).

Another species from Annex II of the Habitats Directive [92/43/EEC] – *Vertigo angustior* also have been reassessed according to IUCN red list category and criteria and at the Europe regional level was reported as Decreasing and Vulnerable species (Moorkens *et al.,* 2012). On the contrary, in Lithuania, the narrow-mouthed whorl snail *V. angustior* has a quite wide distribution range with 53 locations. Majority of them are within highlands which first escaped from the last glacier: central and south-east regions (Vaivilavičius, 2007; Skujienė, 2008; Arbačiauskas, 2015). As the species was considered to be meeting the thresholds of 10% of population decline over the last 10 years it was left in the list of rare species of the Lithuanian Red Data Book.

The conservation assesment as Vulnerable at the European level of *Vertigo moulinsiana* was based on the estimated loss of individuals in sites, combined with total loss of sub-populations from sites that have been well monitored since the Habitat's

Directive monitoring began (Killeen *et al.,* 2011b). In Lithuania only 14 sites are known, of which 11 in southern Lithuania (Meteliai Regional Park, Žuvintas Biosphere Reserve, Aukštadvaris Regional Park, Marijampolė District), several sites in Utena and Ignalina districts (Gurskas, 1997; Vaivilavičius, 2007; Skujienė, 2008).

The inventory of the Geyer`s whorl snail (*V. geyeri*) on the territory of Lithuania was carried out in the implementation of 2018 December 21st signed contract by the Lithuanian Fund for Nature with the State Service for Protected Areas under the Ministry of Environment of the Republic of Lithuania No. F4-2018-219 concerning the provision of an inventory and reporting service on a species of Geyer`s whorl snail (*V. geyeri*). These studies are being carried out by the Ministry of Environment of the Republic of Lithuania implementing the LIFE Integrated Project "Optimization of Natura 2000 Network Management in Lithuania" No. LIFE16IPE/LT/016 (LIFE-IP PAF-NATURALIT), funded by the European Union for the Environment and Climate Policy Program (LIFE). This article provides data on the second year of inventory for *V. geyeri*, results of the first year of inventory already have been published (Skujienė *et al.,* 2019). However, as other rare species have been found with a frequency similar to that of *V. geyeri* at more than one inventory site, this article presents data on all Vertiginidae listed under Annex II of the Habitats and Species Directive [92/43/EEC], found in Lithuania during *V. geyeri* inventory in 2020.

Material and Methods

The present study was approved by the Lithuanian Environment Protection Agency Permission on snail collecting and study (No. 45, 02 07 2020 and No. 57, 17 07 2020). All data have been entered into the Lithuanian Information system of protected species (SRIS) till the end of November, 2020. All collected material is deposited in the Zoological Museum of Vilnius University.

In total, 30 localities from Vilnius, Anykščiai, Elektrėnai, Ignalina, Kėdainiai, Molėtai, Radviliškis, Raseiniai, Rokiškis, Šalčininkai, Širvintos, Ukmergės and Zarasai districts were studied from July to August of 2020.

Each locality was surveyed according to a standardised monitoring protocol (Moorkens & Killeen, 2011), adapted for Lithuanian conditions. This protocol included assessment of area of occupancy and quality of habitat, survey and sampling (0.25 x 0.25 x 0.05 m^3) along linear transects or spot plots, and analysis of molluscan species (*V. geyeri* and other) from 1–10 (generally 3–5) samples taken from each locality. The number of samples were taken considering the suitable habitat area. During the previous survey (Skujienė *et al.,* 2019) the main criterion for selecting study sites was a set of preferred habitat features such as: constantly wet layer of peat, discontinuous vegetation layer formed by low herbaceous plants such as *Carex viridula* subsp. *brachyrhyncha* (Celak.) B.Schmid (synonym *Carex lepidocarpa* Tausch) and *Eleocharis quinqueflora* (Hartmann) O.Schwarz), *Campylium stellatum* (Hedw.) C.E.O. Jensen prevalent in the moss layer. This year (2020), the list of indicator plants was expanded to include species that would allow the habitat to be expected to be the most natural and with calcareous ground water: *Carex buxbaumii*, *Carex distans*, *Cladium mariscus*, *Eriophorum latifolium*, *Liparis loeselii*, *Pinguicula vulgaris*, *Primula farinosa*, *Sesleria caerulea*, *Shoenus ferrugineus*, *Swertia perennis*, *Drepanocladus revolvens*.

