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An updated checklist of the extant freshwater ostracods (Podocopida, Ostracoda, Crustacea) of Slovenia

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Abstract. The article presents an updated checklist of the extant freshwater ostracods in Slovenia. The data were obtained from the published scientific literature up to 2012 and from field collections after 2012, mainly from springs and groundwaters and, to a lesser extent, from ponds and other surface waters. The erroneous and invalid species names cited in the existing literature are listed to avoid further misquotations. The updated checklist contains a total of 70 valid species names. The species belong to 3 superfamilies, 9 families and 32 genera. The species-richest is the family Candonidae (36 species), followed by the family Cyprididae (22 species). Further field samplings are needed to complete the species list, with the focus on the eastern and southeastern parts of Slovenia, and on the sampling of surface waters. Additionally, more in-depth literature investigations and examinations of old museum collections across Europe need to be carried out to obtain all existing data. Moreover, many stygobiotic species (i.e., species inhabiting exclusively subterranean waters), new for science, collected over the last 20 years, need to be scientifically described. Lastly, the Slovenian National Red list on ostracods needs to be urgently updated.

Key words: Ostracoda, species, distribution, freshwater, groundwater, non-marine

Izvleček. Posodobljen seznam recentnih dvoklopnikov (Podocopida, Ostracoda, Crustacea) celinskih voda Slovenije – V članku je predstavljen posodobljen seznam recentnih dvoklopnikov celinskih voda Slovenije. Podatki o vrstah so pridobljeni iz objavljene znanstvene literature do leta 2012 in dopolnjeni s terenskimi podatki, zbranimi po letu 2012, predvsem kot rezultat vzorčenja izvirov in podzemnih voda, v manjši meri pa ribnikov in drugih površinskih voda. Da bi se izognili nadaljnjim napačnim navedbam v znanstveni literaturi, navajamo tudi seznam neveljavnih imen vrst ter napačnih navedb imen iz obstoječe literature. Posodobljeni seznam vsebuje 70 veljavnih imen vrst. Vrste pripadajo 3 naddružinam, 9 družinam in 32 rodovom. Vrstno najbolj bogata je družina Candonidae (36 vrst), sledi ji družina Cyprididae (22 vrst). Za dopolnitev seznama vrst so potrebna nadaljnja terenska vzorčenja, s poudarkom na vzhodnem in jugovzhodnem delu Slovenije ter na vzorčenju površinskih voda. Dodatne, predvsem starejše podatke je treba izbrskati tudi s pomočjo podrobnega pregleda starejše literature in obstoječih muzejskih zbirk na evropskem nivoju. Poleg tega je treba opisati številne stigobiotske vrste (t.j., vrste, ki naseljujejo izključno podzemne vode), nove v znanosti, zbrane v zadnjih 20 letih. Nenazadnje, nujna je posodobitev nacionalnega rdečega seznama dvoklopnikov.

Ključne besede: Ostracoda, vrste, porazdelitev, celinske vode, podzemne vode, nemorski

Introduction

Ostracods are one of the oldest crustacean groups, inhabiting marine, freshwater and semi-terrestrial habitats, mostly in free-living, but also in parasitic/commensal forms (Horne 2003, Karanovic 2012). Currently, approximately 8,000 extant species are described, which is around 12% of all described crustacean species in the world (Karanovic 2012). Class Ostracoda is divided into exclusively marine subclass Myodocopa and subclass Podocopa, containing marine, freshwater, semi-terrestrial, commensal and fossil species (Horne et al. 2002). Non-marine, free-living and commensal species of the order Podocopida compose over 25% of all known extant ostracod species (Meisch et al. 2019), with estimations that up to 57,000 species were found as fossils over different geological periods, starting from the Early Ordovician (Paleozoic, in rocks about 485 million years old) (Horne et al. 2002, Salas et al. 2007).

