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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 methods

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).

*stigobionske 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 <i>Bradleycypris</i> McKenzie, 1982	
<i>Bradleycypris obliqua</i> (Brady, 1868)	Griffiths & Brancelj 1996
Genus <i>Bradleystrandesia</i> Broodbakker, 1983	
<i>Bradleystrandesia fuscata</i> (Jurine, 1820)	Mori et al. 2021
Genus <i>Cavernocypris</i> Hartmann, 1964	
<i>Cavernocypris subterranea</i> (Wolf, 1920)	Brancelj et al. 1995
Genus <i>Cypridopsis</i> Brady, 1867	
<i>Cypridopsis vidua</i> (O.F. Müller, 1776)	Griffiths & Brancelj 1996
Genus <i>Dolerocypris</i> Kaufmann, 1900	
<i>Dolerocypris fasciata</i> (O.F. Müller, 1776)	Bioportal 2022a
<i>Dolerocypris sinensis</i> Sars, 1903	Petkovski 1960a
Genus <i>Eucypris</i> Vávra, 1891	
<i>Eucypris pigra</i> (Fischer, 1851)	Mori et al. 2011
<i>Eucypris virens</i> (Jurine, 1820)	Griffiths & Brancelj 1996
Genus <i>Heterocypris</i> Claus, 1893	
<i>Heterocypris incongruens</i> (Ramdohr, 1808)	Griffiths & Brancelj 1996
<i>Heterocypris reptans</i> (Kaufmann, 1900)	Petkovski 1964
Genus <i>Potamocypris</i> Brady, 1870	
<i>Potamocypris fallax</i> Fox, 1967	Griffiths & Brancelj 1996
<i>Potamocypris fulva</i> (Brady, 1868)	Mori et al. 2011
<i>Potamocypris pallida</i> Alm, 1914	Mori et al. 2011
<i>Potamocypris similis</i> G.W. Müller 1912	Griffiths & Brancelj 1996
<i>Potamocypris smaragdina</i> (Vávra, 1891)	Griffiths & Brancelj 1996
<i>Potamocypris variegata</i> (Brady & Norman, 1889)	Mori & Meisch 2012

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

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

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

Physocypris 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 Podocypida 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 intenzivnostjo 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 stigobionske vrste, nove za znanost, najdene v zadnjih 20 letih. Nenazadnje je nujna posodobitev nacionalnega rdečega seznama dvoklopnikov.

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Favna kačjih pastirjev (Odonata) okolice Hotunj pri Ponikvi (vzhodna Slovenija)

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Izvleček. Za raziskovano območje podajam seznam 35 vrst kačjih pastirjev, opazovanih med majem in septembrom 2022, s pripadajočimi favnističnimi podatki. Na nacionalni rdeči seznam je uvrščenih šest vrst, medtem ko sta koščični škratec *Coenagrion ornatum* in veliki studenčar *Cordulegaster heros* zavarovana in uvrščena na dodatke Direktive o habitatih EU. Tudi najdbe prodnega paškratca *Erythromma lindenii*, deviškega pastirja *Aeshna isoteles* in črnega ploščca *Libellula fulva* so zanimive iz favnističnega vidika in jih predstavljam v širšem kontekstu njihove razširjenosti v Sloveniji. Na izbranih popisnih transektih vzdolž melioracijskih jarkov na ožjem raziskovanem območju severno od Hotunj sem zabeležil 32 vrst. Prikazana je dinamika števila vrst po posameznih popisih med sezono in pripadajoča dinamika naraščanja kumulativnega števila zabeleženih vrst. Za razmeroma majhno območje v okolici Hotunj je doslej skupno znanih 37 vrst kačjih pastirjev. Na širšem območju med Ponikvo in Dramljami so potrebne dodatne favnistične raziskave, saj je poznavanje biodiverzitete in naravovarstvenega pomena območja še zelo pomanjkljivo.

Ključne besede: Zygoptera, Anisoptera, razširjenost, ogroženost, melioracijski jarki, sezonska dinamika

Abstract. Dragonfly fauna (Odonata) of the surroundings of Hotunje near Ponikva (Eastern Slovenia) – A list of 35 species for the study area, observed between May and September 2022, is provided with complete faunistic data. Altogether, six species are listed on the national Red List, while the Ornate Bluet *Coenagrion ornatum* and the Balkan Goldenring *Cordulegaster heros* are protected and listed in the Annexes of the EU's Habitat Directive. The records of the Blue-eye *Erythromma lindenii*, Green-eyed Hawker *Aeshna isoteles* and Blue Chaser *Libellula fulva* are also interesting from a faunistic point of view and are presented in the broader context of their distribution in Slovenia. At selected census transects along melioration ditches in the narrower study area north of Hotunje, 32 species were recorded. The dynamics of the number of recorded species during the season and the corresponding dynamics of the increase in cumulative number of recorded species are shown. A total of 37 odonate species are known so far for the relatively small area around Hotunje. Further faunistic research is needed for the wider area between Ponikva and Dramlje, as it remains poorly studied in terms of biodiversity and nature conservation importance.

Key words: Zygoptera, Anisoptera, distribution, threat status, melioration ditches, seasonal dynamics

Uvod

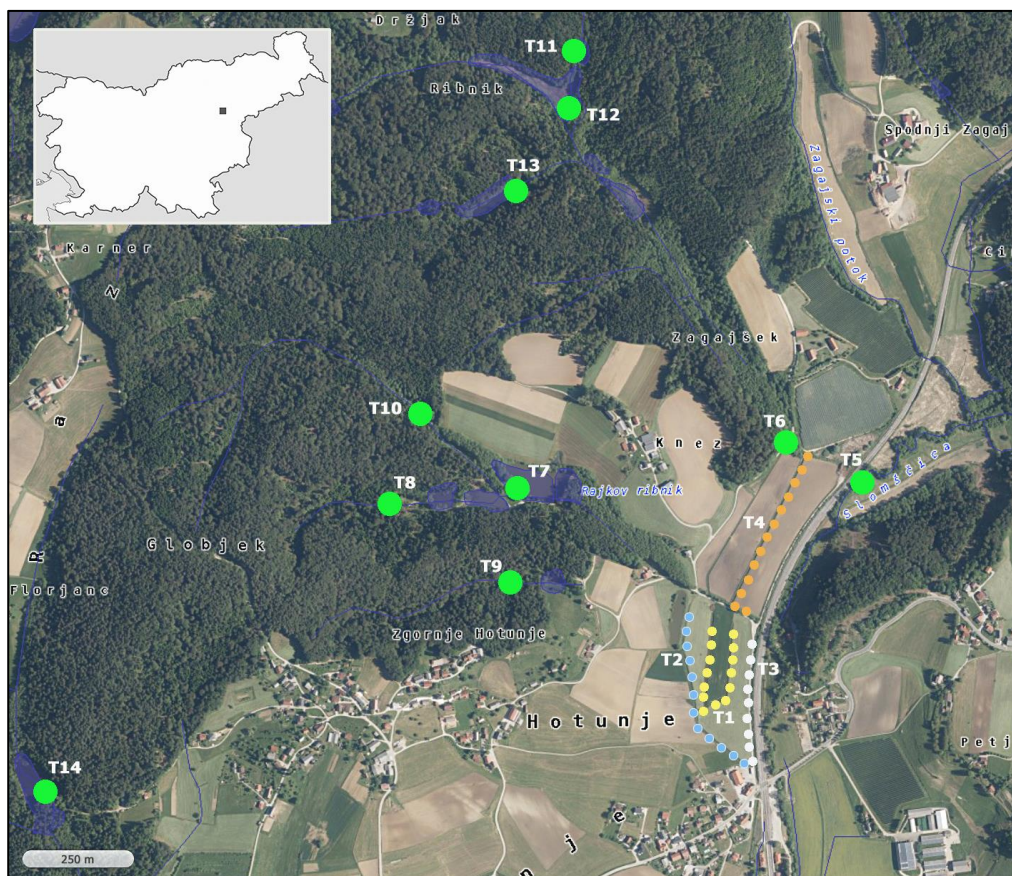
Kačji pastirji sodijo danes med bolj raziskane skupine žuželk v Sloveniji. Pri nas je bilo doslej zabeleženih 73 vrst, odonatološki podatki pa so znani s kar prek 8600 lokalitet (Vinko et al. 2022a). Seveda pa kljub temu v favnističnem oziru ostaja še veliko slabše raziskanih območij, med katera sodi tudi širša okolica Hotunj pri Ponikvi v osrednjem delu Voglajnskega gričevja, vzhodno od Celjske kotline.

Z ožjega območja raziskave doslej ni bilo konkretnih objavljenih podatkov o pojavljanju kačjih pastirjev. Iz zemljevidov razširjenosti v Atlasu kačjih pastirjev (Odonata) Slovenije lahko za širšo okolico Hotunj razberemo pojavljanje dobrega ducata vrst (Kotarac 1997). Za širšo okolico Dramelj podaja Sameja (1999) seznam 30 vrst, zabeleženih na mladinskem raziskovalnem taboru, vendar brez lokalitet in favnističnih podatkov. Za porečje Voglajne, južno od raziskovanega območja, navajata Šalamun & Kotarac (2014) 28 vrst kačjih pastirjev. O najdbi povodnega škratca *Coenagrion scitulum* pri Razborju severozahodno od Hotunj so poročali Bedjanič et al. (2017). V podatkovni zbirki Centra za kartografijo favne in flore in Slovenskega odonatološkega društva je bilo do konca leta 2021 za ožjo okolico Hotunj znano pojavljanje 17 vrst kačjih pastirjev, večina izmed maloštevilnih priložnostno zbranih neobjavljenih podatkov pa izvira iz leta 1994 (CKFF 2022).

Leta 2022 sem v okviru naloge »Strokovna podlaga preveritve habitata morebitnih živalskih vrst (dvoživke in kačji pastirji) na območju OPPN poslovne cone Hotunje na Ponikvi«, ki jo je naročila Občina Šentjur (Bedjanič et al. 2022), raziskoval vrstno pestrost kačjih pastirjev ožjega območja z melioracijskimi jarki severno od vasi Hotunje. Seznam zabeleženih vrst na raziskanem območju in zadevne favnistične podatke podajam s kratkim komentarjem v nadaljevanju prispevka.

Materiali in metode

Hotunje pri Ponikvi ležijo na zahodnem obrobju Panonskega sveta, v osrednjem Voglajnskem gričevju, vzhodno od celjske kotline. Celotno raziskovano območje, ki meri približno 2,3 km², leži jugovzhodno od avtoceste Celje–Maribor, v široki gričevnati dolini med Razborjem in Ponikvo, zahodno od železniške proge Poljčane–Celje. Večji del območja je gozdnat, na manjših potokih najdemo številne ribnike (Sl. 1).



Slika 1. Zemljevid območja inventarizacije kačjih pastirjev v okolici vasi Hotunje pri Ponikvi, vzhodna Slovenija (Kartografska osnova: Javni pregledovalnik grafičnih podatkov MKGP, <https://rkg.gov.si/GERK/WebViewer>).

Figure 1. Map of the study area in the surroundings of the village of Hotunje west of Ponikva, eastern Slovenia (Base map: Javni pregledovalnik grafičnih podatkov MKGP, <https://rkg.gov.si/GERK/WebViewer>).

Ožje raziskovano območje, ki sem mu namenil več pozornosti in kjer sem vzdolž melioracijskih jarkov popisoval kačje pastirje po vnaprej definiranih transektih prek celotne sezone, leži severno od vasi Hotunje oz. severno od ceste Trnovec pri Dramljah–Ponikva ter zahodno od železniške proge Poljčane–Celje, meri pa približno 10 hektarjev (Sl. 1, Tab. 1: transekti T1–T4, sl. 2a–d). Na tem območju v dnu doline prevladujejo njive, mokrotna, dokaj intenzivno obdelovana travišča ter melioracijski jarki. Z izvedbo hidromelioracij in izkopom dveh širokih jarkov sredi območja (Sl. 1: transekt T1; Sl. 2a) je bil hidrološki režim v preteklosti močno spremenjen. Visoka podtalnica ter dotok vode iz severozahodnega gozdnega območja zagotavljata sicer dokaj stalen pretok in višino vodnega stolpca v melioracijskih kanalih prek celega leta. Domnevno visoka vsebnost hranil, ki se stekajo v površinske vode z okoliških kmetijskih površin, povzroča eutrofikacijo, razmere v večjih melioracijskih kanalih še dodatno poslabšuje tudi neavtohtona ribja populacija, intenzivna košnja obrežne vegetacije pa onemogoča njeno pufersko vlogo. Redna košnja in gnojenje sta razloga za precejšnje

monotonost travniških površin, ki le tu in tam še ohranjajo značaj ekstenzivnih mokrotnih travnikov. Ne glede na to je območje melioracijskih jarkov v kmetijsko intenzivno obdelovani okolici Hotunja in Ponikve zanimivo mokriščno življenjsko okolje.



Slika 2. Ožje območje inventarizacije kačjih pastirjev z melioracijskimi jarki severno od vasi Hotunje pri Ponikvi: (a) popisni transekt T1 (18. 7. 2022), (b) popisni transekt T2 (24. 5. 2022), (c) popisni transekt T3 (12. 5. 2022), (d) popisni transekt T4 (24. 5. 2022) (foto: M. Bedjanič).

Figure 2. Inner study area with melioration ditches north of Hotunje: (a) census transect T1 (18. 7. 2022), (b) census transect T2 (24. 5. 2022), (c) census transect T3 (12. 5. 2022), (d) census transect T4 (24. 5. 2022) (photo: M. Bedjanič).