Field surveys in Lithuania included habitat assessment and data collection using

QField – the mobile GIS app, followed by sieving and identification of mollusc species in the laboratory, and adding all information to the QGIS project stored on the server at the State Service for Protected Areas under the Ministry of Environment.

List of localities

No. Locality	Administrative district	Coordinates (LAT, LONG)
1. Paversmių fen	Anykščiai district	55.688935, 24.973639
2. Nendrynas fen	Anykščiai district	55.680728, 24.965358
3. Šeduikiai fen	Anykščiai district	55.72579, 25.47128
4. Stančikai	Elektrėnai district	54.69704, 24.596829
5. Ligūnai I	Ignalina district	55.487876, 26.251605
6. Padysnio fen	Ignalina district	55.325017, 26.546498
7. Bajorai III, Galų fen	Ignalina district	55.447314, 26.223141
8. Pašilėliai reserve I	Kėdainiai district	55.46672, 24.23882
9. Pašilėliai reserve II	Kėdainiai district	55.45999, 24.23473
10. Pašilėliai reserve III	Kėdainiai district	55.45489, 24.23383
11. Kamaraučizna II	Molėtai district	55.083916, 25.225657
12. Kamaraučizna I	Molėtai district	55.083545, 25.2295
13. Palukštinė	Molėtai district	55.214961, 25.372382
14. Liepiškiai	Radviliškis district	55.715368, 23.345619
15. Papušynys	Raseiniai district	55.470702, 23.46095
16. Zvėgiai-2	Raseiniai district	55.440745, 23.423105
17. Remeikiai	Rokiškis district	56.117149, 25.633188
18. Svobiškiai	Rokiškis district	55.967686, 25.938101
19. Skrebiškiai	Rokiškis district	55.872394, 25.539995
20. Between Skrebiškiai and Pempiškiai	Rokiškis district	55.868798, 25.540572
21. Pempiškiai	Rokiškis district	55.867537, 25.538704
22. Iciūnai II	Rokiškis district	56.018539, 25.653947
23. Iciūnai I	Rokiškis district	56.020084, 25.653928
24. Naujakiemis	Šalčininkai district	54.323825, 25.396432
25. Jauniūnai	Širvintos district	54.961304, 25.029511
26. Gaiveniai	Ukmergė district	55.329029, 24.668963
27. Santaka	Vilnius district	54.893007, 25.62532
28. Rukainiai	Vilnius district	54.608099, 25.518458
29. Novinkų mire	Zarasai district	55.662779, 26.427726
30. Grumbinai I	Zarasai district	55.740307, 26.016438

Results

In 2020, during inventory three Vertiginidae species listed under the Annex II of the Habitats and Species Directive [92/43/EEC] were found: *Vertigo geyeri* – in 23 localities (Fig. 1), *V. angustior* – in 23 localities (Fig. 2) and *V. moulinsiana* – in 8 localities (Fig. 3). Only 16 localities overlap for *V. geyeri* and *V. angustior;* 3 localities overlap for all three species. All localities are new records for Lithuania.

We found that 87 % of sites for *V. geyeri* had complexes of wetland habitats with presence of Alkaline fens (7230 habitat). This is no coincidence, as the Alkaline fens (7230 habitat) was specifically selected for *V. geyeri* searches. Several other wet places have been included too, such as Transition mires and quaking bogs (7140 habitat). It was known prior to the expeditions that plants typical for the Alkaline fens had been mentioned by botanists in those wetlands as well.