The first ostracod was reported and named in 1746 by Carl von Linné as *Monoculus conchapedata*. This species was later renamed *Cypris pubera* O.F. Müller, 1776 (Mesquita-Joanes et al. 2020). For Slovenia, the first mention on living (extant) ostracods is, not surprisingly, from groundwaters, mostly due to high interest of European zoologists to explore Slovenian karst region, especially caves. In 1882, the German zoologist Gustav Joseph published an extensive report on 109 arthropod species found in so called »stalactite caves« from Krain (Joseph 1882). Among these, an ostracod *Cypris stygia* n. sp., described as stygobiotic species »similar to *Cypris ovum* but flatter« was listed. The locality for this species was indicated as the cave Podpeška jama (Podpeč, Videm-Dobrepolje). However, this species was later never described, with no drawings provided either. Similarly, ten-years later, in 1893, two ostracod species were reported from the larger dripping pool in the cave Črna jama in Postojna (Schmeil 1893). The species were named *Typhlocypris schmeili* and *Cypria pellucida* by G.W. Müller, as explained in Schmeil (1893), but later never described.

The first currently known record of still valid ostracod species from Slovenia dates to 1920, when the French zoologist Paul Paris reported on *Typhlocypris eremita* (Veydovský, 1882), again from the cave Podpeška jama near the village Videm-Dobrepolje (Paris 1920). Paris provided drawings of his findings, too. It is highly likely that the same species was collected also by Joseph forty years before, but as no evidence exists, it is only a presumption. Further research in ostracods in Slovenia in the following decades is described in details in Mori & Meisch (2012).

In 1996, the first preliminary species list of freshwater ostracods, containing 47 species, was published by Hugh Griffiths and Anton Brancelj, including mostly records from caves, springs and high mountain lakes (Griffiths & Brancelj 1996). In 2012, a first comprehensive checklist of freshwater ostracod species from Slovenia was presented in this journal, containing 61 extant freshwater ostracod species (Mori & Meisch 2012). Due to the first author's continuous field sampling and recording of ostracod distribution across a diversity of aquatic habitats in Slovenia and due to an updated taxonomical nomenclature published by Meisch et al. (2019), the updated checklist of extant freshwater ostracods was prepared.

Materials and metods

The presented species list of extant freshwater ostracods has been extracted from the Slovenian Ostracoda Database (ODS) established in 2022 (Mori in prep.), built by the first author of that publication and incorporated in the database of the Center for Cartography of Fauna and Flora (CKFF). The ODS includes the published data on ostracod species from Slovenian localities and the unpublished data from the Slovenian Ostracoda Species Collection (OSCS), stored at the National Institute of Biology, Ljubljana and managed by the first author.

The taxonomy and nomenclature have been updated according to the recent revision of extant non-marine Ostracoda by Meisch et al. (2019). Only valid species are included in the present updated checklist for Slovenia. During the history of Ostracoda research in Slovenia, many species were reported in different publications but never described (e.g., *nomina nuda*). Some of them were repeatedly cited in subsequent publications. To avoid future misquotations, all these names are separately listed and explanations added. A brief description on ecology of newly discovered species for Slovenia after 2012 (Mori & Meisch 2012) and their localities are also provided.

Results

List of species and nomenclatorial remarks

The updated checklist of extant freshwater ostracods of Slovenia contains 70 valid species (Tab. 1). The species-richest is the superfamily Cypridoidea, containing 36 species from the family Candonidae, 22 species from the family Cyprididae, and 3 and 2 species from the families Ilyocyprididae and Notodromadidae, respectively. Only 6 species belong to the superfamily Cytheroidea and one to the superfamily Darwinuloidea.