Z namenom inventarizacije favne kačjih pastirjev v okolici Hotunj sem na raziskovanem območju med majem in septembrom 2022 opravil šest terenskih popisov, in sicer 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022 in 6. 9. 2022. Kačje pastirje sem popisal na štirih transektih (T1–T4) in desetih točkah (T5–T14) v širši okolici Hotunj (Sl. 1, Tab. 1). Raziskovalni vložek je bil na popisnih transektih T1–T4 v ožjem raziskovanem območju približno enakomerno razporejen, popisi so potekali od maja do septembra. Z namenom pridobitve pregleda nad življenjskimi okolji in odonatno favno širše okolice osrednjega območja raziskav sem na popisnih točkah T5–T14 kačje pastirje popisal le enkrat, in sicer sem vzorčil tako ličinke kot odrasle kačje pastirje.

Tabela 1. Seznam lokalitet v okolici Hotunj, na katerih so bili kačji pastirji vzorčeni v okviru naloge 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022 in 6. 9. 2022. Geografska lega lokalitet je prikazana na Sl. 1.

Table 1. List of localities in the surroundings of Hotunje, where dragonflies were sampled on 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022 and 6. 9. 2022. Geographic position of localities is depicted in Fig. 1.

Zap. št. lokalitete	Opis lokalitete, koordinate in datumi vzorčenja
T1 - transekt 1:	Ponikva, Spodnje Hotunje, široki melioracijski kanali na travniku 200 m SSV od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533462, 123126; datum: 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022, 6. 9. 2022
T2 - transekt 2:	Ponikva, Spodnje Hotunje, melioracijski kanal 200 m SV od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533408, 123071; datum: 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022, 6. 9. 2022
T3 - transekt 3:	Ponikva, Spodnje Hotunje, kanal ob železnici 150 m S od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533538, 123257; datum: 12. 5. 2022, 24. 5. 2022, 18. 7. 2022; 17. 8. 2022, 6. 9. 2022
T4 - transekt 4:	Ponikva, Spodnje Hotunje, melioracijski kanal 650 m S od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533603, 123589; datum: 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022, 6. 9. 2022
T5 - točka 5:	Ponikva, Spodnji Zagaj, potok Slomščica 700 m SSV od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533752, 123596; datum: 18. 7. 2022
T6 - točka 6:	Ponikva, Spodnje Hotunje, potok pri cestnem mostu 770 m S od železniškega prehoda Hotunje–Ponikva; koordinate GK: 533607, 123696; datum: 24. 5. 2022
T7 - točka 7:	Ponikva, Zagaj pri Ponikvi, Knez, Mastenovi ribniki - Rajkov ribnik; koordinate GK: 532986, 123586; datum: 12. 5. 2022
T8 - točka 8:	Ponikva, Zagaj pri Ponikvi, Knez, potok nad Mastenovimi ribniki - Rajkovim ribnikom, 100 m Z od zgornjega ribnika; Koordinate GK: 532724, 123567; datum: 12. 5. 2022
T9 - točka 9:	Ponikva, Zagaj pri Ponikvi, Knez, potok nad majhnim ribnikom v dolini 200 m J od Mastenovih ribnikov - Rajkovega ribnika; koordinate GK: 533005, 123384; datum: 12. 5. 2022
T10 - točka 10:	Ponikva, Zagaj pri Ponikvi, Knez, potok nad Mastenovimi ribniki - Rajkovim ribnikom, 180 m SSZ od zgornjega ribnika; koordinate GK: 532783, 123748; datum: 24. 5. 2022
T11 - točka 11:	Ponikva, Spodnji Zagaj, manjši ribnik 880 m SSZ od Kneza; koordinate GK: 533152, 124562; datum: 24. 5. 2022
T12 - točka 12:	Ponikva, Spodnji Zagaj, večji prazen ribnik 780 m SSZ od Kneza; koordinate GK: 533099, 124473; datum: 24. 5. 2022

Za terensko delo sem izbral tople sončne dneve, ki so bili za popis favne kačjih pastirjev optimalni. Poleg opazovanja odraslih osebkov z daljnogledom in lova težje določljivih vrst z metuljnico sem uporabil tudi metodo vzorčenja ličink z vodno mrežo, po obrežni vegetaciji sem pobiral leve, odrasle žuželke pa sem tudi fotografiral. Določanje odraslih kačjih pastirjev in njihovih ličink je potekalo skoraj izključno na terenu, z uporabo določevalnih ključev (npr. Heidemann & Seidenbusch 1993, Brochard & van der Ploeg 2014, Dijkstra et al. 2020). Podatke o posameznih opazovanih vrstah in številu odraslih osebkov, levov in ličink sem zapisoval v terensko beležnico ter jih nato vnesel v podatkovno zbirko.

Raziskave kačjih pastirjev so potekale na podlagi dovoljenja za lov in raziskovanje vseh vrst kačjih pastirjev za potrebe znanstveno raziskovalne in izobraževalne dejavnosti, ki ga je pod številko 35601-14/2011-08 dne 22. 3. 2011 izdalo Ministrstvo za okolje, prostor in energijo.

Rezultati in razprava

Seznam zabeleženih vrst s favnističnimi podatki

V obdobju od sredine maja do sredine septembra 2022 sem v širši okolici Hotunj na 4 popisnih transektih in 10 popisnih točkah (Tab. 1: T1-14) zabeležil skupno 35 vrst kačjih pastirjev (Tab. 2). Na manjšem, vendar intenzivneje popisovanem območju melioracijskih jarkov severno od Hotunj (Tab. 1: transekti T1–T4) sem zabeležil 32 vrst kačjih pastirjev (Tab. 2).

Število zabeleženih vrst po posameznih popisnih transektih (Tab. 1: transekti T1–T4) je bilo naslednje: T1 – 26 vrst, T2 – 23 vrst, T3 – 11 vrst in T4 – 20 vrst (Tab. 2). Na posameznih popisnih točkah v širši okolici Hotunj, ki so bile v nasprotju s transekti obiskane le enkrat (Tab. 1: točke T5–T14), sem zabeležil naslednje število vrst: T5 – 3 vrste, T6 – 5 vrst, T7 – 3 vrste, T8 – 1 vrsto, T9 – 1 vrsto, T10 – 1 vrsto, T11 – 5 vrst, T12 – 3 vrste, T13 – 3 vrste in T14 – 8 vrst (Tab. 2).

Tabela 2. Seznam 35 vrst kačjih pastirjev, ki so bile zabeležene med majem in septembrom 2022 v okolici Hotunj pri Ponikvi po posameznih popisnih transektih (T1–T4) oz. točkah (T5–T14), kot so označeni na zemljevidu raziskovanega območja (Sl. 1).

V stolpcu »Strokovno in slovensko ime« so v vrsticah po družinah razvrščene zabeležene vrste kačjih pastirjev, pri čemer so vrstice z ogroženimi vrstami označene s temnejšo barvo ozadja. Pri slednjih je predstavljen status ogroženosti (NV status) posamezne vrste po uradnem Rdečem seznamu (RS: V – ranljiva vrsta; Ur. l. RS 2002), dodana je tudi uvrstitev na Uredbo o zavarovanih prosto živečih živalskih vrstah (UR: Prilogi 1A in 2A; Ur. l. RS 2004) ter na priloge Direktive o habitatih EU (FFH: II – Priloga 2, IV – Priloga 4; Ur. l. EU 1992).

V stolpcu »Favnistični podatki« so po posameznih popisnih transektih oz. točkah (T1–T14) ter datumih navedeni konkretni favnistični podatki (okrajšave: lar. – ličinka; ex. – lev; ten. – sveže preobražen osebek; juv. – mlad osebek; tand. – tandem; cop. – parjenje; ovip. – odlaganje jajc). Nomenklatura je povzeta po Dijkstra et al. (2020), slovenska imena pa po Geister (1999).

Table 2. List of 35 dragonfly species recorded between May and September 2022 in the surroundings of Hotunj by individual census transects (T1–T4) or points (T5–T14), as marked on the map of the surveyed area (Fig. 1). In the column »Strokovno in slovensko ime«, the recorded species of dragonflies in the rows are sorted by families. The rows with threatened species are marked with a darker background colour. Threat status (NV status) of each species according to the official national Red List is presented (RS: V – vulnerable species; Ur. l. RS 2002), with added inclusion to the Decree on Protected Wild Animal Species (UR: Annex 1A and 2A; Ur. l. RS 2004) and on the Annexes of the EU's Habitats Directive (FFH: II – Annex 2, IV – Annex 4; Ur. l. EU 1992). In the »Favnistični podatki« column, complete faunistic data are listed according to individual census transects or points (T1–T14) and dates (Abbreviations: lar. – larva; ex. – exuvium; ten. – freshly metamorphosed individual; juv. – juvenile individual; tand. – tandem; cop. – copula; ovip. – egg laying). The nomenclature follows Dijkstra et al. (2020), while Slovenian names are taken from Geister (1999).

Strokovno in slovensko ime	Favnistični podatki
podred ZYGOPTERA - ENAKOKRILI KAČJI PASTIRJI	
družina LESTIDAE - ZVERCE	
1. <i>Chalcolestes viridis</i> (Vander Linden, 1825) ZELENA PAZVERCA	T1: 1♂ 6. 9. 2022; T2: 1♂ 17. 8. 2022
2. <i>Sympecma fusca</i> (Vander Linden, 1820) PRISOJNI ZIMNIK	T1: 10♂, 2♀, 20 tand. 12. 5. 2022; 1♂, 1 tand. 24. 5. 2022; T2: 1♀ 24. 5. 2022
družina CALOPTERYGIDAE - BLEŠČAVCI	
3. <i>Calopteryx splendens</i> (Harris, 1780) PASASTI BLEŠČAVEC	T2: 1♂ 24. 5. 2022; 1♂, 1♀ 22. 6. 2022; 3♂, 2♀ 18. 7. 2022; T3: 1♀ 24. 5. 2022; 5♂, 2♀ 18. 7. 2022; T4: 5♂, 3♀ 22. 6. 2022; 15♂, 5♀ 18. 7. 2022
4. <i>Calopteryx virgo</i> (Linnaeus, 1758) MODRI BLEŠČAVEC	T2: 10♂, 2♀ 24. 5. 2022; 2♂, 1♀ 22. 6. 2022; 2♂, 1♀ 17. 8. 2022; T3: 5 lar. 12. 5. 2022; 5♂ 24. 5. 2022; 5♂ 18. 7. 2022; T5: 3♂, 3♀ 18. 7. 2022; T6: 5♂, 3♀ 24. 5. 2022; T12: 3♂, 1♀ 24. 5. 2022
družina PLATYCNE MIDIDAE - PRESLIČARJI	
5. <i>Platycnemis pennipes</i> (Pallas, 1771) SINJI PRESLIČAR	T1: 20 ten., 5 juv. ♂, 5 juv. ♀ 12. 5. 2022; 10♂, 5 tand. 22. 6. 2022; 20♂, 5 ovip. 18. 7. 2022; 20♂, 5 ovip. 17. 8. 2022; 1♂ 6. 9. 2022; T2: 5♂, 1 cop. 22. 6. 2022; 5♂, 5 ovip. 18. 7. 2022; 10♂, 5 ovip. 17. 8. 2022; T3: 5 ten. 12. 5. 2022; 2♂, 1 tand. 18. 7. 2022; T4: 20♂, 10 cop. 24. 5. 2022; 10♂, 5 ovip. 22. 6. 2022; 10♂, 5 tand. 18. 7. 2022; 3♂, 2♀ 17. 8. 2022; T7: 10 ten. 12. 5. 2022; T12: 1♂, 1 cop. 24. 5. 2022; T13: 2 tand. 24. 5. 2022; T14: 3 juv. ♂, 2 juv. ♀ 24. 5. 2022
družina COENAGRIONIDAE - ŠKRATCI	
6. <i>Coenagrion ornatum</i> (Selys, 1850) KOŠČIČNI ŠKRATEC NV status: RS: V; UR: Pril. 2A; FFH: Pril. II	T2: 3♂ 12. 5. 2022; 5♂ 24. 5. 2022; 5♂ 22. 6. 2022; T4: 30 ten., 5 juv. ♂, 5 juv. ♀, 10♂ 24. 5. 2022; 10♂, 5 tand., 5 ovip 22. 6. 2022