In about 78% of the localities, *V. angustior* was found, this species occurred together with *V. geyeri* or *V. moulinsiana* (Fig. 2). A few sites (Localities No 14, 17, 24, 28, 30) where only *V. angustior* was found, were already too dry (or drying out) for *V. geyeri* or *V. moulinsiana*. Even when all species were found in the same locality, they were found in different samples corresponding to the different microhabitats *V. moulinsiana* always presented in the wettest places. In general only 50 % of sites where *V. moulinsiana* was found had complexes of wetland habitats with presence of Alkaline fens (7230 habitat).

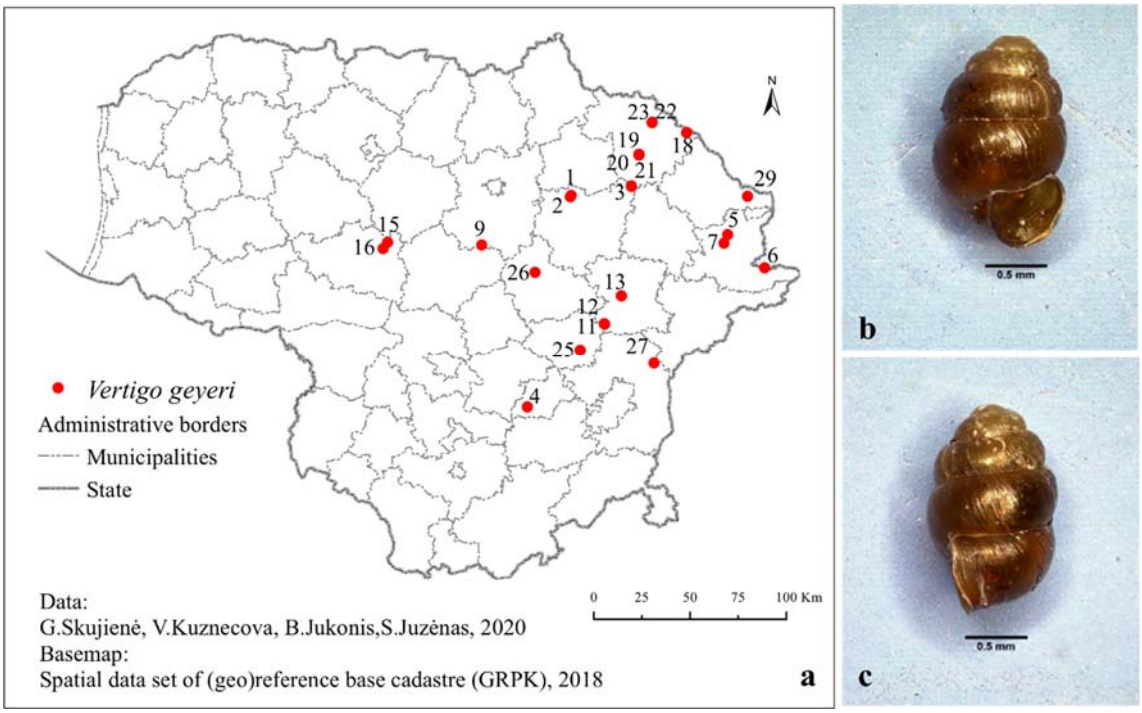

Figure 1. Distribution of 23 localities (a) where *Vertigo geyeri* Lindholm, 1925 was found during inventory in 2020. More detailed information on numbers is provided in the List of localities and description of specimens. Front (b) and profile (c) views of *V. geyeri* collected from the wetland near Santaka village, Vilnius district. Photo: S. Juzėnas.