Table 1. List of extant freshwater ostracod species with at least one recorded report from Slovenia. Nomenclature follows Meisch et al. (2019). Syn. – synonym (including only synonyms reported from locations from Slovenia). *stygobiotic species (i.e., species inhabiting exclusively subterranean waters)

Tabela 1. Seznam recentnih vrst dvoklopnikov z vsaj enim zabeleženim podatkom iz Slovenije. Nomenklatura se naslanja na Meisch et al. (2019). Sin – sinonim (navedeni so sinonimi samo za vrste, ki so bile najdene v Sloveniji). *stigobiontske vrste (tj. vrste, ki naseljujejo izključno podzemne vode)

Taxonomic name/species	**References**
Class Ostracoda Latreille, 1802	
Subclass Podocopa Sars, 1866	
Order Podocopida Sars, 1866	
Suborder Cypridocopina Baird, 1845	
Superfamily Cypridoidea Baird, 1845	
Family Cyprididae Baird, 1845	
Genus *Bradleycypris* McKenzie, 1982	
Bradleycypris obliqua (Brady, 1868)	Griffiths & Brancelj 1996
Genus *Bradleystrandesia* Broodbakker, 1983	
Bradleystrandesia fuscata (Jurine, 1820)	Mori et al. 2021
Genus *Cavernocypris* Hartmann, 1964	
Cavernocypris subterranea (Wolf, 1920)	Brancelj et al. 1995
Genus *Cypridopsis* Brady, 1867	
Cypridopsis vidua (O.F. Müller, 1776)	Griffiths & Brancelj 1996
Genus *Dolerocypris* Kaufmann, 1900	
Dolerocypris fasciata (O.F. Müller, 1776)	Bioportal 2022a
Dolerocypris sinensis Sars, 1903	Petkovski 1960a
Genus *Eucypris* Vávra, 1891	
Eucypris pigra (Fischer, 1851)	Mori et al. 2011
Eucypris virens (Jurine, 1820)	Griffiths & Brancelj 1996
Genus *Heterocypris* Claus, 1893	
Heterocypris incongruens (Ramdohr, 1808)	Griffiths & Brancelj 1996
Heterocypris reptans (Kaufmann, 1900)	Petkovski 1964
Genus *Potamocypris* Brady, 1870	
Potamocypris fallax Fox, 1967	Griffiths & Brancelj 1996
Potamocypris fulva (Brady, 1868)	Mori et al. 2011
Potamocypris pallida Alm, 1914	Mori et al. 2011
Potamocypris similis G.W. Müller 1912	Griffiths & Brancelj 1996
Potamocypris smaragdina (Vávra, 1891)	Griffiths & Brancelj 1996
Potamocypris variegata (Brady & Norman, 1889)	Mori & Meisch 2012

Taxonomic name/species	**References**
Potamocypris villosa (Jurine, 1820)	Griffiths & Brancelj 1996
Potamocypris zschokkei (Kaufmann, 1900)	Brancelj et al. 1995
Genus *Psychrodromus* Danielopol & McKenzie, 1977	
Psychrodromus fontinalis (Wolf, 1920)	Griffiths & Brancelj 1996
Psychrodromus olivaceus (Brady & Norman, 1889)	Griffiths & Brancelj 1996
Genus *Scottia* Brady & Norman, 1889	
Scottia pseudobrowniana Kempf, 1971	Dole-Olivier et al. 2009
Genus *Tonnacypris* Diebel & Pietrzeniuk, 1975	
Tonnacypris lutaria (Koch, 1838)	Bioportal 2022c
Family *Candonidae* Kaufmann, 1900	
Genus *Candona* Baird, 1845	
Candona bimucronata Klie, 1937	Griffiths & Brancelj 1996
Candona candida (O.F. Müller, 1776)	Brancelj et al. 1995
Genus *Candonopsis* Vávra, 1891	
Candonopsis scourfieldi Brady, 1910	Mori & Meisch 2012
Genus *Cryptocandona* Kaufmann, 1900	
Cryptocandona reducta (Alm, 1914)	Bioportal 2022a
Cryptocandona vavrai Kaufmann, 1900	Mori et al. 2011
Genus *Cyclocypris* Brady & Norman, 1889	
Cyclocypris globosa (Sars, 1863)	Mori & Meisch 2012
Cyclocypris laevis (O.F. Müller, 1776)	Griffiths & Brancelj 1996
Cyclocypris ovum (Jurine, 1820)	Brancelj et al. 1995
Genus *Cypria* Zenker, 1854	
Cypria bicolor Petkovski and Meisch, 1994	Petkovski & Meisch 1994
**Cypria cavernae* Wagenleitner, 1990	Dole-Olivier et al. 2009
Cypria exsculpta (Fischer, 1855)	Griffiths & Brancelj 1996
Cypria lacustris Lilljeborg, 1890	Petkovski 1960b
Syn: *Cypria ophtalmica* f. *lacustris* (Lilljeborg, 1890)	
Cypria ophtalmica (Jurine, 1820)	Klie 1931
**Cypria reptans* Bronstein, 1928	Klie 1935
Syn.: *Cypria stygia* Klie, 1935	
**Cypria sketi* Petkovski, 1976	Mori & Meisch 2012
Genus *Fabaeformiscandona* Krstić, 1972	
**Fabaeformiscandona aemonae* (Klie, 1935)	Klie 1935