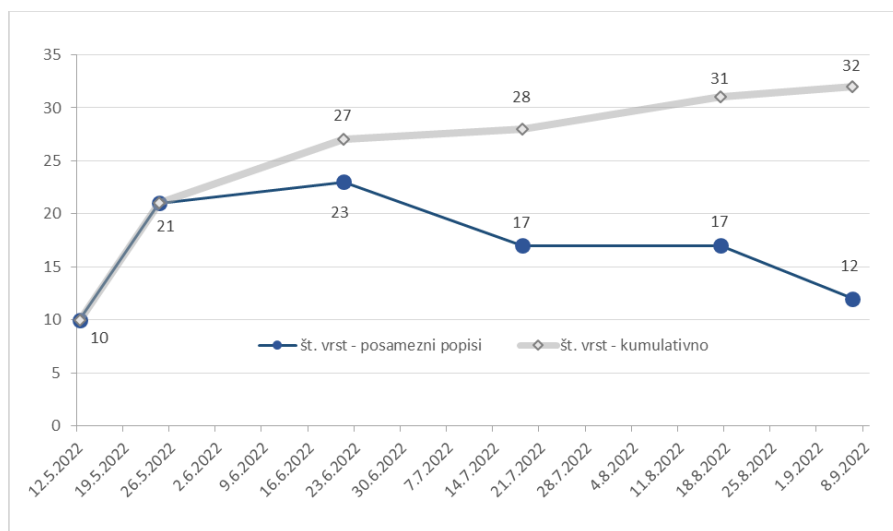
Strokovno in slovensko ime	Favnistični podatki
7. <i>Coenagrion puella</i> (Linnaeus, 1758) TRAVNIŠKI ŠKRATEC	T1: 5 ten., 10♂ 12. 5. 2022; 30♂, 15 cop., 15 ovip. 24. 5. 2022; 5♂, 5 cop. 22. 6. 2022; 20♂, 2 cop. 18. 7. 2022; T2: 5♂ 12. 5. 2022; 10♂, 5 cop. 24. 5. 2022; 5♂, 1 cop. 22. 6. 2022; 10♂ 18. 7. 2022; T3: 3♂ 12. 5. 2022; 5♂ 24. 5. 2022; 3♂ 18. 7. 2022; T4: 5♂ 12. 5. 2022; 10♂ 24. 5. 2022; 10♂ 22. 6. 2022; 5♂ 18. 7. 2022; T11: 5♂, 5 tand. 24. 5. 2022; T14: 5♂, 5 ovip. 24. 5. 2022
8. <i>Enallagma cyathigerum</i> (Charpentier, 1840) BLEŠČEČI ZMOTEC	T1: 1♂ 12. 5. 2022; 2 tand. 24. 5. 2022; 1♂ 18. 7. 2022;
9. <i>Erythromma lindenii</i> (Sélys, 1840) PRODNI PAŠKRATEC NV status: RS: V	T1: 6♂, 1 ovip. 24. 5. 2022; 100♂, 5 ovip. 22. 6. 2022; 30♂ 18. 7. 2022; 10♂, 2 tand. 17. 8. 2022; 10♂, 1 ovip. 6. 9. 2022; T2: 2♂ 24. 5. 2022; 5♂ 22. 6. 2022; 5♂ 18. 7. 2022; 5♂ 17. 8. 2022; 3♂ 6. 9. 2022; T4: 10♂ 22. 6. 2022
10. <i>Erythromma najas</i> (Hanseman, 1823) VELIKI RDEČEOKEC	T1: 2♂ 24. 5. 2022; 1♂ 22. 6. 2022; T14: 5♂, 5 cop. 24. 5. 2022
11. <i>Erythromma viridulum</i> (Charpentier, 1840) MALI RDEČEOKEC	T1: 10♂ 22. 6. 2022; 50♂, 5♀, 5 cop. 18. 7. 2022; 2♂ 17. 8. 2022; 5♂ 6. 9. 2022; T2: 5♂ 22. 6. 2022; 10♂ 18. 7. 2022; T3: 2♂ 18. 7. 2022
12. <i>Ischnura elegans</i> (Vander Linden, 1820) MODRI KRESNIČAR	T1: 3♂ 12. 5. 2022; 5♂ 24. 5. 2022; 1♂ 22. 6. 2022; 1♀, 1 cop. 18. 7. 2022; 2♂ 17. 8. 2022; 1♂ 6. 9. 2022; T2: 5♂ 24. 5. 2022; 2♂ 17. 8. 2022; T4: 2♂ 12. 5. 2022; 2♂ 18. 7. 2022
13. <i>Ischnura pumilio</i> (Charpentier, 1825) BLEDI KRESNIČAR	T1: 1♂ 12. 5. 2022; 2♂ 6. 9. 2022; T2: 1♂ 18. 7. 2022; 2♂ 17. 8. 2022; 3♂ 6. 9. 2022; T4: 1♂ 12. 5. 2022; 10♂, 1 cop. 24. 5. 2022; 5♂, 1 cop. 18. 7. 2022
14. <i>Pyrrosoma nymphula</i> (Sulzer, 1776) RANI PLAMENEC	T1: 5♂, 5 tand. 12. 5. 2022; 2♂ 24. 5. 2022; T2: 2♂ 12. 5. 2022; 5♂, 2 cop. 24. 5. 2022; T3: 1♂ 12. 5. 2022; T4: 1♂ 12. 5. 2022; 5♂, 2 cop. 24. 5. 2022; 1♂ 22. 6. 2022; T6: 1♂ 24. 5. 2022; T11: 1 cop. 24. 5. 2022; T14: 1♂ 24. 5. 2022
<i>podred ANISOPTERA - RAZNOKRILI KAČJI PASTIRJI</i>	
družina AESHNIDAE - DEVE	
15. <i>Aeshna cyanea</i> (Müller, 1764) ZELENOMODRA DEVA	T2: 1 ten. 17. 8. 2022
16. <i>Aeshna isoceles</i> (Müller, 1767) DEVIŠKI PASTIR NV status: RS: V	T1: 2♂ 24. 5. 2022; 3♂ 22. 6. 2022; T2: 5♂ 24. 5. 2022; 2♂ 22. 6. 2022; T4: 2♂ 24. 5. 2022; 2♂ 22. 6. 2022; T14: 1♂ 24. 5. 2022
17. <i>Aeshna mixta</i> Latreille, 1805 BLEDA DEVA	T4: 1♂ 6. 9. 2022
18. <i>Anax imperator</i> Leach, 1815 VELIKI SPREMLJEVALEC	T1: 3♂ 24. 5. 2022; 5♂, 2 ovip. 22. 6. 2022; 5♂, 2 ovip. 18. 7. 2022; 3♂, 1♀ 17. 8. 2022; T2: 5♂ 24. 5. 2022; 2♂, 1 ovip. 22. 6. 2022; 3♂ 18. 7. 2022; 2♂, 1♀ 17. 8. 2022; T14: 1♂ 24. 5. 2022
19. <i>Anax parthenope</i> (Sélys, 1839) MODRORITI SPREMLJEVALEC	T4: 1♂ 24. 5. 2022

Strokovno in slovensko ime	Favnistični podatki
družina GOMPHIDAE - POREČNIKI	
20. <i>Gomphus vulgatissimus</i> (Linnaeus, 1758) POPOTNI POREČNIK NV status: RS: V	T5: 1 lar. 18. 7. 2022
21. <i>Onychogomphus forcipatus</i> (Linnaeus, 1758) BLEDI PEŠČENEC	T3: 1 lar. 12. 5. 2022; T4: 1♂ 22. 6. 2022; 1♂ 18. 7. 2022; T5: 1 lar. 18. 7. 2022
družina CORDULEGASTRIDAE - STUDENČARJI	
22. <i>Cordulegaster heros</i> Theischinger, 1979 VELIKI STUDENČAR NV status: RS: V; UR: Pril. 1A, 2A; FFH: Pril. II, IV	T6: 1 lar. 24. 5. 2022; T8: 4 lar. 12. 5. 2022; T9: 2 lar. 12. 5. 2022; T10: 5 lar. 24. 5. 2022
družina CORDULIIDAE - LEBDUHI	
23. <i>Cordulia aenea</i> (Linnaeus, 1758) MOČVIRSKI LEBDUH	T1: 3♂ 24. 5. 2022; 1♀ 22. 6. 2022; T7: 1♂ 12. 5. 2022; T11: 3♂, 1 cop. 24. 5. 2022; T13: 1♂ 24. 5. 2022; T14: 1♂ 24. 5. 2022;
24. <i>Somatochlora meridionalis</i> Nielsen, 1935 SREDOZEMSKI LESKETNIK	T6: 3 lar. 24. 5. 2022
družina LIBELLULIDAE - PLOŠČCI	
25. <i>Crocothemis erythraea</i> (Brullé, 1832) OPOLDANSKI ŠKRLATEC	T1: 10♂, 2 cop., 1 ovip. 22. 6. 2022; 20♂, 10♀, 2 ovip. 18. 7. 2022; 10♂, 2 ♀ 17. 8. 2022; 1 juv. ♂, 10♂, 6. 9. 2022; T2: 5♂ 22. 6. 2022; 5♂ 18. 7. 2022; 1♂, 6. 9. 2022; T4: 2♂, 1 cop. 22. 6. 2022
26. <i>Libellula depressa</i> Linnaeus, 1758 MODRI PLOŠČEC	T1: 5 ten., 15♂, 1 ovip. 12. 5. 2022; 10♂, 3♀, 1 ovip. 24. 5. 2022; 5♂ 22. 6. 2022; 3♂ 18. 7. 2022; T2: 1 ex., 5 ten. 10♂, 2♀ 24. 5. 2022; 5♂ 22. 6. 2022; 3♂, 1 ovip. 18. 7. 2022; 3♂ 17. 8. 2022; T3: 1 lar. 12. 5. 2022; 1♂ 18. 7. 2022; T4: 10♂, 1 ovip. 12. 5. 2022; 1 ex., 5♂, 2♀ 24. 5. 2022; 5♂, 1 cop. 22. 6. 2022; 2♂ 18. 7. 2022; T7: 1 juv. ♂, 12. 5. 2022; T11: 1♂, 24. 5. 2022; T12: 1♂, 3♀ 24. 5. 2022; T14: 2♂, 24. 5. 2022
27. <i>Libellula fulva</i> Müller, 1764 ČRNI PLOŠČEC NV status: RS: V	T1: 2♂ 22. 6. 2022; T2: 3♂ 24. 5. 2022; 5♂ 22. 6. 2022; T3: 1♂ 24. 5. 2022; T4: 3♂ 24. 5. 2022; 5♂ 22. 6. 2022; T6: 1♂ 24. 5. 2022; T11: 1 ex. 24. 5. 2022; T13: 1♂ 24. 5. 2022;
28. <i>Libellula quadrimaculata</i> Linnaeus, 1758 LISASTI PLOŠČEC	T1: 1♂ 24. 5. 2022; 3♂ 22. 6. 2022
29. <i>Orthetrum albistylum</i> (Selys, 1848) TEMNI MODRAČ	T1: 2 juv. ♀ 12. 5. 2022; 2 ten., 5♂ 24. 5. 2022; 30♂, 5♀, 2 cop., 3 ovip. 22. 6. 2022; 1 ten. 20♂, 3 ovip. 18. 7. 2022; 3♀ 17. 8. 2022; T2: 5♂ 22. 6. 2022; 2♂, 1 ovip. 18. 7. 2022; T4: 2♂ 22. 6. 2022
30. <i>Orthetrum brunneum</i> (Fonscolombe, 1837) SINJI MODRAČ	T1: 10♂ 18. 7. 2022; T2: 10 ten., 1♂ 24. 5. 2022; 5♂, 1 cop. 22. 6. 2022; 50♂ 18. 7. 2022; 10♂ 17. 8. 2022; T3: 5♂ 18. 7. 2022; T4: 5 ten., 2♂ 24. 5. 2022; 10♂, 2 cop. 22. 6. 2022; 15♂, 2♀ 18. 7. 2022; 10♂ 17. 8. 2022
31. <i>Orthetrum cancellatum</i> (Linnaeus, 1758) PRODNI MODRAČ	T1: 2♂ 22. 6. 2022

Strokovno in slovensko ime	Favnistični podatki
32. <i>Orthetrum coerulescens</i> (Fabricius, 1798) MALI MODRAČ	T1: 5♂ 22. 6. 2022; 20♂ 18. 7. 2022; 2♂ 17. 8. 2022; 5♂ 6. 9. 2022; T2: 15♂, 3 cop. 22. 6. 2022; 50♂ 18. 7. 2022; 15♂ 17. 8. 2022; 5♂ 6. 9. 2022; T3: 15♂ 18. 7. 2022; T4: 20♂, 3 cop. 22. 6. 2022; 30♂, 2 cop. 18. 7. 2022; 10♂ 17. 8. 2022; 1♂ 6. 9. 2022
33. <i>Sympetrum sanguineum</i> (Müller, 1764) KRVAVORDEČI KAMENJAK	T1: 1♂ 18. 7. 2022; 1♂ 17. 8. 2022; T2: 1♂ 6. 9. 2022; T4: 1 tand. 18. 7. 2022
34. <i>Sympetrum striolatum</i> (Charpentier, 1840) PROGASTI KAMENJAK	T1: 1 ten. 22. 6. 2022; 5♂ 17. 8. 2022; 15♂, 10 ovip. 6. 9. 2022; T2: 5♂ 17. 8. 2022; 10♂, 5 ovip. 6. 9. 2022; T4: 5♂, 3 ovip. 6. 9. 2022
35. <i>Sympetrum vulgatum</i> (Linnaeus, 1758) NAVADNI KAMENJAK	T1: 20♂, 5 ovip. 17. 8. 2022; 10♂, 15 ovip. 6. 9. 2022; T2: 30♂, 5 ovip. 17. 8. 2022; 5♂, 5 ovip. 6. 9. 2022

Sezonska dinamika števila zabeleženih vrst

Na izbranih popisnih transektih na ožjem, intenzivneje raziskovanem območju severno od Hotunj (Sl.1: T1–T4) se je število zabeleženih vrst med posameznimi popisi med sezono pričakovano spreminjalo (Sl. 3). V drugi polovici maja in junija 2022 sem ob melioracijskih kanalih popisal največ, obakrat prek 20 vrst kačjih pastirjev. Število zabeleženih vrst v prvih treh popisih je znašalo 84,4 % kumulativnega števila zabeleženih vrst v raziskavi.



Slika 3. Dinamika števila zabeleženih vrst kačjih pastirjev po posameznih popisih na transektih T1–T4 (Tab. 1, Sl. 1) med sezono in pripadajoča dinamika kumulativnega števila zabeleženih vrst na ožjem raziskovanem območju severno od Hotunj. Popisi so bili opravljeni 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022 in 6. 9. 2022, upoštevani so le podatki za odrasle žuželke.

Figure 3. Dynamics of the number of recorded dragonfly species in selected census transects T1–T4 (Tab. 1, Fig. 1) during the season and the corresponding dynamics of the cumulative number of recorded species in the inner research area north of Hotunje. Censuses were conducted on 12. 5. 2022, 24. 5. 2022, 22. 6. 2022, 18. 7. 2022, 17. 8. 2022 and 6. 9. 2022, with only data for adult insects taken into account.