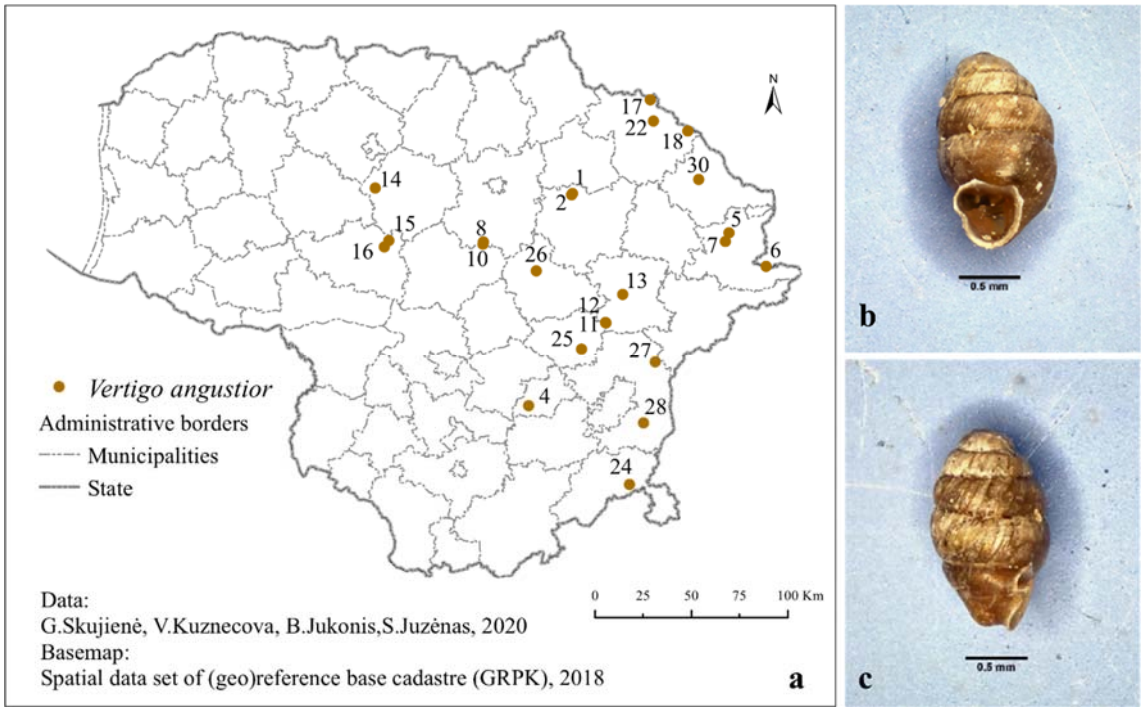

Figure 2. Distribution of 23 localities (a) where *Vertigo angustior* Jeffreys, 1830 was found during inventory in 2020. More detailed information on numbers is provided in the List of localities and description of specimens. Front (b) and profile (c) views of *V. angustior* collected from the wetland near Santaka village, Vilnius district. Photo: S. Juzėnas.