Taxonomic name/species	**References**
Syn.: *Pseudocandona aemonae* (Klie, 1935)	
**Fabaeformiscandona breuili* (Paris, 1920)	Mori & Brancelj 2011
Fabaeformiscandona brevicornis (Klie, 1925)	Mori & Meisch 2012
**Fabaeformiscandona brisiaca* (Klie, 1938)	Mori et al. 2011
Fabaeformiscandona fabaeformis (Fischer, 1851)	Mori et al. 2021
**Fabaeformiscandona latens* (Klie, 1940)	Mori et al. 2011
Genus *Mixtacandona* Klie, 1938	
**Mixtacandona chappuisi* (Klie, 1943)	Dole-Olivier et al. 2009
**Mixtacandona laisi* Klie, 1938	Dole-Olivier et al. 2009
Syn.: *Mixtacandona stammeri* (Klie, 1938)	
**Mixtacandona lattingerae* Rogulj & Danielopol, 1993	Dole-Olivier et al. 2009
Genus *Nannocandona* Ekman, 1914	
Nannocandona faba Eckman, 1914	Brancelj et al. 1995
Genus *Neglecandona* Krstić, 2006	
Neglecandona lindneri (Petkovski, 1969)	Petkovski 1969
Syn.: *Candona lindneri* Petkovski, 1969	
Neglecandona neglecta (Sars, 1887)	Brancelj et al. 1995
Syn.: *Candona neglecta* Sars, 1887	
Genus *Physocypria* Vávra, 1897	
Physocypria kraepelini G.W. Müller, 1903	Mori et al. 2021
Genus *Pseudocandona* Kaufmann, 1900	
Pseudocandona albicans (Brady, 1864)	Griffiths & Brancelj 1996
Pseudocandona hartwigi (G. W. Müller, 1900)	Bioportal 2022b
Pseudocandona lobipes (Hartwig, 1900)	Mori & Meisch 2012
Pseudocandona pratensis (Hartwig, 1901)	Mori & Meisch 2012
Pseudocandona rostrata (Brady & Norman, 1889)	Mori & Meisch 2012
Genus *Typhlocypris* Vejdovski, 1882	
**Typhlocypris cavicola* (Klie, 1935)	Klie 1935
Syn.: *Pseudocandona cavicola* (Klie, 1935)	
Syn.: *Pseudocandona pretneri* Danielopol, 1978	
**Typhlocypris eremita* (Vejdovský, 1882)	Dole-Olivier et al. 2009
Syn.: *Candona eremita* (Vejdovský, 1882)	
Syn.: *Pseudocandona eremita* (Vejdovský, 1882)	
**Typhlocypris trigonella* (Klie, 1931)	Klie 1935