Pregled posamičnih zanimivejših najdb vrst

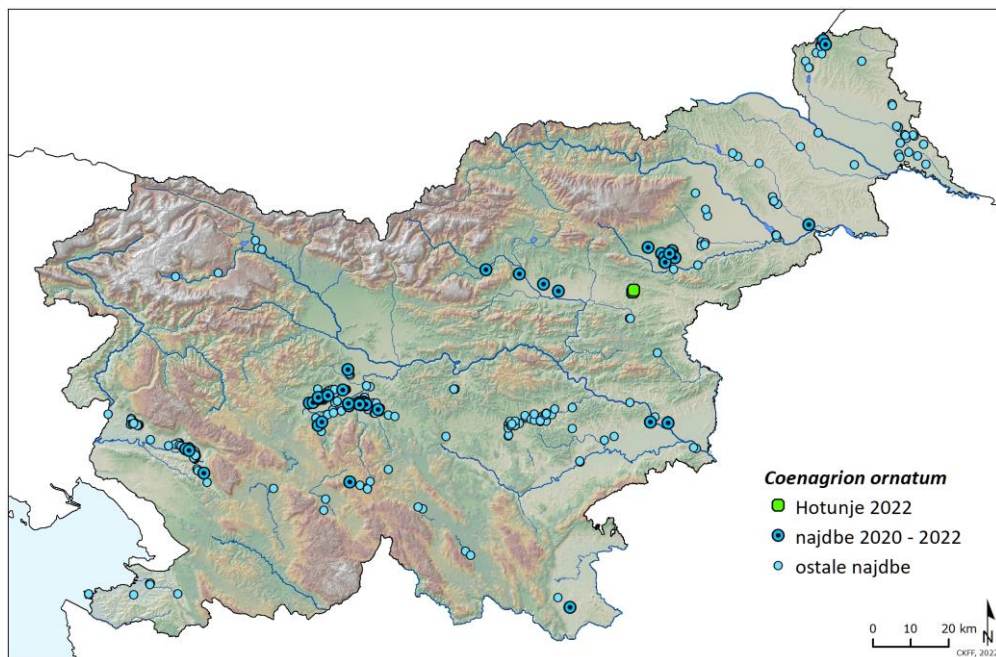
Izmed zabeleženih vrst kačjih pastirjev jih je 6 uvrščenih na sicer zastareli Rdeči seznam s preloma tisočletja in so s Pravidnikom o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam (Ur. l. RS 2002) uvrščene v kategorijo ranljivih vrst (Tab. 2). Te so: koščični škratec *Coenagrion ornatum*, prodni paškratec *Erythromma lindenii*, deviški pastir *Aeshna isoteles*, popotni porečnik *Gomphus vulgatissimus*, veliki studenčar *Cordulegaster heros* in črni ploščec *Libellula fulva*. Koščični škratec *Coenagrion ornatum* in veliki studenčar *Cordulegaster heros* sta varovana z Uredbo o zavarovanih prosto živečih živalskih vrstah (Ur. l. RS 2004) ter z Direktivo o habitatih (Ur. l. EU 1992).

Na ožjem raziskovanem območju melioracijskih jarkov severno od Hotunj, kjer so bili kačji pastirji po transektih popisani prek celotne sezone, se pojavljajo štiri ogrožene vrste: koščični škratec *Coenagrion ornatum*, prodni paškratec *Erythromma lindenii*, deviški pastir *Aeshna isoteles* in črni ploščec *Libellula fulva*, ki jih v nadaljevanju obravnavam v širšem kontekstu njihove razširjenosti v Sloveniji.

Koščični škratec *Coenagrion ornatum*

Koščični škratec je pretežno nižinska vrsta, največ najdb pri nas je na Ljubljanskem barju ter v Vipavski in Mirnski dolini, sledijo Goričko in vzhodni del Prekmurja (Sl. 4; Šalamun et al. 2018). V Sloveniji ima status ogrožene vrste, njegov habitat je zavarovan, saj je uvrščen na Prilogo II *Direktive o habitatih*. V zadnjih letih je koščičnemu škratcu posvečene nekoliko več pozornosti, poznavanje biologije, fenologije in ekoloških zahtev je boljše in posledično se zaradi boljše raziskanosti z različnih koncev Slovenije vrstijo nove najdbe. Mednje sodijo tudi najdbe zahodno od raziskovanega območja v Savinjski dolini (npr. Bedjanič 2019, 2020a, 2021) ter severovzhodno od Hotunj v Dravinjski dolini in dolini Ličence (Šalamun & Bedjanič 2020, Vinko et al. 2021). Najbližja poprej znana najdba vrste leži jugovzhodno od Šentjurja, zabeležena je bila v reguliranem pritoku Voglajne pod zaselkom Velika Gorica (Šalamun & Kotarac 2014).

Koščični škratec na širšem območju raziskave še ni bil znan, zato so nove najdbe v okolici Hotunj zanimive. Življenjska okolja, ki jih vrsta tukaj naseljuje, sodijo med antropogeno predrugačena bivališča v kulturni krajini. Tudi drugod v Sloveniji predstavljajo večino najdb te ogrožene vrste v Sloveniji melioracijski jarki in kanali, v katerih pa so ekološke razmere podobne tistim v primarnih bivališčih – torej v dobro osončenih, počasi tekočih plitvih potokih in povirjih z zmerno do močno razvito vodno in obvodno vegetacijo (Šalamun et al. 2018). Na ožjem območju raziskave se je koščični škratec pojavljal posamič v melioracijskem kanalu 200 m SV od železniškega prehoda Hotunje–Ponikva (Sl. 1 – T2, Sl. 2b). Zaradi zamuljenosti, preobremenjenosti vode s hranili, počasnega vodnega toka in ponekod pregoste zaraščenosti kanala so ekološke razmere tukaj zanj suboptimalne in razmnoževanja vrste nismo zabeležili. Na ločenem melioracijskem kanalu približno 500 m severneje (Sl. 1 – T4, Sl. 2d) so bili opazovani številni sveže preobraženi osebki, samci in samice, opazovanja parjenja (Sl. 5) ter odlaganja jajc pa dodatno potrjujejo, da je tukaj jedro lokalne populacije vrste.



Slika 4. Razširjenost koščičnega škratca *Coenagrion ornatum* v Sloveniji, z izpostavljenimi novimi najdbami iz let 2020–2022 ter najdbami na raziskovanem območju pri Hotunjah leta 2022 (Vir: podatkovna zbirka Slovenskega odonatološkega društva in Centra za kartografijo favne in flore).

Figure 4. Distribution of Ornate Bluet *Coenagrion ornatum* in Slovenia, with highlighted new records from 2020–2022 and new records from the surroundings of Hotunje in 2022 (Source: database of the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora).



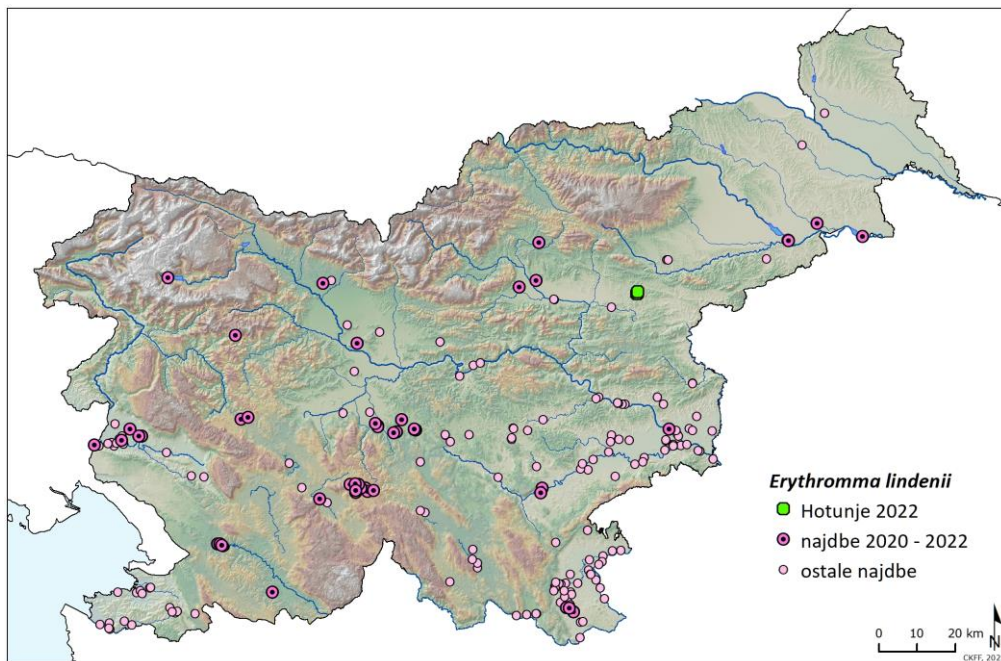
Slika 5. Koščični škratec *Coenagrion ornatum*, samec in samica v tandemu (Hotunje, 22. 6. 2022; foto: M. Bedjanič).

Figure 5. Ornate Bluet *Coenagrion ornatum*, male and female in tandem (Hotunje, 22. 6. 2022; foto: M. Bedjanič).

Prodni paškratec *Erythromma lindenii*

Poznavanje razširjenosti prodnega paškratca v Sloveniji smo v preteklih dveh desetletjih krepko nadgradili in zdi se, da prodni paškratec v zadnjih letih v Sloveniji širi svoj areal, saj ga srečujemo na novih območjih (Sl. 6; Bedjanič 2020a, 2021, Vinko et al. 2021, 2022b). Primerjava z zemljevidom razširjenosti vrste spred četrto stoletja (Kotarac 1997) to zgovorno nakazuje, vendar je zaradi boljše novodobne odonatološke raziskanosti ter izostanka primerljivih podatkov v daljšem časovnem obdobju trend širjenja vrste zelo težko natančneje ovrednotiti.

Številni samci, parjenje in odlaganje jajc kažejo na razmeroma močno populacijo vrste na območju melioracijskih kanalov na ožjem raziskovanem območju pri Hotunjah. Vrsta je bila doslej v tem delu Slovenije znana le z mrtvice ob Voglajni pri Prožinski vasi (Šalamun & Kotarac 2014), nove recentne najdbe pa so znane tudi iz širše Savinjske regije (Bedjanič 2020b, 2021; Sl. 6). Iz favnističnega vidika je pojavljanje vrste vsekakor zanimivo na regionalnem nivoju. Zaradi zelo verjetnega širjenja areala prodnega paškratca v Sloveniji pa močni populaciji vrste na raziskovanem območju vendarle ne pripisujemo izstopajočega naravovarstvenega pomena.

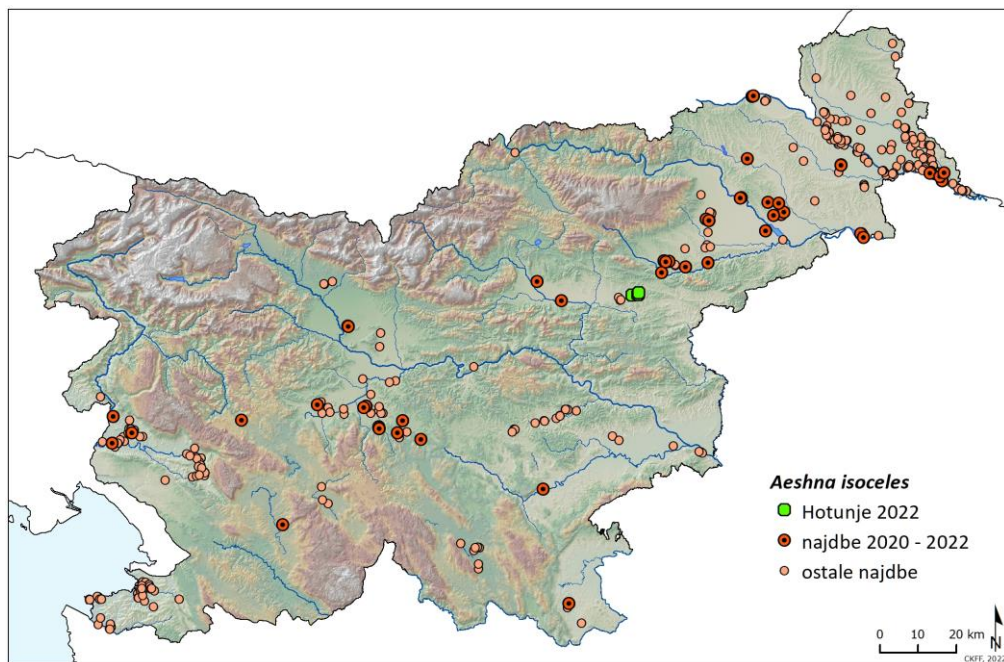


Slika 6. Razširjenost prodnega paškratca *Erythromma lindenii* v Sloveniji, s poudarjenimi novimi najdbami iz let 2020–2022 ter najdbami na raziskovanem območju pri Hotunjah leta 2022 (Vir: podatkovna zbirka Slovenskega odonatološkega društva in Centra za kartografijo favne in flore).

Figure 6. Distribution of Blue-eye *Erythromma lindenii* in Slovenia, with highlighted new records from 2020–2022 and new records from surroundings of Hotunje in 2022 (Source: database of the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora).