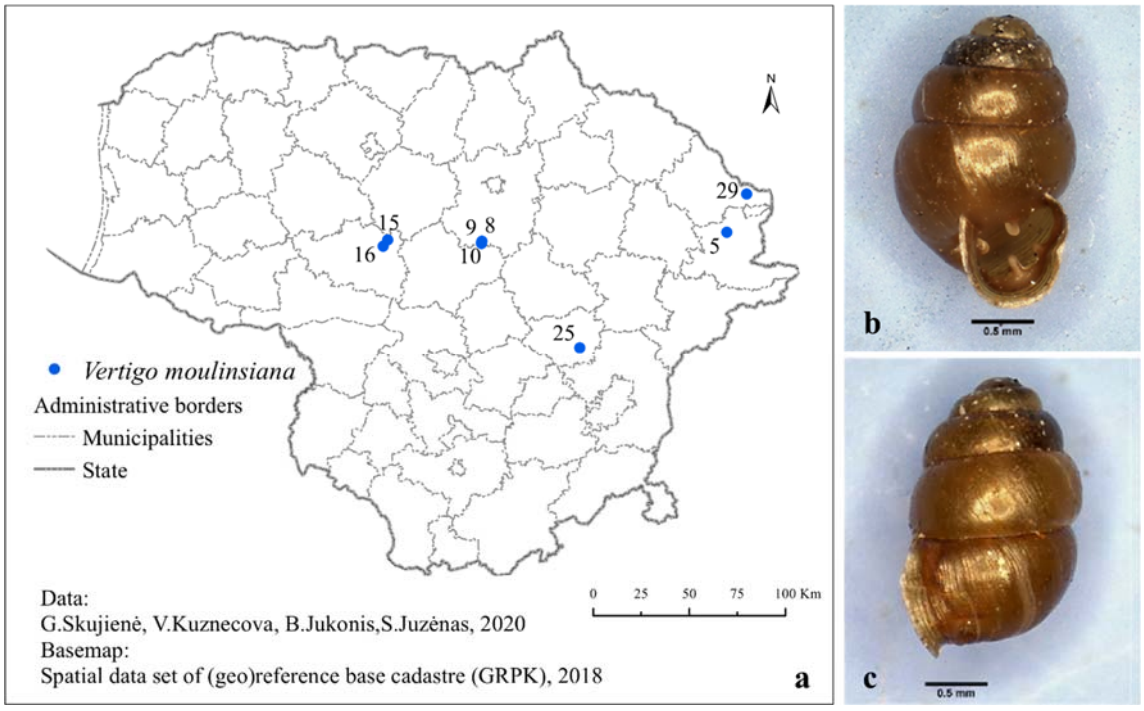

Figure 3. Distribution of 8 localities (a) where *Vertigo moulinsiana* (Dupuy, 1849) was found during inventory in 2020. More detailed information on numbers is provided in the List of localities and description of specimens. Front (b) and profile (c) views of *V. moulinsiana* collected from the wetland near Jauniūnai, Širvintos district. Photo: S. Juzėnas.

List of species

***Vertigo geyeri* Lindholm, 1925**

1. Paversmio fen, 7230 habitat, 17 07 2020, 5 samples, 7 ad.; 2. Nendryno fen, 7230 habitat, 04 07 2020, 6 samples, 21 ad., 6 juv.; 3. Šeduikiai fen, 7230 habitat, 04 07 2020, 5 samples, 6 ad.; 4. Stančikai , 7230 habitat, 07 08 2020, 3 samples, 6 ad., 1 juv.; 5. Ligūnai I, 7230 habitat, 12 08 2020, 3 samples, 6 ad., 2 juv.; 6. Padysnio fen, 7230 habitat, 24 08 2020, 4 samples, 8 ad., 3 juv.; 7. Bajorai III, Galų fen, 80% of 7230 habitat, 12 08 2020, 5 samples, 11 ad., 6 juv.; 9. Pašilėliai Botanical-Zoological reserve II, 7230 habitat, 05 07 2020, 5 samples, 21 ad.; 11. Kamaraučizna II, 7230 habitat, 12 08 2020, 3 samples, 10 ad., 3 juv.; 12. Kamaraučizna I vlg, 7230 habitat, 12 08 2020, 3 samples, 33 ad., 2 juv.; 13. Palukštinė, 7230 habitat, 17 07 2020, 3 samples, 7 ad.; 15. Papušynys, 80% of 7230 habitat, 18 08 2020, 3 samples, 1 ad.; 16. Zvėgiai-2, wet meadows with in the grass cover predominant *Carex cespitosa*, *Cirsium rivulare* and *Calamagrostis canescens*, 18 08 2020, 3 samples, 16 ad., 7 juv.; 18. Svobiškiai, the complex of 70% 7230 and 10% 7140 habitats, 10 08 2020, 4 samples, 6 ad., 7 juv.; 19. Skrebiškiai, 7140 habitat, 10 08 2020, 1 sample, 1 ad.; 20. Between Skrebiškiai and Pempiškiai, the complex of 50% 7230 and 50% 7140 habitats, 10 08 2020, 3 sample, 8 ad., 4 juv.; 22. Iciūnai II, 7230 habitat, 11 08 2020, 3 samples, 9 ad., 1 juv.; 23. Iciūnai I, 7230 habitat, 11 08 2020, 2 samples, 9 ad., 8 juv.; 25. Jauniūnai, 7230 habitat, 08 07 2020, 5 samples, 6 ad., 1 juv.; 26. Gaiveniai, the complex of 80% 7230 and 20% 6410 habitats, 08 07 2020, 5 samples, 16 ad., 1 juv.; 27. Santaka, 7230 habitat, 09 07 2020, 5 samples, 43 ad., 7 juv.; 29. Novinkų mire, 7140 habitat, 12 08 2020, 5 samples, 12 ad., 8 juv.;