Taxonomic name/species	References
Syn.: *Candona trigonella* Klie, 1931	
Syn.: *Pseudocandona trigonella* (Klie, 1931)	
Family Ilyocyprididae Kaufmann, 1900	
Genus *Ilyocypris* Brady & Norman, 1889	
Ilyocypris bradyi Sars, 1890	Petkovski 1958
Ilyocypris gibba (Ramdohr, 1808)	Petkovski 1958
Syn.: *Cypris biplicata* Koch, 1838	
Ilyocypris inermis Kaufmann, 1900	Griffiths & Brancelj 1996
Family Notodromadidae Kaufmann, 1900	
Genus *Notodromas* Lilljeborg, 1853	
Notodromas monacha (O. F. Müller, 1776)	Petkovski 1959
Notodromas persica Gurney, 1921	Klie 1938
Superfamily Cytheroidea Baird, 1850	
Family Cytherideidae Sars, 1925	
Genus *Cytherissa* Sars, 1925	
Cytherissa lacustris (Sars, 1863)	Griffiths & Brancelj 1996
Family Entocytheridae Hoff, 1942	
Genus *Sphaeromicola* Paris, 1916	
**Sphaeromicola stammeri* Klie, 1930	Sket 2000
Family Leptocytheridae Sars, 1925	
Genus *Leptocythere* Sars, 1925	
Leptocythere fluviatilis (Klie, 1939)	Klie 1939
Family Limnocytheridae Sars, 1925	
Genus *Limnocythere* Brady, 1868	
Limnocythere inopinata (Baird, 1843)	Griffiths & Brancelj 1996
Limnocythere sanctipatricii (Brady & Robertson, 1869)	Griffiths & Brancelj 1996
Genus *Metacypris* Brady & Robertson, 1870	
Metacypris cordata Brady & Robertson, 1870	Bioportal 2022a
Superfamily Darwinuloidea Brady & Robertson, 1885	
Family Darwinulidae Brady & Robertson, 1885	
Genus *Darwinula* Brady & Norman, 1889	
Darwinula stevensoni (Brady & Robertson, 1870)	Griffiths & Brancelj 1996

Eleven invalid species names, previously reported in the literature, were not included in the checklist:

- *Cypria pellucida* G.W. Müller
  Nomen nudum in Schmeil (1893): species collected from the dripping pool in the cave Črna jama and named by G.W. Müller, but later never described. Further citations: Brancelj (1996). Mori & Meisch (2012) erroneously mentioned this record as »*Cypris pellucida* by G.W. Müller«.
- *Cypria reptans* stygia Klie, 1935
  Unaccepted name in Petkovski (1976): Petkovski mentioned this species when referring to Klie's (1935) description of *Cypria stygia* Klie 1935, which is now a synonym of *Cypria reptans* Bronstein, 1928. Further citations: Sket & Brancelj (1992), Bole et al. (1993), Petkovski & Meisch (1994), Brancelj (1996), Griffiths & Brancelj (1996), Ur.l. RS (2002).
- *Cypris stygia* n. sp.
  Nomen nudum in Joseph (1882): see Introduction.
- *Ilyocypris biplicata* Koch, 1838
  Unaccepted name in Petkovski (1958): this is a synonym of *Ilyocypris gibba* (Ramdohr, 1808). Further citations: Griffiths & Brancelj (1996).
- *Notodromas persica persica* Gurney, 1921
  Unaccepted name in Petkovski (1959). Further citations: Brancelj (1996).
- *Notodromas persicae* Gurney, 1921
  Typing error in Griffiths & Brancelj (1996). Correct name is *Notodromas persica* Gurney, 1921.
- *Physocypria* cf. *kliei* Schäffer, 1934
  Unverified identification in Griffiths & Brancelj (1996). Synonym of *P. kraepelini*.
- *Pseudocandona* cf. *marchica* (Hartwig, 1899)
  Unverified identification in Griffiths & Brancelj (1996).
- *Pseudocandona* cf. *pseudoparallela* (Löffler, 1961)
  Unverified identification in Griffiths & Brancelj (1996). Synonym of *P. albicans*.
- *Typhlocypris pretneri* Danielopol, 1978
  Erroneous generic assignment in Mori & Meisch (2012). The correct name is *Pseudocandona pretneri* Danielopol, 1978, which is a synonym of *Typhlocypris cavicola* (Klie, 1935) according to the updated taxonomy (Meisch et al. 2019).
- *Typhlocypris schmeili* G.W. Müller
  Nomen nudum in Schmeil (1893): species collected from a dripping pool in the cave Črna jama and named by G.W. Müller, but later never scientifically described. Further citations: Brancelj (1996).