Deviški pastir *Aeshna isoteles*

Deviški pastir je vrsta, ki na širšem raziskovanem območju v okolici Hotunja doslej ni bila zabeležena, najbližje najdbe so znane nekaj kilometrov zahodnejše, iz okolice Blagovne in Goričice (Sl. 7). Na ožjem raziskovanem območju pri Hotunjah sem opazoval posamične odrasle samce, razvoja vrste nisem potrdil. V Sloveniji je deviški pastir dokaj pogost v nižinskih in toplejših regijah, kot na primer v Slovenski Istri, v Vipavski dolini ali v Pomurju, drugje je razmeroma redek. V primerjavi z zemljevidom razširjenosti vrste, ki ga podaja Kotarac (1997), lahko zaključimo, da se v zadnjih 25 letih z različnih koncev Slovenije vrstijo nove najdbe deviškega pastirja, ki pri nas sodi med vrste z verjetnim trendom širjenja (Sl. 7; Vinko et al. 2022b). Pojavljanje vrste na ožjem raziskovanem območju je zanimivo na regionalnem nivoju, vendar tudi tem najdbam ne pripisujemo posebnega naravovarstvenega pomena.



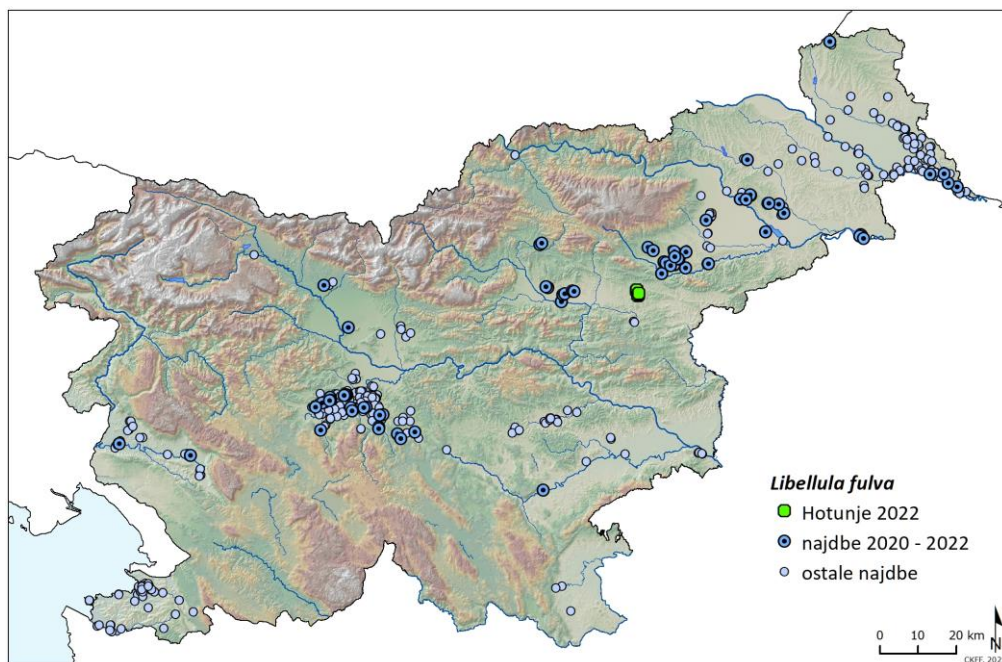
Slika 7. Razširjenost deviškega pastirja *Aeshna isoteles* v Sloveniji, s poudarjenimi novimi najdbami iz let 2020–2022 ter najdbami na raziskovanem območju pri Hotunjah leta 2022 (Vir: podatkovna zbirka Slovenskega odonatološkega društva in Centra za kartografijo favne in flore).

Figure 7. Distribution of Green-eyed Hawker *Aeshna isoteles* in Slovenia, with highlighted new records from 2020–2022 and new records from the surroundings of Hotunja in 2022 (Source: database of the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora).

Črni ploščec *Libellula fulva*

Tudi črni ploščec je vrsta, ki na širšem raziskovanem območju doslej ni bila znana. Na ožjem raziskovanem območju v okolici Hotunj smo opazovali posamične odrasle samce, razvoja vrste nismo potrdili. V Sloveniji je črni ploščec le mestoma pogost, na širšem območju Savinjske doline je razmeroma redek (Bedjanič 2021, Sl. 8). Najbližji poprej znani najdbi vrste ležita ob reki Voglajni jugovzhodno od Sentjurja (Šalamun & Kotarac 2014).

Črnemu ploščcu še posebno ustrezajo počasi tekoče in bogato zaraščene vode jarkov in kanalov, pogosto naseljuje torej tudi sekundarna življenjska okolja, kot jih v omejenem obsegu najdemo v okolici Hotunj. Primerljivo s koščičnim škratcem, ki naseljuje podobna življenjska okolja, se tudi za črnega ploščca v zadnjih letih z različnih koncev Slovenije vrstijo nove najdbe (npr. Bedjanič 2020b, 2021, Vinko et al. 2021). Vrsta ima pri nas verjeten trend širjenja (Vinko et al. 2022b). Njeno pojavljanje je zanimivo na regionalnem nivoju, vendar tudi najdbam te vrste na ožjem raziskovanem območju ne pripisujemo posebnega naravovarstvenega pomena.



Slika 8. Razširjenost črnega ploščca *Libellula fulva* v Sloveniji, s poudarjenimi novimi najdbami iz let 2020–2022 ter najdbami na raziskovanem območju pri Hotunjah leta 2022 (Vir: podatkovna zbirka Slovenskega odonatološkega društva in Centra za kartografijo favne in flore).

Figure 8. Distribution of Blue Chaser *Libellula fulva* in Slovenia, with highlighted new records from 2020–2022 and new records from the surroundings of Hotunje in 2022 (Source: database of the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora).

Zaključek

Raziskava je dala prvi podrobnejši vpogled v vrstno bogastvo kačjih pastirjev v okolici Hotunj in s skupno 35 zabeleženimi vrstami kačjih pastirjev dopolnjuje poznavanje odonatne favne v poprej slabo raziskanem delčku Slovenije. Z upoštevanjem starejših podatkov za povodnega škratca *Coenagrion scitulum* (Bedjanič et al. 2017) in pegastega lesketnika *Somatochlora flavomaculata* (Vir: podatkovna zbirka Slovenskega odonatološkega društva in Centra za kartografijo favne in flore) je za razmeroma majhno območje v okolici Hotunj doslej znanih 37 vrst kačjih pastirjev. Takšno vrstno bogastvo je zanimivo in pomembno na lokalnem nivoju, nima pa samo po sebi kakega posebnega nacionalnega odonatološkega pomena, saj je večina zabeleženih vrst v Sloveniji pogosta in splošno razširjena.

Popisi so v letu 2022 na ožjem raziskovanem območju potekali med majem in septembrom, kar je za celotno inventarizacijo favne kačjih pastirjev ustrezno obdobje, ki omogoča detekcijo tako pomladnih in zgodnje poletnih vrst kot tistih, ki imajo drugačno fenologijo in se pojavljajo v drugi polovici poletja in jeseni. Analiza števila zabeleženih vrst po posameznih popisih med sezono na ožjem raziskovanem območju in pripadajoča dinamika kumulativnega števila zabeleženih vrst kažeta potrebo po opravljanju odonatoloških raziskav prek celotne sezone, saj lahko le tako zajamemo celoten spekter vrst na določenem območju. Razlike med posameznimi popisi v različnih obdobjih bi bile na območjih z bolj raznolikimi habitatmi – na ožjem raziskovanem območju pri Hotunjah sem intenzivneje popisoval le melioracijske kanale (Sl. 1: T1-T4) – gotovo še bolj izrazite. Poudariti je tudi treba, da so bile preostale popisne točke na širšem raziskovanem območju (Sl. 1: T5-T14) povečini obiskane le enkrat, in čeprav sem vzorčil tudi ličinke, je vpogled v celotno favno kačjih pastirjev v tem segmentu pomanjkljiv.

Med favnistično zanimivimi najdbami na ožjem raziskovanem območju melioracijskih jarkov severno od Hotunj so poleg zavarovanega koščičnega škratca *Coenagrion ornatum* enako zanimive tudi nove najdbe prodnega paškratca *Erythromma lindenii*, deviškega pastirja *Aeshna isocetes* in črnega ploščca *Libellula fulva*. Slednje tri sodijo med vrste kačjih pastirjev, pri katerih je v primerjavi s podatki izpred 25 let (Kotarac 1997) tudi zaradi boljše raziskanosti njihova trenutno znana razširjenost v državi mnogo širša. Verjetna je recentna širitev njihove razširjenosti v Sloveniji, bodisi zaradi podnebnihi sprememb kot posledica pulziranja območja naselitve regionalnih populacij, razpoložljivosti novih življenjskih okolij ali kombinacije več dejavnikov (Vinko et al. 2022b). Ob tem je treba poudariti, da v Sloveniji ne poteka sistematično zasnovan državni monitoring za nobeno vrsto kačjih pastirjev in da je sicer bogat nabor odonatoloških favnističnih podatkov pridobljen večinoma v okviru prostovoljskih raziskav članov Slovenskega odonatološkega društva. Zaradi prostorsko in časovno neenakomerne raziskanosti ter izostanka primerljivih podatkov v daljšem časovnem obdobju je omenjene verjetne trende širjenja območja razširjenosti nekaterih vrst in vzroke zanje nemogoče natančneje ovrednotiti.

V prihodnosti velja raziskavam kačjih pastirjev ter druge favne in flore na območju Voglajnskega gričevja, severno in južno od avtoceste Celje–Maribor, med Razgorjem in Dramljami na severu ter Goričko in Ponikvo na jugu nameniti več pozornosti. Gre za območje z verjetno najgostejšo mrežo ribnikov v Sloveniji, katerih raziskanost je v kontekstu biodiverzitete in naravovarstvenega pomena še zelo pomanjkljiva.

Summary

Dragonflies (Odonata) are currently among the better-studied insect groups in Slovenia, with 73 species recorded for the country (Vinko et al. 2022a). However, the surroundings of Hotunje west of Ponikva in the central part of the Voglajnsko Hills, east of the Celje Basin in northeastern Slovenia, belong to odonatologically poorly researched areas from a faunistic point of view.

In the present study, the dragonfly fauna in the area north of the Hotunje village, west of the Poljčane–Celje railroad line, was studied between May and September 2022. The inner study area with melioration ditches, to which more attention was paid and where dragonflies were recorded along the transects throughout the season, covers about 10 hectares. It is located north of Hotunje, or north of the Trnovec pri Dramljah–Ponikva road and west of the Poljčane–Celje railroad line (Fig. 1, Tab. 1 - transects T1–T4, Figs. 2a–d).

A list of 35 dragonfly species for the wider study area is provided with full faunistic data (Tab. 2 – transects T1–T4, points T5–T14). In the smaller, more intensively surveyed area of melioration ditches north of Hotunje, 32 species were recorded (Tab. 2 – transects T1–T4). Here, the number of species recorded along the census transects varied throughout the season (Fig. 3). The species richness was highest in the second half of May and in June 2022 and each time over 20 species of dragonflies were recorded along the melioration ditches. The number of species recorded in the first three censuses till the last decade of June was 84.4% of the cumulative number of species recorded at the end of the survey (Fig. 3).

Of the species recorded (Tab. 2), six are included in the outdated national Red List of dragonflies from the turn of the millennium (Ur. l. RS 2002, Vinko et al. 2022a) and are listed as vulnerable species in the *Rules on the inclusion of endangered plant and animal species in the red list* (Ur. l. RS 2002). These are: Ornate Bluet *Coenagrion ornatum* (Fig. 5), Blue-eye *Erythromma lindenii*, Green-eyed Hawker *Aeshna isoeles*, Common Clubtail *Gomphus vulgatissimus*, Balkan Goldenring *Cordulegaster heros*, and Blue Chaser *Libellula fulva*. Ornate Bluet and Balkan Goldenring are protected in Slovenia by the *Decree on Protected Wild Animal Species* (Ur. l. RS 2004) and listed on the appendices of the *EU's Habitat Directive* (Ur. l. EU 1992). Maps of known distribution in Slovenia, compiled from the database of the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora, are provided and commented for the Ornate Bluet (Fig. 4), the Blue-eye (Fig. 6), the Green-eyed Hawker (Fig. 7) and the Blue Chaser (Fig. 8). The latter three are among those species whose currently known distribution in the country is much wider compared to the data from 25 years ago (Kotarac 1997), which is also due to better research. Their recent range expansion in Slovenia is very likely, either due to climate change, as a result of distributional fluctuations of their regional populations, availability of new habitats, or due to a combination of multiple factors (Vinko et al. 2022b).

A total of 37 odonate species are known so far for the relatively small area around Hotunje. Such species richness is interesting and important at the local level, but with no particular national odonatological significance, as most of the recorded species are common and widespread in Slovenia. In the future, more attention should be devoted to the research of dragonflies and other fauna and flora in the area of the Voglajnsko Hills between Ponikva and Dramlje, which is characterized by probably the densest network of fishponds in Slovenia and is still very poorly studied in terms of biodiversity and nature conservation importance.

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First insight into host ant use of the scarce large blue *Phengaris teleius* (Lepidoptera: Lycaenidae) in Ljubljansko barje (Central Slovenia)

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Abstract. First data on the host ant use of the scarce large blue *Phengaris teleius* in Ljubljansko barje are presented herewith. A survey was carried out in 2021 in the vicinity of the Bevke village. Altogether, 59 *Myrmica* ant nests were surveyed for the presence of scarce large blue caterpillars, 58 of *M. scabrinodis* and one of *M. rubra*. We found four caterpillars of the scarce large blue in three *M. scabrinodis* ant nests. Our results indicate that *M. scabrinodis* is probably the main host of *Phengaris teleius* in Ljubljansko barje, the same as in other regions of Europe.