***Vertigo angustior* Jeffreys, 1830**

1. Paversmio fen, 7230 habitat, 17 07 2020, 5 samples, 5 ad., 2 juv.; 2. Nendryno fen, 7230 habitat, 04 07 2020, 4 ad.; 4. Stančikai, 7230 habitat, 07 08 2020, 11 ad., 3 juv.; 5. Ligūnai I, 7230 habitat, 12 08 2020, 3 samples, 7 ad., 2 juv.; 6. Padysnio fen, 7230 habitat, 24 08 2020, 4 samples, 15 ad., 2 juv.; 7. Bajorai III, Galų fen, 80% of 7230 habitat, 12 08 2020, 5 samples, 12 ad., 5 juv.; 8. Pašilėliai Botanical-Zoological reserve I, 7230 habitat, 06 07 2020, 5 samples, 2 ad.; 10. Pašilėliai Botanical-Zoological reserve II, mire with open patches of peat and in the grass cover predominant *Carex viridula*, *C. panicea* and *Molinia caerulea*, 05 07 2020, 5 samples, 6 ad.; 11. Kamaraučizna II, 7230 habitat, 12 08 2020, 3 samples, 8 ad., 12 juv.; 12. Kamaraučizna I vlg, 7230 habitat, 12 08 2020, 3 samples, 3 ad.; 13. Palukštinė, 7230 habitat, 17 07 2020, 3 samples, 1 ad., 1 juv.; 14. Liepiškiai, close to 6510 habitat, 18 08 2020, 3 samples, 29 ad., 7 juv.; 15. Papušynys, 80% of 7230 habitat, 18 08 2020, 3 samples, 12 ad., 2 juv.; 16. Zvėgiai-2, wet meadows with in the grass cover predominant *Carex cespitosa*, *Cirsium rivulare* and *Calamagrostis canescens*, 18 08 2020, 3 samples, 6 ad., 1 juv.; 17. Remeikiai, 7230 habitat, 10 08 2020, 5 samples, 8 ad., 4 juv.; 18. Svobiškiai, the complex of 70% 7230 and 10% 7140 habitats, 10 08 2020, 4 samples, 1 ad.; 21. Pempiškiai, the complex of 30% 7230 and 70% 7140 habitats, 10 08 2020, 1 sample, 1 ad., 2 juv.; 22. Iciūnai II, 7230 habitat, 11 08 2020, 3 samples, 2 ad.; 24. Naujakiemis, 7230 habitat, 09 07 2020, 4 samples, 11 ad.; 25. Jauniūnai, 7230 habitat, 08 07 2020, 5 samples, 4 ad., 2 juv.; 26. Gaiveniai, the complex of 80% 7230 and 20%

6410 habitats, 08 07 2020, 5 samples, 21 ad.; 27. Santaka, 7230 habitat, 09 07 2020, 5 samples, 103 ad., 15 juv.; 28. Rukainiai, vegetation dominated by tall sedges (Ass. *Caricetum acutae* Tx. 1937), 09 07 2020, 1 sample, 4 ad.; 30. Grumbinai I, wet grassland dominated by *Molinia caerulea*, 11 08 2020, 1 sample, 14 ad., 4 juv.

***Vertigo moulinsiana* (Dupuy, 1849) (VM)**

5. Ligūnai I, 7230 habitat, 12 08 2020, 3 samples, 1 ad., 2 juv.; 8. Pašilėliai Botanical-Zoological reserve I, 7230 habitat, 06 07 2020, 5 samples, 7 ad.; 9. Pašilėliai Botanical-Zoological reserve II, 7230 habitat, 05 07 2020, 5 samples, 1 ad.; 10. Pašilėliai Botanical-Zoological reserve III, mire with open patches of peat and in the grass cover predominant *Carex viridula*, *C. panicea* and *Molinia caerulea*, 05 07 2020, 5 samples, 3 ad.; 15. Papušynys, 80% of 7230 habitat, 18 08 2020, 3 samples, 3 ad., 4 juv.; 16. Zvėgiai-2, wet meadows with in the grass cover predominant *Carex cespitosa*, *Cirsium rivulare* and *Calamagrostis canescens*, 18 08 2020, 3 samples, 9 ad., 5 juv.; 25. Jauniūnai, 7230 habitat, 08 07 2020, 5 samples, 19 ad., 3 juv.; 29. Novinkų mire, 7140 habitat, 12 08 2020, 5 samples, 4 ad., 3 juv.