Taxonomic notes

Cypria lacustris Lilljeborg, 1890 and *Cypria ophtalmica* (Jurine, 1820)

Cypria lacustris was listed as a valid species very recently (Meisch et al. 2019). Previously considered an intraspecific form of *Cypria ophtalmica* because of the occurrence of animals with transitional characters, mainly seen in the number and structure of the female genital processes (Meisch 2000). Meisch examined a very large number of individuals belonging to both »forms« from various regions in Europe and concluded that there were no occurrences of »transitional« animals. Moreover, the ecology of the two species differs: *Cypria lacustris* colonizes springs,

waters connected to springs and the profundal zone of lakes, while *Cypria ophtalmica* occurs in ponds and the littoral zone of lakes (Meisch et al. 2019).

Neglecandona lindneri (Petkovski, 1969) and *Neglecandona neglecta* (Sars, 1887)

The genus *Neglecandona* Krstić, 2007, with *Neglecandona lindneri* (Petkovski, 1969) as the type species, was established to include the three species of the so-called neglecta-group of *Candona* Baird, 1845 recorded from Slovenia (Meisch et al. 2019).

Genera *Typhlocypris* Vejdovský, 1882 and *Pseudocandona* Kaufmann, 1900

The treatment of the genera *Typhlocypris* Vejdovský, 1882 and *Pseudocandona* Kaufmann, 1900 follows Namiotko et al. (2014) and Meisch et al. (2019).

Notes on species new for Slovenia

Bradleystrandesia fuscata (Jurine, 1820)

The species was collected by the first author in small water bodies fed by groundwater, in the forest, southeast from the Čukova jama pond near the Bobovek village, Kranj (46,2727 *lat*, 14,3623 *lon*), during field sampling on 30.VIII.2021 (Mori et al. 2021). The species is widespread, occurring in the Palearctic, Nearctic and Neotropical zoogeographical regions (Meisch et al. 2019) and usually occurs in seasonal pools located in the open field or in woodland where it produces large populations. It is rarely reported from permanent waters, such as fish ponds, littoral zones of lakes, and springs (Meisch 2000).

Cryptocandona reducta (Alm, 1914)

The species was collected during the Bioblitz event in 2017 at Draga pri Igu (Bioportal 2022a). It was collected by the first author from a littoral zone of the pond Rezani ribnik v Dragi (45,9364 *lat*, 14,5506 *lon*), from a muddy bottom, on 20.V.2017. The species is widespread in the Palearctic zoogeographical region (Meisch et al. 2019) and is usually found in springs, water connected to springs, and in the sublittoral and profundal zones of standing waters (Meisch 2000).

Dolerocypris fasciata (O. F. Müller, 1776)

The species was collected during Bioblitz in 2017 at Draga pri Igu (Bioportal 2022a). It was collected by the first author from two ponds overgrown by dense macrophyte vegetation: Rezani ribnik v Dragi (45,9364 *lat*, 14,5506 *lon*) and Srednji ribnik v Dragi (45,9379 *lat*, 14,5496 *lon*), on 20.V.2017. The species is widespread, occurring in the Palearctic, Nearctic and Oriental zoogeographical regions (Meisch et al. 2019). *Dolerocypris fasciata* is usually found in the littoral zone of lakes, (fish)ponds, swamps and similar water bodies where it is actively swimming within the subaquatic macrophyte and reed belts (Meisch 2000).

Fabaeformiscandona fabaeformis (Fischer, 1851)

The species was collected by the first author from the spring benthos connected to the Ledvica pond, near the village of Bobovek, Kranj (46,2759 *lat*, 14,3625 *lon*), during summer field sampling in 2021 (30.VIII.2021) (Mori et al. 2021). The species is common, occurring in the Palearctic and Oriental zoogeographical regions (Meisch et al. 2019). It can usually be found

in muddy and swampy temporary small water bodies, while in lakes it dwells in the very shallow zone that dries up in the summer. It is also reported from drainage ditches and (fish)ponds (Meisch 2000).