Key words: scarce large blue, *Phengaris teleius*, *Maculinea teleius*, Slovenia, host ants, *Myrmica*, Ljubljansko barje

Izvleček. Prvi podatki o gostiteljskih vrstah mravelj strašničinega mravljiščarja *Phengaris teleius* na Ljubljanskem barju (osrednja Slovenija) – V prispevku predstavljamo prve podatke o gostiteljskih vrstah mravelj strašničinega mravljiščarja *Phengaris teleius* na Ljubljanskem barju. Pregled mravljišč za prisotnost gosenic strašničinega mravljiščarja je potekal v letu 2021 na območju Bevk. Skupno smo pregledali 59 mravljišč, 58 mravljišč vrste *Myrmica scabrinodis* in eno mravljišče *Myrmica rubra*. Našli smo štiri gosenice strašničinega mravljiščarja v treh mravljiščih barjanske rdečke *Myrmica scabrinodis*, ki je tudi v drugih predelih Evrope pomembna gostiteljska vrsta strašničinega mravljiščarja.

Ključne besede: strašničin mravljiščar, *Phengaris teleius*, *Maculinea teleius*, Slovenija, gostiteljske mravlje, *Myrmica*, Ljubljansko barje

Introduction

The scarce large blue *Phengaris teleius* is an endangered butterfly species due to its highly specialized myrmecophilous life, its high sensitivity to habitat changes and risk of extinction (Settele et al. 2005). On the European Red List of butterflies (van Swaay et al. 2010), the species

is listed as vulnerable and is protected by the Habitats' Directive Annex II and IV (Ur. l. EU 1992).

In Slovenia, the scarce large blue occurs locally throughout the country from early July to early September (Verovnik et al. 2012). Females lay their eggs on the larval host plant great burnet *Sanguisorba officinalis* and after this the first instar caterpillars need to be adopted by *Myrmica* ants to continue their life cycle in ant nests as social parasites (Thomas et al. 1989, Elmes et al. 1998). The strength of specificity in relationship between *Myrmica* ants and *Phengaris* butterflies is variable between different *Phengaris* species and the scarce large blue is considered as the least host-specific throughout Europe (Tartally et al. 2019).

The scarce large blue can successfully develop and survive in nests of several *Myrmica* species occurring at the same site, although *M. scabrinodis* is the most commonly used host ant species (Stankiewicz & Sielezniew 2002, Tartally & Varga 2008, Witek et al. 2008). The only study in Slovenia was conducted in its north-easternmost part (Goričko region) where the caterpillars of the scarce large blue were found in ant nests of the three *Myrmica* species: *M. scabrinodis*, *M. rubra*, and *M. gallienii* (Zakšek et al. 2021). The total number of ant nests hosting the scarce large blue caterpillar was the highest in *M. scabrinodis*, while the total number of caterpillars was the highest in *M. rubra* nests (Zakšek et al. 2021).

In Ljubljansko barje, two species from the genus *Phengaris* occur, the scarce large blue and the alcon large blue *P. alcon* (Verovnik et al. 2012). The area is part of the Natura 2000 network (SI5000014) and was also designated to protect the scarce large blue. The species inhabits mainly mesotrophic humid meadows with the great burnet. In Ljubljansko barje, the species occurs very locally in two smaller areas, one in the western part of the area close to the Bevke village and the other in the eastern part along the Iščica stream.

So far, a total of 40 ant species have been listed for Ljubljansko barje (Mori et al. 2020), with seven species of the genus *Myrmica* found in this area: *M. curvithorax*, *M. rubra*, *M. ruginodis*, *M. rugulosa*, *M. sabuleti*, *M. scabrinodis* and *M. schencki*.

The aim of our study was to fill the knowledge gap about local host ant specificity, which might be one of the limiting factors for species distribution in the area of Ljubljansko barje Nature Park. Knowledge of host ant specificity is crucial for an insight into local variability that could be integrated in the area specific habitat management and species conservation.

Study area and methods

Ljubljansko barje is the largest Slovenian and the southernmost European bog (Martinčič 1987). Currently, Ljubljansko barje is a very fragmented mosaic of fields, intensively managed meadows, pastures, late-mown wet meadows, rich fen and transition mire patches, forests, tree plantations and some shrub land areas (Trčak & Erjavec 2014).

In June 2021, we searched for *Myrmica* ant nests near Bevke in Ljubljansko barje (Fig. 1). We focused on microlocations with high densities of the scarce large blue butterflies in summer 2020 (Zakšek & Kogovšek 2020) to raise the probability to detect a scarce blue caterpillar. After checking for *Myrmica* nest in close proximity to the great burnet (circular less than 1.5 m), the nest was marked and carefully excavated. Each excavated ant nest was gently opened and precisely checked for *Phengaris* caterpillars. After inspection, the nest material was returned to the excavated site. Ten ant workers were collected from each nest and preserved in 70% ethanol for later identification. *Myrmica* species were identified according to Seifert (2018) and Radchenko & Elmes (2010). Field work was carried out with the licence (35601-56/2016-2) issued by the Slovenian Environment Agency of the Ministry of the Environment and Spatial Planning of the Republic of Slovenia to the Centre for Cartography of Fauna and Flora.

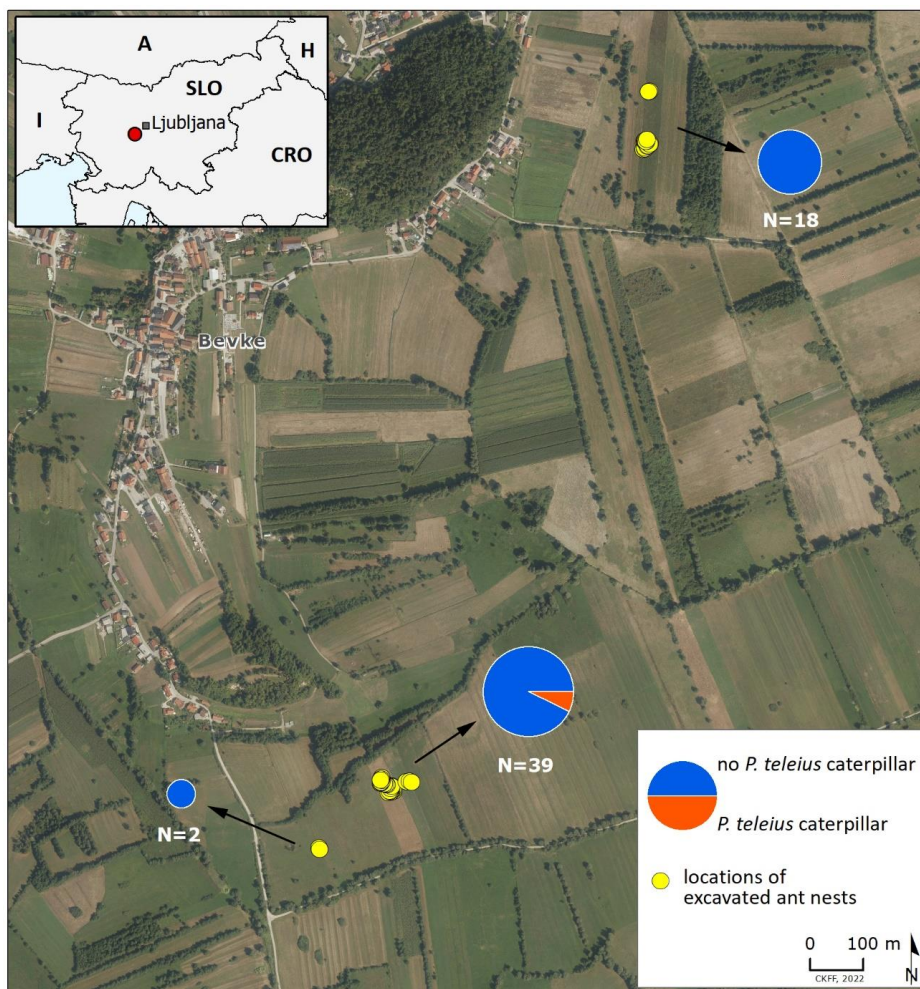


Figure 1. Locations of excavated ant nests and presence of the scarce large blue *Phengaris teleius* caterpillars.
Slika 1. Lokacije pregledanih mravljišč in najdbe gosonic strašničnega mravljiščarja *Phengaris teleius*.

Results and discussion

Altogether, 59 ant nests were excavated, 58 *M. scabrinodis* and one *M. rubra*. We found three ant nests, all of *M. scabrinodis*, that were hosting *Phengaris* caterpillars, i.e. in 5% of the examined *M. scabrinodis* nests. One nest contained two caterpillars and two nests a single caterpillar. All three occupied nests were located in a single meadow (coordinates: N 45.973978° E 14.359716°) (Fig. 1). The maximum distance between occupied nests was 30 metres.

Myrmica scabrinodis and *Myrmica rubra* nests were also dominant species close to the larval host plants in Goričko (Zakšek et al. 2021). Here, almost 2.5× more ant nests were examined and excavated; and the scarce large blue caterpillars were found in 15% of *M. scabrinodis* ant nests, which is slightly higher compared to the results in this study (5%).

The results of our study suggest that in the studied area of Ljubljansko barje *M. scabrinodis*, a very common species here, is probably the main host species for *Phengaris teleius*.



Figure 2. The scarce large blue *Phengaris teleius* caterpillar in *Myrmica scabrinodis* ant nest in Ljubljansko barje (photo: B. Zakšek).

Slika 2. Gosenica strašničinega mravljiščarja *Phengaris teleius* v mravljišču mravlje *Myrmica scabrinodis* na Ljubljanskem barju (foto: B. Zakšek).

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Interspecific interactions between golden jackals (*Canis aureus*) and other mesocarnivores at bait stations in Ljubljansko barje

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Abstract. Considering the recent expansion of the golden jackal's (*Canis aureus*) range, we set out to determine its interspecific interactions at potential food sources with other mesocarnivores in Ljubljansko barje, the area where the first territorial groups in Slovenia were recorded. We set bait and camera traps at six different locations. When analysing the recordings, it seemed that red foxes (*Vulpes vulpes*) were in all probability avoiding jackals at stationary food sources on a fine spatial scale. In addition, we recorded a case of the possible interference competition between the golden jackal with the European badger (*Meles meles*).

Key words: intraguild competition, golden jackal, *Canis aureus*, territorial pair

Izvleček. Medvrstni odnosi med evrazijskim šakalom (*Canis aureus*) in drugimi mezokarnivori ob postajah z vabo na Ljubljanskem barju – V luči nedavnega širjenja areala evrazijskega šakala (*Canis aureus*) smo želeli ugotoviti, kakšni medvrstni odnosi z drugimi mezokarnivori se vzpostavljajo ob potencialnem prehranskem viru na Ljubljanskem barju, območju, kjer so bile v Sloveniji prvič zabeležene teritorialne skupine. Na šestih lokacijah smo postavili vabe in fotopasti. Opazili smo, da se lisica (*Vulpes vulpes*) na stacionarnih prehranskih virih verjetno izogiba šakalom na fini prostorski skali. Poleg tega smo opazili obnašanja, ki bi lahko bila povezana z interferenčno kompeticijo šakala z jazbecem (*Meles meles*).

Ključne besede: znotrajcehovska kompeticija, zlati šakal, *Canis aureus*, teritorialni par

Introduction

The golden jackal (*Canis aureus*) is a medium-sized carnivore of the canid family (Canidae). In recent decades, we have observed a rapid expansion of its range to the west, northwest and north of Europe, after the initial expansion waves in the 19th and 20th centuries (e.g., Lanszki et al. 2015, Rutkowski et al. 2015, Čirović et al. 2016, Krofel et al. 2017, Markov et al. 2018, Spassov & Acosta-Pankov 2019, Potočnik et al. 2019, Stronen et al. 2021). The species has also found a suitable habitat in Slovenia, where the first territorial groups were confirmed in

Ljubljansko barje in 2009 (Krofel 2009), with the vast majority of the population originating from an expansion of the Pannonian population (Stronen et al. 2021). Considering the jackal's status of a relatively new species in the area, its ecology is still largely unknown in local communities.

One of the intriguing issues of ecological interest, aside from interspecific interactions between the jackal and its prey species, is its relationship with other autochthonous mesocarnivores (Potočnik et al. 2019). Intraguild competition, which occurs when two species use similar resources in a similar way, is an important mechanism regulating the abundance, structure, and existence of predator populations (Polis & Myers 1989).

With this in mind, we wished to examine the relationship between the jackal as a newcomer and the already existing members of the mesocarnivore guild in the area.

Materials and methods

Between 20.2. and 27. 5. 2022, we set camera traps and baits (1 kg sliced apples and 5 ml of fish oil per sampling area) to attract animals at six different localities in Ljubljansko barje. First, we placed the cameras at three localities, where members of the local hunting club (LD Brezovica) reported jackal sightings. If no mesocarnivore was recorded within three weeks (or only rare sightings were made), we moved the camera to a different locality (in proximity of jackal tracks or scat, if we found some). Two camera traps were later rearranged (one of them twice), so we were able to observe what was going on at six different locations (Tab. 1) in Ljubljansko barje, near the villages of Bevke and Podplešivica (Fig. 1).

Table 1. Information on six locations with baits in Ljubljansko barje, at which presence of the jackal and other mesocarnivores were observed in spring 2022.

Tabela 1. Informacije o šestih lokacijah z vabo na Ljubljanskem barju, na katerih je bilo opaženo pojavljanje šakala in drugih mezokarnivorov spomladi 2022.

Locality no.	Description	Latitude	Longitude	Sampling period
1	Birches southeast of Bevke	45.971742	14.369633	20. 2. – 27. 5. 2022
2	Field west of Podplešivica	45.997065	14.371528	20. 2. – 19. 3. 2022
3	Apple tree in field west of Podplešivica	45.996554	14.371988	20. 2. – 12. 3. 2022
4	A stand of trees southeast of Bevke	45.969368	14.371991	12. 3. – 8. 4. 2022
5	Next to animal trail southeast of Bevke	45.971011	14.368605	26. 3. – 27. 5. 2022
6	Bushes near animal trail southeast of Bevke	45.971033	14.369041	8. 4. – 15. 5. 2022

We set the camera traps to record a 40-second-long video upon movement detection. We checked the bait stations eleven times (26. 2., 6. 3., 12. 3., 19. 3., 26. 3., 3. 4., 8. 4., 18. 4., 2. 5., 6. 5., 15. 5. 2022) to retrieve footage, add bait, and replace camera trap batteries. After each field visit, we reviewed the recordings, selected videos where the target species (mesocarnivores) were present. We excluded incidental footage (e.g., triggered by wind) or footage of non-target species (most frequently *Capreolus capreolus*, *Lepus europaeus*).