Discussion

After reviewing of the results of the two years of inventory of *V. geyeri* in Lithuania (for the inventory for the first year, see Skujienė *et al.* 2019), we reaffirm that situation is far from the worst for this species as distribution of *V. geyeri* throughout Lithuania is much wider than previously thought. A similar increase in the number of known sites for *V. angustior* confirms the general trend in Europe for both species, when the situation of *V. moulinsiana* is the most critical (Cameron *et al.*, 2003; Beran, 2006; Pilāte, 2004; Drake, 1999; Killeen *et al.*, 2011a/b; Moorkens & Killeen, 2011). Summarizing the inventory data, we can state that currently the smallest number of sites in Lithuania is known for *V. moulinsiana*, but it should be borne in mind that there is a real lack of this type of research in Lithuania, and it is possible that the situation will change after a targeted search.

However, all three species have a scattered and often localised distribution in many countries and there are documented local extinctions especially where the species occurs in isolated populations (Killeen *et al.*, 2011a; Moorkens *et al.*, 2012). These species have been found to be very sensitive to micro-environmental changes. They are specifically adaptable to humidity and vegetation composition and even when they are found in the same wetland they live in different niches (Horsák & Hájek, 2005; Vavrová *et al.*, 2009; Moorkens & Killeen, 2011).

We conclude that the success of the research was largely influenced by the selection for the most typical habitats and plants / mosses for *V. geyeri* and improved mollusc collection methodology according to a standardised monitoring protocol by Moorkens & Killeen (2011), adapted for Lithuanian conditions. Probably, the higher levels of other species (especially *V. angustior*) depended on humidity of microhabitats: majority of fens were drier than in previous years when majority of surveyed Alkaline fens (7230 habitat) were complexes with Transition mires and quaking bogs (7140 habitat) (Skujienė *et al.,* 2019).

Acknowledgements

Creation of QGIS project on GIS server and customized maps with attribute collection forms configured to the field work for this project was carried out by Giedrius Vaivilavičius – a consultant of State Service for Protected Areas under the Ministry of Environment. We thank Giedrius Vaivilavičius for his help with this aspect of the project.

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Naujos retų Vertiginidae (Mollusca: Gastropoda) radimvietės Lietuvoje

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Santrauka

Ištyrus 2020 metų *V. geyeri* inventorizacijai suplanuotas potencialiai tinkamas 30 teritorijų Vilniaus, Anykščių, Elektrėnų, Ignalinos, Kėdainių, Molėtų, Radviliškio, Raseinių, Rokiškio, Šalčininkų, Širvintų, Ukmergės and Zarasų rajonuose, *V. geyeri* ir *V. angustior* buvo rastos 23-jose pelkėse, *V. moulinsiana* – 8-iose. Kadangi 2020 metais tyrimai buvo atliekami nesaugomose teritorijose (išskyrus Pašilėlių botanį-zoologinį draustinį), visos čia pateiktos retųjų Vertiginidae radimvietės – naujos Lietuvai. Sėkminga inventorizacija siejama su tipingų *V. geyeri* buveinių ir augalų/samanų paieška ir jau pernai pakoreguota moliuskų rinkimo metodika. Šiais metais indikatorinių augalų sąrašas buvo išplėstas įtraukiant rūšis, kurios leistų tikėtis, kad buveinė bus natūraliausia ir mažiausiai pažeista: *Carex buxbaumii*, *Carex distans*, *Cladium mariscus*, *Eriophorum latifolium*, *Liparis loeselii*, *Pinguicula vulgaris*, *Primula farinosa*, *Sesleria caerulea*, *Shoenus ferrugineus*, *Swertia perennis*, *Drepanocladus revolvens*.

Received: 11 November, 2020