Metacypris cordata Brady & Robertson, 1870

The species was collected during Bioblitz in 2017 at Draga pri Igu (Bioportal 2022a). It was collected by the first author from the pond Rezani ribnik v Dragi (45,9364 *lat*, 14,5506 *lon*), which is densely overgrown by macrophyte vegetation, on 20.V.2017. The species is widespread in the Palearctic zoogeographical region (Meisch et al. 2019) and usually occurs in littoral vegetation in mesotrophic to eutrophic waters, from ditches, slow streams to ponds and lakes (Meisch 2000).

Physocypria kraepelini G. W. Müller, 1903

The species was collected by the first author in two ponds, Krokodilnica (46,2727 *lat*, 14,3623 *lon*) and Ledvička (46,2727 *lat*, 14,3623 *lon)*, near the village of Bobovek, Kranj, during the field sampling on 30.VIII.2021 (Mori et al. 2021). The species is widespread, occurring in the Palearctic, Nearctic and Oriental zoogeographical regions (Meisch et al. 2019). It is usually found in (fish)ponds, the littoral zone of lakes, stream, canals and ditches (Meisch 2000).

Pseudocandona hartwigi (G. W. Müller, 1900)

The species was collected by the first author during Bioblitz in 2018 in the Rački Ribniki-Požeg Landscape Park (Rače, Maribor) (Bioportal 2022b) from a temporary pool on the southern side of the Srednji Turnski ribnik pond (46,4346 *lat*, 15,6736 *lon*), on 16.VI.2018. The species is globally present in the Palearctic zoogeographical region (Meisch et al. 2019) and known from muddy small water bodies and the shallow zone of lakes (Meisch 2000).

Pseudocandona rostrata (Brady & Norman, 1889)

The species was collected in the Bohinj Lake littoral by A. Brancelj on 22.VI.2005 (46,2786 *lat*, 13,8863 *lon*). The species was erroneously quoted as »*Pseudocandoma rostrata*« in Mori & Meisch (2012) under New records for Slovenia and erroneously not listed in the 2012 species list. The species is globally present in the Palearctic and Nearctic zoogeographical regions (Meisch et al. 2019) and known from permanent and temporary small water bodies and lakes, springs, streams and interstitial groundwater (Meisch 2000).

Sphaeromicola stammeri Klie, 1930

The species is reported from the cave Križna jama (46,2794 *lat*, 13,8868 *lon*) by Sket (2000) and later by Sket and Stoch (2014), and was not included in the previous checklists which reported only on free-living species. The species is recorded for the Palearctic zoogeographical region and lives as commensal (ectoparasite) on hypogean crustaceans (Meisch et al. 2019).

Tonnacypris lutaria (Koch, 1838)

The species was collected by the first author during Bioblitz 2021 in the karst intermittent Pivka River, under the bridge, west of the village Slovenska vas (45,7005 *lat*, 14,2078 *lon*), on 23.VI.2021 (Bioportal 2022c). The species is widespread, occurring in the Palearctic and Neotropical zoogeographical regions (Meisch et al. 2019) and usually inhabiting grassy seasonal

pools and ditches, mainly in the open field, which dry up in late spring or early summer. It is sometimes found also in springs and water connected with springs (Meisch 2000).

Discussion

The total number of currently known extant freshwater ostracod species for Slovenia is 70. The species belong to families Candonidae, Cyprididae, Ilyocyprididae and Notodromadidae (superfamily Cypridoidea); families Cytheridae, Entocytheridae, Leptocytheridae, Limnocytheridae (superfamily Cytheroidea); and family Darwinulidae (superfamily Darwinuloidea). The species distribution among three main lineages (i.e., Cypridoidea, Cytheroidea, Darwinuloidea) is in accordance with global diversity patterns, where Cypridoidea is the largest group, comprising 4 families, followed by Cytheroidea, which are mostly marine, but have several non-marine incursions of which the Limnocytheridae are the commonest. The Darwinuloidea, with one extant family, are fully non-marine and containing only about 38 species (Martens et al. 2008; Meisch et al. 2019). However, the species distribution between families differs substantially from the global pattern, where the most diverse family in non-marine habitats is the Cyprididae, comprising 43.2% of all species, followed by the Candonidae (29.0%), Entocytheridae (9.1%) and Limnocytheridae (7.0%) (Meisch et al. 2019). The main reason is unbalanced ostracod sampling and research in Slovenia, focusing mostly on groundwater habitats, where highest species diversity belongs to Candonidae, while surface waters, where Cyprididae prevails, were sampled with much less effort.