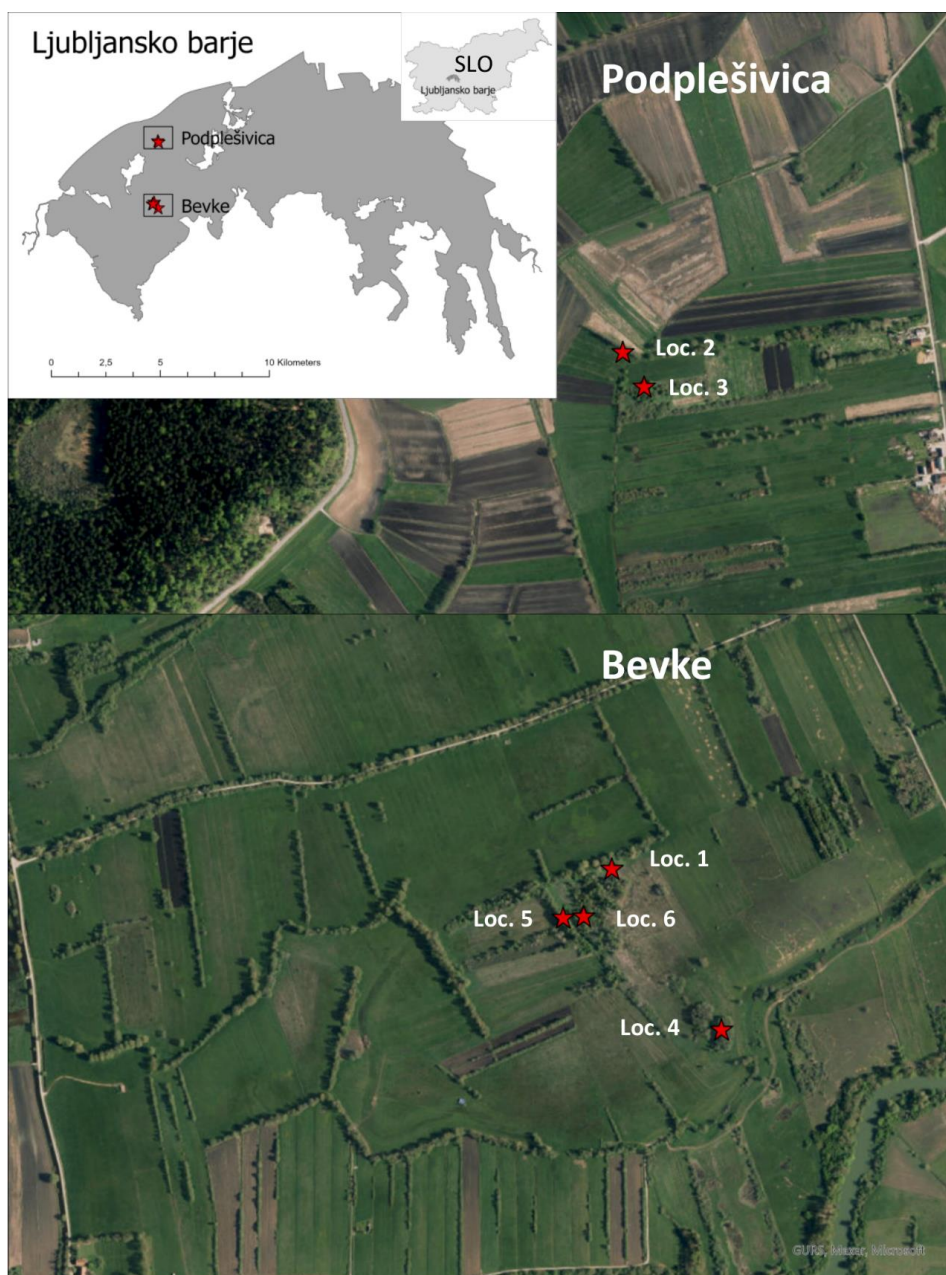


Figure 1. The top left image represents an outline of Ljubljansko barje with sampling locations Podplešivica and Bevke. The map at the top shows the sampling localities (abbreviation Loc.) at Podplešivica and the bottom map the sampling localities at Bevke.

Slika 1. Slika levo zgoraj prikazuje obris Ljubljanskega barja z vzorčnima lokacijama Podplešivica in Bevke. Zgornja karta prikazuje vzorčni točki (okrajšava Loc.) v Podplešivici, spodnja pa vzorčne točke v Bevkah.

During the analyses of selected videos, we identified the species and individuals' behaviours, as well as recorded date and time of video recordings. We considered activity of the species present in multiple clips within a 30-minute period as one sighting, unless visible differences existed between two individuals (e.g., specific markings, size...).

Results and discussion

From a total of 3,531 videos, in 334 of them the mesocarnivore species were present. The species observed most often were golden jackal (65 times) and European badger (64 times), followed by red fox (12 times), beech marten (*Martes foina*) (3 times) and European wildcat (*Felis silvestris*) (2 times) (Tab. 2).

Table 2. Number of observations of five different mesocarnivores at bait stations, set at six different locations in Ljubljansko barje in spring 2022. Letters refer to: A – golden jackal, B – European badger, C – red fox, D – beech marten, E – European wildcat. The numbers refer to the number of individuals recorded during the given sampling period.

Tabela 2. Število opažanj petih različnih mezokarnivorov na šestih lokacijah z vabo na Ljubljanskem barju spomladi 2022. Črke se nanašajo na: A – evrazijski šakal, B – jazbec, C – lisica, D – kuna belica, E – divja mačka. Številke se nanašajo na število posameznih osebkov, posnetih v danem obdobju vzorčenja.

Sampling period	Loc. 1	Loc. 2	Loc. 3	Loc. 4	Loc. 5	Loc. 6
20. - 26. 2. 2022	A-5	/	/	/	/	/
26. 2. - 6. 3. 2022	/	/	/	/	/	/
6. - 12. 3. 2022	A-1, B-13, C-1, D-1	C-3	/	/	/	/
12. - 19. 3. 2022	B-5, C-4	/	/	/	/	/
19. - 26. 3. 2022	B-5	/	/	/	/	/
26. 3. - 3. 4. 2022	B-5	/	/	C-1	B-4	/
3. - 8. 4. 2022	A-4, B-6, C-1	/	/	/	A-1, B-2	/
8. - 18. 4. 2022	A-1, B-2	/	/	/	A-2, B-6	A-1, B-5, D-1, E-1
18. 4. - 2. 5. 2022	A-2, B-2, C-2	/	/	/	A-3	A-5
2. - 6. 5. 2022	A-3, B-2	/	/	/	A-3, E-1	A-7
6. - 15. 5. 2022	A-2, B-5	/	/	/	A-1, B-1	A-9
15. - 27. 5. 2022	A-8	/	/	/	A-7, B-1, D-1	/
Total	A-26, B-45, C-8, D-1, E-0	A-0, B-0, C-3, D-0, E-0	A-0, B-0, C-0, D-0, E-0	A-0, B-0, C-1, D-0, E-0	A-17, B-14, C-0, D-1, E-1	A-22, B-5, C-0, D-1, E-1

Because the jackal and red fox are more closely related and occupy similar ecological niches compared to other mesocarnivores present in the study area, the species are expected to have the highest rate of intraguild competition, with the jackal being the dominant species (Scheinin et al. 2006). The data collected suggest that such interspecific relationship between the two species also exists in Ljubljansko barje. Both species were present at only one of the sampling localities (Loc. 1; Tab. 2). At the other five localities we either detected the jackal (Loc. 5, 6; Tab. 2), the fox (Loc. 2, 4; Tab. 2) or neither of them (Loc. 3; Tab. 2).

When we compared the frequency of species recorded during our research with the recorded relative abundance of each species in the barje (LISjak 2022), we noted a significantly lower occurrence of foxes in our recordings. Using data from the regional area (Notranjsko LUO) as well as from the studied hunting ground (LD Brezovica) recorded from 1. 1. 2018 to 19. 9. 2022, we can approximate the relative species densities based on the annual mortality (excluding culling), which represents a random subsample of the present population (i.e., traffic mortality, disease...). These show that the mortality rate of fox exceeded that of jackals by 19.6 times at the regional level of Notranjsko LUO and by 13.0 times at the local scale of the hunting ground LD Brezovica (LISjak 2022). Based on this data we would expect a significantly higher ratio of foxes to jackals present in our study area. However, we recorded the presence of the jackal 5.4 times more often than that of the fox. Of course, we do have to note that the mortality rate doesn't necessarily reflect the actual state of natural populations, but it was the only data regarding species abundance available at this time. Thus, although the data clearly indicate coexistence between red fox and golden jackal, they also point at partial exclusion at a fine spatial scale – a conclusion similar to that of Tsunoda et al. (2018).

However, the data recorded on jackal interaction with badgers were somewhat more unexpected, as jackals appear to be quite cautious around this species, although some authors suggest a bigger difference in resource partitioning between the two of them (Tsunoda et al. 2018). The video recorded by a camera trap at 3:07 a.m. on 8. 3. 2022, shows a jackal nearing a badger feeding on the bait. The jackal demonstrates a typical posture of alertness (Fig. 2, left) and flees after interacting with the badger (Fig. 2, right).



Figure 2. In the left image, we see a jackal in the upper left corner displaying high alertness, while a badger is feeding (bottom right). The right image shows the badger approaching the jackal, which flees from the study area.

Slika 2. Levo vidimo šakala v zgornjem levem delu slike. Z držo izkazuje visoko previdnost, medtem ko se jazbec hrani (desno spodaj). Desna slika kaže jazbeca, ki se šakalu približuje, ta pa zbeži z območja snemanja.

On the video taken on 10. 4. 2022 at 1:56 a.m., a badger can be seen showing clear aggression (hissing, growling, scratching at the ground). However, it is unclear what the aggression is directed at. We suspect it may be directed at a jackal, as the bait station in question

represents the central area of the breeding pair's territory. Several photo-monitoring events show jackals being aggressive towards badgers (Potočnik et al. 2019). The behavioural differences could be a consequence of the age and social status of the individual animals involved. Interestingly, badgers predominated during the colder months of the study period, before the somewhat higher temperatures and the first heavier rains, when there is presumably a greater variety and abundance of naturally available food. Thereafter, the frequency of badger sightings at bait stations largely declined, while the frequency of jackal sightings increased (Fig. 3). This shift in species presence indicates a potential difference in interactions at stationary food sources in different time periods.

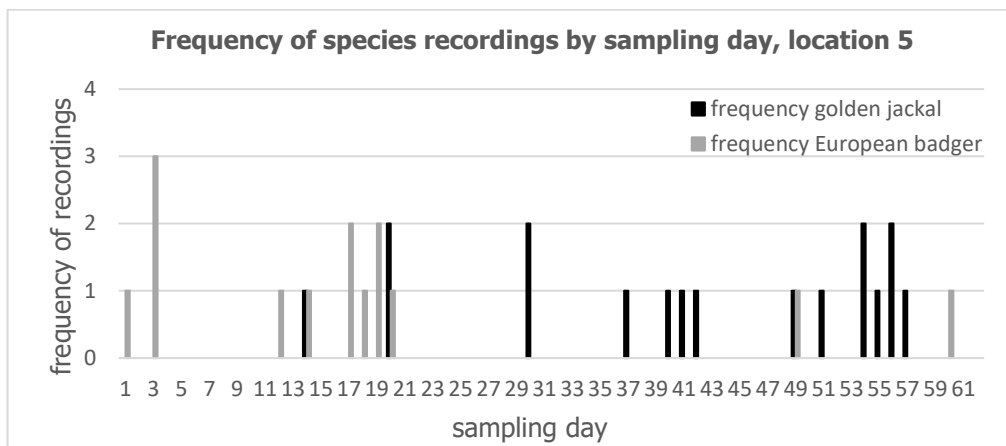


Figure 3. The frequency of jackal and badger recordings by sampling days (sampling from 26 March to 27. 5. 2022) at site five. The graph clearly indicates that at around the same time when the frequency of badger recordings drops, the frequency of jackal recordings increases.

Slika 3. Graf prikazuje frekvenco pojavljanja šakala oziroma jazbeca na posamezen vzorčni dan (vzorčenje od 26. 3. do 27. 5. 2022) s 5. vzorčne lokacije. Vidimo, da na točki, ko frekvenca pojavljanja jazbeca močno upade, naraste frekvenca pojavljanja šakala.

The jackal is reported to be a highly adaptable and opportunistic species (Lanszki et al. 2015, Penezić & Čirović 2015, Spassov & Acosta-Pankov 2019, Potočnik et al. 2019). In light of this, we found some behaviours of the territorial pair present here interesting. On 7. 4. 2022 at 3:45 a.m., a camera first shows a pregnant female feeding on bait at location five near Bevke. Her presence is later recorded almost every night, while the male never ate or approached the bait, but just lurked in the background (Fig. 4).

It is possible that the female's increased need for food during the gravidity and lactation period made her take greater risks to find enough food in the human dominated environment. After the whelping, which we estimate to had happened around 2nd May 2022, the female also visited the bait during daylight hours, although this is not the golden jackal's peak activity period (Fig. 5). We believe this happened as a consequence to the female's increased need for calories in the lactation period. As the female was visibly pregnant (and later lactating) and had a distinctive coloured coat on her back (stripes), we believe that all these observations relate to the same individual.