In comparison to other European countries, the current number of extant freshwater ostracod species in Slovenia is similar to Belgium (71 species) and the Czech Republic (70 species). The highest number of extant freshwater ostracod species is according to Pieri et al. (2015) known for Italy (152 species), Germany (126 species) and France (113 species), which is, most likely, connected with the size of the study areas, diversity of habitats and with the intensity of ostracod sampling and research. Due to the transitional nature of Slovenia by means of climate, hydrogeology and vegetation and due to turbulent geological history as well as connectivity with the Dinaric region and highly developed karstic region, the number of species currently known for Slovenia is most likely underestimated.

Povzetek

Dvoklopniki so ena izmed najstarejših skupin rakov, ki naseljujejo morje, celinske vode in semiterestrične habitate. Trenutno je opisanih približno 8000 recentnih vrst, kar je približno 12 % vseh opisanih vrst rakov na svetu. Nemorske, prostoživeče in komenzalne vrste iz redu Podocopida sestavljajo več kot 25 % vseh znanih obstoječih vrst dvoklopnikov. Prvi zaenkrat znani zapis veljavne vrste dvoklopnika iz Slovenije je iz leta 1920, ko je francoski zoolog Paul Paris poročal o vrsti *Typhlocypris eremita* (Veydovský, 1882) iz Podpeške jame pri vasi Podpeč (Videm-Dobrepolje). V prispevku predstavljamo posodobljen seznam dvoklopnikov iz Slovenije. Zadnji objavljeni seznam iz leta 2012 poroča o 61 prostoživečih vrstah

dvoklopnikov. Posodobljeni seznam, predstavljen v tej publikaciji, vsebuje 70 veljavnih vrst. Vrstno najbolj bogata je naddružina Cypridoidea, ki vsebuje 36 vrst iz družine Candonidae, 22 vrst iz družine Cyprididae ter 3 oziroma 2 vrsti iz družine Ilyocyprididae in Notodromadidae. Samo 6 vrst pripada naddružini Cytheroidea in ena naddružini Darwinuloidea.

V primerjavi z drugimi evropskimi državami je trenutno število znanih vrst dvoklopnikov v Sloveniji podobno kot v Belgiji (71 vrst) in na Češkem (70 vrst). Največja vrstna pestrost je trenutno zabeležena za Italijo (152 vrst), Nemčijo (126 vrst) in Francijo (113 vrst), kar je najverjetneje povezano z velikostjo preučevanih območij, pestrostjo habitatov in z intenzivnost vzorčenja in raziskovanja. Zaradi podnebno, hidrogeološko in vegetacijsko prehodne narave Slovenije, zaradi burne geološke zgodovine ter povezanosti z dinarskimi predeli in dobro razvitim krasom predvidevamo, da je trenutno število vrst dvoklopnikov podcenjeno. Za dopolnitev seznama vrst so potrebna nadaljnja terenska vzorčenja, s poudarkom na vzhodnem in jugovzhodnem delu Slovenije ter na vzorčenju površinskih voda. Poleg tega je treba za pridobitev vseh obstoječih podatkov opraviti še bolj poglobljeno raziskavo literature in starih muzejskih zbirk po Evropi, pa tudi opisati številne stigobiontske vrste, nove za znanost, najdene v zadnjih 20 letih. Nenazadnje je nujna posodobitev nacionalnega rdečega seznama dvoklopnikov.

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