Figure 4. In the image we can see a female golden jackal (front) feeding on the bait. The male (circled red) stands in the distance and observes. The camera never recorded him feeding on the bait. The image was taken on the 24th of April 2022 at 3:45 AM.

Slika 4. Na fotografiji vidimo brejo samico evrazijskega šakala (spredaj), ki se hrani z vabo. Samec (obkrožen z rdečo) stoji zadaj in zgolj opazuje, njegovo hranjenje na vabi ni nikoli zabeleženo. Posnetek je nastal 24. 4. 2022 ob 3.45.



Figure 5. A female golden jackal visiting the bait during daytime. The picture was taken on the 19th of May 2022 at 7:38 AM, after she presumably gave birth to pups.

Slika 5. Samica evrazijskega šakala med dnevnim obiskom vabe. Fotografija je bila posneta 19. 5. 2022 ob 7.38, po predvidenem obdobju kotitve mladičev.

Even though we present results of a rather short study, limited to a relatively few sites, we were able to observe some interesting instances of intraguild interactions at potential stationery feedings sites in Ljubljansko barje. We hope these data will provide valuable initial information on the behaviour of the species in the habitat colonized relatively recently. Further studies should consider conducting a similar experiment with a larger number of sampling sites and locations, as well as monitoring across all seasons, to obtain more comprehensive data set on the interactions and to account for differences in seasonal environmental conditions and various site-specific dependent factors.

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Two new records of *Trithemis annulata* (Palisot de Beauvois, 1807) (Odonata: Libellulidae) in Slovenia

Novi najdbi ciklamnega telovnikarja *Trithemis annulata* (Palisot de Beauvois, 1807) (Odonata: Libellulidae) v Sloveniji

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For Slovenia, 73 dragonfly and damselfly species (Insecta: Odonata) are reported (Vinko et al. 2022a), with *Trithemis annulata* (Palisot de Beauvois, 1807) being the most recent addition to the Odonata fauna of the country (Vinko & Šalamun 2021).

Trithemis annulata is a widespread Afrotropical species, with its range in Europe restricted to the extreme south and eastern Mediterranean coast until the end of the 19th century (Ferrerias Romero 1981, Kalkman et al. 2015). Due to the effects of global warming, the species has rapidly expanded its range in Europe in the recent two decades and is now widespread and common in large parts of the eastern and western Mediterranean (Ott 2010, Kalkman et al. 2015, Stefanov & Vasilev 2021, Cabana et al. 2022, Rebassa & Canyelles 2022). Its distribution in Europe is outlined in Vinko & Šalamun (2021), who also prepared a map of its distribution in Slovenia and nearest neighbouring countries. Only recently, the species was discovered for the first time also in Croatia (Koren et al. 2022, Observation.org 2022). Up to this note, only one male imago of *T. annulata* was recorded in Slovenia in July 2021 at Lake Vogršček in the Vipava Valley (Vinko & Šalamun 2021).

In July 2022, two additional interesting observations of the species were made. We recorded *T. annulata* during field trips to Lake Vogršček in the Vipava Valley (W Slovenia) and Lake Škalsko jezero in the Šaleška Valley (N Slovenia) (Fig. 1). The weather was sunny and hot on both occasions. One imago

on each location was caught with entomological net. No voucher specimens were taken, and no larvae were sampled. Search for exuviae was performed at Lake Vogršček, although none belonged to *T. annulata*.

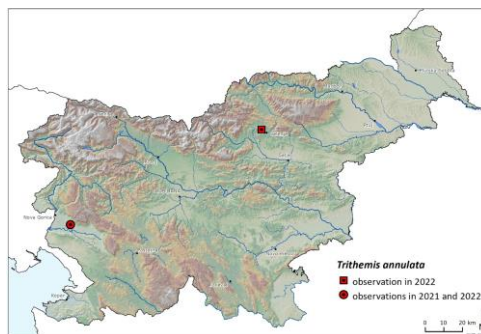


Figure 1. Observations of *Trithemis annulata* in Slovenia.

Slika 1. Najdbe ciklamnega telovnikarja *Trithemis annulata* v Sloveniji.

The first observation originates from the north-eastern inlet of Lake Vogršček (45°54'39.7" N 13°45'05.0" E, 100 m alt., Fig. 1 in Vinko & Šalamun (2021), where the area is also described). Three *T. annulata* males were recorded by the first and the third authors on 2. 7. 2022 (around 12:20 p.m.), almost exactly at the site of the first record for the country (Vinko & Šalamun 2021). Observation of the individuals lasted nearly an hour. At least two males performed rapid flights low over the water up to 15 m from the bank. Two males were also observed engaging in territorial behaviour with males of *Crocothemis erythraea* (Brullé, 1832) and *Orthetrum albistylum* (Sélys, 1848), or with each other. Besides the aforementioned behaviour, one male used a small black alder bush *Alnus glutinosa* (L.) on the bank as a perching site for at least 10 minutes, while another male occasionally perched also on sedges *Carex* sp. and dry reed remnants (Fig. 2).

On the same day prior to this observation, other two inlets of Lake Vogršček were also surveyed without detecting *T. annulata*. In the afternoon of the same day (around 15:30–16:30 p.m.), the north-eastern inlet was surveyed again. However, no *T. annulata* was recorded (Tivadar N. & Kogovšek P., pers. comm.).



Figure 2. One of three *Trithemis annulata* males recorded at the north-eastern inlet of Lake Vogršček (Vipava Valley, W Slovenia) in 2022. The species can be easily identified by its abdomen colour and patterning, frons colour, thorax patterning, wings and veins colouration (photo: D. Goertzen, 2.7.2022).

Slika 2. Eden od treh zabeleženih samcev ciklamnega telovnikarja *Trithemis annulata* na severovzhodnem kraku jezera Vogršček (Vipavska dolina, Z Slovenija) leta 2022. Vrsto zlahka prepoznamo po barvi in vzorcih na zadku, barvi temena, vzorcih oprsja in barvi kril ter ožilja (foto: D. Goertzen, 2. 7. 2022).

Second surprising observation of *T. annulata* was made 120 km as the crow flies northeast from Lake Vogršček at Lake Škalsko jezero in the Šaleška Valley, N Slovenia (46°22'26.43"N 15°06'18.06"E, 375 m alt.). On 20. 7. 2022, a single male was observed there at around 12:10 p.m. Lake Škalsko jezero is one of three lakes where the mining of lignite caused subsidence of the valley, which was gradually flooded with the water from passing streams. It is the oldest and smallest of the three lakes, covering 16 ha, and is nowadays designated for human activities. Southern and south-eastern shores of the lake were investigated during the short excursion by the second author. Some small reeds were present only at the south-eastern part of the lake. Before caught, a single *T. annulata* male flew low over the water at the southern shore of the lake very near to the bank. The bank had recently been mowed, with some bushes and trees present nearby (Fig. 3), hence there was hardly any place available for dragonflies to perch. The recorded *T. annulata* male perched on a wooden stick intended for holding a fishing rod and aggressively defended it against *Orthetrum cancellatum* (Linnaeus, 1758) and *O. albistylum* males.

No additional *T. annulata* individuals were recorded during other field trips to Lake Škalsko jezero later



Figure 3. Southern shore of the Lake Škalsko jezero (Šaleška Valley, N Slovenia) is the second known location of *Trithemis annulata* in Slovenia, where a single male imago was recorded on the sunny part of the lake further away from the tree on the photo (photo: M. Bahr, 20.7.2022).

Slika 3. Južno obrežje Škalskega jezera (Šaleška dolina, S Slovenija) je drugo znano najdišče ciklamnega telovnikarja *Trithemis annulata* v Sloveniji. Samec je bil zabeležen na osončenem delu jezera naprej od drevesa na fotografiji (foto: M. Bahr, 20. 7. 2022).

in the season, specifically on 12.8. 2022 (Šabeder N., pers. comm..) and 17. 8. 2022 (Bedjanič M., pers. comm.).

Although new records of *T. annulata* for the country were expected, in western Slovenia at least (Vinko & Šalamun 2021), the record from north-eastern Slovenia is surprising. On the other hand, at least occasional dispersal of the species in Europe also to the east had already been documented some years ago in Hungary (Farkas 2017). The finding of a single imago at Lake Škalsko jezero suggests that our record concerns a wandering specimen of unknown origin not belonging to the local population, whereas individuals from Lake Vogršček are questionable in terms of their origin due to repeated observations in the ensuing years. It is possible that the species reproduced at Lake Vogršček in 2021, with its eggs or/and larvae surviving the winter. However, dispersal of imagoes in both years separately from other populations is also plausible. No female has yet been recorded in Slovenia.

Trithemis annulata inhabits a wide variety of sun-exposed, stagnant and slow-flowing waters, including man-made habitats (Kalkman et al. 2015),

with its larvae developing in 7–8 weeks (Boudot et al. 2017). The species has so far been recorded in Slovenia at two large reservoirs, both of which seem suitable for the establishment of this ubiquitous pioneer species. Due to the ecological characteristics of the species and ongoing climatic changes, further detections, including breeding records, are expected in Slovenia nationwide.

Systematic, state-funded monitoring of the Odonata fauna is not conducted in Slovenia and there are no data on the occurrence of 11 species since 2014 at least (Vinko et al. 2022a, b). The state should immediately start investing more in odonatological knowledge, also owing to the fact that dragonflies and damselflies are a cost-effective and sensitive group to monitor the consequences of human activities, apart from being considered good indicators of climate change (Ott 2010, Termaat et al. 2019). The present article additionally indicates changes in the environment in Slovenia that also affect the Odonata fauna, further confirming an urgent need for monitoring.

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Peter Kogovšek and Nika Tivadar gave information on their field trip to the north-eastern inlet of Lake Vogršček in the afternoon of 2.7.2022, Nik Šabeder and Matjaž Bedjanič furnished us with their observations made at Lake Škalsko jezero in August 2022, while Ali Šalamun prepared the map (all Slovenia). We wish to thank the reviewers for their suggestions and hints.

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Two new findings of dicephalic snakes from Croatia

Dve novi najdbi dvoglavih primerkov kač na Hrvaskem

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Dicephalism in snakes is a condition when a snake has two more-or-less joined heads, with or without a short neck. Although relatively rarely observed in the wild, there have been hundreds of observations reported from different parts of the world over many centuries (Wallach 2007). In Croatia, the first known occurrence of this condition was the case of a dicephalic Balkan whip snake (*Hierophis gemonensis* (Laurenti, 1768)), a 20 cm long juvenile, found on 19.6.1930 between Zamet and Kastav near Rijeka by Josip Vidović (Hirtz 1937a). The snake died several days after capture, probably due to injuries while being »tortured with a stick« by children who found it [original: »...ali ona je za nekoliko dana poginula, očito zbog povreda, jer su je djeca mučila šibom.«]. The second record for the country was a juvenile Aesculapian snake (*Zamenis longissimus* (Laurenti, 1768)), found on 28.9.2002 near Zlatna Greda in the surroundings of Monjoroš Hunting Lodge by Siniša Urbanović (Barišić 2002). It survived in captivity until the first half of March 2003 (Anonymous 2003).

Here we report on two new observations of dicephalic snakes in Croatia. A dicephalic juvenile grass snake (*Natrix natrix* (Linnaeus, 1758)) was found on 29.9.2016 near Kravarsko (south of Velika Gorica; N: 45.584138, E: 16.043756) by a local homeowner, who contacted the second author. The snake was a juvenile, about 25 cm in total length. It survived for a year and a half in captivity, during which it grew to about 50 cm in total length. It ate fish and used both heads during feeding (Fig. 1). The most recent finding of a dicephalic snake is a juvenile smooth snake (*Coronella austriaca*

Laurenti, 1768) found on 31.8.2022 in Sisak, on the parking lot of ABS Sisak d.o.o. (within the Sisak Ironworks, N: 45.452435, E: 16.392525) by Lucija Odobašić (Fig. 1). The snake was found and photographed *in situ* and was not caught. The finder posted the photo on the »Sisački Forum« Facebook group on the same day [<https://www.facebook.com/groups/SisackiForum/permalink/2139939209512306/>]. The sex of the individual could not be determined from the photo. Dicephalic snakes rarely survive for long in the wild (see Wallach 2007 for a brief overview), and in combination with the industrial nature of the location where this specimen was found, there are poor chances of its survival and reaching adulthood.

Dicephaly has already been known for grass snakes, but to the author's knowledge this is the first finding of a dicephalic grass snake in the region. Dicephalic smooth snakes are known in the region, e.g. from Bosnia and Herzegovina (Hirtz 1935) and Slovenia (Hirtz 1937b), but to the author's knowledge this is the first observation from Croatia.

Acknowledgments

Heartfelt thanks go to Lucija Odobašić for sharing her finding of the dicephalic *Coronella austriaca* and her written permission to publish it and use the photo, and to Maja Pavičić for bringing it to our attention. Our thanks also go to Barbara and Berislav Horvatić for their constructive feedback on the manuscript.

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Figure 1. Left: Dicephalic grass snake (*Natrix natrix*), found on 29.09.2016 in Kravarsko (photo: Tomislav Šarić). Right: Dicephalic smooth snake (*Coronella austriaca*) found on 31.08.2022 on the ABS Sisak d.o.o. parking lot in Sisak (photo: Lucija Odobašić).

Slika 1. Levo: Dvoglava belouška (*Natrix natrix*), najdena 29.09.2016 v Kravarskem (foto: Tomislav Šarić). Desno: Smokulja (*Coronella austriaca*), najdena 31.08.2022 na parkirišču ABS Sisak d.o.o. v Sisku (foto: Lucija Odobašić).

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